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VARIATIONS AND RELATIONSHIPS IN THE SNAKES OF THE GENUS PITUOPHIS

BY

OLIVE GRIFFITH STULL

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The present work forms No. 175 of the *Bulletin* series.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *April 23, 1940.*

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VARIATIONS AND RELATIONSHIPS IN THE SNAKES OF THE GENUS PITUOPHIS

By Olive Griffith Stull

INTRODUCTION

From its wide range and varied habitat, its conspicuous size and pattern, and its abundance the genus *Pituophis* is popularly one of the best-known genera of North American snakes. Throughout most of North America these snakes are familiar—under the name of "bull snakes," "pine snakes," or "gopher snakes" in the United States, in Mexico as the "cencuate" or "alicante," and in Lower California as the "corallilo." Nevertheless, it is doubtful whether any other North American ophidian genus is in greater confusion with reference to the taxonomic position of the included forms, and our knowledge of their probable affinities.

An understanding of the phylogenetic relationships within a genus can be attained only by a synthetic survey of all the included forms, based upon a detailed analytical study of the structural variations of each form in their relation to geographic distribution. No such consideration of the genus as a whole has been undertaken. The work of Van Denburgh and Slevin (Van Denburgh and Slevin, 1919, and Van Denburgh, 1920) represents the only attempt to correlate variation with distribution, as a basis for the interpretation of affinities between several forms of the genus. The deficiencies that must be recognized in their conclusions are undoubtedly due to the insufficiency of the material studied and to the limitations imposed by the consideration of a circumscribed geographic region.

The purpose of the present study is to define the taxonomic status of the included forms on a structural and geographic basis, to determine their mutual affinities as far as is possible from the available material, and to assemble the accumulated data concerning them.

In the attempt to make the conclusions as complete and accurate as possible, material has been borrowed from every available source. In every specimen the scale and pattern features were examined in detail. For every form the teeth were studied in a representative series of specimens, and the hemipenes were dissected in several individuals. Drawings to represent the color pattern of each form have been made from typical specimens.

About 1,200 specimens were examined. The number of specimens in collections, however, is no criterion of the relative abundance of these snakes, as the large size of the individuals has evidently made the accumulation and preservation of large series of specimens seem impractical. The lack of definite locality records has rendered useless in the study of geographic variation a small percentage of the specimens examined, and in several cases the localities recorded are obviously erroneous. The importance of detailed locality data, accompanied by physiographic and ecological records, cannot be stressed too strongly. Such data will immeasurably increase the value of specimens in modern taxonomic work. In several groups the material available is admittedly inadequate, and a conclusive study of variation in these forms must await the collection of larger series of specimens.

Most of the extant types in America are in the collection of the United States National Museum, and all these were examined. Detailed descriptions of the types in the Muséum d'Histoire Naturelle de Paris were very kindly sent to me by M. F. Angel.

I am greatly indebted for assistance to several individuals and institutions. In addition to the collection of specimens in the Museum of Zoology of the University of Michigan, which served as a nucleus for the work, I have had access to the collections of many museums and universities and to the private collections of several individuals. Often single specimens proved of unusual value; some by showing an extreme variation, others by contributing a new locality record. Every additional specimen, even though it possess no unusual features, is an important contribution in swelling the numbers necessary for accurate interpretation of individual, sexual, and geographic variation.

ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. Leonhard Stejneger and Dr. Doris M. Cochran, of the United States National Museum; to the late Dr. B. W. Evermann and Joseph R. Slevin, of the California Academy of Sciences; to the late Prof. Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; to Dr. Thomas Barbour and Arthur Loveridge, of the Museum of Comparative Zoology of Harvard University; to Dr. G. K. Noble, of the American Museum of Natural History; to Prof. J. O. Snyder, of Stanford University; to Henry W. Fowler, of the Academy of Natural Sciences of Philadelphia; to M. Graham Netting, of the Carnegie Museum; to Karl P. Schmidt, of the Field Museum of Natural History; to Dr. Howard K. Gloyd, of the Chicago Academy of Sciences; to Prof. W. B. Wilson and Dr. Wesley Clanton, of Ottawa (Kans.) University; to Dr. A. I. Ortenburger, of the University of Oklahoma Museum of Zoology; to the late Prof. J. E. Guthrie, of Iowa State College of

Agriculture and Mechanic Arts; to L. M. Klauber, of the San Diego Society of Natural History; to Miss Elberta L. Craig, of the University of Colorado; to Dr. Vasco M. Tanner, of Brigham Young University; to Prof. Howard S. Brode, of Whitman College; to Dr. D. J. Leffingwell, of the Charles R. Conner Museum of the State College of Washington; to W. B. Mabee, of Montana State College; to Dr. H. P. Loding, of the Alabama Museum of Natural History; to Roy E. Rodock, of Lewiston State Normal School; to Prof. John W. Scott, of the University of Wyoming; to Prof. Franklin Sherman, of Clemson College; to Prof. J. Percy Moore, of the University of Pennsylvania; to Frank C. Baker, of the University of Illinois; to Prof. Austin P. Larrabee, of Yankton College; and to O. B. Giltner, of St. Ambrose College, for the loan of specimens from the collections of the institutions they represent.

I am equally indebted to L. M. Klauber and Percy Viosca, Jr., for the use of their private collections. Mr. Viosca's collection included the type of *ruthveni*, which has since been deposited in the collection of the United States National Museum. Live specimens were also sent to me by Mr. Klauber, some of them through the kindness of Charles Bogert.

To Mrs. Helen T. Gaige, the late Dr. Frank N. Blanchard, and Prof. E. C. Case, all of the University of Michigan, I am grateful for advice and criticism. Helpful data were furnished by Dr. Blanchard, M. F. Angel, Dr. C. S. Brimley, Dr. H. S. Brode, Henry W. Fowler, L. M. Klauber, Prof. Franklin Sherman, and Dr. Tracy I. Storer.

Figures 2 to 5 were drawn on enlargements of photographs, and the photographs subsequently faded. The photographic work was done by Miss Dorothy Chipman, of the Museum of Zoology of the University of Michigan, and the drawings, as well as figure 6, were made by Miss Grace Eager, of the same Museum. To both of them I wish to express my gratitude.

Dr. Norman Hartweg I sincerely thank for much kind assistance in the laboratory, and the tender care of my live specimens during my absence.

Above all, I am indebted to President Alexander G. Ruthven, of the University of Michigan. At his suggestion the problem was undertaken, under his direction the work has been carried on, and its completion is due to his unfailing advice and encouragement. To him I dedicate this study as an expression of my appreciation.

NOTES ON THE ILLUSTRATIONS

On the graphs illustrating sexual variation (figs. 7–9) the numbers on the abscissas represent the characters, while those on the ordinates indicate the frequency. On all other graphs the localities represented are indicated on the abscissas by name or number. In the latter

case, a key is given in the accompanying text. The numbers on the ordinate in every case represent the characters. At the top of each graph the number of specimens from each locality is given.

The color patterns were drawn free-hand, but scale by scale, from typical specimens. When the pattern of the form illustrated is more or less uniform throughout, a single drawing of an area just anterior to the middle of the body was made to represent the form, as in the case of *affinis*. When the patterns of the anterior and posterior parts of the body are noticeably different, as in the case of *deppei jani*, drawings were made from two regions of the same individual, one taken about one-third of the distance from neck to vent, the other about two-thirds of the distance. In a few cases, e. g., *lineaticollis*, three drawings were made, one each of the anterior, middle, and posterior parts of the body of a single individual.

ABBREVIATIONS USED IN THE TEXT

Throughout this bulletin the following abbreviations are used when reference is made to specimens or collections:

Ala. Mus.: Alabama Museum of Natural History, University, Ala.
A. M. N. H.: American Museum of Natural History, New York.
A. N. S. P.: Academy of Natural Sciences of Philadelphia.
B. Y. U.: Brigham Young University, Provo, Utah.
C. A. S.: California Academy of Sciences, San Francisco.
Carnegie: Carnegie Museum, Pittsburgh.
Clemson: Clemson Agricultural College, Clemson College, S. C.
Conner: Charles R. Conner Museum of the State College of Washington, Pullman, Wash.
Field: Field Museum of Natural History, Chicago.
I. S. C.: Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.
Klauber: Private collection of L. M. Klauber, San Diego, Calif.
K. S. A. C.: Kansas State Agricultural College, Manhattan, Kans.
Lewiston: Lewiston State Normal School, Lewiston, Idaho.
M. C. Z.: Museum of Comparative Zoology of Harvard University, Cambridge.
M. S. C.: Montana State College, Bozeman, Mont.
M. V. Z.: Museum of Vertebrate Zoology of the University of California, Berkeley, Calif.
Ottawa: Ottawa University, Ottawa, Kans.
San Diego: San Diego Society of Natural History, San Diego, Calif.
St. A. C.: St. Ambrose College, Davenport, Iowa.
Stanford: Stanford University, Palo Alto, Calif.
U. Colo.: University of Colorado, Boulder, Colo.
U. Ill.: University of Illinois, Urbana, Ill.
U. Mich.: University of Michigan Museum of Zoology, Ann Arbor.
U. Okla.: University of Oklahoma Museum of Zoology, Norman, Okla.
U. Pa.: University of Pennsylvania, Philadelphia.
U. S. N. M.: United States National Museum, Washington.
U. Wyo.: University of Wyoming, Laramie, Wyo.
Viosca: Private collection of Percy Viosca, Jr., New Orleans, La.
Whitman: Whitman College, Walla Walla, Wash.
Yankton: Yankton College, Yankton, S. Dak.

Genus PITUOPHIS Holbrook

Coluber Linnaeus, Systema naturae, ed. 10, vol. 1, p. 216, 1758 (type, *constrictor* Linnaeus).

Pituophis Holbrook, North American herpetology, vol. 4, p. 7, 1842 (type, *Coluber melanoleucus* Daudin).

Churchillia Baird and Girard, Reptiles, *in* Expedition to the Valley of the Great Salt Lake of Utah (Stansbury), p. 350, 1852 (type, *bellona* Baird and Girard).

Epiglottophis Cope, Amer. Nat., vol. 25, p. 157, 1891 [type, *Spilotes deppei* (Duméril and Bibron)].

Description.—The genus *Pituophis* of Holbrook, established in 1842 upon the form *Coluber melanoleucus* of Daudin (1803, vol. 6, p. 409), belongs to the family Colubridae. It may be diagnosed as follows: Maxillary teeth solid, 14 to 18 in number, without a diastema, the anterior ones slightly longer, and decreasing in size posteriorly; mandibular teeth 16 to 22, the anterior ones slightly larger than the posterior; head only slightly distinct from the neck; eye large, pupil round; scales keeled, with the exception of the several most ventral rows on either side, and with apical pits; maximum number of dorsal scales varying from 27 to 37, but mostly 29, 31, or 33; anal plate entire; caudals in two series; tail relatively short; hemipenes slightly bilobed with calyces and spines, sulcus spermaticus simple.

The body is rather stout, being pronouncedly so in the four subspecies of *melanoleucus* and in *sayi sayi*, somewhat so in *sayi affinis*, and comparatively slender in the other forms of the genus, particularly those of the *deppei* group—*deppei*, *jani*, and *lineaticollis*. The head is only slightly distinct from the neck. In the subspecies of *sayi* and particularly in the subspecies of *melanoleucus*, the snout is rather pointed, in correlation with the elongated rostral, and in these forms the upper jaw protrudes considerably beyond the lower. In forms with a low, broad rostral, such as *vertebralis*, the subspecies of *catenifer*, and the three forms of the *deppei* group, the snout is blunt and almost square, and protrudes only slightly beyond the lower jaw. The tail is relatively short, and forms as little as 0.100 of the total length in specimens of *sayi*, which form shows the smallest average length for the genus—0.122 of the total length. The greatest proportionate length attained in the genus is 0.185 of the total length in a specimen of *c. catenifer*, and the greatest average length in any form is 0.161 in *c. annectens*.

A single rostral and frontal are present (fig. 1). The rostral varies in shape from very long and narrow in the subspecies of *melanoleucus* (fig. 2), moderately long in *sayi sayi*, only slightly longer than broad in *sayi affinis* (fig. 3) and occasional specimens of *catenifer deserticola*, to as broad as, or slightly broader than, long in the other forms of the genus (figs. 4 and 5). It penetrates from a slight fraction to all the distance between the internasals. The internasals, supraoculars,

and parietals are paired; prefrontals two in the three forms of the *deppei* group (fig. 5), four in all other forms of the genus (figs. 2–4); loreal usually present in some forms, only occasionally in others; nasals paired on either side, with the external nares between them; preoculars normally 1 or 2, occasionally 3; postoculars normally 2 in *deppei* and *lineaticollis*, normally 3 or 4 in all other forms of the

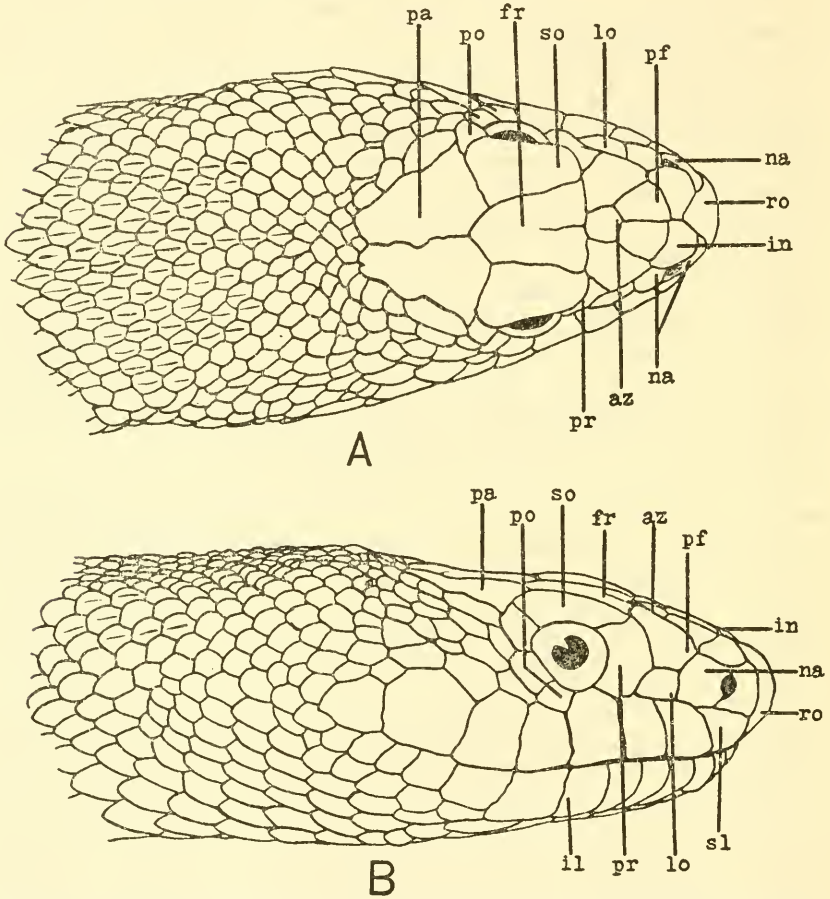

FIGURE 1.—The normal arrangement of head scales in *Pituophis: A*, From above; *B*, from the side. *az*, Azygos; *fr*, frontal; *il*, infralabial; *in*, internasal; *lo*, loreal; *na*, nasal; *pa*, parietal; *pf*, prefrontal; *po*, postocular; *pr*, preocular; *ro*, rostral; *sl*, supralabial; *so*, supraocular.

genus, occasionally 2, 5, or 6; azygos between frontal and prefrontals always absent in some forms, present or absent in others; azygos between prefrontal and preocular on either side, or between other head scales, occasionally present; supralabials 8 or 9 normally, most often 9 in *vertebralis*, most often 8 in all other forms, occasionally 7 or 10; infralabials 10 to 15, usually 14 in *mugitus* and *ruthveni*, most often 11 in *deppei*, normally 12 or 13 in all other forms; a single men-

tal plate separating the first infralabials at the symphysis of the lower jaw; anterior pair of chin shields longer and wider than the posterior pair, in contact with each other, but separated from the mental by the first pair of infralabials; posterior chin shields usually separated by a few scales.

The scales are keeled, with the exception of the several lower rows on either side. Apical pits are present in all forms. The dorsal scales are arranged in a series of longitudinal alternating rows around

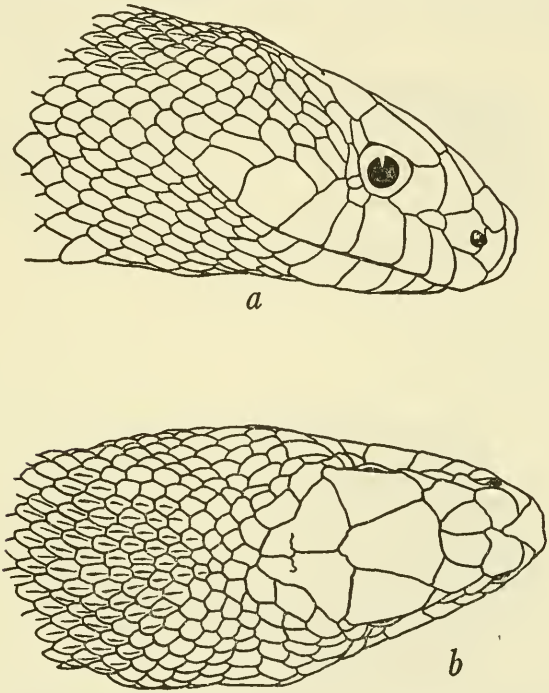

FIGURE 2.—Head of *Pituophis melanoleucus melanoleucus: a*, From the side; *b*, from above.

the body, which number from 25 to 35 just posterior to the neck, from 27 to 37 in the middle of the body, and from 19 to 25 just anterior to the vent. The lower number of scale rows anterior and posterior to the middle of the body results from the loss of certain definite scale rows. The method of reduction will be discussed below. The ventral surface of the body is covered by a single series of transverse scutes, the ventrals, which vary in number from 205 to 262 in the genus. Posterior to the ventral scutes, and just anterior to the vent, is a single anal plate, semilunar in shape. Posterior to the vent are the caudal scutes, which vary in number from 47 to 84 pairs.

The structure of the hemipenes is so constant throughout the genus that the description of these organs in a typical specimen of any of

the forms may serve to illustrate the organs for the entire genus (fig. 6). The hemipenes are slightly bilobed, with the sulcus spermaticus simple and running diagonally across the organ to the tip of one of the lobes. The anterior two-thirds of the surface is smooth, except for several shallow irregular longitudinal furrows and a large number of minute spinules scattered irregularly over the posterior two-thirds of this area. On the opposite side from the sulcus there is a noticeable elongated ovoid prominence. The posterior third of the surface is covered with irregular rows of calyces, each calyx bearing a terminal spine. On either side of the sulcus in this region there is a narrow

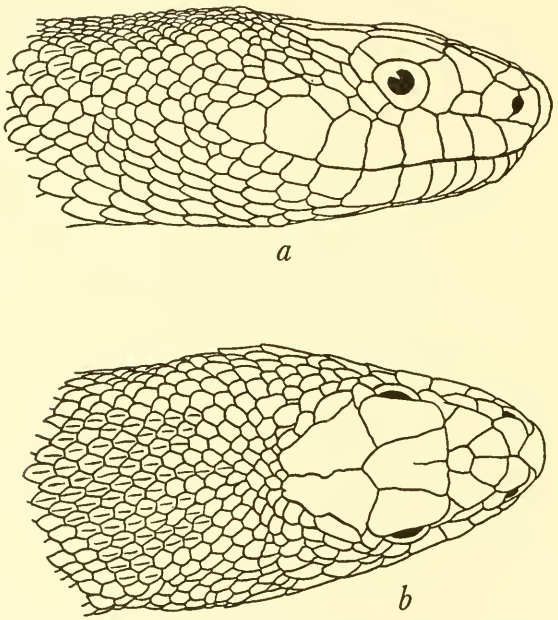

FIGURE 3.—Head of *Pituophis sayi affinis: a*, From the side; *b*, from above.

smooth border. In the accompanying drawing of the hemipenis of *sayi sayi* (fig. 6), the organ has been dissected open, and the muscle removed from the posterior end.

The dentition is as follows: Mandibular teeth 16 to 22, decreasing slightly in size posteriorly; maxillary teeth 14 to 18, solid and without a diastema, decreasing slightly in size posteriorly; palatines 7 to 12, slightly smaller than the mandibular and maxillary teeth, but relatively stouter; pterygoids 6 to 14, smaller than the palatines and decreasing in size posteriorly.

The fundamental type of pattern throughout the genus is spotting. Most forms bear a median dorsal series of large dark, more or less quadrangular spots on a light ground. In most cases there is one or more additional alternating series of spots on either side. In *lineati-*

collis only the posterior part of the dorsum bears the typical median series, while the midregion bears two series of annuli, and the anterior part of the body is distinguished by the presence of two continuous black stripes. In the four subspecies of *melanoleucus* the typical pattern is variously modified by intensification or diminution of color in the background or spots, or by the fusion of spots, rendering the anterior background dark with the spots only slightly darker in *ruthveni*, the anterior spots so blended with the background as to be indistinguishable in *mugitus*, and the dorsum uniformly black in *lodingi*. The

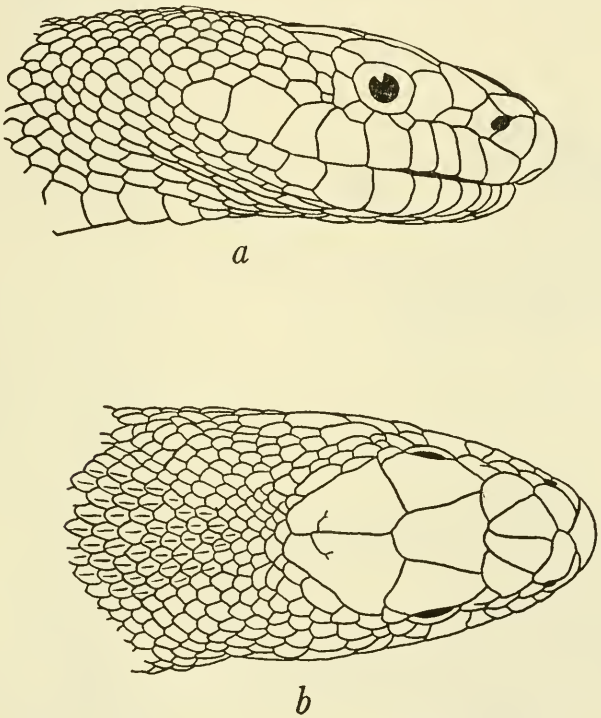

FIGURE 4.—Head of *Pituophis catenifer deserticola*: *a*, From the side; *b*, from above.

number of spots, when distinguishable, varies within a wide range in the different forms, from 21 to 94 on the body, and from 5 to 36 on the tail. The coloration of the belly varies from an immaculate white to white heavily spotted with black throughout.

Range.—The range of this form extends from Guatemala to Canada and includes most of Mexico and all the United States west of the Mississippi, and, east of the Mississippi, Wisconsin, Illinois, Indiana, Tennessee (?), and all the States of the Atlantic coast from Alabama to southeastern New York.

Habits and habitat.—Of most of the forms of this genus, as indeed of most reptiles, little or nothing is known of the habits or habitat.

What detailed observations have been recorded are included in the discussions of the several forms.

It is evident from the wide range of the genus that it must be little restricted as to habitat. Although the various forms are each more restricted than the genus as a whole—*sayi*, for example, being typi-

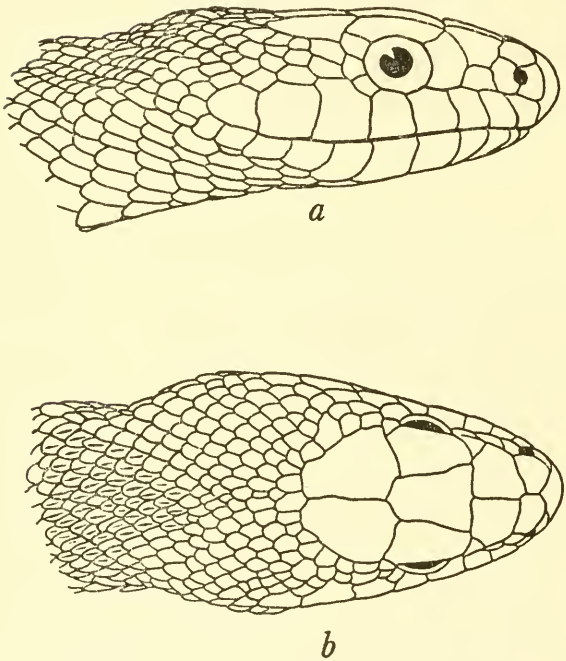

FIGURE 5.—Head of *Pituophis deppei jani: a*, From the side; *b*, from above.

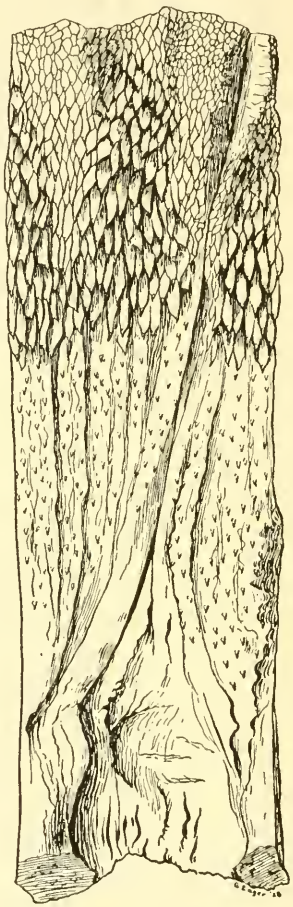

FIGURE 6.—Dissected hemipenis of *Pituophis sayi sayi*

cally a plains form, while *deserticola* is more or less restricted to desert regions—many of the forms show a wide range of habitat. Thus, in several cases the same subspecies is found with equal frequency in desert lowlands and on mountainsides at an altitude of several thousand feet. The eastern forms are generally believed to be confined to the pine forests and sandy barrens of the Coastal Plain, but *m. melanoleucus* appears to be equally common in the Allegheny Mountain region.

The food is varied, although quite uniform throughout the genus. The major part consists of small mammals, especially such rodents as pocket gophers, rats, mice, ground squirrels, and young rabbits, but also occasionally includes birds, eggs, lizards, and even other snakes. The prey is constricted and swallowed whole, or, if it is small and weak, may be taken alive without constriction.

Most of the forms are known to be oviparous, and the remaining ones are undoubtedly so. At the time of deposition the eggs contain

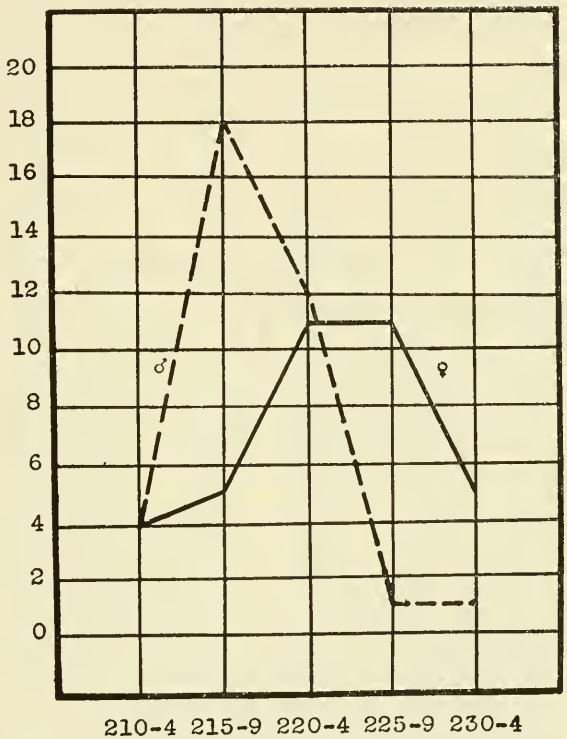

FIGURE 7.—Sexual variation in the number of ventrals in 72 specimens of *Pituophis c. catenifer* from the vicinity of Palo Alto, Calif.

embryos, which are fairly well developed in all the forms that have been studied. What few records we have of breeding habits are included under the descriptions of the forms to which they pertain.

Variation.—The phylogenetic relationships of the forms within a genus can be understood only from a thorough study of the variation—individual, sexual, and geographic—found within each form. Among the various forms of a genus the variability of a given character may differ greatly in degree as well as kind. Thus, in one form the geographic variation in a certain character may be marked, even though the individual variation in any given part of the range may be very

slight, or, on the other hand, a wide range of individual or sexual variation may be present throughout the range of the form, and nevertheless show only a slight correlation with geographic distribution, or none at all. In the attempt to determine the relative value of scale and pattern characters in indicating relationships, the relative constancy of a character throughout the group is the best index to its diagnostic importance.

In the genus *Pituophis* the amount of individual variation is very great, and completely overshadows the geographic variations, which, though in most forms slight, are nevertheless observable in many of the characters. The apparent insignificance of the geographic

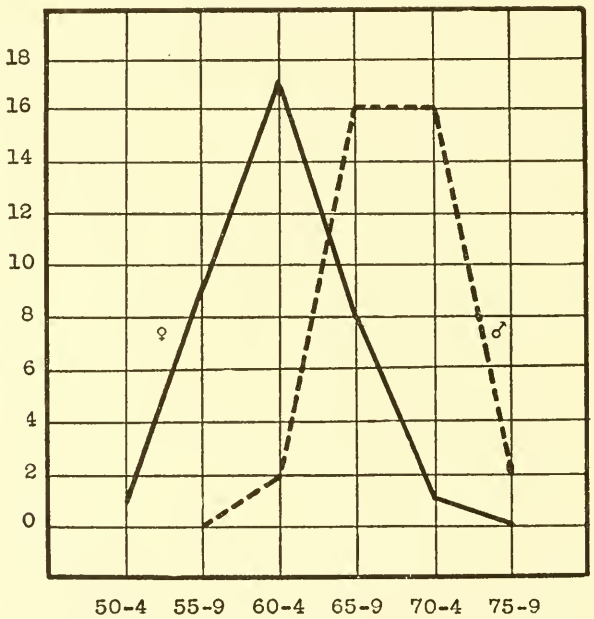

FIGURE 8.—Sexual variation in the number of caudals in 72 specimens of *Pituophis c. catenifer* from the vicinity of Palo Alto, Calif.

variation may be due in some cases to the small amount of material available, but it seems probable that if a marked variation were present it would be evident in even a small series of specimens. Even in the case of *sayi*, with the largest range of any form of the genus (extending from Mexico to Canada, and from Colorado, Wyoming, and Montana to Indiana) and a large series of specimens fairly representative of the entire range of the form, the individual variation that exists shows only a moderate correlation with the distribution. In other forms a correlation is generally less rather than more evident. Graphs illustrating the geographic variation in scale and pattern characters are included in the discussion of the

forms to which they pertain. Individual and sexual variations are summarized in the discussions of the several forms.

A study of sexual variation, to be significant and undistorted by geographic variation, must include specimens in equal numbers for either sex from a limited area. To illustrate sexual variation in the genus *Pituophis* a comparative study was made of the scale characters and numbers of spots in 72 specimens of *Pituophis catenifer catenifer*,

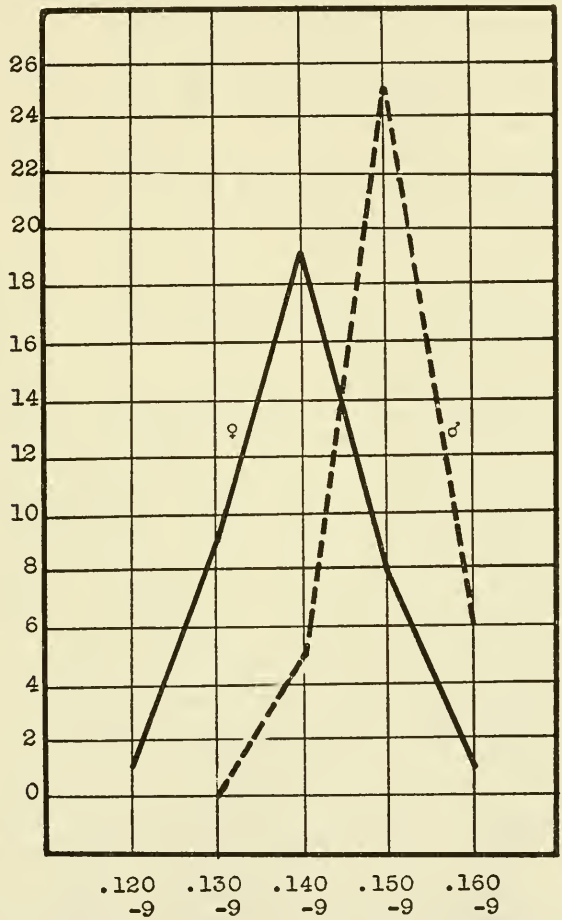

FIGURE 9.—Sexual variation in the ratio of tail length to total length in 72 specimens of *Pituophis c. catenifer* from the vicinity of Palo Alto, Calif.

36 of each sex, chosen at random from the vicinity of Stanford University, Palo Alto, Calif. The results for all characters showing a definite variation are presented diagrammatically in the accompanying graphs (figs. 7–9).

Variation in number of scale rows.—The dorsal scales are arranged, as stated above, in alternating longitudinal rows, which vary in

number throughout the length of the body. The maximum number for any given individual occurs slightly anterior to the middle of the body, and the number decreases both anteriorly and posteriorly, the minimum number of rows occurring just anterior to the vent. Thus, to represent the scale rows of any individual a formula of three numbers is used, e. g., 29–33–23. In such a formula the first number represents the minimum number of rows in the anterior part of the body, generally found a short distance posterior to the neck; the second number represents the maximum number for the individual; and the last, the minimum number in the posterior part of the body. It is obvious that the reduction in the number of the scale rows must indicate the loss of some of the rows. If on a typical specimen the scale rows are counted at frequent intervals throughout the body length, it will be found that generally two lateral rows (one on each side) are dropped simultaneously, and if the sides of the body are carefully examined the actual point where the loss occurs in each case can be discovered, and the rows involved can be determined. Thus, the formula of a typical specimen as given above, in order to represent the true situation, should read 29–31–33–31–29–27–25–23. For convenience, this formula is shortened to include only the maximum and anterior and posterior minimum numbers, the others being understood. It will be noted that in occasional specimens one or more numbers in the formula are even, rather than odd, as normally. This peculiarity is due to an abnormality in the method of reduction, by which either a single vertebral row is lost somewhere on the body, or a single lateral row is lost in one reduction. For a given specimen the maximum number of rows lost anteriorly is 6, posteriorly 12, while the minimum number is none anteriorly and 5 posteriorly. The amount of variation in the number of scale rows is very great, not only within the genus as a whole but in many of the separate forms as well. Thus, the range of variation in *sayi*, one of the most variable forms, of from 25–28–23 to 35–37–27, is nearly as great as the range of from 25–27–19 to 35–37–27 for the entire genus.

Ruthven (1908, p. 17) found that in *Thamnophis* the reduction in the number of scale rows was due to the loss of definite rows throughout the genus. His results may be expressed in the following diagram, in which the upper row of figures represents the numbers of scale rows, and the lower series the scale rows concerned in each change, the number being counted dorsally from the ventral series of scutes:

23	21	19	17	15
5	5	4	4	

In *Lampropeltis* (Blanchard, 1921a, p. 9), *Coronella*, *Vipera*, *Tropidonotus* (Proctor, 1920, p. 357), *Coluber*, *Masticophis* (Ortenburger, 1928, p. 8), *Elaphe*, *Natrix*, and other genera, it has been demonstrated

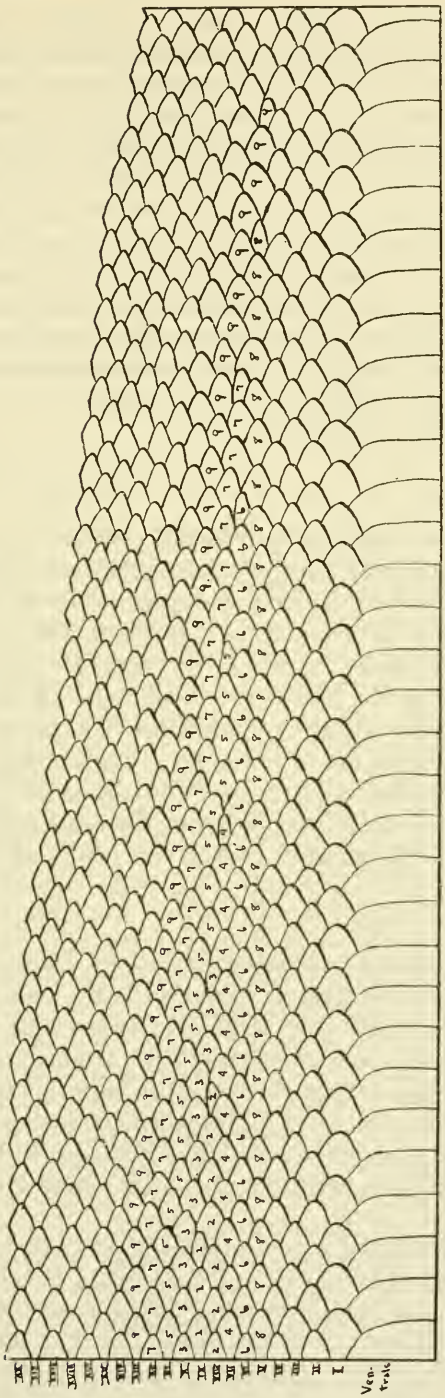

FIGURE 10.—Typical method of reduction in number of scale rows throughout the genus *Pituophis*.

that in each case the reduction is due to the loss of certain definite scale rows, and although different rows are involved in the various genera, the method is typical and constant in each genus.

The examination of a large number of specimens of *Pituophis* reveals that in this genus also a typical system of reduction is normally, although not invariably, followed. Thus, in the reduction from 33 to 31 scale rows the eighth row is normally lost almost simultaneously on each side; in the reduction from 31 to 29, the seventh; and so on. The same rows are lost anteriorly as posteriorly in each case, in comparable reductions. A composite of the normal reductions that occur in the genus taken as a whole may be expressed in the following numerical diagram, in which the upper series of numbers represents the numbers of scale rows, and the lower series the lateral rows lost on either side in the corresponding reductions:

37	35	33	31	29	27	25	23	21	19
9	8	8	7	7	6	6	5	5	

The lower series of numbers represents the lateral rows involved in reduction when counted from the ventral series each time, as is usually done. If a hypothetical individual representing the entire range of variation from 37 to 19 rows is considered, it will be seen that proceeding posteriorly from the region in which 37 rows are found, the first row lost will be the ninth, the second the eighth, the third the tenth, etc., the loss alternating from one side of the ninth row to the other. This is shown in figure 10, in which the Roman numerals represent the actual number of each row, and the small Arabic numerals on the scales represent the order in which the rows are lost. Expressed numerically the actual number of each row lost is as follows:

37	35	33	31	29	27	25	23	21	19
9	8	10	7	11	6	12	5	13	

As mentioned above, individual variations from this typical sequence occur. The commonest variation is the loss of the vertebral row, or of a single lateral row, instead of two simultaneously, and in either case results in an even number of rows around the body for some distance. In a genus where the range of variation is as great as in *Pituophis*, a greater degree of individual variation is to be expected than in a genus such as *Thamnophis* or *Coluber*, where the range of variation is much more limited and a much smaller number of scale rows is involved.

From a comparison of the numerical diagrams above with that illustrating the method of reduction in *Thamnophis*, it is evident that the series of rows involved in reduction in *Pituophis* overlaps and completes the corresponding series for *Thamnophis*, and that the same rows are lost in each comparable reduction in the two genera. Blanchard (1921a, p. 10) has called attention to the similarity in the methods of

scale reduction in *Elaphe* and *Lampropeltis* on the one hand, and in *Thamnophis* and the allied genus *Natrix* on the other. The discovery of a third genus corresponding in method with the two latter genera is exceptionally interesting in its relation to the question of generic relationships. However, only the study of many more genera can determine the value of the method of scale reduction in indicating intergeneric affinities.

In *Pituophis*, as in all the other forms studied, there is an evident correlation between scale row formulae and sex. In every form of the genus the formula is on the average higher in females than in males, and in almost every case the abnormally high formulae that occasionally occur are found in female specimens. This sexual variation in the diameter of the body might be expected in correlation with the egg-laying function of the females, and the undoubted retention of large eggs for a considerable period.

The high formulae are generally found, furthermore, near the probable center of origin for the form, and there is always a noticeable tendency toward a general decrease in the number of scale rows away from the center of distribution. Although there is no appreciable difference in the diameter of individuals of approximately the same size, but with different scale formulae, nevertheless the geographic correlation between the decrease in scale rows and the decrease in other scale characters occurring in some forms seems to indicate that scale reduction, in these forms at least, is evidence of a general dwarfing toward the periphery of the form. Thus, for example, in *sayi* and other forms there is a fairly constant decrease in numbers of scale rows and ventrals from south to north, and the average size of the individuals seems to be greater from the southern than the northern part of the range, while all the largest specimens examined are southern. On the other hand, the forms possessing the smaller average formulae for the genus are not always the smaller in general size and may, on the contrary, be distinctly larger than forms with much higher average formulae. This is true of the subspecies of *melanoleucus*, which, although possessing comparatively low scale formulae, are the largest forms of the genus. Furthermore, in the subspecies of *melanoleucus* the individual scales are proportionately larger than in any other forms. Thus the theory of dwarfing can be applied only to intraspecific variation, and not to variation between different forms.

Variation in numbers of ventrals and caudals and in proportionate tail length.—As stated above, the ventral surface is covered with a series of large transverse scutes, the ventrals anterior to the vent in a single series, and the caudals on the under surface of the tail in a paired series. The number of scutes in these series varies within definite limits in each form and has been generally recognized as of primary importance as a systematic criterion. In this genus, how-

ever, the range of individual variation is so great in these characters that there is a wide overlap between most of the forms, and thus they generally can be used as diagnostic specific criteria only in combination with other less variable scale and pattern characters. For the genus as a whole, the range of variation in ventrals is from 205 to 262, for caudals from 47 to 84, while in *c. deserticola* alone the ventrals vary from 214 to 259, and in only 25 specimens of *d. deppei* the caudals vary from 52 to 79.

A sexual difference in the numbers of ventrals and caudals is apparent in every form. The number of ventrals on the average, and generally in the extremes as well, is higher in females than in males (fig. 7), while the number of caudals is higher in males (fig. 8). These sexual differences are doubtless correlated with the dissimilar reproductive functions of the two sexes. Thus, the larger number of ventrals, as well as the larger number of scale rows, in females is correlated with the longer body necessary for the accommodation of the eggs, while the larger number of caudals in males is correlated with the use of this appendage as a clasping organ in copulation. The variation in the number of caudals is relatively considerably greater than that in the number of ventrals. Thus, the average difference in the number of ventrals is from 1 to 10 in the genus, for caudals from 2 to 12.

In every form for which the number of specimens available was large enough to furnish conclusive evidence, there is a marked correlation between the geographic variation apparent in the number of scale rows and that observable in the ventrals and caudals. The tendency is always toward decrease away from the center of distribution for the form, furnishing further evidence for the theory that there is a general trend toward dwarfing within most of the forms of the genus. In the subspecies of *melanoleucus* the situation is apparently different, but the series of specimens for these forms are too small to warrant any conclusions being based upon them.

In general, when any distinct geographic variation in the proportionate tail length is observable, it is the opposite of that evident in the numbers of scale rows, ventrals, and caudals in the same form. This is doubtless to be explained by the close correlation between caudals and tail length and by the fact that, since geographic variation is so much more marked in ventrals than in caudals, a general geographic decrease simultaneously in both would result in a general increase in the ratio between tail length and total length. In every form the average proportionate tail length is greater in males than in females. In the genus as a whole the tail length varies from 0.100 to 0.185 of the total length.

Variation in numbers of labials and oculars.—The individual variation in the numbers of labials and oculars in most forms is very

great. For the genus as a whole the range of variation in the number of supralabials is 7 to 10, of infralabials 9 to 15, of preoculars 1 to 3, and of postoculars 2 to 6. In several of the forms represented by large series of specimens, such as *affinis*, *sayi*, *catenifer*, and *deserticola*, the range of variation in several of or all these characters is the same as for the entire genus. In the more specialized forms, such as the subspecies of *melanoleucus* and the three forms of the *deppei* group, the variations seem to be more specific, but it must be noted that in all these the series of specimens are too small to furnish conclusive evidence. It is obvious, however, that in each form each of these characters varies around a definite norm. For example, the number of supralabials occurring most commonly is 8 in every form except *vertebralis*, where 9 is the usual number. The number of infralabials is most often 12 or 13, except in *ruthveni* and *mugitus*, where it is commonly 14, and in *deppei*, where it is commonly 11. Similarly, the number of preoculars is rarely or never more than one in the forms of the *deppei* group and in the four subspecies of *melanoleucus*, and is most commonly one in *sayi* and *affinis*, while in *vertebralis* and the three subspecies of *catenifer* it is usually 2. In most of the forms the most usual number of postoculars is 3, with 4 next in frequency, and in some forms equally common, but in *deppei* and *lineaticollis* the usual number is 2, and in *jani* 3, with 2 occurring more frequently than 4. These three forms also differ from the rest of the genus in the entrance of two supralabials into the orbit, instead of one. These are usually the fourth and fifth, but are occasionally the third and fourth (when the number of supralabials is 7), or the fifth and sixth (when the number of supralabials is 9).

No fixed rule as to the method of reduction in the number of labials can be discovered. Indeed, specimens are not infrequently found in which the number of labials is the same on both sides of the head, but obviously results from the fusion of different scales on either side. In one specimen of *m. melanoleucus*, for example, with 7 supralabials on either side, the fusion of the second and third has apparently occurred on the right side, while on the left side the fifth and sixth have evidently been fused. Blanchard's general rule for change in the number of labials in *Lampropeltis* (1921a, p. 14) apparently has no application to either supralabials or infralabials in *Pituophis*. It reads: "In reduction—when the number of labials is odd a scute is lost behind, and when the number is even, one is lost in front of the eye; in addition—when the number of labials is odd, a scute is added in front of the eye, and when the number is even, a scute is added behind the eye." In the change from 8 to 9 supralabials a scale is usually added in front of the eye, but the change from 9 to 10 and from 7 to 8 may result from the addition of a scale either behind or in front of the eye. The changes in the infralabials

are even more irregular and may involve any of the scales except those that lie directly beneath the eye.

The existence of a sexual variation in the labials and oculars is open to question, although a very slight one seems to occur in most forms. In *affinis*, *vertebralis*, and the subspecies of *catenifer* the average numbers of supralabials and infralabials and of preoculars and postoculars are all higher in females than males, with the exception of the preoculars in *c. deserticola*, which are slightly higher in males. In *sayi*, all except the preoculars are slightly higher in males, which is equally true of *d. deppei* and *lineaticollis*. In *d. jani*, all these characters, except preoculars, are higher in females. The small number of specimens studied must be taken into account in the consideration of the last three forms. The same thing, however, cannot be said of *sayi*, which is represented by 255 specimens. In the three subspecies of *melanoleucus* represented by specimens of both sexes, supralabials are higher in females and infralabials higher in males, while preoculars are one in both sexes, with the exception of one female *melanoleucus* and one male *mugitus*, which have 2 on either side. In *lodingi* and *mugitus* the postoculars are higher in females, but in *melanoleucus* in males. Here again the small series of specimens must be taken into account. On the whole, the sexual variation in these characters seems to be of little significance.

The presence of any general tendencies in geographic variation in these scales is equally doubtful. What slight tendencies are evident in forms represented by adequate series of specimens are, however, generally in harmony with the corresponding variational tendencies in scale rows, ventrals, and caudals.

Variation in other head plates.—The number of prefrontals is one of the most constant scale characters of the genus, and the two prefrontals of *deppei*, *jani*, and *lineaticollis* distinguish those three forms from the rest of the genus. A single specimen of *deppei* shows four prefrontals, however, while a very small percentage of specimens of *sayi*, *deserticola*, and *catenifer* have only two prefrontals.

Another character of extreme constancy within the various forms is the shape of the rostral plate. This, however, shows marked interspecific differences and is therefore of great taxonomic importance. The rostral is invariably at least twice as long as broad in all the four subspecies of *melanoleucus;* is nearly, but never fully, twice as long as broad in *sayi sayi;* and is slightly longer than broad in *sayi affinis*. In all other forms of the genus, except occasional specimens of *catenifer deserticola*, it is invariably at least as broad as long.

The loreal is usually but not always present and is always longer than high. It is not infrequently divided to form two or even three small scales on one or both sides, in which cases the division is longitudinal rather than vertical.

The presence or absence of azygos plates is extremely variable. None of the specimens of the subspecies of *melanoleucus* shows an azygos, but the few specimens available may not accurately represent the true situation in these forms. In other forms one and occasionally two or even three azygos plates are common between the frontal and prefrontals. Occasionally an azygos appears between prefrontal and preocular on either side, and in a few cases in other positions between the head plates.

Variation in pattern.—The fundamental pattern throughout the genus is a series of large, dark, median, dorsal blotches on a light ground. Several additional alternating series of smaller spots are generally present on each side. Marked modifications of this basic pattern appear in the most highly specialized forms of the genus, *lineaticollis*, on the southern periphery, and the subspecies of *melanoleucus*, in the eastern part of the range. In *lineaticollis*, the typical dorsal spots break up into two series of annuli in the midregion, which fuse to form two continuous dorsal stripes on the anterior part of the body. The various patterns typical of the subspecies of *melanoleucus* may be derived readily from that of *ruthveni*, the ancestral form of the group, by intensification or diminution of color and fusion of spots, as described hereinafter under the separate forms. In the forms of the *melanoleucus* group the number of spots, when distinguishable, varies between 22 and 41 on the body and 5 and 10 on the tail. In the rest of the genus the number of spots varies between 21 and 94 on the body and 7 and 36 on the tail. The number of spots is sufficiently constant within definite limits in each form to serve as a diagnostic character of considerable importance.

In correlation with the higher number of caudals in males than in females, the number of tail spots is slightly higher in males in every form. No such correlation can be observed between the higher number of ventrals in females and the number of body spots.

Except in *deppei* and to a slight extent in *affinis* and *annectens*, no geographic variation in the number of spots is apparent. In these three forms it is in harmony with variation in scale rows, ventrals, and caudals in *affinis*, but in *deppei* and *annectens* the tendency is the reverse of that observable in those characters. The geographic variation noted in these forms is of doubtful significance.

Affinities.—A close relationship generally has been considered to exist between *Pituophis* and the genus *Arizona*. The lack of apical pits and of keels on the scales in *Arizona* indicates, however, that the affinity between these two genera is not so great as generally believed.

The problem of genetic relationships between genera is quite different from that of intrageneric affinities, and in the field of herpetology much more thorough researches on the anatomy, embryology, and variations within the genera in question are necessary for the

TABLE 1.—*Synopsis of the forms of the genus* Pituophis

Form	Maximum number of scale rows	Ventrals	Caudals	Tail length / Total length	Supralabials	Infralabials	Preoculars	Postoculars
affinis	[1] 31 (29, 33; 35; 28, 32)	215–260	51–71	0.111–0.152	8 (9)	12, 13 (11, 14; 15)	1 (2)	3, 4 (5; 2, 6)
annectens	33 (31, 35; 32, 34; 29, 37)	210–253	60–84	0.135–0.182	8 (9; 10; 7)	12, 13 (14; 11; 15)	2 (1; 3)	3 (4; 5)
catenifer	31 (33; 29, 35; 32, 37)	206–234	54–80	0.122–0.185	8 (9; 7, 10)	12, 13 (11, 14; 10)	2 (1; 3)	3 (4; 5; 2, 6)
deppei	29 (27, 31)	211–233	52–79	0.114–0.157	8 (9; 7)	11 (12, 13; 14; 10)	1 (2)	2 (3; 4)
deserticola	31 (29, 33; 35)	214–259	54–71	0.115–0.166	8 (9; 10)	12, 13 (11, 14; 10, 15; 9)	2 (1)	3, 4 (5; 2; 6)
jani	29 (31)	225–235	52–66	0.120–0.141	8 (9)	13 (11; 12; 10)	1	3 (2; 4)
lineaticollis	27	236–249	61–71	0.122–0.138	8 (9)	12 (11, 13)	1	2 (3)
lodingi	29 (31)	214–224	58–66	0.132–0.160	8 (7)	13 (14; 15)	1	3 (4)
melanoleucus	29 (27; 31)	205–223 (249)	52–66	0.120–0.141	8 (7; 9)	12 (13; 11; 10)	1 (2)	3 (4; 2)
mugitus	31 (29, 33; 32; 35)	218–235	53–67	0.118–0.147	8 (9)	14 (13; 15; 12)	1 (2)	3 (4)
ruthveni	33, 31	218–219	59–60	0.125–0.131	8 (9)	14, 15	1	4, 3
sayi	31, 33 (29, 35; 32; 28, 37)	212–244	47–67	0.100–0.145	8 (9; 7, 10)	12, 13 (11; 14 10, 15)	1 (2; 3)	3 (4; 2, 5)
vertebralis	33 (35; 31)	237–262	51–69	0.110–0.149	9 (8; 10)	12, 13 (14; 11, 15)	2 (1; 3)	3 (4; 5)

[1] In each case the first number given is the most common and the numbers following in parentheses are in order of frequency, with numbers of approximately equal frequency placed one above the other.

TABLE 1.—*Synopsis of the forms of the genus* Pituophis—Continued

Form	Number of spots		Teeth				Shape of rostral	Number of specimens examined
	Body	Tail	Mandibular	Maxillary	Palatine	Pterygoid		
affinis	33–68	9–19	[1] 18–19	16–17	8–10	10–14	Slightly longer than broad.	146
annectens	55–92	14–36	18–20	14–18	9–10	8–14	As broad as long	176
catenifer	44–94	12–31	16–19	14–17	7–11	7–14	do	256
deppei	32–44	9–16	20–22	18	9–11	8–14	do	25
deserticola	43–74	11–22	16–22	14–17	9–11	7–13	do	190
jani	21–25	7–10	18–20	16–18	10	12–14	do	8
lineaticollis	Stripes anteriorly, annuli in midregion, spots posteriorly.		20–22	18	9–12	15	do	4
lodingi	Dorsum black		18	16	10	8–10	Twice as long as broad	5
melanoleucus	22–29	6–9	17	16–17	9–12	6–8	do	30
mugitus	26–29 (Or indistinct.)	5–10	17–19	16–17	9–10	7–10	do	22
ruthveni	41	9	18	15	9	8	do	2
sayi	33–68	8–20	17–21	16–17	9–11	9–13	Almost twice as long as broad.	255
vertebralis	34–63	10–18	18–22	16–18	9–11	11–14	As broad as long	38
Total								1,157

attainment of a valid understanding of intergeneric relationships. The number of genera of Colubridae that have been studied intensively is too small to warrant the drawing of any conclusions concerning affinities between genera of that family.

KEY TO THE FORMS OF THE GENUS PITUOPHIS

a^1. Eye in contact with 2 supralabials; only 2 prefrontals present normally.

b^1. Dorsum lacking continuous stripes, but with a series of ovoid, quadrangular, or saddle-shaped spots throughout; ventrals 211–235.

c^1. Dorsal spots on body and tail more than 40; interspaces between spots generally each less than 4 scales in length; posterior spots quadrangular without a tendency to fuse at the sides (throughout Mexico to California and Texas) **deppei deppei** (p. 25)

c^2. Dorsal spots on body and tail less than 40; interspaces between spots generally each 5 or more scales in length; posterior spots saddle-shaped and tending to fuse at the sides (Miquihuana and Buenavista, Mexico) **deppei jani** (p. 42)

b^2. Anterior part of dorsum with 2 continuous black vertebral stripes, central portion of body with 2 rows of ovoid annuli, and posterior dorsum with a single row of spots; ventrals 236–249 (Guatemala to Guerrero, Mexico) **lineaticollis** (p. 47)

a^2. Eye in contact with one or no supralabials; 4 prefrontals present normally.

b^1. Rostral at least twice as long as broad; dorsum black and white with less than 40 spots, or brown and white with anterior spots indistinct, or uniformly black; rarely more than 1 preocular; azygos never present between frontal and prefrontals.

c^1. Distinct spots on at least the posterior half of dorsum.

d^1. Pied black and white with anterior spots distinct (New Jersey to eastern Tennessee and South Carolina)

melanoleucus melanoleucus (p. 51)

d^2. Pied brown and white.

e^1. Dorsum pied rusty brown and white; spots less than 40 when distinguishable; anterior spots indistinct or lacking; posterior spots often red (Florida to southern Georgia)

melanoleucus mugitus (p. 66)

e^2. Dorsum brown with chocolate-brown spots numbering more than 40; anterior spots more or less distinct; posterior spots never red (Longleaf, La.)---**melanoleucus ruthveni** (p. 74)

c^2. Spots entirely lacking except in young; uniformly black above, slate-gray below (Mobile County, Ala.)---**melanoleucus lodingi** (p. 79)

b^2. Rostral less than twice as long as broad; dorsum always with more than 40 distinct dark spots, never black and white with less than 40 spots, nor brown and white with anterior spots indistinct, nor uniformly black; frequently more than 1 preocular; azygos often present between frontal and prefrontals.

c^1. Rostral longer than broad; sum of ventrals and caudals added to number of dorsal spots on body and tail rarely exceeding 360.

d^1. Rostral nearly twice as long as broad; posterior spots not reddish; spots generally quadrangular or bar-shaped (northern Mexico north to southern Alberta, west to the Rocky Mountains, and east to Wisconsin, Illinois, Indiana, and the Mississippi River)-**sayi sayi** (p. 91)

d^2. Rostral only slightly longer than broad; anterior spots often distinctly reddish or red-brown; spots often slightly saddle-shaped (northern Mexico, Arizona, New Mexico, and southwestern Colorado)

sayi affinis (p. 123)

c^2. Rostral rarely longer than broad; sum of ventrals and caudals added to number of dorsal spots on body and tail rarely less than 360.

d^1. Anterior dorsal spots black or reddish, central spots reddish, and posterior spots black; spots usually saddle-shaped and tending to fuse at the sides; anterior spots generally each 5 or more scales in length; ventrals 236–262 (Lower California north to San Bernardino County, Calif.)---**vertebralis** (p. 82)

d^2. Spots uniformly brown or black throughout series, ovoid or quadrangular in shape; each spot rarely more and usually less than 4 scales in length.

e^1. Dorsal spots less than 90, or sum of ventrals and caudals less than 300, or tail length divided by total length less than 0.135; anterior dorsal spots not or only slightly fusing with smaller alternating lateral spots and never fusing with one another.

f^1. Ventrals generally less than 228 (average 220); when scale rows are less than 31, ventrals are less than 215: light-colored scales usually lacking each a central black spot (California south to San Diego County, the western parts of Oregon and Washington, to southern British Columbia)--**catenifer catenifer** (p. 140)

f^2. Ventrals generally more than 228 (average 236); when scale rows are less than 31, ventrals are more than 215; light-colored scales generally each with a central black spot, at least on the anterior part of the body (eastern desert regions of southern California, Nevada, Utah, and Idaho and the eastern parts of Oregon and Washington)---**catenifer deserticola** (p. 166)

e^2. Dorsal spots more than 90, or sum of ventrals and caudals more than 300, or tail length divided by total length more than 0.145; anterior dorsal spots generally fusing with the smaller alternating lateral spots, and often fusing with each other (Lower California and southern California north to Monterey along the coast and inland to San Bernardino County and Mohave Desert)

catenifer annectens (p. 185)

PITUOPHIS DEPPEI DEPPEI (Duméril and Bibron)

Elaphis Deppei Duméril, Mem. Acad. Inst. France, vol. 23, p. 453, 1853.—Duméril and Bibron, Erpétologie générale, vol. 7, p. 268, 1854 (type in Leiden Museum; type locality, Mexico).

Pituophis deppei Jan, Elenco sistematico degli Ofidi, p. 59, 1863; Iconographie générale des ophidiens, livr. 22, pl. 2, fig. 2, 1867.

Pityophis Deppei Dugès, La Naturaleza, ser. 1, vol. 1, p. 144, 1870; ibid., ser. 2, vol. 1, p. 125, 1888; ibid., ser. 2, vol. 1, p. 286, 1889.

Pityophis catenifer deppei Garman, Bull. Essex Inst., vol. 16, p. 27, 1884.

Spilotes deppei Cope, U. S. Nat. Mus. Bull. 32, p. 72, 1887.

Pituophis pleurostictus var. *deppei* Bocourt, Mission scientifique au Mexique et dans l'Amérique Centrale, Reptiles, p. 668, pl. 42, figs. 3, 3a, 3b, 3d, 3f, 1888.

Pithyophis deppei Herrara, La Naturaleza, ser. 2, vol. 1, pp. 278, 281 ff., 1889.

Pitiophis deppei Herrara, ibid., p. 338, 1890.

Epiglottophis deppei Cope, Amer. Nat., vol. 25, p. 157, 1891.

Coluber deppei Boulenger, Catalogue of snakes in the British Museum, vol. 2, p. 66, 1894.

Pituophis deppii Günther, Biologia Centrali-Americana, Reptilia, p. 124, 1894 (part).

Pityophis deppei Terron, Mem. Rev. Soc. Cient. "Antonio Alzate," vol. 39, p. 170, 1921.

Pituophis deppei deppei Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 1, 1932.—Burt, Journ. Washington Acad. Sci., vol. 25, No. 8, p. 381, 1935.—Dunkle and Smith, Occ. Pap. Mus. Zool. Univ. Michigan, No. 363, p. 7, 1937.

Elaphis pleurostictus Duméril, Mem. Acad. Inst. France, vol. 23, p. 453, 1853.—Duméril and Bibron, Erpétologie générale, vol. 7, p. 244, 1854 (type in Paris Museum; type locality, Montevideo [probably erroneous]).

Pituophis pleurostictus Jan, Elenco sistematico degli Ofidi, p. 59, 1863.—Bocourt, Mission scientifique au Mexique et dans l'Amérique Centrale, Reptiles, p. 666, pl. 42, figs. 2–2d, 1888.

Epiglottophis pleurostictus Cope, Amer. Nat., vol. 30, pp. 1014, 1021, 1896; Rep. U. S. Nat. Mus. for 1898, p. 861, 1900.

Pituophis vertebralis (not of de Blainville) Günther, Catalogue of the colubrine snakes in. . . the British Museum, p. 86, 1858.

Pituophis deppei var. *pholidostictus* Jan, Elenco sistematico degli Ofidi, p. 59, 1863.

Pituophis mexicanus (not of Duméril and Bibron), ibid., p. 59.

Original description.—Duméril and Bibron (1854, p. 268) describe this form under the name "*Elaphis Deppei*" as follows:

Caractères.—Une seule plaque anale, ainsi qu'une préoculaire; flancs non piquetés. Sommet de la rostrale assez distinctement rabattu sur le museau; une préoculaire, deux postoculaires, quatrième et cinquième sus-labiales touchant l'oeil. Scutelle anale entière. Point de lignes noires sur la tête, ni de bandes longitudinales sur la nuque, ni de raie allant de l'oeil à l'angle de la bouche.

Écaillure.—Écailles: 27 rangées longitudinales au tronc, 8 à la queue. Scutelles: 2 gulaires, 233 gastrostèges, 1 anale non divisée, 67 urostèges divisées.

Dents.—Coloration: Les notes que Bibron avait sans doutes prises sur les particularités du système dentaire et sur les couleurs n'ayant point été trouvées dans le petit nombre de feuillets manuscrits qu'il avait laissés sur le grand genre Élaphe, il nous est malheureusement impossible de compléter ce qui manque à cette description, puisque l'Élaphe de Deppe a été rendu au Musée de Leyde qui l'avait envoyé en communication au Musée de Paris.

Dimensions.—La tête a en longueur une fois et deux tiers sa largeur prise vers le milieu des tempes, largeur qui est triple de celle du museau, en avant des narines. Les yeux ont leur diamètre longitudinal égal à la moitié de l'espace sus-interorbitaire. Le tronc est d'environ un tiers plus et 58 fois aussi long qu'il est large à sa partie moyenne. La queue entre ou moins pour un septième dans la longueur totale. Le sujet qui nous offre ces diverses proportions est long de 1^m 658 du bout du museau a l'extrémité de la queue, soit; Tête, long. 0^m 048. Queue, long. 0^m 23.

Patrie.—Le Musée de Leyde, à qui appartient ce Serpent, l'a reçu du Mexique.

Observations.—Il nous a été envoyé en communication par M. Schlegel, sous le nom de *Coluber Deppei*, adopté dans le Musée d'histoire naturelle de Berlin.

Systematic notes.—Although the name *pleurostictus* has priority over the name *deppei* by page precedence, the descriptions of both appearing within a few pages of each other in Duméril and Bibron's "Erpétologie Générale" (1854, pp. 244, 268), the name *deppei* has been most generally used. It is accepted by Günther (1894, p. 124), who says; "I select the term *deppii* for this species in preference to *pleurostictus*, because the locality for the latter specimen has been erroneously given as 'Monte Video,' the difficulty of recognizing the species having been thus unduly increased." It must therefore be retained.

Cope, in 1891 (p. 157), proposed a new genus, *Epiglottophis*, including *deppei* and *lineaticollis* and based on the character of the epiglottis. Of this structure Cope says:

> Dr. Chas. A. White describes the epiglottis of the pine-snakes (Pityophis), and figures it as it appears in the *P. sayi bellona*, B. and G. He shows that instead of having the horizontal form found in the higher Vertebrata it is a vertical lamina standing erect in front of the *rima glottidis*. He states that he has found it in all of the species of Pityophis, but that it is wanting in all other serpents which he has examined. * * * I have found it well developed in the four species of Pityophis, and in the two Mexican snakes which I have enumerated under Spilotes; the *S. deppei* D. and B., and the *S. lineaticollis* Cope. It is, however, wanting in Spilotes proper, and curiously in the *Rhinechis elegans*, which is otherwise a good deal like Pityophis. It is not present in any other American snakes, harmless or venomous. It appears to me to be a character of generic importance, so I propose to separate the two Mexican snakes referred to from Spilotes on account of its presence under the name of Epiglottophis, with *E. deppei* as the type.

It is to be expected that the forms included in "*Epiglottophis*," being true *Pituophis*, would show the structure of the epiglottis typical of the other forms of *Pituophis*. Thus, Cope's genus has never been accepted by other authors.

Diagnosis.—This form may be distinguished from *lineaticollis* by the smaller number of ventrals (211 to 233 rather than 236 to 249 in *lineaticollis*) and by the pattern. The presence of quadrangular spots throughout the entire length of the dorsum, and the complete lack of dorsal stripes, characterize *deppei*, while *lineaticollis* bears two continuous black dorsal stripes on the anterior part of the dorsum, a double series of annuli posterior to these, and a single series of annuli on the posterior half of the dorsum. *P. d. deppei* may be separated from its closest relative, *jani*, by the larger number of, and smaller interspaces between, the dorsal spots. In the former, the spots vary in number from 43 to 59 on body and tail and are separated by interspaces generally each fewer than four scales in length. In the latter, the spots vary from 29 to 35 in number on body and tail and are separated by interspaces of at least five scales in length. In common with the other members of the *deppei* group, *jani* and *lineaticollis*, *deppei* may be distinguished readily from all other forms of the genus by the presence of two rather than four prefrontals, and the entrance into the orbit of two supralabials on each side, rather than one.

Description.—Like the other members of the *deppei* group, this form has a slender body and blunt snout. The tail length varies from 0.114 to 0.157 of the total length, tending to be less in females than in males. The largest specimen examined was 1,790 mm. long.

The dorsal scale formula is most often 27–29–21, but it is rather variable. The maximum number for the series studied varied from 27 to 31; the number at the neck, from 25 to 29; the number anterior to the vent, from 19 to 23. The other scale characters are as follows: Ventrals 211 to 233 (average 221.8); caudals 52 to 79 (average 61.5); supralabials 7 to 9 (average 8.1) with the fourth and fifth usually, or third and fourth or fifth and sixth occasionally, entering the eye; infralabials 10 to 14, most often 11 (average 11.9); preoculars usually 1, rarely 2; postoculars 2 to 4; loreal present in about 50 percent of the specimens; azygos lacking between frontal and prefrontals, but in two (12 percent) specimens a small azygos present on each side between prefrontal and preocular; rostral as broad as or broader than long, penetrating from one-third to all the distance between the internasals; frontal undivided.

The dentition is as follows: Mandibular teeth 20 to 22, decreasing slightly in size posteriorly; maxillary teeth 18, decreasing slightly in size posteriorly; palatines 9 to 11, subequal and slightly smaller than the mandibular and maxillary teeth; pterygoids 8 to 14, smaller than the palatines and decreasing slightly in size posteriorly.

The dorsum bears a series of large dark spots, generally quadrangular but occasionally saddle-shaped in the midregion. These are each 3 to 8 scales in length and 10 to 13 scales wide and are separated by light interspaces rarely 4, and generally less than 4, scales in length.

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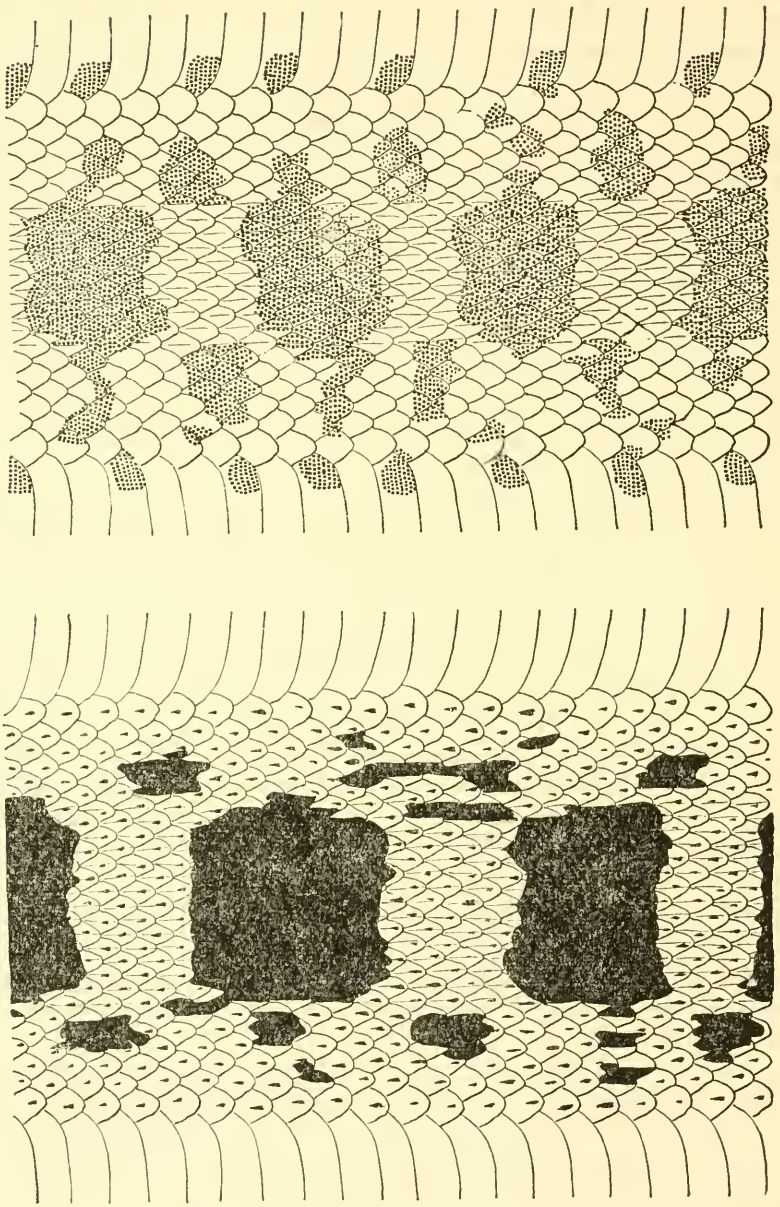

FIGURE 11.—Color pattern of *Pituophis deppei deppei*: *a*, Anterior; *b*, posterior.

On the tail the spots appear as black bars 2 or 3 scales each in length. The spots number 32 to 44 on the body (average 36.9) and 9 to 16 on the tail (average 12.7). They are black or dark brown anteriorly and posteriorly, and brown, usually outlined with darker brown, in the middle of the body. The ground color in alcoholic specimens is yellowish white or buff, tending in some specimens to be almost orange in the anterior interspaces. In most specimens, in at least the anterior region, many of the light scales of the sides and interspaces bear a small central dark spot. The belly is a yellowish white and lacks spots anteriorly, or has small dark spots scattered irregularly at the sides of the ventral scutes. Posteriorly and under the tail there is a series of small dark spots on either side, which are 1 or 2 scutes each in length and are separated by 1 to 4 scutes. Anterior to the vent and on the under side of the tail additional small spots are scattered irregularly between the lateral series. The head and throat are usually pale, with dark lines between the supralabials and between the infralabials, and sometimes with small brownish spots appearing as far anterior as the frontal and supraoculars. (Fig. 11.)

Variation.—As the number of specimens under consideration in the study of this form is small, the results obtained in attempting to correlate variation with distribution must be accepted with caution. This is especially true in regard to characters that show a marked sexual variation, as unequal proportions of the sexes from given localities would tend to distort the averages and extremes of variation for those localities. Some geographic variation seems to be evident, however, in several of the characters.

From southern to northern Mexico, there is a slight tendency toward an increase in the dorsal scale formula, as shown by the graph (fig. 12). This tendency continues to California, but from northern Mexico to Texas there is, on the contrary, a decrease. It must be remembered here, as in the discussion of all other characters of this form, that the data of the Texas and California specimens may be very deceptive, as there were in the available collections only two specimens from the former region, and one from the latter, which may in either case represent an extreme of variation for the region in any of or all the characters. The tendency of the ventrals (fig. 13), as well as the caudals (fig. 14), to increase from south to north is negligible. The increase in the Texas specimens, however, is sufficiently marked in both cases to make the sum of ventrals and caudals (fig. 15) in both Texas specimens lie without the range of variation for the other specimens of the series. The only specimen with 7 supralabials is from the southern part of the range, and, although the average number shows a slight decrease from south to north in Mexico, it is apparent from a consideration of both extremes of variation and averages for the entire series that any general trend that may be present is rather

toward increase from south to north. The infralabials are more variable, 11 being the commonest number, while 12 and 13 are almost equally common. We find only one specimen, from Chihuahua, Mexico, in which there is a decrease to 10, and one specimen each from Tacambaro in Michoacan, Jamay in Jalisco, and San Marcos, Tex., that have 14 infralabials on one or both sides. One specimen only, from Chihuahua, Mexico, varies from the normal in having 2 prefrontals on each side instead of 1. The postoculars are more variable, 2 being the commonest number, while nearly as large a

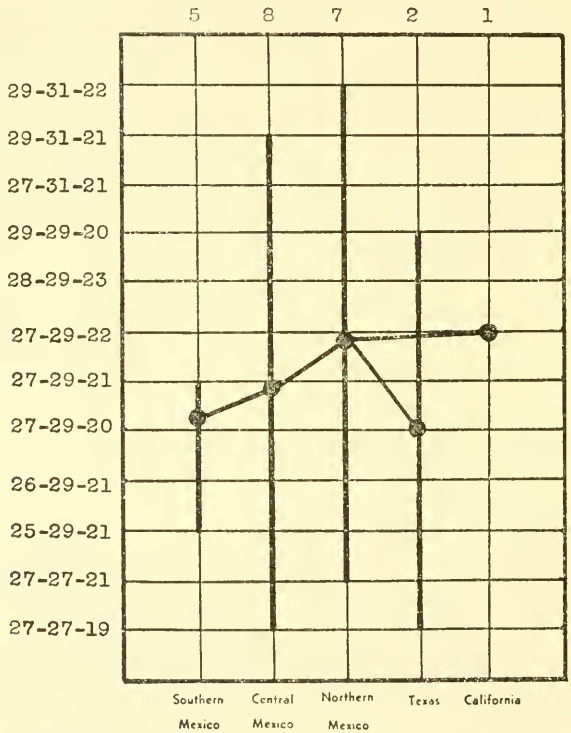

FIGURE 12.—Geographic variation in number of scale rows in *Pituophis deppei deppei*.

proportion have 3, and a large number have 3 on one side and 2 on the other. One specimen from Jamay, Jalisco, and the specimen from Real de Pinos, Calif., each have 4 on one side, and a specimen from Ada Magdalena, Durango, has 4 on both sides. These variations in the oculars seem to be of little, if any, geographical significance, and a much larger series of specimens is needed to furnish reliable evidence.

The variation in the number of spots seems to be very definitely correlated with the distribution of the form, showing a constant decrease from south to north in both averages and extremes of variation (fig. 16).

The tail length varies as stated above from 0.114 to 0.157 of the total length. The lowest extreme, found in a specimen from Guanajuato, is considerably below the next higher number, and the average for the form is 0.141. From the graph of this character (fig. 17) it will be seen that it remains fairly constant throughout Mexico and is considerably higher in the California and Texas specimens, indicating a tendency toward an increase in these regions. It must be remembered, however, that the California specimen and one of the Texas

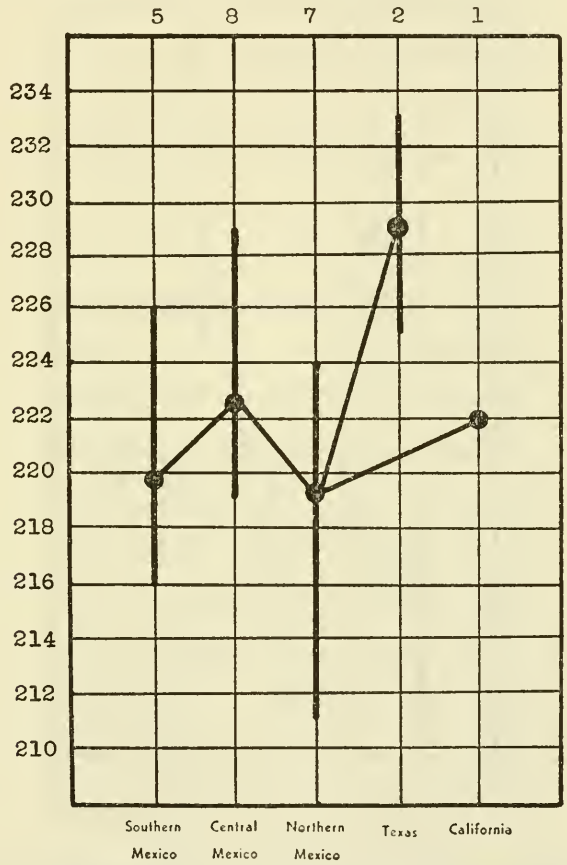

FIGURE 13.—Geographic variation in number of ventrals in *Pituophis deppei deppei*.

examples are males and would tend normally to have a greater than average tail length.

Thus, to summarize, we find that the evidence from a consideration of the totality of the characters indicates a dwarfing from north to south, away from the probable center of origin for the form, accompanied by an increase in the number of spots.

Sexual variation is evident in many of the characters. Thus, the scale rows in males vary from 26–27–21 to 29–31–21, while in females

they range from 27–27–21 to 29–31–22, the formula tending to be higher in females than in males, as in other forms of the genus. Ventrals vary from 211 to 225 (average 220.3) in males and from 215 to 233 (average 223.3) in females, while caudals average 62.6 in males and 60.1 in females. The variation in proportionate tail length ranges from 0.130 to 0.157 (average 0.145) in males and from 0.127 to 0.156 (average 0.136) in females. The average number of supralabials, in-

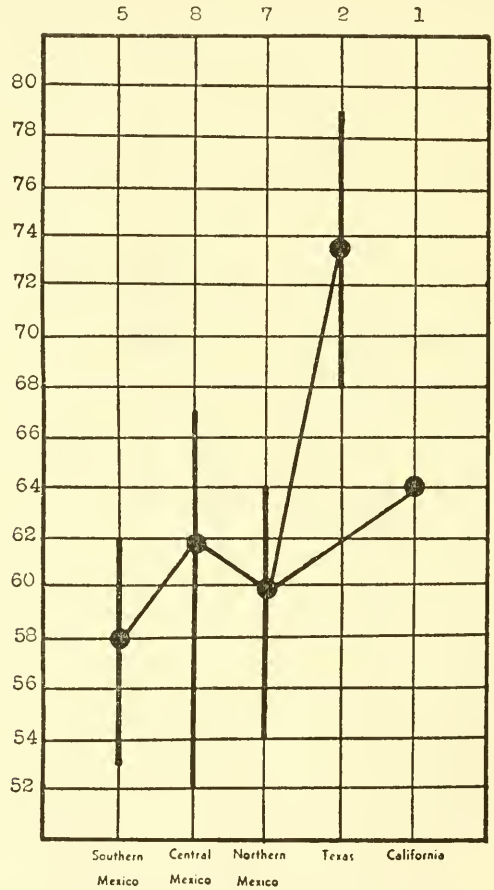

FIGURE 14.—Geographic variation in number of caudals in *Pituophis deppei deppei*.

fralabials, and postoculars is slightly higher in each case in males than in females, as in *lineaticollis* and *sayi*, while the reverse is true in most of the other forms of the genus. Contrary to expectation, in consideration of the proportionately longer body of females, as indicated by the higher number of ventrals, the number of body spots, as well as of tail spots, is higher in males. The total number of spots on body and tail averages 50.4 in males and 47.8 in females.

Range.—P. d. deppei is known to occur from Tehuantepec, in the southern part of Oaxaca, Mexico, north to Real de Pinos, Calif., on the west, and to San Marcos, Hays County, Tex., on the east. The

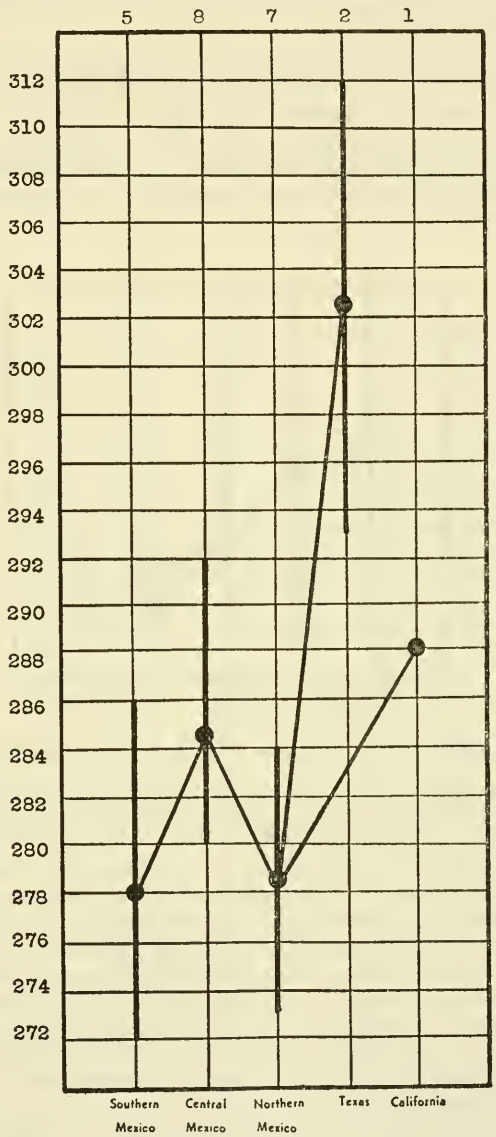

FIGURE 15.—Geographic variation in number of ventrals plus caudals in *Pituophis deppei deppei.*

westernmost locality reported in Mexico is "Gulf of California," while the easternmost is "San José Acateno, Veracruz." The distribution is shown on the map (fig. 18).

Specimens of *deppei* have been examined from the following definite localities:

Mexico: *Puebla*, southeast of Puebla, Atlixco; *Michoacan*, Tacambaro; *Mexico*, west of Atzocozlco, San Juan Teolihuacan; *Jalisco*, Atemajac, Guadalajara, Jamay; *Guanajuato*, Guanajuato; *San Luis Potosi*, San Luis Potosi; *Durango*, Ada Magdalena; *Coahuila*, Castanuelas; *Chihuahua*, Chihuahua.
Texas: *Hays County*, San Marcos.
California: Real de Pinos.

The following additional localities for this form have been recorded:

Mexico: *Veracruz*, San José Acateno (Cope, 1887, p. 72; Günther, 1894, p. 124); *Mexico*, Mexico City (Günther, l. c.; Boulenger, 1894, vol. 2, p. 67); *Oaxaca*, Tehuantepec (Günther, l. c.; Boulenger, l. c.); *Jalisco*, Belén (Dunkle and Smith, 1937, p. 7); *Aguascalientes*, 10 miles east of Aguascalientes (Dunkle and Smith, l. c.).

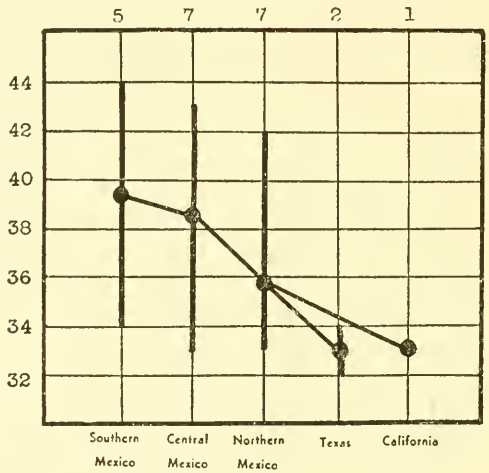

FIGURE 16.—Geographic variation in number of dorsal spots on body in *Pituophis deppei deppei*.

Habits and habitat.—Very little has been recorded of the habits of this form. Dugès (1888, p. 126) gives the following account:

Este grande y bello ofidio habita el Valle de México, donde es conocido con el nombre de *Zincuate ó Cencuate* y en Guanajuato y Guadalajara, donde le llaman *Alicante*. La fuerza es muy grande, y al cogerlo se defiende con energía, mordiendo cruelmente, pero á los poco días de cautiverio es rarísimo que no se torne muy manso. Cuando se enoja se lanza con furor sobre su enemigo con la boca abierta, y produciendo un sordo rugido muy perceptible á diez pasos de distancia: este fenómeno es debido á la vibración, bajo la influencia del aire espirado, de una lámina cartilaginosa colocada perpendicularmente delante de la glotis: antes de abalanzarse el cencoate dobla en tres partes la porción anterior de su cuerpo contrayéndola con fuerza, aplasta su cabeza é imprime á su cola unas trepidaciones rápidas. La secreción de las glándulas caudales de *Pit. Deppei* es cremosa, de un olor débil algo nauseabundo. Estos ofidios son muy amantes del aqua, y gustan encaramarse en los árboles: se alimentan de ratas, ratones, avecillas, pequeños tlacuaches y comen bien estos animales muertos; en cuanto á su carne propria es sabrosa y de fácil degestión, recordando la de las anguilas. En el mes de Junio la hembra contiene huevos con embriones ya bastante desarrollodos: no he vista más que un huevo puesto: era esferoidal y con diámetros de $0^{m}042$ por $0^{m}033$, cascaron blanco ligeramente granoso y correoso.

Herrera (1889, p. 282) describes the structure and use of the vocal apparatus, which are the same as in other forms of the genus.

The following observations on the habitat of this form are given by Herrera (1890, p. 338): "Se le encuentra más comunmente cerca de los depósitos de agua sin corriente; pero también suele hallarse en las montañas cubiertas de plantas herbáceas, aunque no se le ve jamás en los bosques de coníferas, ne en los pedregales, ó en el interior de los lagos."

Affinities.—The closest affinities of *deppei* are undoubtedly with the two forms *jani* and *lineaticollis*, which may be included with it in the *deppei* group. The former, although known from only two

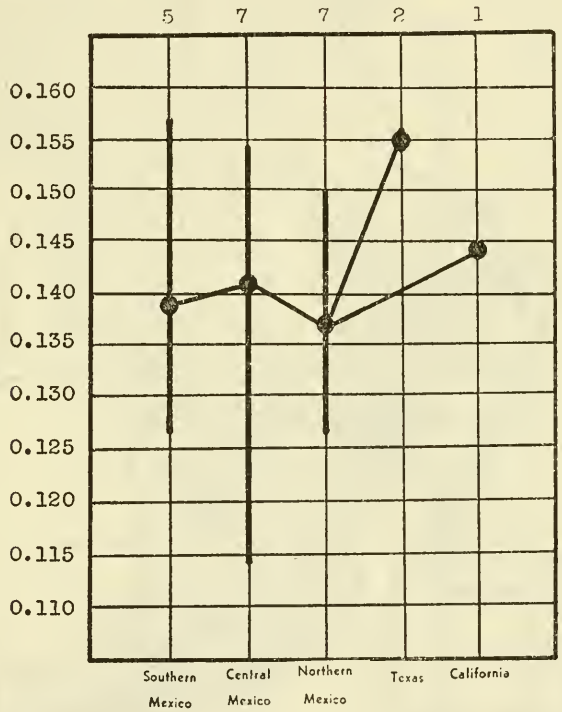

FIGURE 17.—Geographic variations in ratio of tail length to total length in *Pituophis deppei deppei*.

localities, undoubtedly has a range contiguous with that of *deppei* (fig. 18). It has generally been considered identical with *deppei*, and most of the characters of the two forms, while differing in some cases on the average, overlap in range of variation. In pattern and the number of spots they are distinct, however, and Cope's *jani* is therefore retained as a subspecies of *deppei*. The ranges of *deppei* and *lineaticollis*, on the other hand, overlap, and the two forms are quite distinct in scale characters as well as pattern (fig. 19). The tendencies exhibited in *lineaticollis*, and to a lesser extent in each

case in *jani*, to decrease the proportionate tail length from that typical of *deppei* (fig. 20), to increase the numbers of ventrals and caudals (figs. 21–23), and to develop stripes, all indicate that *deppei* is the common ancestor of these two forms. The derivation of *deppei*

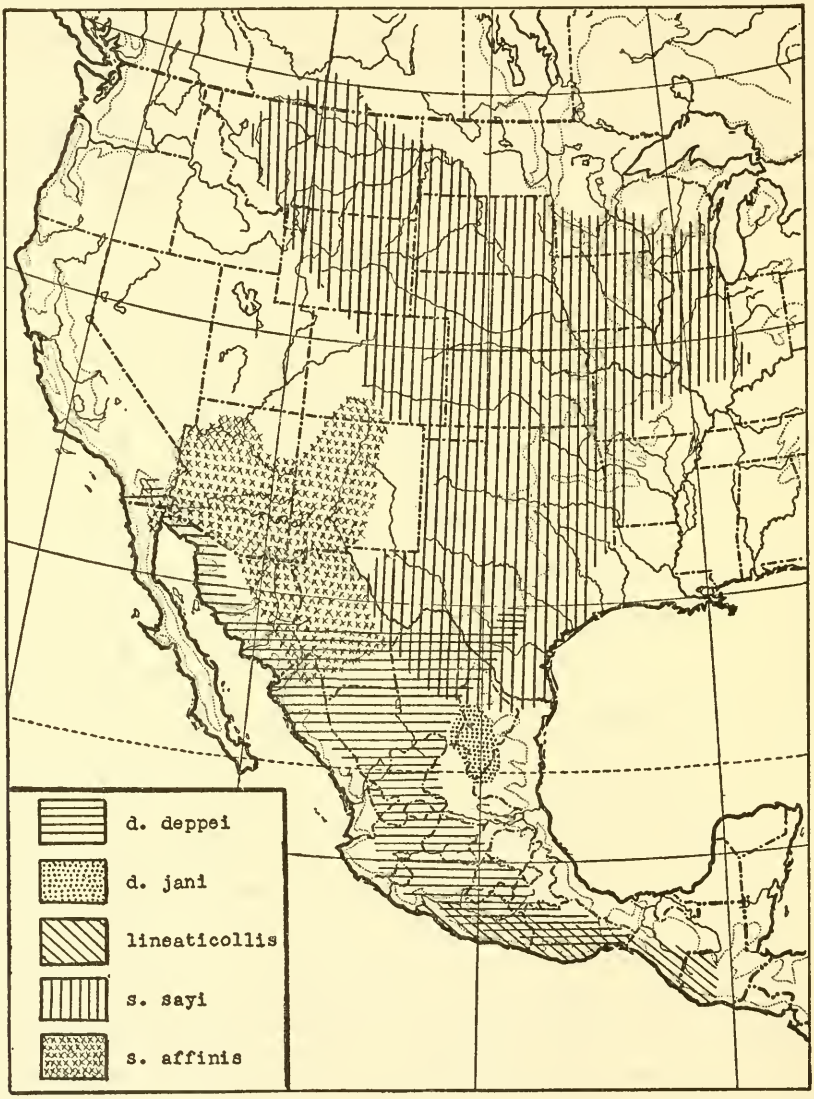

FIGURE 18.—Distribution of *Pituophis deppei deppei*, *P. d. jani*, *P. lineaticollis*, *P. sayi sayi*, and *P. s. affinis*.

from *sayi affinis* is suggested by the contiguous ranges of the two forms and by the similarity in pattern. That *deppei* is derived from *affinis*, rather than the reverse, seems probable in consideration of the presence in the former of only two prefrontals, and the contact

between the eye and two supralabials on either side, both of which are obviously specialized characters for the genus. The shape of the rostral, also, which is low and flattened in *deppei*, is intermediate in *affinis* between the *deppei* and *catenifer* groups and *vertebralis* on the

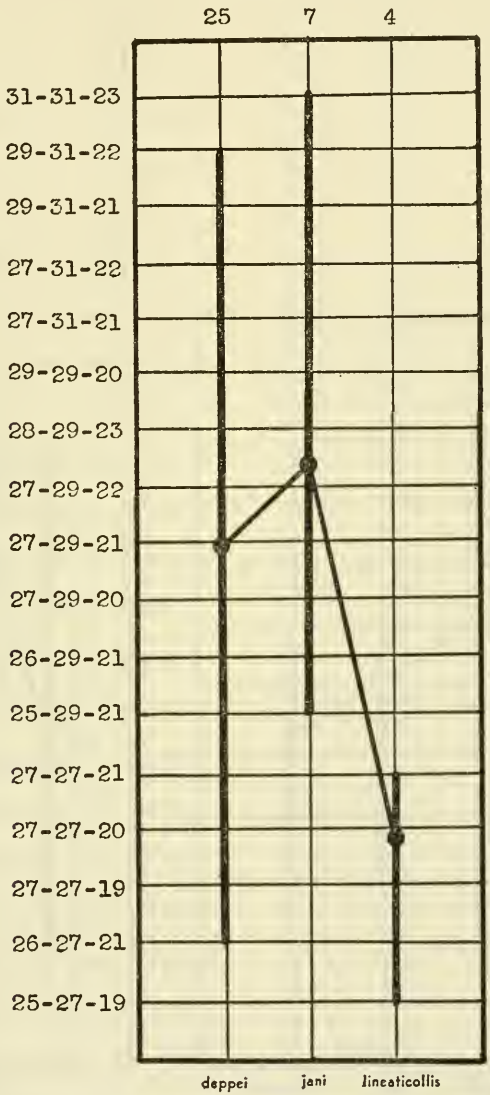

FIGURE 19.—Variation in number of scale rows in the forms of the *deppei* group.

one hand, and *sayi* and the *melanoleucus* group on the other. The other scale characters, and the pattern as well, are intermediate in *affinis* between those of *deppei* and *vertebralis*, *deppei* and *deserticola*, and *deppei* and *sayi*. If *deppei* were postulated as the ancestral

form, many of the trends in variation observable from *affinis* outward along the lines of evolution of the *vertebralis*, *catenifer*, and *sayi–*

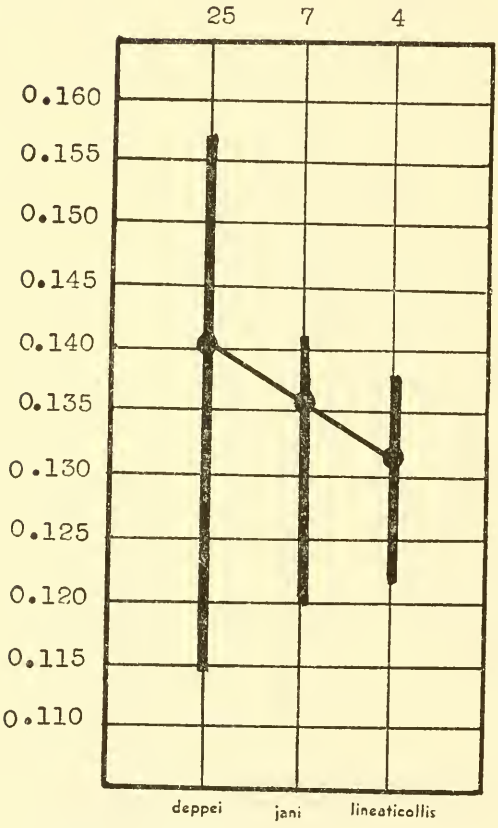

FIGURE 20.—Variation in ratio of tail length to total length in the forms of the *deppei* group.

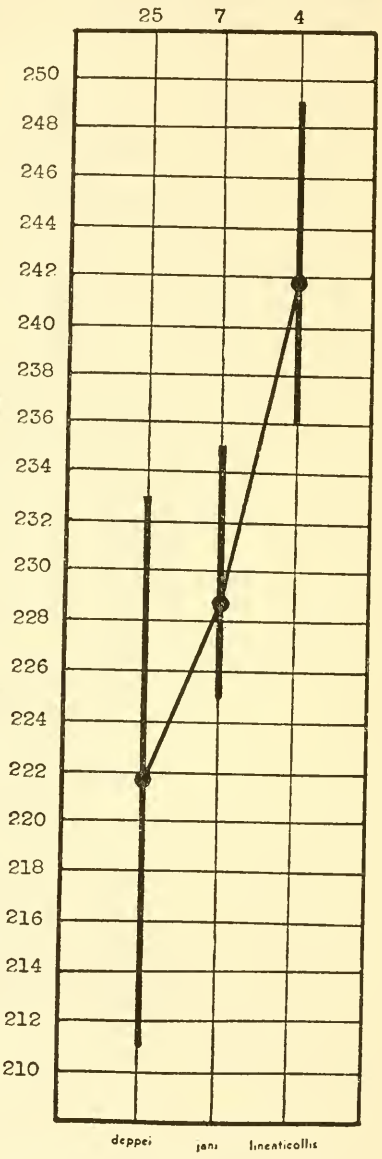

FIGURE 21.—Variation in number of ventrals in the forms of the *deppei* group.

melanoleucus groups, would necessarily proceed in a given direction from *deppei* to *affinis*, from which the trend would continue along certain of the lines of dispersal unchanged, and be reversed along

others. If, however, *affinis* is accepted as the central form of the genus phylogenetically, the apparent trends in variation proceed in

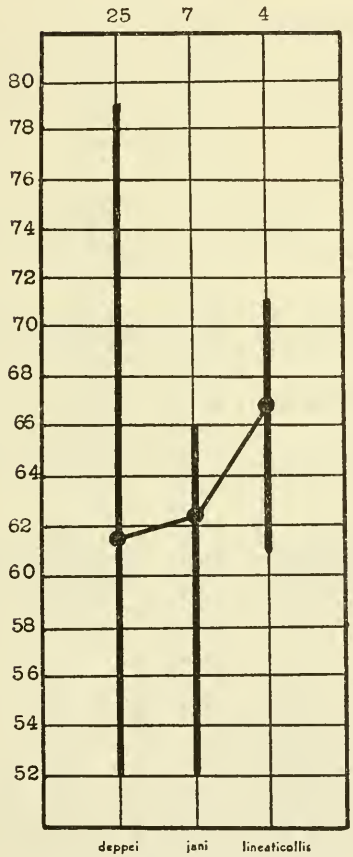

FIGURE 22.—Variation in number of caudals in the forms of the *deppei* group.

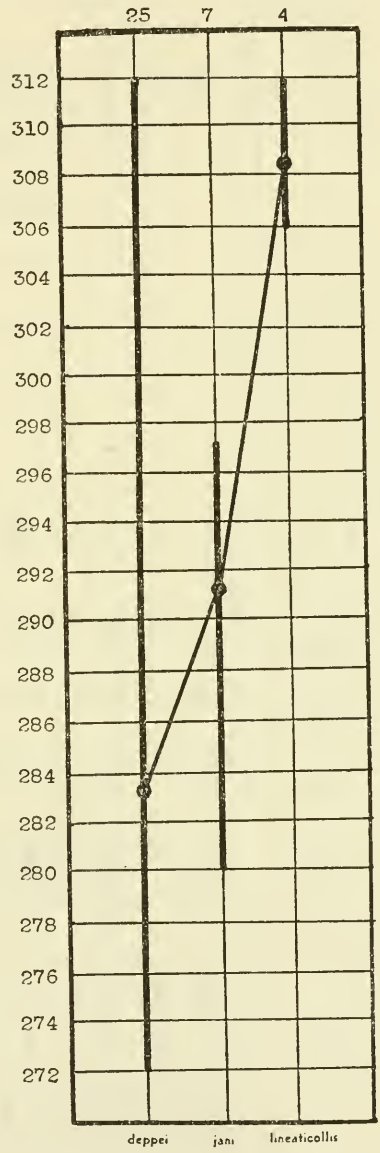

FIGURE 23.—Variation in number of ventrals plus caudals in the forms of the *deppei* group.

most cases unreversed along the lines of dispersal represented by the *deppei*, *vertebralis*, *catenifer*, and *sayi–melanoleucus* groups.

TABLE 2.—*Specimens of* Pituophis deppei deppei *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
M.C.Z. No. 7804	Mexico	♂	26–27–21	218	61	279	8/9	12/13	1	2	38	14	52	100	0.140	1	0
M.C.Z. No. 407	Castanuelas, Coahuila, Mexico.	?	27–31–22	228	62	290	8	13	1	3	38	11	49	131	0.145	1	0
M.C.Z. No. 16051	San Juan, Teolihuacan, Mexico.	♂	27–29–21	217	61	278	8	12	1	3/2	44	14	58	126	0.146	1	0
U.S.N.M. No. 46557	Tacambaro, Michoacan, Mexico.	♂	27–29–21	219	53	272	8	14/13	1	3	37	12	49	100	0.130	1	0
U.S.N.M. No. 46554	San Luis Potosi, Mexico.	♂	27–29–21	223	57	280	8	12	1	2	34	9	43	89	0.134	1	0
U.S.N.M. No. 46433	Atlixco, Puebla, Mexico	♂	27–29–21	216	62	278	9	12/13	1	3	34	12	46	121	0.157	1	0
U.S.N.M. No. 46385	Atemajac, Jalisco, Mexico.	♂	29–31–21	225	67	292	8	11/12	1	3/2	36	13	49	110	0.154	1	0
U.S.N.M. No. 8321a	Chihuahua, Mexico	♀	27–27–21	215	58	273	8	10/11	2	2/3	33	10	43	35	0.142	1	0
U.S.N.M. No. 8321b	do	♀	26–29–21	221	54	275	8	11	1	3	35	11	46	64	0.132	1	0
U.S.N.M. No. 24969	Guadalajara, Mexico	♂	27–29–20	225	61	286	8	12	1	3/2	33	12	45	122	0.139	1	0
U.S.N.M. No. 16442	Guanajuato, Mexico	?	27–27–19	229	52	281	8	12/11	1	2	30	9	39	105	0.114	1	0
U.S.N.M. No. 46365	Ada Magdalena, Durango, Mexico.	♂	28–29–23	219	64	283	8	12/13	1	4	42	12	54	80	0.137	1	0
A.M.N.H. No. 19850	West of Atzocozlco, Mexico.	♀	27–29–21	221	55	276	8	11	1	2	44	12	56	121	0.132	1	0
A.M.N.H. No. 19856	Southeast of Puebla, Mexico.	♀	25–29–21	226	60	286	7/8	11	1	3	38	12	50	102	0.127	0	0
A.M.N.H. No. 19852	Jamay, Jalisco, Mexico	yg.	27–29–21	219	64	283	8	11	1	3	41	15	56	42	0.154	0	2
A.M.N.H. No. 19851	do	♂	27–29–21	219	64	283	8/9	14	1	4/3	43	16	59	111	0.144	0	0
A.M.N.H. No. 19848	do	♂	27–29–21	220	64	284	8	13/12	1	3	43	14	57	113	0.150	0	0
A.M.N.H. No. 19849	do	♂	27–29–21	223	67	290	8	11/12	1	2	39	13	52	-------	-------	0	2
A.M.N.H. No. 3521	Gulf of California, Mexico.	♀	29–31–22	223	59	282	8	12	1	2	33	12	45	86	0.139	0	0
A.M.N.H. No. 4382	do	♂	27–31–21	211	64	275	8	11	1	3/2	35	15	50	160	0.150	0	0
A.M.N.H. No. 3520	do	♀	27–29–21	224	56	280	8	11/12	1	2	35	14	49	94	0.127	0	0
A.M.N.H. No. 4383	do	♂	27–29–21	220	64	284	9/8	11	1	2	37	14	51	160	0.137	0	0

A.M.N.H. No. 3522	Real de Pinos, Calif.	♂	27-29-22	224	64	288	9/8	11/13	1	2/4	33	14	47	134	0.149	0	0
A.M.N.H. No. 32397	San Marcos, Hays County, Tex.	♂	27-27-19	225	68	293	8	13	1	2	34	14	48	162	0.154	0	0
A.M.N.H. No. 32398	do	♀	29-29-20	233	79	312	8	14	1	2	32	14	46	179	0.156	0	0

TABLE 3.—*Specimens of* Pituophis deppei jani *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
M.C.Z. No. 19549	Miquihuana, Tamaulipas, Mexico.	♂	27-29-20	231	66	297	8	10/11	1	3	23	8	31	92	0.141	1	0
M.C.Z. No. 19545	do	♂	27-29-21	227	61	288	8	11	1	3	23	7	30	102	0.137	1	0
M.C.Z. No. 19544	do	♀	29-31-22	228	52	280	9/8	13	1	3	23	7	30	124	0.120	1	0
M.C.Z. No. 19546	do	♂	31-31-23	235	66	301	8/9	12/13	1	3	23	10	33	106	0.136	1	0
M.C.Z. No. 19550	do	♂	27-29-20	225	63	288	8	12/13	1	2	24	8	32	132	0.140	1	0
M.C.Z. No. 19547	do	♂	25-29-21	225	64	289	8	11	1	3/2	21	8	29	83	0.138	1	0
M.C.Z. No. 19548	do	♂	27-29-21	231	65	296	9/8	12/13	1	4	25	10	35	83	0.138	1	0
U.S.N.M. No. 1522 (type)	Buena Vista, Coahuila, Mexico.	♂	29——21	-------	60	-------	9/8	12/13	1	3	------	11	------	------	-------	1	0

The probable relationships of *deppei* and the adjacent forms may be expressed by the following diagram:

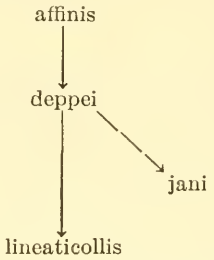

Table 2 lists the specimens of this form examined.

PITUOPHIS DEPPEI JANI (Cope)

Arizona jani Cope, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 369 (type, U.S.N.M. No. 1522; type locality, Buena Vista, Mexico).

Pituophis deppei jani Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 2, 1932.

Pituophis deppei Günther, Biologia Centrali-Americana, Reptilia, p. 124, 1894 (part).

Original description.—The following description of this form is given by Cope (1860a, p. 369):

Head not very distinct, tapering. Rostral plate rounded, presenting an obtuse angle between the prefrontals. Postfrontals bent upon the sides of the head. Vertical longer than broad, the lateral borders much converging, posterior angles obtuse. Occipitals longer than vertical, subdivided as in Pityophis sp. Nostril between the nasals; loreal plate longer than high. One preocular not reaching the vertical, three postoculars. Superior labials eight, fourth and fifth entering the orbit, inferior labials twelve, sixth largest. Postgenecials shorter than pregenecials. Scales of the body in 27 or 29 rows, the central thirteen keeled. Tail short.

Coloration.—Above a pale yellowish brown, browner on the crown and muzzle. A series of quadrate dorsal spots extends throughout the whole length, involving from 13 to 17 medial rows. Anteriorly they are separated by spaces eight scales wide, but these intervals diminish posteriorly. There is a lateral series of spots which alternate with those of the dorsal row, and are sometimes confluent with others, which form a series along the tips of the gastrosteges posteriorly. Anteriorly the dorsal intervals are divided by a transverse series of three small spots, which are probably sometimes confluent. These markings are all black anteriorly; posteriorly they are shaded with brown. Belly dirty yellowish. The length and number of gastrosteges of our specimen cannot be given, owing to its mutilated condition. Urosteges 58, the tail terminating in a rather long corneous appendage.

Habitat.—Buena Vista, Mexico, Lieut. Couch. Mus. Smithsonian.

Systematic notes.—This form was described by Cope as *Arizona jani* (1860a, p. 369) but has never since been recognized. The type specimen (U.S.N.M. No. 1522), although lacking the central part of the body, has enough of the anterior part of the trunk present to show an interspace of 9 scales in length, which places it beyond doubt with specimens from Miquihuana. These latter specimens, while agreeing with *deppei* in all other characters, are quite distinct in the number of spots

and the length of the interspaces between them and show, in addition, a marked average difference in the number of ventrals and the proportionate tail length. Although only two localities are known for *jani*, it is probable that it has a range contiguous with that of *deppei*, and that a large series of specimens would show an area of intergradation between the two forms.

Diagnosis.—This form may be distinguished from *P. d. deppei* only by the smaller number of spots and the greater length of the interspaces between them. In *jani* the number of spots on body and tail varies from 29 to 35, and the interspaces are at least 5 scales and generally more in length. In *deppei* the interspaces are usually less than 4 scales in length, but rarely 4, and the number of spots varies from 43 to 59. From *lineaticollis*, *jani* may be distinguished readily by the lack of the continuous black dorsal stripes on the anterior part of the body, which characterize the former species. Like the other two forms of the *deppei* group, *deppei* and *lineaticollis*, *jani* differs from all other forms of the genus in having two supralabials on either side in contact with the eye, rather than one, and two prefrontals present, instead of four.

Description.—The body of this form, as of the other members of the *deppei* group, is slenderer than that of most other forms of the genus, and the snout is blunt. The tail length forms from 0.120 to 0.141 of the total length (average 0.135). The longest specimen examined measured 1,320 mm.

The small number of specimens available renders a proper determination of the scale characters difficult, and the study of larger series will undoubtedly greatly extend the range of variation in the scale counts. On the basis of the limited number of specimens examined the scutellation may be described as follows: Maximum number of scale rows usually 29, occasionally 31; number of rows at the neck 25–31, most frequently 27 (in 50 percent of the specimens examined); number anterior to the vent 20 to 23, most often 21; ventrals 225 to 235 (average 228.9); caudals 52 to 66 (average 62.4); supralabials usually 8, sometimes 9, with the fourth and fifth or fifth and sixth entering the eye; infralabials 10–13; a single preocular; postoculars generally 3, occasionally 2 or 4; loreal present; no azygos present between frontal and prefrontals; rostral as broad as or broader than long and penetrating at least one-third of the distance between the internasals; frontal undivided.

The dentition is as follows: Mandibular teeth 18 to 20, decreasing slightly in size posteriorly; maxillary teeth 16 to 18, decreasing slightly in size posteriorly; palatines 10, slightly smaller than the mandibular and maxillary teeth; pterygoids 12 to 14, smaller than the palatines, and decreasing in size posteriorly.

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A series of large dark spots is found on the dorsum. These number 21 to 25 on the body and 7 to 10 on the tail. They are usually quadrangular anteriorly, although sometimes ovoid or saddle-shaped; are generally more or less saddle-shaped, and frequently confluent at the sides, in the middle of the body; become quadrangular anterior to the vent; and appear as bars on the tail. In color they are gray anteriorly and reddish brown outlined with black on the middle and posterior parts of the dorsum and on the tail. They vary from 5 to 12 scales in length and from 10 to 13 scales in width and are separated by interspaces at least 5 scales, and generally more, in width. On each side two or three series of smaller spots, gray or black anteriorly, and brown outlined with black posteriorly, alternate with one another and with the dorsal spots, the rows being somewhat irregular and more or less confluent with one another and with the median spots. The ground color is yellowish white. Many of or all the light scales of the sides and interspaces, at least on the anterior part of the trunk, bear each a central black spot. The white belly may have the anterior half immaculate, and the posterior half and under side of the tail bearing a series of small brownish spots, 1 or 2 scales each in length, and 2 to 4 scales apart, on each side of the ventral scutes; or may have the lateral series of spots present throughout the entire length of the body, with additional small or minute spots scattered irregularly between the lateral series. The head is pale brown, darkest on top, and the throat is white. (Figs. 24, 25.)

Variation.—Since all the specimens known of this form, with the exception of the mutilated type, are from the same locality, no study of geographic variation can be made; and in such a small series, in which only one of the eight specimens is a female, a consideration of sexual dimorphism is equally impossible. It is perhaps significant, however, that the single female specimen has only 52 caudals, as compared with 61 to 66 in the male specimens, and that, in correlation with this, the tail length is 0.120 of the total length, while it varies from 0.136 to 0.141 in the males. Furthermore, the female has a dorsal scale formula of 29–31–22, equaled in only one of the males, which has a formula of 31–31–23. It will be noted that in these three characters the tendencies in sexual variation correspond with those found in all other forms of the genus.

Range.—The only localities from which specimens are known are Buena Vista (probably in Coahuila), Mexico, and Miquihuana, Tamaulipas, Mexico.

Habits and habitat.—Apparently there is no published record of the habits or habitat of this form. They would, however, doubtless agree closely with those of the allied form, *d. deppei.*

Affinities.—The color pattern and scale characters of this form all indicate that it is very closely related to *deppei*, and although at

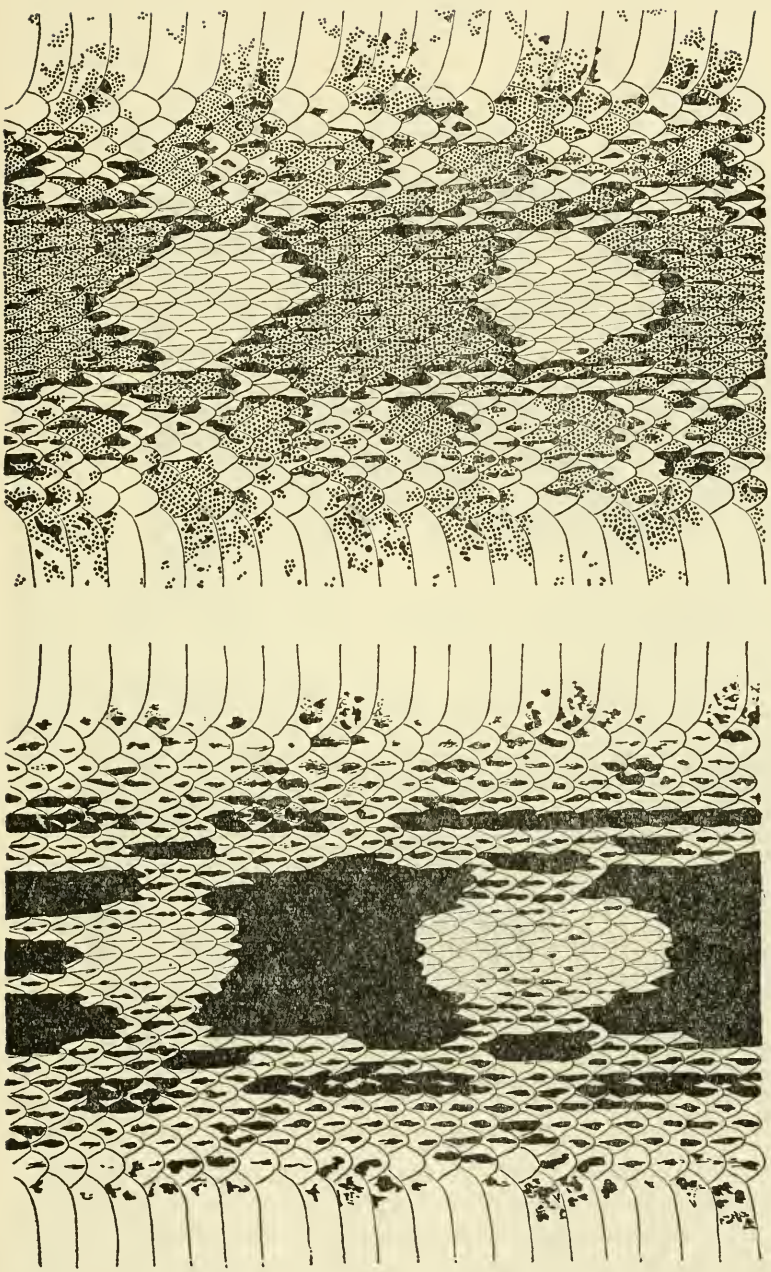

FIGURE 24.—Extremes of variation in color pattern of *Pituophis deppei jani* (first specimen): *a*, Anterior; *b*, posterior.

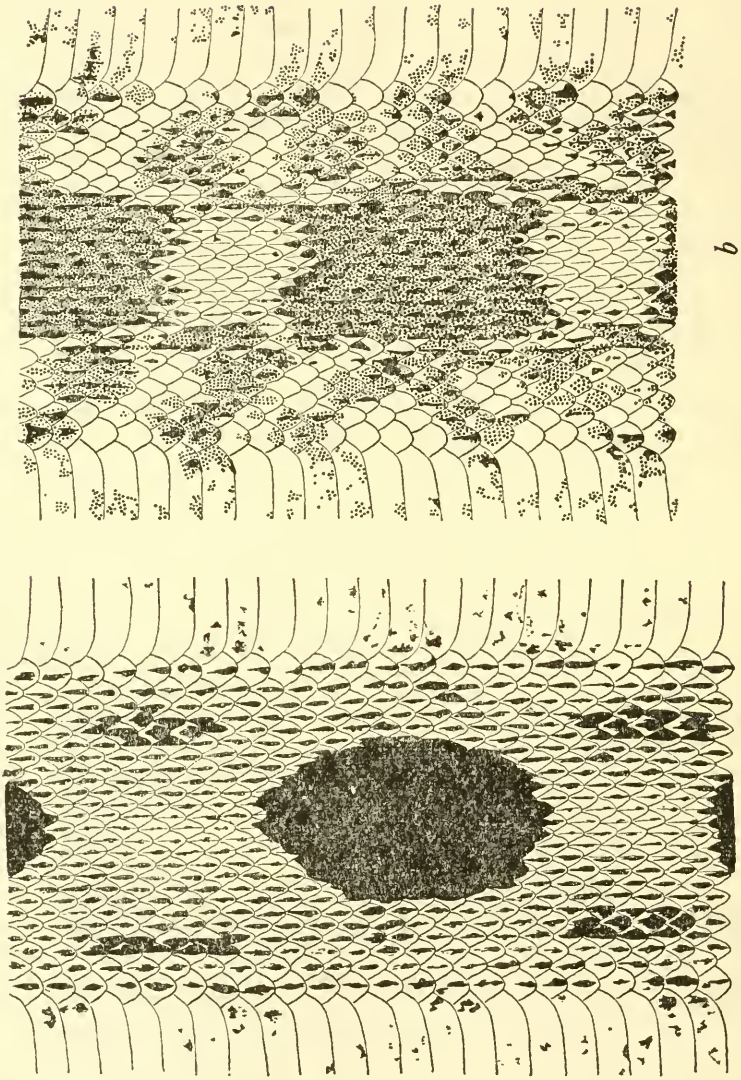

FIGURE 25.—Extremes of variation in color pattern of *Pituophis deppei jani* (second specimen): *a*, Anterior; *b*, posterior.

present intergradation is not known to occur between the two forms, intermediates would undoubtedly be found in a much larger series of specimens representing the entire ranges of the two forms. Thus *jani* may be considered most properly as a subspecies of *deppei*, derived from *d. deppei*.

The probable affinities of this form with the adjacent forms have been expressed in the diagram on page 42.

Table 3 lists the specimens of this form examined.

PITUOPHIS LINEATICOLLIS (Cope)

Arizona lineaticollis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 300 (no type known; type locality, Mexico).

Spilotes lineaticollis Cope, U. S. Nat. Mus. Bull. 32, p. 72, 1887.

Epiglottophis lineaticollis Cope, Amer. Nat., vol. 25, p. 156, 1891; Amer. Nat., vol. 30, p. 1023, 1896; Rep. U. S. Nat. Mus. for 1898, p. 861, 1900.

Coluber lineaticollis Boulenger, Catalogue of snakes in the British Museum, vol. 2, p. 64, 1894.

Pituophis lineaticollis Günther, Biologia Centrali-Americana, Reptilia, p. 124, pl. 47, 1894.—Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 2, 1932.

Original description.—Cope (1861, p. 300) gives the following description of this form:

Head distinct, elongate. Rostral plate rounded in profile, much elevated, the posterior angle right, not reaching postfrontals. The latter three times the size of the prefrontals. Vertical longer than broad, the anterior border straight, as long as the occipitals. Five or six small temporals on each side. Nasal plates large, loreal longer than high. Preoculars one or two, postoculars three. Superior labials eight or nine, liable to irregular subdivision; fourth and fifth, or fourth fifth, and sixth entering the orbit. Twelve inferior labials, postgeneials very small. Scales small, in 27 rows, the median 10 keeled. Tail very short.

General color of a specimen long preserved in spirits; above light brown, beneath paler. The head is without markings. On the anterior part of the body two black bands, two and two halves rows of scales apart, extend for four times the length of the head, and terminate each in a narrow elliptical annulus. The latter are nearly confluent with the succeeding pair of annuli, which are very narrow. These increase in breadth posteriorly until near the middle of the body they become confluent on the median line forming geminate open spots; near the tail they lose the geminate form. Their whole number is 36 pairs, separate or united. Alternating with these is a small series of annuli which become elongate anteriorly and finally become short black lines, parallel to, and three scales from, the median pair. A few spots on the extremities of the gastrosteges on the posterior part of the abdomen. Total length 30 in.; tail 3.9 in.

Habitat. Mexico. Mus. Acad. Nat. Sciences.

Diagnosis.—With its range extending to Guatemala, *lineaticollis* is the southernmost form of the genus as well as the most distinct. It may be separated readily from its nearest neighbors, *deppei deppei* and *d. jani*, by the higher number of ventrals (236 to 249 as opposed to 211 to 235 in *deppi* and *jani*) and by the markings. In *lineaticollis*

two continuous black stripes are present on the anterior part of the dorsum, which break up to form a series of paired elongated annuli, which in turn become progressively less elongated posteriorly, until they fuse in the midline to form a single series of ovoid annuli. In *deppei* and *jani*, and in all other forms of the genus, continuous dorsal stripes are lacking, and in all but *lodingi*, which has the dorsum uniformly black, and *mugitus*, which has the anterior spots indistinct or lacking, the pattern consists of a series of large quadrangular, ovoid, or saddle-shaped spots throughout the length of the dorsum. This form, like the two subspecies of *deppei*, may be distinguished from all other forms of the genus by the presence of two rather than four prefrontals, and the entrance into the eye of two supralabials on each side instead of one.

Description.—Specimens of this form, in common with others of the *deppei* group, are slenderer than the others of the genus. The head is rather narrow, but the snout is blunt and almost square. In the limited number of specimens available the tail forms from 0.122 to 0.138 of the total length, the average being 0.132. The largest specimen examined measured 2,100 mm. in length.

It is difficult to determine properly the scale characters of forms that are known by only a few specimens, and although access has been had to the collections of all the large and most of the small museums in the United States, this form is represented by only four specimens in the United States National Museum. On the basis of these examples, the scutellation of the species may be described as follows: Dorsal scale formula 27–27–21 in two specimens, 27–27–20 in a third, and 25–27–19 in the fourth; ventral scutes 236 to 249 (average 241.7); caudals 61 to 71 (average 66.7); supralabials 8 or 9/8, with the fourth and fifth or the fifth and sixth entering the eye; infralabials 11 to 13, most frequently 12; preocular single; postoculars 2 or 3; loreal present; azygos between frontal and prefrontals lacking; rostral rather flattened and as broad as or broader than long; frontal undivided.

The dentition is as follows: Mandibular teeth 20 to 22, decreasing slightly in size posteriorly; maxillary teeth 18, decreasing slightly in size posteriorly; palatines 9 to 12, subequal, slightly smaller than the mandibular and maxillary teeth; pterygoids 15, smaller than the palatines and decreasing slightly in size posteriorly.

The pattern is the most remarkable in the genus and is unique in having two continuous black stripes on the anterior part of the dorsum. These stripes extend from about one-fourth to one-third the length of the body, are separated by 3 and 2 half scales, and vary throughout their length from 1½ to 3 and 2 half scales each in width. Posteriorly the narrowing, which occurs at more or less regular intervals, becomes more marked until the stripes break up into a

paired series of elongated elliptical annuli, a light spot appearing in the center of each annulus. These annuli become progressively shorter and wider posteriorly until slightly posterior to the middle of the body, the pairs fuse in the midline, producing a single series of ovoid annuli posteriorly. Anterior to the vent these lose the light center, and they become black bars on the tail. On the sides there is a series of black spots, which are anteriorly in the form of short bars 3 to 8 scales each in length and 2 to 3 scales in width; posterior to these they appear as smaller rings alternating with the paired annuli of the dorsal series; posterior to the middle of the body they alternate with the dorsal series as small, quadrangular or ovoid spots; and they disappear just posterior to the vent. The total number of spots, paired or single, varies from 26 to 34 on the body (average 28.7) and from 11 to 13 on the tail (average 12.2). The ground color in alcoholic specimens is a dirty yellowish white. The under side is yellowish white and lacks spots anteriorly, although posteriorly small black spots appear at the sides of the ventrals and under the tail. These are separated by 2 to 4 scales, and each spot is 1 or 2 scales in length. A few brownish spots are scattered irregularly between these lateral spots on belly and tail. The head is uniformly pale. (Fig. 26.)

Variation.—Any attempt to correlate the variations in scale counts in this form with its geographical distribution would be futile, since so few specimens are known, and of these only two have definite locality records.

Sexual variation, however, seems to be apparent in several characters even in this limited series of specimens, of which three are males and only one is a female. The ventrals in males range from 236 to 241 and are 249 in the female, while caudals in the female are 61 in number and vary from 65 to 71 in the males. In correlation with the latter character, the tail length is 0.122 of the total length in the female, while in the male specimens it varies from 0.133 to 0.137. The female specimen is one of those with the highest number of scale rows, agreeing in this with the similar tendency in other forms of the genus. It has also the lowest number of infralabials, 11, while males have 12 or 13. In correlation with the higher number of ventrals, the female specimen has also a higher number of spots, 45 on body and tail, as opposed to 39 to 40 in males. These variations can be considered significant only as they agree with the general tendencies in sexual variation evident throughout the genus, and furnish conclusive evidence only if they agree with such information as may be obtained by a later study of a much larger number of specimens of the species.

Range.—Of the four specimens of *lineaticollis* examined, only two have definite locality records. These are from Acahuizotla and

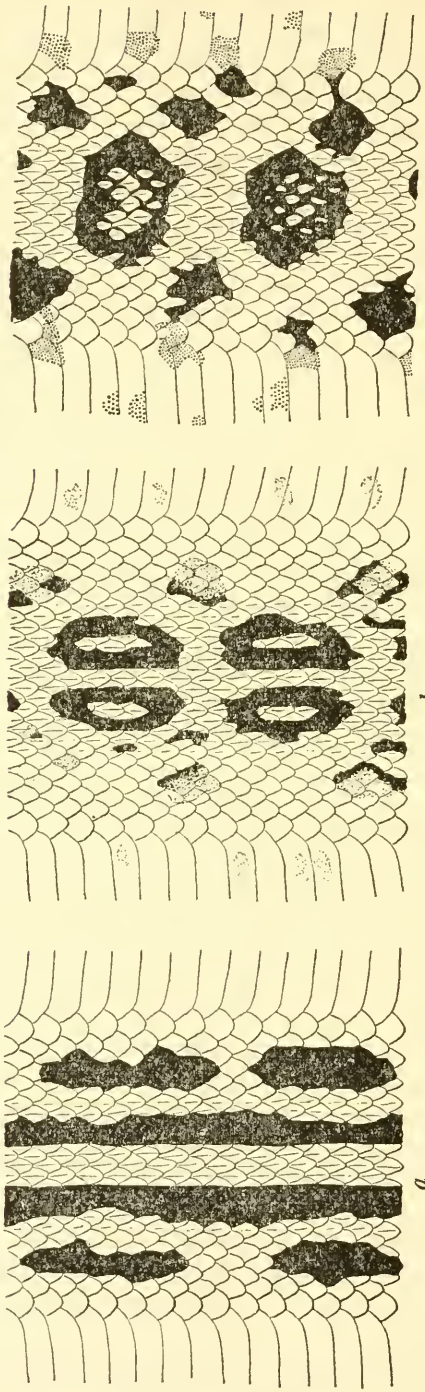

FIGURE 26.—The color pattern of *Pituophis lineaticollis*: *a*, Anterior; *b*, midregion; *c*, posterior.

TABLE 4.—*Specimens of* Pituophis lineaticollis *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 46537	Acahuizotla, Guerrero, Mexico.	♂	25-27-19	211	65	306	9/8	12	1	3	28	12	40	210	0.133	1	0
U.S.N.M. No. 46462	Omiltema, Guerrero, Mexico.	♀	27-27-21	249	61	310	8	11	1	2	34	11	45	163	0.122	1	0
U.S.N.M. No. 30506	Mexican Plateau, Mexico.	♂	27-27-21	236	70	306	8	13	1	2	26	13	39	101	0.138	1	0
U.S.N.M. No. 32220	Mexico	♂	27-27-20	241	71	312	9/8	12	1	2	27	13	40	138	0.137	1	0

Omiltema, both in Guerrero, Mexico. *P. lineaticollis* has been reported by Boulenger (1894, vol. 2, p. 65) and Günther (1894, p.124) from as far south as Duenas, Guatemala, which is the southernmost locality known for the form. I have not been able to find this locality or Omiltema upon any map of the region. Cope (1887, p. 72, and 1900, p. 861) and Günther (1894, p. 124) give the locality "southern Mexican plateau." Cope (1900, p. 861) says: "This species was originally described from a specimen in the Museum of the Philadelphia Academy from Jalapa." This reference is confusing rather than helpful, as there are four towns by that name in as many different states of Mexico. It seems probable, however, that the town referred to is Jalapa, Oaxaca, since it is in a direct line between Guerrero and Guatemala, and thus undoubtedly lies within the known range of the species. (Fig. 18.)

Habits and habitat.—Apparently nothing has been recorded of the habits of this species.

Affinities.—That *lineaticollis* is closely related to the two subspecies of *deppei* is clearly indicated by their common possession of two rather than four prefrontals and the entrance into the orbit of two supralabials rather than one in all three forms, in contradistinction to all the other members of the genus. The derivation of *lineaticollis* from *deppei* is suggested by the ranges of these two forms (fig. 18), which overlap in southern Mexico, while those of *lineaticollis* and *jani*, as judged from our limited knowledge of each, are widely separated, with that of *deppei* intermediate. The common tendency in both *jani* and *lineaticollis* to a decrease in tail length and an increase in the numbers of ventrals and caudals, as well as the tendency toward the development of stripes (which results in marked continuous stripes in all specimens of *lineaticollis* and in the formation of small discontinuous stripes between the anterior spots in some specimens of *jani*), seems to signify a common ancestry rather than a direct relationship. Certain tendencies probably appeared on the periphery of the ancestral form, *deppei*, which became so accentuated as to give rise to a distinct species in the case of *lineaticollis*, whereas they appeared to a much lesser extent in each case in *jani*.

The probable relationships of these forms have been expressed in the diagram on page 42.

Table 4 lists the specimens of this species examined.

PITUOPHIS MELANOLEUCUS MELANOLEUCUS (Daudin)

Coluber melanoleucus Daudin, Histoire naturelle générale . . . des reptiles, vol. 6, p. 409, 1803 (no type known; type locality, Florida and South Carolina).—Harlan, Journ. Acad. Nat. Sci. Philadelphia, vol. 5, pt. 2, p. 359, 1827; Medical and physical researches, p. 122, 1835.—Boulenger, Catalogue of snakes in the British Museum, vol. 2, p. 68, 1894 (part).

Pituophis melanoleucus Holbrook, North American herpetology, vol. 4, p. 7, pl. 1, 1842.—Baird and Girard, Catalogue of North American reptiles,

pt. 1 (Serpentes), p. 65, 1853.—Duméril and Bibron, Erpétologie générale, vol. 7, pt. 1, p. 233, 1854.—Günther, Catalogue of the colubrine snakes in . . . the British Museum, p. 86, 1858.—Jan, Elenco sistematico degli Ofidi, p. 59, 1863 (part).—Wied, Acta Acad. C. L. C. G. Nat. Curios., vol. 32, No. 1, p. 95, 1865.—Jan, Iconographie générale des ophidiens, livr. 22, pl. 1, fig. 2, 1867.—Lockwood, Amer. Nat., vol. 9, p. 1, 1875.—Bocourt, Mission scientifique au Mexique et dans l'Amérique Centrale, Reptiles, p. 666, pl. 47, figs. 5, 5a, 5b, 5c, 5d, 1888.—Hay, 17th Ann. Rep. State Geologist of Indiana, p. 591, 1892.—Morse, Spec. Pap. Ohio State Acad. Sci., No. 9, vol. 4, p. 129, 1904.—Stone, Amer. Nat., vol. 40, p. 166, 1906.—Surface, Bull. Div. Zool. Pennsylvania State Dept. Agr., vol. 4, Nos. 4 and 5, p. 171, 1906.—Ditmars, The reptile book, p. 316, 1907 (part); Zoologica, vol. 1, No. 11, p. 234, 1912.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, p. 86, 1917 (part).—Dunn, Copeia, No. 51, p. 101, 1917; No. 53, p. 24, 1918.—Bishop, Copeia, No. 54, 1918.—Brimley, Copeia, No. 63, p. 92, 1918; No. 109, p. 64, 1922.—Pratt, A manual of the vertebrates of the United States, pp. 219–220, 1923 (part).—Stejneger and Barbour, Checklist of North American amphibians and reptiles, ed. 2, p. 95, 1923.—Myers, Copeia, No. 131, p. 61, 1924.—Blanchard, Pap. Michigan Acad. Sci. Arts Lett., vol. 4, pt. 2, p. 15, 1924.—Brimley, Journ. Elisha Mitchell Sci. Soc., vol. 42, Nos. 1 and 2, p. 88, 1926; Copeia, No. 162, p. 12, 1927.—Roddy, Reptiles of Lancaster County and the State of Pennsylvania, p. 42, 1928.—Conant and Bailey, Occ. Pap. Mus. Zool. Univ. Michigan, No. 328, pp. 5–6, 1936.

Rhinechis melanoleucus Duméril, Mem. Acad. Inst. France, vol. 23, p. 453, 1853.

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Pityophis melanoleucos Terron, Mem. Rev. Soc. Cient. "Antonio Alzate," vol. 39, p. 170, 1921.

Pituophis melanoleucus melanoleucus Barbour, Proc. New England Zool. Club, vol. 7, p. 117, 1921.—Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, pp. 2–3, 1932.—Burt, Journ. Washington Acad. Sci., vol. 25, No. 8, p. 383, 1935.

Original description.—This form is described as *Coluber melanoleucus* by Daudin (1803, p. 409) as follows:

Cette espèce de couleuvre a été découverte par W. Bartram dans la Floride, et il l'a décrite assez légèrement dans la Relation de son voyage: "Le serpent pin ou

taureau est," dit-il, "le plus grand que l'on connoisse dans l'Amérique septentrionale, après le serpent à sonnette, et peut-être le surpasse-t-il en longeur. Il est marqueté de noir et de blanc. Il ne fait aucun mal à l'homme; mais il mange les écureuils, les oiseaux, les lapins, et tous les autres petits animaux qu'il peut atteindre. Lorsqu'il est en colère, ou lorsque deux mâles se disputent une femelle, ils font entendre un bruit effrayant, un sifflement fort et profond. On appelle aussi ce reptile *serpent à corne*, parce que sa queue est terminée par une sorte d'éperon dur comme de la corne, que l'animal irrité agite avec vîtesse, mais avec lequel il ne frappe jamais. Il habite des trous dans la terre où il se rétire précipitamment aussitôt qu'il craint quelque danger."

Palisot Beauvais n'a jamais trouvé ce serpent dans la Pennsylvanie et dans les autres contrées des États-Unis qu'il a parcourues; mais il paroît néanmoins que cet ophidien est connu des habitans de la Caroline méridionale et de la Floride.

Systematic notes.—When the group of snakes generally known as *Pituophis melanoleucus*, based on Daudin's *Coluber melanoleucus*, for which the type locality was given as "Florida," was divided by Barbour (1921, 117) into the Floridan form *mugitus* and the northern form *melanoleucus*, the latter was chosen as the typical form. The reasons for this choice have been most aptly described by Dr. Barbour as follows (*in litt.*):

Bartram,[1] describing snakes seen in Carolina and Florida, but not specifying which, describes the pine or bull snake in the most general terms; and the fact that Daudin speaks of the species having been found in Florida is not in at all the sense of acting as reviser, but by ignorance of geography or looseness of expression. Bartram's travels took him only to the extreme northern part of Florida where I suspect the Carolina pine snake probably occurs. Also you will note that both writers speak of "the black."

As first reviser I had the right to settle the type locality, and I picked Carolina principally because Duméril and Bibron had based their redescription on a type from that locality.

Of course we know Bartram never saw a specimen from the Floridan zoological region for he never was in it, and for this reason I think there is every reason to believe that I sized the situation up correctly, particularly as I do not believe that Daudin's reference to Florida has any bearing on the matter at all, since Florida at the time of his writing was very broadly used and might easily include Georgia and Carolina in Daudin's mind, particularly as Bartram himself who was specifically being quoted, says nothing about Florida that he does not say equally of Carolina. Hence the two regions actually constitute the type locality and while I believe the same forms probably inhabit the whole area I preferred to restrict the locality to Carolina.

If you will read Holbrook's remarks on page 10 of volume 4 of the North American Herpetology you will find there after all is a good deal of doubt whether Daudin's remarks constitute a recognizable description. *C. melan.* of Harlan,[2] p. 122, is a composite of east and western species as is also Duméril's, as the latter included *bellona* of Baird and Girard. * * * The black and white as against reddish and white is the real crucial character. That this occurred to Holbrook is shown by the fact that he had his original sketch, which I have before me, very much darkened before it was finally reproduced in the Herpetology. Had he published it as it originally was sketched it might easily have been mistaken

[1] Bartram, 1791, p. 276.

[2] Harlan, 1835, p. 122.

for the Florida form. As corrected and published it is very typical of the Carolina forms. * * * Holbrook's was the first good description, and it seemed wise on this basis to establish the type locality.

Diagnosis.—This form may be distinguished from its allies, *m. mugitus*, *m. lodingi*, and *m. ruthveni*, by the coloration. While *mugitus* is pied rusty brown or red, and white, *lodingi* is uniformly black above and slate-gray below, and *ruthveni* is brown with darker brown spots, *melanoleucus* is distinctly black and white. It may be separated readily from *lineaticollis*, *deppei*, and *jani* by the presence of four, rather than two, prefrontals, by the entrance of a single supralabial into the eye on either side, instead of two, and by the shape of the rostral, which is at least twice as long as broad in *melanoleucus*, while it is as broad as or broader than long in the three forms of the *deppei* group. It may be distinguished from all other forms of the genus also by the higher rostral, since it is never twice as long as broad in the latter forms, and in addition by the smaller number of spots (30 to 37 in *melanoleucus* as opposed to more than 40 in all of the other forms under consideration).

Description.—The body is stout, with the snout rather pointed. Owing to the great elongation of the rostral, the upper jaw protrudes somewhat beyond the lower. The tail length is 0.120 to 0.141 of the total length (average 0.131). The longest specimen examined measured 1,980 mm. in length. Engelhardt (1916, p. 7) records a specimen that "at the time of capture was said to have measured seven feet, four inches. Actual measurement shows a total of six feet and nine inches, but it is possible that on account of mutilation in the killing, part of the skin was rendered useless, for the head and neck, for a length of eight inches, have been preserved separately."

The commonest dorsal scale formula is 27–29–21; the number of dorsal scales varies, however, from 25 to 29 on the neck, from 27 to 31 in the middle of the body, and from 19 to 23 just anterior to the vent. The other scale characters are as follows: Ventrals normally 205 to 223 (average 214.6), 249 in one aberrant specimen; caudals 52 to 66 (average 58.2); supralabials 6 to 9, usually 8 (average 7.9) the fourth usually, third or fifth occasionally, entering the eye on either side; infralabials 10 to 13, most often 12 (average 12.2); preoculars generally single, rarely 2; postoculars 2 to 4, generally 3; loreal usually present; no azygos; rostral long and narrow, at least twice as long as broad, and penetrating at least one-half the distance between the internasals; frontal divided for as much as one-half of its length, or undivided.

The dentition is as follows: Mandibular teeth 17, decreasing slightly in size posteriorly; maxillary teeth 16 to 17, decreasing slightly in size posteriorly; palatines 9 to 12, subequal, smaller than mandibular and maxillary teeth; pterygoids 6 to 8, smaller than palatines, and decreasing slightly in size posteriorly.

The coloration is distinctly black and white. The dorsum bears a median series of large black spots, which are more or less quadrangular in shape anteriorly and become elongated laterally on the posterior part of the dorsum and on the tail, by fusion with the lateral series of spots. The anterior spots frequently have a narrow light stripe included on either side. The spots vary from 4 to 8 scales each in length and from 10 to 12 in width, and are separated by interspaces from 3 to 5 scales long, the anteriormost of which often bear each a narrow black spot or transverse bar. Lateral to the median dorsal series three series of smaller black spots are present, which alternate with one another and with the dorsal series. Anteriorly in some specimens the small spots of the interspaces and of the three lateral series of each side are so arranged as largely to obliterate the light ground color; and frequently the spots of the median lateral series fuse to form a broken longitudinal stripe for a short distance anteriorly on each side. Posteriorly the ventralmost series of lateral spots (and, even more posteriorly the dorsalmost series) fuse with the lateral series of spots on the belly; while the spots of the median lateral series fuse posteriorly with the dorsal spots. The belly bears on each side a lateral series of black spots, which are each 1 to 3 scutes in length and separated by 2 to 9 scutes (generally 4 or 5), and in addition a number of spots, which are progressively more numerous posteriorly, scattered irregularly between the lateral series. The under side of the tail is irregularly spotted. The ground color of dorsum, belly, and throat is yellowish white. The head is more or less spotted with black, and black lines are present on many of the sutures between the head scales, particularly the supralabials and infralabials. (Fig. 27.)

Variation.—Far too few specimens of this form are available to reveal with any certainty whether geographic variation exists. What slight variational tendencies appear to be present occur, however, between the eastern specimens of the pine barrens of the Coastal Plain, and the western ones from the Allegheny Mountains of Virginia, North Carolina, and eastern Tennessee. As seen by the accompanying graphs (figs. 28 to 32), evident variations are found in the ventrals, the caudals, the labials, and the number of spots. It must be pointed out that a study of a large series of specimens might greatly modify, or even completely reverse, these results.

One specimen, of which the locality is given (probably erroneously, since no such county can be found in Virginia) as Atston, Birmingham County, Va., is very erratic in the presence of 249 ventral scutes and was disregarded in graphing the normal variation of that character. The same specimen has the anal plate partially divided but is in all other respects a typical *melanoleucus*. All the specimens having 9 supralabials on one or both sides, except one for which no locality is given, are from New Jersey, as are also all those with 7, while the only

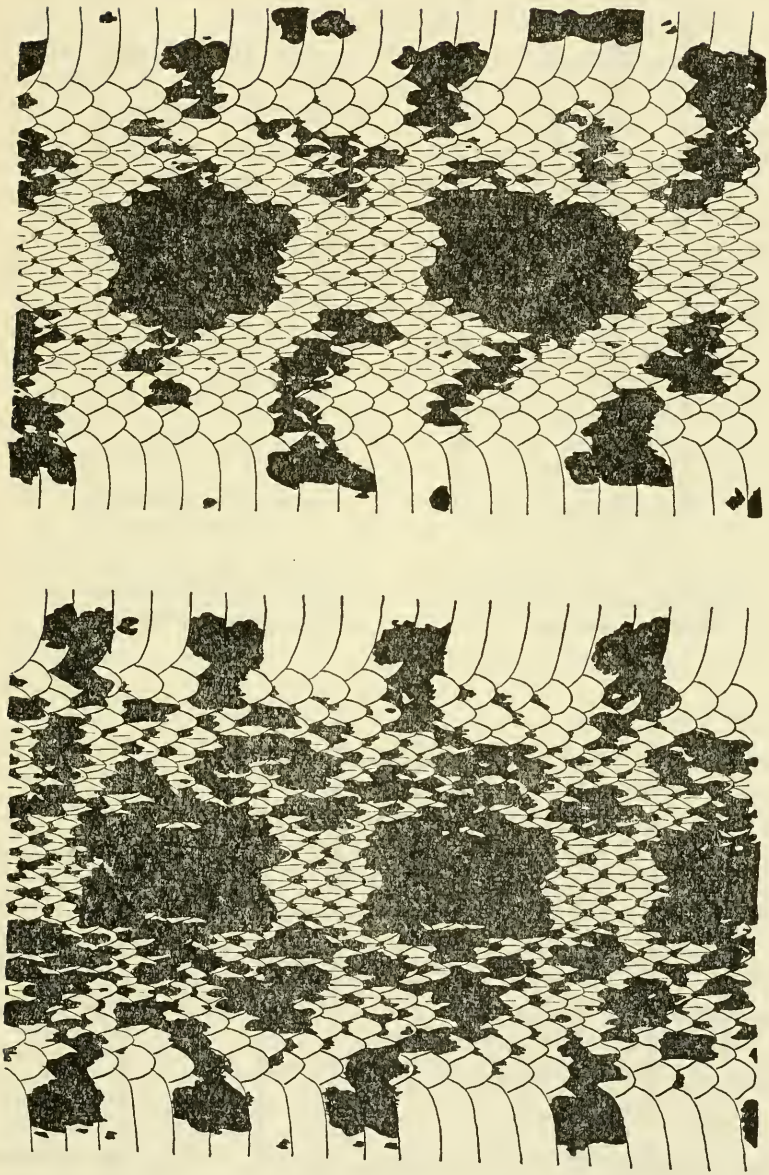

FIGURE 27.—The color pattern of *Pituophis melanoleucus melanoleucus*: *a*, Anterior; *b*, posterior.

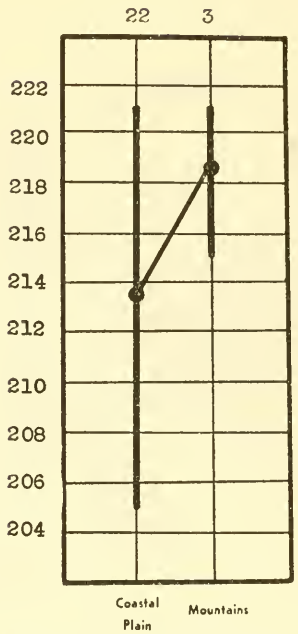

FIGURE 28.—Geographic variation in number of ventrals in *Pituophis melanoleucus melanoleucus*.

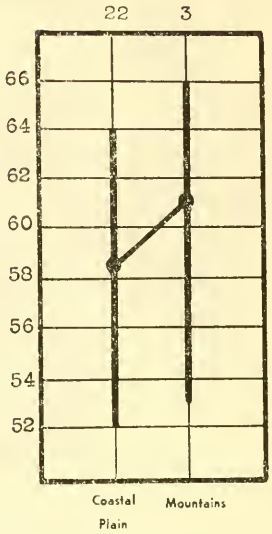

FIGURE 29.—Geographic variation in number of caudals in *Pituophis melanoleucus melanoleucus*.

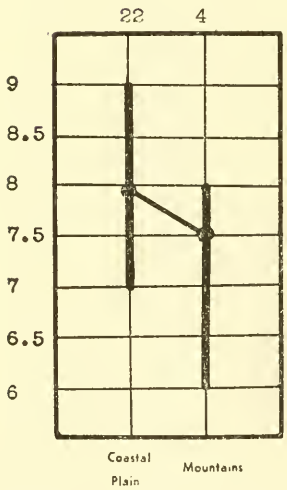

FIGURE 30.—Geographic variation in number of supralabials in *Pituophis melanoleucus melanoleucus*.

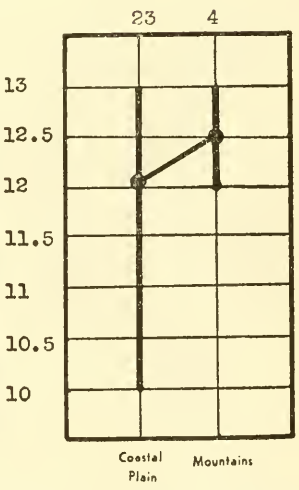

FIGURE 31.—Geographic variation in number of infralabials in *Pituophis melanoleucus melanoleucus*.

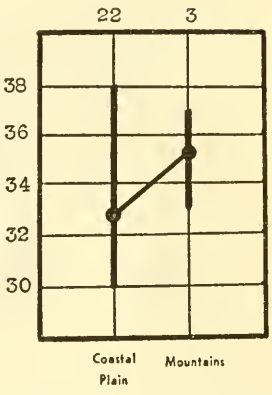

FIGURE 32.—Geographic variation in number of dorsal spots in *Pituophis melanoleucus melanoleucus*.

specimen with 6 supralabials is from Murphy, Tenn. A single specimen from Belleplain, N. J., varies from the normal in the presence of two preoculars, while another from the same locality lacks a loreal on both sides, and an example from Charleston, S. C., has a loreal on the left side only. One-tenth of the specimens examined have the rostral penetrating the whole distance between the internasals, one-third have it penetrating only one-half of the distance, and the remaining specimens vary between these two extremes. About two-thirds of the specimens have the frontal undivided, while the additional third have it partially divided, from one-sixth to one-half of the frontal length.

Sexual, as well as geographic, variation is difficult to determine accurately in such a limited series of specimens. In the specimens examined the dorsal scale formula averages slightly higher in females than in males. The ventrals range from 205 to 221 (average 211.7) in males and from 212 to 223 (average 216.8) in females; caudals vary from 56 to 66 (average 60.9) in males and from 52 to 59 (average 55.0) in females; supralabials average 7.8 in males and 7.9 in females, while infralabials average 12.2 in males and 12.0 in females; postoculars average 3.2 in males and 3.1 in females, while the only specimen with more than one preocular is a female. The number of spots on the body, in correlation with the higher number of ventral scutes in females, averages 25.6 in males, and 26.1 in females, while the number of tail spots, in correlation with the higher number of caudals in males, averages 7.5 in males and 7.0 in females. The tail length varies in males from 0.122 to 0.141 of the total length (average 0.134) and in females from 0.120 to 0.136 (average 0.127).

Range.—The recorded range of this form extends from Charleston, S. C., north to Rockland County, N. Y., and west to Murphy, Tenn. (near Knoxville). Although *melanoleucus* is generally considered typical of the pine barrens of the Coastal Plain, it appears to be not uncommon in the Allegheny Mountains, as several specimens of the small series studied are from that region. In this connection Dunn (1917, p. 101) says: "This snake is fairly well known in Virginia as the 'bull snake.' It does not seem to occur outside of the mountains as all of the many stories of this snake, reputed to reach a length of twelve feet, have their scene in the western tier of counties."

Specimens have been examined from the following localities:

South Carolina: *Charleston County,* Charleston; *Oconee County,* Walhalla.
North Carolina: *Moore County,* between Vass and Southern Pines.
Tennessee: *Knox County,* Murphy.
Virginia: *Bath County,* Nimrod Hall; *Birmingham County,* Atston (this locality must be erroneous; possibly it should be Atsion, Burlington County, N. J.).
New Jersey: *Atlantic County,* Mays Landing; *Burlington County,* Speedwell (near Chatsworth); Browns Mills in the Pines; Mount Holly; *Cape May County,* Belleplain; *Ocean County,* Stafford Forge (near Tuckerton); Lakehurst.

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Additional published records are as follows:

South Carolina: *Oconee County*, Jocassee (Franklin Sherman, 1938, *in litt.*).

North Carolina: *Brunswick County*, 7 miles west of Wilmington (Brimley, 1927, p. 12); *Cherokee County*, Topton (Brimley, 1928, *in litt.*); *Moore County*, Southern Pines (Brimley, 1918b, p. 92); Aberdeen (Brimley, 1922, p. 64); *New Hanover County*, Wilmington (Myers, 1924, p. 61; Brimley, 1928, *in litt.*); *Richmond County*, Hoffman (Brimley, 1927, p. 12); *Swain County*, Bushnell (Brimley, 1915, p. 10).

Tennessee: *Blount County* (Dunn, 1917, p. 101).

New Jersey: *Cape May County*, Formosa Bay (Moore, 1893, p. 878); *Monmouth County*, Lakaway Plantation, Hornerstown (Engelhardt, 1916, p. 7); *Ocean County*, Laurelton, Forked River, Lakewood, 5 miles south of Lakewood (all Conant and Bailey, 1936, p. 5).

New York: *Rockland County*, Tallmans Mountain near Nyack (Wallace, 1902, p. 139; Eckel and Paulmier, 1902, p. 373; Bishop, 1918, p. 35).

Of the last locality listed, Wallace (1902, p. 139) says:

> The occurrence of the pine snake in Rockland County is possibly explained by the migration of a single specimen, or of a pair of specimens, beyond the northern limit of their habitat, southern New Jersey. A series of such migrations, extending through a period of time, would, of course, tend to establish the southern parts of Rockland County as the northern limit of distribution of the pine snakes. It would however seem best to wait until further evidence can be secured before placing the pine snake permanently in the state fauna.

Bishop (1918, p. 35) says: "The single New York specimen does not necessarily indicate that the range of the Pine snake extends naturally as far north." The New York specimen is probably a straggler, but extensive collecting in northern New Jersey and southeastern New York might reveal additional specimens and show southeastern New York to be a true part of the range of this form.

Habits and habitat.—Although few specimens of this form have been preserved in collections, it has long been with naturalists a favorite subject for observation, and more has been recorded of its habits than of those of any other member of the genus, with the exception of *s. sayi*.

Probably the earliest record is Bartram's (1791, p. 276), in which he says:

> The pine or bull snake is very large and inoffensive with respect to mankind, but devours squirrels, birds, rabbits, and every other creature it can take as food. They are the largest snake yet known in North America, except the rattlesnake, and perhaps exceed him in length; they are pied black and white; they utter a terrible loud hissing noise, sounding very hollow and like distant thunder, when irritated, or at the time of incubation, when the males contend with each other for the desired female. These serpents are also called horn snakes, from their tail terminating with a hard, horny spur, which they vibrate very quick when disturbed, but they never attempt to strike with it; they have dens in the earth, whither they retreat precipitately when apprehensive of danger.

These remarks serve as the basis of Daudin's description (1803, vol. 6, p. 409), which is quoted above (p. 53), and that of Holbrook

(1842, vol. 4, p. 9), who adds that this form "inhabits the pine forests along the sea coast . . . and is taken alive with much difficulty, as they frequently have large holes in the earth, to which they precipitately retreat when danger is apprehended."

The account of Duméril and Bibron (1854, vol. 7, p. 236) of the habits of *melanoleucus* is a summary of Holbrook's remarks.

The most complete discussion of the habits of this form is given by Lockwood (1875a, pp. 1–14, and 1875b, p. 424), who kept specimens as pets for several years, observing their behavior closely during that time. One female in his collection laid 7 eggs. Another (on July 18) laid 12, and "an attempt was made to hatch the eggs, but without success." In nature, the eggs are laid "in sandy soil, where it is dry, and of course somewhat higher than the swamps and streams." The drinking process he describes as "a true drinking" similar to that of a horse. One specimen under observation that had gone 4 weeks without water drank for 10 minutes and consumed more than a gill. Young chickens, mice, rats, young rabbits, and quail eggs are mentioned as articles of diet, and the method of constricting and swallowing the prey is described in detail. He notes that the food is not beslimed or lubricated before swallowing, and that dead prey is often accepted as readily as living. One specimen is said to have fasted for a year. A detailed account is given also of the process of exuviation (this lasted 35 minutes in one case) and of the mechanism of hissing or "blowing."

Smith (1881, p. 688) says of this form: "Usually, if not always, the Bull Snake is found in pine woods. It lays from 7 to 12 eggs in July, and prior to oviposition the female is very irritable. They emit an odor which is believed to be of use in attracting the opposite sex."

Cope (1892, p. 640) says: "This species ranges from New Jersey to Florida, preferring the sandy pine woods of the coastal plain. . . . It is of a very harmless disposition, and may be handled with impunity."

Apparently the only account of the egg-laying habits based on actual observation is given by Moore (1893, p. 878 ff.):

> The material which furnished the data for this account was collected on Aug. 3, 1892, at Formosa Bay, Cape May County, N. J. . . .
>
> The snake which mothered the brood was a fine specimen of its kind, nearly six feet in length. . . . At the time of oviposition, which occurred in the middle of May, Mr. Hoff saw the snake traverse the entire length (about 100 yards) of a field planted with squash and cucumber vines, pausing frequently to test the quality of the soil, which was of a loose sandy nature, with its snout. A spot was finally selected by the side of a row of plants, where the more tenacious character of the soil favored the construction of a nest, Excavation was begun by loosening the soil with the head, which was worked under the surface; and the loose earth thrown out. By alternately breaking the ground with the head, and brushing away the loosened soil with the tail, as Mr. Hoff stated, a tunnel was finally constructed of sufficient length to entirely conceal the snake. Within this

tunnel it remained entirely hidden from view until oviposition was accomplished, when the entrance was closed and the locality deserted. When excavated, they were found to occupy an enlargement of the tunnel six to eight inches below the surface, where they were massed together in a single coherent cluster—the shells being very closely cemented together wherever they came in contact. Ten eggs in all were found. . . .

A description of the eggs and some information concerning the embryological development of the form follow. Conant and Bailey (1936, p. 6) report that "a female 1,372 mm. in length . . . laid nine eggs on July 9, 1934." Four of these were abnormal, but "the last five eggs . . . were white with soft leathery shells" and averaged 56.0 mm. by 31.3 mm. in size.

In the account of the habits of *melanoleucus* given by Ditmars (1907, p. 318) the form is described as bad-tempered and sullen in captivity. "Small rabbits, squirrels, and other rodents" and "birds and eggs" are listed as food. The method of swallowing eggs is given as follows:

> The egg is engulfed entire—without breaking the shell—and swallowed for a distance of about eight or ten inches down the neck, when that portion of the reptile is pressed firmly against the ground, the muscles are called violently into play and exert themselves in such a manner that strong pressure is brought against the egg from anterior and posterior directions. Subjected to this compression the shell is broken and the fragments are swallowed along with the contents of the egg, all parts of which are digested. . . . A Pine Snake of five feet in length can easily swallow the eggs of a hen, and will consume from four to six at a meal.

Engelhardt (1916, p. 7) records an egg, apparently that of a ruffed grouse, "intact and in perfect preservation," removed from the intestinal tract of one of these snakes, which indicates that eggs engulfed as food, small ones, at least, are not always crushed in the gullet in this manner. The number of eggs, according to Ditmars, varies "from 15 to 2 dozen in number."

Of the habitat of *melanoleucus*, Dunn (1917, p. 101) says: "A dead specimen about 3′ 6″ long was found on August 19, on the road across the 'Spur' between Nimrod Hall and Milboro Springs, in Bath County, Va. This locality is in the Alleghany Mountains and the altitude is about 1,000 feet. The road at this point was bordered on each side by a rather steep slope covered with laurel and rhododendron."

Affinities.—P. m. melanoleucus is closely allied to the other subspecies of *melanoleucus*. Its probable derivation from *ruthveni* is indicated by the color pattern and scale characters. The pattern of *melanoleucus* may be derived easily from that of *ruthveni* by an intensification of color in the spots from chocolate-brown to black, a diminution in the ground color from pale brown to a yellowish white, and a fusion of the anterior spots in pairs, thus decreasing the

number from 50 in *ruthveni* to from 30 to 37 in *melanoleucus*. Such a tendency toward the fusion of spots is apparent in *ruthveni*, as shown by the comparative size of anterior and posterior spots, as well as by the partial fusion actually evident in the middle of the dorsum. If on the type specimen of *ruthveni* this fusion were carried forward and the smaller anterior spots were fused in pairs, the total number of spots on body and tail would be 40, rather than 50, a number only slightly without the known range of variation in the number of spots in typical *melanoleucus*. In scale characters as well, *melanoleucus* is easily derivable from *ruthveni*, the general tendency being a continuation of the dwarfing in length and diameter (accompanied by a decrease in the number of spots, but an increase in the average ratio of tail length to total length), which is evident from *s. sayi* to *m. ruthveni*.

The possibility of either *lodingi* or *mugitus* being phylogenetically intermediate between *ruthveni* and *melanoleucus* is precluded in either case by the coloration. In *mugitus* a decided diminution in color from the condition present in *ruthveni* is found, in direct opposition to the tendency toward intensification apparent in *melanoleucus*. In *lodingi*, on the other hand, the intensification is far greater than that in *melanoleucus*, since it affects the ground color as well as the spots, and results in a uniformly black dorsum and slate-gray belly. In addition, *lodingi* appears to be more specialized than *melanoleucus* in the proportionately greater tail length and in the dorsal scale formula, in both of which characters it has departed farther from *ruthveni* than has the latter form. Furthermore, in *lodingi* the average sum of the ventrals and caudals is higher than in *ruthveni*, while in *melanoleucus* it is lower. Thus it seems probable that *melanoleucus* and *mugitus* have both been derived directly, but independently, from *ruthveni*, while *lodingi* has arisen later in an anomalous position where it is geographically (fig. 33), but neither morphologically nor phylogenetically, intermediate between *ruthveni* and the two earlier derivatives of the latter.

The probable relationships of *melanoleucus* and the allied forms may be expressed by the following diagram:

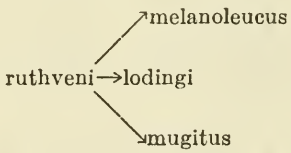

Table 5 lists the specimens of this form that have been examined.

TABLE 5.—*Specimens of* Pituophis melanoleucus melanoleucus *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U. Pa. No. 278	"Near Atston, Birmingham County, Va."	♂	27-29-21	249	62	311	8	12	1	3	23	9	32	159	0.138	1	0
U. Mich. No. 65211	Between Vass and Southern Pines, Moore County, N. C.	♀	27-29-21	217	59	276	8	12	1	3	27	7	34	170	0.135	1	0
Carnegie No. 4002	Mays Landing, N. J.	♀	27-29-21	219	------	------	8	13	1	3	26	------	------	------	------	1	0
Clemson No. 14	Walhalla, S. C.	♂	28-31-21	221	66	287	8	13	1	3	29	8	37	180	0.138	1	0
M.C.Z. No. 43	Charleston, S. C.	♂	25-27-22	212	60	272	8	13/12	1	3/4	27	6	33	149	0.134	0/1	0
M.C.Z. No. 15527	Near Lakehurst, N. J.	♂	26-27-20	205	60	265	7/9	13	1	4	25	6	31	137	0.138	1	0
M.C.Z. No. 18851	Browns Mills in the Pines, N. J.	♂	27-29-21	213	59	272	9	12	1	3	25	9	34	150	0.133	1	0
M.C.Z. No. 18852	----do----	♀	27-27-22	213	56	269	9	13	1	4/3	26	7	33	125	0.136	1	0
M.C.Z. No. 18853	----do----	♂	27-29-19	207	60	267	8	12	1	4	26	9	35	162	0.141	1	0
M.C.Z. No. 18854	----do----	♂	25-27-19	207	56	263	7	12/11	1	4	25	8	33	133	0.135	1	0
A.N.S.P. No. 3817	Eastern United States	♂	27-29-21	214	61	275	8	12	1	2	28	8	36	185	0.130	1	0
A.N.S.P. No. 14932	Speedwell, N. J. (near Chatsworth).	♂	27-29-21	208	58	266	7/8	12	1	3	22	6	30	126	0.134	1	0
A.N.S.P. No. 14931	----do----	♀	27-29-21	216	58	274	8/7	12	1	3	28	6	34	140	0.128	1	0
A.N.S.P. No. 17570	Stafford Forge, N. J. (near Tuckerton).	♂	25-29-19	215	59	274	8	13	1	3	28	6	34	172	0.127	1	0
A.N.S.P. No. 17571	----do----	♀	27-29-21	220	53	273	7	13/11	1	3	26	8	34	150	0.120	1	0
U.S.N.M. No. 4610	Mount Holly, N. J.	------	27-29-21	215	64	279	9/8	12/13	1	3	26	7	33	198	0.131	1	0
U.S.N.M. No. 8008	No data	♀	27-29-21	213	54	267	8/9	12/13	1	2/3	27	7	34	150	0.133	1	0
U.S.N.M. No. 10363a	Murphy, Tenn.	♀	27-27-20	220	53	273	8	12/13	1	4/3	27	6	33	158	0.120	1	0
U.S.N.M. No. 10363b	----do----	♂	27-29-21	215	64	279	6	12	1	2	27	8	35	------	------	1	0
U.S.N.M. No. 23810	No data	♀	29-31-23	223	52	275	8	11/12	1	3	26	7	33	176	0.125	1	0
U.S.N.M. No. 38682	Belleplain, N. J.	♀	29-29-22	212	53	265	8	13	2	3	24	7	31	168	0.125	1	0
U.S.N.M. No. 38890	----do----	♂	27-29-20	214	63	277	8	12	1	4	25	7	32	177	0.129	1	0
U.S.N.M. No. 38403	New Jersey	♀	27-29-21	215	56	271	8	12	1	4/3	26	6	32	162	0.129	1	0
U.S.N.M. No. 38368	Belleplain, N. J.	♀	28-29-21	213	52	265	8	11/12	1	3	24	8	30	153	0.124	1	0
U.S.N.M. No. 37097	----do----	♀	25-29-20	216	54	270	8	11/10	1	3	27	7	34	153	0.124	1	0

U.S.N.M. No. 39382	do	♂	27-29-21	211	63	274	8	11/12	1	3	26	8	34	141	0.141	1	0
U.S.N.M. No. 38502	do	♀	27-29-21	220	57	277	8	12/13	1	3	26	7	33	163	0.128	1	0
U.S.N.M. No. 38503	do	♀	27-27-20	221	58	279	8/7	11	1	3	25	8	33	168	0.125	1	0
U.S.N.M. No. 36394	do	♂	27-27-19	210	61	271	8	13	1	4/3	23	7	30	177	0.135	0	0
U.S.N.M. No. 61186	Nimrod Hall, Bath County, Va.		25-27-19	220			8	13/12	1	3/4	28					1	0

TABLE 6.—*Specimens of* Pituophis melanoleucus mugitus *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots		Length			Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail Total		
														Cm.			
M.C.Z. No. 15525 (type).	10 miles north of West Palm Beach, Fla.	♀	31-33-23	222	55	277	8	14/13	1 1	3	31	8	39	152	0.128	1	0
M.C.Z. No. 47	Pensacola, Fla.	♀	31-31-23	220	55	275	8	12/13	8	3		7		156	0.121	1	0
M.C.Z. No. 6838	Eau Gallie, Fla.	♂	29-31-22	223	65	288	9	14/15	1	4/3		10		167	0.137	1	2
M.C.Z. No. 15526	Fort Pierce, Fla.	♀	31-33-23	229	54	283	9	13/15	1	3	26	7	33	59	0.118	1	0
M.C.Z. No. 12774	Sebastian, Fla.	♂	30-32-22	219	66	285	8	15/14	1	3	29	10	39	59	0.144	1	0
M.N.S.P. No. 10853	Volusia, Fla.	♀	29-29-20	224	62	286	8/9	14/13	1	3	27	9	36	70	0.142	1	0
A. Mich. No. 65934	Florida	♀	29-31-20	227	54	281	8	13/12	1	3		7		169	0.130	1	0
U. Mich. No. 58900	Eureka, Fla.	♂	29-31-21	227	64	291	8	15	1	3		7		167	0.137	1	2
Carnegie No. 2108	do	♀	29-31-21	235	57	292	9/8	14	1	3		7		169	0.130	1	0
Field No. 8277	Marion County, Fla.	♂	29-29-19	222	67	289	8	14	1	3		8		161	0.142	1	0
Field No. 6143	No data	♀	30-31-23	226	53	279	8	13	1	3		5		155	0.129	1	0
Field No. 6142	do	♀	29-31-23	219	67	286	8	12/13	1	3/4		9		156	0.147	0/1	0
U.S.N.M. No. 10819	Gainesville, Fla.	♂	30-32-22	218	61	279	9/8	13/14	1	3				167	0.137	1	0
U.S.N.M. No. 10930	do	♀	29-31-22	228	56	284	8	14	1	4		7		162	0.129	0	0
U.S.N.M. No. 11443	do	♀	31-31-23	226	54	280	8/9	14	1	3		7		162	0.129	1	0
U.S.N.M. No. 22481	Orange City, Fla.	♀	31-31-23	227	55	282	8	14	1	4		9		58	0.120	1	0
U.S.N.M. No. 8997	St. Johns River, Fla.	♂	29-31-22	224	62	286	8	13/15	1	3		7		174	0.137	1	0
U.S.N.M. No. 8945	do	♂	30-31-21	220			8	14/15	1	3						1	0
U.S.N.M. No. 26340	Florida	♀	31-35-23	226	55	281	9	14	1	3/4		7		180	0.122	1	0
U.S.N.M. No. 24341	Eustis, Fla.	♀	29-33-21	231	55	286	8	12/13	1	3		7		158	0.126	1	0
U.S.N.M. No. 10343	Florida	♂	31-33-23	227	61	288	8	13/14	2	3		7		177	0.141	0	0
U.S.N.M. No. 26055	do	♂	29-31-22	221	61	282	8/9	13/12	1	3		6		161	0.142	1	0
U.S.N.M. No. 55893	Lake Kerr, Marion County, Florida.	♂	29-31-23	220	65	285	8	15/14	1	3		8		157	0.146	1	0

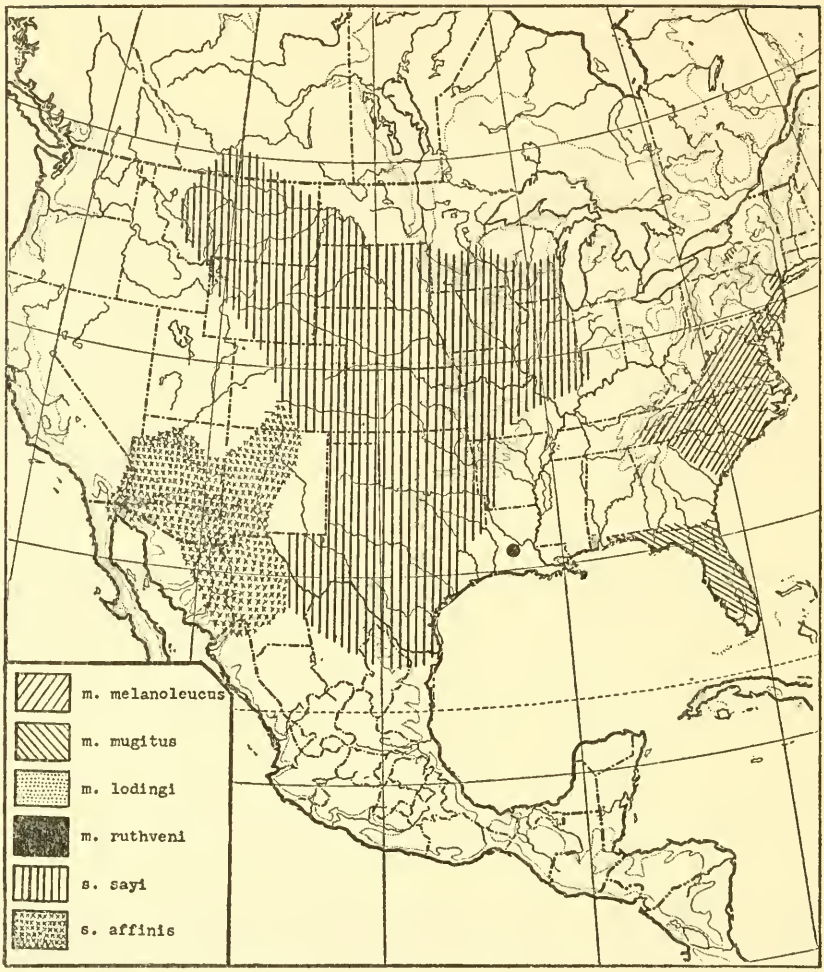

FIGURE 33.—Distribution of the four subspecies of *Pituophis melanoleucus* and the two subspecies of *P. sayi*.

PITUOPHIS MELANOLEUCUS MUGITUS Barbour

Pituophis melanoleucus mugitus BARBOUR, Proc. New England Zool. Club, vol. 7, p. 117, 1921 (type, M.C.Z. No. 15525; type locality, 10 miles north of West Palm Beach, Fla.).—BARBOUR and LOVERIDGE, Mus. Comp. Zool. Bull., vol. 69, No. 10, p. 320, 1929.—STULL, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 3, 1932.—BURT, Journ. Washington Acad. Sci., vol. 25, No. 8, p. 383, 1935.

Pituophis mugitus STEJNEGER and BARBOUR, Checklist of North American reptiles and amphibians, ed. 2, p. 96, 1923.—BLANCHARD, Pap. Michigan Acad. Sci. Arts Lett., vol. 4, pt. 2, p. 16, 1924.

Pituophis melanoleucus WIED, Acta Acad. C. L. C. G. Nat. Curios., vol. 32, No. 1, p. 95, 1865 (part).—LOENNBERG, Proc. U. S. Nat. Mus., vol. 17, p. 328, 1894.—DITMARS, The reptile book, p. 316, 1907 (part).—STEJNEGER and BARBOUR, Checklist of North American reptiles and amphibians, p. 86, 1917 (part).—DECKERT, Copeia, No. 54, p. 32, 1918.—PRATT, Manual of the vertebrates of the United States, pp. 219–20, 1923 (part).

Pityophis melanoleucus Cope, Proc. Amer. Phil. Soc., vol. 17, p. 64, 1877.—Garman, Mem. Mus. Comp. Zool., vol. 8, No. 3, p. 51, 1883 (part).—Yarrow, U. S. Nat. Mus. Bull. 24, pp. 16, 105, 1883 (part).—Garman, Bull. Essex Inst., vol. 16, p. 27, 1884 (part).—Cope, Proc. U. S. Nat. Mus., vol. 11, pp. 391, 394, 1888; vol. 14, p. 640, 1892 (part); Amer. Nat., vol. 30, pp. 1008, 1011, 1896 (part); Rept. U. S. Nat. Mus. for 1898, p. 867, 1900 (part).—Brown, Proc. Acad. Nat. Sci. Philadelphia, 1901, p. 55 (part).—Brimley, Proc. Biol. Soc. Washington, vol. 23, p. 14, 1910.

Original description.—Barbour (1921, p. 117) gives the following description of this form:

Similar to *P. m. melanoleucus*, but heavily washed and pied with rusty brown, not black. Ventrals and subcaudals of Florida examples average about 280, as against 267 for specimens from Carolina and New Jersey. The scale rows about the middle of the body are 31–33 (usually 33), on the neck 29–31, and anterior to the vent 22, 23, or 24. In the northern specimens examined the midbody rows were 27, neck 25, and anterior to the vent 21 or 22.

This description is prefaced by the following discussion:

An examination of the pine snakes from the eastern seaboard states reveals the fact that Daudin's old name *Coluber melanoleucus* based on the pine snake of Bartram, which he speaks of as being "pied black and white," includes two different forms at least. Bartram travelled in both Carolina and Florida, and these regions constitute the type locality for the species. Bartram, however, makes no mention of actually having seen pine snakes in both of the regions he visited, and as the pine snakes which I have seen from South Carolina and New Jersey are "pied black and white," I propose to restrict Daudin's name to this black form, to stand as *Pituophis melanoleucus melanoleucus* Daudin, with the type locality Carolina.

Florida specimens are brown-pied, not black-, and have a larger number of scale rows and on the average a higher number of combined ventrals and subcaudals.

Diagnosis.—From the three forms of the *deppei* group this form may be distinguished at a glance by the presence of four, rather than two, prefrontals, the entrance of a single supralabial into the eye on each side, instead of two, and the shape of the rostral, which is always at least twice as long as broad in *mugitus*, and never so long as broad in the forms of the *deppei* group. From the other three subspecies of *melanoleucus*, *mugitus* may be separated by the pattern. Thus, in *mugitus* the dorsum is pied rusty brown or reddish, and white, and the anterior spots are distinct only in young specimens; in *melanoleucus* the pattern consists of distinct black spots on a white ground throughout the length; in *lodingi* the dorsum is uniformly black; and in *ruthveni* the spots are chocolate-brown on a lighter brown ground, with the anterior ones more or less distinct. From all other forms of the genus *mugitus* may be distinguished by the longer rostral, since it is never twice as long as broad in these forms, and by the coloration. Thus, in *mugitus* the anterior spots are usually so blended with the ground color as to produce an almost uniform rusty brown, but if the spots are all distinguishable the number never exceeds 40, while in

the other forms under consideration the anterior spots are always in distinct contrast with the light ground color, and the total number of spots always exceeds 40.

Description.—The body is rather stout, and the snout is narrow and rather pointed, protruding slightly beyond the lower jaw. The tail length varies from 0.118 to 0.147 of the total length, while the average for the series examined is 0.133. The longest specimen examined was 1,800 mm. long.

The dorsal scale formula ranges from 29–29–19 to 31–35–23. The number of scales around the neck is 29 to 31, oftenest 29; the maximum number of rows 29 to 35, usually 31; the minimum number just anterior to the vent 19 to 23. The remaining scale characters, as based on the small number of specimens available, are as follows: Ventrals 218 to 235 (average 224.5); caudals 53 to 67 (average 59.5); supralabials generally 8, but sometimes 9, with the fourth usually, the fifth occasionally, in contact with the eye; infralabials 12 to 15; preoculars usually single, rarely 2; postoculars oftenest 3, occasionally 4; loreal usually present; azygos never present between frontal and prefrontals, but occasionally a small azygos present on each side between prefrontal and preocular; rostral very long and narrow, at least twice as long as broad, and penetrating at least one-half, and generally more, of the distance between the internasals; frontal generally undivided, but occasionally split for as much as one-half of its length.

The dentition is as follows: Mandibular teeth 17 to 19, decreasing slightly in size posteriorly; maxillary teeth 16 to 17, decreasing in size posteriorly; palatines 9 to 10, slightly smaller than mandibular and maxillary teeth; pterygoids 7 to 10, smaller than the palatines, and decreasing slightly in size posteriorly.

The dorsum is pied brown and white, or reddish and white. Except in young specimens the spots are so blended with the brownish ground on the anterior part of the body that they are almost or entirely obscured and are readily distinguishable only on the posterior part and on the tail. The spots when distinct number from 26 to 29 on the body and range from 5 to 10 on the tail. They are each 4 to 8 scales in length and 10 to 12 scales in width and are separated by interspaces of 3 to 6 scales in length. These interspaces, as in *melanoleucus*, may bear each a central narrow dark spot or bar. In color the spots are a rusty brown and in some specimens even become a bright red on the posterior part of the dorsum and on the tail. One or more irregular series of spots are present on either side, but anteriorly these are so blended with the ground color as to be indistinguishable, and posteriorly they are fused either with the lateral ventral or the median dorsal spots. The belly bears a lateral series of small spots on each side of the ventral scutes, which more or less intrude on the sides by

fusion with the lateral spots. These ventral spots are each 1 to 3 scutes in length and are separated by 2 to 7 scutes. Between them, becoming progressively more numerous posteriorly, additional small brown spots occur. On the posterior part of the belly these frequently fuse with one another and with the spots of the lateral ventral series to form a kind of continuous network of brown. The ground color of the anterior part of the dorsum is pale rusty brown, while that of the posterior dorsum and of the belly and head is a pale buff or yellowish white. The top of the head is more or less dappled with brown. (Fig. 34.)

Variation.—Because of the very limited number of specimens of this form, and the lack of definite locality records for many of these, a detailed study of geographic variation is impossible. The slight variations apparent in the small series studied are shown on the accompanying graphs (figs. 35 to 40). These must be interpreted with caution and due consideration of the fact that the northwestern area is represented by a single specimen from Pensacola, while only three specimens, one each from Fort Pierce, Sebastian, and Eau Gallie, represent the southern region. Even the central part of Florida, with the highest number for any region plotted, contributes only 11 specimens.

Although the true range of sexual variation can be determined only by the study of a large series of specimens, it seems to be apparent in several characters even in the small series examined. Thus the ventrals vary from 218 to 227 (average 222.1) in males and from 219 to 235 (average 226.5) in females; caudals vary from 61 to 67 (average 63.6) in males and from 53 to 67 (average 56.4) in females; supralabials average 8.2 in males, and 8.3 in females; infralabials average 13.9 in males, and 13.4 in females; postoculars average 3.0 in males and 3.2 in females. In males the tail length varies from 0.137 to 0.146 (average 0.138) of the total length, and in females from 0.118 to 0.147 (average 0.128), while in correlation with this, the number of tail spots ranges from 6 to 10 (average 7.9) in males and from 5 to 9 (average 7.3) in females. Here again it must be remembered that the examination of a much larger series of specimens more truly representative of the entire range of the form might greatly modify, or even reverse, these results.

A single specimen from Eureka, Fla. (U. Mich. No. 58900), bears a divided anal. In this character the specimen is unique among all those examined of the entire genus, and only one other specimen, an example of *m. melanoleucus* (U. Pa. No. 278), which has the anal plate partially divided, exhibits a similar anomaly.

Range.—The known range of this form extends from 10 miles north of West Palm Beach, the type locality on the eastern coast of southern Florida, north to Jacksonville in the northeastern, and to Pensacola

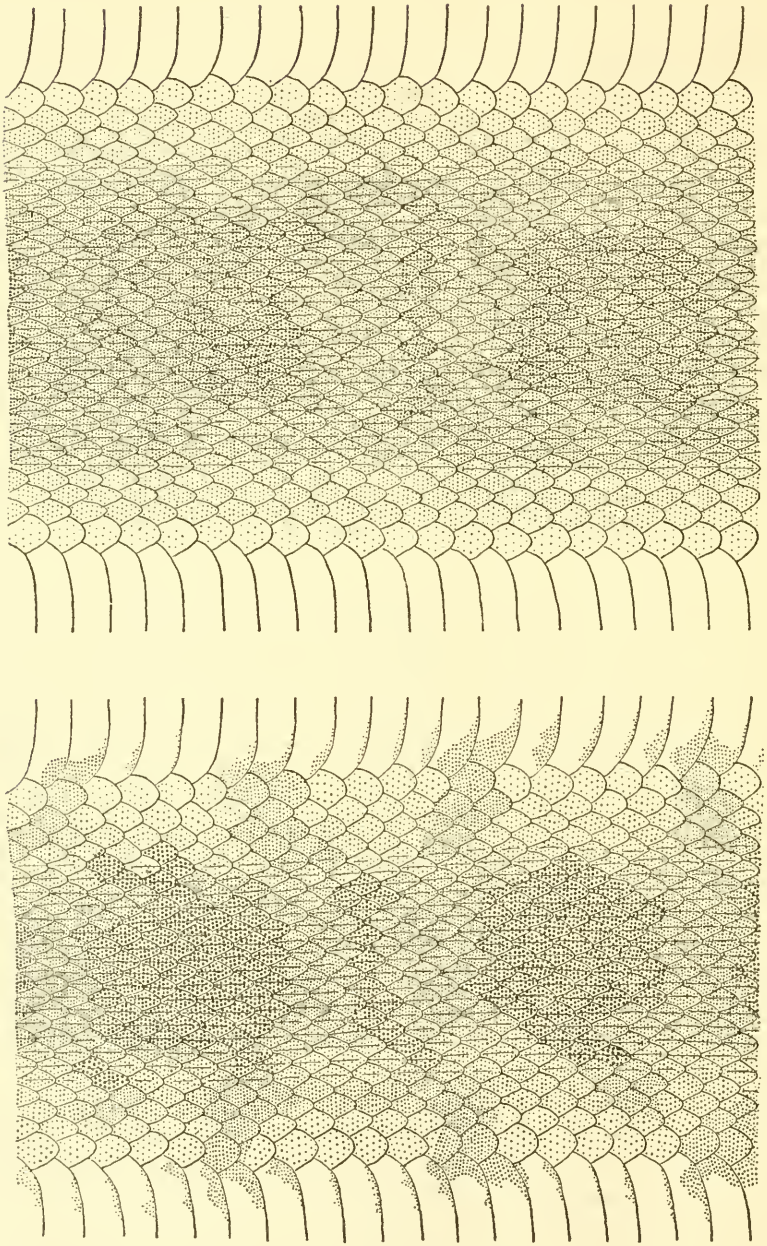

FIGURE 34.—The color pattern of *Pituophis melanoleucus mugitus*: *a*, Anterior; *b*, posterior.

in the extreme northwestern part of Florida. Specimens from Mimsville, Baker County, Ga. (Brimley, 1910, p. 14), should probably be

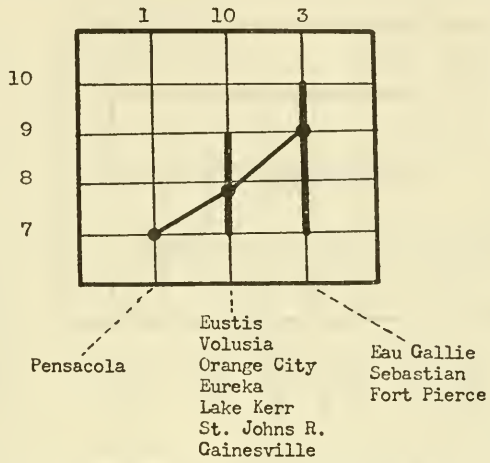

FIGURE 35.—Geographic variation in number of dorsal spots on the tail in *Pituophis melanoleucus mugitus*.

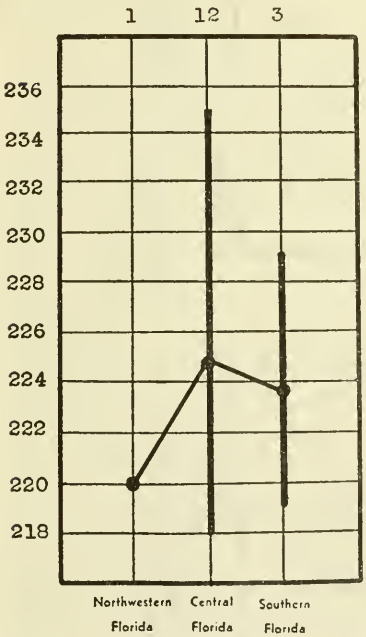

FIGURE 36.—Geographic variation in number of ventrals in *Pituophis melanoleucus mugitus*.

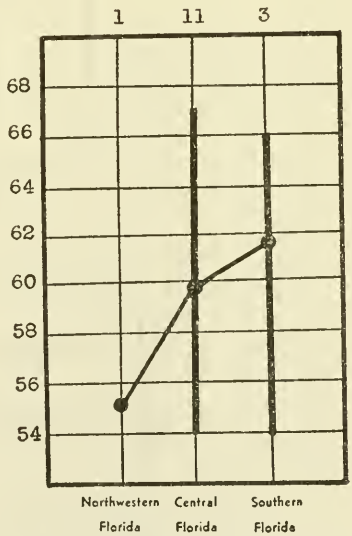

FIGURE 37.—Geographic variation in number of caudals in *Pituophis melanoleucus mugitus*.

referred to this form, although no description of the specimens is given in the reference.

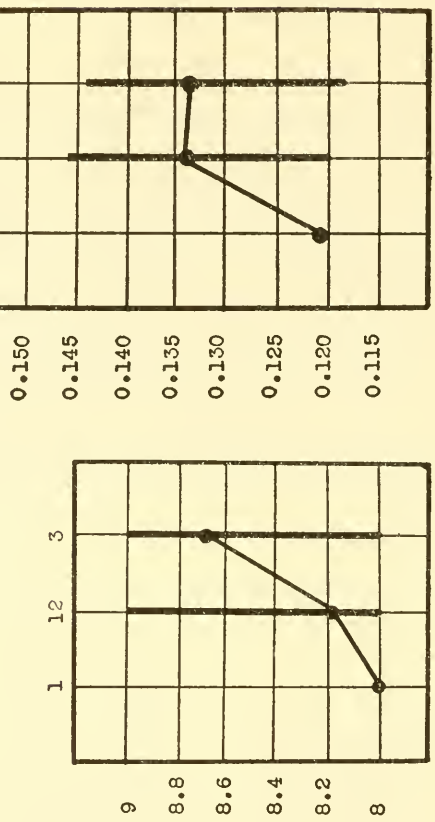

FIGURE 38.—Geographic variation in number of supralabials in *Pituophis melanoleucus mugitus*.

FIGURE 39.—Geographic variation in number of infralabials in *Pituophis melanoleucus mugitus*.

FIGURE 40.—Geographic variation in ratio of tail length to total length in *Pituophis melanoleucus mugitus*.

Specimens have been examined from the following localities:

Florida: *Alachua County*, Gainesville; *Brevard County*, Eau Gallie; *Escambia County*, Pensacola; *Lake County*, Eustis; *Marion County*, Lake Kerr, Eureka; *St. Lucie County*, Sebastian, Fort Pierce; *Volusia County*, Orange City, Volusia; *Palm Beach County*, 10 miles north of West Palm Beach.

Additional published records for the form are as follows:

Florida: *Duval County*, Jacksonville (Deckert, 1918, p. 32); *Orange County* (Lönnberg, 1894, p. 328), Orlando (Brimley, 1910, p. 14).
Georgia: *Baker County*, Mimsville (Brimley, 1910, p. 14).

Habits and habitat.—Almost nothing is recorded concerning the habits of *mugitus*. They are, however, probably very similar to those of the closely allied form, *m. melanoleucus*, with which *mugitus* was generally identified until Barbour separated the two forms in 1921. The observations of Cope (1892, p. 640) and of Ditmars (1907, p. 317) on the habits of *melanoleucus* (quoted above) undoubtedly refer as much to the Florida form as to the more northern subspecies.

Lönnberg (1894, p. 328) says of the Florida form: "From its loud hissing it is called 'bull snake' and 'pine snake' from its living in the pine woods. All the specimens observed by me are from dry, sandy pine woods in Orange County."

Deckert (1918, p. 32) reports finding "one specimen in a pine forest near a bayou" near Jacksonville.

Affinities.—The closest affinities undoubtedly exist between this form and the other subspecies of *melanoleucus*. The direct derivation of *mugitus* from *ruthveni* is indicated by the coloration and scale characters of the two forms. The pattern of the former may be derived readily from that of *ruthveni* by a diminution in the color of the spots, a fusion of the smaller anterior spots in pairs, and a blending of the spots with the ground color on the anterior part of the dorsum. The acceptance of *lodingi* as a phylogenetic intermediate between *ruthveni* and *mugitus* is precluded by a consideration of the coloration and other characters of the two forms. The color is greatly darkened throughout in *lodingi* to produce a dorsum uniformly black and a slate-gray belly, while the tendency in *mugitus*, on the contrary, is decidedly toward a loss of pigment. In addition, both the dorsal scale formula and the proportionate tail length of *mugitus* are intermediate between those of *lodingi* and *ruthveni*, rather than those of *lodingi* being intermediate. In spite of the fact that in the dorsal scale formula and the number of spots *mugitus* is intermediate between *ruthveni* and *melanoleucus*, it cannot be accepted as a phylogenetic intermediate between those two forms, since in the variations in ventrals and caudals, and particularly in the coloration, the trends apparent from *ruthveni* to the other two forms are in each case directly opposed. Furthermore, in the increase of the ratio of tail length to total length *mugitus* has

apparently advanced farther than *melanoleucus*. It must be concluded, therefore, that both *melanoleucus* and *mugitus* have been derived directly, but independently, from *ruthveni*, while *lodingi* is a later and more highly specialized derivative of the same form, and is intermediate only in geographic position between *ruthveni* on the one hand, and *melanoleucus* and *mugitus* on the other.

The probable relationships of *mugitus* and the neighboring forms have been expressed by the diagram on page 63.

Table 6 lists the specimens of *mugitus* that have been examined.

PITUOPHIS MELANOLEUCUS RUTHVENI Stull

Pituophis melanoleucus ruthveni Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 205, p. 1, 1929 (type, U. S. N. M. No. 76278; type locality, Longleaf, Rapides Parish, La.); No. 250, p. 3, 1932.—Burt, Journ. Washington Acad. Sci., vol. 25, No. 8, pp. 381–383, 1935 (part).

Original description.—The following description of the type has been given by the writer (Stull, 1929, p. 1):

The scales are keeled, with the exception of the seven outer rows of either side. The squamation is as follows: scale rows 31–33–25; ventrals 219; caudals 59; supralabials 9/8, the fifth entering the eye on the right side, the fourth on the left; infralabials 15; preoculars 1, postoculars 4; loreal present; rostral twice as long as wide, penetrating two thirds of the distance between the internasals; frontal undivided.

The dentition is as follows: mandibular teeth 18; maxillary teeth 15; palatines 9; pterygoids 8.

The ground color of the dorsum is pale brown, becoming progressively paler to white posteriorly. A mid-dorsal series of dark chocolate brown spots numbering 41 on the body and 9 on the tail is present; the spots are largest in the midregion of the body. Additional smaller dark brown spots are present on the sides of the body, forming two rather indefinite alternating rows on either side of the mid-dorsal series on the anterior part of the body. These smaller spots fuse to form one lateral series on either side posteriorly and fuse with the mid-dorsal spots just anterior to and on the tail. The belly is white with a series of rectangular dark brown spots at either end of the ventral scutes, and numerous additional spots scattered irregularly between. The spots of the lateral series are one to two scutes in width and are separated by two to five scutes. The under side of the tail is irregularly spotted with brown. [Fig. 41.]

Total length 1,520 mm.; tail length 200 mm.; tail length 12.5 percent of the total length.

Diagnosis.—This form is to be distinguished from all other subspecies of *Pituophis melanoleucus* by its coloration and the larger number of dorsal spots. Thus *m. melanoleucus* is white, with 30 to 37 black spots on the body and tail; *m. mugitus* is pied rusty brown and white; the dorsum of the anterior part of the body is almost uniformly brown with the spots indistinguishable in most specimens; the spots of the posterior half become decidedly red approaching and on the tail; and the spots, when distinguishable, do not exceed 39; *m. lodingi* is uniformly black above and slate-gray below; while

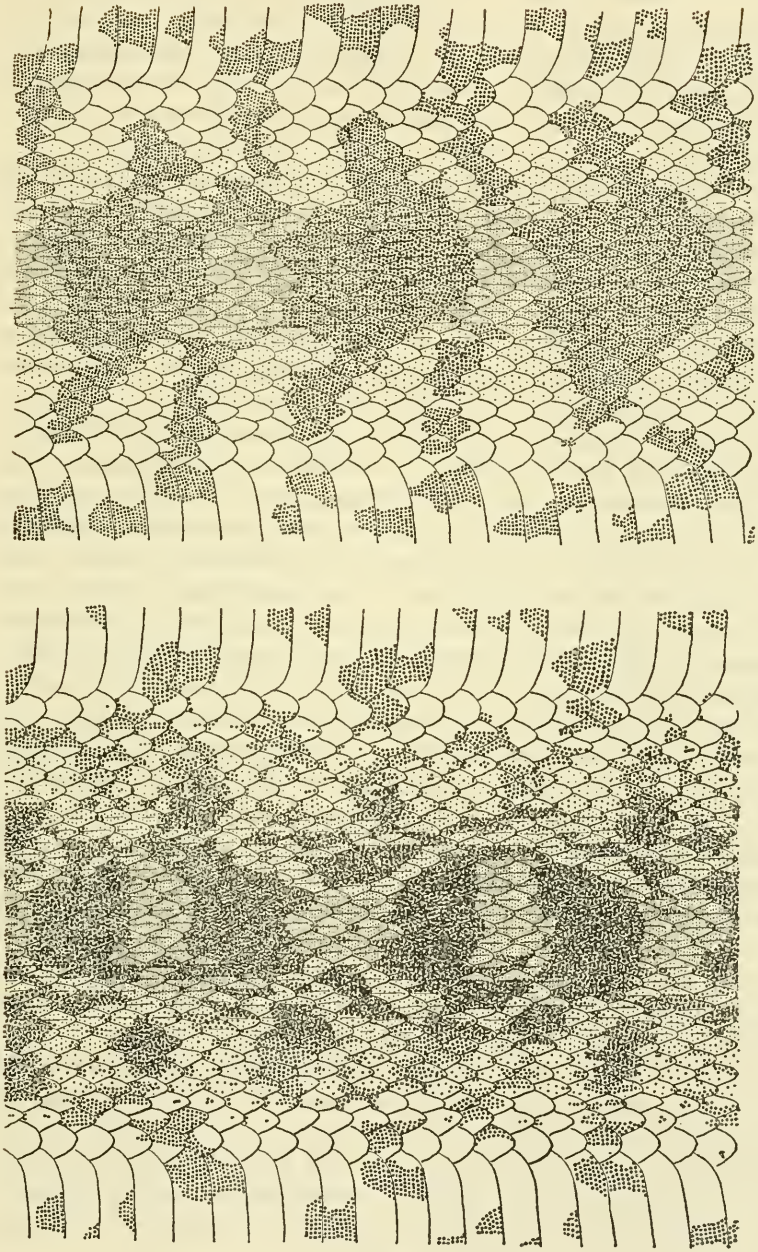

FIGURE 41.—The color pattern of *Pituophis melanoleucus ruthveni*: *a*, Anterior; *b*, posterior.

m. ruthveni has the dorsum pale brown with 50 chocolate-brown spots on the body and tail.

From the forms of the *deppei* group *ruthveni* may be separated readily by the presence of four, rather than two, prefrontals, by the contact of a single preocular with the eye on either side, instead of two, and by the elongated rostral, which is twice as long as broad in *ruthveni,* while it is at least as broad as long in the three forms of the *deppei* group.

From all other forms of the genus *ruthveni* may be distinguished by the longer rostral, which is never twice as long as broad except in the subspecies of *melanoleucus,* and by the pattern. Thus, in *ruthveni* the ground color is decidedly brownish, and the anterior spots are much smaller than the posterior ones, while in the other forms under consideration the ground color is always yellowish white, forming a marked contrast with the dark spots, and the spots are more or less uniform in size throughout the length of the body.

Description.—Since the description of this form (Stull, 1929, p. 1) no specimen has been reported in addition to the original two. [A specimen was collected by Burt (1935a, p. 381) at Zavalla, Angelina County, Tex., which "resembled *sayi* of more western and northern areas so closely that it was presumed to be that form until it was identified in the laboratory. Here it was soon found to have the reduced number of dorsal saddles or blotches assigned to '*P. melanoleucus ruthveni*' by Stull (1929), rather than the higher number specified for the form which was termed '*P. sayi sayi*' in the same publication. This led to the identification of the specimen at hand as *ruthveni* . . ." No distinction between these two forms on the basis of the number of dorsal spots was mentioned in the paper cited (Stull, 1929, p. 1), and none has been found to exist, the number of spots in *s. sayi* in the specimens examined ranging from 41 to 84, while the type of *m. ruthveni* has 50. The distinction, as described above, lies rather in the proportionate length of the rostral, and in coloration and pattern. This specimen, therefore, should undoubtedly be referred to *sayi,* of which it appears to be a typical example.] Of the two specimens known, the type is described above, and the second specimen will be considered below under the discussion of variation.

Variation.—The paratype of this form, another male, is from the same locality as the type. It differs from the type in having the dorsal scale formula 31–31–22, ventrals 218, caudals 60, supralabials 8, infralabials 14, postoculars 3, and the tail length 0.131 of the total length. The specimen is so badly preserved as to render the number of dorsal spots indistinguishable, but the general scheme of coloration closely resembles that of the type specimen.

Range.—Known only from the type locality.

Habits and habitat.—Apparently nothing has been recorded of the habits of *ruthveni*. They are, however, probably similar to those of the other subspecies of *melanoleucus*.

Affinities.—This form is morphologically as well as geographically intermediate between *P. sayi sayi* and the more eastern subspecies of *P. melanoleucus*, since it is nearer than the other forms of *melanoleucus* to *sayi* in the number of scale rows, the shape of the rostral plate, the proportionate tail length, and the number of spots. That *m. melanoleucus*, *m. mugitus*, and *m. lodingi* are all derived directly from *ruthveni* is indicated by the coloration and scutellation of these forms. Thus, *melanoleucus* is easily derivable from *ruthveni* by an intensification of the color of the spots accompanied by a diminution of ground color, by a fusion of the smaller anterior spots in pairs, by an increase in rostral length and in proportionate tail length, and by a decrease in the numbers of scale rows and ventrals; *mugitus* may be derived from *ruthveni* by a uniform diminution of color, accompanied by a fusion of the smaller anterior spots in pairs and their blending with the ground color, and by an increase in rostral length, in proportionate tail length, and in the number of ventrals; and *lodingi* is derivable from *ruthveni* by a strong intensification of color throughout, producing a uniform black above and slate-gray below, by an increase in rostral length and in proportionate tail length, and by a decrease in the number of scale rows.

The possibility of accepting *lodingi* as phylogenetically intermediate between *ruthveni* and either *mugitus* or *melanoleucus* is precluded by the decidedly aberrant coloration of *lodingi*, and by the fact that it apparently has advanced farther than the other forms in question in increase in the proportionate tail length, and decrease in the number of scale rows. Similarly, *mugitus* cannot be accepted as intermediate between *ruthveni* and *melanoleucus*, because of its coloration and the opposing tendencies in scale change evident in the two derived forms.

The probable affinities of *ruthveni* with the neighboring forms may be expressed by the following diagram:

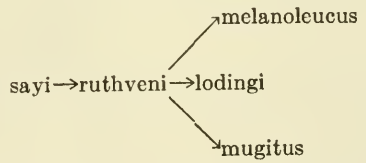

Table 7 lists the specimens of *ruthveni* that have been examined.

TABLE 7.—*Specimens of* Pituophis melanoleucus ruthveni *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 76278 (type)	Longleaf, La	♂	31-33-25	219	59	278	9/8	15	1	4	31	9	40	155	0.125	1	0
Viosca No. 2	do	♂	31-31-22	218	60	278	8	14	1	3	-------	9	-------	152	0.131	1	0

TABLE 8.—*Specimens of* Pituophis melanoleucus lodingi *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Total	Tail / Total		
											Cm.			
U. Mich. No. 58800 (type)	Between Irvington and Grand Bay, Mobile County, Ala.	♂	28-29-21	215	66	281	8	15	1	4	150	0.160	1	0
U.S.N.M. No. 62340 (cotype)	14 miles west of Mobile, Ala	♀	27-29-22	224	58	282	8	14/13	1	4	173	0.132	1	0
U.S.N.M. No 75292	Mobile, Ala	♂	29-31-21	219	61	280	7/8	14	1	3	150	0.146	1	0
Ala. Mus. No. 1	Theodore, Ala	♂	27-29-21	214	66	280	8	13	1	3	101	0.156	1	0
M.C.Z. No. 22373	Mobile County, Ala	♂	27-29-20	220	63	283	8	13	1	3	160	0.138	1	0

PITUOPHIS MELANOLEUCUS LODINGI Blanchard

Pituophis lodingi Blanchard, Pap. Michigan Acad. Sci. Arts Lett.; vol. 4, pt. 1, p. 531, 1924 (type, U. Mich. No. 58800; cotype, U.S.N.M. No. 62340; type locality, Mobile County, Ala.); vol. 4, pt. 2, p. 16, 1924.

Pituophis melanoleucus lodingi Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 3, 1932.—Burt, Journ. Washington Acad. Sci., vol. 25, No. 8, p. 383, 1935.

Pituophis melanoleucus Blanchard, Copeia, No. 81, p. 30, 1920.—Löding, Geol. Surv. Alabama, Mus. Pap. No. 5, p. 30, 1922.

Original description.—Blanchard (1924a, p. 531) describes the type specimen of this form as follows:

> Ventrals 215; anal, single and entire; 65 divided caudals; upper labials, 8 on each side; lower labials 15 on each side; one preocular on each side; 4 postoculars on each side; 4 temporals in the first row; rostral dividing the internasals for ¾ of their length; maximum number of scale rows, 29 (27 rows for a short distance anteriorly, and 21 rows at the posterior end); keels on dorsal scales prominent above, progressively fainter on the sides, descending as low as the sixth row anteriorly, and the third row posteriorly. Total length, 1,563 mm.; tail length, 261 mm. Sex, male.
>
> The color (by reference to Ridgway's "Color Standards and Nomenclature") is as follows: Above, a glossy black; below slate color; most of the gular and lower labial scales somewhat flecked with a dark shade of cinnamon.

Diagnosis.—This form may be distinguished readily from all other forms of the genus by its very distinctive coloration, which in this form alone is uniformly black above and slate-gray below.

Description.—The body is rather stout, and the snout is pointed and protrudes somewhat beyond the lower jaw. The tail length varies from 0.132 to 0.160 (average 0.146) of the total length, a proportion that is greater than in any of the other subspecies of *melanoleucus*. The longest specimen examined was 1,800 mm. long.

As a very limited number of specimens of this form were available, the study of a larger series of specimens will undoubtedly greatly extend the range of variation in the scale characters. The scutellation, as based on the specimens examined, may be described as follows: Dorsal scale formula varying from 27–29–20 to 29–31–21; number of rows at the neck 27 to 29, usually 27; maximum number of rows in the middle of the body, usually 29, occasionally 31; number of rows anterior to the vent 20 to 22, usually 21; ventrals 214 to 224 (average 218.4); caudals 58 to 66 (average 62.8); supralabials 7 or 8, the third or fourth entering the eye; infralabials 13 to 15, usually 13; preoculars single; postoculars 3 or 4; loreal present; azygos lacking between frontal and prefrontals and between prefrontal and preocular of either side; rostral long and narrow, at least twice as long as broad, and penetrating at least one-half, and usually more, of the distance between the internasals; frontal usually undivided but occasionally split for a small part of its length.

The coloration is unique for the genus and very distinctive—shiny black above and slate-gray below. The top of the head is generally a dark cinnamon-brown, and the throat is white or gray. One of the smaller adults examined has several large black spots faintly and vaguely outlined in white on the posterior fourth of the dorsum (these are suggestive of the spots typical of the other subspecies of *melanoleucus*) and has the belly more or less mottled gray and white.

Variation.—Since the number of specimens available is so small, and all are from Mobile County, Ala., no study of geographic variation can be made in this form.

Only one of the five specimens examined was a female. Scale counts for another female specimen, which the writer was unable to obtain for examination, have been listed by Blanchard (MS.). A comparison of these two specimens with the males examined show the following variations: Dorsal scale formula varying from 27–29–20 to 29–31–21 in males, from 27–29–22 to 29–31–21 in females; ventrals 214 to 220 (average 217) in males, and 221 to 224 (average 222.5) in females; caudals 61 to 66 (average 62.8) in males, and 58 in females; tail length from 0.138 to 0.160 (average 0.150) of the total length in males, from 0.132 to 0.138 (average 0.135) in females.

Two additional specimens are described by Blanchard (MS.), of which one is the female mentioned above, an immature specimen from Irvington, Mobile County, Ala. Blanchard gives the following description of this specimen:

> This specimen possesses 28 large dorsal blotches or saddles on the body and 7 on the tail, but the anterior 6 or 7 body blotches are too ill-defined to be counted with certainty. Posterior to the middle of the body they are very sharply defined. All the dorsal saddles reach down on the sides to the lowermost row of dorsal scales, except for the most anterior ones, which are too indefinite to delimit. The anterior saddles are emarginate in the median line, but the rest are little or not at all emarginate. There are obscure lateral alternating markings, transversely elongated, along the middle of the body. The lower surfaces are checked with dark quadrate spots with hazy margins.

The following scale counts are given for this specimen: Scale rows 29–31–21; ventrals 221; caudals 58; supralabials 8; infralabials 14/15; preoculars 1; postoculars 4. The tail length forms 0.138 of the total length.

The other specimen, from a few miles north of Dawes, Mobile County, Ala., is described by Blanchard as follows:

> This was a very large example. It was shiny black on the sides and dull-shiny above; below it was slate color and shiny, except that the first two ventral scales were pure white. On the scales at the side of the head, cream-color was mixed with black. This was true of the scales on the under side of the head, except that the large anterior chin shields were conspicuously darker than the smaller scales surrounding them. On the posterior third of the body numerous blackish-brown to cream-brown colored patches showed on the ventrals, subcaudals, and lateral dorsal scales of the body, faintly outlining on the latter the large dorsal blotches of

the patterned species of the genus. The dorsal blotches so outlined are 7 to 8 scales wide on the mid-dorsal line. Laterally they reach the lowest row of scales and are here 3 to 4 scales wide. About six such blotches are indicated anterior to the vent. In front of these a few others are suggested.

The following scale counts are given: Scale rows 27–29–20; ventrals 219; caudals 58; supralabials 8; infralabials 13/14; preoculars 1; postoculars 4/3; loreal absent. The specimen is a male.

Range.—All the known specimens of *lodingi* have been collected in Mobile County, Ala. Specimens have been examined from Theodore, Mobile, 14 miles southwest of Mobile, and between Irvington and Grand Bay.

Additional records are as follows:

Alabama: *Mobile County,* Irvington (Blanchard, MS.; Löding, 1922, p. 30); Grand Bay (Löding, 1922, p. 30), Abbotts Station (Löding, 1922, p. 30); Dawes (Blanchard, MS.).

Habits and habitat.—Almost nothing has been recorded of the habits of this form. One specimen (Blanchard, 1920, p. 30) "was found dead on the Hall's Mill Road, in the vicinity of high sandy hills near Hall's Mill Creek."

Löding (1922, p. 30) describes it as "a harmless, docile, and very useful species."

The following note on the habitat of *lodingi* is given by Blanchard (1924a, p. 531): "The territory over which these four specimens have been taken, Mr. Loding writes, consists now mostly of Satsuma orange and pecan orchards, but was formerly fairly high and dry pine lands."

Affinities.—The closest affinities doubtless exist between *lodingi* and the other subspecies of *melanoleucus.* Its derivation from *ruthveni* is indicated not only by its geographic position in regard to that form, but by its scale characters. Thus it may be derived readily from *ruthveni* by an increase in rostral length, and in proportionate tail length, and by a decrease in dorsal scale formula. The pattern may be derived from that of *ruthveni* by a strong intensification of color, producing an almost uniform black above (except in young specimens, where, although melanism is far advanced, the dorsal spots are still distinguishable) and slate-gray below. Since *lodingi* is much more specialized in coloration, as well as in dorsal scale formula and proportionate tail length, than is either *melanoleucus* or *mugitus,* it seems evident that it has arisen later than the two latter forms as a separate derivative of *ruthveni,* and can by no means be accepted as a phylogenetic intermediate between *ruthveni* and either *melanoleucus* or *mugitus.*

The probable relationships of *lodingi* and the allied forms have been expressed in the diagram on page 63.

Table 8 lists the specimens of *lodingi* that have been examined.

PITUOPHIS VERTEBRALIS (Blainville)

Coluber vertebralis Blainville, Nouv. Ann. Mus. Hist. Nat. Paris, vol. 4, p. 293, pl. 27, figs. 2, 2a, 2b, 1835 (type in Paris Museum; type locality, "California").

Rhinechis vertebralis Duméril, Mem. Acad. Inst. France, vol. 23, p. 453, 1853.

Pituophis vertebralis Duméril and Bibron, Erpétologie générale, vol. 7, p. 238, 1854.—Bocourt, Mission scientifique au Mexique et dans l'Amérique Centrale, Rept., p. 672, pl. 47, figs. 1, 1a, 1b, 1c, 1d, 1888.—Van Denburgh, Proc. California Acad. Sci., ser. 2, vol. 5, p. 150, 1895.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, p. 86, 1917.—Van Denburgh and Slevin, Proc. California Acad. Sci., ser. 4, vol. 9, p. 220, 1919; vol. 11, p. 67, 1921.—Van Denburgh, *ibid.*, vol. 10, p. 27, 1920; Occ. Pap. California Acad. Sci., No. 10, vol. 2, p. 737, 1922.—Nelson, Mem. Nat. Acad. Sci , vol. 16, No. 1, p. 115, 1922.—Schmidt, Bull. Amer. Mus. Nat. Hist., vol. 46, p. 689, 1922.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, ed. 2, p. 96, 1923.—Blanchard, Pap. Michigan Acad. Sci. Arts Lett., vol. 4, pt. 2, p. 16, 1924.—Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 3, 1932.—Mosauer, *ibid.*, No. 329, p. 16, 1936.

Pityophis vertebralis Cope, Proc. Acad. Nat. Sci. Philadelphia, 1861, p. 300; U. S. Nat. Mus. Bull. 1, p. 39, 1875.—Yarrow, U. S. Nat. Mus. Bull. 24, p. 107, 1883.—Cope, U. S. Nat. Mus. Bull. 32, p. 72, 1887.—Belding, West Amer. Sci., vol. 3, No. 24, p. 98, 1887.—Cope, Proc. U. S. Nat. Mus., vol. 12, p. 147, 1889; vol. 14, p. 642, 1892; Amer. Nat., vol. 30, p. 1012, 1896; Rep. U. S. Nat. Mus. for 1898, p. 879, 1900.—Terron, Mem. Rev. Soc. Cient. "Antonio Alzate," vol. 39, p. 170, 1921.

Pituophis melanoleucus var. *vertebralis* Jan, Elenco sistematico degli Ofidi, p. 59, 1863; Iconographie générale des ophidiens, livr. 22, pl. 1, fig. 3, 1867.

Pityophis catenifer vertebralis Garman, Bull. Essex Inst., vol. 16, p. 27, 1884.

Coluber catenifer var. *vertebralis* Mocquard, Nouv. Arch. Mus. Hist. Nat. Paris, ser. 4, vol. 1, p. 320, 1899.

Pityophis haematois Cope, Proc. Acad. Nat. Sci. Philadilphia, 1860, p. 342.

Coluber catenifer Boulenger, Catalogue of snakes in the British Museum, vol. 2, p. 67, 1894.

Original description.—The following description of this form is given by Blainville (1835, p. 293):

Corps alongé et grêle dans ses parties antérieures, tête petite, assez distincte, à museau atténué, queue courte, conique, et aiguë.

Narines latérales, petites, rondes, échancrant également le milieu des deux scutelles nasales.

Yeux grands, latéraux, presque entièrement entourés de scutelles oculaires.

Scutelles céphaliques: frontales 4, loréales 2 superposées, 2–3 oculaires.

Scutelles ventrales 245, caud. 64.

Ecailles assez petites, lozangiques, lisses, imbriquées.

Couleur d'un jaune roussâtre ou fauve, marbré de brun foncé, formant des taches enchaînées, en forme de vertèbres de poissons coupées, se détachant et s'éloignant entre elles de plus en plus, à mesure qu'elles deviennent plus postérieures.

Longueur totale: $0^{m}.530^{r}$, dont $0^{m}.075$ pour la queue.

Observ. Cette couleuvre, des mêmes pays que les précédents, offre une particularité assez remarquable dans le système de scutelles qui entourent l'oeil, et que je n'ai encore recontré que dans une espèce que je crois nouvelle, et qui a été rapportée du mont Liban par M. P. E. Botta.

Diagnosis.—This species may be distinguished from the four subspecies of *melanoleucus* by the shape of the rostral, which is twice as long as broad in the latter forms, while it is always at least as broad as long in *vertebralis*. From *sayi sayi* and *s. affinis* also it may be distinguished by the shorter rostral, since in these forms the rostral is always longer than broad. In addition, the coloration of *vertebralis* distinguishes it from the two subspecies of *sayi* and from the three subspecies of *catenifer*. Thus, in *vertebralis* the anterior spots are either black or reddish, the spots in the midregion of the body are always reddish, and the posterior spots are always black; the spots are always more or less saddle-shaped, and the interspaces are a reddish orange. In the subspecies of *sayi* and *catenifer*, on the other hand, the spots are more or less uniform in color and are never saddle-shaped except in *affinis*, and the interspaces are never orange. *P. vertebralis* may be further distinguished from *c. catenifer* by the larger number of ventrals (237 to 262 in *vertebralis* as opposed to 206 to 234 in *c. catenifer*), from *c. annectens* by the smaller number of spots (48 to 81, generally less than 70, in *vertebralis*, as opposed to 69 to 129, rarely less than 80, in *annectens*), and from *c. deserticola* frequently by the maximum number of scale rows, which is oftenest 31 or 29 in *deserticola* and rarely as low as 31 in *vertebralis*. From the three members of the *deppei* group *vertebralis* may readily be separated by the presence of four rather than two prefrontals and by the entrance into the eye on each side of a single supralabial, instead of two.

Description.—The body is rather slender, and the snout is blunt and somewhat square. The tail length forms from 0.110 to 0.149 (average 0.132) of the total length. The longest specimen examined measured 1,920 mm. in length.

The series of specimens available was rather limited, and probably does not represent the full range of variation in the scale characters. As based on the specimens studied, the scutellation may be described as follows: Dorsal scale formula varying from 29–31–23 to 35–35–25; number of rows at the neck 29 to 35, oftenest 31; maximum number in the middle of the body 31 to 35, usually 33; number anterior to the vent 23 to 25, usually 23; ventrals 237 to 262 (average 244.9); caudals 51 to 69 (average 63.4); supralabials 8 to 10, with the fourth, fifth, or sixth, entering the eye; infralabials 11 to 15; preoculars 1 to 3, usually 2; postoculars 3 to 5, usually 3; loreal always present, occasionally divided to form two scales on one or both sides; azygos rarely present between frontal and prefrontals, never between prefrontals and preoculars (present in one specimen between internasals); rostral as broad as or broader than long, penetrating never more than one-half, and frequently less, of the distance between the internasals; frontal never divided.

The dentition is as follows: Mandibular teeth 18 to 22, decreasing slightly in size posteriorly; maxillary teeth 16 to 18, decreasing slightly in size posteriorly; palatines 9 to 11, slightly smaller than mandibular and maxillary teeth, pterygoids 11 to 14, slightly smaller than palatines, and decreasing in size posteriorly.

The dorsum bears a series of large median spots, which are generally distinctly saddle-shaped anteriorly, and become less or not at all so posteriorly. These vary from 34 to 63 (average 44.8) on the body and from 10 to 18 (average 11.9) on the tail, are each 3 to 7 scales in length and 8 to 12 scales in width, and are separated by light interspaces of 2 to 7 scales long in the vertebral line. In color the dorsal spots are either black or reddish brown on the anterior part of the body, reddish brown in the middle of the body, and black on the posterior third of the dorsum and on the tail. The ground color is a yellowish white, except in the interspaces between the dorsal spots, where it is noticeably orange. Each side bears three series of smaller dark spots, which follow the dorsal series in color, and alternate with one another and with the dorsal series. In the midregion of the body, where the spots are reddish, frequently each scale included in the spots of both the lateral and the median series bears a small black spot centrally or at the posterior tip. The belly is white and bears a series of small dark spots on either side, and occasionally additional black spots scattered irregularly between these lateral series posteriorly and on the under side of the tail, where they frequently fuse to form a single dark median streak. The top of the head is pale or reddish brown, and the throat is yellowish white (fig. 42).

Variation.—Although the number of specimens studied is much smaller than is desirable in a study of geographic variation, some variations appear to exist that may be of some significance, although they cannot be accepted as conclusive. In the accompanying graphs, the regions represented by specimens have been numbered 1, 2, 3, etc., along the abscissas. A key to the regions is as follows:

Region 1. California: Jim Grey, San Bernardino County; Fort Reading.
2. Northern part of Lower California: Onyx Mine, San Pedro, and Alamo.
3. Central part of Lower California: San Ignacio, Ballenas Bay.
4. Southern part of Lower California, except the extreme tip: Miraflores, La Paz, San Bartolo, Santa Anita, Aqua Caliente, Trinidad, San Antonio.
5. Extreme southern tip of Lower California: Cape San Lucas, San José del Cabo.
6. Cerros Island, Lower California.
7. Margarita Island, and Magdalena Island, Lower California.

The island specimens have been graphed as separate units, since it is evident that they cannot be introduced properly at any given point in a continuous geographic series, and they will not be included in the following discussion, except when explicitly mentioned.

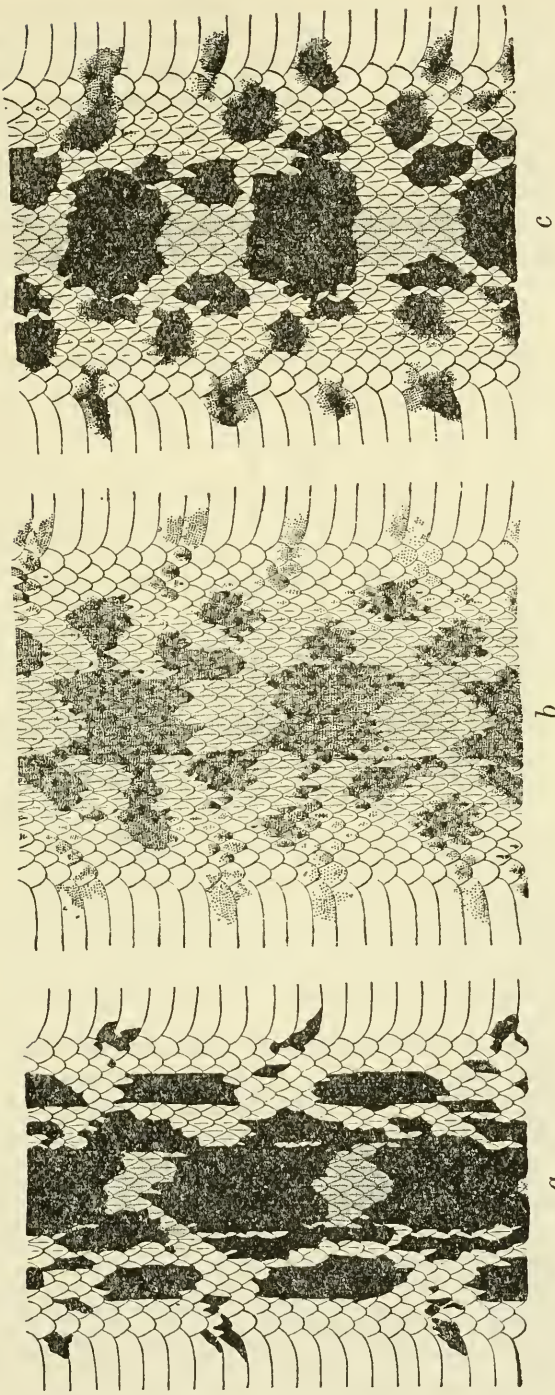

FIGURE 42.—The color pattern of *Pituophis vertebralis*: *a*, Anterior; *b*, midregion; *c*, posterior.

Although the number of scale rows tends in general to increase slightly from north to south (fig. 43) and the number of ventrals shows a slight constant increase from California to the extreme southern tip of Lower California (fig. 44), these, as well as the other scale characters, appear to be remarkably constant throughout the range of the species (figs. 45 to 47). For most characters the extremes of variation for the peripheral geographic groups vary but little, if any, beyond the extremes for the area represented by the largest number of specimens and showing the widest range of variation for most of the characters. A larger number of specimens may, of course, greatly extend the

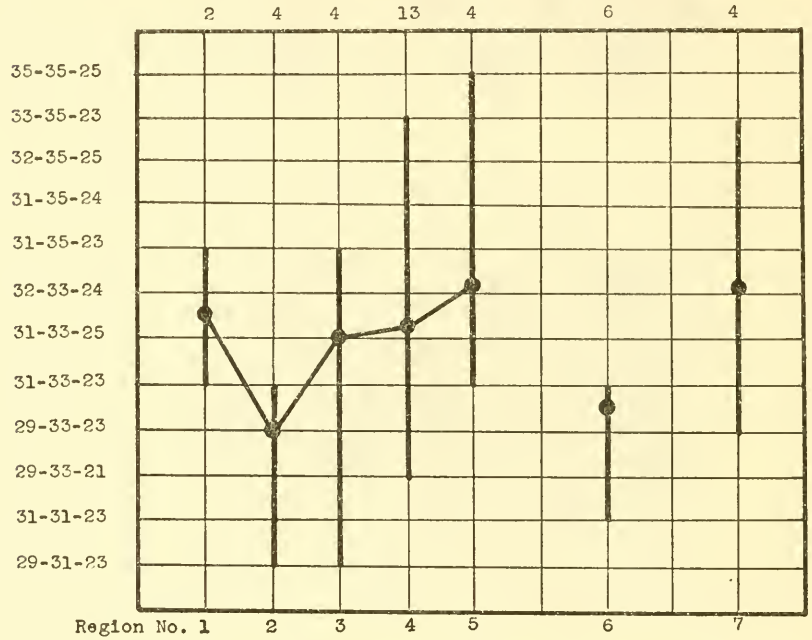

FIGURE 43.—Geographic variation in number of scale rows in *Pituophis vertebralis*.

extremes of variation for those localities. The most marked variation is in the proportionate tail length, which drops gradually from an average of 0.141 in the California specimens to an average of 0.124 in specimens from the Cape (fig. 48). In the number of spots (fig. 49) the only significant variation seems to be in the Cerros Island specimens, which have 64 to 81 spots on body and tail (average 68.8), while of all the other specimens examined only two (one from Miraflores with 61 and one from Trinidad with 73) have more than 60 spots on the body and tail. The Cerros Island examples thus form a local race, which I have hesitated to separate from the mainland form because of the very small number of specimens, and the overlapping, however slight, that exists between the Cerros Island and the

mainland specimens is the only differentiating character. It is possible, however, that in a large series of specimens this character may prove sufficiently constant to warrant the separation of the Cerros specimens as a distinct subspecies.

Some degree of sexual variation is evident in some of the characters, which may be summarized as follows from an analysis of the specimens examined: Dorsal scale formula varying from 29–31–23 to 32–35–25 in males and from 29–33–23 to 35–35–25 in females; ventrals 237 to 249 (average 242.3) in males and 238 to 262 (average 248.7) in females; caudals 62 to 69 (average 64.7) in males, 51 to 67 (average

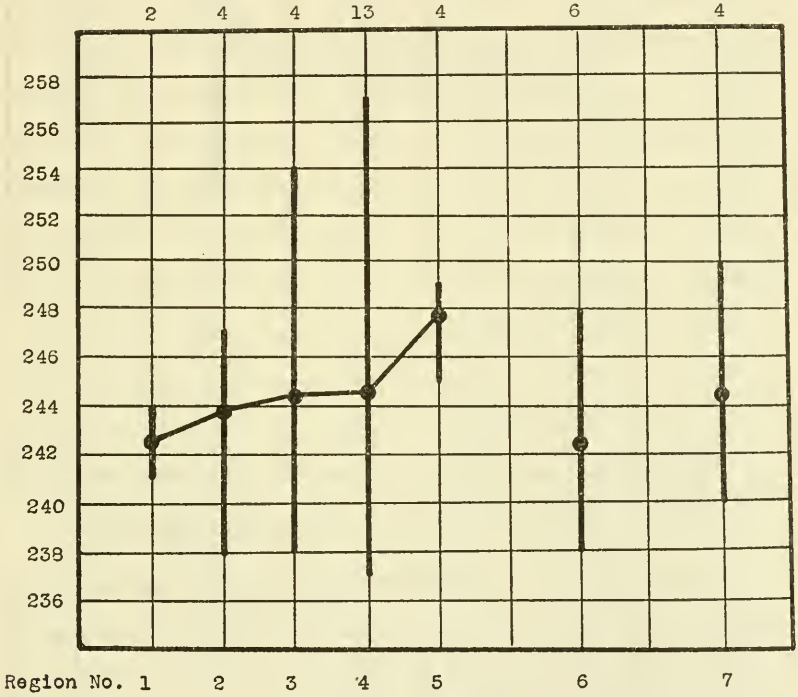

FIGURE 44.—Geographic variation in number of ventrals in *Pituophis vertebralis*.

61.1) in females; supralabials average 8.8 in males, 8.9 in females; infralabials average 12.8 in males, 13.1 in females; postoculars average 3.3 in males, 3.5 in females; number of body spots averages 43.7 in males, 45.1 in females; tail spots average 12.2 in males, 11.3 in females; proportionate tail length averages 0.135 in males, 0.128 in females.

Range.—This species ranges throughout Lower California, and as far north in California as Jim Grey, San Bernardino County. It occurs also on the outlying islands of Cerros, Margarita, and Magdalena.

Specimens have been examined from the following localities:

California: *San Bernardino County,* Jim Grey. The locality "Ft. Reading" I could not find in any atlas.

Mexico: *Lower California,* Onyx Mine, San Pedro, Alamo, San Ignacio (Ballenas Bay), San Antonio, Trinidad, Santa Anita, Miraflores, Aqua Caliente, San Bartolo, La Paz, San José del Cabo, Cape San Lucas, Magdalena Island, Margarita Island, Cerros Island.

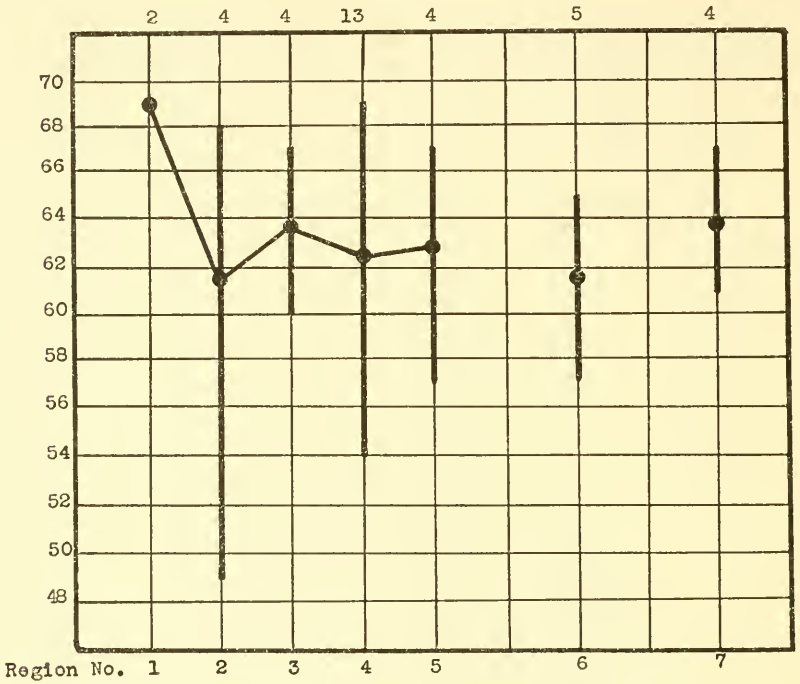

FIGURE 45.—Geographic variation in number of caudals in *Pituophis vertebralis.*

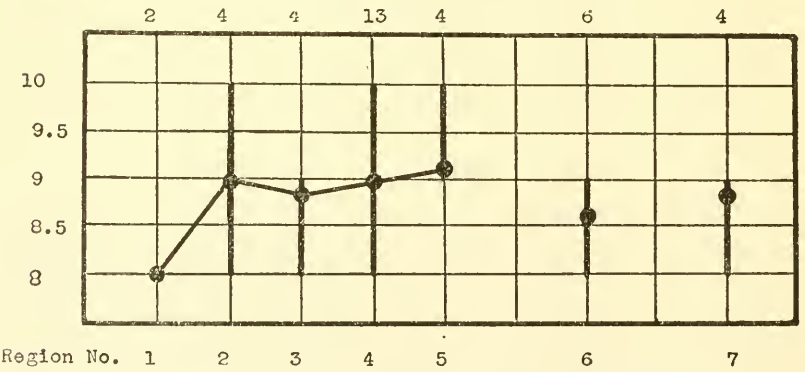

FIGURE 46.—Geographic variation in number of supralabials in *Pituophis vertebralis.*

The following additional published records of the species occur:

Mexico: *Lower California,* l'Arroyo de Santa Agueda (Mocquard, 1899, p. 321; Van Denburgh, 1922, vol. 2, p. 740); Comondu (Van Denburgh, 1922, vol. 2, p. 740); San Bartolome Bay (Mosauer, 1936, p. 16).

The locality "Mont Liban, California" (Blainville) cannot be found in any atlas.

Habits and habitat.—Almost nothing has been recorded of the habits of this species, although it must be fairly common throughout Lower California.

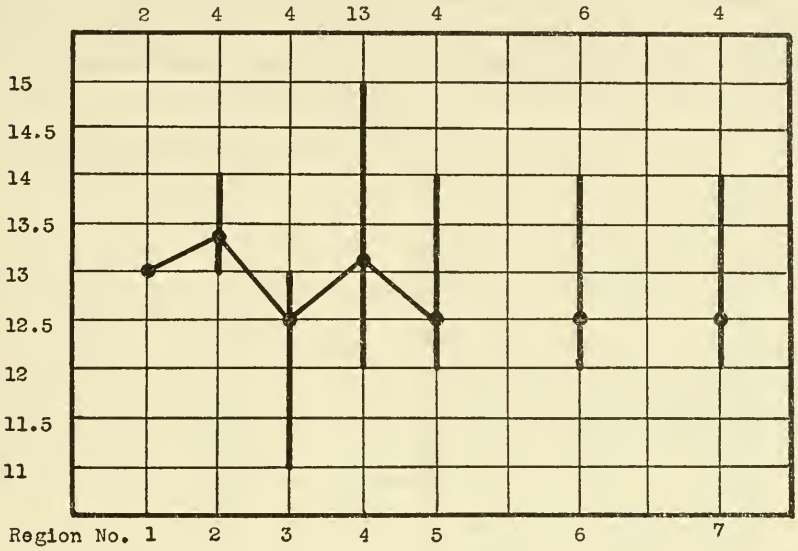

FIGURE 47.—Geographic variation in number of infralabials in *Pituophis vertebralis*.

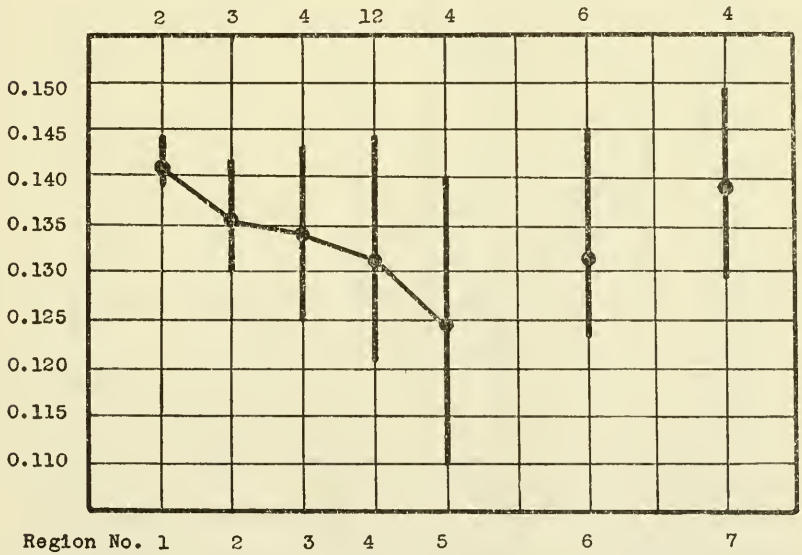

FIGURE 48.—Geographic variation in ratio of tail length to total length in *Pituophis vertebralis*.

Van Denburgh and Slevin (1921c, p. 67) say of it: "All the specimens of this species taken were found in the vicinity of towns or small rancherias. According to the natives this species is fairly abundant.

One specimen taken at a small ranch about three miles from San Pedro, had the remains of a small mammal in its stomach. The species is well known to the natives who call it *Corallilo.*"

Terron (1921, p. 170) gives the following note on this species: "Indebidamente se le llama Corallilo en la Baja California, pero quizá dependa esto del solor que decimos tiene. Habitualmente se le encuentra en terrenos donde la vegetación es poca, y en los arenosos."

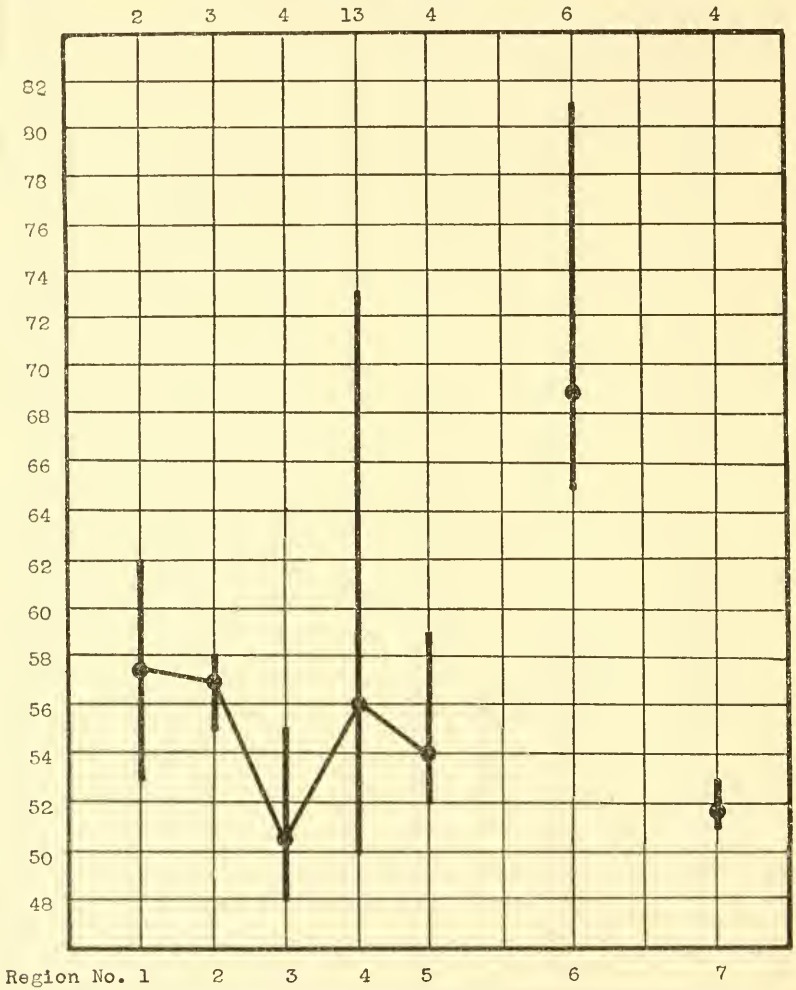

FIGURE 49.—Geographic variation in total number of dorsal spots in *Pituophis vertebralis.*

Nelson (1922, p. 115) lists *vertebralis* from the Cape district, or arid tropical zone of Lower California, which comprises most of the lower half of the peninsula.

Affinities.—That the affinities of this species are with *sayi affinis* rather than with the Mexican form *deppei deppei* is clearly indicated by both the coloration and the scale characters. Thus the pattern is

more readily derivable from that of *affinis* than from that of *deppei* both in the size and shape of the spots and the coloration, although in *deppei* as in *vertebralis* we find the orange interspaces between the spots, which are lacking in *affinis*. In most of the scale characters, as for example the dorsal scale formula, number of ventrals, supralabials, and infralabials, *affinis* is intermediate between *deppei* and *vertebralis*. It will be noted that *vertebralis* resembles the more southern specimens of *affinis*, rather than the more northern, in scale characters, and doubtless arose from the southern group of *affinis*. The number of scale rows, ventrals, and supralabials decreases in *vertebralis* from south to north, or away from the southern part of the range of *affinis*. This would be expected if *vertebralis* were derived from the latter form, as a result of the separation of the two forms by the invasion of the present Gulf of California.

The derivation of *vertebralis* from *annectens* seems highly improbable in consideration of the much greater number and smaller size of the dorsal spots in the latter, as well as their vastly different shape.

The probable affinities of *vertebralis* and the neighboring forms may be expressed in the following diagram:

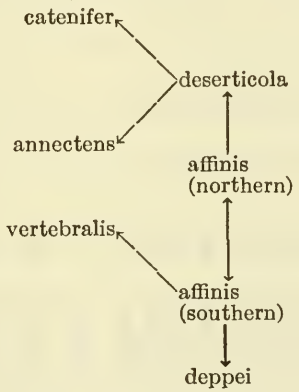

Table 9 lists the specimens of this form that have been examined.

PITUOPHIS SAYI SAYI (Schlegel)

Coluber sayi Schlegel, Essai sur la physionomie des serpens, p. 157, 1837 (type unknown; type locality, Missouri).

Coluber melanoleucus var. *Say* Harlan, Journ. Acad. Nat. Sci. Philadelphia, vol. 5, pt. 2, p. 360, 1827; Medical and physical researches, p. 123, 1835.

Pityophis sayi Baird, U. S. and Pac. R. R. Explor. and Surv., vol. 10, pt. 4, No. 4, pl. 29, fig. 45, 1859.—Hayden, Trans. Amer. Phil. Soc., vol. 12, p. 177, 1863.—Hoy, Geol. Surv. Wisconsin, vol. 1, p. 424, 1883.—Hurter, A catalogue of the reptiles and batrachians collected in the State of Missouri, p. 4, 1883.—Cope, Proc. U. S. Nat. Mus., vol. 11, p. 398, 1888.—Johnson, Trans. Wisconsin Acad. Sci. Arts Lett., vol. 13, p. 527, 1901.—Strecker, Trans. Texas Acad. Sci. for 1901, p. 97, 1902.—Hurter and Strecker, Trans. Acad. Sci. St. Louis, vol. 18, No. 2, p. 25, 1909.—Strecker, Baylor Univ. Bull., vol. 13, Nos. 4 and 5, p. 15, 1910.

TABLE 9.—*Specimens of* Pituophis vertebralis *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 4682a (cotype of *haematois*).	Cape San Lucas, Lower California.	♂	31-33-23	249	63	312	9	12	2	3	41	11	52	118	0.110	1/2	0
U.S.N.M. No. 4682b (cotype of *haematois*).	-----do-----	♀	35-35-25	249	64	313	9/10	13/14	3/2	4	41	11	52	86	0.127	1	0
U.S.N.M. No. 44191	No data	♀	31-33-23	241	61	302	9	13	2	3	43	11	54	65	0.122	1	0
U.S.N.M. No. 12631b	La Paz, Lower California.	♀	31-33-23	243	66	309	8	13	2	4	40	10	50	158	0.126	2	0
U.S.N.M. No. 15157	Ballenas Bay, Lower California.	♂	31-35-23	254	60	314	9	12/11	2	4	43	12	55	120	0 125	1	0
U.S.N.M. No. 12644	La Paz, Lower California.	♂	29-33-23	253	58	311	9	13	2	3/5	42	10	52	144	0.121	1	0
U.S.N.M. No. 14088	Cerros Island, Lower California.	------	31-33-23	240	--------	--------	8/9	12	2	5/4	63	18	81	160	0.137	1	0
U.S.N.M. No. 1824	Fort Reading, California.	------	31-35-23	244	69	313	8	13	2	3	41	12	53	158	0.139	1	0
U.S.N.M. No. 37537	Margarita Island, Lower California.	♂	29-33-23	262	64	328	9	13	2	3	38	11	49	167	0.125	1	0
U.S.N.M. No. 37538	-----do-----	♀	29-33-23	247	67	314	9	12	2	3	40	11	51	114	0.149	1	0
U.S.N.M. No. 37539	-----do-----	♂	33-35-23	250	61	311	8	13	2	4/3	42	11	53	85	0.129	1	0
U.S.N.M. No. 37540	Santa Anita, Lower California.	♂	29-33-23	240	65	305	9	12/14	2	3	39	12	51	76	0.144	1	0
U.S.N.M. No. 54764	Cerros Island, Lower California.	♂	31-33-23	248	59	307	8	14/13	2	4	53	12	65	127	0.125	2	0
U.S.N.M. No. 64583	Miraflores, Lower California.	♀	29-33-23	242	69	311	9	13/12	2	3	47	14	61	138	0.144	1	0
U.S.N.M. No. 37536	Alamo, Lower California.	♀	29-31-23	244	--------	--------	9/10	14/13	2	3	34	-------	-------	-------	--------	1	0
U.S.N.M. No. 12631a	La Paz, Lower California.	♀	31-33-23	237	64	301	9/8	12/13	2	3	40	12	52	145	0.137	1	0

A.N.SNo. .P. 3791	Cape San Lucas, Lower California.	------	31-33-23	245	67	312	9	12	2/1	3	47	12	59	178	0.140	4/2	0
A.M.N.H. No. 5588	Miraflores, Lower California.	♀	29-33-23	241	64	305	9/10	13	2	3	42	13	55	171	0.137	1	0
A.M.N.H. No. 5589	do	♀	31-33-23	239	62	301	9/8	13/14	2	3	46	11	57	144	0.131	1	0
A.M.N.H. No. 5590	do	♂	31-35-23	247	57	304	10	14/13	2	4/3	47	11	58	102	0.127	1	0
C.A.S. No. 59568	Cerros Island, Lower California.	♀	31-33-23	238	63	301	9	13	2	4/5	53	14	68	46	0.130	2/1	0
C.A.S. No. 59390	Magdalena Island, Lower California.	♀	32-35-25	244	62	306	9	12	2	3	41	11	52	80	0.131	1	0
C.A.S. No. 45875	San Antonio, Lower California.	♂	33-35-23	248	61	309	9	15/14	2	3/4	48	11	59	93	0.134	1	0
C.A.S. No. 45874	San Pedro, Lower California.	♀	31-33-23	238	64	302	9/10	13	2	3	46	12	58	138	0.130	1	1
C.A.S. No. 45878	Aqua Caliente, Lower California.	♀	29-33-23	245	64	309	9	12/13	2	3	39	11	50	132	0.128	1	0
C.A.S. No. 45876	San Bartolo, Lower California.	♂	31-35-24	248	--------	--------	9	13	2	3	44	9	53	-------	--------	1	0
C.A.S. No. 45877	do	♂	31-35-23	257	62	319	10/9	14	2	3	46	11	57	111	0.126	1	0
Klauber No. 1181	Onyx Mine, Lower California.	♀	31-33-23	247	65	312	9	14	2	3	44	11	55	95	0.136	1	0
Klauber No. 1129	do	♀	31-33-23	246	68	314	9/8	13	2	4/5	45	13	58	140	0.142	1/2	0
Klauber No. 107	Jim Grey, San Bernardino Co., Calif.	♀	31-33-23	241	69	310	8	13	2	3/4	48	14	62	90	0.144	1/2	1
Field No. 1394	Trinidad, Lower California.	♂	33-35-23	238	64	302	8/9	14	2	4	58	15	73	121	0.132	1	0
M.V.Z. No. 10673	San Ignacio, Lower California.	♀	29-33-23	244	64	308	9	13	2	4	39	11	50	192	0.130	1	0
M.V.Z. No. 10674	do	♀	29-31-23	238	63	301	9/8	13	2	3/4	39	10	49	132	0.143	1	0
Stanford No. 4113	San José del Cabo, Lower California.	♂	31-33-25	247	57	304	9	13/12	2	4/3	45	10	55	137	0.120	1	0
San Diego No. 1553	San Ignacio, Lower California.	♂	32-33-24	242	67	309	9	13/12	2	3	38	10	48	65	0.138	1	0
M.C.Z. No. 19734	Cerros Island, Lower California.	♀	31-33-23	240	63	303	9	12	2	3	52	14	66	124	0.145	1	0
M.C.Z. No. 19732	do	♂	31-33-23	248	57	305	9/8	12/13	2	3/4	53	11	64	69	0.123	1/2	0
M.C.Z. No. 19733	do	♀	31-31-23	240	65	305	9	12	1	3	54	15	69	121	0.132	1	0

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Pituophis melanoleucus ruthveni? Burt, Journ. Washington Acad. Sci., vol. 25, No. 8, pp. 381–383, 1935 (part).

Original description.—This form is described by Schlegel (1837, p. 157) as follows:

Le Prince de Musignano nous a adressé un individu empaillé d'une Couleuvre inédite, découverte et rapportée du Missouri par M. Say. C'est sans contredit une des plus belles espèces du genre et également caractérisée par la forme de son museau et des plaques qui le revêtent que par la belle teinte d'un jaune rougeâtre qui domine sur toutes les parties. Le dos cependent est d'un brun marron plus foncè, qui laisse entrevoir la couleur du fond sous forme de taches ovales, transversales et très nombreuses: ces deux teintes forment, vers les parties postérieures, de larges bandes alternes qui se prolongent sur le dessous de l'animal. Les parties antérieures sont plus foncées, mouchetées ou maculées de noir comme l'abdomen, ou même ornées de larges taches de cette même teinte.

La tête est distincte du cou et revetue de plaques dont la verticale est en triangle sphérique presqu'équilatéral: les occipitales se font reconnaître a leur petitesse, les labiales, bordées de noir, sont grandes, mais elles ne se distinguent pas des écailles du tronc, qui sont lancéolées, surmontées d'une carène et disposées sur 25 rangées.

L'oeil est entouré postérieurement de 3 plaques mais on ne voit qu'une seule oculaire antérieure précédée d'une frénale très petite. Le museau va en pointe conique et se termine par une lame en forme de nez saillant, les nasales se trouvent à son côté. Notre sujet offre 2 paires de frontales postérieures disposées sur une seule rangee transversale.

Les os, qui composent le crâne, sont plus vigoreux que chez les autres couleuvres, les caisses sont plus longues et les nasaux alongés, l'intermaxillaire est très déprimé. Toutes les dents offrent la même longueur.

1,53 0,20; 224 55

N'ayant pas été a portée d'examiner des sujets en bon état de conservation, je ne puis ni donner une bonne description de cette espèce dont j'ai vu plusieurs ndividus dans la collection formée par le Prince de Neuwied lors de son dernier voyage dans l'Amérique du nord, ni la ranger avec certitude ni la rapporter á aucun de celles déscrites par les naturalistes anglo-américains.

Diagnosis.—This form may be separated readily from the three forms of the *deppei* group by the presence of four rather than two prefrontals, by the entrance of a single labial into the eye on each side, instead of two, and by the shape of the rostral; which in *sayi* is always considerably longer than broad, while in the other forms under consideration it is at least as broad as long. From *vertebralis* and the three subspecies of *catenifer*, also, it may be distinguished by

the longer rostral, since in these forms the rostral is as broad as long, except in a few specimens of *deserticola* where it is slightly longer than broad, although never so long as in *sayi*. From the forms of the *melanoleucus* group *sayi* may be separated by the shorter rostral plate, which is never twice as long as broad in *sayi*, as it is in the subspecies of *melanoleucus*, and by the coloration. Thus *sayi* has a dorsal series of more than 40 dark spots in marked contrast to the light ground color throughout the entire length, and these are more or less uniform in size; *m. melanoleucus* has a dorsal series of less than 40 black spots on body and tail; *m. mugitus* is pied brown and white, with the anterior spots usually indistinguishable from the brown ground color, and the total number, when distinguishable, never more than 40; *m. lodingi* is uniformly black above and slate-gray below, with spots suggested on the posterior part of the dorsum only in young or occasional adult specimens; and *m. ruthveni* has a dorsal series of 50 chocolate-brown spots on a paler brown ground, with the anterior spots about one-half the size of those in the middle of the body and more or less blended with the ground color, although not indistinguishable. From *sayi affinis*, *s. sayi* may be distinguished by the longer rostral, which is nearly twice as long as broad in *sayi*, and only slightly longer than broad in *affinis* and by the coloration. In *sayi* the spots are quadrangular or bar-shaped and are never reddish on the posterior part of the body, while in *affinis* the spots are usually saddle-shaped, at least on the posterior part of the body, and are generally reddish on the posterior part of the body.

Description.—The body is rather stout, and the snout is rather pointed. The tail is shorter than in other forms of the genus, being 0.100 to 0.145 (average 0.122) of the total length. The longest specimen examined was 2,110 mm. in length.

The dorsal scale formula varies from 25–28–23 to 35–37–27, thus covering almost the entire range of variation for the genus as a whole. The number of scale rows at the neck is 25 to 35, oftenest 29; the maximum number of rows at the middle of the body 28 to 37; the minimum number anterior to the vent 21 to 27. The remaining scutellation is as follows: Ventrals 212 to 244 (average 224.8); caudals 46 to 67 (average 56.4); supralabials 7 to 10 (average 8.5), the fourth, fifth, or sixth entering the eye; infralabials 10 to 15, oftenest 12 or 13 (average 12.3); preoculars 1 to 3 (average 1.3); postoculars 2 to 5 (average 3.4); loreal usually but not always present, occasionally divided to form two plates on one or both sides; one or more azygos plates present in 50 percent of the specimens, usually between the frontal and prefrontals, but occasionally one on either side between prefrontal and preocular, or between postnasal and prefrontal; rostral nearly twice as long as broad, penetrating from one-third of to all

the distance between the internasals; frontal undivided, or partially split for as much as one-half of its length.

The dentition is as follows: Mandibular teeth 17 to 21, decreasing slightly in size posteriorly; maxillary teeth 16 or 17, decreasing slightly in size posteriorly; palatines 9 to 11, slightly smaller than mandibular and maxillary teeth; pterygoids 9 to 13, slightly smaller than the palatines, and decreasing in size posteriorly.

The dorsum bears a series of black, brown, or grayish-brown spots, which number 33 to 68 (average 50.7) on the body and 8 to 20 (average 13.0) on the tail. When the spots are brownish they are frequently outlined with black or darker brown, at least on the posterior border. Each spot is 2 to 5 scales in length and 9 to 12 scales in width, and the interspaces between the spots are 1 to 4 scales each in length. These interspaces occasionally have a narrow median dark transverse streak, and frequently the light scales, as well as the light scales of the sides, each bear a small median or anterior dark spot. There are three or four lateral series of small dark spots on each side, which alternate with one another and with the dorsal series, and which frequently fuse with one another and with the median series at the edges, forming a kind of syncytium, particularly in the anterior part of the body. The lateral spots are frequently partially outlined with black. The belly always bears a series of lateral spots on each side, which are usually separated from one another by from 1 to 4 scutes. In addition to these lateral series, the belly generally is heavily spotted throughout, but occasionally these additional irregularly scattered spots are inconspicuous or lacking. The ground color of both dorsum and belly is a yellowish white. The top of the head is a reddish brown, more or less dappled with black, and usually each scale of the posterior part of the head and of the neck bears a small black spot. A black streak marks each suture between the supralabials and between the infralabials. The throat is white (fig. 50).

Variation.—In many of the characters there appears to be a marked correlation between variation and geographic distribution. On the accompanying graphs the regions that are represented by specimens are numbered along the abscissas, 1, 2, 3, etc., as follows:

Region 1. Northern Mexico and Texas.
2. Oklahoma.
3. Kansas and southwestern Missouri.
4. Colorado, Nebraska, southeastern Wyoming, and the southern part of South Dakota.
5. Northern Wyoming, northern South Dakota, North Dakota, and Montana.
6. Iowa, western Indiana, Illinois, and Minnesota.

In the number of scale rows (fig. 51), the number of ventrals (fig. 52), and the number of infralabials (fig. 54) and postoculars (fig. 55) there is a more or less constant decrease from south to north, which is

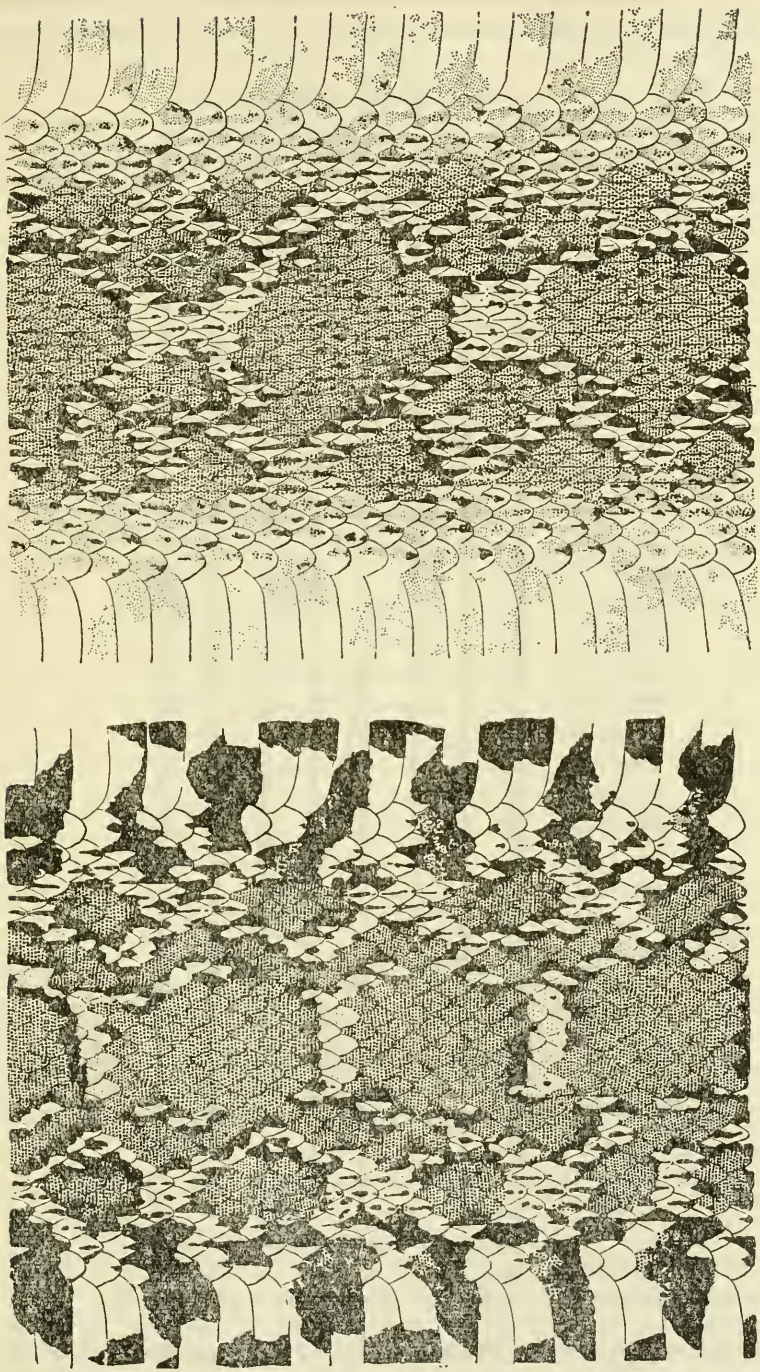

FIGURE 50.—The color pattern of *Pituophis sayi*: *a*, *P. s. sayi*; *b*, *P. s. affinis*.

in each case more marked to the west than to the east. This indicates a dwarfing in both length and diameter toward the north, away from

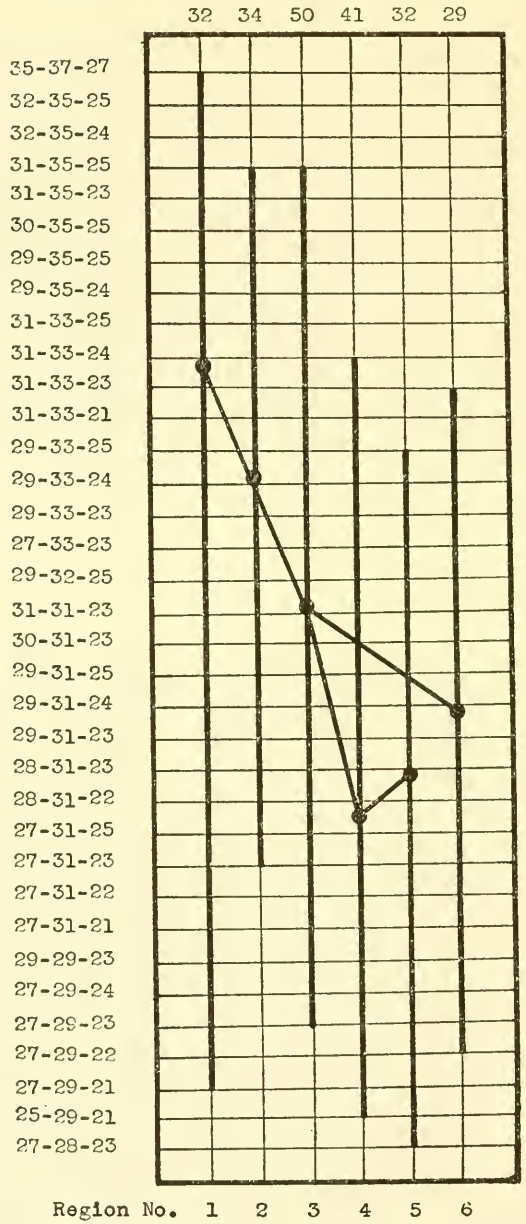

FIGURE 51.—Geographic variation in number of scale rows in *Pituophis sayi sayi*.

the probable center of distribution. The greater dwarfing in the northwestern part of the range than in the northeastern seems to be in correlation with the more severe climate of the former region. Although

the variation in the number of supralabials is very slight, a tendency toward an increase in number from the southern to the central part of the range is indicated, which continues to the northwest, while there is a slight decrease to the northeast. In the preoculars, on the contrary, there is a general tendency to decrease the number from the south to the center of the range, and the decrease is continued to the

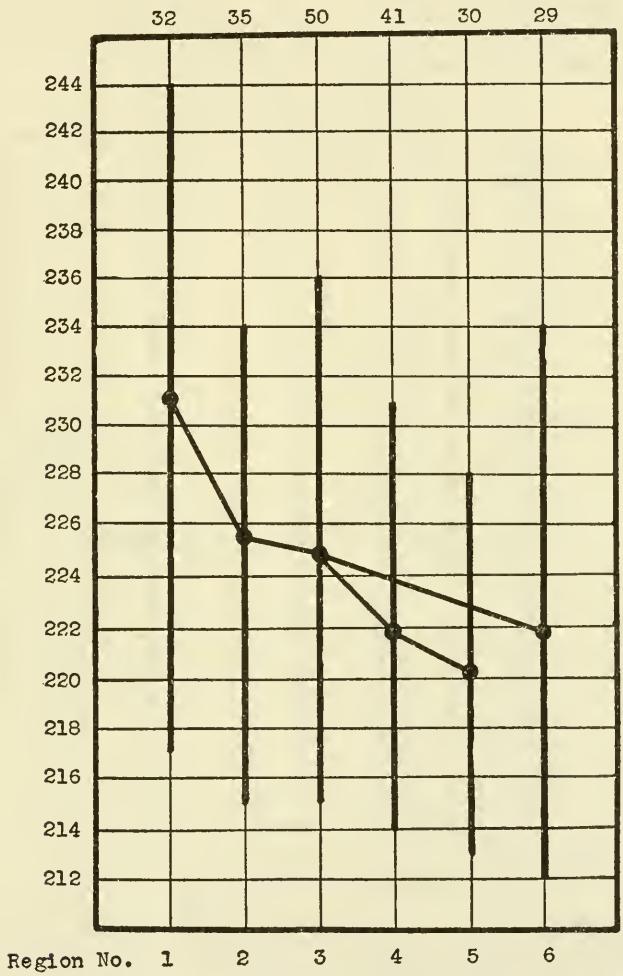

FIGURE 52.—Geographic variation in number of ventrals in *Pituophis sayi sayi*.

northeastern part of the range, but reversed to the northwestern. The proportionate tail length remains fairly constant throughout the range (fig. 56), tending to increase slightly from south to north, the greatest increase (as also, to a very slight extent, in the caudals, fig. 53) appearing in the northwestern part of the range. The variation in the number of body and tail spots (fig. 57) seems to be of little, if

any, geographic significance, the average number remaining fairly constant throughout the range of the form. Whatever geographic trend is present is toward a decrease in the number of spots from south to north, as might be expected in correlation with the dwarfing that occurs. However, the decrease in the number of spots appears to be more marked to the east than to the west, while the reverse is true of most of the scale characters.

Sexual variation evidently exists in many of the scale characters. The variations that occur may be summarized as follows: Dorsal scale

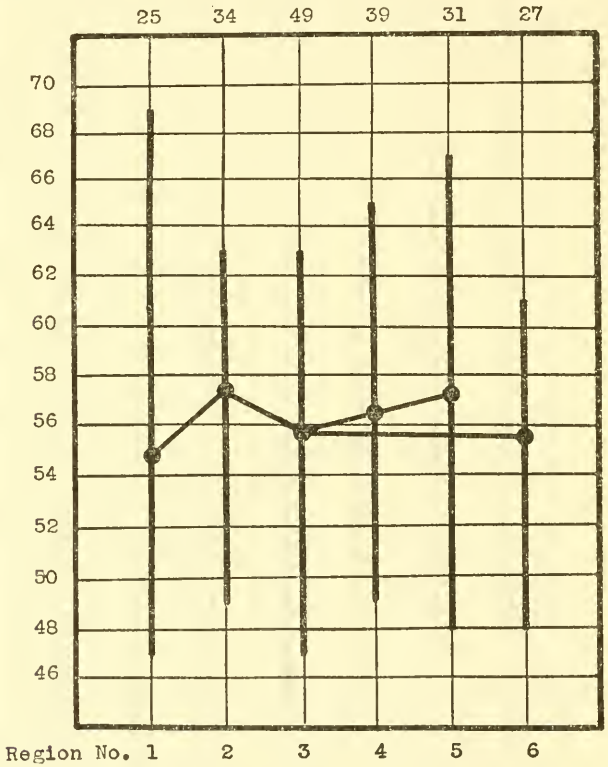

FIGURE 53.—Geographic variation in number of caudals in *Pituophis sayi sayi*.

formula varying from 25–28–23 to 31–37–27 in males, from 23–29–21 to 35–37–27 in females; ventrals 212 to 236 (average 222.9) in males, 216 to 244 (average 227.2) in females; caudals 49 to 67 (average 58.8) in males, 47 to 65 (average 53.2) in females; supralabials average 8.5 in males, 8.4 in females; infralabials average 12.4 in males, 12.3 in females; preoculars average 1.3 in males, 1.4 in females; postoculars average 3.5 in males, 3.4 in females; body spots average 51.2 in males, 51.0 in females; tail spots average 13.6 in males, 12.6 in females; proportionate tail length varies from 0.104 to 0.145 (average 0.125) in males and from 0.100 to 0.140 (average 0.117) in females. In the

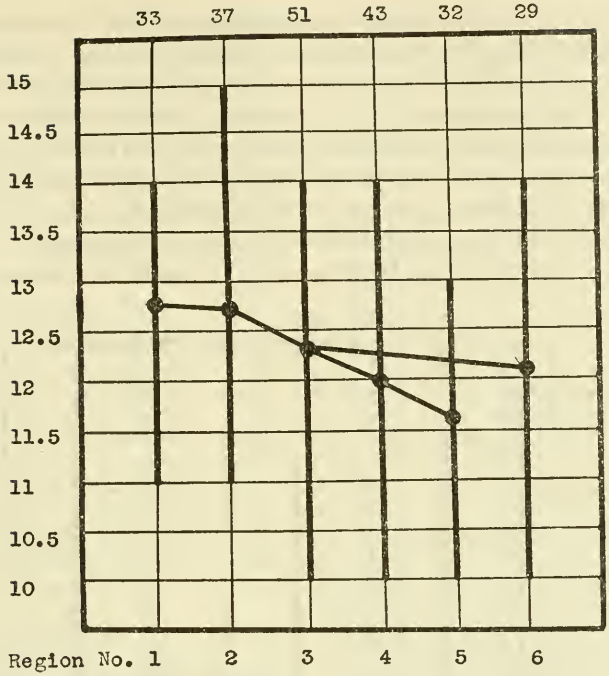

FIGURE 54.—Geographic variation in number of infralabials in *Pituophis sayi sayi*.

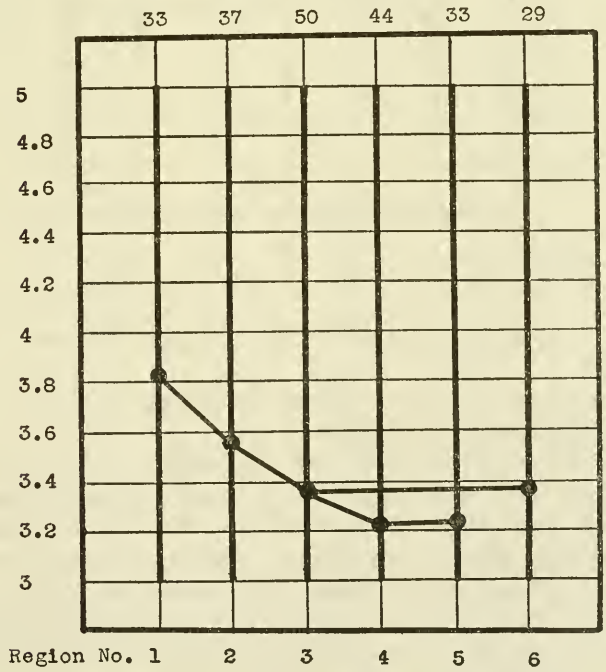

FIGURE 55.—Geographic variation in number of postoculars in *Pituophis sayi sayi*.

higher number of supralabials, infralabials, and postoculars in males, *sayi* disagrees with the tendencies common to *affinis*, *vertebralis*, and the three subspecies of *catenifer*, which in every case are toward a higher number in females than in males. In *lineaticollis* and *deppei*, however (as well as can be judged from the limited series of specimens), the postoculars, and supralabials and infralabials are all higher in males than in females, as are the infralabials and postoculars in *melanoleucus*, and the infralabials in *mugitus* and *lodingi*. It must be remembered that in these latter cases the numbers of specimens are

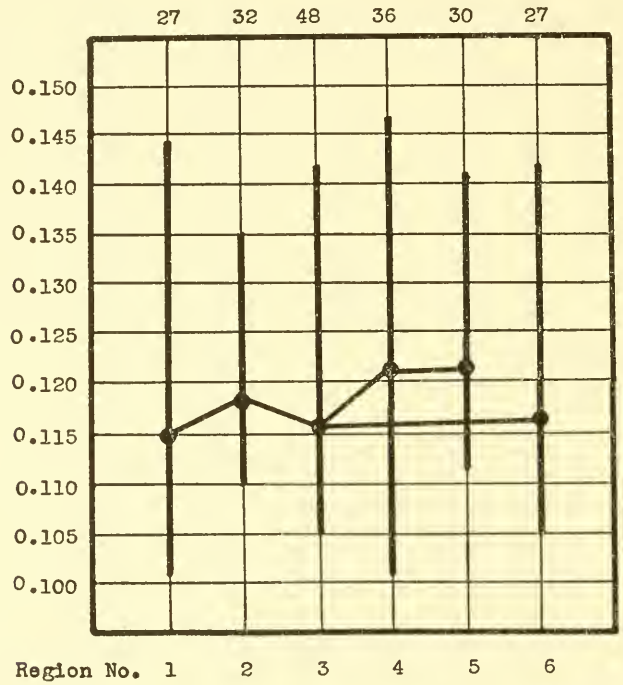

FIGURE 56.—Geographic variation in ratio of tail length to total length in *Pituophis sayi sayi*.

so small as possibly to be deceiving, although the same cannot be said of *sayi*.

Four specimens (less than 2 percent of the specimens examined) had only two prefrontals instead of four.

A 2-headed specimen (U.S.N.M. No. 25398) had two well-formed heads, which unite to form one body about 2 inches posterior to the neck. The scale counts of the two heads are different, and the right neck is slightly longer than the left. Thus, the right head has 9 supralabials, 11 and 12 infralabials, 2 preoculars, and 3 and 4 postoculars, a loreal, no azygos, and the rostral penetrating two-thirds of the distance between the internasals; the left head has 8 supralabials, 11 and 10 infralabials, 2 preoculars, and 3 and 4 postoculars, a loreal, an

azygos, and the rostral penetrating one-half of the distance between the internasals. The dorsal scale formula is 27–33–23, there are 42 ventrals on the right neck and 31 on the left before the point of union, and 175 from there to the anal plate. The caudals number 62. The right head also has two more spots in the dorsal series before the junction of the two necks, the total number being 53 or 55 on the body and 16 on the tail. Of this same specimen Johnson (1901, p. 526) says: "This specimen is remarkable for the extreme length of the anterior doubled portion, which is much longer than in any case ever described, with the exception of that of Redi. The skiagraph reveals the division of the vertebral column very much farther back than that of the bodies proper, although the color markings show irregularities over the portion underlaid by the two vertebral columns."

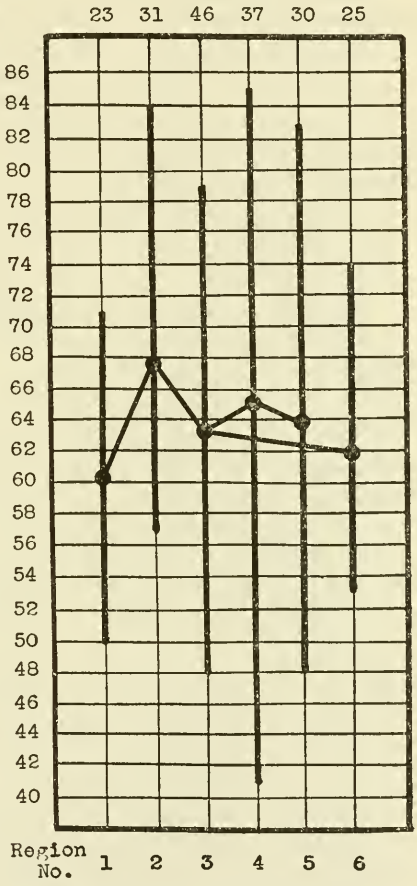

FIGURE 57.—Geographic variation in total number of dorsal spots in *Pituophis sayi sayi*.

Another 2-headed specimen, in which, however, the head scales are similar, is described by Pope (1925, p. 161) as follows: "The cephalic plates are similar in number and arrangement and there is a small anterior frontal plate between the four prefrontals and the frontal plate. . . . Our specimen of Bull Snake has the two heads joined together just behind the angle of the jaw, there being one fold of skin connecting the lower jaws for one-half of their length and another fold running diagonally from the angle of one to the posterior base of the skull of the other. Where the vertebrae unite to form a single vertebral column is probably within one inch of their heads."

Range.—This form has the greatest range of any in the genus and is found throughout the Great Plains region. It occurs from the northern part of Mexico north to Door County, Wis., in the east, and to Medicine Hat, Alberta, Canada, in the west, and ranges from the Rocky Mountains to western Indiana.

Specimens have been examined from the following localities:

Mexico: *Chihuahua*, San Antonio, Presidio del Norte; *Coahuila*, Castanuelas.

Texas: *Archer County; Bexar County; Borden County*, Gail; *Cameron County*, Brownsville; *Crosby County*, Llano Estacado; *Deaf Smith County*, Red River; *Duval County*, San Diego; *Presidio County*, Paisano; *Reeves County*, Weinachts Draw; *Val Verde County*, 20 miles north of Comstock. Additional records for Texas specimens that are indefinite or that cannot be located in any available atlas are: Rio Pecos, Camp Bullis, between San Antonio and El Paso, Lower Rio Grande River, and Senterfitt (Centerville, Leon County?).

Oklahoma: *Canadian County; Cimarron County; Cleveland County; Comanche County; Grady County; Harmon County; Major County; Okmulgee County; Pawnee County; Roger Mills County; Stephens County; Texas County; Woods County*, Alva, White Horse Springs; *Woodward County*. One specimen is labeled "Ft. Supply," a locality that does not appear in any atlas consulted.

Missouri: *Jasper County; Stone County*.

Kansas: *Cowley County; Dickinson County; Douglas County; Edwards County*, Offerle; *Ford County; Franklin County; Geary County*, Fort Riley; *Gove County; Hamilton County; Marshall County; Miami County; Norton County*, Almena; *Pratt County; Republic County; Riley County*, Manhattan; *Trego County; Wallace County*. One record, "between Stafford and Sylvia," cannot be limited to any county, since those towns occur in different counties (Stafford and Reno Counties), and another record, "Ft. Harker," cannot be located.

Indiana: *Knox County*, Wheatland.

Illinois: *Champaign County*, Champaign; *Rock Island County*, Rock Island.

Iowa: *Cass County*, Atlantic; *Delaware County*, Manchester; *Madison County; Scott County*, Davenport; *Story County*, Ames; *Woodbury County*, Sioux City.

Minnesota: *Hennepin County*, Fort Snelling.

Nebraska: *Buffalo County*, Fort Kearney; *Cherry County*, Kennedy; *Douglas County*, Omaha; *Howard County*, Loup Fork. The following indefinite records are also given: Upper Missouri River, Platte Valley, western Nebraska.

South Dakota: *Custer County*, Battle Creek Canyon; *Tripp County*, Carter; *Yankton County*, Yankton. In addition, the localities for specimens labeled "Quinn's Draw, Bad Lands" and "Thumbdance" could not be found in any atlas.

North Dakota: *Billings County*, 4 miles north of Medora; *Morton County*, Cannon Ball. The indefinite locality "Upper Missouri and Yellowstone Rivers" and the locality "Goodall," which cannot be located (Goodwill, Roberts County, S. Dak.?), are also given.

Colorado: *Boulder County*, Boulder, Lee Hill, Marshall; *Chaffee County*, Buena Vista; *Fremont County*, Canon City; *Huerfano County*, Walsenburg; *Morgan County*, Orchard; *Washington County*, Akron; *Weld County*, Greeley.

Wyoming: *Big Horn County*, Grey Bull; *Carbon County*, west fork of the Medicine Bow River; *Crook County*, Belle Fourche Valley; *Goshen County*, Rawhide Butte, Fort Laramie; *Laramie County; Sheridan County*, Arvada; *Yellowstone Park*.

Montana: *Chouteau County*, Benton; *Custer County*, Yellowstone River above Powder River; *Dawson County*, Jordan, Glendive; *Gallatin County*, Anceny Station, Trident, Bozeman; *Rosebud County*, 8 miles south of Hardin, Crow Agency, Fort Custer; *Sanders County*, Hot Springs; *Yellowstone County*, East Pryors Creek, north base of the Big Horn Mountains, Yellowstone region.

One specimen (U.S.N.M. No. 1575) is labeled "Tyree Springs, Tennessee." This locality is not in any available atlas and is doubt-

less erroneous, since there is apparently no other Tennessee record for *sayi*, and Tennessee is well without the known range of the form.

Another specimen has the locality given as "Belleplain, N. J.," which is obviously an error. The specimen probably escaped from captivity in New Jersey, after being transported there; or the locality data for the specimen was mixed with that of a specimen of *melanoleucus*. A specimen captured in Ann Arbor, Mich., is known to have escaped from a circus.

Additional published records for *sayi*, which are probably authentic, are as follows:

Mexico: *Nuevo Leon* (Günther, 1894, p. 124; Boulenger, 1894, p. 69), 3 miles west of Sabinas Hidalgo (Dunkle and Smith, 1937, p. 7).

Texas: *Angelina County*, Zavalla (Burt, 1935a, p. 383); *Armstrong County*, Panther Arroyo (Strecker, 1910, p. 15); *Bexar County*, San Antonio, Helotes (Strecker, 1922, p. 24); *Brewster County*, Alpine (Strecker, 1909a, p. 7); *Burnet County* (Strecker, 1909a, 7); *Cameron County*, Harlingen (Strecker, 1928a, p. 8); *Carson County*, 6 miles west of Groom (Burt, 1935a, p. 383); *Clay County*, 1 mile northwest of Jolly (Burt, 1935a, p. 383); *Comal County* (Strecker and Williams, 1927, p. 14); *Crosby County*, 2 miles northwest of Crosbyton (Burt, 1935a, p. 383); *Culberson County*, head of Dog Canyon, southern Guadaloupe Mountains (Bailey, 1905, p. 47); *Donlevy County*, Jericho (Burt, 1935a, p. 383); *Edwards County*, Rock Springs (Bailey, 1905, p. 47); *Ellis County*, 1 mile northwest of Waxahachie (Burt, 1935a, p. 383); *Foard County*, 3 miles northeast of Thalia (Burt, 1935a, p. 383); *Gray County*, 1 mile west of Alanreed (Burt, 1935a, p. 383); *Hays County*, near San Marcos (Strecker and Williams, 1927, p. 14); *McClellan County*, west of Waco (Strecker, 1902, p. 3); *Moore County*, Dumas, 1 mile north of Etter (Burt, 1935a, p. 383); *Pecos County*, 12 miles northeast of Fort Stockton (Burt, 1935a, p. 383); *Potter County*, 8 miles east of Amarillo (Burt, 1935a, p. 383); *Reeves County*, 1 mile south of Red Bluff (Burt, 1935a, p. 383); *Refugio County* (Strecker, 1908a, p. 48); *Sherman County*, 3 miles southwest of Texhoma, 2 miles northeast of Stratford (Burt, 1935a, p. 383); *Tarrant County* (Strecker, 1929b, p. 13); *Travis County* (Strecker and Williams, 1927, p. 14); *Val Verde County*, Comstock (Bailey, 1905, p. 47); *Victorio County* (Strecker, 1908a, p. 48); *Wichita County* (Strecker, 1915, p. 35); *Wilbarger County*, Pease River Valley (Strecker, 1929a, p. 7); *Williamson County*, 6 miles north of Georgetown (Burt and Burt, 1929a, p. 11).

Arkansas: *Polk County*, near Mena (Hurter and Strecker, 1909, p. 25); Red River (Baird and Girard, 1853, p. 69).

Oklahoma: *Alfalfa County*, 3 miles east of Carmen (Burt, 1935b, p. 331); *Beckham County*, 4 miles northeast of Elk City (Burt, 1935b, p. 331); *Cimarron County*, 7 miles south of Boise City, 3 miles north of Kenton (Ortenburger, 1927c, p. 47; Ortenburger and Freeman, 1930, p. 184); *Comanche County*, Wichita Mountains (Ortenburger, 1926, p. 138), Wichita National Forest and Game Preserve (Ortenburger and Freeman, 1930, p. 184); *Garfield County*, 5 miles north of Enid (Burt and Hoyle, 1934, p. 209), 1 mile southeast of Hillsdale (Burt, 1935b, p. 331); *Grady County*, Tuttle (Ortenburger, 1925, p. 85); *Harmon County*, 7 miles southwest of Hollis (Ortenburger and Freeman, 1930, p. 184); *Kay County*, Grainville, 101 Ranch, 5 miles south of Ponca City (Burt, 1935b, p. 331); *Logan County*, 2 miles north of Guthrie (Burt, 1935b, p. 331); *Noble County*, 4 miles east of Marland (Burt, 1931, p. 15), 4

miles north of Billings (Burt, 1935b, p. 331); *Okmulgee County*, Okmulgee (Ortenburger, 1925, p. 85); *Osage County*, 3 miles east of Burbank (Burt, 1935b, p. 331); *Roger Mills County*, Antelope Hills 6 miles northeast of Durham (Ortenburger and Freeman, 1930, p. 184); *Texas County*, 8 miles southeast of Guymon (Ortenburger, 1927c, p. 47; Ortenburger and Freeman, 1930, p. 184); *Woods County*, 4 miles west of Capron, north bank of Cimarron River just south of Waynoka (Burt, 1935, p. 331); *Woodward County*, 10 miles southwest of Freedom (Ortenburger and Freeman, 1930, p. 184).

Missouri: *Jasper County*, Carthage (Hurter, 1911, p. 174), 3 miles west of Arvilla, 4 miles east of Carthage (Burt, 1933a, p. 172); *Phelps* and *Taney Counties* (Hurter, 1911, p. 174).

Kansas: *Barber County*, Deerhead, 2 miles west of Medicine Lodge, Sharon (Burt and Hoyle, 1934, p. 208), 1 mile south of Deerhead, 5 miles northeast of Aetna, 4 miles southeast of Lake City (Burt, 1935b, p. 331); *Barton County*, 3 miles west of Ellinwood, Lake Barton 4 miles south of Hoisington (Burt, 1935b, p. 331); *Bourbon County*, 2 miles east of Fort Scott (Burt, 1935b, p. 331); *Brown County* (Branson, 1904, p. 360); *Butler County*, Augusta, 1 mile southwest of Cassoday, 3 miles southeast of Douglas (Burt and Hoyle, 1934, p. 208); *Chase County*, Bazaar (Burt and Hoyle, 1934, p. 208); *Clark, Clay*, and *Cloud Counties* (Branson, 1904, p. 360); *Cowley County*, 1 mile south of Akron, 1 mile east of Arkansas City, 2 miles northeast of Burden, 6 miles east of Cambridge, 1 mile north of Hooser, 10 miles west of Winfield, 8 miles north of Winfield (all Burt and Hoyle, 1934, p. 208), Winfield, 1 mile east of Winfield, 2 miles east of Winfield, 6 miles northeast of Winfield, 5 miles northwest of Winfield, 2 miles south of Winfield, 2 miles southeast of Winfield (all Burt, 1933b, p. 199), 1 mile west of Cambridge, 1 mile northeast of Otto, 6 miles east of Winfield (all Burt, 1935, p. 331); *Decatur County*, Norcatur, Oberlin (Burt, 1933b, p. 199); *Dickinson County*, 9 miles north of Herington (Burt, 1933b, p. 199), 3 miles north of Elmo, 2 miles southwest of Hope (Burt and Hoyle, 1934, p. 208); *Doniphan County* (Branson, 1904, p. 360), Geary (Linsdale, 1927, p. 79); *Douglas County*, Rock Creek (Burt, 1933b, p. 199); *Ellis County*, 1 mile north of Schoenchen (Burt, 1933b, p. 199); *Ellsworth County*, county line west of Brookville (Burt and Hoyle, 1934, p. 208); *Finney County*, 4 miles east of Essex (Burt, 1935b, p. 331); *Geary County*, 9 miles south of Junction City (Burt, 1931, p. 15), 4 miles south of Junction City (Burt and Hoyle, 1934, p. 208), 1 mile east of Fort Riley, 3 miles east of Junction City (Burt, 1935b, p. 331); *Grant County*, 6 miles north of Ulysses (Burt, 1933b, p. 199); *Greenwood County* (Branson, 1904, p. 360), 2 miles southeast of Climax, 8 miles south of Tonovay (Burt and Hoyle, 1934, p. 208), 2 miles south of Virgil (Burt, 1935b, p. 331); *Hamilton County*, 1 mile west of Mayline (Burt, 1933b, p. 199), 1 mile west of Coolidge, 3 miles east of Syracuse, 3 miles west of Syracuse (Burt, 1935b, p. 331); *Harper County*, Harper (Burt and Hoyle, 1934, p. 208); *Harvey County* (Branson, 1904, p. 360), 10 miles northwest of Halstead (Burt, 1933b, p. 199); *Hodgeman County*, 4 miles northeast of Grayling, 3 miles southwest of Hanstan, Jetmore (Burt, 1935b, p. 331); *Jackson County*, 2 miles east of Netawaka (Burt, 1935b, p. 331); *Jefferson County* (Branson, 1904, p. 360), 1 mile north of Rock Creek, 4 miles south of Valley Falls (Burt and Hoyle, 1934, p. 208); *Kearney County*, 1 mile east of Deerfield, 1 mile east of Lakin (Burt, 1933b, p. 199), 3 miles east of Lakin (Burt, 1935b, p. 331); *Kingman County*, 3 miles northwest of Cheney, 3 miles west of Kingman (Burt, 1935b, p. 331); *Lane County*, 5 miles north of Dighton (Burt, 1933b, p. 199); *Lincoln County*, Sylvangrove (Pope, 1925, p. 161); *Logan County* (Branson, 1904, p. 360); *Lyon County* (Branson, 1904, p. 360), 5 miles south of Admire (Burt, 1935b,

p. 331); *Marion County*, 3 miles south of Lost Springs (Burt, 1931, p. 15), 2 miles north of Marion (Burt, 1933b, p. 199); *Marshall County*, 3 miles west of Blue Rapids (Burt, 1931, p. 15), 5 miles north of Cleburne (Burt, 1933b, p. 199), 2 miles west of Blue Rapids, 3 miles north of Marysville (Burt and Hoyle, 1934, p. 208), 4 miles west of Lillis (Burt, 1935b, p. 331); *Miami County*, northeast of Pigeon Lake (Gloyd, 1932, p. 404); *Mitchell County* (Branson, 1904, p. 360); *Morris County*, 3 miles east of Delavan (Burt and Hoyle, 1934, p. 208); *Nemaha County*, 2 miles east of Corning (Burt, 1935b, p. 331); *Neosho County* (Branson, 1904, p. 360); *Osage County*, 3 miles north of Osage City (Burt and Hoyle, 1934, p. 208); *Osborne* and *Phillips Counties* (Branson, 1904, p. 360); *Potawatomie County* (Branson, 1904, p. 360), Belvue (Burt and Burt, 1929b, p. 457), 3 miles north of Blaine, Wamego (Burt, 1935b, p. 331); *Reno County*, 1 mile south of Penalosa (Burt, 1935b, p. 331); *Republic County*, 4 miles north of Belleville (Burt and Burt, 1929a, p. 11); *Rice County*, Silica (Burt, 1935b, p. 331); *Riley County*, 5 miles west of Cleburne (Burt and Hoyle, 1934, p. 208), Randolph (Burt, 1935b, p. 331); *Rooks County*, 4 miles south of Plainville, 3 miles east of Stockton (Burt, 1933b, p. 199); *Saline County*, 4 miles southeast of Mentor (Burt and Hoyle, 1934, p. 208); *Scott County* (Branson, 1904, p. 360), 4 miles east of Scott City (Burt, 1933b, p. 200); *Sedgwick County*, 1 mile southwest of Clearwater (Burt, 1933b, p. 200); *Shawnee* and *Sherman Counties* (Branson, 1904, p. 360); *Smith County*, 1 mile southwest of Kensington (Burt and Burt, 1929b, p. 457); *Stafford County*, near Big Salt Marsh (Burt and Burt, 1929b, p. 457), 2 miles west of Macksville (Burt, 1933b, p. 200); *Sumner County* (Branson, 1904, p. 360), Conway Springs (Burt, 1933b, p. 200), Argonia (Burt and Hoyle, 1934, p. 209); *Wabaunsee County*, 5 miles west of Maplehill (Burt and Hoyle, 1934, p. 209), 5 miles north of Alma (Burt, 1935b, p. 331); *Wallace County* (Burt, 1933b, p. 200); *Washington County*, 3 miles west of Barnes (Burt and Burt, 1929a, p. 11), 6 miles north of Haddam, 5 miles northeast of Haddam, 2 miles northwest of Haddam (Burt and Burt, 1929b, p. 457), west outskirts of Haddam (Burt, 1933b, p. 200).

Illinois: *Henry County*, 4 miles south of Cleveland (Burt and Hoyle, 1934, p. 209); *Kankakee County*, Pembroke Township (Schmidt and Necker, 1935, p. 70); *Madison* and *St. Clair Counties* (Hurter, 1911, 174). Garman's reference to "Rockland" (1892, p. 287) probably pertains to Rock Island, since no locality of the former name can be found.

Wisconsin: *Buffalo*, *Columbia*, *Crawford*, *Door*, *Grant*, *Milwaukee*, *Outagamie*, *Sauk*, and *Vernon Counties* (Pope and Dickinson, 1928, p. 27).

Iowa: *Ida County* (Ruthven, 1919, p. 2); *Jasper County*, 1 mile east of Colfax (Burt and Hoyle, 1934, p. 209); *Monona County*, Onawa (Ruthven, 1919, p. 2); *Page County*, 2 miles west of Clarinda (Burt and Hoyle, 1934, p. 209); *Poweshiek County*, Grinnell (Ruthven, 1913, p. 207); *Woodbury County* (Ruthven, 1919, p. 2).

Nebraska: *Boyd County*, 9 miles west of Butte (Burt and Burt, 1929a, p. 11), 3 miles southeast of Spencer (Burt, 1931, p. 15); *Brown County* (Taylor, 1891, p. 337); *Cherry County*, Simeon (Burt and Hoyle, 1934, p. 209); *Dawes County* (Taylor, 1891, p. 337); *Dodge County*, 4 miles southeast of Scribner (Burt and Hoyle, 1934, p. 209); *Furnas County*, Cambridge (Morse, 1927, p. 71); *Gage County* (Taylor, 1891, p. 337), Blue Springs, 1 mile southwest of Cortland, 7 miles east of Odell (Burt and Hoyle, 1934, p. 209); *Jefferson County*, 6 miles east of Reynolds (Burt and Hoyle, 1934, p. 209); *Keyapaha County*, 3 miles west of Norden (Burt and Burt, 1929a, p. 11); *Knox County*, 1 mile west of Niobrara (Burt and Hoyle, 1934, p. 209), 7 miles north of Crofton (Burt, 1935b, p. 331); *Lancaster County* (Taylor, 1891, p. 337), Lincoln (Burt and Hoyle, 1934,

p. 209); *Morrill County*, 5 miles southwest of Bonner (Burt and Hoyle, 1934, p. 209); *Nemaha* and *Sarpy Counties* (Taylor, 1891, p. 337); *Sheridan County* (Taylor, 1891, 337), 4 miles east of Bingham (Burt and Hoyle, 1934, p. 209); Sand Hills of the Loup Fork of the Upper Missouri River (Hayden, 1862, p. 177).

Minnesota: *Fillmore County*, 1 mile east of Preston (Burt, 1935b, p. 331).

South Dakota: *Fall River County*, 7 miles south of Hot Springs (Burt and Burt, 1929a, p. 11); *Gregory County*, right bank of Missouri River near Wheeler Bridge, near Wheeler (Burt and Burt, 1929b, p. 457); *Mellette County*, 9 miles east of Cedarbutte (Burt and Hoyle, 1934, p. 209); *Pennington County*, 1 mile east of Imlay (Burt and Burt, 1929a, p. 11); *Tripp County*, 5 miles southeast of Witten (Burt and Hoyle, 1934, p. 209).

Colorado: *Adams County:* Barr (Ellis and Henderson, 1913, p. 94); *Baca County* (Ellis and Henderson, 1913, p. 94); *Chaffee County*, Hortense Hot Springs near Buenavista (Ellis and Henderson, 1915, p. 262); *Jefferson County*, 12 miles west of Denver (Burt and Burt, 1929b, p. 457); *Larimer County*, Fort Collins, 5 miles south of Box Elder (Ellis and Henderson, 1913, p. 94); *Las Animas County* (Ellis and Henderson, 1913, p. 94); *Morgan County*, Wild Cat Creek northeast of Fort Morgan (Ellis and Henderson, 1913, p. 94); *Prowers County*, Arkansas River at Holly (Burt, 1935b, p. 331); *Sedgwick County*, Julesburg (Ellis and Henderson, 1913, p. 94); *Yuma County*, Wray (Ellis and Henderson, 1913, p. 94); ? *County*, Osgood (Ellis and Henderson, 1913, p. 94).

Wyoming: *Big Horn County*, 3 miles north of Basin (Burt and Hoyle, 1934, p. 209); *Converse County*, 6 miles west of Careyhurst, 2 miles west of Glenrock (Burt and Hoyle, 1934, p. 209); *Fremont County*, 3 miles northwest of Diversion Dam (Burt and Hoyle, 1934, p. 209); *Johnson County*, 16 miles south of Buffalo (Burt and Hoyle, 1934. p. 209).

Montana: *Custer County*, mouth of Custer's Creek (Allen, 1874, 69); *Valley County*, Poplar River (Cope, 1900, 871).

Alberta, Canada: *Assiniboia*, Medicine Hat (Boulenger, 1894, p. 69).

Habits and habitat.—This form, which has the widest range of any in the genus, is probably better known than any other form of *Pituophis*. Accordingly, more observations of its habits have been recorded than for the other members of the genus, with the possible exception of *m. melanoleucus*.

Cooper (1860, p. 301) says that they are "occasionally ploughed up by settlers" and that "during the rutting season they seem to follow each other by the scent."

Wied (1865, p. 97) tells of finding frogs in the stomachs of these snakes.

Taylor (1891, p. 336) describes their food as "almost wholly made up of rodents, most notably ground mice, but also including rats, gophers, squirrels, moles and similar animals." He says also that they are "very prolific" and that although naturally docile "when forced to fight these snakes prefer to get against some object or coil the body around some bush or stake, when they can strike a blow sufficient to defend themselves against the attack of an ordinary sized dog."

Garman (1892, p. 289) describes the hissing as "bearing a very remote resemblance to the bellow of a bull, hence the common name,"

and the accompanying vibration of the tail as like the noise made by the rattle of *Crotalus*.

Branson (1904, p. 359) adds birds to the list of foods, and says: "One three feet in length . . . swallowed three fully grown sparrows for one meal and the next day it swallowed a pigeon egg." He gives also some interesting notes on the life history of *sayi*, which may be summarized as follows: Of 12 eggs found on August 15, one opened immediately was found to contain a living embryo 8 inches long. Ten of the others hatched on September 28 and 29, the young measuring 15 to 15½ inches. They were very irritable at first, becoming gradually less so. On October 19 they molted. By that time their length had increased to 18 inches, although they had eaten nothing. Their first meal, egg and water, was eaten the following April. Five of the young snakes were buried 2½ feet deep in earth and rubbish on December 5 and were found in good condition on March 10.

Bailey gives the following note (1905, p. 47): "In a prairie-dog town near Gail I killed an unusually large individual, measuring 7 feet 8 inches in length . . . Near Rock Springs, a smaller individual was found in the act of swallowing a freshly killed squirrel."

The following note is given by Ditmars (1907, p. 319): "The species is fairly hardy as a captive, feeding upon rats, rabbits, and birds. It is particularly fond of eggs, and consumes them entire, breaking the shell in the throat by a contraction of the muscles . . . One of these creatures . . . swallowed fourteen hen's eggs . . . The demonstration closed by the supply of eggs becoming exhausted and not from indifference on the reptile's part." The same author (1912, p. 220) comments on the value of *sayi* as an enemy "to several species of highly destructive ground-squirrels."

Strecker (1908b, p. 74) describes "an aerial combat between a snake of this species and a large hawk," in which the captured snake "squirmed so vigorously and struck at its captor so furiously that the bird was forced to relinquish its hold." In later papers (1909a, p. 7, and 1910, p. 15) he states that the form is very common in prairie-dog towns.

Ellis and Henderson (1913, p. 94) report the form as "eating the eggs of the Pin Tail Duck."

Dice (1923, pp. 50 and 53) lists *sayi* as a member of both the "prairie community" and the "edificarian community."

Further notes on the usefulness of the bull snake as a destroyer of harmful rodents on farms are given by Over (1923, p. 25), who also says: "In a few instances Bull Snakes have been known to kill Rattlesnakes."

Force (1925, p. 27) reports finding *sayi* "in the gardens, golf course, or open meadows."

Wooster (1925, p. 58) gives the following note: "The bull snake is a much more effective ratter than most cats, and a good-sized one about the barn pays for itself many times over, provided it does not have access to the chicken nests, for it eats eggs and sometimes small chickens."

Guthrie (1926, p. 180) also stresses the value of this snake to agriculture. He gives the number of eggs laid as 13 to 19 and describes and figures the development of the embryo.

The food habits of *sayi* were studied in the laboratory by Hisaw and Gloyd, who observed about 40 snakes of this form under conditions made as normal as possible. Their paper (1926, p. 200) may be briefly summarized as follows: "The bull snake kills its larger prey by constriction. Smaller and weaker animals are simply swallowed alive." The prey is swallowed head first. "The bull snake is also an active and efficient burrower and apparently is able to capture burrowing rodents in their subterranean tunnels . . . When a snake attacks a small animal in a narrow space . . . instead of employing its coils in the usual manner, it attempts to compress its prey against one of the walls of its confine . . . The power of sight of the bull snake is apparently somewhat limited. Though used in capturing the prey, it is not essential. A snake is very sensitive to contact stimuli, and in the dark recognizes prey very readily by this means. If, when in the act of killing a victim by use of the coils, another animal comes in contact with the snake's body, it is at once pressed against the side of the cage or constricted by another series of loops. A single snake has been known to kill as many as three half-grown rats in this way at one time. It was also observed that the bull snake has a cyclic activity which includes feeding, fasting, and moulting. This is apparently repeated about every thirty days." By comparing the average weight of the food eaten with the average weight of small mammals in its natural habitat, it was estimated that an adult snake could consume twelve adult pocket gophers or their equivalent in smaller rodents durings its six months of activity.

Morse (1927, p. 71) relates watching a bull snake kill a pocket gopher and then drag it into a burrow to devour it.

Another note on feeding habits is given by Linsdale (1927, p. 79) as follows: "A large bull snake was eating rabbits in a nest on the lower part of the bluff on April 25, 1925. The snake was coiled over the nest to prevent the escape of the rabbits and had one of the young mammals in its jaws."

Gloyd (1928, p. 125) describes the hatching on September 18 of 6 eggs from a nest of 16 laid on July 4. The young snakes shed their skins ten days later, but no food was taken until, at the age of nine weeks, infant rats were swallowed.

Burt (1935b, p. 331) reports finding "on the sunny afternoon of March 29 a number of large bull snakes and several adult blueracers . . . basking on the south slope of a hill . . . Just below the mass of snakes a hole about three inches in diameter extended straight downward for a distance of over a foot and then it zig-zagged through some buried rocks." Most of the snakes escaped into this retreat, and it was assumed that they had been "in this den during the winter."

Affinities.—Undoubtedly *P. sayi sayi* is closely related to the neighboring form *sayi affinis*. The latter is here included as a subspecies of *sayi*, rather than of *catenifer*, since it intergrades with *s. sayi* in northern Mexico, where the two forms can be distinguished only with the greatest difficulty, while it intergrades with none of the subspecies of *catenifer*; and since it is in both scale and pattern characters obviously more closely related to *s. sayi* than to any of the subspecies of *catenifer*, or any other forms of the genus. The derivation of *sayi* from *affinis* is indicated by the similarity of scale characters and pattern of the two forms, particularly in northern Mexico. In these characters *affinis* is in general intermediate between *sayi* on the one hand, and the *catenifer* and *deppei* groups and *vertebralis* on the other.

That *sayi* is directly ancestral to *ruthveni*, and thus indirectly to the entire *melanoleucus* group, is indicated by the similar scale characters of the two forms. Thus, except for the slightly longer rostral, *ruthveni* might readily be confused with *sayi* in scale characters, although never in coloration. It is noteworthy that in the dorsal scale formula *ruthveni* more closely resembles the neighboring Texas and Oklahoma specimens of *sayi* than the more northern specimens with a lower average dorsal scale formula.

The probable affinities of *sayi* with the neighboring forms may be expressed by the following diagram:

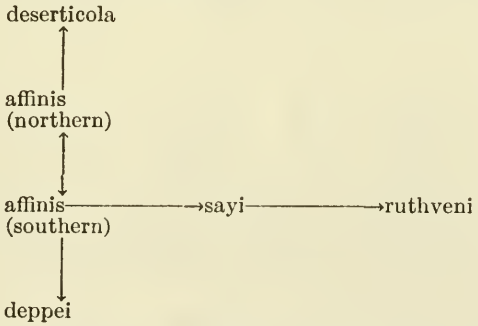

Table 10 lists the specimens of this form that have been examined.

TABLE 10.—*Specimens of* Pituophis sayi sayi *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail Total		
														Cm.			
U.S.N.M. No. 1519 (type of bellona).	West Rio Grande, Chihuahua, Mexico.	♀	31-35-25	232	52	284	9/8	13	2	4	41	10	51	54	0.111	1	1
U.S.N.M. No. 1540 (type of *mcClellanii*)	Red River, Deaf Smith County, Tex.	♀	31-35-25	230	52	283	9/8	14/13	2	5/4	53	12	65	102	0.127	2/1	0
U.S.N.M. No. 1541 (paratype of McClellanii).	----do----------	♀	31-33-25	230	53	283	8	13	1	4/3	52	15	67	63	0.111	1	0
U.S.N.M. No. 1539----	Castanuelas, Coahuila, Mexico.	♂	29-33-22	236	49	285	9	13/12	1	4	-------	-------	-------	134	0.104	1	0
U.S.N.M. No. 14532b--	Fort Custer, Mont------	♀	25-29-21	218	50	268	8/9	12	1	3	53	14	67	36	0.125	1	1
U.S.N.M. No. 14532c--	----do----------	♂	27-31-23	218	65	283	9	12/13	1	4	67	16	83	74	0.135	1	1
U.S.N.M. No. 31036---	Yellowstone Park, Wyo.	♂	29-33-25	214	62	276	8	-------	1	3	43	13	56	162	0.141	1	0
U.S.N.M. No. 1558a---	Fort Snelling, Minn-----	♂	29-33-23	221	-------	-------	8	11/12	1	3	55	-------	-------	-------	-------	1	1
U.S.N.M. No. 1553----	Upper Missouri and Yellowstone Rivers, N. Dak.	♂	25-28-23	224	61	285	8/9	11	1	3	51	16	67	109	0.128	1	1
U.S.N.M. No. 5233a---	Kansas----------	------	29-33-23	225	55	280	9/8	12	2	3	39	10	49	139	0.122	1	0
U.S.N.M. No. 5233b---	----do----------	yg.	27-31-23	223	55	278	8	12/11	1	3	51	12	63	35	0.128	0	0
U.S.N.M. No. 4765b---	Fort Riley, Kans-------	♂	29-31-23	230	60	290	9/8	13	1	3	45	12	57	169	0.118	1	0
U.S.N.M. No. 29349---	Mexico----------	♀	31-33-25	225	49	274	9/8	13	3	4	54	-------	-------	-------	-------	2	1
U.S.N.M. No. 1543----	Between San Antonio and El Paso, Tex.	------	27-29-21	217	62	279	9	12	1	3/4	50	14	64	180	0.144	1	0
U.S.N.M. No. 9321a---	Yellowstone region, Mont.	♂	29-31-23	223	62	285	9	12/13	2	4	52	14	66	141	0.127	1	0
U.S.N.M. No. 9321b---	----do----------	♀	29-31-23	222	50	272	9/8	10/11	1	3/4	39	9	48	139	0.115	1	0
U.S.N.M. No. 1558b---	Fort Snelling, Minn-----	------	27-31-23	215	59	274	9	11	2	3	52	14	66	147	0.142	1	1
U.S.N.M. No. 9128----	Yellowstone River above Powder River, Mont.	♂	27-31 23	214	56	270	9	11/12	1	3	49	12	61	121	0.132	1	0
U.S.N.M. No. 1548----	Lower Rio Grande River, Tex	♀	29-33-24	227	47	274	8	13	2	3	-------	11	-------	125	0.112	1	0
U.S.N.M. No. 14146---	Minnesota----------	♂	27-31-23	217	61	278	9	13	1/2	4/3	50	16	66	155	0.129	1	--------

U.S.N.M. No. 13464	Sioux City, Iowa	♂	27-29-23	212	61	273	8	13/12	1	3	44	14	58	157	0.133	0
U.S.N.M. No. 1840	Benton, Mont	♂	27-29-23	220	61	281	9	12	1	3	57	14	71	159	0.132	1	0
U.S.N.M. No. 1415	Mexico	♂	31-35-23	234	65	299	9	12/13	2	4	52	15	67	210	0.123	1	0
U.S.N.M. No. 1525b	West fork Medicine Bow River, Wyo.	♀	25-29-21	217			8	10	2/1	4/3	48					1	0
U.S.N.M. No. 1525c	do	yg.	29-31-23	221	49	270	9	11	1	3	40	9	49	33	0.121	1	1
U.S.N.M. No. 13463	Sioux City, Iowa		29-31				8/9	11/13	1	4/3						1	0
U.S.N.M. No. 9147a	Fort Kearney, Nebr		27				9/8	11	1	3						1	1
U.S.N.M. No. 9147b	do	yg.	28-31-23	225	66	291	8	13	1	2	52	19	71	56	0.142	1	1
U.S.N.M. No. 55871	Cowley County, Kans	♂	27-31-23	224	56	280	8	13	1	4	46	13	59	144	0.125	1	1
U.S.N.M. No. 56671	Jasper County, Mo	♀	31-33-25	236	52	288	8	12/13	2	3	43	9	52	160	0.106	1	0
U.S.N.M. No. 56670	Stone County, Mo	♀	31-33-25	230	51	280	10/9	13	1	3	38	10	48	122	0.114	1	0
U.S.N.M. No. 56676	Bexar County, Tex	♀	31-33-25	227			9	13	2	4	42					1	0
U.S.N.M. No. 56675	Cameron County, Tex	♀	31-35-25	244	53	297	8	13	2	4/3	51	12	63	89	0.101	1	0
U.S.N.M. No. 53081	Cannon Ball, N. Dak	♀	27-29-23	218	56	274	9/8	12/10	2	3	52	15	67	92	0.130	1	0
U.S.N.M. No. 60232	North base Big Horn Mountains, Mont.	yg.	29-31-23				9	11/12	1	3	58					1	0
U.S.N.M. No. 69345	Crow Agency, Mont		29——				8/9	12	1	3						1	1
U.S.N.M. No. 59740	do	♂	27-31-21	219	63	282	8	11	1	3/4	49	14	63	160	0.137	1	0
U.S.N.M. No. 54435	Glendive, Mont	♂	27-31-23	218	52	270	8	11	2/1	4	46	13	59	146	0.123	2/1	1
U.S.N.M. No. 60226	8 miles south of Hardin, Mont.	♂	29-31-23	218	60	278	8	12/11	2	3	47	14	61	126	0.126	1	1
U.S.N.M. No. 53027	Goodall, N. Dak	♀	29-33-23	228	54	282	9	12	2	3	47	14	61	50	0.120	1	0
U.S.N.M. No. 56672	Hamilton County, Kans	♀	29-33-25	227	55	282	9	12	2	3	45	13	58	47	0.127	1	0
U.S.N.M. No. 44146	Belle Fourche Valley, Wyo.	♀	29-31-23	226	50	276	3/7	12/11	2	4/3	43	12	55	40	0.125	1	1
U.S.N.M. No. 39400	Belleplain, N. J. (?)	♂	33-35-25	224	61	285	9	13/14	2	4/5	45	11	56	202	0.123	1	0
U.S.N.M. No. 1575	Tyree Springs, Tenn	♀	27-29-22	227	55	282	9/8	12/11	1	3/4	47	10	57	105	0.114	1	0
U.S.N.M. No. 1530	Llano Estacado, Tex	♂	29-33-23	233	56	289	8/9	12/13	2	3/4	50	12	62	74	0.114	1	1
U.S.N.M. No. 1539	Castanuelas, Coahuila, Mexico.	♀	29-33-25	236	50	286	9	13/12	1	4	46	10	56	134	0.100	1	0
U.S.N.M. No. 14103	Wheatland, Ind	♂	27-31-23	217	54	271	9	12	2/1	3	45	11	56	138	0.115	1	2
U.S.N.M. No. 14532a	Fort Custer, Mont	♂	29-31-23	213	62	275	9	11/13	2	3	52	14	66	122	0.131	1	0
U.S.N.M. No. 1525a	West fork Medicine Bow River, Wyo.	♂	29-31-23	214	57	271	8	13	1	4/3	54	15	69	72	0.131	1	1
U.S.N.M. No. 32748	Gail, Tex						8	14	2	5/4						1	22
U.S.N.M. No. 8011	Fort Riley, Kans	♀	29-32-25	229	47	276	8	12	1	3	45	11	56	83	0.108	1	1
U.S.N.M. No. 4765a	do	♂	29-33-25	221	62	283	9	13	1	3	50	16	66	48	0.135	1	1
U.S.N.M. No. 1561	Rock Island, Ill	♂	27-29-24	222	60	282	9/8	11	2	3	50	14	64	128	0.132	1	0

TABLE 10.—*Specimens of* Pituophis sayi sayi *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail Total		
														Cm.			
U.S.N.M. No. 1559	Rock Island, Ill	♂	27-31-22	219	57	276	9	12	1	3	58	16	74	92	0.130	1	0
U.S.N.M. No. 9147c	Fort Kearney, Nebr		27-29-22	225	53	278	8	13/12	1	3	48	12	60	122	0.114	2/1	0
U.S.N.M. No. 9147d	do	♂	27-31-23	219	55	274	8	12/13	1	4/3	56	14	70	78	0.128	1	1
U.S.N.M. No. 28441	East Pryors Creek, Mont.	♂	27-29-22	218	60	278	8	12/11	1	3	61	16	77	122	0.131	1	0
U.S.N.M. No. 5465a	Platte Valley, Nebr	♀	29-31-23	226	56	282	8	11/12	1	3	60	16	76	114	0.122	1	0
U.S.N.M. No. 5465b	do		27-29-22	219	57	276	8	11/12	1	3	47	13	60	123	0.130	1	1
U.S.N.M. No. 5465c	do	♀	27-31-25	220	50	270	9	13/12	2	3	57	14	71	133	0.112	2/1	1
U.S.N.M. No. 5465d	do	♂	29-31-23	218	62	280	10/9	13/12	1	4	48	13	61	119	0.117	1	0
U.S.N.M. No. 10829	Senterfitt, Tex		29-33-25	230	59	289	8/9	12/13	1	4	47	13	60	211	0.113	1	0
U.S.N.M. No. 29347	Mexico	♀	32-35-25	229			10	13	2	4	55					1	1
U.S.N.M. No. 1542	Presidio del Norte, Chihuahua, Mexico.		29-33-23	241	52	293	9/8	12	2	3/4	51	11	62	142	0.112	1	1
U.S.N.M. No. 32750	Paisano, Tex	♂	31-35-23	223	64	287	8	12/13	2/1	4/3	39	13	52	104	0.144	1	0
U.S.N.M. No. 32749	20 miles north of Comstock, Tex.	♂	31-35-25	233	59	292	9/8	13	2	4/5	48	12	60	168	0.119	1	1
U.S.N.M. No. 22501	No data	♀	29-31-23	220	53	273	8	11/13	1	3	44	12	56	140	0.114	1	1
U.S.N.M. No. 29348	Mexico	♀	35-37-27	237			8	14	2	3/4	51					1	1
U.S.N.M. No. 14532d	Fort Custer, Mont	yg.	28-31-22	215	53	268	8/7	11	1	3	41	11	52	38	0.131	1	0
U.S.N.M. No. 15665	San Diego, Tex	♀	31-33-25	229	49	278	8/9	13	1	3	40	10	50	60	0.108	1	0
U.S.N.M. No. 22723	No data	♀	29-31-25	227	55	282	9	13/12	2	3	60	15	75	131	0.122	1	2
U.S.N.M. No. 17063	Cameron County, Tex	♂	31-35-25	232	61	293	9/10	14	2	4	52	12	64	54	0.129	1	1
U.S.N.M. No. 21444	Quinns Draw, Bad Lands, S. Dak.	♂	29-31-23	222	61	283	8	13	2	5	46	15	61	45	0.133	1	0
U.S.N.M. No. 28460	Greeley, Colo	♀	27-31-23	226	54	280	8/9	11/12	1	3	45	12	57	38.5	0.129	1	2
U.S.N.M. No. 44299	Kennedy, Nebr	♂	28-31-23	222	58	280	8/9	12	1/2	4	52	13	65	95	0.115	1	0
U.S.N.M. No. 56674	Madison County, Iowa	♀	29-31-23	228	48	276	8	12	1	3/4	48	11	59	136	0.117	1	0
U.S.N.M. No. 48164	Grey Bull, Wyo	♀	29-31-23	226	55	281	8	12	2/1	3	54	13	67	95	0.115	1	0
U.S.N.M. No. 56673	Douglas County, Kans.	♂	29-33-23	223	57	280	9/8	12	1	3	46	12	58	97	0.113	1	0
U. Ill. No. 2609	Champaign, Ill	♂	27-31-23	221	59	280	8	12/11	1	3	42	12	54	126	0.119	0	0
St. A. C. No. 1	Davenport, Iowa	♀	29-33-23	228	53	281	8/9	11/12	2	3	48	12	60	133	0.112	2	1
U. Wyo. No. 1	Laramie County, Wyo.	♀	27-29-21	224	57	281	8/9	11/12	1	3/4				110	0.122	1	1

U. Wyo. No. 2	do	♀	27-31-23	220	61	281	8	11	1	3				156	0.128	1	0
U. Mich. No. 57857	Iowa	♀	28-33-25	228	52	280	8/9	11/12	1	3		12		157	0.105	1	1
U. Mich. No. 51691	Weinachts Draw, Reeves County, Tex.	♀	29-33-25	236	55	291	8	12	2	4	42	11	53	121	0.115	1	0
U. Mich. No. 51692	do	♀	31-33-21	230	59	289	8	12	1	4	40	13	53	123	0.130	1	1
U. Mich. No. 56594	Almena, Kans.	♂	29-33-23	224			9/8	13	1	3	42					1	1
U. Mich No. 56595	Canon City, Colo.	♀	29-31-23	221	53	274	8/9	12	2	5	59	13	72	74	0.114	1	1
U. Mich. No. 56596	Arvada, Wyo.	♀	29-31-23	226	57	283	8/9	11	1	3	48	13	61	118.5	0.118	1	1
U. Mich. No. 52185	Sioux City, Iowa	♂	29-33-25	234	55	289	9	13		4	47	13	60	117	0.106	1	1
U. Mich. No. 52186	do	♀	29-33-25	219	51	270	9	12	1/2	3	44	11	55	141	0.117	1	0
U. Mich. No. 49831	Jordan, Dawson County, Mont.	♀	29-31-23	219	55	274	9/8	11/12	2	3	50	14	64	133	0.118	1	1
U. Mich. No. 49832	do	♀	29-31-23	223	51	274	8/9	11	1	3	52	13	65	91	0.113	1	1
U. Mich. No. 49333	do	♀	29-33-23	222	57	279	9/8	11/12	1	3	53	14	67	117	0.119	1	1
U. Mich. No. 49821	do	♂	29-33-23	220	67	287	9	12	1	3/4	54	14	68	140	0.135	1	0
U. Mich. No. 62669	Orchard, Colo.	♀	29-31-23	218	54	272	8	12	2	5/4	52	12	64	120	0.112	2	0
U. Mich. No. 3737	Upper Mississippi River, Nebr.	♂	29-33-25	221	58	279	9	13	1	4/3	62	12	74	149	0.127	1/2	0
U. Mich. No. 62469	Walsenburg, Colo.	♂	29-31-23	216	60	276	8	12	1	3	52	14	66	126	0.127	1	0
U. Mich. No. 59090	Kansas	♂	29-33-23	219	58	277	9/8	11	2	4	54	12	66	137	0.124	1	1
U. Mich. No. 56912	North Dakota	♂	29-31-23	226	63	289	9	10/12	1	3	47	14	61	149	0.127	1	1
U. Mich. No. 52924	Texas	♂	29-33-23	230	63	293	8/9	11/13	1	3/4	47	12	59	165	0.127	1	0
U. Mich. No. 52923	do	♀	31-33-25	226	50	276	8	12/13	1	4	48	12	60	143	0.108	1	0
U. Mich. No. 52922	do	♀	29-31-23	224			8	12	1	4/3						1	0
U. Mich. No. 52184	Sioux City, Iowa	♂	29-33-23	221	57	278	8	12/13	1	3	54	13	67	120	0.116	1	0
U. Mich. No. 57045	Montana	♂	29-33-23	218	59	277	8	11/12	1	3	45	14	59	105	0.123	1	0
U. Mich. No. 57042	do	♀	29-33-25	221	55	276	9/8	12	2	3	56	16	72	123	0.113	1	0
U. Mich. No. 64425	Manhattan, Kans.	♀	29-33-23	225	51	276	9/8	13	2	3/4	54	12	66	114	0.114	1	1
U. Mich. No. 766	Miami County, Kans.	♂	29-31-23	223	64	287	9	13	1	4/3	50	12	62	116	0.120	1	1
U. Mich. No. 905	Dickinson County, Kans.	♂	27-31-23	223	55	278	9	11	1	3	47	13	60	105	0.142	1	1
U. Mich. No. 1331	Marshall County, Kans.	♀	29-33-23	233	52	285	8/9	13	1	3	43	11	54	43	0.116	0	1
U. Mich. No. 62667	Akron, Colo.	♀	29-31-23	216	51	267	9	11/12	2	3	51	12	63	91	0.120	1	0
U. Mich. No. 62668	Buena Vista, Colo.	yg.	29-33-23	225	50	275	8	11/12	1	3	33	8	41	43	0.109	1	1
U. Mich. No. 58805	Riley County, Kans.	♂	29-31-23	225	58	283	9	11/12	1	3	56	15	71	84	0.119	1	0
U. Mich. No. 63515	Oklahoma	♂	29-33-23	223	59	282	9	12	1	4	57	17	74	95	0.126	1	1
U. Mich. No. 31373	Sioux City, Iowa	♂	29-31-23	216	57	273	8	12	1	3	54	14	68	86	0.122	1	2/1
U. Mich. No. 64906	Between Stafford and Sylvia, Kans.	♂	29-31-23	223	58	281	9/8	13	1	3/4	53	15	68	44	0.125	1	0

TABLE 10.—*Specimens of* Pituophis sayi sayi *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U. Mich. No. 64907	Offerle, Kans	♂	29-33-23	218	62	280	8	13/12	1	3	61	15	76	43	0.127	1	0
U. Mich. No. 5981	Rio Pecos, Tex		29-31-23	231	64	295	9	13/12	1	5/4				122	0.131	1	1
U. Mich. No. 32973	Ann Arbor, Mich. (from circus).	♀	29-35-25	243	50	293	8/9	13	1	4/3	52	10	62	193	0.101	1	0
K.S.A.C. No. 2813	No data	♂	—33-25	221	58	279	8	13/12	1	3/4		12		154	0.126	3	1
K.S.A.C. No. 2797a	do	♀	29-33-25	231			9	13/12	1	3/4	48	10	58			2	0
K.S.A.C. No. 3463	Trego County, Kans	♀	29-33-23	218	53	271	10/9	13	2/1	3/4	54	13	67	125	0.120	1	0
K.S.A.C. No. 2797b	No data	♂	31-33-23	222	61	283	8	13	1	3		14		133	0.127	1	0
K.S.A.C. No. 4155	Manhattan, Kans	♂	27-29-23	225	58	283	9	13/12	1	4	50	12	62	101	0.123	1	0
K.S.A.C. No. 2784	do	♂	29-33-25	220	60	280	8	11/12	1	4	49	13	62	152	0.118	1	1
K.S.A.C. No. x	do	♂	29-33-23	222	58	280	9/8	13/12	1/2	4/3	47	14	61	142	0.126	1	1
K.S.A.C. No. 2783	No data	♂	29-33-23	219	53	272	8	12	1	4/3		13		129	0.116	1	0
K.S.A.C. No. 2789a	do	♂	29-33-23	231	57	288	9	11/12	1	3	54	13	67	122	0.119	1	2
K.S.A.C. No. 2966	Manhattan, Kans	♂	27-31-22	225	55	280	8/9	12	1	3		12		167	0.113	1	0
K.S.A.C. No. 2794	Gove County, Kans	♂	29-31-23	223	53	276	8/9	12	2	4				126	0.119	1	2
K.S.A.C. No. 2789b	No data	♂	29-33-23	222	57	279	9	13/14	1	4	47	11	58	100	0.125	1	0
K.S.A.C. No. 2802	Wallace County, Kans	♂	29-33-23	218	58	276	9	13	1	4/3		12		116	0.129	1	1
K.S.A.C. No. y	Manhattan, Kans	♀	27-31-23	228	53	281	8/9	13	1	3	54	11	65	92	0.119	1	1
K.S.A.C. No. 2785	do	♂	29-33-25	223	60	283	9	13	2	3	54	13	67	79	0.126	1	1
K.S.A.C. No. 2875a	No data	yg.	27-31-23	229	50	279	8/9	12	1	4	47	11	58	52	0.115	1	0
K.S.A.C. No. 2875b	do	yg.	31-33-25	221	59	280	9	13	2/1	3/4	45	11	56	44	0.125	1	0
U. Okla. No. 7959	Pawnee County, Okla	♂	29-33-23	223	58	281	8/9	14	2	3/4	54	12	66	169	0.124	1	0
U. Okla. No. 8622	Major County, Okla	♂	31-35-25	229	61	290	8/9	12	2	3/4	55	16	71			1	1
U. Okla. No. 585	Cleveland County, Okla.	♂	27-31-23	224	57	281	8/9	12/13	1	3		12		137	0.124	1	1
U. Okla. No. 4949	Cimarron County, Okla.	♂	29-33-23	225	59	284	9	12/11	1	5	66	18	84	120	0.125	1	1
U. Okla. No. 8100	Cleveland County, Okla.	♂	31-33-24	224	60	284	8/9	13	1	4	55	14	69	172	0.127	1	0
U. Okla. No. 1537	do	♀	29-33-25	229	54	283	8	13/12	1	3	47	13	60	140	0.114	1	1
U. Okla. No. 5286	Cimarron County, Okla.		29——				9	13/11	2/1	4/3						1	0

U. Okla. No. 5219	do	♂	29-35-24	215	54	269	8	12/11	1	3	56	15	71	145	0.131	1	0
U. Okla. No. 4466	Harmon Co., Okla.	♂	31-35-25	226	57	283	8/9	13	2	4	53	14	67	135	0.118	2	1
U. Okla. No. 1761	Comanche County, Okla.	♂	31-35-25	218	56	274	8	14/13	2	4	45	12	57	146	0.116	1	1
U. Okla. No. 4897	Cimarron County, Okla.	♀	29-31-23	218	51	269	9	12/13	1	4/5	54	12	66	120	0.116	1	0
U. Okla. No. 1439	Canadian County, Okla.	♀	29-33-25	233	53	286	8	13	1	4/3	53	12	65	120	0.116	1	1
U. Okla. No. 473	Grady County, Okla.	♂	31-35-25	226	63	289	9	13	2	5/4	48	12	60	151	0.125	1	0
U. Okla. No. 1356	Okmulgee County, Okla.	♂	29-33-23	226	62	288	9/8	11	2	3	48	14	62	156	0.135	1	0
U. Okla. No. 3972	Cleveland County, Okla.	♂	29-33-23	231	58	289	8	13	1	4/3	51	12	63	160	0.125	1	0
U. Okla. No. 4709	Roger Mills County, Okla.	♂	31-35-23	225	59	284	9/8	13	1	3	58	15	73	140	0.121	1	1
U. Okla. No. 7962	Pawnee County, Okla.	♂	29-31-24	226	60	286	9/10	13	1	3/4	48	13	61	113	0.132	1	1
U. Okla. No. 4820	Texas County, Okla.	♂	29-31-23	223	60	283	8	12	1	3	62	16	78	102	0.127	1	0
U. Okla. No. 8808	Cleveland County, Okla.	♀	31-33—	230	52	282	9/8	13	1	3	49	14	63	152	0.111	1	0
U. Okla. No. 2194	Grady County, Okla.	♂	31-35-25	226	59	285	9/8	14/15	1	3/4	50	13	63	47	0.127	1	0
U. Okla. No. 569	Cleveland County, Okla.	♂	29-31-23	228	61	289	9	14/13	2/1	4/5	48	15	63	53	0.132	1	0
U. Okla. No. 4724	Texas County, Okla.	♂	30-31-23	229	59	288	9/8	13/12	1	3	55	18	73	154	0.120	1	1
U. Okla. No. 1546	Stephens County, Okla.	♀	31-31-23	234	56	290	8/9	13/12	2	3	61	15	76	66	0.121	2/1	1
U. Okla. No. 2188	Grady County, Okla.	♂	29-31 23	-------	61	-------	8	12	1	4/3	51	15	66	-------	-------	1	1
U. Okla. No. 7960	Pawnee County, Okla.	♂	29-33-25	218	57	275	8	12/13	1	3	45	12	67	51	0.127	0/1	1
U. Okla. No. 5418	Woodward County, Okla.	♀	29-35-25	230	49	279	9	14/13	1	3	57	13	70	152	0.111	0/1	1
U. Okla. No. 5183	Cimarron County, Okla.	♀	29-33-24	233	57	290	8	13	2	3	59	16	75	99	0.121	1	1
U. Okla. No. 4917	do	♂	29-31-23	222	-------	-------	8/9	14/13	2	4/3	58	-------	-------	-------	-------	1	0
A.N.S.P. No. 10851	Fort Harker, Kans.	♂	29-33-23	220	61	281	9	13	1	3	52	13	65	77	0.142	1	0
A.N.S.P. No. 10850	do	♀	29-33-25	233	52	285	9	13	1	3	63	16	79	119	0.109	0/1	0
A.N.S.P. No. 10852	Archer County, Tex.	♀	31-33-24	227	49	276	8/9	13	2	4	51	10	61	163	0.104	1	1
A.N.S.P. No. 3820	Western Illinois	♀	29-31-24	224	54	278	9	12/13	1	3	54	11	65	168	0.112	1	0
A.N.S.P. No. 3819	do	♂	27-31-23	225	60	285	9/8	12	1	4	46	12	58	193	0.113	1	0
A.N.S.P. No. 3822	United States Plains	♂	31-33-25	231	62	293	9/8	14	1/2	4/5	54	16	70	141	0.127	2	1
A.N.S.P. No. 3723	Fort Riley, Kans.	♂	29-31-23	215	56	271	10/9	12/14	2	4/3	59	14	73	96	0.125	1	0

TABLE 10.—*Specimens of* Pituophis sayi sayi *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
A.N.S.P. No. 3724	Fort Riley, Kans	♀	27-29-23	224	53	277	8/9	12	1	4/3	54	14	68	95	0.115	1	1
A.N.S.P. No. 3725	do	♀	29-33-23	235	57	292	8	13/11	1	3	49	12	61	57	0.122	1	1
A.N.S.P. No. 3726	do	yg.	29-29-23	215	59	274	8	11/13	1	1	50	15	65	46	0.130	1	0
A.N.S.P. No. 3727	do	♀	27-31-23	223	50	273	9	12	1/2	3	51	14	65	118	0.114	1	0
A.N.S.P. No. 3796	Fort Kearney, Nebr	♀	27-31-23	231	53	284	8	10	1	3	49	12	61	119	0.117	1	0
A.N.S.P. No. 3797	do	♂	29-31-23	230	65	295	8	12	1	3	65	20	85	122	0.147	1	1
A.N.S.P. No. 3799	Fort Supply, Okla	♀	31-35-23	225	52	277	8	12	1	4	52	13	65	50	0.120	1	0
A.N.S.P. No. 3792	Fort Kearney, Nebr	♂	29-33-23	222	59	281	9	13	2/1	4	56	16	72	138	0.123	1	0
A.N.S.P. No. 3794	do	------	27-31-23	219	60	279	9	12/13	1	3	51	15	66	152	0.131	1	0
M.C.Z. No. 5877	Fort Riley, Kans	♂	29-31-23	230	61	291	8	12/13	1	3	49	13	62	122	0.122	1	0
M.C.Z. No. 412	Loup Fork, Nebr	♂	27-31-21	222	58	280	8/9	12	1	4	56	12	68	133	0.135	1	0
M.C.Z. No. 4598	Fort Laramie, Wyo	♀	27-31-23	226	54	280	9/8	12/11	2	5/3	53	12	65	126	0.119	1	0
M.C.Z. No. 16709	4 miles north of Medora, N. Dak.	♀	29-31-23	228	53	281	8	13	1	3	50	13	63	133	0.120	1	0
M.C.Z. No. 21680	Carter, S. Dak	♂	29-31-23	219	61	280	8	11/12	1	3	52	14	66	103	0.135	1	1
M.C.Z. No. 25059	Omaha, Nebr	♀	29-33-23	223	55	278	8/9	13/12	1	3	48	13	61	-------	-------	1	0
A.M.N.H. No. 17832	Boulder, Colo	♂	27-31-23	227	60	287	9/8	12	1	4	48	13	61	90	0.127	1	1
A.M.N.H. No. 16996	Brownsville, Tex	♂	32-35-24	230	56	296	8	13	2	4	56	13	69	172	0.110	1	0
A.M.N.H. No. 16995	do	♀	30-35-25	234	50	284	9/8	13/14	2	3/4	57	14	71	100	0.110	1	0
A.M.N.H. No. 22744	Camp Bullis, Tex	♀	31-35-23	236	52	288	8	13/12	1	4/3	49	12	61	134	0.111	1	1
A.M.N.H. No. 4248	Oklahoma	yg.	29-31-23	220	59	279	8	12/11	1	4	68	16	84	46	0.130	1	1
A.M.N.H No. 3560	North America	♂	—31-23	218	59	277	8/9	12/13	1	3	55	16	71	103	0.145	1	0
Field No. 5575	No data	♂	31-37-27	230	57	287	9	12	1	4	46	12	58	185	0.108	1	1
Field No. 3554	do	♀	31-35-25	236	51	287	8	13	2	5/4	46	11	57	171	0.111	1	0
Field No. 3417	Brownsville, Tex	♀	29-33-23	235	53	288	8	12/13	1	4	45	11	56	209	0.110	1	0
Field No. 3553	No data	♂	29-33-25	229	54	283	8	12/13	1	3	41	10	51	171	0.116	1	1
Field No. 4771	do	♂	29-31-21	229	67	296	8/9	13	1	4	39	15	54	137	0.138	1	1
Field No. 3555	do	yg.	29-33-23	239	50	289	8	11/13	1	3	47	10	57	46	0.108	1	1
Field No. 6304	Manchester, Iowa	♂	29-31-23	221	58	279	9	13	1	3	45	14	59	144	0.125	1	2
Field No. 8481	Douglas County, Kans	♂	29-31-23	231	58	289	8/9	12/13	2	3	49	13	62	114	0.122	1	0
Field No. 1525	Thumbdance, S. Dak	♀	29-33-23	231	57	288	8/9	12/13	1	3	52	14	66	134	0.119	1	1

Field No. 7890	Battle Creek Canyon, S. Dak.	------	29——	--------	--------	--------	8	12/13	2	4	-------	-------	------	-------	--------	2	0
Field No. 1895	Rawhide Butte, Wyo.	♂	27-29-21	217	54	271	8	12	2	4	57	15	72	100	0.120	1	0
Field No. 626	Alva, Okla.	♀	31-33-25	225	59	284	9/8	13/14	2	3	52	14	66	53	0.132	1	1
Field No. 627a	do	♂	29-33-23	227	48	275	9	14/13	1/2	4	59	12	71	-------	--------	1	1
Field No. 627b	do	♀	31-33-23	232	53	285	9	13/14	1	5	55	13	68	53	0.113	1	1
Field No. 628	do	♂	29-31-23	221	53	274	9/8	11/12	1	4	47	11	58	142	0.119	1	0
Field No. 632	do	♀	29-31-23	228	60	288	8	13	1	3	54	16	70	61	0.122	1	0
Field No. 652	White Horse Springs, Okla.	♂	29-31-23	222	59	281	9	14	1	4	53	13	66	100	0.125	1	1
Field No. 6141	No data	♂	27-31-21	234	63	297	8	13	2	4/5	45	14	59	148	0.128	1	1
Field No. 6144	do	♀	29-33-23	232	52	284	8	13	1	3	54	15	69	149	0.107	1	0
Field No. 6155	do	♂	29-31-23	222	53	275	9	13	1	3/4	42	11	53	160	0.112	1	1
Field No. 3392	Brownsville, Tex.	♀	31-35-25	233	48	281	8	13	1	4	46	10	56	158	0.101	1	1
Field No. 3528	No data	♂	29-31-23	234	59	293	9	14	2	3	50	11	61	165	0.121	1	0
U. Colo. No. 145	Boulder, Colo.	yg.	27-31-25	227	49	286	8/9	12	2	4	55	12	67	41.5	0.120	1	1
U. Colo. No. 716	Lee Hill, Boulder County, Colo.	------	29-31-23	218	--------	--------	9	13	1	4	55	13	68	-------	--------	1	0
U. Colo. No. 77	Boulder, Colo.	♂	27-31-21	216	56	272	9	12/11	1	5/4	53	12	65	-------	--------	1	1
U. Colo. No. 441	Marshall, Colo.	♀	31-33-24	225	51	276	8	12/11	1	3	53	10	63	166	0.102	1	1
U. Colo. No. 716	Boulder, Colo.	♂	28-31-23	221	58	279	8/9	12	1	3	46	14	60	163	0.128	1	1
U. Colo. No. 514	do	yg.	27-29-22	220	58	278	8	12	1	3	54	13	67	38	0.131	1	1
M. S. C. No. 1	Hot Springs, Sanders County, Mont.	♂	27-31-23	214	61	275	8	13	1	4	48	15	63	118	0.127	1/2	1
M.S.C. No. 2	Anceny Station, Gallatin County, Mont.	♂	29-31-23	220	--------	--------	8	13/12	2	3	51	10	61	-------	--------	1	0
M.S.C. No. 3	Trident, Mont.	♀	27-31-23	223	53	276	8	12/11	1	3	52	14	66	126	0.119	1	0
M.S.C. No. 4	Bozeman, Mont.	♀	27-31-23	222	55	277	8	13/12	2	3	49	12	61	103	0.126	1	0
Ottawa No. 420	Franklin County, Kans.	♂	27-33-23	225	51	276	9	13/14	2	4	52	12	64	158	0.110	2	1
Ottawa No. 52	Republic County, Kans.	♂	27-31-23	223	55	278	8	13/12	2	3	54	12	66	162	0.111	1	0
Ottawa No. 419	do	♂	27-31-21	221	51	272	8	11/12	1	3	48	11	59	141	0.117	1	0
Ottawa No. 24	Riley County, Kans.	♂	29-31-23	220	60	280	9/8	13/14	1	4/3	49	12	61	86	0.127	1	1
Ottawa No. 418	Ford County, Kans.	♂	29-31-25	223	63	286	8/9	12/13	2	4/5	56	15	71	125	0.128	1	1
Ottawa No. 26	Republic County, Kans.	♂	29-33-23	222	61	283	9	13	1	3	54	13	67	139	0.129	1	1
Ottawa No. 69	do	♂	27-33-23	220	62	282	8/9	12	1	4	55	14	69	118	0.127	1	1
Ottawa No. 25	do	♀	27-31-22	233	54	287	8	11	1	3	56	13	69	-------	--------	1	1
Ottawa No. 421	Pratt County, Kans.	♀	27-33-23	230	50	280	8	13	1	4/3	56	13	69	75	0.120	1	0
Ottawa No. 1003	Franklin County, Kans.	yg.	31-35-25	232	52	284	9/8	13	1	3	47	11	58	42	0.119	1	0
Ottawa No. 1004	do	yg.	29-33-23	227	50	277	9	12	1	3	49	13	62	43	0.116	1	0

TABLE 10.—*Specimens of* Pituophis sayi sayi *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
Ottawa No. 1005	Franklin County, Kans.	yg.	29-31-23	232	51	283	8	13/12	1	4	49	11	60	42	0.119	1	0
Ottawa No. 1006	do	yg.	29-33-25	228	53	281	9/8	12/11	1	3	49	12	61	42	0.119	1	0
Ottawa No. 1007	do	yg.	31-33-25	227	48	275	9/8	10	2	3	38	10	48	43	0.116	1	0
Ottawa No. 1008	do	yg.	29-33-25	230	50	280	8/9	12	1	4	47	11	58	42	0.119	1	1
Ottawa No. 1009	do	yg.	27-31-23	228	64	292	9/8	12	1	4	57	14	71	44	0.125	1	0
Carnegie No. 836	Brownsville, Tex	♀	29-33-23	235	53	288	8	13	1	4	52	10	62	180	0.111	1	1
Carnegie No. 1609	Nebraska	♂	29-31-23	225	59	284	8/9	12/14	1	3	58	17	75	140	0.128	1	1
Carnegie No. 2004	Western Nebraska	♀	27-31-21	223	52	275	8/7	11/12	1	3	51	10	61	114	0.122	1	1
Carnegie No. 2005	do	♀	29-31-23	228	56	284	9	14/13	2	4/3	56	16	72	121	0.123	1	1
Yankton No. 1	Yankton, S. Dak	yg.	29-31-23	221	60	281	9	13	1/2	3/4	47	13	60	36.5	0.136	1	0
I.S.C. No. 836	No data	♀	29-31-23	222	------	------	9	12/14	2/1	3/4	55	11	66	------	------	1	1
I.S.C. No. 838	do	♀	29-33-23	225	52	277	9	11	2/1	4	47	12	59	137	0.116	1	1
I.S.C. No. 835	do	♀	29-33-23	221	53	274	9/10	12/13	1/2	3/4	------	12	------	139	0.115	0	0
I.S.C. No. 837	do	♂	31-31-23	224	61	285	9	12/13	1	3/4	------	14	------	159	0.132	1	0
I.S.C. No. 831	do	♂	29-31-23	216	58	274	9/8	12	1/2	5	46	13	59	36	0.138	1	1
I.S.C. No. 832	do	♂	27-31-23	224	59	283	8	10/11	1	4/3	41	12	53	95	0.126	1	1
I.S.C. No. x	Ames, Iowa	♂	29-33-25	216	56	272	8/9	12	1	3	49	14	63	98	0.132	1	1
I.S.C. No. y	do	♀	27-31-23	221	54	275	9/8	13	1	3/4	60	14	74	99	0.121	1	0
I.S.C. No 2731	No data	♂	27-31-21	217	58	275	8	13	1	3	56	13	69	49	0.122	1	0
I.S.C. No. 2718	do	♀	31-33-23	227	52	279	9	13/12	1	4	51	13	64	39	0.128	0	0
I.S.C. No. 830	Atlantic, Iowa	♀	29-31-23	220	48	268	9/8	11/12	1	3	43	11	54	51	0.117	1	1

PITUOPHIS SAYI AFFINIS Hallowell

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Pityophis sayi bellona Yarrow, Rept. Expl. Surv. W. 100th Merid., vol. 5, p. 540, 1875 (part).—Yarrow and Henshaw, Rep. Chief. Eng. for 1878, Surv. W. 100th Merid., vol. 3, app. NN, p. 1634, 1878 (part).—Yarrow, U. S. Nat. Mus. Bull. 24, pp. 12, 103, 1883 (part).—Cope, Proc. U. S. Nat. Mus., vol. 14, p. 641, 1892 (part); Amer. Nat., vol. 30, p. 1015, 1896 (part); Rep. U. S. Nat. Mus. for 1898, p. 872, 1900 (part.)

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Pityophis sayi sayi Yarrow, U. S. Nat. Mus. Bull. 24, p. 105, 1883 (part).

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Pituophis catenifer rutilus Van Denburgh, Proc. California Acad. Sci., ser. 4, vol. 10, p. 24, 1920 (type, C.A.S. No. 33869; type locality, Tucson, Pima Co., Ariz.); Occ. Pap. California Acad. Sci., No. 10, vol. 2, p. 733, pl. 78, 1922.—Schmidt, Bull. Amer. Mus. Nat. Hist., vol. 46, p. 688, 1922.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, ed. 2, p. 95, 1923.—Blanchard, Pap. Michigan Acad. Sci. Arts Lett., vol. 4, pt. 2, p. 17, 1924.—Ortenburger and Ortenburger, Contrib. Zool. Lab. Univ. Oklahoma, ser. 2, No. 64, p. 117, 1927.—Burt and Burt, Journ. Washington Acad. Sci., vol. 19, No. 20, p. 457, 1929.—Klauber, Bull. San Diego Zool. Soc., No. 9, pp. 24, 25, 79, 1932.

Original description.—Hallowell (1852, p. 181) gives the following description of this form under the name *Pityophis affinis:*

Sp. char.: Scales much larger upon the sides than upon the back, where they are comparatively small, a series of brownish or black subquadrate blotches upon

the back, a row of much smaller blotches on each side, transverse bands of jet black upon the tail, tail short, abdomen and tail thickly maculated with black, thirty-one rows of carinated scales, abdominal scuta 221; subcaudal 64.

Dimensions: Length of head 1 inch 2 lines; greatest breadth 8 lines; length of body 2 ft. 5 inches, of tail 5 inches 5 lines; greatest circumference 2 inches 2½ lines.

Another specimen was received of the same species as the above, but which presents a remarkable deviation in the form and arrangement of the plates upon the head, which is no doubt abnormal. Thus there are seven plates upon the head instead of six, as in *Pityophis*; these are arranged in three rows, two in the middle, and three in the posterior; on each side of the middle row is a small quadrangular plate lying immediately above the loral, constituting as it were a superior loral; there is but one antorbitar and four posterior orbitars on the right side, and three on the left; there are nine superior labials; abdominal scuta 227; subcaudal 71.

Habitat: New Mexico.

Systematic notes.—The name *affinis* proposed in 1852 by Hallowell for specimens from New Mexico has never since been recognized by other authors. However, as both the description and the type locality would identify his specimens with this form, it must be retained as the earliest name applied to the form.

The name *bellona* was given by Baird and Girard in the same year to a specimen from Presidio del Norte, Chihuahua, Mexico, and was for many years used rather generally to apply to specimens from Arizona and New Mexico as well as to specimens of typical *sayi*. Of the name *bellona* Stejneger (1893, p. 206) says: "There can be no doubt that Baird's and Girard's original *Churchillia bellona*, which came from Presidio del Norte, Chihuahua, Mexico, was a typical *P. sayi*. The type appears now to be lost, but I have before me a specimen from the identical locality (U. S. N. M. No. 1542) with a most pronouncedly narrow rostral and agreeing with *P. sayi* in all other respects also." Thus, although this name has frequently been applied to specimens of *affinis*, it is originally a synonym of *P. s. sayi* and must be discarded.

The name *P. catenifer rutilus* was proposed by Van Denburgh in 1920 for the Arizona gopher snakes. Since Arizona and New Mexico specimens are identical, *rutilus* becomes a synonym of *affinis*.

P. s. affinis is here considered as a subspecies of *sayi* rather than of *catenifer*, since it intergrades with *s. sayi* in northern Mexico, where the two forms can be distinguished only with the greatest difficulty, while it is evidently quite distinct from all the subspecies of *catenifer* throughout its range. Furthermore, *affinis* is obviously much closer to *sayi* than to any of the subspecies of *catenifer* in both scale and pattern characters.

Diagnosis.—From the forms of the *melanoleucus* group, *affinis* may be separated at a glance by the shorter rostral, which is only slightly longer than broad, while in the subspecies of *melanoleucus* it is at least twice as long as broad. It may be distinguished from the subspecies of *melanoleucus* also by coloration. Thus in *affinis* there are

always more than 40 median dark spots on body and tail, which are in marked contrast with the light ground color throughout the body length; in *m. melanoleucus* there are less than 40 dorsal spots; in *m. mugitus* the anterior spots are generally blended with the brown ground, but the spots, when distinguishable, number less than 40; in *lodingi* the dorsum is uniformly black; and in *ruthveni* the dorsum is brown with 50 darker brown spots, of which the anterior ones are more or less indistinct.

From the forms of the *deppei* group, *affinis* may be distinguished readily by the presence of two, rather than four, prefrontals, by the entrance of a single supralabial into the orbit on each side, instead of two, and by the longer rostral.

The longer rostral also distinguishes *affinis* from *vertebralis*, which has the rostral always at least as broad as long. From the subspecies of *catenifer*, *affinis* may be distinguished by the longer rostral, which (except rarely in *deserticola*) is never longer than broad in the forms of *catenifer*. It may be distinguished from these forms also by the pattern. Thus in *affinis* the dorsal spots number 43 to 86 (average 59.5) on body and tail, the posterior ones are generally reddish and always more or less saddle-shaped, and central black spots are lacking on the light scales of the interspaces; in *c. deserticola* the dorsal spots number 57 to 95 (average 72.9), are never reddish or saddle-shaped, and small central black spots are frequently present on the light scales of interspaces and sides, particularly on the anterior part of the body; in *c. catenifer* the dorsal spots number 58 to 125 (average 87.3) and are never reddish or saddle-shaped; and in *c. annectens* the dorsal spots number 69 to 129 (average 99.7) and are never reddish or saddle-shaped.

From *s. sayi*, *affinis* may be distinguished by the shorter rostral, which is only slightly longer than broad, while it is nearly twice as long as broad in *s. sayi*. Furthermore, in *sayi* the spots are quadrangular or bar-shaped and never saddle-shaped or reddish, as in *affinis*.

Description.—The body is rather stout, and the snout is neither blunt nor pointed but moderately rounded. The tail forms from 0.111 to 0.152 (average 0.132) of the total length. The longest specimen examined was 1,880 mm. long.

The dorsal scale formula varies from 25–28–20 to 31–35–25. The number of scale rows at the neck is 25 to 33, most often 29; the maximum number in the middle of the body 28 to 35, usually 31; the minimum number anterior to the vent 20 to 25, usually 23. The remaining scutellation is as follows: Ventrals 215 to 260 (average 233.1); caudals 51 to 71 (average 61.0); supralabials 8 or 9, with the fourth, fifth, or none entering the eye; infralabials 11 to 15, usually 12 or 13; preoculars 1 to 3, usually single; postoculars 2 to 6, usually 3 or 4; loreal

usually present, occasionally divided to form two scales on one or both sides; one or two azygos plates usually present between the frontal and prefrontals, and occasionally a small azygos present on each side between the prefrontal and preocular; rostral always slightly longer than broad, and generally penetrating from ⅓ to ¾ of the distance between the internasals; frontal usually undivided, but occasionally split for as much as one-half of its length.

The dentition is as follows: Mandibular teeth 18 to 19, decreasing gradually in size posteriorly; maxillary teeth 16 to 17, decreasing slightly in size posteriorly; palatines 8 to 10, slightly smaller than the mandibular and maxillary teeth; pterygoids 10 to 14, slightly smaller than the palatines and decreasing in size posteriorly.

The dorsum bears a series of large median spots, which are a grayish or reddish brown on the anterior part of the body, reddish brown to red posteriorly, and reddish brown to dark brown or black on the tail. Each spot on the body is 3 to 7 scales long and 9 to 11 scales wide and is narrowly outlined with black. The spots are quadrangular anteriorly and saddle-shaped posteriorly or are more or less saddle-shaped throughout; and are in the shape of transverse bars on the tail. On the body they tend to fuse with one another and with the lateral spots at the sides. Three rows of smaller spots are present on each side, which are reddish brown outlined with black and alternate with one another and with the dorsal series. These lateral spots are more or less indefinitely delimited, since they tend to run together and to fuse with the edges of the dorsal spots. The ground color of both belly and dorsum is a yellowish white. The belly bears on each side a series of small dark spots, which are each 1 to 2 scutes long and are separated from one another by 1 to 4 scutes. The area between the lateral spots may be almost or entirely immaculate, or may be more or less heavily spotted. The top of the head is a reddish brown, only slightly dappled with dark brown or black, and the throat is white. The sutures between the supralabials and between the infralabials are frequently marked by dark streaks. (Fig. 50.)

Variation.—In several characters a rather marked geographical variation seems to exist. In the accompanying graphs illustrating the geographic variations of the form the range has been divided into five regions, as follows:

Region 1. Northern Mexico.
2. Southern New Mexico and southeastern Arizona.
3. Central and northern New Mexico, and southwestern Colorado.
4. Central and northern Arizona.
5. Southwestern Arizona, southeastern California, and northern Lower California.

In most of the scale characters it may be observed that whatever tendency to variation exists is in general continuous from Mexico to

the southern parts of New Mexico and Arizona, and to the north and west in Arizona, and may be continued or reversed to California and Lower California, while in almost every case the character remains

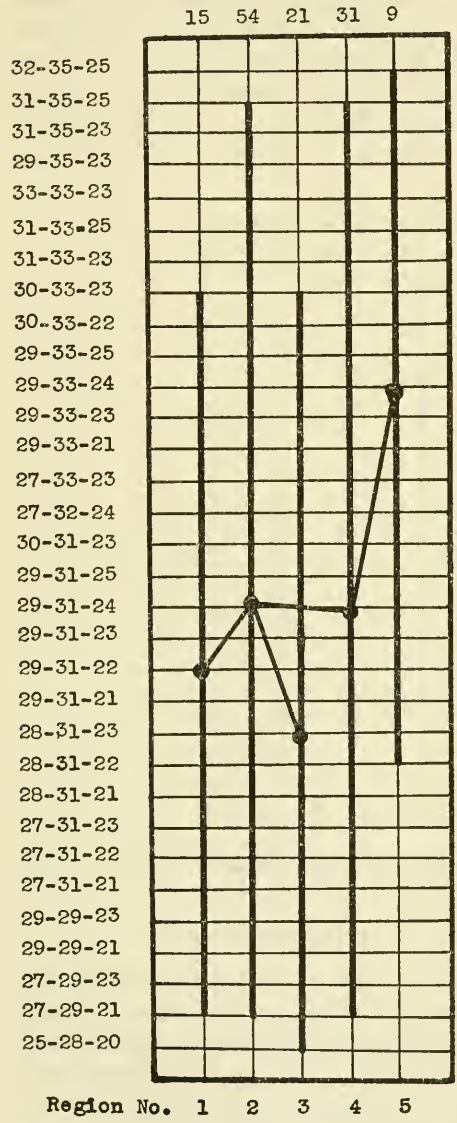

FIGURE 58.—Geographic variation in number of scale rows in *Pituophis sayi affinis*.

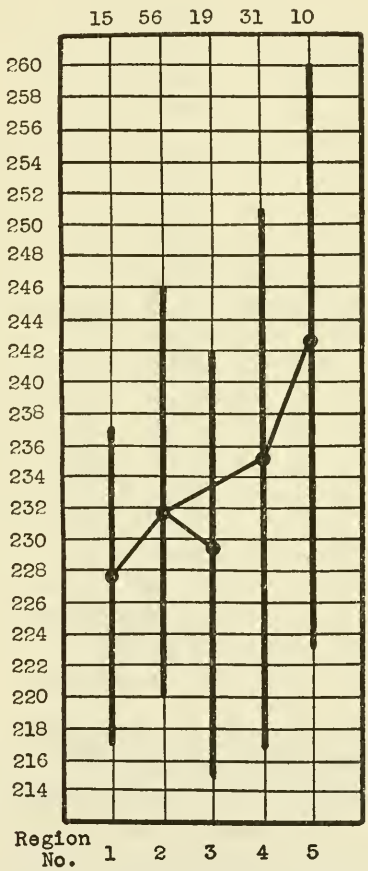

FIGURE 59.—Geographic variation in number of ventrals in *Pituophis sayi affinis*.

unchanged in northern New Mexico, or else the variational tendency apparent elsewhere is reversed. Thus, in dorsal scale formula (fig. 58), ventrals (fig. 59), the sum of the ventrals and caudals, infralabials,

and preoculars, there is more or less tendency toward an increase from Mexico north and then west in Arizona to California and Lower California, while from southern to northern New Mexico there is more or less decrease apparent. The labials and oculars, however, all remain remarkably constant throughout the range, as does the proportionate tail length (fig. 61). The latter, however, decreases noticeably in the Californian region, as does the average number of caudals to some extent also. The number of spots appears to increase in general from south to north, and the increase is slightly greater to the east than to

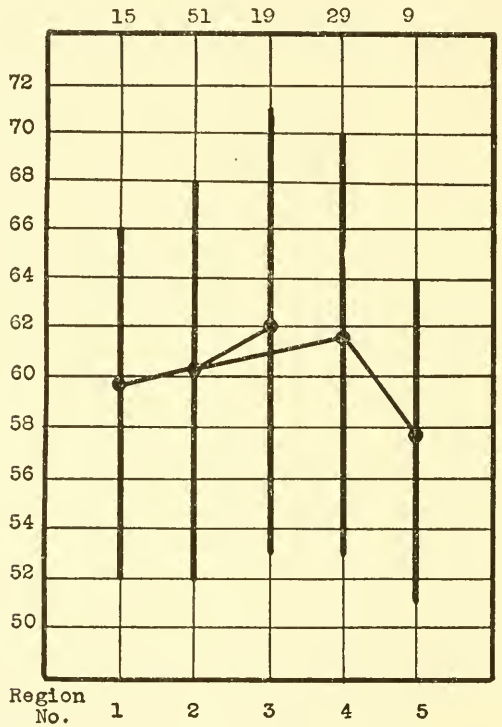

FIGURE 60.—Geographic variation in number of caudals in *Pituophis sayi affinis*.

the west, in contradistinction to the tendency found in most of the scale characters (fig. 62). The average number, however, is fairly constant, varying only between 56 and 64 in the specimens represented.

The sexual variation may be summarized as follows: Dorsal scale formula varying from 25–28–20 to 31–35–25 in males, from 27–29–21 to 31–35–25 in females; ventrals from 215 to 248 (average 230.3) in males, from 221 to 260 (average 236.1) in females; caudals 54 to 71 (average 63.8) in males, 51 to 65 (average 56.9) in females; supralabials average 8.1 in males, 8.2 in females; infralabials average 12.5 in males, 12.6 in females; preoculars average 1.4 in males, 1.5 in females; postoculars average 3.4 in males, 3.6 in females; body spots average

45.8 in males, 46.3 in females; tail spots average 13.9 in males, 12.6 in females; proportionate tail length varies from 0.121 to 0.150 (average 0.136) in males, from 0.111 to 0.144 (average 0.127) in females.

Range.—This form is found as far south as Batapilas, Chihuahua, Mexico, and north to Pagosa, Colo. It ranges throughout Arizona, east in New Mexico to Otero and Guadalupe Counties, west in California to Silsbee, Imperial County, and south in Lower California to the Colorado desert.

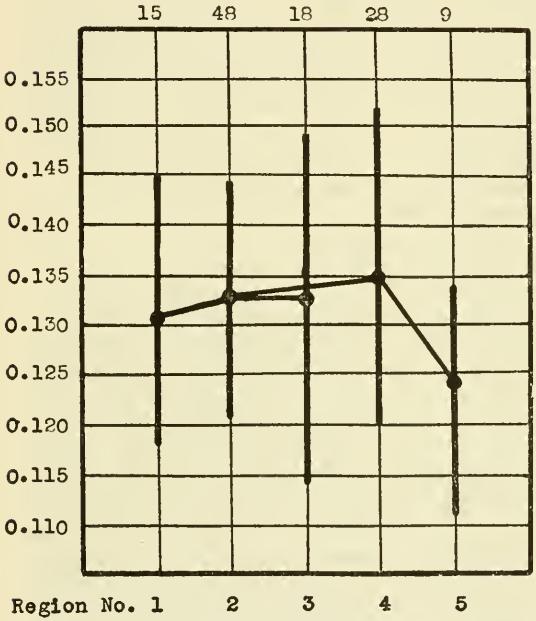

FIGURE 61.—Geographic variation in ratio of tail length to total length in *Pituophis sayi affinis*.

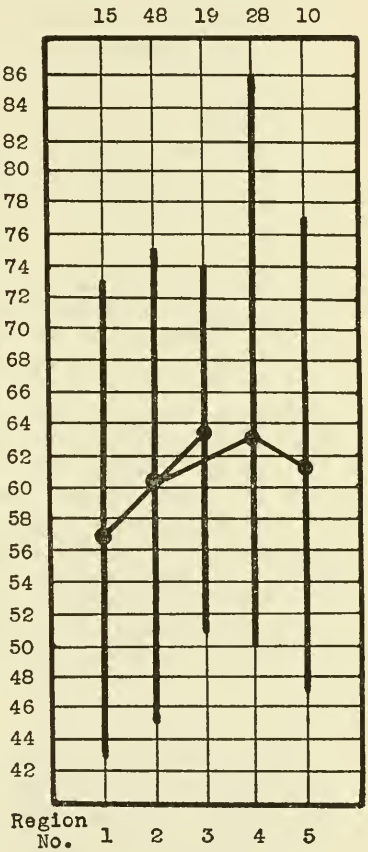

FIGURE 62.—Geographic variation in total number of dorsal spots in *Pituophis sayi affinis*.

Specimens have been examined from the following localities:

Mexico: *Chihuahua*, Madera, Pacheco, Chihuahua, Casas Grandes, Ahumada, near Batapilas; *Lower California*, Colorado Desert, 23 miles north of El Mayor; *Sonora*.

New Mexico: *Bernalillo County*, Isleta; *Dona Ana County*, Las Cruces; *Grant County*, Santa Rita del Cobre, Redrock, Hachita; *Guadalupe County*, Anton Chico; *Lincoln County*, Jicarilla Mountains; *McKinley County*, Wingate,

Fort Wingate; *Otero County*, near Alamogordo; *San Juan County*, Aztec; *Santa Fe County*, San Ildefonso; *Socorro County*, San Francisco River, San Mateo Mountains; *Valencia County*, Tajique. Additional specimens were labeled "east of the White Sands" and "Ft. Conrad," localities that could not be found in atlases.

Colorado: *Archuleta County*, Pagosa.

Arizona: *Cochise County*, Hereford, Fort Huachuca, Chiricahua Mountains, Pinery Canyon in Chiricahua Mountains, White River Canyon; *Coconino County*, Canyon Diablo, Walnut, Colorado Chiquito (Little Colorado River); *Graham County*, Camp Grant; *Maricopa County*, Glendale; Phoenix; Cavecreek; *Mohave County*, 15 miles south of Hackberry, mesa near Fort Mohave, Colorado River above Bill Williams River; *Navajo County*, Winslow; *Pima County*, Tortillita Mountains; Solider Canyon in Tortillita Mountains, Fort Lowell, Tucson, 28 miles northwest of Tucson; *Pinal County*, Superior; *Santa Cruz County*, Nogales; *Yavapai County*, Camp Verde, Fort Whipple, near Kirkland; *Yuma County*, Yuma. Other specimens bear the indefinite localities Huachuca Mountains, Gila River, Kaibab Forest, Camp J. A. Packer, Oak Orchard, Willow Spring, Canyon del Muerto, or Cedar Ranch Wash, none of which could be located.

California: *Imperial County*, Silsbee; *Riverside County*, Bottom Lands, between San Bernardino and Rio San Pedro, Mecca.

Additional published records are as follows:

Mexico: *Sonora*, Rush Lake (Cope, 1900, p. 871); Noria (Taylor, 1936, p. 493).

New Mexico: *Grant County*, Fort Webster (Baird and Girard, 1853, p. 68; Van Denburgh, 1924, p. 220), Fort Bayard (Yarrow, 1875, p. 541; Van Denburgh, 1924, p. 220), 2 miles north of Rodeo (Burt and Burt, 1929b, p. 457); *Otero County*, Alamogordo, southern Guadalupe Mountains (Mosauer, 1932, p. 15); *Sandoval County*, Bernalillo (Van Denburgh, 1924, p. 220).

Arizona: *Cochise County*, Carr Canyon (Huachuca Mountains) (Stone, 1911, p. 232; Van Denburgh, 1920, p. 26; Van Denburgh, 1922, vol. 2, p. 736); Miller Canyon (Huachuca Mountains) (Van Denburgh, 1920, p. 26; Van Denburgh, 1922, vol. 2, p. 736), Ash Canyon (Huachuca Mountains), San Pedro Valley, 2 miles east of Benson, 2 miles south of Fairbank, 5 miles southeast of Fort Huachuca, 10 miles east of Fort Huachuca, 13 miles north of Tombstone, Sulphur Springs Valley (3 miles west of Dos Cabezas), 12 miles southeast of Dos Cabezas, 10 miles southeast of Willcox (all Gloyd, 1937b, p. 119); *Coconino County*, Painted Desert (Franklin, 1914, p. 2), El Tovar (Grand Canyon), Williams, Canyon Padre, Two Guns, 3 miles west of Dennison (Klauber, 1932a, p. 79); *Maricopa County*, Wickenburg (Gloyd, 1937a, p. 17), 7 miles east of Mesa (Gloyd, 1937b, p. 119); *Mohave County*, north side Grand Canyon (Stone, 1911, p. 232; Van Denburgh, 1920, p. 26; Van Denburgh, 1922, vol. 2, p. 736); *Pima County*, Las Gijas (Stone, 1911, p. 232; Van Denburgh, 1920, p. 26; Van Denburgh, 1922, vol. 2, p. 736), Canada del Ore (20 miles north of Tucson) (Gloyd, 1937b, p. 119), 9 miles north of Tucson (MacCoy, 1932, pl 23); *Yavapai County*, Nelson, 4 miles east of Seligman, Crookton (Klauber, 1932a, p. 79); *Yuma County*, Lechuguilla Desert, 15 miles south of Wellton (Gloyd, 1937b, p. 119); ? *County:* Wilton Spring (Cope, 1900, p. 876; Van Denburgh, 1920, p. 26; Van Denburgh, 1922, vol. 2, p. 736).

Habits and habitat.—Comparatively little has been recorded of the habits of *affinis*. The earliest note found is given by Coues (1875, p. 618), who says: "Specimens could be found [about Fort Whipple]

at any time during the summer in the grass and woods. Numbers used to be killed in the fort and surrounding buildings."

Klauber (1932a, p. 79) reports collecting specimens in "grassy plain," "grass and juniper," "grass, trees," "rocks, brush," "rocky plain," and "plain scattered rocks."

Taylor (1936, p. 493) found a specimen "on the morning of June 20 in the shade of a small tree in the arid region of Noria [Sonora, Mexico]."

The most complete account of the habits of this form is given by Ruthven (1907, p. 583) as follows:

> This bull snake has a very wide range of habitat. At Alamogordo it was found in the mesquite association on the plains, in the Creosote association on the alluvial slope, and in the Pinon-Cedar zone on the mountain slope at an elevation of 6,000 feet. It undoubtedly ranges higher than this, as Mr. Edwin Walters of Alamogordo informed us that he had observed it in the Pine-Spruce forest of the highest elevations.
>
> In spite of their large size these snakes are very docile. . . .
>
> The food consists for the most part of small mammals, although a considerable number of birds are probably also taken. The specimen secured in the Pinon-Cedar association had recently swallowed a young rabbit. . . . A specimen kept by myself for several months was fed on freshly killed sparrows.

Some additional information is given in the discussion of the Arizona specimens (p. 586) as follows: "At Tucson it occurs commonly on the Greasewood plains, and is doubtless also to be found on the mountains, as Dr. Stejneger records a specimen that was taken in the Huachuca Mountains at an elevation of 5,300 feet. As in the case of many other snakes in this region, while probably not nocturnal it is seldom seen during the hotter part of the day, being found principally in the morning and evening. The large specimen (No. 1043) which was taken about sundown on August 22, had recently swallowed an adult ground squirrel."

Evidence that the form is also found in a desert habitat is given by Franklin (1914, p. 2), who lists it as one of the only three forms of snakes seen on the Painted Desert of Arizona during the summer of 1913, and by Burt and Burt (1929b, p. 457), who say: "An adult was stretched out in front of a hole beneath a soapweed bush in the sandy desert."

Ortenburger and Ortenburger (1927, p. 117) give the following notes: "They were found only in the lower flats of the mesquite association. In almost every case they were taken in the evening, one as late as 10:30 P. M. . . ."

Mosauer (1932, p. 15) reports finding specimens "in the southern Guadalupe Mountains in the coniferous forest of the plateau region . . . at over 9,000 feet elevation" and "at the east base of the southern Guadalupe Mountains."

Gloyd (1937a, p. 16) writes of experiences in Arizona: "Our depredations among the homes of the wood rats often revealed gopher snakes . . . which had sought a quiet refuge beneath the barriers of

FIGURE 63.—Distribution map of the two subspecies of *Pituophis sayi*, the three subspecies of *P. catenifer*, and *P. vertebralis*.

dead cholla joints or, more likely, the juicy young rats themselves. One large gopher snake found in such a place regurgitated five newly born cottontail rabbits."

Specimens kept in captivity for some time by the writer were well-mannered and could be freely handled without showing resentment. They would eat two or three mice whenever offered, killing the victim by constricting it, and swallowing it usually head first. The swallowing process, as compared with that of some specimens of *Sistrurus catenatus catenatus* in a neighboring cage, appeared to be much more efficient and rapid in the gopher snakes than in the rattlers.

Affinities.—The fact that in scale characters, particularly the shape of the rostral, and in coloration and pattern *affinis* is the most generalized form of the genus seems to indicate that it is ancestral to the adjacent forms and represents more nearly than any other form of *Pituophis* the central form of the genus. Further evidence of this lies in the geographic position of *affinis* near the geographic center of the genus with several distinct evolutionary lines radiating from it (figs. 18, 33, and 63). Furthermore, in most of the important scale characters and pattern features *affinis* is intermediate between any two of the forms adjacent to it.

The reasons for including *affinis* as a subspecies of *sayi* rather than of *catenifer* are given above.

The probable relationships of *affinis* and the adjacent forms may be expressed in the following diagram:

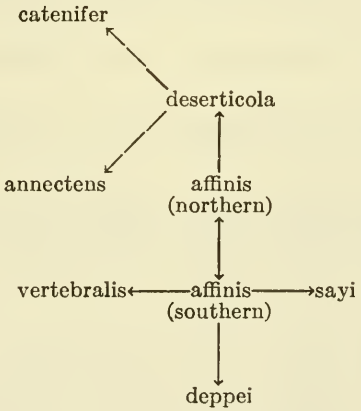

Table 11 lists the specimens of this form that have been examined.

TABLE 11.—*Specimens of* Pituophis sayi affinis *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 1518	Sonora, Mexico	♂	28-31-22	221	62	283	8	12/13	1	4	46	15	61	74	0.141	1	2
U.S.N.M. No. 22141	Las Cruces, N. Mex.	♂	28-31-21	221	64	285	8	14	1/2	3/4	51	14	65	128	0.132	1	2
U.S.N.M. No. 22130	do	♀	29-35-23	223	56	279	8/9	13	1	3	42	14	56	122	0.122	1	0
U.S.N.M. No. 22139	do	♀	27-31-21	227	57	294	9	12/13	2	3	48	13	61	46	0.131	1	0
U.S.N.M. No. 10610	Camp J. A. Packer, Ariz.	♂	27-31-21	225	64	289	8/9	12/13	1	3	37	12	49	90	0.133	1	1
U.S.N.M. No. 1532	Anton Chico, N. Mex.	♂	27-31-23	219	62	281	8	11	1	3	46	14	60	103	0.135	1	0
U.S.N.M. No. 8046	New Mexico	♂	27-31-21	-------	66	-------	8/9	12	2	3	53	16	69	-------	-------	1	0
U.S.N.M. No. 16545	Fort Whipple, Prescott, Ariz.	♂	28-31-23	232	65	297	8	13	1	4/5	47	14	61	114	0.140	1	1
U.S.N.M. No. 1520	Santa Rita del Cobre, N. Mex.	♀	29-33-23	227	59	286	8/9	12	2	3	47	15	62	118	0.144	1	1
U.S.N.M. No. 21797	Tucson, Pima County, Ariz.	♀	27-33-23	240	57	297	8	13	2	3/5	43	13	56	48	0.125	1	1
U.S.N.M. No. 1533	Fort Conrad, N. Mex.	♀	29-31-23	231	54	285	8	11/12	1/2	4/3	55	14	69	59	0.118	1	2
U.S.N.M. No. 16766	Fort Whipple, Ariz.	♂	29-29-23	231	69	300	8/9	11	1	3	63	19	82	67	0.149	1	0
U.S.N.M. No. 16767	do	♀	29-31-22	232	54	286	8	13	2	4	43	13	56	58	0.120	1	1
U.S.N.M No. 10203	White River Canyon, Ariz.	♂	27-31-23	229	66	295	8	12/13	1/2	4/3	40	13	53	49	0.142	1	1
U.S.N.M. No. 8405	Pagosa, Colo.	♂	27-29-21	238	65	303	8	13	1	4/3	47	13	60	40	0.137	1	0
U.S.N.M. No. 44386	Canyon Diablo, Ariz.	♂	28-29—	-------	65	-------	9/8	13	2	4/3	-------	-------	-------	-------	-------	1	1
U.S.N.M. No. 46372	Casas Grandes, Chihuahua, Mexico.	♂	29-33-23	222	61	283	8	13	1	3	40	12	52	120	0.133	1	1
U.S.N.M. No. 46381	Near Batapilas, Chihuahua, Mexico.	♀	29-31-23	230	58	288	8	12	2	3	38	10	48	119	0.126	1	0
U.S.N.M. No. 44467	San Mateo Mountains, N. Mex.	♂	25-28-20	215	61	276	8	11	2/1	3	52	15	67	135	0.140	2/1	0
U.S.N.M. No. 44506	Redrock, Grant County, N. Mex.	♀	29-33-23	226	60	286	8	12	1	4	49	13	62	128	0.132	1	0
U.S.N.M. No. 44507	Hachita, N. Mex.	♀	29-31-23	230	56	286	9/8	12	1	4	50	13	63	122	0.139	1	0
U.S.N.M. No. 44390	Jicarilla Mountains, N. Mex.	♀	29-33-23	229	61	290	8	13	1	3/4	49	16	65	79	0.132	1	0

U.S.N.M. No. 54718	Fort Whipple, Ariz	♀	27-31-23	238			8	11	1	3	41					1	0
U.S.N.M. No. 8402	Colorado Chiquito, Ariz.	♂	27-29-21	231	66	297	8	11	1/2	4	55	17	72	126	0.142	1	0
U.S.N.M. No. 8404	Pagosa, Colo	♂	27-29-21	231	66	297	8	13/12	1	3	43	15	58	188	0.132	1	0
U.S.N.M. No. 71242	Kaibab Forest, Ariz	♂	27-29-21	248	68	316	8/9	12/13	1	3	68	18	86	118	0.144	1	0
U.S.N.M. No. 19284	Mexican Boundary	♀	27-29-21	236	56	292	9/8	12/13	1	4/3	53	12	65	143	0.118	1	0
U.S.N.M. No. 19283	do	♂	27-31-23	229	65	294	8	11	1	4/3	46	14	60	117	0.145	0	0
U.S.N.M. No. 19282	do	♂	27-31-23	227	59	286	8	12/13	2/1	4	51	14	65	131	0.129	1	0
U.S.N.M. No. 8407	Gila River, Ariz		—29-23	223							48	12	60				
U.S.N.M. No. 19301	United States	♀	27-31-23	234	55	289	8	13	1	3	43	11	54	44	0.125	1	1
U.S.N.M. No. 8759	Pagosa, Colo	♀	29-31-23	235	53	288	8/9	11/12	1/2	4/3	44	10	54	35	0.114	1	1
U.S.N.M. No. 1546	Between San Bernardino and Rio San Pedro, Calif.	♂	28-31-22	231	64	295	8	11	1	3	35	12	47	126	0.134	1	0
U.S.N.M. No. 8401	San Ildefonso, N. Mex	♀	29-31-24				?/9	12/13	?/2	?/6						1	0
U.S.N.M. No. 16544	Fort Whipple, Prescott, Ariz.	♂	27-31-21	230	60	290	8	12	1	3	44	14	58	160	0.131	1	1
U.S.N.M. No. 34588	Tajique, Valencia Co., N. Mex.		27-29-21	227	65	292	8	13	1	3/4	53	16	69	182	0.148	1	0
U.S.N.M. No. 14222a	Chihuahua City, Mexico	♂	29-31-23	226	59	285	8	13	1	4	39	11	50	120	0.125	1	0
U.S.N.M. No. 14222b	do	♀	27-33-23	230	52	282	8/9	13	2	4	48	12	60	119	0.126	2/1	0
U.S.N.M. No. 14239a	do	♂	30-33-23	221	61	282	8	13	1	3/4	41	12	53	132	0.128	1	0
U.S.N.M. No. 14293b	do	♀	27-31-23	227	57	284	8	13	1	3	40	12	52	114	0.122	1	0
U.S.N.M. No. 8403	Willow Spring, Ariz	♂	27-31-23	229	70	299	8	12/?	1	4	50	16	66	110	0.145	1	0
U.S.N.M. No. 8400	Oak Orchard, Ariz	♀	27-31-21	230	61	291	8	11/12	2	3/4	43	13	56	103	0.135	1	0
U.S.N.M. No. 1534	Bottom Lands, Calif	♂	29-33-23	244	63	307	8	12/13	2	3	45	16	61	80	0.131	1	0
U.S.N.M. No. 11418a	Fort Whipple, Ariz	♂	27-29-21	229			8		2/1	3	45					1	1
U.S.N.M. No. 11418b	do	♂	—31-22	230	65	295	8	11/12	1	3	46	16	62	74	0.135	1	1
U.S.N.M. No. 11418c	do	♀	29-33-23	233	64	297	8	13/12	1	3	43	15	58	43	0.139	1	0
U.S.N.M. No. 11418d	do	♀	29-31-22	236	57	293	9/8	13	2	4/5	53	15	68	92	0.130	1	1
U.S.N.M. No. 11418e	do	♀	29-31-23	235	55	290	8	12	1	3	52	12	64	47.5	0.126	1	1
U.S.N.M. No. 19281	Mexican Boundary	♂	27-31-23	230	65	295	8	12	2	3	47	15	62	150	0.126	1	1
U.S.N.M. No. 8758	Fort Wingate, N. Mex	♂	27-29-21	224	63	287	8	12/11	1	3	51	15	66	103	0.145	0	0
U.S.N.M. No. 8006a	Fort Whipple, Ariz	♂	29-31-23	217	66	283	8	14/13	2	3	42	12	54	94	0.148	1	1
U.S.N.M. No. 8006b	do	yg.	29-31-23	230	59	289	8/9	13/12	2	3	55	16	71	38	0.131	1	0
U.S.N.M. No. 14744	Fort Huachuca, Ariz	♂	29-33-23	220	60	280	8	13/12	2	3	39	12	51	136	0.132	1	0
U.S.N.M. No. 8004a	Camp Grant, Ariz		31-33-25	241			8	14/13	2	4/5	45					1	1
U.S.N.M. No 8004b	do	♂	29-31-23	240	66	306	8	13	2	4	40	13	53			1	0

TABLE 11.—*Specimens of* Pituophis sayi affinis *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 22035	Colorado Desert, Lower California.	♂	31-35-25	244	55	299	8	14	2	3/4	55	14	69	158	0.127	1	0
U.S.N.M. No. 60231	15 miles south of Hackberry, Ariz.	yg.	29-33-23	234	70	304	8	12/13	2	4	49	15	64	46	0.152	1	0
U.S.N.M. No. 19675	Fort Huachuca, Ariz.	♂	29-33-23	223	64	297	8	13/12	1	3/4	41	13	54	127	0.133	0/1	1
U.S.N.M. No. 14810	Camp Verde, Ariz.	♂	29-33-23	231	65	296	8	13	1	3	42	13	55	158	0.139	1	1
U.S.N.M. No. 17791	Near Fort Huachuca, Ariz.	♀	27-32-24	232	53	285	8	13	2	4	34	------	------	------	------	1	1
U.S.N.M. No. 16616	Tucson, Ariz.	♀	29-33-23	239	56	295	8	13	1	3	49	12	61	138	0.123	1	0
U.S.N.M. No. 17022	----do----	♂	27-31-23	231	64	295	8/9	12	1	4	42	13	55	164	0.140	1	0
U.S.N.M. No. 22204	Walnut, Ariz.	yg.	31-33-23	238	64	302	8	13/12	2	4	39	11	50	37	0.135	1	0
U.S.N.M. No. 30884	Fort Huachuca, Ariz.	♂	29-33-23	228	62	290	8	13	1	4/3	44	12	56	133	0.127	1	0
U.S.N.M. No. 21105	----do----	♂	27-31-23	235	65	300	8	13	1	4	36	12	48	141	0.134	1	1
U.S.N.M. No. 20579	Arizona.	♂	27-31-21	236	61	297	9	13	2/1	3	39	12	51	159	0.125	1	1
U.S.N.M. No. 59771	Camp Verde, Ariz.	♀	29-33-23	241	59	300	8	13/14	2	3	46	12	58	64	0.132	1	1
U.S.N.M. No. 15979	----do----	♀	29-33-23	244	53	297	8	13	1	4	45	11	56	133	0.120	0	0
U.S.N.M. No. 37111	Near Fort Mohave, Ariz.	♂	29-33-23	238	67	305	9	14	2	4	52	16	68	58	0.137	1	0
U.S.N.M. No. 60227	Cedar Ranch Wash, Ariz.	♂	29-31-23	235	------	------	8	12	1	4	54	------	------	------	------	1	2
U.S.N.M. No. 60228	Canyon del Muerto, Ariz.	♂	27-31-21	242	67	309	8	12/13	1	3	59	16	75	120	0.150	1	0
C.A.S. No. 48061	Huachuca Mountains, Ariz.	♂	31-35-23	226	66	292	8	12/13	2	4	39	13	52	144	0.138	1	1
C.A.S. No. 33870	Tucson, Ariz.	♂	27-31-23	226	65	291	8	13/12	2	3	44	14	58	140	0.135	1	0
C.A.S. No. 17541	Cavecreek, Ariz.	♂	29-31-23	239	64	303	9	14	2	4	50	12	62	143	0.132	1	1
C.A.S. No. 33447	Yuma, Ariz.	♀	29-33-23	258	59	317	8	13/12	2	5/4	54	14	68	132	0.121	1	1
C.A.S. No. 48062	Huachuca Mountains, Ariz.	yg.	27-31-23	231	56	287	8	13/12	1	3	33	12	45	38	0.131	1	1
C.A.S. No. 17546	Cavecreek, Ariz.	yg.	31-35-25	246	60	306	9	13	2	4	41	11	52	53	0.132	1	0
C.A.S. No. 17547	----do----	yg.	27-31-23	240	59	299	8	13	1	3	47	13	60	50	0.130	1	1

C.A.S. No. 48064	Huachuca Mountains, Ariz.	♀	29-29-21	235	56	291	9	11/12	1	4	36	10	46	70	0.128	1	1
C.A.S. No. 48065	Hereford, Ariz	♀	27-31-21	221	64	285	8	13	2/1	4	39	10	49	121	0.140	1	1
C.A.S. No. 48063	Huachuca Mountains, Ariz.	♀	29-31-23	232			8	11/12	1	4	40					1	0
A.M.N.H. No. 3544	Tucson, Ariz	♀	29-33-24	237	47	284	8/9	13/14	2	3	46					2/1	1
A.M.N.H. No. 8355	Phoenix, Ariz	♂	29-31-24	237	64	301	8/9	13/14	2	3	45	12	57	159	0.125	1	1
A.M.N.H. No. 6969	do	♂	27-31-23	240	68	308	8	13	1	3	54	15	69			1	0
A.M.N.H. No. 3563	San Diego, Chihuahua, Mexico.	♂	29-33-23	235	64	299	8	12	2	3	41	12	53	152	0.131	1	1
A.M.N.H. No. 5208	Arizona	♀	29-31-23	240			8	12/13	2/1	3/4	66					1	0
A.M.N.H. No. 3552	Aztec, N. Mex	♂	29-31-22	232	71	303	8	13	1	5/4	46	14	60	168	0.142	1	0
A.M.N.H. No. 3565	Arizona	♂	29-31-23	236	66	302	8	12	2/1	3	41	13	54	152	0.131	1	0
A.M.N.H. No. 3545	Tucson, Ariz		29——				8	13	2	3						1	2
A.M.N.H. No. 1043	do	♀	——25		55							10					
A.M.N.H. No. 3542	East of White Sands, N. Mex.	♀	30-33-22	233	54	287	9	13	2	3	42	11	53	90	0.122	1	2
A.M.N.H. No. 3540	do	♂	27-31-21	223	60	283	8	12/13	2	4	39	12	51	134	0.141	1	0
A.M.N.H. No. 3541	do	♂	30-33-23	231	61	292	8	12/13	1	4/3	43	14	57	75	0.133	1	1
A.M.N.H. No. 3539	do	♂	30-31-23	232			8/9	12	1	3	52					1	0
A.M.N.H. No. 15082	Huachuca Mountains, Ariz.	♂	29——23	228			8	13	1	4	35					0	0
A.M.N.H. No. 3558	Arizona		27——				8	14	1	3						1	0
A.M.N.H. No. 9724	Aztec, N. Mex	♀	27-31-21	242	63	304	8/9	13	2	4	58	16	74	75	0.140	1	0
A.M.N.H. No. 20375	Near Kirkland, Ariz	♂	27-29-23	232	67	299	9/8	13	2	3	47	15	62	51	0.137	1	0
A.N.S.P. No. 15195	Otero County, N. Mex., near Alamogordo.	♂	29-33-23	226	64	290	8/9	12/13	2/1	4	45	12	57	161	0.136	1	1
A.N.S.P. No. 15967	do	♀	29-31-23	234			8	12	2	4	56					1	0
A.N.S.P. No. 15196	do	♀	29-33-23	237	57	294	8/9	13	1	4/3	54	13	67	136	0.125	1	1
A.N.S.P. No. 16438	do	♂	27-29-23	224	60	284	8	12	2	3	47	15	62	125	0.136	1	1
A.N.S.P. No. 15168	do	♀	27-29-21	229	61	290	8	11	1	3	45	12	57	82	0.134	1	0
A.N.S.P. No. 15169	do	♀	— 31-23	239			8	12	2	4						1	0
A.N.S.P. No. 3792	New Mexico	♂	27-31-23	223	65	288	8	11	1	3/2	51	16	67	104	0.144	1	0
A.N.S.P. No. 10848	San Francisco River, N. Mex.	♀	27-31-23	234	65	299	8/9	12	2	3	58	17	75	128	0.140	2/1	0
A.N.S.P. No. 3788	Santa Rita del Cobre, N. Mex.	♀	27-31-23	224	61	285	8	13	1	4	49	18	67	93	0.139	1	1
A.N.S.P. No. 3787	do	♂	29-31-25	228	54	282	8	12	3/1	4	60	14	74	105	0.133	2	0
A.N.S.P. No. 3786	do	♂	29-31-23	220	59	279	8	11	1	3	55	16	71	116	0.137	1	0
U. Mich. No. 64716	Otero Co., N. Mex	♂	33-33-23	224	66	290	8	13/14	1	3/4	46	14	60	128	0.132	1	1

TABLE 11.—*Specimens of* Pituophis sayi affinis *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U. Mich No. 46617	Yuma, Ariz	♂	29-33-23	234	56	290	8	13/14	1	3/4	46	14	60	46	0.130	1	0
U. Mich. No. 64905	Wingate, N. Mex	♀	29-31-21	239	58	297	8	11	1	5/3	51	13	64	121	0.119	1	0
U. Mich. No. 64989	Arizona	♂	29-31-23	245	65	310	8	12	1	4	54	17	71	98	0.145	1	1
U. Mich. No. 64067	do	♀	27-29-21	233	60	293	8	12	2	4	49	12	61	53.5	0.130	1	0
U. Mich. No. 65101	do	♂	29-31-21	231	69	300	8	13/12	1	4	40	14	54	87	0.144	1	1
Klauber No. 1123	Winslow, Ariz	yg.	29-31-21	237			8	12/13	2	3/4	48			50	0.130	1	0
Carnegie No. 4441	Tortillita Mountains, Pima County, Arizona.	♀	29-33-23	228	56	284	8	13/14	1	3/4	43	11	54	156	0.128	1	0
Carnegie No. 4442	do	♀	29-31-23	237	57	294	9	14/15	3/1	4	50	13	63	145	0.124	1	1
Field No. 12374	Glendale, Ariz	♂	31-35-25	235	61	296	9	13/14	2	4/3	50	14	64	131	0.129	1	0
Field No. 12375	do	♀	29-31-23	246	55	301	8	13	1	3	44	12	56	113	0.123	1	0
Field No. 12376	do	♀	31-35-25	240	58	298	8/9	14	2	4	48	14	62	132	0.128	1	1
Field No. 3475	Phoenix, Ariz	yg.	29-33-23	232	61	293	8	12/13	1	3	46	14	60	44	0.136	1	0
U. Colo. No. 75	Fort Mohave, Ariz		29-33-23								46						
Stanford No. 1713	Near Fort Lowell, Pima County, Ariz.	♂	——23		63		8	13	1	3						1	0
Stanford No. 1131	Fort Lowell, Pima County, Ariz.	yg.	29-33-25	241	57	298	8	12	1	3	55	16	71	40	0.125	1	0
Stanford No. 1714	do	♀	29-33-23	238	52	290	8	13	1	4/3	42	11	53	51	0.127	0	0
Stanford No. 5212	Isleta, N. Mex	♂	28-31-23	225	60	285	8	13	2/1	3	50	14	64	122	0.131	1	1
Stanford No. 1705	Fort Lowell, Ariz	♂	29-33-23	238	68	306	8	14/13	2	3	42	13	55	71	0.140	1	0
M.C.Z. No. 15923	Madera, Chihuahua, Mexico.	♂	27-29-21	217	66	283	8	12	1	4	36	13	49	158	0.145	1	1
M.C.Z. No. 15699	Pacheco, Chihuahua, Mexico.	♀	29-33-23	237	59	296	9/8	12	2	5/4	34	9	43	41	0.134	1	2
M.C.Z. No. 14459	Superior, Ariz	♀	27-31-21	234	64	298	8	13	1	3	46	13	59	51	0.137	1	1
M.C.Z. No. 14814	Huachuca Mountains, Ariz.	♀	27-31-23	244	55	299	8/9	13	1	4	35	11	46	47.5	0.126	1	0
Field No. 986	Ahumada, Chihuahua, Mexico.	♀	29-31-23	225	54	279	8	13	1/2	4	59	14	73	53.3	0.130	1	0

M.V.Z. No. 7945	Maricopa County, Ariz.	♀	31-33-23	244	56	300	8/9	15/14	2	4	54	13	67	64	0.125	2/1	0
M.V.Z. No. 7954	Chiricahua Mountains, Cochise County, Ariz.	♀	29-31-23	236	63	299	8	13/12	-------	-------	45	14	59	132	0.136	0	1
M.V.Z. No. 7952	-----do-----	♂	29-35-23	228	54	282	8	13	1/2	3	52	13	65	69	0.130	1	0
M.V.Z. No. 7270	-----do-----	♂	27-29-21	232	66	298	8	12/13	1	3	43	15	58	70	0.121	1	0
M.V.Z. No. 7946	28 miles northwest of Tucson, Ariz.	♀	29-33-23	240	53	293	8	13	1	3	45	10	55	80	0.125	1	1
M.V.Z. No. 1003	Silsbee, Imperial County, Calif.	♀	29-33-23	249	51	300	9/8	13	2	4	43	12	55	117	0.111	2	0
M.V.Z. No. 9562	23 miles north of El Mayor, Lower California.	♀	33-35-25	245	51	296	8	13	2	3/4	46	11	57	133	0.112	1	0
M.V.Z. No. 7948	Chiricahua Mountains, Cochise County, Ariz.	♀	27-31-21	226	63	289	8	11	1	3	48	15	63	41	0.134	1	0
M.V.Z. No. 7950	-----do-----	♂	27-29-21	224	57	281	8	13	1	3	36	10	46	148	0.121	1	1
M.V.Z. No. 7949	-----do-----	♂	29-31 23	230	68	298	8	13/12	1	4/3	41	16	57	42	0.142	1	1
M.V.Z. No. 469	Mecca, Riverside County, Calif.	♀	31-33-23	260	59	319	8	12	1	3	60	17	77	46	0.119	1	0
M.V.Z. No. 1824	Colorado River above Bill Williams River, Ariz.	yg.	29-33-23	251	60	311	8/9	13/12	2	4	54	14	58	34	0.132	1	1
M.V.Z. No. 7953	Chiricahua Mountains, Cochise County, Ariz.	♀	29-33-23	231	60	291	9	12/13	2	3	46	14	60	67	0.134	1	1
M.V.Z. No. 7947	-----do-----	♂	27-31-22	226	61	287	8	12/11	2/1	3	43	12	55	127	0.141	1	1
M.V.Z. No. 7951	-----do-----	♂	27-31-23	230	67	297	8/9	12	1	3	50	14	64	154	0.136	1	1

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PITUOPHIS CATENIFER CATENIFER (Blainville)

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Pityophis vertebralis Hallowell, U. S. Pac. R. R. Expl. and Surv., vol. 10, pt. 4, No. 1, p. 24, 1859.

Pityophis sayi bellona Yarrow and Henshaw, Rep. Chief Eng. for 1878, Surv. West 100th Merid., vol. 3, app. NN, p. 1634, 1878 (part).—Yarrow, U. S. Nat. Mus. Bull. 24, pp. 16, 106, 1883 (part).—Townsend, Proc. U. S. Nat. Mus., vol. 10, p. 239, 1887.—Cope, Proc. Acad. Nat. Sci. Philadelphia, 1893, p. 182.

Pityophis mexicanus bellona Cope, Proc. Acad. Nat. Sci. Philadelphia, 1883, p. 21.

Pityophis sayi sayi Yarrow, U. S. Nat. Mus. Bull. 24, pp. 16, 105, 1883 (part).

Coluber melanoleucus, Boulenger, Catalogue of snakes in the British Museum, vol. 2, p. 68, 1894 (part).

Original description.—Blainville (1835, p. 290) describes this form as "La Couleuvre porte-chaine" or "Coluber catenifer" as follows:

Corps fort alongé, assez gros, cylindrique, tête petite, peu distincte, et colubriforme; queue proportionellement fort courte, conique et très-aiguë.

Bouche médiocre; anus fort reculé.

Narines latérales, petites, entre les deux scutelles nasales, au point de contact et de jonction avec la scutelle frontale antérieure.

Yeux médiocres.

Scutelles céphaliques:—4 frontales, 1–4 oculaires, 2 loréales.

Scutelles abdominales fort larges, et uniseriées sous le corps, biseriées sous la queue.

Écailles ovales, alongées, foliacées, carénées, assez grandes, et s'accroissant de la ligne médiodorsale aux flancs.

Couleur générale d'un gris jaunâtre, avec une suite de taches noires, formant une chaîne serrée dans toute la longueur du dos, et une autre série plus petite sur chaque flanc.

Longueur totale: 1^{m} 08, dont 0^{m} 15 pour la queue.

Observ. Cette belle espèce de couleuvre, remarquable par l'ordre dans lequel les taches noires du dos se disposent de manière à ressembler à une chaîne à anneaux serrés, et par une série de taches séparées sur chaque flanc, offre aussi une disposition toute particulière dans les scutelles oculaires.

Systematic notes.—The description of *"heermanni"* by Hallowell (1853a, p. 236) gives no character that distinguishes the form from typical *catenifer*. Although the name was revived by Van Denburgh (1920, pp. 4, 12, and 16) to apply to specimens of *catenifer* from "the Klamath region, Oregon, and in California, Modoc County, the

Sacramento Valley, the northern part of the San Joaquin Valley, and the western slope of the Sierra Nevada," the only character he gives to distinguish the form from *c. catenifer* is the lower average number of dorsal spots. The ranges of variation in the number of spots in the two forms as given by Van Denburgh show a wide overlap, however, and the difference in the averages for the two groups of specimens is well within the possible range of geographic variation within a single subspecies and should undoubtedly be accepted as such. Thus, *heermanni* must again be considered a synonym of *c. catenifer.*

Diagnosis.—This form may be separated readily from the three forms of the *deppei* group by the presence of four, rather than two, prefrontals, and the entrance into the eye of a single supralabial on each side, instead of two. From all the subspecies of *melanoleucus* and the two subspecies of *sayi*, *catenifer* may be separated by the shorter rostral, which is never longer than broad, as it is in all the other forms under consideration; *catenifer* may be distinguished from *affinis* also by the pattern, since in *catenifer* the spots vary in number from 58 to 125 (average 87.3), are quadrangular or bar-shaped but never saddle-shaped, and are never reddish in color, and in *affinis* the spots vary in number from 43 to 86 (average 59.5), and the posterior ones at least are usually saddle-shaped and reddish in color. From *vertebralis* this form may be distinguished by the lower number of ventrals (206 to 234 in *catenifer* as opposed to 237 to 262 in *vertebralis*) and by the coloration. In *vertebralis* the dorsal spots are black or reddish brown anteriorly, reddish brown in the middle of the body, and black posteriorly and on the tail, and are always more or less saddle-shaped; in *catenifer* the spots are more or less uniformly brown, grayish brown, or black throughout, and are never saddle-shaped. From *deserticola*, *catenifer* may be distinguished by the lower number of ventral scutes. Thus, in *catenifer*, while the number varies from 206 to 234, the number is generally less than 228, the average number being 220; in *deserticola*, while the number varies from 214 to 259, the number is rarely less than 228, the average being 236. Furthermore, in *deserticola* the light scales of the interspaces between the dorsal spots and of the sides generally bear each a small central black spot, on at least the anterior part of the body, while such spots are generally lacking in *catenifer*. From *annectens*, *catenifer* may be separated by the lower number of ventrals and caudals or the lower number of dorsal spots on body and tail. In *annectens* the sum of ventrals and caudals is rarely less than 300, and the number of dorsal spots is rarely less than 90, while in *catenifer* the number of dorsal spots is generally less than 90, and the sum of ventrals and caudals rarely exceeds 300.

Description.—The body is rather slender and the snout is blunt and almost square. The tail forms 0.122 to 0.185 (average 0.153) of the

total length. The longest specimen examined measured 1,630 mm. in length.

The dorsal scale formula varies from 27–29–21 to 31–37–27. The number of scale rows at the neck is 25 to 33, usually 29; the maximum number of rows in the middle of the body 29 to 37, most often 31; the minimum number anterior to the vent 21 to 27, usually 23. The remaining scutellation is as follows: Ventrals 206 to 234 (average 220.3); caudals 54 to 80 (average 66.4); supralabials usually 8, frequently 9, occasionally 7 or 10, with the fourth usually, fifth occasionally, sixth or none rarely, entering the orbit; infralabials 10 to 14, usually 12 or 13; preoculars 1 to 3, uually 2; postoculars 2 to 6, most often 3; loreal usually present, occasionally divided to form two or even three small scales; azygos present occasionally between frontal and prefrontals, rarely between prefrontals and preocular on either side; rostral low and broad, at least as broad as long, and penetrating from one-third of to all the distance between the internasals; frontal never divided.

The dentition is as follows: Mandibular teeth 16 to 19, decreasing slightly in size posteriorly; maxillary teeth 14 to 17, decreasing slightly in size posteriorly; palatines 7 to 11, slightly smaller than the mandibular and maxillary teeth; pterygoids 7 to 14, decreasing slightly in size posteriorly, slightly smaller than the palatines.

The dorsum bears a series of median, brown, grayish-brown, or black spots, which are quadrangular or bar-shaped, and number 44 to 94 (average 66) on the body and 12 to 31 (average 21.1) on the tail. Each spot is 1 to 5 scales long and 7 to 11 scales wide, and the interspaces between the spots are 1 to 3 scales long. Frequently the spots are partly or completely outlined narrowly with black. There are three series of smaller dark spots on either side, which alternate with one another and with the dorsal series. The spots of the uppermost lateral series are darkest and largest and are frequently outlined with black. The lowest series has the smallest and palest spots. The median lateral series frequently has the scales between the spots slightly darker than the surrounding ground color, forming a more or less continuous pale-brown stripe dotted at regular intervals with the spots of the series. The ground color of the dorsum is yellowish white or pale brown; of the belly, white. The belly bears a series of lateral spots on either side, each ½ to 1 scute in length and separated by 1 to 4 scutes, or rarely occurring on several successive scutes. The belly may be immaculate between the lateral series of spots or irregularly spotted for part or all of its length. The top of the head is pale brown, more or less dappled with darker brown, and usually bears a transverse band of dark brown between the eyes, on the anterior part of the supraoculars and frontal, and the posterior part of the prefrontals. Dark streaks occasionally mark the sutures between the supralabials and between the infralabials. The throat is white. (Fig. 64, *b*.)

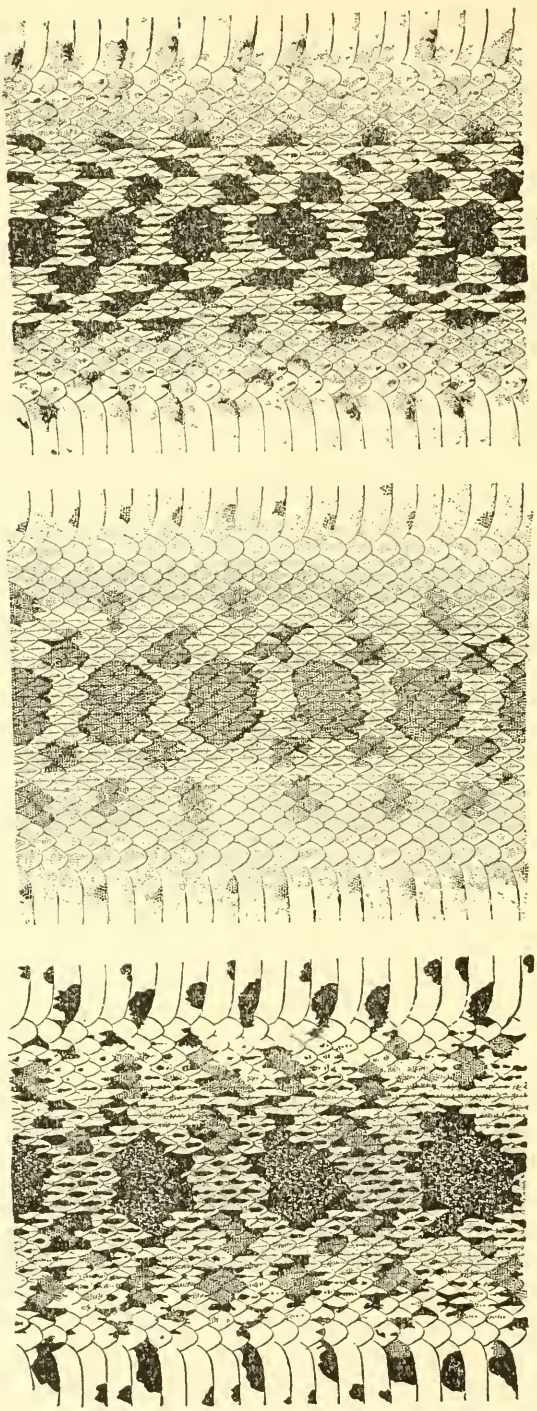

FIGURE 64.—The color patterns of the three subspecies of *Pituophis catenifer*: *a*, *P. c. deserticola*; *b*, *P. c. catenifer*; *c*, *P. c. annectens*.

Variation.—Some geographic variation seems to exist, as may be illustrated by the accompanying graphs. On all the graphs region 1 represents Santa Cruz Island, which is graphed as a separate unit, since an island fauna obviously cannot be inserted at any given point in a continuous series of mainland specimens arranged geographically. In the graphs representing the variation in scale characters and in proportionate tail length the numbers 2 to 10 refer to regions in a continuous series from south to north as follows:

Region 2. San Diego and Los Angeles Counties, Calif.
3. Kern and San Luis Obispo Counties, Calif.
4. Tulare, Kings, Fresno, San Benito, and Monterey Counties, Calif.
5. Santa Cruz, San Mateo, San Francisco, Santa Clara, Merced, Madera, Mariposa, Stanislaus, San Joaquin, Alameda, and Contra Costa Counties, Calif.
6. Marin, Sonoma, Napa, Solano, Eldorado, and Placer Counties, Calif.
7. Yolo, Sutter, Butte, Glenn, Lake, Mendocino, and Tehama Counties and the southern parts of Trinity and Humboldt Counties, Calif.
8. The northern part of Humboldt County, and Shasta, Modoc, Siskiyou, and Del Norte Counties, Calif.
9. Oregon.
10. Washington.

In the graphs illustrating the variation in the numbers of spots these regions have been further subdivided so as to separate the specimens of the coastal strip of California from those of the inland counties. The regions represented are as follows:

Region 2. San Diego and Los Angeles Counties, Calif.
3. Kern and San Luis Obispo Counties, Calif.
4. San Benito and Monterey Counties, Calif.
5. Tulare, Kings, Fresno, Merced, Madera, Mariposa, Stanislaus, and eastern San Joaquin Counties, Calif.
6. Santa Cruz, San Mateo, San Francisco, Santa Clara, Alameda, Contra Costa, and western San Joaquin Counties, Calif.
7. Eldorado and Placer Counties, Calif.
8. Marin, Solano, Napa, and Sonoma Counties, Calif.
9. Yolo, Sutter, Butte, and Tehama Counties, Calif.
10. Glenn, Lake, Mendocino, Trinity, and Humboldt Counties, Calif.
11. Shasta, Modoc, Siskiyou, and Del Norte Counties, Calif.
12. Oregon.
13. Washington.

In range of variation the number of scale rows is remarkably constant throughout the geographic range of the form, but in the average number there is an evident decrease from south to north (fig. 65). The numbers of ventrals and caudals (figs. 66 and 67) also remain remarkably constant throughout the range, except that there is a marked decrease in the number of caudals in the Oregon and particularly the Washington specimens and that the number of ventrals in the Santa Cruz Island specimens is noticeably low. The latter variation, however, may not represent the true condition of the island

fauna, since only four specimens are considered, and the range of variation is well within the extremes for the subspecies as a whole. A general tendency toward decrease in the sum of ventrals and caudals from south to north is observable. The numbers of oculars and labials are also very constant throughout the wide range of this form, and the

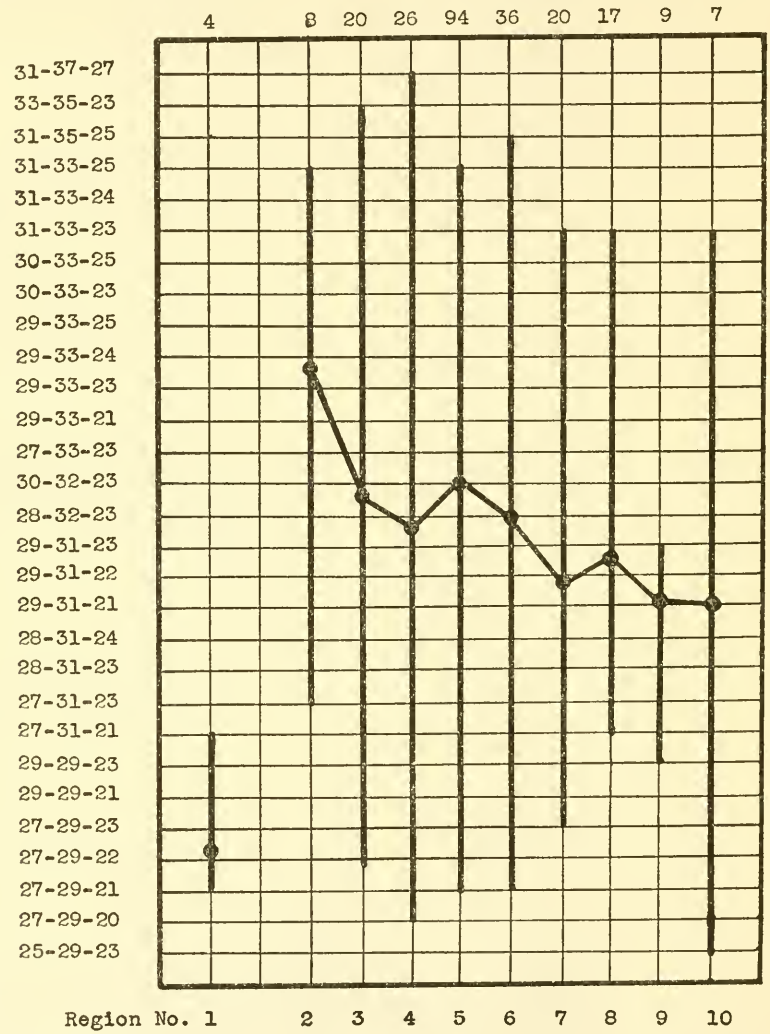

FIGURE 65.—Geographic variation in number of scale rows in *Pituophis catenifer catenifer*.

only variation of any apparent significance is a slight general decrease in the number of infralabials from south to north (fig. 68). The proportionate tail length shows no variation that seems to be of geographic significance (fig. 69).

Specimens from the coastal counties of central and northern California show in general a higher number of dorsal spots on both body

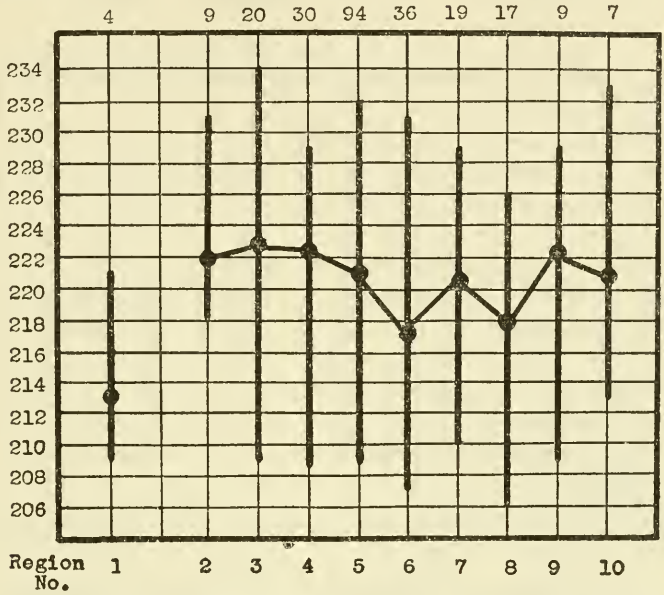

FIGURE 66.—Geographic variation in number of ventrals in *Pituophis catenifer catenifer*.

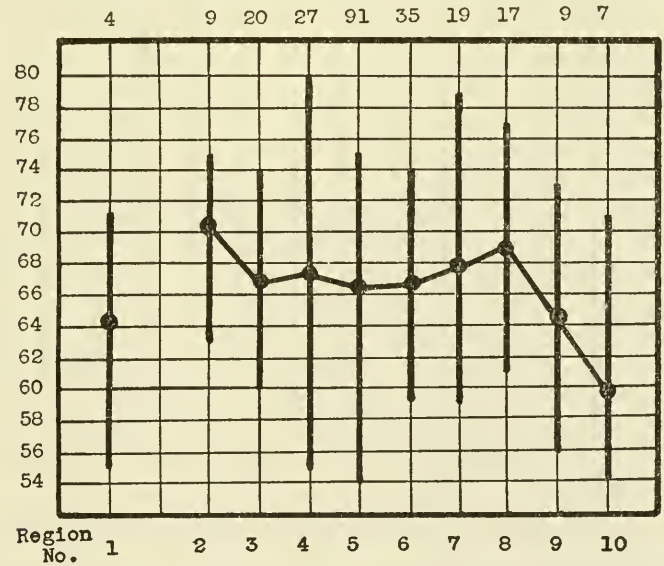

FIGURE 67.—Geographic variation in number of caudals in *Pituophis catenifer catenifer*.

and tail than do specimens from the counties farther inland (figs. 70–72). In scale counts, however, no consistent variation between these two areas could be discovered.

The sexual variation observable in this form may be summarized as follows: Dorsal scale formula varies from 27–29–21 to 31–35–25 in males, from 27–29–21 to 31–37–27 in females; ventrals 206 to 231

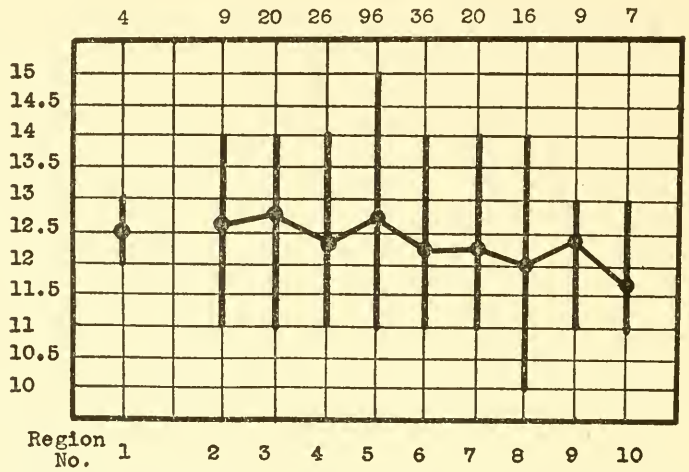

FIGURE 68.—Geographic variation in number of infralabials in *Pituophis catenifer catenifer*.

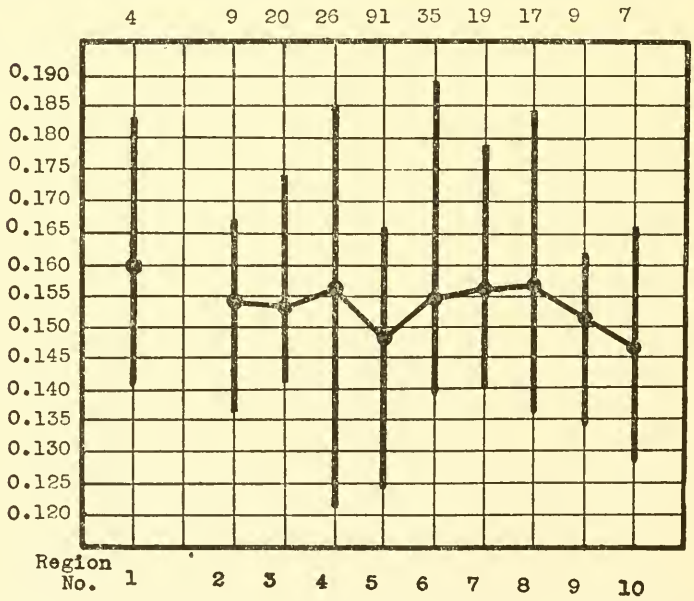

FIGURE 69.—Geographic variation in ratio of tail length to total length in *Pituophis catenifer catenifer*.

(average 218.5) in males, 207 to 234 (average 222.4) in females; caudals 56 to 80 (average 69.1) in males, 54 to 75 (average 63.6) in females; supralabials, infralabials, preoculars, and postoculars all average slightly higher in females than in males; dorsal body spots

average 66.6 in males, 65.4 in females; tail spots average 22.1 in males, 19.9 in females.

Two specimens, one from Fort Tejon, Kern County, Calif., and the other from Puget Sound, Wash., vary from the normal in the presence of only two prefrontals instead of four.

A specimen of *catenifer* with two heads, from Los Gatos, Santa

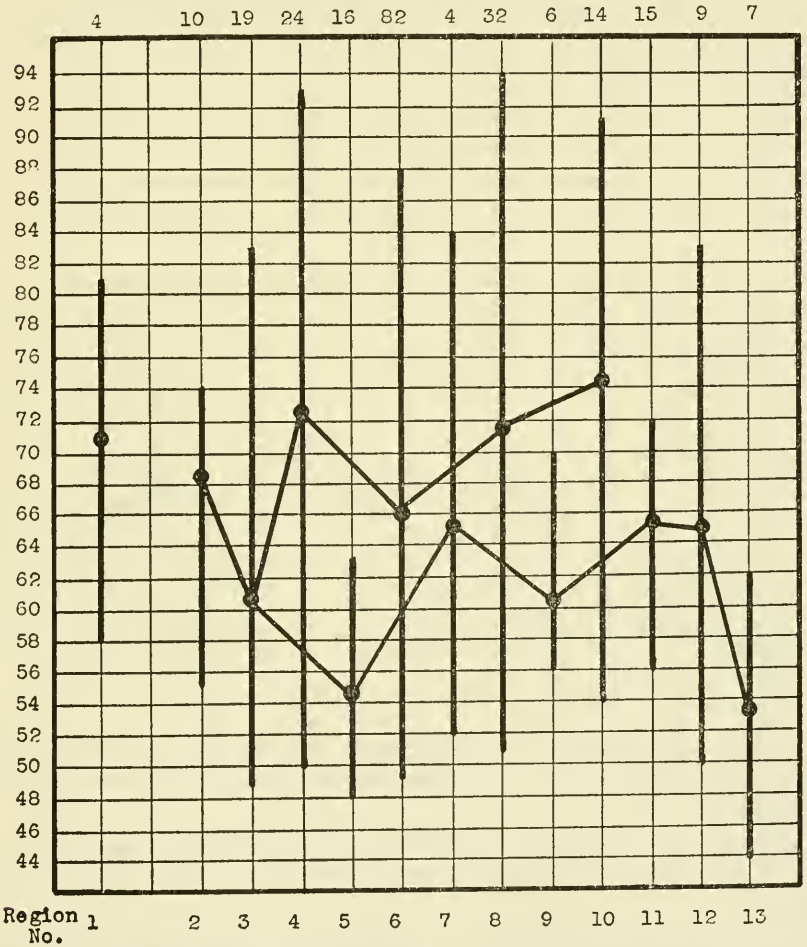

FIGURE 70.—Geographic variation in number of dorsal spots on the body in *Pituophis catenifer catenifer*.

Clara County, Calif., is described by Wright (1878, p. 97) and later by Johnson (1901, p. 526). Wright says:

This two-headed one is 22 inches long, of uncertain age, but perhaps only a few months old, since full-grown ones attain a length of from six to seven feet. Its ground color is a dingy, yellowish-white, with a dorsal row of chestnut brown spots, nearly square and 75 in number, from the point where the two necks separate, extending its full length. On each side are two lateral rows of smaller spots of

similar form and color. It has on each head the two sets of occipital plates, which help to distinguish its species, and one set of three of nearly equal size, in a row between the eyes. There are two additional dorsal spots on each neck above the point of division. From the point where the crotch formed by the two necks begins, to the tip of each snout, is about an inch and a half. The two heads and necks are entirely separated for nearly an inch. Both heads and necks appear perfect and entirely symmetrical in every way. Each head has two eyes, equally large and full. It can shoot out each forked tongue together or one by one. The two perfect mouths open into one throat. Each neck is equally flexible and the movement of each head is perfectly natural and easy. The two heads can be placed closely side by side, or one above the other and even crossed or spread widely apart at will. . . .

Each seems to have equal power, and to be alike subject to separate control and motion. It eats and drinks equally well with either mouth. . . .

Of the same specimen Johnson says: "The angle presented by the frontal planes of the two heads is about 115°, that between the

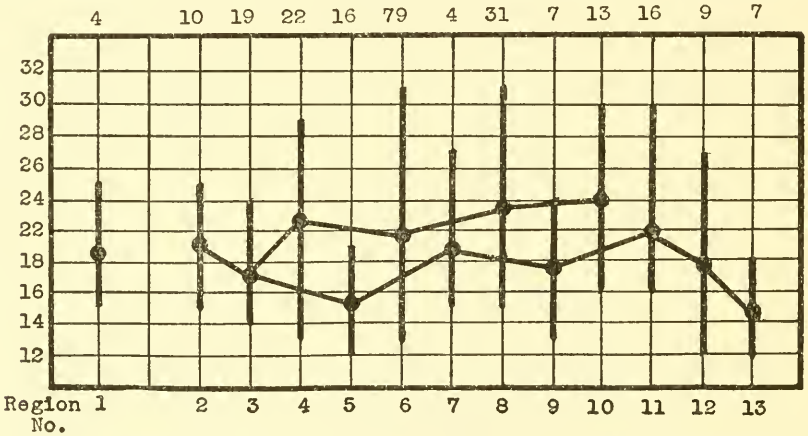

FIGURE 71.—Geographic variation in number of dorsal spots on the tail in *Pituophis catenifer catenifer*.

sagittal planes about 35°. A ventral fold of skin which extends forward from the point of division in the plane of the gastrosteges is present. . . ."

A specimen from Pescadero, San Mateo County, Calif. (M.V.Z. No. 8291), is a partial albino. Of this specimen Storer (1916, p. 74) says:

The specimen under discussion was captured in a dormant state at Pescadero. . . . early in November, 1913, on black adobe soil where gopher snakes were said to be fairly common. . . .

The coloration of a typical gopher snake seems to be made up of three distinct materials; a yellow deposit found generally distributed in the scales of the body and forming the ground color, and two darker pigments, a red and a black, occurring locally and forming the contrasted part of the color pattern. The yellow pigment is present in the scales of the albino specimen as is also (in part at least) the red, but the black is entirely lacking. Upon the anterior portion of the body, where ordinarily the black and red together form brown spots only the

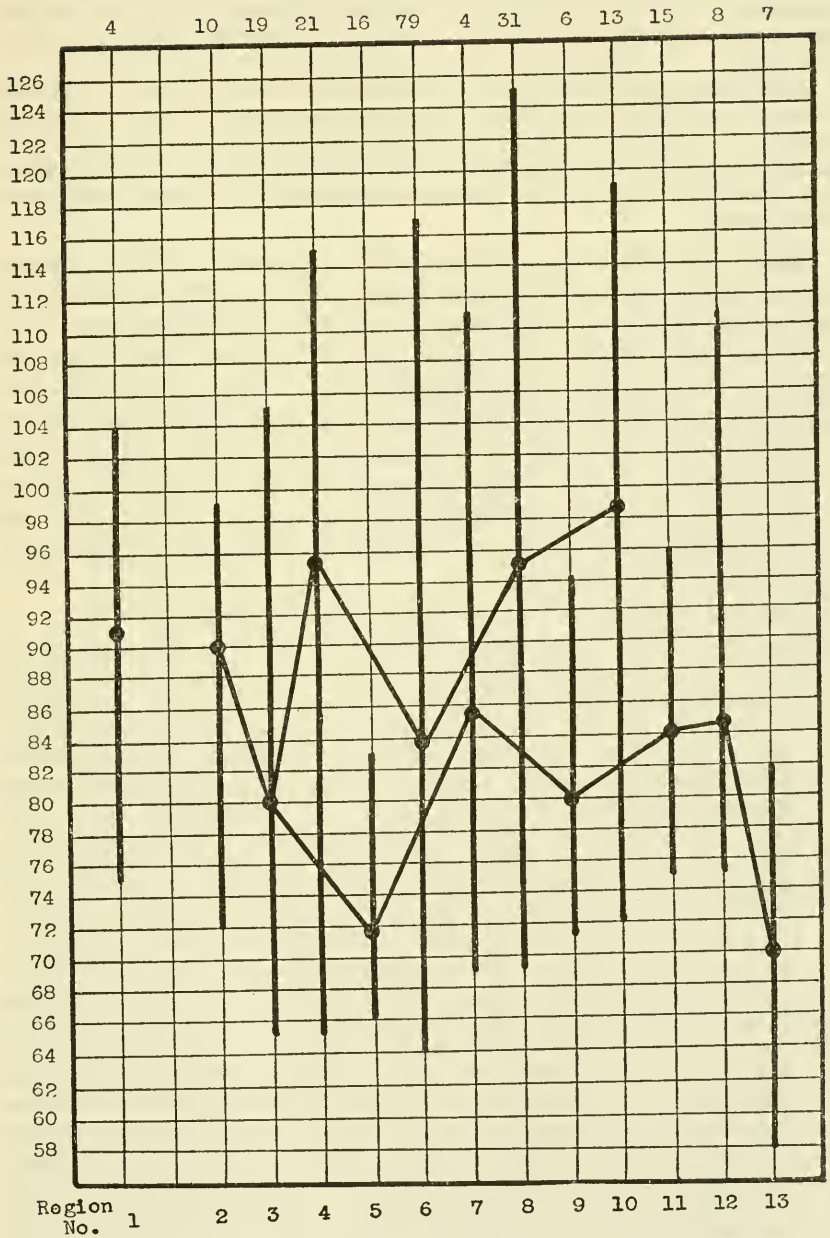

FIGURE 72.—Geographic variation in total number of dorsal spots in *Pituophis catenifer catenifer*.

red is present, and on the tail where a normal specimen is black, only pale bluish or uncolored areas are to be seen. The iris and tongue which are normally dark shared in the loss and were of a light pinkish cast. Evidently the factor controlling the formation and deposition of black pigment failed of operation throughout the entire body.

Accompanying this abnormality in coloration there were irregularities in scale pattern, especially on the head, which suggests that whatever cause operated to prevent the formation of black pigment also may have some effect on scale formation. Several of the head scales are of quite different shape than those found on a normal specimen, and some show suggestions of divisions which were not completed.

Range.—This form ranges from San Diego County, Calif., to Washington, and one specimen has been taken in Vernon, British Columbia. It occurs also on Santa Cruz Island, off the coast of California. It is found as far east in California as Kernville, Kern County; in the southern part of the range as Eldorado and Placer Counties farther north; and as the Warner Mountains in the northeasternmost part of Modoc County. In Oregon it is found as far east as Summer Lake, Lake County, in the southern part, and as Heppner, Morrow County, in the northern part. In Washington it is found west and north of the Columbia River. In the eastern parts of Oregon and Washington it is replaced by *deserticola.*

Specimens have been examined from the following localities:

California: *Alameda County*, Alameda, Berkeley, Leona Heights, near Sunol; *Butte County*, Gridley, Chico; *Contra Costa County*, Walnut Creek, Mount Diablo, San Pablo Valley, Antioch; *Del Norte County*, Indian Creek; *Eldorado County*, Fyffe, Riverton; *Fresno County*, Fowler, Clovis; *Glenn County*, Winslow (west of Fruto); *Humboldt County*, Garberville, Humboldt Bay; *Kern County*, Mount Pinos, Fort Tejon, Kernville, Buttonwillow, Delano, Tehachapi Mountains; *Kings County*, Tulare Lake; *Lake County*, Kelseyville, Lower Lake, Middletown; *Los Angeles County*, Los Angeles, Pasadena, Hollywood, Sierra Madre, Charter Oak; *Madera County*, Madera, Raymond; *Marin County*, Sausalito, Fort Barry, between Mill Valley and Muir Woods, San Anselmo, Manzanita Station, Mailliard, Inverness, Point Reyes, Nicasio, Lagunitas; *Mariposa County*, near Kinsley, Pleasant Valley, Coulterville; *Mendocino County*, Cahto, Willits, Hopland; *Merced County*, Merced, Los Banos, Snelling; *Modoc County*, Goose Lake, between Alturas and Davis Creek, Sugar Hill, Dry Creek in Warner Mountains, Canby; *Monterey County*, Monterey, Carmel, Bradley, Welby, San Lucas, Coburn, Metz; *Napa County*, 2 miles southwest of Napa, Calistoga; *Placer County*, Lander (near Colfax); *San Benito County*, Hollister, San Juan, Carmel Valley; *San Diego County*, Oakzanita; *San Francisco County*, San Francisco; *San Joaquin County*, Tracy, Stockton; *San Luis Obispo County*, 7 miles southeast of Simmler, Shandon, Creston, Pismo, Edna, Pozo, San Juan River; *San Mateo County*, Redwood City, Woodside, Millbrae, Menlo Park, Pescadero; *Santa Barbara County*, Santa Cruz Island; *Santa Clara County*, Stanford University, Palo Alto, Los Gatos, Sunnyvale, Coyote, Coyote Creek, San Jose, Alma, Alum Rock Park; *Santa Cruz County*, Corralitos, Soquel; *Shasta County*, Baird; *Siskiyou County*, Fort Jones, Callahan, Fort Crook; *Solano County*, Montezuma; *Sonoma County*, Guerneville, Duncans Mills, Monte Rio, Petaluma; *Stanislaus County*, Modesto; *Sutter County*, west of West Butte;

Tehama County, Red Bluff; *Trinity County*, Yolla Bolly Mountain; *Tulare County*, Rose Station; *Ventura County*, Lockwood Valley near Tejon Pass; *Yolo County*, Grant Island west of Knights Landing. The following additional California records could not be discovered in any available atlas: Pine Hill Junction, Fort Lyon, and source of the Salinas River.

Oregon: *Douglas County*, Camas Mountains, Roseburg; *Gilliam County*, Willows; *Lake County*, Summer Lake; *Morrow County*, Heppner; *Multnomah County*; *Wasco County*, The Dalles, Sherars Bridge; Columbia River.

Washington: *Chelan County*, Meadow Creek; *Okanogan County*, Omak Lake; *Pierce County*, Fort Steilacoom; *Yakima County*, Wenas Creek; Puget Sound.

British Columbia: *Yale*, Vernon.

The following additional records for the form have been published:

California: *Alameda County*, Hayward (Van Denburgh, 1897, p. 198; Van Denburgh and Slevin, 1919, p. 212; Van Denburgh, 1920, p. 13; Van Denburgh, 1922, vol. 2, p. 711); *Butte County*, between Live Oak and Gridley (Van Denburgh and Slevin, 1919, p. 213; Van Denburgh, 1920, p. 16; Van Denburgh, 1922, vol. 2, p. 717); *Fresno County*, Pitman Creek (Van Denburgh 1897, p. 196); *Marin County*, Buddha Canyon (Van Denburgh and Slevin, 1919, p. 212; Van Denburgh, 1920, p. 13; Van Denburgh, 1922, vol. 2, p. 711); *Sacramento County*, 4 miles southeast of Folsom (Burt and Burt, 1929b, p. 456); *San Joaquin County*, Consumnes River [east of Stockton] (Hallowell, 1859, p. 15); *Shasta County*, McCloud River (Townsend, 1887, p. 239; Van Denburgh, 1897, p. 198; Van Denburgh and Slevin, 1919, p. 213; Van Denburgh, 1920, p. 16; Van Denburgh, 1922, vol. 2, p. 717); *Siskiyou County*, Mount Shasta (Townsend, 1887, p. 239; Van Denburgh, 1897, p. 198; Van Denburgh and Slevin, 1919, p. 213; Van Denburgh, 1920, p. 16; Van Denburgh, 1922, vol. 2, p. 717); *Tehama County*, Tehama (Van Denburgh and Slevin, 1919, p. 213; Van Denburgh, 1920, p. 16; Van Denburgh, 1922, vol. 2, p. 717).

Oregon: *Klamath County*, Klamath Falls (Van Denburgh and Slevin, 1919, p. 213; Van Denburgh, 1920, p. 16; Van Denburgh, 1922, vol. 2, p. 717); "Willmette Valley" (Baird, 1859b, p. 11; probably properly Williamette Valley); "Foot of the Galton Mts." (Lord, 1866, vol. 2, p. 307).

Washington: *Stevens County*, Colville (Lord, 1866, vol. 2, 307; Van Denburgh and Slevin, 1919, p. 213; Van Denburgh, 1920, p. 16; Van Denburgh, 1922, vol. 2, p. 717); *Whatcom County*, Sumas (Lord, 1866, vol. 2, p. 307); *Yakima County*, Yakima Valley (Cooper, 1860, p. 300).

Habits and habitat.—More has been recorded of the habits of this snake than of those of most of the forms of *Pituophis*, but in consideration of its great abundance in California it is surprising that so little is actually known.

Hallowell (1853, p. 236; 1859, p. 15) says the type specimen of "*heermanni*" "came from the mines, in the vicinity of the Consumnes river; one specimen was found under a log, and Dr. Heermann found several basking in the sun, during the middle of the day, on the banks of streams, in sandy and gravelly places."

Girard says of the genus (1858, p. 134), with special reference to *catenifer:* "They are of terrestrial habits. Quite timid in spite of their great size."

Cooper (1860, p. 300) gives the following note: "This large snake. . . is . . . quite harmless, and must destroy a great many mice, gophers, and other vermin. . . . It is . . . mostly confined to the open country."

The following note is given by Lord (1866, vol. 2, p. 307): "In the spring it keeps on the grassy prairie land, but in the hot weather retires to the shores of lakes and ponds, or the margins of streams, and spends much of its time in the water."

Van Denburgh gives several notes on this form. In an early paper (1897, p. 198) he says: "Its food so far as known, consists of small mammals, of which gophers are said to form a large part." A description is given elsewhere (1898, p. 139) of 19 eggs laid by a female in captivity on July 14 and 15. In a later paper (1922, p. 712), the following notes on feeding habits are given: "Young birds also are sometimes eaten. On one occasion a half-grown snake of this kind was found in an aviary where domestic canaries were breeding. . . . When I opened it I found three nearly fledged young canaries."

Ditmars (1907, p. 321) says of *catenifer:* "This snake is of a less vicious disposition than the other species. When greatly disturbed it hisses loudly and vibrates the tail."

Grinnell (1907, p. 46) stresses the value of this form to farmers in destroying pocket gophers and squirrels, and advocates protecting and encouraging it. Of its hibernation, he says: "The gopher snake hides away during the winter months in rock-piles, and possibly in holes in the ground." The same author (1908, p. 165) describes the death of an individual from "sunstroke due to violent exercise in the hot sun" where it was kept in an attempt to photograph it. The specimen was found at 6,200 feet elevation. Another was seen at "about 4,300 feet altitude" in Mountain Home Canyon "climbing among the lower branches of a scrubby golden oak a yard or more above the ground."

Storer (1916, p. 75) gives a detailed account of the molting process in the albino specimen mentioned above.

Grinnell and Camp (1917, p. 193) give the range of *catenifer* in California as "the whole length of the state west of the desert divides, but chiefly east of the coast redwood belt. . . . Occupies Lower and Upper Sonoran and Transition life-zones. Shows no particular restrictions as regarding habitat, though certainly not aquatic."

Fisher (1924, p. 108) gives an account of the breeding of *catenifer* in captivity which may be briefly quoted as follows:

> Copulation was first noted on the night of April 21. In the morning of April 22 it was again observed. . . . It was noted to continue between 9:30 A. M. and 12:05 P. M. . . . On April 28 another female gopher snake was put in the cage, and the following day copulation with the original male took place. . . . The first female and male were brought to Berkeley June 21 and put in a large cage.

. . . . While kept in the laboratory, copulation was attempted several times. . . . Although there were two other gopher snakes of about the same size in the cage with this pair, there were no signs of friendship toward them by either of the mated pair in question. The male and the female stayed in the same part of the cage and seldom mingled with the other snakes, though there were no hostile actions. . . . On August 7, five eggs were found in the cage in the corner with the female, and the next day five more were laid. . . . They . . . were found scattered about the corner of the cage occupied by the female. There was no noticeable attempt on the part of the female to protect, or maintain contact with, the eggs. On August 9, I opened one of the eggs and found an embryo within, well started in development. Embryonic development had evidently begun some time previous to the laying of the eggs. [An attempt to hatch the eggs was unsuccessful.]

Affinities.—The closest affinities of *catenifer catenifer* are undoubtedly with the forms *c. deserticola* and *c. annectens*. Although in the number of dorsal spots there is a continuous increase from *deserticola* to *catenifer* to *annectens*, most of the scale counts show a decrease from *deserticola* to *catenifer* but not to *annectens*. This seems to indicate that both *catenifer* and *annectens* are derived directly from *deserticola* and exhibit different evolutionary tendencies in scale variation, but a similar tendency in pattern variation, which is, however, further developed in *annectens* than in *catenifer*. The probable relationships of these forms have been expressed by the diagram on page 133.

Table 12 lists the specimens of this form that have been examined.

136423—40——11

TABLE 12.—*Specimens of* Pituophis catenifer catenifer *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 5471 (type of wilkesii).	Puget Sound, Wash.	♂	25-29-23	215	56	271	8/9	11	2	3	62	20	82	106	0.132	1	0
U.S.N.M. No. 56519	Los Angeles County, Calif.	♀	27-31-23	219	75	294	9/8	13	1	2/3	74	25	99	55	0.163	1	0
U.S.N.M. No. 13937a	Berkeley, Calif.	♀	29-33-21	212	67	279	8	13	1	3	59	17	76	39	0.153	1	0
U.S.N.M. No. 13937b	do	♀	29-33-23	221	61	282	9	12	1	3/4	62	21	83	39	0.141	1	0
U.S.N.M. No. 8590	Kernville, Calif.	♂	27-31-21	227	66	293	8	12	2	4	57	19	76	48	0.145	1	0
U.S.N.M. No. 9244a	The Dalles, Oreg.	♀	29-31-23	226	60	286	8	13	2	3	58	17	75	104	0.134	1	0
U.S.N.M. No. 9244b	do		—31—														
U.S.N.M. No. 10812	Columbia River, Oreg.	♀	29-31-23	229	62	281	8/9	13	2	3	62	18	80	39	0.141	2	0
U.S.N.M. No. 56518	Multnomah County, Oreg.	♂	29-31-23	226	69	295	8	12	2	3	83	27	110	94	0.159	1	0
U.S.N.M. No. 44329	Willows, Oreg.	♂	29-31-23	226	69	295	9/8	13/12	1	3	63	22	85	77	0.155	1	0
U.S.N.M. No. 44454	Cahto, Calif.	♂	29-31-23	218	79	297	9	13/12	2	3	85	30	115	95	0.178	1	2
U.S.N.M. No. 44455	do	♂	29-31-23	210	72	282	8	12	2	3	76	26	102	54	0.166	1	0
U.S.N.M. No. 44394	Sherars Bridge, Oreg.	♀	29-31-23	225	66	291	8	13	2	3	59	18	77	54	0.157	1	2
U.S.N.M. No. 44236	Heppner, Oreg.	♂	29-31-23	222	67	289	8/9	12	2	4	59	19	78	106	0.150	3/2	1
U.S.N.M. No. 63278	Omak Lake, Okanogan County, Wash.	♀	29-31-23	224	54	278	8	11/13	2	4/3	48	15	63	86	0.139	1	0
U.S.N.M. No. 63277	do	♀	29-31-23	225	63	288	8	11	1/2	4	58	19	77	96	0.146	2	0
U.S.N.M. No. 61630	Meadow Creek, Chelan County, Wash.	♀	27-21-23	233	55	288	8	11	1/2	3	44	14	58	70	0.128	1	0
U.S.N.M. No. 2287	Fort Steilacoom, Wash.	♀	27-31-22	213	64	277	8/9	12/13	2	3	54	20	74	114	0.166	1	0
U.S.N.M. No. 1822	Wenas Creek, Wash.	♂	29-31-23	214	71	285	9	12	2	3	54	19	73	106	0.165	1	0
U.S.N.M. No. 50285	Sausalito, Calif.	♀	31-33-23	214	62	276	8	13/12	2	3	76	23	99	98	0.153	1	0
U.S.N.M. No. 50286	do	♀	27-31-23	224	60	284	8	12/11	2	4	54	17	71	106	0.141	1	0
U.S.N.M. No. 50287	do	♂	29-31-21	215	64	279	8	11/12	1	3	68	20	88	116	0.146	1	0
U.S.N.M. No. 50281	do	yg.	29-31-22	217	63	280	9	11/12	2	3	58	20	78	31	0.161	1	0
U.S.N.M. No. 35736	Menlo Park, Calif.	♂	29-33-23	218	70	288	9/8	13	2	4	65	24	89	136	.147	1	0
U.S.N.M. No. 35738	do	♀	29-31-23	213			8	12	2	3/4	59					1	0
U.S.N.M. No. 52658	Calistoga, Napa County, Calif.	♀	29-31-23	220	66	286	8/9	13	2	4	77	21	98	103	0.155	1	2

U.S.N.M. No. 52659	do	♂	29-31-22	211	71	282	8	10/11	2	4/3	70	24	94	127	.165	1	0
U.S.N.M. No. 52660	do	♂	27-33-23	211	69	280	8	12/13	2	4/3	69	26	95	79	0.164	1	2
U.S.N.M. No. 52636	do	♀	29-31-23	218	59	277	8	13/12	2	3	64	20	84	76	0.144	1	1
U.S.N.M. No. 56525	Napa County, Calif.	♀	29-31-23	224	65	289	8/9	12	2	3	73	23	96	55	0.145	2	0
U.S.N.M. No. 56524	Southern California	yg.	29-31-23	213	67	280	8	13	2/1	3	63	23	86	37	0.162	1	0
U.S.N.M. No. 52637	Calistoga, Napa County, Calif.	yg.	29-33-25	223	63	286	8	12/13	2	3	69	20	89	47	0.151	1	0
U.S.N.M. No. 50280	Fort Barry, Marin County, Calif.	♀	27-29-21	207	68	275	8	11	1	3	70	22	92	91	0.164	1	0
U.S.N.M. No. 51781	Stockton, Calif.	♀	27-29-22	229	54	283	8	11	2	2/3	53	15	68	127	0.133	2	0
U.S.N.M. No. 50722	Stanford University, Calif.	yg.	29-31-23	215	62	277	9/8	11/12	1	3	65	23	88	43	0.151	1	0
U.S.N.M. No. 28293	do	yg.	29-31-23	221	59	280	9	13	2	4	73	22	95	34	0.147	1	1
U.S.N.M. No. 8594	Southern California	♀	28-20-23	223	65	288	8	12	1	3	78	21	99	79	0.151	1	0
U.S.N.M. No. 1816	Monterey, Calif.	♂	27-29-20	210	71	281	8/9	12	2	4/3	76	25	101	86	0.168	1	0
U.S.N.M. No. 10731	do	♀	29-31-23	221	68	289	8	12	2	6/4	77	21	98	60	0.158	3	0
U.S.N.M. No. 48679	Lagunitas, Calif.	♀	29-31-23	224	60	284	8	11/12	2	3	70	19	89	96	0.156	1	0
U.S.N.M. No. 23735	Pacific Coast, Calif.	♂	27-29-23	219	68	287	8	13/14	2	4	62	16	78	72	0.152	1	0
U.S.N.M. No. 19142	Butte County, Calif.	yg.	27-31-23	222	62	284	9/8	13	2	3	57	17	74	40	0.150	1	2
U.S.N.M. No. 51005	Millbrae, San Mateo County, Calif.	yg.	29-33-23	209	66	275	8	11	2	4/3	64	23	87	37	0.162	1	0
U.S.N.M. No. 44373	Tulare Lake, Calif.	♂	17-31-23	225	67	292	8	13	2	5	61	21	82	102	0.166	2	1
U.S.N.M. No. 44374	do	♂	27-31-21	213	60	273	8	13	2	3/4	54	16	70	-------	-------	1	0
U.S.N.M. No. 18064	Old Fort Tejon, Calif.	♂	29-31-23	227	68	295	8	14	1/2	3	66	21	87	103	0.155	1	0
U.S.N.M. No. 8003a	do	♂	29-31-23	225	74	299	9	12/14	2	3	59	19	78	115	0.174	1	1
U.S.N.M. No. 8003b	do	♀	30-33-25	234	67	301	8	12	2	3	66	18	84	49	0.142	1	1
U.S.N.M. No. 8003c	do	♂	29-31-23	217	66	283	8	13	2/1	3	-------	-------	-------	120	0.166	1	0
U.S.N.M. No. 13932	Red Bluff, Calif.	♂	27-29-23	214	73	287	9	13	2	4	64	23	87	43	0.162	1	2
U.S.N.M. No. 13933	do	♀	28-31-23	224	59	283	8	13/12	1	3	56	15	71	84	0.142	1	0
U.S.N.M. No. 5469	California	♂	29-31-22	228	72	300	8/9	12/13	2	3	58	19	77	98	0.147	1	0
U.S.N.M. No. 8782	do	♀	27-29-21	212	61	273	8	12	2	3/2	63	20	83	81	0.148	1	0
U.S.N.M. No. 9130	do	♀	29-31-23	224	-------	-------	8/9	13/14	2	3	63	-------	-------	-------	-------	1	1
U.S.N.M. No. 2443	Petaluma, Calif.	♂	31-33-23	218	74	292	8/9	12	1/2	2	71	25	96	88	0.170	1	0
U.S.N.M. No. 1804	Humboldt Bay, Calif.	♂	31-33-23	206	71	277	8	12	2	3	57	19	76	125	0.136	1	0
U.S.N.M. No. 13978a	Baird, Shasta County, Calif.	♂	28-31-23	223	72	295	9/8	13/12	2	4/3	62	22	84	117	0.153	1	2
U.S.N.M. No. 13978b	do	♀	31-33-23	221	61	282	9/8	14	2	4/5	63	19	82	100	0.150	1	1

TABLE 12.—*Specimens of* Pituophis catenifer catenifer *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 13802a	Baird, Shasta County, Calif.	♂	27-31-21	215	72	287	8	13	2	3	-------	-------	-------	121	0.169	1	1
U.S.N.M. No. 13802b	-----do-----	♀	28-31-24	222	61	283	8	13	2	3	68	18	86	118	0.139	1	0
U.S.N.M. No. 13802c	-----do-----	♀	27-31-23	226	67	293	8	12/13	2	3	68	22	90	113	0.154	1	2
U.S.N.M. No. 9103	Fort Crook, Calif.	♂	27-31-21	215	74	289	8	13	1	4	72	24	96	126	0.166	1	0
U. Mich. No. 3736	Humboldt Bay Calif.	♂	29-31-23	215	67	282	9	12	2	3	-------	20	-------	103	0.165	1	0
U. Mich. No. 4092	Monterey, Calif.	♂	29-31-21	209	79	299	8	11/12	2	4	-------	30	-------	124	0.185	1	0
U. Mich. No. 55286	Santa Cruz County, Calif.	♂	31-33-23	221	61	282	8	12	3	4	78	20	98	47	0.149	1	0
U. Mich. No. 55287	-----do-----	♂	29-31-23	220	71	291	8	12	2/1	3	90	20	120	48	0.146	1	0
U. Mich. No. 58865	Stanford University, Calif.	♂	29-31-23	216	75	291	9	13	2	3	70	22	92	37	0.162	1	0
U. Mich. No. 64899	Oregon	♂	29-49-21	212	74	286	8	12	2	3	74	24	98	100	0.165	1	2
U. Pa. No. x	California	♂	31-33-23	217	74	291	8/9	13	2	3/4	70	30	100	116	0.176	2/1	0
Carnegie No. 4013	Mount Pinos, Calif.	yg.	29-31-23	217	65	282	8	13	2	3	64	20	84	45	0.155	1/2	0
Field No. 955	Nicasio, Marin County, Calif.	♀	31-35-25	223	68	291	8	13	1	3	79	25	104	112	0.151	1	0
Field No. 951	-----do-----	♀	31-33-25	221	66	287	8/9	12	2	4	72	22	94	96	0.161	1	0
Field No. 954	-----do-----	yg.	29-31-23	220	66	286	8	12	1	3	72	20	92	39	0.153	1	0
Field No. 1429	Rose Station, Calif.	♀	31-33-23	225	55	280	9/8	14/13	2	3	55	16	71	114	0.122	1	0
Field No. 1710	Near Fort Tejon, Calif.	yg.	29-31-23	222	67	289	8	14	2	4/5	56	17	73	38	0.156	2	0
Field No. 856a	Redwood City, Calif.	♂	31-31-23	217	65	282	9/8	13	2/1	3	61	21	82	42	0.154	1	0
Field No. 856b	----do-----	♂	29-31-21	219	-------	-------	8	14	1/2	3	65	-------	-------	-------	-------	1	0
Field No. 856c	-----do-----	yg.	29-33-23	221	63	284	8	12	2	4/3	68	22	90	44	0.147	2/1	2
M.C.Z. No. 153	California	♀	31-31-23	215	-------	-------	8/9	14	2	3	70	-------	-------	-------	-------	1	2
M.C.Z. No. 341	San Francisco, Calif.	♀	29-33-23	225	60	285	9	14/13	2	3	70	18	88	118	0.135	2/1	0
M.C.Z. No. 410	Fort Lyon, Calif.	♂	29-31-23	215	66	281	8	11	2	3	66	20	86	83	0.156	1	0
M.C.Z. No. 8165	Palo Alto, Calif.	yg.	29-33-23	228	64	292	8	12	2	4	53	18	71	35	0.142	1	0
M.C.Z. No. 22803	Montezuma, Calif.	♀	29-31-23	218	63	281	8	12/13	2	4/3	57	18	75	151	0.145	1	0
M.C.Z. No. 21203	Fowler, Fresno County, Calif.	♂	29-31-23	222	60	282	9/8	13	2	5/4	60	19	79	82	0.146	2/1	1

M.C.Z. No. 12679	Santa Cruz Island, Calif.	yg.	27-29-21	221	61	282	8	11/12	2	3	81	22	103	23.5	0.149	1	0
M.V.Z. No. 5284	8 miles east of Yolla Bolly Mountain, Trinity County, Calif.	♀	27-31-23	222	68	290	8/9	14/13	2	3	75	23	98	117	0.153	1	0
M.V.Z. No. 848	Berkeley, Calif.	♂	29-31-23	214	72	286	8	13/12	1	3	78	22	100	95	0.157	1	0
M.V.Z. No. 2434	do	♂	29-31-23	215	67	282	8	12/13	1	7/4	70	22	92	35	0.142	1	0
M.V.Z. No. 1589	do	♀	29-29-21	216	73	289	8	13	1	3	67	24	91	36	0.166	1	0
M.V.Z. No. 2314	do	yg.	29-31-23	219	59	278	9/8	12/13	1/2	3	75	18	93	20	0.150	1	0
M.V.Z. No. 9206	do	♂	27-26-21	211	73	284	8/9	13	2	3/4	65	21	86	106	0.160	1	0
M.V.Z. No. 9322	do	♂	29-31-23	221	65	287	8	13/12	2/3	3	55	18	73	133	0.142	2/1	0
M.V.Z. No. 1626	do	♂	29-31-23	213	70	283	8	13/14	2	3/4	65	23	88	116	0.155	2/1	0
M.V.Z. No. 4014	Winslow, west of Fruto, Glenn County, Calif.	♂	27-29-23	224	74	298	8/9	13	2	3	63	24	87	84	0.166	1	0
M.V.Z. No. 4016	do	♀	29-31-22	224	67	291	8	13	2	4/3	54	18	72	61	0.147	1	0
M.V.Z. No. 4015	do	♀	29-33-23	219			3/9	13	2	5	58					1	1
M.V.Z. No. 5285	Inverness, Marin County, Calif.	♂	29-33-23	209	70	279	9/8	13	2	3	74	23	97	91	0.164	1	0
M.V.Z. No. 2768	7 miles southeast of Simmler, San Luis Obispo County, Calif.	♂	29-31-22	228	63	291	8	13	2	3	52	18	70	134	0.141	1	0
M.V.Z. No. 2764	do	♂	29-33-23	230	67	297	8	13/14	2	5/3	55	18	73	77	0.155	1	0
M.V.Z. No. 2759	Tracy, San Joaquin County, Calif.	♂	29-33-23	224			9/8	13	2	3	57					1	0
M.V.Z. No. 4017	Walnut Creek, Contra Costa County, Calif.	♂	27-31-22	218	75	293	9/8	13	2	4	59	22	81	132	0.159	1	0
M.V.Z. No. 4018	Mount Diablo, Contra Costa County, Calif.	♂	29-31-23	221	70	291	8	12	2	3	67	21	88	122	0.155	1	0
M.V.Z. No. 4019	do	♀	29-31-23	226	62	288	8	14/15	2	4	67	21	88	102	0.137	1	1
M.V.Z. No. 5614	San Pablo Valley, Contra Costa County, Calif.	♂	29-31-23	216	64	280	8	13/14	2	3/4	64	19	83	136	0.147	2	1
M.V.Z. No. 849	Contra Costa County, Calif.	♀	27-31-21	224	60	284	9	11/12	1/2	2	56	18	74	90	0.133	1	0
M.V.Z. No. 2081	Goose Lake, Modoc County, Calif.	♂	29-31-23	210	68	278	8	12	2	3	63	20	83	141	0.156	2/1	2
M.V.Z. No. 2080	Between Alturas and Davis Creek, Modoc County, Calif.	♂	27-31-21	219	73	292	9/8		2	3/4	63	25	88	137	0.160	1	0

TABLE 12.—*Specimens of* Pituophis catenifer catenifer *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
M.V.Z. No. 2082	Sugar Hill, Modoc County, Calif.	♂	27-31-23	216	67	283	7	13/12	1	3	56	19	75	120	0.158	0/1	0
M.V.Z. No. 2083	Dry Creek, Warner Mountains, Calif.	♀	29-31-23	222	72	294	8	12/13	2	4/3	57	19	76	128	0.164	1	0
M.V.Z. No. 7121	Hollywood, Calif.	♀	31-23	220	73	293	8/7	-------	2	4	68	20	88	47	0.148	2	0
M.V.Z. No. 9463	Modesto, Calif.	♂	29-31-23	219	68	287	8	13	2	4/3	48	18	66	39	0.153	2/1	0
M.V.Z. No. 749	Pasadena, Calif.	♂	31-33-24	227	73	300	8	13/14	2	3	73	23	96	146	0.157	1	0
M.V.Z. No. 750	----do----	♀	31-33-25	231	63	294	8	13/11	1	3	67	20	87	44	0.136	1	0
M.V.Z. No. 7203	Between Mill Valley and Muir Woods, Marin County, Calif.	♂	29-31-22	209	67	276	8	13/14	2	3	90	27	117	113	0.141	1	1
M.V.Z. No. 5283	San Anselmo, Marin County, Calif.	♂	27-31-23	218	68	286	8	12	1	3	79	30	109	100	0.170	1	0
M.V.Z. No. 5282	----do----	♂	29-33-23	216	71	287	8	12	1	3	94	31	125	114	0.166	1	0
M.V.Z. No. 4845	Near Manzanita Station, Marin County, Calif.	♀	27-29-21	214	69	283	8	11	2	3	68	24	92	36	0.152	1	0
M.V.Z. No. 975	Mailliard, Marin County, Calif.	♀	29-31-23	219	66	285	8	13	1	3	73	24	97	38	0.144	1	2
M.V.Z. No. 4911	Guerneville, Sonoma County, Calif.	♂	29-33-23	212	74	286	9/8	13	1/2	3	81	30	111	114	0.175	1	0
M.V.Z. No. 4131	Monte Rio, Russian River, Sonoma County, Calif.	♀	29-31-23	217	64	281	8/9	12	2	4	75	25	100	36	0.139	1	0
M.V.Z. No. 6166	Alma, Santa Clara County, Calif.	yg.	29-33-23	220	62	282	8	12	1	3	64	24	88	32	0.140	1	0
M.V.Z No. 10515	Alum Rock Park, Santa Clara County, Calif.	♀	29-31-23	224	59	283	8	13	2	3	60	18	78	39	0.141	2	0
M.V.Z. No. 10544	Petaluma, Calif.	♀	29-33-23	223	-------	-------	8	13/12	2	3	77	-------	-------	-------	-------	1	0
M.V.Z. No. 5883	Coulterville, Mariposa County, Calif.	♀	29-33-23	217	60	277	10	14	2	4/3	54	14	68	105	0.142	1	0

M.V.Z. No. 5884	do	♀	29-33-23	230	61	291	8	14	2	4	55	19	74	64	0.156	2/1	0
M.V.Z. No. 4012	Chico, Butte County, Calif.	♂	27-31-23	222	68	290	9/8	14/12	2	3	70	24	94	131	0.152	1	0
M.V.Z. No. 5595	Snelling, Merced County, Calif.	♀	29-33-23	226	59	295	8/9	13	2	4	59	16	75	90	0.144	1	0
M.V.Z. No. 4010	West of West Butte, Sutter County, Calif.	♂	——23		70							18					
M.V.Z. No. 8291	Pescadero, San Mateo County, Calif.	♀	27-31-23	223	66	289	8	13	2	3				84	0.154	1	0
M.V.Z. No. 8227	Near Sunol, Alameda County, Calif.	♂	29-31-23	218	69	287	8	13	2	3	72	23	95	49	0.153	1	0
M.V.Z. No. 2758	No data	♂	29-33-23	229	65	294	8	12	1	3	61	21	82	57	0.131	1	0
M.V.Z. No. 2757	Raymond, Madera County, Calif.		29——				8/9	14	2	4						2/1	0
M.V.Z. No. 4011	Grant Island, west of Knights Landing, Yolo County, Calif.	♂	27-29-23	219	73	292	8	12	2	4/5	58	20	78	115	0.165	1	1
M.V.Z. No. 7263	Hopland, Mendocino County, Calif.	♂	28-31-23	222	70	292	8/9	11	2	4/3	91	28	119	40	0.162	1	0
M.V.Z. No. 4312	2 miles southwest of Napa, Calif.	♂	29-31-23	212	69	281	9/8	12/13	2	3	72	26	98	35	0.157	1	0
M.V.Z. No. 3608	Los Banos, Calif.	♀	29-33-23	231	56	287	8	13	2	4	53	15	68	153	0.124	1	0
M.V.Z. No. 5885	Near Kingsley, Mariposa County, Calif.	♀	29-33-23	230	56	286	10/9	13	1	4	53	15	68	55	0.136	1	0
M.V.Z. No. 5886	Pleasant Valley, Mariposa County, Calif.	♂	29-31-23	223	66	289	8	13	2	4	51	19	70	105	0.152	1	0
M.V.Z. No. 7249	San Lucas, Monterey County, Calif.	♂	27-31-23	217	77	294	9	11	2	3	70	25	95	127	0.165	2	0
Stanford No. 4049	Stanford University, Calif.						9/8	14	2	4						1	0
Stanford No. 1171	do	♂	29-33-23	218	69	287	8	13	2	3	54	20	74	96	0.156	1	0
Stanford No. 1749	do	♀	31-33-23	226	63	289	9	14	2	3	58	18	76	39	0.153	1	0
Stanford No. 1168	do	♀	29-33-23	225	62	287	8	13	2	3	67	21	88	41	0.147	1	0
Stanford No. 4045	do	♂	27-31-23	222	66	288	9/8	13	2	4	60	17	77	36	0.152	1	0
Stanford No. 1748	do	♀	27-31-23	220	69	289	8	13/12	2	3	64	23	87	36	0.152	1	0
Stanford No. 1773	do	♀	29-33-23	223	56	279	8/9	11	2	3	64	16	80	39	0.141	1	0
Stanford No. 1119	do	yg.	27-31-23	230	60	290	10/9	14	2	3/4	70	21	91	37	0.135	1	0
Stanford No. 4043	do	♂	29-33-23	224	64	288	8	11/12	2/1	3	66	22	88	163	0.135	1	0
Stanford No. 1117	do	♀	29-33-23	223	61	284	8	12	2	3/4	71	21	92	41	0.146	1	1

TABLE 12.—*Specimens of* Pituophis catenifer catenifer *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
Stanford No. 1751	Stanford University, Calif.	♀	29-33-23	214	56	270	9	13/12	2	3	58	15	73	38	0.144	1	0
Stanford No. 5806	do	♀	29-33-23	224	57	281	8	13	2	4/3	72	20	92	39	0.141	1	1
Stanford No. 7195	do	♀	31-33-25	225	64	289	9	13/12	2	3	71	22	93	40	0.150	1	2
Stanford No. 4046	do	♀	29-31-23	212	67	279	9/8	12/11	2	4/3	70	23	93	44	0.147	1	0
Stanford No. 1747	do	♂	29-31-23	221	62	283	8	13/12	2	4	64	19	83	94	0.141	2	1
Stanford No. 4044	do	♀	29-31-23	225	68	293	8	13	2	3	62	21	83	41	0.146	1	0
Stanford No. 4048	do	♀	29-31-23	232	65	297	8	13	2	3	77	22	99	50	0.140	1	0
Stanford No. 4047	do	♂	29-33-23	217	68	285	8	13	1	3	66	22	88	42	0.166	1	1
Stanford No. 4042	do	♂	28-31-23	221	71	292	8	12	2/1	3/4	78	25	103	131	0.152	1	0
Stanford No. 1790	do	♀	29-33-23	232	60	292	8/9	13	1	3	66	20	86	52	0.135	1	0
Stanford No. 1752	do	♂	29-31-23	217	74	291	8	12	2	4/3	65	25	90	117	0.153	1	0
Stanford No. 1118	do	♂	29-33-23	219	72	291	8	13/12	2	4	63	24	87	39	0.153	1	0
Stanford No. 1169	do	♂	31-33-23	220	71	291	8/9	13	2	4	57	22	79	38	0.157	1	0
Stanford No. 1808	Palo Alto, Santa Clara County, Calif.	♀	29-31-23	219	67	286	8/9	13	2	3/4	88	29	117	42	0.142	1	1
Stanford No. 1799	do	♂	29-31-23	217	71	288	8	13	2	4/3	70	28	98	39	0.153	1	0
Stanford No. 1798	do	♂	29-33-23	218	69	287	9	14	2	4	20	24	94	38	0.157	1	0
Stanford No. 4017	do	♀	29-31-23	215	64	279	8	11/12	1	3	71	19	90	31	0.145	1	0
Stanford No. 4026	do	♂	29-33-23	215	67	282	8	13/14	2	4/3	64	20	84	151	0.152	1	0
Stanford No. 1150	do	♂	31-33-23	215	71	286	8/9	12	2	3/4	64	22	86	58	0.155	1	0
Stanford No. 1165	Coyote Creek, Santa Clara County, Calif.	♂	29-31-23	223	69	292	8	14/13	2	3	72	24	96	105	0.161	1	0
Stanford No. 6500	Lander, near Colfax, Calif.	♀	30-33-23	219	62	281	9	13	2	4	52	17	69	88	0.147	1	0
Stanford No. 1163	Coyote Creek, Santa Clara County, Calif.	♀	29-33-23	225	64	289	8	12	2/1	3	56	20	76	71	0.154	1	0
Stanford No. 1740	Fort Jones, Calif.	♀	29-31-23	219	62	281	9/8	12	2	4/3	62	20	82	98	0.142	1	0
Stanford No. 1741	Kelseyville, Lake County, Calif.	♂	29-31-23	223	64	287	8	12/13	1	2/3	70	19	89	44	0.147	1	0
Stanford No. 1697	do	♀	29-31-23	222	68	290	8/9	12/11	2	3	65	71	86	58	0.155	1	0

Stanford No. 4220	Garberville, Humboldt County, Calif.	♂	29–33–23	220	73	293	9	13/11	2	3	84	27	111	72	0.165	1	0
Stanford No. 5633	Fyffe, Eldorado County, Calif.	♀	27–31–23	219	69	288	8/9	13	2	3	59	23	82	36	0.152	2	1
Stanford No. 5631	do	♀	31–35–25	219	63	282	8	13/12	2	4	59	21	80	54	0.157	1	1
Stanford No. 4092	Corralitos, Santa Cruz County, Calif.	♂	29–33–23	211	70	281	8	13	2	4	72	25	97	57	0.157	1	0
Stanford No. 1681	Soquel, Santa Cruz County Calif.	♂	29–31–23	225	74	299	9	12	2	3/4	82	31	113	102	0.166	1/2	0
Stanford No. 1772	do	♂	29–33–23	218	69	287	8	13	2	3	83	27	110	42	0.154	2	0
Stanford No. 5163	Charter Oak, Los Angeles County, Calif.	♂	29–33–23	219	73	292	8	13	1	2/3	65	21	86	83	0.167	1	0
Stanford No. 1170	San Diego County, Calif.	♂	29–33–23	218	64	282	8/9	13	2	4	55	17	72	41	0.146	1	0
Stanford No. 4062	Roseburg, Oreg.	♂	27–31–21	209	69	278	8/9	12	2	3	60	20	80	81	0.160	1	2
Stanford No. 17858	Carmel, Calif.	♂	31–33–23	214	80	294	10/9	13	2	4/5	70	28	98	139	0.179	1	0
Stanford No. 13766	do	♀	29–31–23	220	64	284	8	11	2	3	93	22	115	89	0.151	1	0
Stanford No. 13767	do	♀	31–33–23	218	66	284	8	12/13	2	3	86	26	112	102	0.156	1	0
Stanford No. 13770	do	♀	28–32–23	228	69	297	8/9	11/13	2	4	84	21	105	128	0.148	1	0
Stanford No. 39553	Buttonwillow, Calif.	♂	31–33–23	225	61	286	8	13	2	3	55	17	72	41	0.146	1	1
Stanford No. 41671	Stanford University, Calif.	♂	29–33–23	212	71	283	8	12/11	2	3	61	22	83	51	0.166	1	0
Stanford No. 41667	San Jose, Calif.	♂	31–33–23	219	73	292	9/8	13/14	2	3	66	22	88	56	0.151	1	0
Stanford No. 43376	Coburn, Calif.	♂	29–31–23	226	68	294	8	13/12	2	4/3	65	21	86	45	0.155	1	0
Stanford No. 43375	do	♂	27–31–21	216	67	283	8	13	2	3	76	24	100	37	0.162	2/1	0
Stanford No. 45120	Middletown, Calif.	♀	29–31–23	229	65	294	8	13	2	3	88	25	113	104	0.153	1	1
Stanford No. 45121	do	♀	29–33–25	219	62	281	9/8	13/12	2	3/4	72	20	92	128	0.148	1	1
Stanford No. 43434	Coyote, Calif.	♂	29–31–23	218	74	292	8	13	2/1	4	64	23	87	105	0.166	1	0
Stanford No. 30888	Lower Lake, Calif.	♂	29–31–23	--------	65	--------	9/8	13	2	3	69	24	93	60	0.166	1	2
Stanford No. 43322	Metz, Calif.	♀	29–31–23	226	68	294	8	12/13	1	3	74	22	96	126	0.158	1	0
Stanford No. 43321	do	yg.	27–31–23	228	62	290	8	13	2	3	71	21	92	42	0.142	1	0
Stanford No 39361	San Francisco, Calif.	♀	29–31–23	214	60	274	8/9	12/13	2	4	62	21	83	101	0.138	1	1
Stanford No. 43413	Source Salinas River, Calif.	♂	29–33–23	223	66	289	8	12/13	2	4/3	49	16	65	95	0.152	2	0
Stanford No. 43419	Indian Creek, Calif.	♂	29–33–23	222	67	289	9/8	12	2	3	72	20	92	59	0.152	1	0
Stanford No. 43418	do	♀	29–33–23	224	77	301	9/10	13	2	3/4	64	25	89	43	0.174	1	0
Stanford No 27942	Duncans Mills, Calif.	♂	27–29–21	212	74	286	9	12	2	3	72	28	100	112	0.188	1	0
Stanford No. 43523	Solano County, Calif.	♀	29–31–23	222	65	287	9/8	13	2	3/4	71	22	93	121	0.148	1	0
Stanford No. 36061	Callahan, Calif.	♂	29–31–23	209	76	285	8	10/11	2	3	66	22	88	103	0.184	1	0
Stanford No. 45131	Santa Cruz Island, Calif.	♂	27–31–21	209	71	280	9	12	1	4	79	25	104	68	0.183	1	0

TABLE 12.—*Specimens of* Pituophis catenifer catenifer *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
Stanford No. 44242	Canby, Calif.	♀	29–33–23	224	66	290	9/7	13	2	4	57	18	75	116	0.155	1	0
Stanford No. 41670	Madera, Calif.	♂	27–31–21	217	63	280	9	13	2	3	51	18	69	125	0.144	1	1
Stanford No. 44161	Gridley, Calif.	♀	29–31–23	224	62	286	8	13	2	3	58	18	76	118	0.140	1	0
Stanford No. 39637	Riverton, Calif.	♂	27–31–21	231	62	293	8/9	13	2	3	63	18	81	115	0.139	1	0
Stanford No. 41702	Los Banos, Calif.	♂	29–31–22	223	66	289	9/8	13	2	3	51	18	69	100	0.155	1	1
Stanford No. 58033	Oakzanita, Calif.	♀	31–33–23	222	65	287	8/9	12	1	3	66	21	87	75	0.152	1	0
Stanford No. 43381	Delano, Calif.	♂	31–33–23	229	60	289	9	13	2	3/4	56	16	72	90	0.144	1	1
Stanford No. 38958	Tehachapi Mountains, Calif.	♂	31–33–23	224	72	296	8	12/13	2	4	56	20	76	110	0.168	2	1
Stanford No. 38959	do	♀	33–35–23	223	63	286	8/10	13	2	4	55	16	71	86	0.150	1	0
Stanford No. 43347	Pozo, Calif.	♀	29–31–23	230	65	295	8/9	13/14	2/1	4/5	60	18	78	51	0.147	1	2
Stanford No. 27333	Clovis, Calif.	♂	29–31–23	222	67	289	9/8	14	2	4/3	63	20	83	40	0.150	1	0
A.M.N.H. No. 17757	No data	♂	28–31–23	218	70	288	9/8	13	2	4	67	23	90	127	0.165	1	0
A.M.N.H. No. 20563	Merced, Merced County, Calif.	♂	29–33–23	224	64	288	8	12	2	2/3	50	16	66	138	0.144	2/1	0
A.M.N.H. No. 20564	do	♂	29–33–23	218	60	278	8	13	2	3	50	17	67	72	0.138	1	0
A.M.N.H. No. 15298	Los Angeles, Calif.		—33—				8		2	3	73	25	98			1	0
A.M.N.H. No. 20561	Carmel, Calif.	♀	29–31–23	216	67	283	9	13	2	4	75	22	97	80	0.162	1	0
A.M.N.H. No. 20562	do	♂	31–35–25	222	63	285	9/8	12	2	4	78	20	98	43	0.151	1/2	0
C.A.S. No. 40413	Los Gatos, Calif.	♀	29–33–25	224	65	289	8	13	2/3	3/4	62	22	84	58	0.146	2/1	0
C.A.S. No. 13361	do	♂	29–33–23	222	69	291	8	13/12	2	4	70	23	93	71	0.154	1	0
C.A.S. No. 43377	Bradley, Calif.	♂	29–31–22	220	63	283	8	13	2	4/3	66	19	85	142	0.141	1	0
C.A.S. No. 43373	Welby, Calif.	♀	29–31–23	224	66	290	8	12/13	2	5/4	68	20	88	51	0.156	1	0
C.A.S. No. 43374	do	♂	27–31–23	219	75	294	9/8	12/13	2	3/4	70	25	95	43	0.162	1/2	0
C.A.S. No. 43440	Sunnyvale, Calif.	♂	29–31–23	223	68	291	8	13/12	1	3	68	22	90	47	0.148	1	0
C.A.S. No. 43424	Shandon, Calif.	♀	31–37–27	228	67	295	9/8	14	2/3	4	50	15	65	58	0.155	2	1
C.A.S. No. 29492	Camas Mountains, Oreg.	♂	28–31–22	211	73	284	8	11	2	4	71	22	93	92	0.162	1	1
C.A.S. No. 54220	Stanford University, Calif.	♂	29–33–23	222	71	293	9/8	12	2	5	69	23	92	119	0.151	1	0
C.A.S. No. 53938	Hollister, Calif.	♂	29–33–23	229			10	13	2	4/3						1	0
C.A.S. No. 53944	Woodside, Calif.	♀	29–33–24	225	59	284	8	13	1	3/4	60	20	80	107	0.135	1	0

C.A.S. No. 54221	Stanford University, Calif.	♂	29-33-23	213	67	280	8	14/12	2	3	70	23	93	119	0.142	1	0
C.A.S. No. 36121	Santa Cruz Island, Calif.	yg.	27-29-21	212	55	267	9	13/12	2	3	58	17	75	28	0.142	1	0
C.A.S. No. 53935	Millbrae, Calif	♂	31-33-23	219	69	288	8	12	?/2	?/3	70	24	94	135	0.148	1	0
C.A.S. No. 53939	Hollister, Calif	♂	30-31-23	220	71	291	9	14/13	2	3	74	23	97	145	0.158	1	0
C.A.S. No. 43380	Creston, Calif	♀	29-31-23	224	68	292	8/9	13	3	4/3	80	21	101	46	0.152	1	0
C.A.S. No. 58134	Pine Hill Junction, Calif.	♂	29-31-23	218	71	289	8	13	2	3	70	22	92	48	0.156	1	0
C.A.S. No. 27326	Lagunitas, Calif	♂	29-33-25	210	70	280	8	11/12	1	3/4	78	24	102	37	0.162	1	0
C.A.S. No. 43365	Pismo, Calif	♂	27-31-23	213	73	286	8	11	2	3	66	22	88	42	0.166	1	0
C.A.S. No. 43364	do	♂	29-31-23	227	66	293	8/9	13/12	2	3	83	22	105	86	0.151	1	0
C.A.S. No. 43274	Edna, Calif	♂	27-29-23	211	72	283	8	11/12	1	3	76	24	100	36	0.166	0	0
C.A.S. No. 44104	Mount Diablo, Calif	♀	27-29-21	226	64	290	9	13	2	4/3	69	20	89	62	0.145	1	0
C.A.S. No. 44943	Willits, Calif	♀	31-33-23	224	67	291	8	13	2	3	77	23	100	67	0.149	1	0
C.A.S. No. 43412	San Juan, Calif	♂	27-31-23	211	67	278	8/9	13	2	5	75	23	98	39	0.153	1	0
C.A.S. No. 36120	Santa Cruz Island, Calif.	♂	27-29-21	211	70	281	8	13	1	4	67	19	86	60	0.166	1	0
C.A.S. No. 13222	Leona Heights, Calif	♂	29-31-21	214	64	278	8/9	12/13	2	4	58	18	76	112	0.151	1	0
C.A.S. No. 45127	Point Reyes, Calif	♂	29-31-23	213	72	285	8	13	2	3	72	24	96	127	0.151	1	1
C.A.S. No. 43560	Antioch, Calif	♂	31-33-23	222	67	289	8	13/12	2	3	69	22	91	150	0.166	1	0
C.A.S. No. 45119	San Juan, Calif	♂	29-31-22	216	------	------	8	13	2	3/4	63	------	------	------	------	1	0
C.A.S. No. 43519	Contra Costa County, Calif.	♀	29-31-23	216	65	281	8	13	2	4	70	23	93	87	0.155	1	0
C.A.S. No. 43414	San Juan River, Calif	♂	29-31-23	223	66	289	8	13	2	3/4	75	20	95	129	0.155	2/1	0
C.A.S. No. 43452	Antioch, Calif	♂	29-31-23	230	67	297	8	12	2	3	58	18.	76	123	0.154	1	0
C.A.S. No. 38919	Los Angeles County, Calif.	♂	29-31-23	220	74	294	8	11/12	2	3	74	23	97	43	0.163	1	0
C.A.S. No. 27774	Sierra Madre, Calif	♂	29-33-25	222	72	294	9	12/13	2	3	72	18	90	56	0.160	1	0
C.A.S. No. 44001	Carmel Valley, Calif	♂	29-31-22	211	------	------	8	13/12	2	3	60	------	------	------	------	1	0
C.A.S. No. 44003	Coyote, Calif	♂	30-32-23	220	23	293	8	12	2	4	79	25	104	120	0.166	3/2	0
C.A.S. No. 43522	Tracy, Calif	♀	29-31-23	222	56	278	8	13/14	2	3/4	56	16	72	63	0.142	3/2	1
C.A.S. No. 43521	do	yg.	27-29-21	223	64	287	8	12	2	3	49	15	64	38	0.131	1	0
A.N.S.P. No. 10847	Summer Lake, Oreg.	♂	29-29-23	227	56	283	8	13	2/1	4/3	50	------	------	------	------	1	1
A.N.S.P. No. 3800	Fort Tejon, Calif	♂	27-29-22	209	66	275	8	12	2/1	3	65	22	87	119	0.159	1	0
A.N.S.P. No. 3801	do	♂	29-31-23	228	69	297	8	13	2	3/2	60	18	78	128	0.156	1	0
A.N.S.P. No. 3789	Alameda, Calif	♀	29-33-23	221	64	285	9	13	2	4	66	20	86	54	0.148	1	1
A.N.S.P. No. 15635	California	♂	27-29-22	214	68	282	9	13/14	1	3/4	75	22	97	81	0.160	1	0
A.N.S.P. No. 4609	Vernon, British Columbia.	♀	31-33-23	223	55	278	8	12	2	4	51	12	63	119	0.134	3	2

PITUOPHIS CATENIFER DESERTICOLA Stejneger

Pituophis catenifer deserticola Stejneger, North Amer. Fauna, No. 7, p. 206, 1893 (type, U.S.N.M. No. 18070; type locality, Beaverdam Mountains, Utah).—Van Denburgh, Occ. Pap. California Acad. Sci., No. 5, p. 198, 1897.—Ruthven, Bull. Amer. Mus. Nat. Hist., vol. 23, p. 584, 1907 (part).—Taylor, Univ. California Publ. Zool., vol. 7, No. 10, p. 354, 1912.—Ruthven and Gaige, Occ. Pap. Mus. Zool. Univ. Michigan, No. 8, p. 31, 1915.—Van Denburgh and Slevin, Proc. California Acad. Sci., ser. 4, vol. 5, p. 107, 1915.—Richardson, Proc. U. S. Nat. Mus., vol. 48, p. 427, 1915.—Grinnell and Camp, Univ. California Publ. Zool., vol. 17, No. 10, p. 193, 1917.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, p. 86, 1917.—Pack, Copeia, No. 68, p. 16, 1919.—Van Denburgh, Proc. California Acad. Sci., ser. 4, vol. 10, p. 19, 1920.—Blanchard, Copeia, No. 90, p. 5, 1921.—Stephens, Trans. San Diego Soc. Nat. Hist., vol. 3, No. 4, p. 64, 1921.—Van Denburgh and Slevin, Proc. California Acad. Sci., ser. 4, vol. 11, p. 37, 1921.—Nelson, Mem. Nat. Acad. Sci., vol. 16, No. 1, p. 115, 1922.—Van Denburgh, Occ. Pap. California Acad. Sci., No. 10, vol. 2, p. 725, 1922.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, ed. 2, p. 95, 1923.—Blanchard, Pap. Michigan Acad. Sci. Arts Lett., vol. 4, pt. 2, p. 17, fig. 28, 1924.—Tanner, Copeia, No. 166, p. 27, 1928.—Klauber, Bull. San Diego Zool. Soc., No. 4, p. 7, 1928.—Burt and Burt, Journ. Washington Acad. Sci., vol. 19, No. 20, p. 456, 1929.—Klauber, Bull. San Diego Zool. Soc., No. 8, pp. 3, 9, 16, 17, 18, 23, 33, 35, 44, 45, 70, 77, 78, 79, 81, 81, fig. 2, 1931.—Stull, Occ. Pap. Mus. Zool. Univ. Michigan, No. 250, p. 5, 1932.—Ruthven, Occ. Pap. Mus. Zool. Univ. Michigan, No. 243, p. 4, 1932.—Klauber, Copeia, No. 3, p. 125, 1932; Bull. San Diego Zool. Soc., No. 11, p. 17, 1934.—Mosauer, Ecology, vol. 16, No. 1, p. 22, 1935.

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Pityophis bellona Cope, Ann. Rep. U. S. Geol. Surv. Terr. for 1871, p. 468, 1872.

Pityophis sayi var. *bellona* Cope, U. S. Nat. Mus. Bull. 1, p. 39, 1875 (part).

Pityophis sayi bellona Yarrow, Rep. Expl. Surv. West 100th Merid., vol. 5, p. 540, 1875 (part).—Yarrow and Henshaw, Rep. Chief Eng. for 1878, Surv. West 100th Merid., pt. 3, app. N N, p. 1634, 1878 (part).—Yarrow, U. S. Nat. Mus. Bull. 24, pp. 16, 106, 1883 (part).—Cope, Proc. U. S. Nat. Mus., vol. 14, p. 641, 1892 (part); Amer. Nat., vol. 30, p. 1015, 1896 (part); Rep. U. S. Nat. Mus. for 1898, p. 872, 1900 (part).

Pityophis catenifer bellona Garman, Bull. Essex Inst., vol. 16, p. 27, 1884.—Brown, Proc. Acad. Nat. Sci. Philadelphia, 1901, p. 54 (part).

Pityophis catenifer Cope, Proc. Acad. Nat. Sci. Philadelphia, 1883, p. 18.—Garman, Bull. Essex Inst., vol. 16, p. 27, 1884 (part).—Cope, Proc. U. S. Nat. Mus., vol. 14, p. 641, 1892 (part); Rep. U. S. Nat. Mus. for 1898, p. 876, 1900 (part).

Pituophis catenifer Stejneger, North Amer. Fauna, No. 5, p. 110, 1891.—Van Denburgh, Proc. California Acad. Sci., ser. 4, vol. 3, p. 158, 1912 (part).—Pratt, Manual of the vertebrates of the United States, pp. 219–220, 1923 (part).

Coluber catenifer Boulenger, Catalogue of snakes in the British Museum, vol. 2, p. 67, 1894 (part).

Pityophis sayi sayi Yarrow, U. S. Nat. Mus. Bull. 24, pp. 16, 105, 1883 (part).

Pituophis catenifer sayi Ruthven, Bull. Amer. Geogr. Soc., vol. 47, pp. 950, 952, 1915.

Pituophis catenifer stejnegeri Van Denburgh, Proc. California Acad. Sci., ser. 4, vol. 10, p. 21, 1920 (type, C.A.S. No. 14203; type locality, Fort Douglas, Salt Lake County, Utah).—Van Denburgh and Slevin, Proc. California Acad. Sci., ser. 4, vol. 11, p. 45, 1921.—Van Denburgh, Occ. Pap. California Acad. Sci., No. 10, vol. 2, p. 729, pl. 77, 1922.—Stejneger and Barbour, Checklist of North American amphibians and reptiles, ed. 2, p. 95, 1923.—Blanchard, Pap. Michigan Acad. Sci. Arts Lett., vol. 4, pt. 2, p. 17, 1924.—Tanner, Copeia, No. 163, p. 57, 1927.—Woodbury, Copeia, No. 166, p. 20, 1928.

Original description.—This form is described by Stejneger (1893, p. 206) as follows:

By this name I propose to designate the form usually called *P. bellona* or *P. sayi bellona*, as there can be no doubt that Baird's and Girard's original *Churchillia bellona*, which came from Presidio del Norte, Chihuahua, Mexico, was a typical *P. sayi*. The type appears now to be lost, but I have before me a specimen from the identical locality (U.S.N.M. No. 1543) with a most pronouncedly narrow rostral and agreeing with *P. sayi* in all other respects also. Of all the later names applied to various forms or individuals of the present species none seem to have been based upon the richly colored form from the Great Basin and the southwestern deserts, which agrees with true *P. catenifer* in having a broad and low rostral. That Baird and Girard later referred specimens of this form to *P. bellona* can not, of course, justify the shifting of this name to another type.

As a general rule this form has a more pronounced carination of the scales, and a less number of smooth scales on the sides, but this character can not be relied upon at all, and whether a specimen shall be referred to either typical *P. catenifer* or to this desert form must be decided upon the totality of the characters, as a reliance upon the carination leads to very erroneous results.

(This subspecies, according to Mr. Stejneger, is the form inhabiting the Great Basin, while . . . typical *P. catenifer* is restricted to the coastal slope of California.

On the east side of Pahrump Valley, Nevada, one of these snakes, measuring 5 feet in length, was killed April 29, among the tree yuccas along the upper edge of the Larrea belt, at an altitude of 1,340 meters (4,400 feet.). Another was obtained on the east slope of the Beaverdam Mts., in southwestern Utah,[1] May 11.

In California, specimens were obtained at Lone Pine and Haway Meadows in Owens Valley, and in the Panamint and Argus Mts.—C. Hart Merriam.)

Systematic notes.—Van Denburgh in 1920 (p. 21) separated the Utah specimens of the desert subspecies of *catenifer*, *c. deserticola*, from those of the rest of the range, calling the Utah specimens *catenifer stejnegeri*. To distinguish the two forms he gives the sum of the scale rows and of preoculars on both sides of the head rarely exceeding 33 in *stejnegeri* and usually exceeding 33 in *deserticola*. The examination of larger series of specimens, however, shows that this character is not valid, since a large number of Utah specimens have 31 or 33 scale rows, and two preoculars on each side, while, on the other hand, many specimens from other parts of the range have only 29 scale rows and frequently a single preocular on each side. The name *stejnegeri* must therefore be considered a synonym of *deserticola*.

[1] This specimen, U.S.N.M. No. 18070, was designated the type.

Diagnosis.—From the forms of the *deppei* group *deserticola* may be readily separated by the presence of four, rather than two, prefrontals and the entrance into the orbit of a single supraocular on either side, instead of one. The shape of the rostral distinguishes it from all the subspecies of *melanoleucus*, which have the rostral at least twice as long as broad, and from the two species of *sayi*, *s. sayi* with the rostral nearly twice as long as broad and *s. affinis* with the rostral always slightly longer than broad. In *deserticola* the rostral is rarely longer than broad and never more than slightly so. From *affinis* it may be further distinguished by the coloration, since in the latter form the dorsal spots are generally saddle-shaped and reddish in color, at least posteriorly, while in *deserticola* the spots are never saddle-shaped or reddish. In addition, in *deserticola* the light scales of interspaces and sides frequently each bear a small central black spot, at least on the anterior part of the body, while such markings are generally absent in *affinis*. From *vertebralis*, *deserticola* may be separated by the pattern. Thus in *vertebralis* the dorsal spots are black or reddish anteriorly, reddish in the middle of the body, and black on the posterior part of the body and on the tail, and are more or less saddle-shaped throughout, and the interspaces between the spots are frequently orange. In *deserticola* the spots are more or less uniform in color throughout, are never reddish or saddle-shaped, and the interspaces are never orange. Furthermore the small black spots on the light scales of interspaces and sides, which are usually characteristic of *deserticola*, are lacking in *vertebralis*. These same markings generally serve to distinguish *deserticola* from *catenifer* and *annectens*. From *catenifer*, *deserticola* may be separated also by the higher number of ventral scutes. In *deserticola* the number varies from 214 to 259 but is generally more than 228, and the average number is 236; in *catenifer*, although the number varies from 206 to 234, it is generally less than 228, and the average number is 220. From *annectens*, *deserticola* may be distinguished also by the lower number of spots, which is rarely more than 90 in *deserticola* and rarely less than 90 in *annectens*. Furthermore, the sum of ventrals and caudals is generally less than 300 in *deserticola* and rarely so in *annectens*.

Description.—The body is rather slender, and the snout is moderately blunt. The tail length varies from 0.115 to 0.166 (average 0.140) of the total length. The longest specimen examined measured 1,750 mm. in length.

The dorsal scale formula varies from 27–29–19 to 33–35–23. The number of rows at the neck is 27 to 33, oftenest 29; the maximum number in the middle of the body 29 to 35, most commonly 31; the minimum number anterior to the vent 19 to 25, usually 21 or 23. The remaining scutellation is as follows: Ventrals 214 to 259 (average 235.9); caudals 54 to 71 (average 62.5); supralabials 8 to 10,

oftenest 8, with the fourth, fifth, or none entering the eye; infralabials 9 to 15, most commonly 12 or 13; preoculars 1 or 2; postoculars 2 to 6, usually 3 or 4; loreal usually present, occasionally split to form two or even three small scales; one or more azygos plates present between the prefrontal and preocular in about 25 percent of the specimens examined and occasionally one present between the prefrontal and preocular on either side, or between prefrontals and internasal on each side; rostral plate generally as broad as long but occasionally very slightly longer than broad, penetrating from one-third to all the distance between the internasals; frontal usually undivided but rarely split for as much as one-third of its length.

The dentition is as follows: Mandibular teeth 16 to 22, decreasing slightly in size posteriorly; maxillary teeth 14 to 17, decreasing slightly in size posteriorly; palatines 9 to 11, slightly smaller than the mandibular and maxillary teeth; pterygoids 7 to 13, slightly smaller than the palatines, and decreasing slightly in size posteriorly.

The dorsum bears a series of median quadrangular spots, which are black, dark brown, or grey-brown and number 43 to 74 (average 56.6) on the body and 11 to 22 (average 16.2) on the tail. These spots are 2 to 6 scales each in length and 8 to 12 scales in width and are separated by interspaces of 1 to 4 scales. There are two or three rows of smaller spots on each side, of which the uppermost are the most distinct and the largest. The lightest spots of both dorsal and lateral series are more or less outlined in black. The light scales of the sides and interspaces frequently bear each a small central black spot, at least on the anterior part of the body. The ground color of both dorsum and belly is a yellowish white. The belly bears a series of lateral spots on each side, which are each 1 or 2 scutes in length and are separated by 1 to 3 scutes. The middle of the belly may be immaculate or irregularly spotted with small dark spots throughout or on the posterior half only. The top of the head is grey or pale brown, more or less mottled with black or dark brown. Dark streaks are commonly present from the eye to the posterior angle of the jaw on either side, and transversely across the top of the head, including the posterior halves of the prefrontals, the anterior halves of frontal and supraoculars, the upper part of the preocular, and the supralabials lying just below the eye. Dark streaks often mark the sutures between the supralabials and the infralabials. The throat is white. (Fig. 64, *a*.)

Variation.—In the study of geographic variation the range of the form has been divided into regions from south to north, which are numbered along the abscissas of the accompanying graphs as follows:

Region 1. Imperial, Riverside, and San Bernardino Counties, Calif., and the southern part of Clark County, Nev.

2. Kern, Fresno, Tulare, Inyo, and Mono Counties, Calif.; the northern part of Clark County, Nev., and Washington County, Utah.

3. Beaver, Millard, Juab, Uinta, and Grand Counties, Utah; Montrose and Mesa Counties, Colo., and Esmeralda, Ormsby, Nye, and Washoe Counties, Nev.
4. Humboldt, Elko, and White Pine Counties, Nev.; and Salt Lake, Utah, and Weber Counties, Utah.

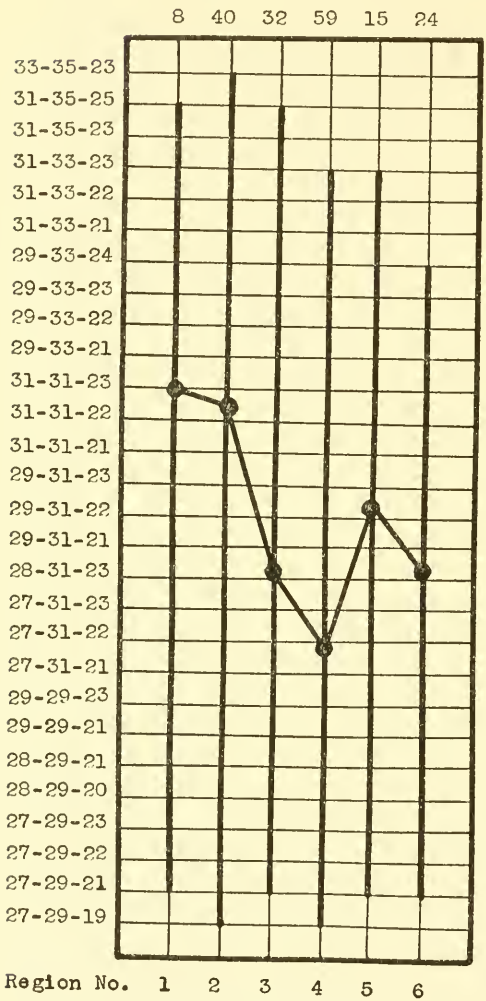

FIGURE 73.—Geographic variation in number of scale rows in *Pituophis catenifer deserticola*.

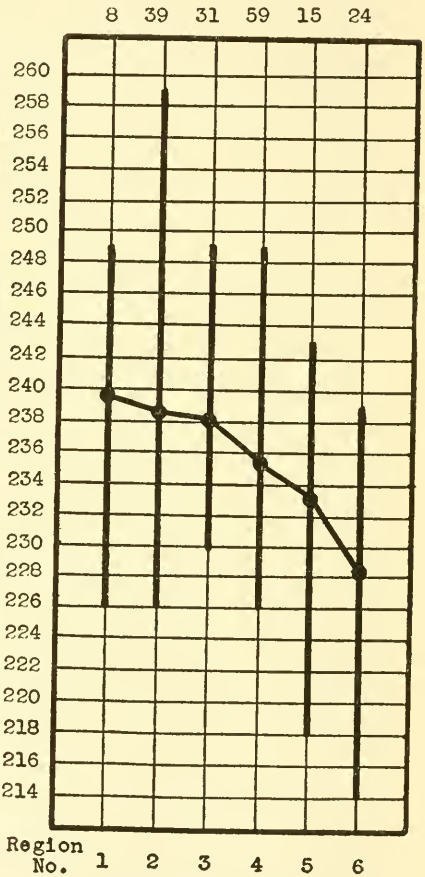

FIGURE 74.—Geographic variation in number of ventrals in *Pituophis catenifer deserticola*.

5. Harney and Malheur Counties, Oreg.; and Elmore, Adams, Ada, Bear Lake, Twin Falls, Blaine, and Owyhee Counties, Idaho.
6. Umatillo County, Oreg.; Nez Perce County, Idaho; and Asotin, Walla Walla, Spokane, and Whitman Counties, Wash.

Although the range of variation in the number of scale rows is remarkable throughout the geographic range of *deserticola*, the average shows a general tendency to decrease from south to north (fig. 73).

In both the extremes of variation and the average, the number of ventrals shows a rather marked decrease from south to north (fig. 74). while the tail length shows a decided tendency to increase over the same territory (fig. 77). The labials and oculars (fig. 76) remain extremely constant throughout the range of the form, exhibiting in each case a very slight tendency toward decrease in number from south to north. No evidence of geographic variation in the number of dorsal spots seems to exist (fig. 78), and the averages for the different regions considered lie between 54 and 59 for the body spots, and between 69 and 76 for the total number.

The observable sexual variation may be summarized as follows: The scale rows average slightly higher in females than in males; ventrals vary from 217 to 249 (average 233.0) in males from 214 to 259 (average 238.3) in females; caudals 57 to 71 (average 65.4) in males, 54 to 67 (average 59.2) in females; supralabials, infralabials, and preoculars average slightly higher in females than in males, while postoculars are slightly higher on the average in males; body spots average 57.7 in males, 55.4 in females; tail spots average 17.3 in males, 15.2 in females; tail length forms 0.129 to 0.166 (average 0.145) of the total length in males, 0.115 to 0.159 (average 0.135) in females.

One specimen from Salt Lake City, Utah (A.N.S.P. No. 10387), is abnormal in the presence of two frontals.

Range.—This snake ranges from the eastern desert regions of California throughout the States of Utah and Nevada to western Colorado, and north to Idaho and the western parts of Oregon and Washington. Specimens have been examined from the following localities:

California: *Fresno County*, Dunlap, Mercey Hot Springs, Fresno; *Imperial County*, Brawley; *Inyo County*, Coso Valley, Shoshone, Owens Valley, Lone Pine, 10 miles south of Owens lake, Shepard Canyon in Argus Range, Surprise Canyon in Panamint Mountains, Jackass Spring in Panamint Mountains; *Kern County*, Wheeler Ridge, Isabella, Edison Station, 8 miles northeast of Bakersfield, Walker Pass; *Mono County*, Benton; *Riverside County*, Mecca, Palm Springs; *San Bernardino County*, Victorville, between Hinchley and Barstow; *San Luis Obispo County*, Palo Prieta Canyon. Other California specimens bore the labels "Lone Willow Springs" and "Wild Rose Springs," localities that could not be found, and the indefinite record "Colorado River."

Nevada: *Clark County*, Virgin Valley, opposite Fort Mohave in southeast Nevada; *Elko County*, Carlin; *Esmeralda County*, Palmetto Mountains; *Humboldt County;* Big Creek in Pine Forest Mountains, Thousand Creek, south fork of the Humboldt River, Winnemucca; *Nye County*, Round Mountain; *Ormsby County*, Carson City; *Washoe County*, Pyramid Lake; *White Pine County*, Piermont (or Pyrmont, 75 miles east of Eureka). Other specimens had the indefinite records "Peavine Creek in Toyabe Range" and "Truckee River."

Utah: *Beaver County*, Beaver Creek Hills; *Grand County*, Thompson, Moab; *Juab County; Millard County*, 20 miles northwest of Delta, 30 miles north of Delta, 8 miles northeast of Delta, Fillmore, Kanosh; *Salt Lake County*, Salt Lake City, Fort Douglas; *Uinta County*, near Jensen, White River, Ouray

Agency, west of Dragon; *Utah County*, Provo; *Washington County*, St. George, Leeds, Rockville, Beaverdam Mountains; *Weber County*, Ogden. Other Utah localities are the indefinite references Provo Canyon in Wasatch Mountains; near 38°; and Salt Lake.

Colorado: *Mesa County*, Grand Junction; *Montrose County*, Naturita.

Wyoming.

Idaho: *Ada County*, Boise; *Adams County*, Indian Valley; *Bear Lake County*, east side of Bear Lake; *Blaine County*, Arco, Big Butte; *Elmore County*, Indian Creek, 5 miles south of Cleft; *Nez Perce County*, Lewiston; *Owyhee County*, Snake River west of Bruneau River; *Twin Falls County*, Blue Lakes.

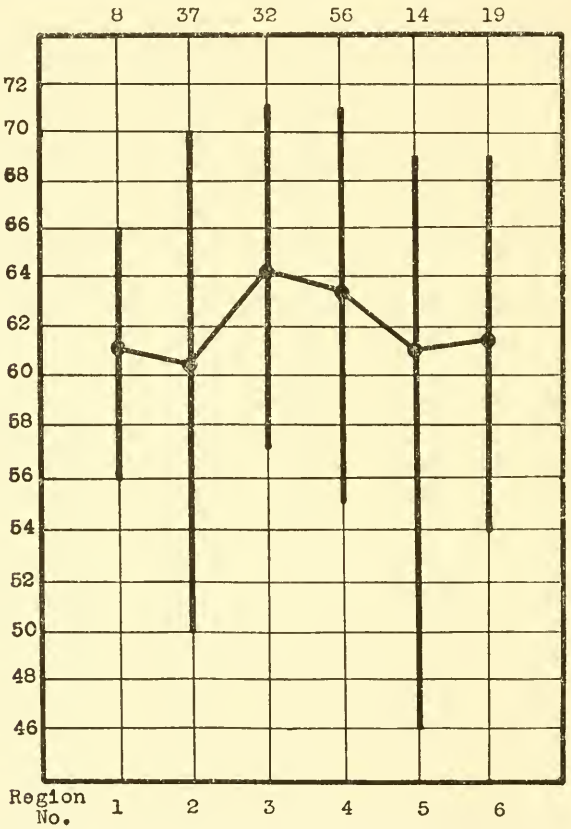

FIGURE 75.—Geographic variation in number of caudals in *Pituophis catenifer deserticola*.

Oregon: *Harney County*, Burns; *Malheur County*, Juntura, Rome on Owyhee River; *Umatilla County*, Umatilla, John Day River, John Day Valley.

Washington: *Asotin County*, Asotin; *Spokane County*, Marshall; *Walla Walla County*, Walla Walla, Prescott, 15 miles west of Walla Walla, Fort Walla Walla, Wallula; *Whitman County*, Wawawai, Almota, Pullman.

Additional published records for this form are:

California: *Imperial County*, Coyote Wells, El Centro (Klauber, 1928, *in litt.*), Seeley (Klauber, 1928, *in litt.;* Klauber, 1931, p. 78), Westmoreland, 2 miles west of Yuma, 4 miles west of Yuma, 6 miles west of El Centro, 10 miles west

of El Centro, Meloland (all Klauber, 1931, pp. 77–81); *Riverside County*, 4 miles northwest of Indian Wells in Coachella Valley (Mosauer, 1935, p. 20), 4 miles south of Coachella (Klauber, 1931, p. 77); *San Bernardino County*, Bryman, Wild, Yermo, Halloran Spring, Mountain Pass (Klauber, 1932b, p. 125); *San Diego County*, Carrizo (Klauber, 1931, p. 49).

Nevada: *Clark County*, Glendale, State Line Wells (Klauber, 1932b, p. 125); *Lander County*, Austin (Van Denburgh and Slevin, 1919, p. 217; Van Denburgh, 1920, p. 20; Van Denburgh and Slevin, 1921a, p. 37; Van Denburgh 1922, vol. 2, p. 728); 10 miles northeast of Battle Mountain (Burt

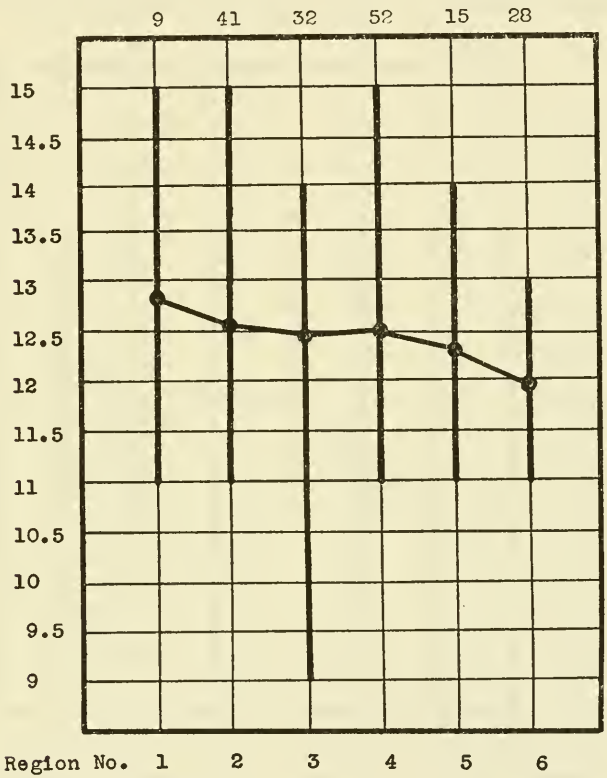

FIGURE 76.—Geographic variation in number of infralabials in *Pituophis catenifer deserticola*.

and Burt, 1929b, p. 457; *Nye County*, east side of Pahrump Valley (Merriam, *in* Stejneger, 1893, p. 207); *Washoe County*, Nixon (Van Denburgh and Slevin, 1919, p. 217; Van Denburgh, 1920, p. 20; Van Denburgh, 1922, vol. 2, p. 728); Sutcliffe (Van Denburgh and Slevin, 1921a, p. 37), 3 miles east of Reno (Burt and Burt, 1929b, p. 456); Snake Creek (Yarrow, 1875, p. 541), an indefinite locality that could not be found.

Utah: *Beaver County*, Beaver (Yarrow, 1875, p. 541); *Iron County*, Rush Lake (Yarrow, 1875, p. 541; Van Denburgh, 1922, vol. 2, p. 732); *Juab County*, Silver City (Tanner, 1927, p. 27); near Eureka (Tanner, 1928, p. 57); *Millard County*, 7 miles south of Kanosh (Van Denburgh, 1922, vol. 2, p. 732); Fillmore Canyon; flats in vicinity of Fillmore (Ruthven, 1932, p. 4); *Salt Lake County*, Dry Canyon; flats in vicinity of Salt Lake City (Ruthven, 1932, p. 4); *Tooele County*, Orrs Ranch in Skull Valley (Ruthven, 1932, p. 4);

Zion National Park (Woodbury, 1928, p. 20); Green River (Ruthven, 1932, p. 4).

Colorado: *Mesa County*, Fruita (Ellis and Henderson, 1913, p. 94); *Moffat County*, Douglas Spring (Ellis and Henderson, 1915, p. 262).

Idaho: *Oneida County*, Preston (Pack, 1919, p. 16).

Habits and habitat.—The habits of this form are undoubtedly similar to those of the allied forms, *catenifer* and *annectens*, except that *deserticola* is typically a desert inhabitant, though found elsewhere.

Merriam, *in* Stejneger (1893, p. 207), reports finding one of these

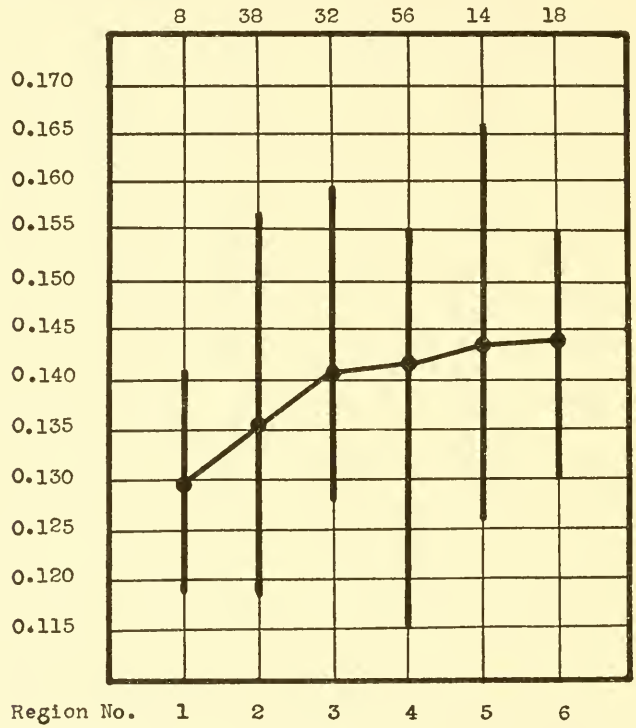

FIGURE 77.—Geographic variation in ratio of tail length to total length in *Pituophis catenifer deserticola*.

snakes "among the tree yuccas along the edge of the Larrea belt, at an altitude of 1,340 meters (4,400 feet)."

Meek (1906, p. 15) took one specimen "from the nest of a *Neotoma*" and another "from the burrow of *Spermophilus leucurus*."

Taylor (1912, p. 354) says: "The gopher snake undoubtedly occurs generally in small numbers over the deserts of northern Nevada, and to some extent on the broad flats of the mountains" and reports finding one example "in sagebrush on the ground not far from the creek near the Dugout Camp, Big Creek Canyon."

Richardson (1915, p. 427) records finding one specimen "on top of a rat's nest (*Neotoma* sp.) where it lay coiled. Its stomach contained

a ground squirrel, *Citellus mollis.*" Another was taken "under a small sagebrush not far from a river bank. It contained large eggs (July 9)."

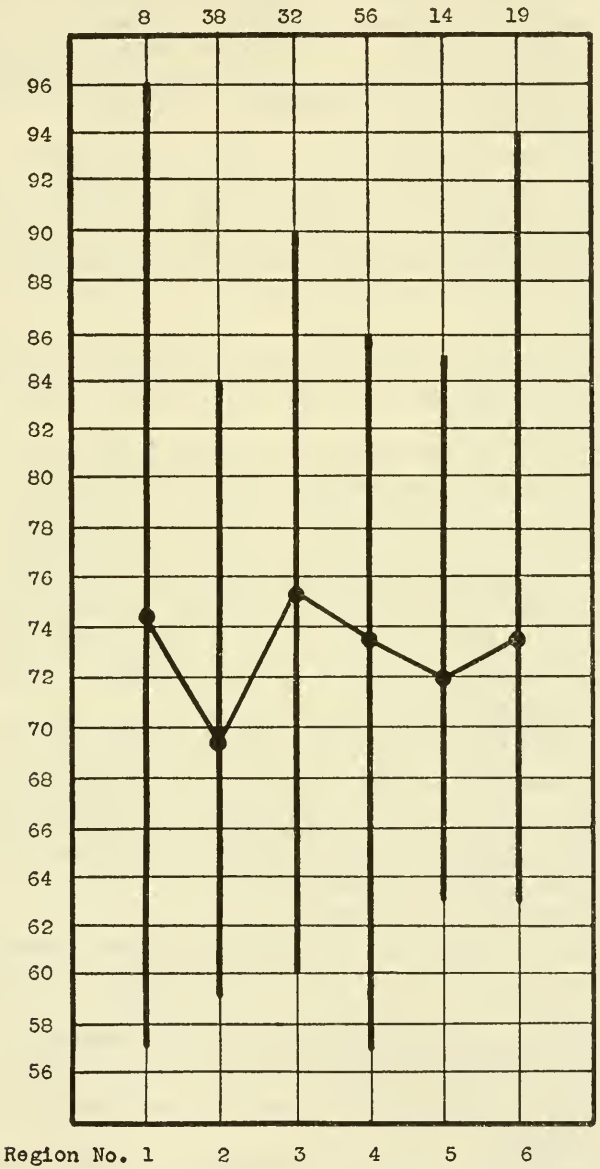

FIGURE 78.—Geographic variation in total number of dorsal spots in *Pituophis catenifer deserticola.*

Ruthven (1915, p. 952) says that the form is found "in apparently equal abundance in the mountains and on the basin floor," and is "equally at home in all habitats, regardless of the soil or the presence of rocks."

Ruthven and Gaige (1915, p. 31) give the following note:

> It was found in the *Chrysothamnus* zone along the streams, in the sagebrush on the hills and flats on the basin floor, and on the slopes and rock slides and in the canyons of all of the mountains (except the Pinyon Range) to the summit of the Carlin Peaks. It is apparently common everywhere, and we could not discover any habitat preference. A large female taken on July 30 contains large eggs. The specimens examined had all eaten small mammals, and to judge by the extent to which the alimentary duct was filled with remains the number consumed must be enormous.

Dice (1916, pp. 303, 307, 308, 310) includes this form (under the name *c. catenifer*) in lists of species from the following regions in southeastern Washington: The willow habitat and association of the Columbia Basin sagebrush faunal area; the bunchgrass, the rocky slope, and the cottonwood-willow habitats and associations of the Prairie area.

Grinnell and Camp (1917, p. 194) say that *deserticola* "occupies the Lower and Upper Sonoran Life zone" and "inhabits nearly all types of arid environment."

Klauber (1931, pp. 77–81) found specimens both in the desert and in cultivated fields in the Imperial Valley. He lists this form as crepuscular (1931, p. 18) and reports (1931, p. 70) finding a specimen "crossing the road just before seven P. M., it being quite dark at the time." The same author reports (1932b, p. 125) collecting specimens in "sparse brush," "desert," "rocks," "brush, sand," "light brush," "sparse brush and rocks," and "rocky desert, light brush." One of these was found (1932b, p. 126) "crossing the highway at 8:30 on a cold, windy night."

Mosauer (1935, p. 20), in a study of desert reptiles, says of *deserticola:*

> Several specimens, dead and alive, were found on the highway quite close to the dune region; others were found under boards of the ruins of homesteads in the sand hills and at the margin of a date palm plantation in the neighborhood of the dunes. No specimens were collected in the dunes proper. The gopher snake seems to be largely nocturnal or crepuscular, to conclude from the number of specimens found on the road at night.

Pack (1919, p. 16) gives an account of a 5-foot specimen of this form that contained 35 small mice. It was killed in an alfalfa field at haying time.

Van Denburgh and Slevin (1921a, p. 37) report finding an example "on a shelf in a kitchen closet."

Nelson (1922, p. 126) lists *deserticola* from the Lower Sonoran Zone of Lower California.

The following note is given by Woodbury (1928, p. 20): "One medium-sized snake three and one-half to four feet in length had nine mice in its stomach. . . . I have seen these snakes eat both mice and gophers in captivity. They are constrictors and kill their prey before eating it."

Dr. H. S. Brode (*in litt.*, 1928) mentions specimens taken in the Blue Mountains at an elevation of 2,500 feet where the rainfall was between 20 and 25 inches, at Walla Walla in the arid Transition Zone, and near the Columbia River where the rainfall is only 5 inches and the elevation 300 feet. One in the latter locality was seen imitating a rattlesnake.

The writer kept several snakes of this form in captivity for some time. They could be handled freely. Mice were eaten whenever offered, and sometimes several would be taken in rapid succession. The food is usually, although not always, swallowed head first. The method of swallowing seems to be dependent upon which end the snake grasps before constricting, and this is generally the head. On one occasion two snakes of about the same size were observed attempting to swallow the same mouse. One had a hold upon the head, the other upon the back. First one and then the other was forced to loosen its hold but would return for another try immediately, until one of the two finally gave up in despair and retired to a corner of the cage to sulk.

Affinities.—The derivation of *catenifer deserticola* from *sayi affinis* is indicated by the pattern and scale characters as well as by the ranges of the two forms (fig. 63). The pattern of *deserticola* may be derived readily from that of *affinis* by a slight increase in number and decrease in the size of the dorsal spots, accompanied by an intensification of color in the spots from reddish to dark brown, grayish brown, or black. In the ranges of variation in most of the scale characters *affinis* and *deserticola* are almost identical, and the average proportionate tail length is only slightly higher in *deserticola* than in *affinis*. Occasional specimens of *deserticola* also have the rostral slightly longer than broad, as is typical in *affinis*, but is never found in *c. catenifer* or *c. annectens*.

The separate derivation of *annectens* and *catenifer* from *deserticola* is indicated by the fact that, although in the number of dorsal spots there is a continuous increase from *deserticola* to *catenifer* to *annectens*, most of the scale counts show a decrease from *deserticola* to *catenifer*, but not from *deserticola* to *annectens*.

The probable relationships of *deserticola* and the adjacent forms have been expressed by the diagram on page 133.

Table 13 lists the specimens of this form that have been examined.

TABLE 13.—*Specimens of* Pituophis catenifer deserticola *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 18070 (type).	Beaverdam Mountains, Utah.	♂	31-33-23	234	70	304	8	12	2	4	57	19	76	102	0.156	1	0
U.S.N.M. No. 11745a	Fresno, Calif.	♀	31-33-23	228	55	283	9/8	13	2	4	59	17	76	95	0.136	1	0
U.S.N.M. No. 11745b	do	♂	29-31-23	230	59	289	8	13	2	4	57	15	72	62	0.137	1	0
U.S.N.M. No. 11745c	do		31——				8	13	2	4						1	0
U.S.N.M. No. 11755	do	♀	29-33-23	237	54	291	8	14	2	3	58	15	73	169	0.130	1	1
U.S.N.M. No. 12563	do	♂	29-31-23	227	67	294	8	13/14	2	4	54	21	75	59	0.152	1	1
U.S.N.M. No. 12562	do	♂	29-33-23	230	64	294	9/8	13	2	3	65	21	86	139	0.140	1	0
U.S.N.M. No. 11779	do	♂	29-31-21	236	59	295	8	13	2	3	53	16	69	39	0.140	1	2
U.S.N.M. No. 48139a	Pyrmont, Nev.	♀	27-31-21	238	60	298	8	13/14	1	3	55	15	70	121	0.140	1	0
U.S.N.M. No. 48139b	do	♂	28-29-21	233	71	304	8	12	1	4	56	19	75	87	0.149	1	0
U.S.N.M. No. 40070	Indian Valley, Idaho	♀	29-33-23	239	57	296	8	11	2	4/3	49	14	63	106	0.141	1	0
U.S.N.M. No. 4676	Salt Lake, Utah	♀	29-31-23	237			8	13	2	4						1	0
U.S.N.M. No. 44375	Brawley, Calif.	♀	29-33-23	248	58	306	8	13	2	3/4	46	11	57	116	0.120	1	0
U.S.N.M. No. 16777	Arco, Idaho	♀	27-29-21	231	60	291	9/8	12	2	3	53	15	68	80	0.137	1	0
U.S.N.M. No. 11728	Truckee River, Camp 12, Nev.	♂	29-31-23	237	65	302	8	13	2/1	3	52	15	67	141	0.148	1	2
U.S.N.M. No. 61595	Juntura, Oreg.	♀	29-33-23	243	57	300	8	13/14	2	4	58	13	71	79	0.126	1	1
U.S.N.M. No. 1552	Near 38°, Utah	♀	29-31-23	238	58	296	8	13	1/2	3	55	13	68	120	0.141	1	0
U.S.N.M. No. 4632a	South fork Humboldt River, Nev.	♂	29-31-21	228	68	296	8	13	2	3	55	18	73	114	0.153	0/1	0
U.S.N.M. No. 16776	Big Butte, Idaho	♂	29-31-31	231	66	297	8	11	1	3/2	53	17	70	97	0.144	1	0
U.S.N.M. No. 1550	Near 38°, Utah	♀	27-29-23	246	67	313	8	12/14	1	4/3	66	17	83	110	0.145	1	0
U.S.N.M. No. 4632b	South fork Humboldt River, Nev.	♀	29-31-21	235	62	297	8/9	13	2	4	49	17	66	84	0.142	1	0
U.S.N.M. No. 4632c	do	♂	29-33-23	237	65	302	8	12/13	2	3/4	43	14	57	124	0.141	1	0
U.S.N.M. No. 8130a	Fillmore, Utah	♂	29-31-22	232	66	298	9	13	2	3	53	17	70	102	0.147	1	1
U.S.N.M. No. 8130b	do	♂	29-31-21	241	71	312	9	14	2	4	53	18	71	79	0.139	1	2
U.S.N.M. No. 44384	Burns, Oreg.	♀	29-31-23	226	54	280	8	11/12	2	4	53	14	67	99	0.131	1	0
U.S.N.M. No. 12579	John Day River, Oreg.	♂	29-31-23	222	69	291	8	12/13	2	4	61	19	80	87	0.166	2	1

U.S.N.M. No. 53080	Owyhee River, Rome, Oreg.	------	31-33-23	233	--------	--------	9/8	13	2	4/3	57	-------	-------	-------	--------	3/2	1
U.S.N.M. No. 12580	John Day Valley, Oreg.	♂	29-29-21	218	68	286	9/8	11/12	2/1	3	51	20	71	73	0.164	0	0
U.S.N.M. No. 44369	Almota, Wash.	♂	29-31-21	228	58	286	8	12	2	3	48	15	63	102	0.137	1	0
U.S.N.M. No. 10633	Fort Walla Walla, Wash.	♀	29-31-23	224	58	282	8	11/12	2	4/3	53	16	69	64	0.140	1	0
U.S.N.M. No. 10913	do	♀	27-31-22	231	--------	--------	8	11	1	3	48	-------	-------	-------	--------	0	0
U.S.N.M. No. 12582	do	♂	27-29-21	229	66	295	8	11	2	3	52	20	72	87	0.149	1	0
U.S.N.M. No. 10907	do	♀	27-29-23	231	55	286	8	12/11	1	3	51	15	66	96	0.130	1	0
U.S.N.M. No. 16495	Marshall, Wash.	♂	29-31-22	225	--------	--------	8	12/11	2	3	49	-------	-------	-------	--------	1	0
U.S.N.M. No. 44441	East side Bear Lake, Idaho.	♀	29-31-21	236	62	298	8	13	1/2	3	62	18	80	100	0.140	1	0
U.S.N.M. No. 44190	South fork Humboldt River, Nev.	♀	29-31-23	226	56	282	9	11/12	1	4/3	47	13	60	106	0.132	1	0
U.S.N.M. No. 40202	Naturita, Colo.	♀	29-31-23	--------	66	--------	8/9	12	1/2	4/3	56	22	78	74	0.148	1	1
U.S.N.M. No. 44235	Umatilla, Oreg.	yg.	29-31-23	239	--------	--------	8/9	11/12	1	3	66	-------	-------	-------	--------	1	0
U.S.N.M. No. 53082	do	♀	29-29-21	225	59	284	8	12/11	2	3	54	18	72	65	0.146	1	0
U.S.N.M. No. 55872	Elko County, Nev.	yg.	27-29-21	244	65	299	8	12	2	3	55	17	72	33	0.151	1	0
U.S.N.M. No. 52435	Round Mountain, Nev.	♀	29-31-21	235	61	296	9	12	2	3	48	14	62	117	0.145	1	1
U.S.N.M. No. 52434	do	♀	29-33-22	238	57	295	9/8	12	2	4/3	54	15	69	127	0.133	2	2
U.S.N.M. No. 44537	Pyramid Lake, Nev.	yg.	29-31-21	241	67	308	9	13	2	4	59	17	76	48	0.145	1	0
U.S.N.M. No. 66194	Near Jensen, Utah	♀	29-31-21	242	62	304	9	13	2/1	4	62	16	78	66	0.136	1	2
U.S.N.M. No. 66195	do	♀	29-31-22	246	66	312	8/9	13	1/2	4/3	71	19	90	44	0.159	1	2
U.S.N.M. No. 36345	Beaver Creek Hills, Beaver County, Utah.	♂	27-29-21	232	65	297	8	12	2	3/4	52	19	71	144	0.131	1	2
U.S.N.M. No. 55873	Elko County, Nev.	yg.	29-33-23	241	58	299	9	13/12	2	4	46	14	60	37	0.135	1	0
U.S.N.M. No. 18065	Jackass Spring, Panamint Mountains, Calif.	♂	31-35-23	240	66	306	8/9	11/13	2	3	52	15	67	99	0.151	2/1	0
U.S.N.M. No. 18066	Surprise Canyon, Panamint Mountains, Calif.	♀	31-35-23	245	--------	--------	8	13	2	4/3	54	-------	-------	-------	--------	1	1
U.S.N.M. No. 18067	Argus Range, Shepard Canyon, Calif.	♀	33-35-23	245	62	307	9	14/13	2	5/3	51	14	65	137	0.131	1	1/1
U.S.N.M. No. 18068	10 miles south of Owens Lake, Calif.	♀	31-33-23	242	57	299	8/9	13	2	4	52	13	65	125	0.120	3/2	0
U.S.N.M. No. 18069	Lone Pine, Calif.	♂	27-29-19	242	64	306	8	13	1	4/5	53	14	67	116	0.137	1	0
U.S.N.M. No. 52433	Toyabe Range, Peavine Creek, Nev.	yg.	29-33-23	232	64	296	8	11	1/2	4	54	16	70	42	0.142	1	0
U. Mich. No. 62141	Utah	♀	29-31-23	239	60	299	9/8	11/12	2	3	61	17	78	53	0.141	1	0
U. Mich. No. 62142	do	♀	29-31-23	241	59	300	8/9	12/11	2	3	58	15	73	137.5	0.138	1	0
U. Mich. No. 59714	do	♀	29-31-23	236	61	297	9	11/13	2	5	48	13	61	111	0.139	1	0

TABLE 13.—*Specimens of* Pituophis catenifer deserticola *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U. Mich. No. 59713	Utah	♀	29-31-21	243	60	303	8	13	2	3	65	15	80	50.3	0.133	2	0
U. Mich. No. 56235	Wawawai, Wash.	♀	27-29-23	224	65	289	8/9	12	2/1	3	51	14	65	103	0.140	1/2	0
U. Mich. No. 56236	do	♀	29-31-23	223	60	293	9	12/13	2	3	55	13	68	83	0.138	1	0
U. Mich. No. 56954	Walla Walla, Wash.		29——				9/8	12	1	2/3						1	0
U. Mich. No. 56956	do	♂	29-31-21	230	66	296	8	11	1	2	60	18	78	95	0.147	0/1	0
U. Mich. No. 56957	do		29——				8	12	2	3						1	0
U. Mich. No. 56959	do		29——				8/10	12/13	2	3						1	0
U. Mich. No. 56960	Prescott, Wash.		29——				10	13	2	5/3						2/1	0
U. Mich. No. 56958	do	♂	29-31-23	220	61	281	8	12/11	2	3	51	17	68	106	0.150	1	0
U. Mich. No. 43106	Near Carlin, Nev.	♂	27-31-23	216	61	277	8	11	2	3/4	51	16	67	100	0.140	1	1
U. Mich. No. 43105	do	♀	31-33-23	235	60	295	9	13/12	2	3	65	16	81	92	0.141	1	0
U. Mich. No. 43103	do	♀	29-29-23	238	56	294	9/8	13	2	4	53	14	67	98.5	0.132	1	0
U. Mich. No. 43104	do	♂	29-29-23	233	63	296	8/9	13	2/1	3	59	17	76	83	0.144	1	0
U. Mich. No. 43102	do	♀	29-31-23	241	55	296	8/9	13	2	4	55	15	70	112	0.133	1	0
U. Mich. No. 43113	do	♀	29-31-21	237	57	294	8	11	1/2	3/4	61	15	76	87	0.138	1	0
U. Mich. No. 43109	do	♂	29-31-23	235	62	297	8	12	2	3	57	17	74	108	0.148	1	0
U. Mich. No. 43112	do	♀	29-31-23	233	55	288	9	13/12	2	4/3	65	17	82	54	0.138	1	0
U. Mich. No. 43107	do	♀	29-31-21	239	57	296	8	13	2	3	55	16	71	106	0.132	1	1
U. Mich. No. 43110	do	♀	29-33-23	237	57	294	8	15/13	2/1	3	62	16	78	79	0.132	1	0
U. Mich. No. 43108	do	♀	29-31-23	232	55	287	8	13	2	3	56	16	72	89	0.134	1	1
U. Mich. No. 43111	do	♀	27-29-23	234			9	12/13	2	3	56					1	0
U. Mich. No. 3738	No data	♂	29-31-23	231	66	297	8	11/12	1	4/3	54	16	70	100	0.150	1	0
U. Wyo. No. 1191	Wyoming?	♀	27-29-19	249	51	300	8	10/12	2/1	3	65	14	79			1/2	0
C.A.S. No. 54001	Kanosh, Utah	♂	27-31-21	238	67	305	8	12	2	3/4	62	18	80	144	0.131	1	0
C.A.S. No. 43383	Palo Prieta Canyon, Calif.	♀	29-31-23	237	60	297	8	13	2	3	66	18	84	130	0.134	1	1
C.A.S. No. 39595	Isabella, Calif.	♂	29-31-21	235	65	300	8	13/12	2	3	62	21	83	66	0.144	1	0
C.A.S. No. 54036	Rockville, Utah	♀	27-29-21	239	60	299	8	13	1	3	49	16	65	89	0.134	1	0
C.A.S. No. 40504	Pyramid Lake, Nev.	♂	29-31-21	240	66	306	8	14/12	1	3	58	17	75	83	0.140	1	0
C.A.S. No. 30918	Fort Douglas, Utah	♀	29-31-21	234	60	294	9/8	13/12	2	4	61	17	78	115	0.130	1	2
C.A.S. No. 27198	do	♂	29-31-21	231	69	300	8	13/12	2	4	63	18	81	139	0.151	1	1

C.A.S. No. 30913	do	♂	27-29-21	229	66	295	8	13	2	4	50	17	67	101	0.148	2	0
C.A.S. No. 38756	do	♂	27-29-21	231	71	302	9	13	2	4	62	21	83	117	0.145	1	1
C.A.S. No. 30916	do	♂	31-33-22	240	62	302	9	13/12	2	4	61	17	78	97	0.134	1	0
C.A.S. No. 14201	do	♂	27-29-21	235	67	302	8	13	1/2	3/4	57	19	76	99	0.145	1	0
C.A.S. No. 30915	do	♂	27-29-21	239	68	307	9	13	2	3	61	20	81	122	0.155	1	0
C.A.S. No. 27199	do	♂	27-29-21	228	64	292	9/8	14/12	2	4	54	16	70	118	0.135	1	0
C.A.S. No. 14199	do	♂	27-29-21	234	70	304	9/8	13	2	3	50	17	67	129	0.155	1	2
C.A.S. No. 45129	do	♂	29-31-21	230	64	294	8	12/11	2/1	5/4	59	15	74	87	0.149	1	2
C.A.S. No. 14197	do	♂	27-29-21	232	66	298	8	12	1	3	62	20	82	83	0.150	1	0
C.A.S. No. 30917	do	♂	27-29-21	228	64	292	8	12/13	2	3/4	55	17	72	128	0.140	1	0
C.A.S. No. 30920	do	♀	29-31-21	238	62	300	8/9	13	2	3	53	18	71	35	0.142	1	0
C.A.S. No. 40961	Thompson, Utah	♂	29-31-21	243	65	308	8	13/12	2	4	65	17	82	81	0.142	1	0
C.A.S. No. 40925	Carlin, Nev	♂	29-33-23	242	57	299	8	13	2	3	66	19	85	66	0.130	1	0
C.A.S. No. 14200	Fort Douglas, Utah	♂	27-29-21	232	71	303	8/9	12/13	1	4	56	19	75	96	0.151	1	0
C.A.S. No. 45130	Boise, Idaho	♂	27-31-23	237	64	301	8	12	1/2	4/3	58	17	75	103	0.150	1	0
C.A.S. No. 14202	Fort Douglas, Utah	♂	29-31-23	234	70	304	9	14/13	2	5/4	57	17	74	98	0.153	1	0
C.A.S. No. 30919	do	♂	27-29-21	229	68	297	8	13	1	4	62	19	81	110	0.154	1	0
C.A.S. No. 14198	do	♀	29-31-21	239	60	299	8	13	2	4	58	17	75	113	0.132	1	0
C.A.S. No. 14207	do	♀	29-31-23	234	60	294	8	13/14	2	4	54	15	69	123	0.138	2	2
C.A.S. No. 14196	do	♂	27-29-19	233	70	303	8	13/11	1	3/4	62	15	77	112	0.151	1	0
C.A.S. No. 14205	do	♂	27-29-21	230	68	298	------	------	------	------	57	17	74	91	0.153	------	------
C.A.S. No. 14195	do	♂	29-31 21	237	67	304	8	11	2	4	50	15	65	116	0.146	1	0
C.A.S. No. 14194	do	♀	27-29-22	238	59	297	------	13	------	------	57	14	71	101	0.138	------	------
C.A.S. No. 14206	do	♂	29-31-22	237	67	304	8	------	2	3	54	16	70	138	0.144	1	1
C.A.S. No. 14204	do	♀	29-31-21	237	62	299	8	13/12	2	3	53	15	68	119	0.142	1	2
C.A.S. No. 14193	do	♂	27-29-21	238	67	305	8	12/?	1/2	4	66	20	86	121	0.148	1	0
C.A.S. No. 38755	Wasatch Mountains, Utah.	♂	29-31-22	238	70	308	8/9	12/11	2	3/5	67	17	84	135	0.144	1	1
M.V.Z. No. 10226	Indian Creek, Elmore County, Idaho.	♂	29-33-23	232	63	295	8	13	2	3	56	16	72	119	0.134	1	1
M.V.Z. No. 10316	Cleft, Elmore County, Idaho.	♂	29-31-23	236	62	298	8	13	2	4/3	61	17	78	85	0.141	2	5
M.V.Z. No. 6695	Owens Valley, Calif	♀	31-33-21	240	57	297	9/8	14/13	2	4	55	12	67	57	0.131	2/3	1
M.V.Z. No. 1530	Winnemucca, Humboldt County, Nev.	------	— 31—	------	------	------	------	------	------	------	------	------	------	------	------	------	------
M.V.Z. No. 5577	Wallula, Wash	♂	27-29-21	230	63	293	8	11	2	3	63	20	83	50	0.140	1	0
M.V.Z. No. 471	Mecca, Riverside County, Calif.	♀	29-31-23	241	55	296	8	12/13	1/2	4	45	13	58	59	0.118	1	0
M.V.Z. No. 1528	Big Creek, Pine Forest Mountains, Nev.	♀	29-31-23	246	63	309	8	12	2	3	51	15	66	90	0.133	1	0

TABLE 13.—*Specimens of* Pituophis catenifer deserticola *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Lablals		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
M.V.Z. No. 1276	Virgin Valley, Nev.	♂	29-31 22	234	63	297	8/9	13	2	4	64	16	80	116	0.129	1	0
M.V.Z. No. 10315	5 miles south of Cleft, Elmore County, Idaho.	♂	27-31-21	238	64	302	8	13/12	2	4/3	68	17	85	71	0.140	1	1
M.V.Z. No. 1274	Thousand-Creek Flat, Nev.	♀	29-33-23	242	59	301	8	13	2	3/4	50	16	66	67	0.126	1	0
M.V.Z. No. 1275	Virgin Valley, Nev.	♂	29-31-21	228	67	295	9	13	3/2	5	51	15	66	105	0.142	2	0
M.V.Z. No. 1529	Big Creek, Pine Forest Mountains, Nev.	♀	28-31-23	243	59	302	8	11/12	2	3	53	15	68	103	0.135	1	0
M.V.Z. No. 3716	Benton, Mono County, Calif.	♀	29-31-23	234	58	292	9/8	13	2	3	46	13	59	113	0.132	2	0
M.V.Z. No. 470	Mecca, Riverside County, Calif.	♀	29-33-23	250	65	315	9/8	12/11	2	4	55	16	71	61	0.131	1	2
M.V.Z. No. 3715	Benton, Mono County, Calif.	♀	29-31-23	249	60	309	8	12	2	3	62	15	77	128	0.125	1	0
M.V.Z. No. 6696	South of Benton, Mono County, Calif.	♀	29-33-23	244	56	300	9	13	2	5	68	16	84	126	0.127	1	0
M.V.Z. No. 6697	Shoshone, Inyo County, Calif.	♂	29-33-23	249	66	315	9	13	2	4	49	14	63	155	0.129	1/2	0
M.V.Z. No. 2798	Walker Pass, Kern County, Calif.	♀	29-33-22	245	59	304	8	13	2	3	47	12	59	72	0.131	1	0
M.V.Z. No. 7122	Palm Springs, Riverside County, Calif.	♂	31-35-25	248	62	310	8	14	2	6/4	72	19	91	146	0.130	1	0
M.V.Z. No. 5365	Victorville, Calif.	♀	29-31-23	241	62	303	9	12	2	4	52	16	68	46	0.141	1	0
M.V.Z. No. 761	8 miles northeast of Bakersfield, Calif.	♀	31-35-23	230	56	286	8	13	2	4	53	15	68	101	0.138	1	0
M.V.Z. No. 2760	do	♂	27-31-23	237	59	296	9/8	13	2	4	51	16	67	114	0.140	2	0
M.V.Z. No. 6338	Edison Station, Kern County, Calif.	♂	31-33-23	228	67	295	8	14	2	4	49	18	67	98	0.153	1	1
M.V.Z. No. 6264	Dunlap, Fresno County, Calif.	♀	29-33-23	231	-------	-------	8/9	14	2	4	57	-------	-------	-------	-------	1	0

M.V.Z. No. 8209	Mercey Hot Springs, Fresno County, Calif.	♀	29-33-23	232	58	288	8/9	13	2	5/3	49	12	61	175	0.131	1	1
M.V.Z. No. 6837	Wheeler Ridge, Kern County, Calif.	♀	29-33-23	226	54	280	8	12/13	2	4	49	14	63	115	0.139	1	0
A.N.S.P. No. 10849	Snake River, west of Bruneau River, Idaho.	♂	29-31-23	233	63	296	9	13/14	2	5	59	16	75	90	0.155	1	0
A.N.S.P. No. 3804	Owens Valley, Calif.	♂	29-31-23	234	64	298	9/8	13/14	2	3/4	46	14	60	118	0.144	3	0
A.N.S.P. No. 3803	do	yg.	29-29-21	238	63	301	8	12	1	4	55	15	70	35	0.142	1	0
A.N.S.P. No. 3802	do	yg.	29-29-21	243	59	302	8/9	12	2	5	56	13	69	36.5	0.123	1	1
A.N.S.P. No. 3805	do	yg.	29-31-21	243	-------	-------	9/8	12/11	2	4	57	13	70	35.5	0.123	1	0
A.N.S.P. No. 10387	Salt Lake City, Utah	♂	27-29-21	228	66	294	9	12	2	4/3	59	18	77	97	0.154	1	0
A.N.S.P. No. 3798	Ogden, Utah	♀	29-33-21	232	61	293	8	11/12	2	3	61	18	79	113	0.115	1	0
A.N.S.P. No. 3782	Owens Valley, Calif.	♂	29-31-21	245	62	307	9/8	14	2	3	56	15	71	123	0.138	0	0
A.N.S.P. No. 3783	Colorado River	♂	31-31-21	232	63	295	9/8	12	2	4/5	68	17	85	108	0.138	1	0
A.N.S.P. No. 3785	do	♀	29-33-23	244	56	300	9	13/14	2	3	51	14	65	59	0.118	1	0
A.N.S.P. No. 3784	do	yg.	27-29-21	226	56	282	8	11/12	2	2/3	74	21	95	34	0.132	1	0
U. Colo. No. 457	Naturita, Colo	♀	29-31-23	240	60	300	9/8	13	1	4	61	17	78	106	0.132	1	0
U. Colo. No. 103	Lake, southeast Nev. opposite Fort Mohave, Ariz.	------	31------	--------	--------	--------	8	15/14	2	3	-------	-------	-------	-------	--------	2/1	0
U. Okla. No. 6401	Elmore County, Idaho	♂	31-31-22	231	66	297	8	13/12	2	4	53	15	68	100	0.150	2/1	1
Klauber No. 670	20 miles northwest of Delta, Utah.	♂	29-31-21	235	68	303	8	12	1/2	3	54	16	70	75	0.146	1	0
M.C.Z. No. 2372	Salt Lake, Utah	♂	28-29-20	235	68	303	9	12	2	3	-------	-------	-------	103	0.150	1	0
M.C.Z. No. 13166	Utah	yg.	28-29-21	234	68	302	9	13	2	3	60	17	77	41	0.134	1	0
M.C.Z. No. 8900	Salt Lake County, Utah	♀	27-29-21	241	61	302	9	14/13	2	5	60	16	76	41	0.134	1	0
M.C.Z. No. 13157	Salt Lake City, Utah	♀	29-31-21	241	-------	-------	9	12	2	3	51	-------	-------	-------	--------	4/3	0
M.C.Z. No. 19149	St. George, Utah	yg.	27-29-21	248	61	309	8	14/13	2	3/4	53	15	68	42	0.142	1	1
A.M.N.H. No. 20566	Fort Douglas, Utah	♂	28-29-21	236	62	298	9/8	12	2	3	61	18	79	98	0.142	1/2	0
A.M.N.H. No. 20565	do	♂	27-29-21	234	63	297	8	13	2		59	18	77	91	0.142	1	0
N.M.N.H. No. 3562	Ouray Agency, Utah	♂	27-29-21	230	68	298	8/9	14/13	1	3	63	19	82	124	0.153	--------	--------
A.M.N.H. No. 9666	Carson City, Nev.	♂	29-31-23	230	65	295	8	12	2	3	56	16	72	118	0.144	1	1
Lewiston No. 1	Lewiston, Idaho	♂	29-31-23	232	62	294	8	12	2	3/2	57	14	71	82	0.134	1	3
Lewiston No. 2	do	♀	29-31-23	214	56	270	8/9	12	2/1	4	49	14	63	57	0.131	1	1
Field No. 1420	Coso Valley, Calif.	♀	29-31-23	246	56	302	8/9	13/15	2	4	48	11	59	124	0.120	2	0
Field No. 1411	Wild Rose Springs, Calif.	♀	31-33-23	259	57	316	8	12	2	4	56	13	69	143	0.118	1	0
Field No. 1415a	Lone Willow Springs, Calif.	♀	31-35-23	251	60	311	8	14/13	2	3	58	15	73	121	0.132	1	0
Field No. 1415b	do	♂	33-35-23	249	65	314	9	14/13	2	5/4	47	14	61	128	0.131	2	1
Field No. 921	Grand Junction, Colo.	♂	27-29-21	237	68	305	8	13	1	4	63	19	82	125	0.152	1	0

TABLE 13.—*Specimens of* Pituophis catenifer deserticola *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
Field No. 2793a	West of Dragon, Utah	♂	29-29-21	230	71	301	9	12/11	2	4	72	16	88	119	0.151	1	2
Field No. 2793b	do	♀	29-31-21	242	59	301	8	13/12	1	4	68	17	85	104	0.134	1	0
Field No. 2793c	do	♀	29-29-21	237	59	296	9/8	13/11	2	4/3	57	15	72	64	0.140	1	0
B.Y.U. No. 2288	Juab County, Utah	♂	29-31-21	234	66	300	8	12	2	3	65	18	83	95	0.145	------	-------
B.Y.U. No 929	Provo, Utah	♀	29-31-21	242	60	302	8	12	------	-------	55	16	71	94	0.145	-------	-------
B.Y.U. No. 2205	St. George, Washington County, Utah.	yg.	29-31-23	246	61	307	8	12/13	2	4/3	48	16	64	43	0.144	-------	-------
B.Y.U. No. 2236	Leeds, Washington County, Utah.	♀	31-33-21	252	67	319	8/9	11/12	2	4	46	16	62	88	0.147	-------	-------
B.Y.U. No. 781	Moab, Utah	yg.	27-29-21	247	62	309	9/8	13	1/2	4	55	15	70	54	0.140	-------	-------
Carnegie No. 387	No data	♂	27-29-21	217	62	279	8	12	1	4	48	12	60	130	0.138	1	0
Carnegie No. 1431	White River, Uinta County, Utah.	♂	27-29-21	240	67	307	8	9	1	4	68	17	85	111	0.148	1	2
Stanford No. 6406	Pyramid Lake, Nev	♀	31-33-25	244	63	307	8	14	2	3	61	15	76	113	0.132	1	1
Stanford No. 6407	Carson, Nev	♀	29-31-23	233	58	291	8	13	2	3	53	14	67	103	0.135	1	0
Stanford No. 4064	Blue Lake, Idaho	♀	29-31-23	243	59	302	8	13/12	1	3	59	15	74	105	0.133	1	1
Stanford No. 5649	Palmetto Mountains, Esmeralda County, Nev.	♀	29-31-21	245	66	311	9	14	2	3/4	50	16	66	43	0.139	1	0
Stanford No. 5640	Esmeralda County, Nev.	♀	31-33-23	249	61	310	9/10	14	2	4	48	12	60	39	0.128	1	1
Conner No. 1	Wawawai, Wash	♂	29-29-21	225	65	290	8	13	2	4	59	20	79	94	0.148	1	0
Conner No. 2	Asotin, Asotin County, Wash.	♂	29-31-23	229	-------	-------	8	12	2	4/3	67	-------	-------	-------	-------	1	0
Conner No. 3	Almota, Whitman County, Wash.	♂	29-31-23	225	-------	-------	8/7	12	2	3/4	62	-------	-------	-------	-------	1	0
Conner No. 4	Pullman, Whitman County, Wash.	♀	29-33-23	236	54	290	8	13/12	1	3	61	14	75	-------	-------	1	0
Whitman No. 5488	Walla Walla, Wash	♂	29-31-21	226	69	295	8	13/12	1	3	67	20	87	103	0.155	1	0
Whitman No. 5487	do	♂	29-31-21	220	66	286	8	11/12	1	3/4	55	19	74	109	0.155	1	2
Whitman No. 5486	15 miles west of Walla Walla, Wash.	♂	31-31-23	230	65	295	8	12/11	2	4	73	21	94	91	0.153	2	0
Whitman No. 3192	Near Walla Walla, Wash.	♀	29-33-24	233	58	291	10/8	13	2	3/4	61	16	77	112	0.142	1	0
Whitman No. 3301	do	♀	29-31-22	236	60	296	8	11/12	2/1	3	57	16	73	95	0.147	1	0

PITUOPHIS CATENIFER ANNECTENS Baird and Girard

Pituophis annectens Baird and Girard, Catalogue of North American reptiles, pt. 1 (Serpentes), p. 72, 1853 (type, U. S. N. M. No. 1839 (3 specimens); type locality, San Diego, Calif.).

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Pituophis reticulatus Jan, Elenco sistematico degli Ofidi, p. 59, 1863.—Bocourt, Mission scientifique au Mexique et dans l'Amérique Centrale, Reptiles, p. 666, note 1, pl. 47, figs. 3, 3a, 3b, 3c, 1888.

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Pityophis sayi bellona Streets, U. S. Nat. Mus. Bull. 7, p. 40, 1877.—Yarrow and Henshaw, Rep. Chief Eng. for 1878, Surv. West 100th Merid., vol. 3, app. NN, p. 1634, 1878 (part).—Yarrow, U. S. Nat. Mus. Bull. 24, pp. 16, 106, 1883 (part).—Cope, Rep. U. S. Nat. Mus. for 1898, p. 872, 1900 (part).

Pituophis catenifer deserticola Van Denburgh, Proc. California Acad. Sci., ser 2, vol. 5, p. 149, 1895.—Van Denburgh and Slevin, Proc. California Acad. Sci., ser. 4, vol. 4, pp. 133, 142, 1914.

Original description.—Baird and Girard (1853, p. 72) describe this form as follows:

> Head elongated, elliptical. Vertical plate subpentagonal, elongated, posteriorly obtuse, with sides concave. Anteorbitals 2; postorbitals 2. Dorsal rows of scales 33, 5 outer rows smooth. Triple series of dorsal blotches confluent for nearly the whole length of the body.
>
> Differs from *P. catenifer* in having much smaller dorsal blotches, and more interspaces. The fifteen anterior blotches of the three dorsal series almost united in a transverse or oblique band, anteriorly and posteriorly irregular. The blotches on the flanks are also proportionally smaller than in *P. catenifer*. From *P. Wilkesii*, which it resembles in the small size of the blotches, it differs by a more conical head, a narrower and longer vertical plate, and a rostral reaching higher up on the snout. The loral and superior anteorbital are quite large and the lower anteorbital very small. In one specimen we have noticed 5 postorbitals, the 5th contiguous to the lower anteorbital, thus constituting a continuous chain beneath the eye. Dorsal scales in 33 rows, the 5 outermost perfectly smooth. San Diego, Cal. 243.71.33. 28 5/8.4 13/16. Dr. J. L. Leconte.

Diagnosis.—From the forms of the *deppei* group *annectens* may be separated at a glance by the presence of four, rather than two, prefrontals, and the entrance into the eye of a single supralabial on either side, instead of one. From the *melanoleucus* group it may be distinguished by the low rostral, which in *annectens* is always at least as as broad as long, while in the subspecies of *melanoleucus* it is at least twice as long as broad. The same character distinguishes *annectens* from *s. sayi* and *s. affinis*, since the former has the rostral nearly twice as long as broad, and the latter has it always slightly longer than broad. In addition, *annectens* may be distinguished from *affinis* by the pattern, since in the former the spots are never reddish in color and are rarely less than 90 in number on body and tail, while in the latter the spots are generally reddish, at least on the posterior part of the body, and are always less than 90 in number. From *vertebralis*, *annectens* may be separated readily by the pattern and coloration. Thus in *annectens* the spots are never saddle-shaped, are usually black and never reddish, and are rarely less than 90 in number; in *vertebralis* the spots are always more or less saddle-shaped, are reddish or black anteriorly, reddish in the midregion of the body, and black on the posterior part of the body and on the tail, and are 48 to 81 in number.

From *c. catenifer*, *annectens* may be distinguished by the larger number of ventrals and caudals, and the larger number of spots. Thus in *annectens* the sum of the ventrals and caudals is generally greater than 300, and the total number of dorsal spots is rarely less than 90, and usually more than 100; in *catenifer* the sum of ventrals and caudals is rarely greater than 300, and the total number of spots is usually less than 90 and rarely more than 100. The same characters serve to distinguish *annectens* from *deserticola*, and in addition the latter frequently has the light scales of the interspaces and sides on

the anterior part of the body each with a small central black spot, while such markings are generally lacking in *annectens*.

Description.—The body is rather slender, and the snout is rather blunt. The tail varies from 0.135 to 0.182 (average 0.161) of the total length and is thus proportionately longer than that of any other form of the genus. The longest specimen examined measured 1,620 mm. in length, but Klauber (1931, p. 70) reports one measuring 1,739 mm. (5 ft. 8½ in.) long.

The dorsal scale formula varies from 29–29–21 to 33–37–25. The number of scale rows at the neck is 27 to 33, usually 29 or 31; the maximum number in the middle of the body 29 to 35, oftenest 33; the minimum number anterior to the vent 21 to 25, usually 23 or 25. The remaining scutellation is as follows: Ventrals 210 to 253 (average 229.4); caudals 60 to 84 (average 74.1); supralabials 7 to 10, usually 8 or 9; the fourth, fifth, or none entering the eye; infralabials 11 to 15, usually 12 or 13; preoculars 1 to 3, usually 2; postoculars 3 to 5; loreal present, frequently divided to form two or even three small scales; azygos present between frontal and prefrontals in about 10 percent of the specimens examined, occasionally present between prefrontal and preocular on either side, between the two pairs of prefrontals, or behind the rostral; rostral low and as broad as long, penetrating usually from one-third to all the distance between the internasals; frontal usually undivided but rarely split for a very small fraction of its length.

The dentition is as follows: Mandibular teeth 18 to 20, decreasing slightly in size posteriorly; maxillary teeth 14 to 18, decreasing slightly in size posteriorly; palatines 9 to 10, slightly smaller than the mandibular and maxillary teeth; pterygoids 8 to 14, slightly smaller than the palatines and decreasing slightly in size posteriorly.

The dorsum bears a series of dark brown, dark gray, or black spots, each 1 to 4 scales long and 4 to 8 scales wide, separated by interspaces of 1 to 3 scales each and numbering 55 to 92 (average 75.5) on the body and 14 to 36 (average 24.0) on the tail. On each side there are four or five lateral series of dark spots. The uppermost of these series is composed of spots nearly as large as those of the dorsal series, with which they fuse at the corners to form a more or less continuous network, presenting the appearance of a complete or broken chain. On the neck and for a short distance posterior one or more of the lateral series have the spots fused to form one or more continuous or broken longitudinal streaks. The lower rows of lateral spots are more or less irregular and indistinct in many specimens and are always paler than the dorsal and uppermost lateral series. The ground color of both dorsum and belly is a yellowish white, with pale brown often shading the interspaces between the dorsal spots and forming a more

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or less distinct longitudinal stripe at the level of the second and third and fourth lateral series of spots. The belly bears a series of small dark spots at each side, which are rarely more than one-half to one scale in length and are separated by 1 to 4 scutes. On some specimens these spots are rather pale and indistinct. In addition to the lateral series of spots the belly may have numerous brownish or black spots scattered irregularly over the posterior part, or even throughout the entire length, but is more often merely dotted with minute dark specks, or is immaculate. The top of the head is pale brown, occasionally somewhat dappled with darker brown, and frequently with the suggestion of a dark transverse band crossing the top of the head from the supralabials underlying the eyes, over the anterior part of the supraoculars and frontal, and the posterior part of the prefrontals. On each side a dark band from the eye to the posterior angle of the jaw also is frequently apparent. The throat is white. (Fig. 64, *c*.)

Variation.—In the accompanying graphs representing geographic variation in the form, the range has been divided into regions that are numbered from south to north along the abscissas of the graphs as follows:

Region 1. San Jose del Cabo, Lower California.
2. Northern part of Lower California.
3. San Diego County, Calif.
4. Riverside, Los Angeles, and San Bernardino Counties, Calif.
5. Ventura, San Luis Obispo, and Santa Barbara Counties, Calif.
6. Monterey and Santa Cruz Counties, Calif.
7. San Martin Island, Lower California.
8. South Coronado Island, Lower California.

The island specimens have been graphed as separate units, since they cannot logically be inserted at any point in such a geographic series. Although the small numbers of specimens from the southern and northern extremes of the range and from the islands of San Martin and South Coronado render the conclusions drawn in regard to those regions of slight value, nevertheless certain general variational tendencies appear to exist in correlation with the geographic distribution of the form. In regard to the island specimens, it will be noted that the scale rows of the South Coronado specimens are markedly high (fig. 79), although well within the range of variation for the group as a whole, and thus perhaps the specimens under consideration represent an extreme of variation for that region. The numbers of both body and tail spots appear to be low in both the San Martin and the South Coronado specimens (fig. 84), but here again the small number of specimens necessitates extreme caution in the interpretation of the data. In the numbers of scale rows (fig. 79), ventrals (fig. 80), and infralabials (fig. 82) there seems to be a general tendency toward a slight decrease from south to north, which is most marked in the case of the ventrals. The remaining scale characters (fig. 81),

as well as the proportionate tail length (fig. 83), are so constant throughout the range that no significant variations can be discovered. A slight tendency toward a general increase in the number of both body and tail spots from north to south appears to exist (fig. 84).

The sexual variation evident from a study of the form may be summarized as follows: Dorsal scale formula varies from 29–29–21 to

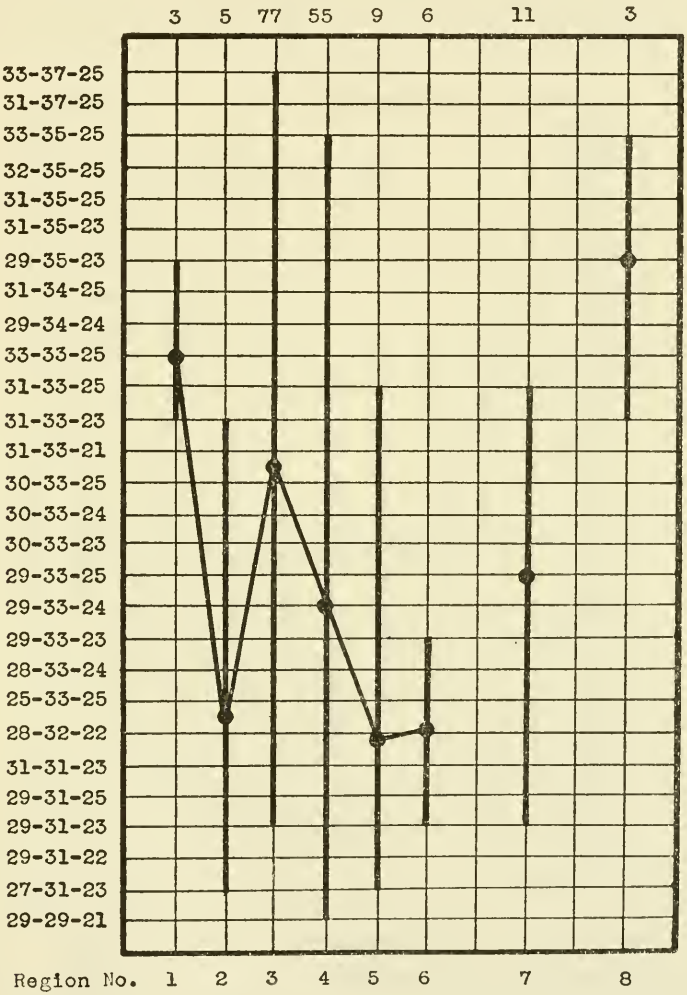


FIGURE 79.—Geographic variation in number of scale rows in *Pituophis catenifer annectens*.

31–35–25 in males, from 29–31–22 to 33–37–25 in females; ventrals from 210 to 253 (average 227.8) in males, 224 to 241 (average 232.7) in females; caudals 60 to 84 (average 76.4) in males, 62 to 82 (average 70.0) in females; supralabials, infralabials, preoculars, and postoculars all slightly higher on the average in females than in males; body spots average 75.8 in males, 75.0 in females; tail spots average 24.8 in males,

22.8 in females; proportionate tail length varies from 0.145 to 0.182 (average 0.165) in males, from 0.135 to 0.166 (average 0.155) in females.

An albino specimen is described by Klauber (1924, p. 21) as follows: "A small albino *Pituophis catenifer annectens* was taken January 14, 1923, at La Mesa (San Diego County, Calif.). It was said to have been ploughed out. The spots normally brown were faint straw color, while those normally black were translucent and hence pink,

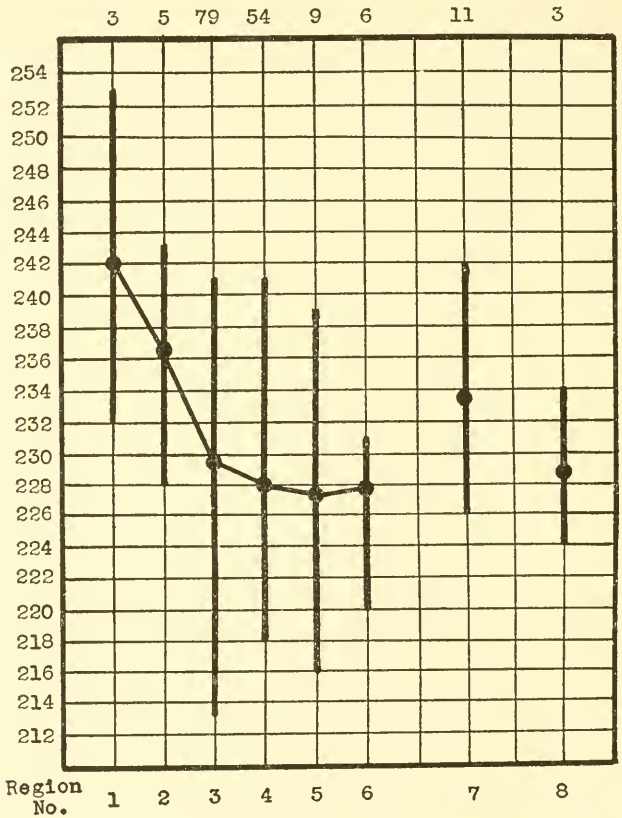


FIGURE 80.—Geographic variation in number of ventrals in *Pituophis catenifer annectens*.

as were the eyes also. The remaining areas were white. The eyes jerked involuntarily in strong light."

In 1931 (p. 70) Klauber reports having seen another albino specimen 3 feet long "in Schubach's collection. . . . The normal yellow was straw, the normal black, brown, and red were white. The parietals were distorted."

Range.—The range of this form extends from the southernmost tip of Lower California north to Santa Cruz and Contra Costa Counties, in the coastal strip of California, and the Mojave Desert farther

inland, and includes San Martin and South Coronado Islands, Lower California, and Catalina Island, Calif. The form is most abundant in San Diego, Riverside, San Bernardino, and Los Angeles Counties, Calif., and the specimens from the most northern and most southern

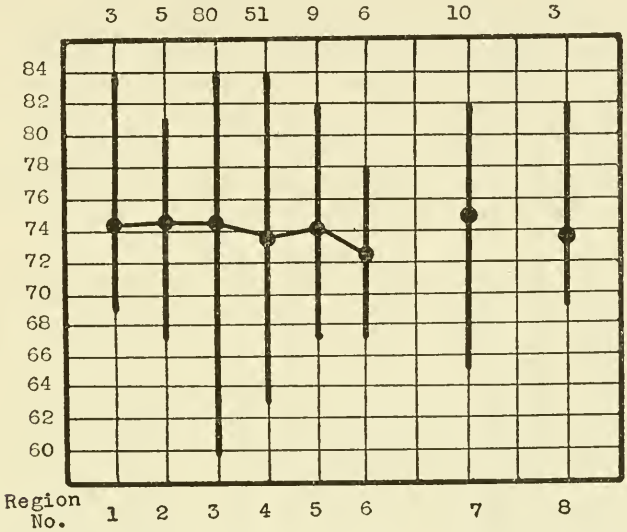


FIGURE 81.—Geographic variation in number of caudals in *Pituophis catenifer annectens*.

parts of the range undoubtedly are occasional stragglers, rather than typical members of the fauna of those regions.

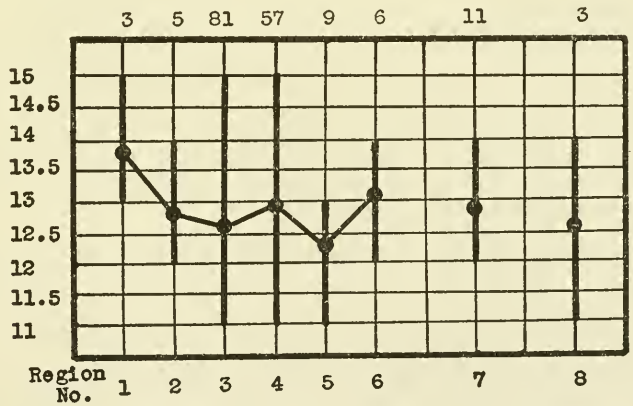


FIGURE 82.—Geographic variation in number of infralabials in *Pituophis catenifer annectens*.

Specimens have been examined from the following localities:

Mexico: *Lower California*, San José del Cabo, Sierra Juarez, San Pedro Mountains, San Antonio del Mar, Ensenada, Pacific coast, San Martin Island, South Coronado Island.

California: *Contra Costa County*, Clayton; *Los Angeles County*, Claremont, San Pedro, Sierra Madre, Sierra Madre Mountains, Irvine, La Crescenta, Pasadena, San Gabriel Mountains near Sierra Madre, Los Angeles, Glendale, Azusa, old Mount Wilson Trail, Placerita Canyon (35 miles north of Los Angeles), Catalina Island; *Monterey County*, Chalk Peak, Soledad; *Riverside County*, Moreno, San Jacinto, Banning, Strawberry Valley in San Jacinto Mountains, Ranger's Cabin in San Jacinto Mountains, Shain's Ranch in San Jacinto Mountains, Riverside; *San Bernardino County*, Ontario, near Colton, Santa Ana in San Bernardino Mountains, Seeley Flats in San Bernardino Mountains, Hesperia, San Bernardino; *San Diego County*, La Mesa, San Diego, Vista, Campo, El Cajon, Ramona, San Onofre, Lakeside, La Posta, Deerhorn Flat, Santa Ysabel, Pacific Beach, Flynn Springs, Cottonwood, Cuyamaca Mountains, Warner Pass, Julian, Aqua Caliente, Cahuilla Valley, Witch Creek, west of the mountains, Oceanside, San Dieguito Valley, Boule-

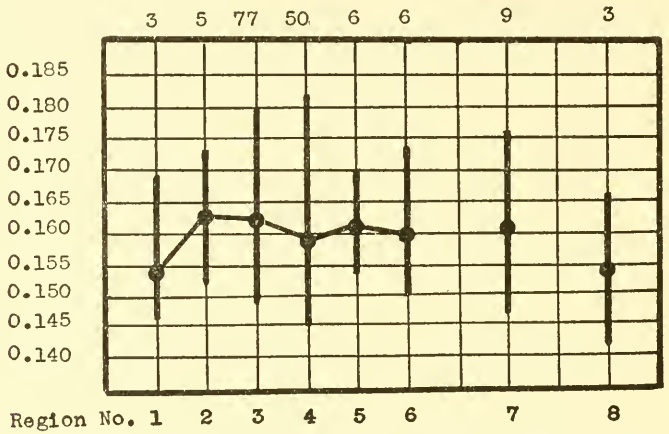


FIGURE 83.—Geographic variation in ratio of tail length to total length in *Pituophis catenifer annectens*.

vard, Laguna, Point Loma, Sorrento, Jacumba, Wynola Grade, Pine Valley; *San Luis Obispo County*, San Miguel; *Santa Barbara County*, Santa Barbara, Schoolhouse Canyon; *Santa Cruz County*, near Santa Cruz City; *Ventura County*, Pine Creek. The following localities are indefinite or cannot be located: Antelope Valley; Boquet Canyon, Sangers; Rattlesnake Park; Pitt River; south fork of Kings River; Mohave Desert.

The following additional records have been given which are probably authentic:

Mexico: *Lower California*, Gardners Laguna on Salton River (Cope, 1900, p. 879), Rosarita Beach (Klauber, 1928, *in litt.*).

California: *Los Angeles County*, between Shain's Ranch and Strawberry Valley in San Jacinto Mountains, between Strawberry Valley and Hemet in San Jacinto Mountains (Atsatt, 1913, p. 43), Coldwater Canyon (Van Denburgh and Slevin, 1919, p. 216; Van Denburgh, 1920, p. 17; Van Denburgh, 1922, vol. 2, p. 711); *Orange County*, San Clemente, Capistrano (Klauber, 1928, *in litt.*); *Riverside County*, Temecula, Wildomar, Elsinore, Cabazon (Klauber, 1931, p. 74), Val Verde (Klauber, 1931, p. 75; Klauber, 1932b, p. 125), March Field, Riverside (Klauber, 1932b, p. 125); *San Bernardino County*, Mountain Home Canyon in San Bernardino Mountains, Seven Oaks in San Bernardino Mountains (Grinnell, 1908, p. 165), Bluff Lake in San Bernardino

Mountains (Van Denburgh, 1912b, p. 149); *San Diego County*, near Orcutt (Grantville) (Cope, 1900, p. 879), Rancho Santa Fe, Del Mar, Torrey Piness Linda Vista, La Jolla, Encanto, North Island, National City, Chula Vista, Nestor, Pine Hills, Cuyamaca, Fallbrook, Pala, San Marcos, Richland,

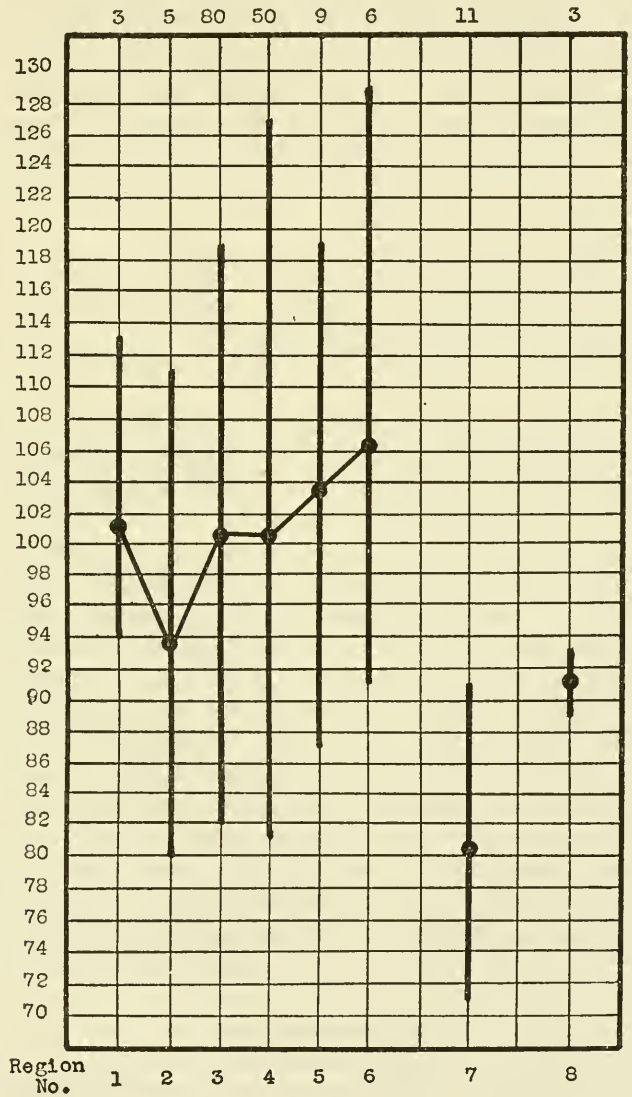


FIGURE 84.—Geographic variation in total number of dorsal spots in *Pituophis cantenifer annectens*.

Bernardo, Poway, Mussey, Miramar, Dehesa, Lemongrove, Otay Dam, La Puerta, Pauma, Rincon, Warners, Valley Center, Mesa Grande, Boulder Creek, Oakzanita, Japatul, Lyons Valley, Jamul, Barrett Dam, Potrero (all Klauber, 1924, p. 12; Klauber, 1928, *in litt.*), Ocean Beach, La Costa, Merle, San Pasqual, Murray Dam, Cardiff, Encenitas, Bonita, Otay, Paradise

Valley, Monument, Sweetwater Dam, Spring Valley, Helix, Jamacha, Bostonia, Mission Gorge, Lakeview, Twin Brooks, El Monte, Foster, Shady Dell, Wildwood, Bear Valley Dam, Palomar, Amago, Henshaw Dam, Montezuma, Sutherland, Stewart Well, San Felipe Valley, Ballena, El Capitan, Hipass, Banner (all Klauber, 1928, *in litt.*), San Luis Rey, Rose Canyon, Alpine, Grossmont, Viejas, Guatay, Las Flores (Klauber, 1928, *in litt.;* Klauber, 1931, pp. 74–81), Chollas Heights, Dulzura, Descanso, Santee, Rosedale (Klauber, 1924, p. 12; Klauber, 1928, *in litt.;* Klauber, 1931, pp. 74–81), Bonsall (Klauber, 1924, p. 12; Klauber, 1928, *in litt.;* Klauber, 1932b, p. 125), Escondido (Klauber, 1932b, p. 125), northwest of El Cajon, Wynola, Riverview, Terrinitos (Klauber, 1931, pp. 74–80), Mission Valley (Klauber, 1924, p. 12; Klauber, 1928, *in litt.;* Klauber, 1931, p. 75; Klauber, 1932b, p. 125); Rainbow (Klauber, 1928, *in litt.;* Klauber, 1931, p. 75; Klauber, 1932b, p. 125).

Habits and habitat.—Van Denburgh (1897, p. 198) says of the species, including this form: "Its food . . . consists of small mammals, of which gophers are said to form a large part."

Stephens (1921, p. 64) says, "They feed on gophers, mice, rats, and squirrels."

Klauber (1934, p. 17) calls this the most beneficial snake of the region, "as it lives exclusively on mice, rats, gophers, and other rodents."

In regard to the hibernation of this form Rüthling says (1915b, p. 10): "Now and then a Pacific Bull Snake . . . will wander in search of food and may be found abroad even in winter. Only exceptional warm days will cause this, however." Of its feeding habits he says (1916a, p. 91): "Its food consists chiefly of rodent pests, such as gophers, mice, ground squirrels, and small rabbits. Although he prefers these animals for food, the Pacific Bull Snake has a rather accommodating appetite, which must under the force of necessity adapt itself to circumstances and include in his ophiological menu, birds, an occasional rat, bats, and sometimes a lizard or two. Sometimes an egg (or several) is commandeered, but I have never known of a Pacific Bull Snake's having eaten any egg as large as a chicken's." One 64-inch snake, he reports, vomited four full-grown pocket gophers, and another ate more than a dozen mice at one meal. The same author reports (1916b, p. 6) finding a specimen among stones at the foot of a group of oak trees "far out in the open grape field" at the mouth of a canyon.

Nelson (1922, p. 129) lists *annectens* from the Upper Sonoran Zone, San Diegan district, of Lower California.

Klauber (1931, opp. p. 8) lists *annectens* from the following zones of San Diego County: Coast, inland valleys and mesas, foothills, mountains, and desert foothills. The same author gives many interesting notes on this form, some as follows (1931, p. 70): The greatest activity is during the day, but one specimen "was observed coming out of a gopher hole at seven P. M.," and another "was caught crossing the road at 5:50 P. M." Specimens were collected "in a manzanita bush

one foot above ground," "on the margin of the San Luis Rey River," "on a concrete highway making almost no progress despite violent efforts" [mortality from automobiles was found to be particularly high in this form, especially among juveniles], "under a piece of tin in a field," and also (1932b, p. 125) in "brush," "orchard," "creek and fields," "fields," and "orange groves." Specimens collected were found to have eaten "a full grown mouse," "two small rabbits," "a large mouse." "A buzzard was observed eating a large freshly killed specimen by the roadside." Specimens in captivity laid eggs on July 19, July 21, and August 29 (1931, p. 70).

Affinities.—The closest affinities evidently exist between this form and the other subspecies of *catenifer*, *catenifer* and *deserticola*. Although there is a continuous increase in the number of dorsal spots from *deserticola* to *catenifer* to *annectens*, nevertheless the direct derivation of *annectens* from *deserticola* rather than from *catenifer* would seem to be indicated by the fact that in most of the scale characters there is a decrease from *deserticola* to *catenifer*, but not to *annectens*. The observations of Klauber (1931, p. 49) on *annectens* and *deserticola* would suggest the derivation of *annectens* from *deserticola* elsewhere than in southeastern California. In this connection Klauber says:

> From the first I have naturally been desirous of determining the area of intergradation of these two forms, if such an area exists. Therefore, all border specimens coming into my hands have been examined with care, and I have been surprised to find that there is apparently no intergradation. I do not know, as yet, whether the ranges of the two subspecies overlap, but at least it is evident that they closely approach each other. I have had specimens of *annectens* from a number of desert foothill localities. . . . Strange as it may seem, these specimens appear to average rather darker and with a higher number of dorsal blotches than is usual in *annectens*, thus showing a tendency away from, rather than toward, *deserticola*. It is true that an occasional specimen light in color and with few spots will come to hand, which will fall between *deserticola* and *annectens* according to the key, but these are quite as likely to be found in the coastal zone as elsewhere and seem to be conspicuous by their absence in the desert foothill area. A single typical *deserticola* has been taken within San Diego County at Carrizo and further eastward the subspecies becomes relatively common. Here it is quite uniform in coloration and distinct from *annectens*. Thus we have in the place of a single changing form, two separate subspecies which have not been shown to intergrade in this region, although they may elsewhere, or through a third member of the species.

The probable relationships of *annectens* and the adjacent forms have been expressed by the diagram on page 133.

Table 14 lists the specimens of this form that have been examined.

TABLE 14.—*Specimens of* Pituophis catenifer annectens *examined*

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 1839a (cotype).	San Diego, Calif.	♀	31-33-25	241	70	311	8/9	13	2	5	75	25	100	78	0.153	1	0
U.S.N.M. No. 1839b (cotype).	do						8	12	1/2	3						1	0
U.S.N.M. No. 1839c (cotype).	do						8	14/13	2	3						2	0
U.S.N.M. No. 75202	Banning, Calif.	♀	29-31-23	226	67	293	9	13	2	4	65	20	85	68	0.147	1	0
U.S.N.M. No. 75203	do	♀	29-31-23	227	75	302	8/9	13	2	5	74	21	95	57	0.157	2/1	1
U.S.N.M. No. 75204	do	♂	29-31-23	229	75	304	8	13	2	4	83	28	111	41	0.170	2	0
U.S.N.M. No. 75205	do	♀	31-33-25	241	68	309	8/9	13	2	3	81	24	105	37	0.152	2/1	0
U.S.N.M. No. 8565	San Martin Island, Lower California.	♂	29-33-23	233	76	309	9	13/14	1	3	70	21	91	43	0.162	1	0
U.S.N.M. No. 24395	do	♂	29-33-23	228	82	310	9	13	1	4	67	21	88			1	1
U.S.N.M. No. 44385	Catalina Island, Calif.	♂	28-32-22	224	77	301	9/8	12	2/1	3/4	64	25	89	109	0.169	1	0
U.S.N.M. No. 54369	San Diego County, Calif.	♀	29-33-23	234	69	303	8	13/12	2	3	84	23	107	53	0.150	1	0
U.S.N.M. No. 54370	do	♂	31-35-25	228	74	302	8	13	2	3	79	23	102	118	0.152	2	0
U.S.N.M. No. 54373	do	♂	30-33-25	220	73	293	8	13	1	3/4	71	24	96	63	0.174	2/1	1
U.S.N.M. No. 54374	do	♂	29-31-23	232	79	311	8	13	1	4	77	24	101	65	0.169	2	1
U.S.N.M. No. 54375	do	♂	29-33-23	228	78	306	8	12/13	2	4	72	25	97	68	0.161	1	0
U.S.N.M. No. 54376	do	♀	31-35-25	228	67	295	9	13	2	3	80	22	102	97	0.154	1	0
U.S.N.M. No. 54377	do	♂	29-33-23	222	75	297	8	13/12	2	3/4	80	26	106	72	0.166	1	0
U.S.N.M. No. 20481	do	yg.	31-35-25	230	72	302	8	13	2	4	72	25	97	45	0.155	1	0
U.S.N.M. No. 16344	do	♀	31-34-25	236	72	308	9/8	13/14	3	5/4	72	25	97	88	0.158	1	0
U.S.N.M. No. 14128	San Diego, Calif.	♂	31-33-25	226	69	295	8	13/12	2	3/4	72	23	95	108	0.157	1	0
U.S.N.M. No. 53551	do	♂	30-33-23	227	76	303	8/9	14	2	3/4	75	25	100	54	0.166	2	0
U.S.N.M. No. 53552	do	♂	31-33-23	233	81	314	9/8	14	2	5	79	24	103	56	0.178	2	1
U.S.N.M. No. 22578	do	♂	31-33-25	213	80	293	9	13	2	4	78	28	106	46	0.177	1	0
U.S.N.M. No. 54378	do	♀	31-35-25	234	65	299	9	13/14	2	5/3	73	21	94	113	0.150	1	1
U.S.N.M. No. 55102	do	♂	31-35-25	230	78	308	10/8	13	1	4	80	27	107	131	0.167	1	0

U.S.N.M. No. 55103	---- do	♂	29-33-23	232	77	309	8	11/12	2	3/4	79	25	104	133	0.165	1	0
U.S.N.M. No. 55104	-----do	♂	29-33-25	234	77	311	8	13	2	5/4	72	23	95	133	0.165	2	0
U.S.N.M. No. 55101	-----do	♂	31-35-25	232	79	311	9/8	12	2	4	75	23	98	143	0.160	1	1
U.S.N.M. No. 44460	Oceanside, Calif	♀	31-35-25	231	67	298	8	12	1	3	84	29	113	64	0.156	1	0
U.S.N.M. No. 53672	San Dieguito Valley, Calif.	♂	31-35-25	239	70	309	8	13	2	4	76	26	102	64	0.156	1	0
U.S.N.M. No. 54343	Boulevard, San Diego County, Calif.	♂	29-33-24	233	84	317	8	13	2	3/4	89	31	120	147	0.170	1	0
U.S.N.M. No. 54342	-----do	♂	29-35-25	230	77	307	8	13/14	2	4	68	21	89	125	0.168	1/2	2
U.S.N.M. No. 22034	Laguna, San Diego County, Calif.	♂	31-33-25	224	60	290	8	13/14	2/1	4	83	24	107	121	0.161	1	1
U.S.N.M. No. 56521	San Bernardino County, Calif.	♂	28-33-23	227	77	304	8	13	2	4	82	25	107	76	0.171	2	0
U.S.N.M. No. 56522	-----do	♀	33-35-25	235	72	307	9'8	14	2/1	4/3	68	24	92	53	0.150	1	0
U.S.N.M. No. 56523	-----do	♂	30-33-24	223	72	295	8	13	2/1	4	61	20	81	132	0.159	1	2
U.S.N.M. No. 59362	No data	yg.	29-31-23	228	82	310	9/8	12/13	1	5/4	81	28	109	45	0.177	1	0
U.S.N.M. No. 23732	San Pedro Mountains, Lower California.	♂	27-31-23	237	80	317	8	14	1	4	69	24	93	123	0.170	1	0
U.S.N.M. No. 47959	San Gabriel Mountains, Calif.	♂	27-31-23	226	77	303	8	13	2	3/4	76	26	102	98	0.173	1	0
U.S.N.M. No. 56520	Los Angeles, Calif	♂	29-33-23	225	75	300	8	12/13	1	3	81	27	108	82	0.158	1	2
U.S.N.M. No. 54843	35 miles north of Los Angeles, Calif.	yg.	29-31-23	219	74	293	8	12	1	4	79	26	105	42	0.166	1	0
U.S.N.M. No. 49608	No data	♀	31-33-25	-------	62	-------	9	14	2	3	96	28	124	74	0.135	1	1
U.S.N.M. No. 53670	Campo, Calif	♀	31-35-25	230	73	303	9	13/14	2	4	75	24	99	118	0.152	1	2
U.S.N.M. No. 53676	-----do	♀	31-35-25	237	69	306	8	13	2	3	75	22	97	53	0.160	1	0
U.S.N.M. No. 53669	-----do	♂	29-31-23	232	76	308	8	11/12	1	3	79	28	107	63	0.158	1	0
U.S.N.M. No. 53675	-----do	♂	31-33-25	232	79	311	8/9	13/14	2	4	71	27	98	46	0.172	1	0
U.S.N.M. No. 53673	Point Loma, Calif	♀	31-33-23	239	67	306	8/9	13/14	2	3	73	20	93	101	0.158	1	0
U.S.N.M. No. 53550	-----do	♂	29-31-23	230	78	308	8	13	1	4	76	28	104	105	0.180	1	0
U.S.N.M. No. 8592a	Santa Barbara, Calif	♂	29-31-23	226	77	303	8/9	13	2	5/4	79	21	100	102	0.166	2/1	0
U.S.N.M. No. 8592b	-----do	♂	27-31-23	216	78	294	8	12	1/2	4	81	26	107	-------	-------	1	0
U.S.N.M. No. 8593	-----do	♂	—31-23	-------	70	-------	-------	-------	-------	-------	-------	24	-------	-------	-------	-------	-------
U.S.N.M. No. 8582	-----do	♀	29-31-22	229	72	299	8	12/11	2	3/4	67	20	87	51	0.156	1	0
U.S.N.M. No. 8591	Mojave Desert, Calif	yg.	29———	-------	------	-------	8/9	13	1	3	-------	-------	------	-------	-------	1	0
U.S.N.M. No. 21461	Pacific coast, Lower California.	♂	28-33-24	236	81	317	8	12	1/2	4/3	68	21	89	142	0.161	1	0
U.S.N.M. No. 53671	Campo, Calif	♂	29-31-23	228	76	304	9/8	13	1	5/4	75	24	99	79	0.164	1	0
U.S.N.M. No. 1810	Bank of Pitt River, Calif.	♂	29-31-23	220	82	302	8	13	2	3	66	25	91	93	0.176	2	2

TABLE 14.—*Specimens of* Pituophis catenifer annectens *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
U.S.N.M. No. 18063	South fork of Kings River, Calif.	♂	29-33-23	231	67	298	9/8	14/13	2	3/4	66	23	89	112	0.151	1	1
M.V.Z. No. 9662	San José, Lower California.	♂	31-33-25	253	70	323	8	13	2	5/4	90	23	113	47	0.159	1	0
M.V.Z. No. 10492	Sierra Juarez, Lower California.	♀	29-31-25	243	67	310	8	12	2	4	60	20	80	39	0.153	1	0
M.V.Z. No. 9705	San Martin Island, Lower California.	♀	31-33-25	244	71	315	8/9	13/14	2	4/3	60	16	76	50	0.150	2	0
M.V.Z. No. 9703	do	♀	31-33-25	242	64	306	9/8	13	1/2	5/3	58					1	0
M.V.Z. No. 9706	do	♂	29-31-25	231	77	308	8/9	13/14	1	5/3	57	19	76	132	0.159	1	1
M.V.Z. No. 9704	do	♂	29-33-25	232	75	307	8	13/12	1	5/4	68	22	90	102	0.176	2	1
M.V.Z. No. 623	Cuyamaca Mountains, California.	♂	29-31-23	223	75	298	9	13	1/2	5	74	24	98	56	0.169	2	0
M.V.Z. No. 553	Strawberry Valley, San Jacinto Mountains, Calif.	♀	29-33-23	229	63	292	8/9	13/14	2	3	75	20	95	44	0.147	1	0
M.V.Z. No. 551	do	♀	29-31-23	226	72	298	9	12/13	2	3	88	27	115	110	0.163	1	0
M.V.Z. No. 552	do	♂	31-33-23	228	74	302	8	13	2/1	4	81	26	107	92	0.163	1	0
M.V.Z. No. 104	Ranger's Cabin, San Jacinto Mountains, Calif.	yg.	29-31-23	232	79	311	9/8	13/14	2/1	3	97	30	127	45	0.166	1	0
M.V.Z. No. 343	Shain's Ranch, San Jacinto Mountains, Calif.	♂	29-31-23	227	82	309	8	13	2	3	74	25	99	120	0.175	1	0
M.V.Z. No. 1040	Warner Pass, San Diego County, Calif.	♂	31-35-25-	228	78	306	9/8	13	2	3	86	28	114	122	0.172	1	0
M.V.Z. No. 9813	San José, Lower California.	♂	29-35-23	232	69	301	9	15	2	4	72	22	94	150	0.146	1	1
M.V.Z. No. 9889	do	♂	31-33-23	241	84	325	8	14/13	1	3	73	24	97	155	0.168	1	0

M.V.Z. No. 4313	San Gabriel Mountains near Sierra Madre, Los Angeles County, Calif.	♀	29-33-23	228	65	293	9	13	2	3/4	82	24	106	52	0.153	1	0
M.V.Z. No. 4310	Sierra Madre, Los Angeles County, Calif.	♀	31-33-23	226	74	300	9	13	1	3	71	23	94	134	0.156	1	0
M. V. Z. No. 7120	Griffith Park, Los Angeles County, Calif.	♀	31-31-23	234	65	299	9/8	13	2	3	82	23	105	48	0.156	1	0
M.V.Z. No. 7123	Glendale, Los Angeles County, Calif.	♂	29-33-23	219	72	291	8	13	1	3	75	23	98	42	0.154	1	0
M.V.Z. No. 7124	Sierra Madre, Los Angeles County, Calif.	♂	29-33-25	218	72	290	8	13	2	4	73	25	98	42	0.154	1	0
M.V.Z. No. 751	Near Azusa, Calif.		29——				9	15/13	2	3						1	0
M.V.Z. No. 4311	Old Mount Wilson Trail, Calif.	♀	29-31-23	232	70	302	8/9	11/13	2	3	72	23	95	117	0.162	2/1	0
M.V.Z. No. 3819	Schoolhouse Canyon, Santa Barbara County, Calif.	♀	31-33-25	239			8	13	2	3/4	73					1	0
M.V.Z. No. 756	Santa Ana, San Bernardino Mountains, Calif.	♂	31-31-23	225	75	300	8/9	12/13	1/2	4	79	25	104	111	0.162	1	0
M.V.Z. No. 75	Near Colton, Calif.	♀	31-33-25	226	65	291	9	14	2	3	73	24	97	117	0.153	1	2
M.V.Z. No. 622	Julian, Calif.	♀	33-37-25	225	68	293	9	13	2	4	75	22	97			1	0
M.V.Z. No. 7247	Chalk Peak, Monterey County, Calif.	♀	29-33-23	230	69	299	8	13/14	2	3	82	26	108	80	0.150	2	0
M.V.Z. No. 7248	do	♂	29-31-23	220	78	298	9/8	13	2	4	93	36	129	53	0.169	1	0
Stanford No. 5240	Riverside, Calif.		31-35——				8	14/13	2	4						2	1
Stanford No. 1750	San Jacinto, Calif.	♂	31-35-23	224	76	300	9	14/13	1/2	4	72	22	94	125	0.176	1	2
Stanford No. 1164	do	♂	31-33-23	231	76	307	9/8	12	3/2	3/4	76	26	102	85	0.182	1/2	0
Stanford No. 1135	do	♂	31-33-23	224	84	308	8	12	1	3/4	81	30	111	148	0.182	1	0
Stanford No. 1146	do	♂	31-33-23	224	74	298	9	13	2	4	78	26	104	128	0.163	2	0
Stanford No. 1197	do	♂	29-31-23	226	78	304	9	14/13	1/2	4	82	26	108	133	0.172	1	2
Stanford No. 1784	do	♂	29-29-21	231	78	309	9	13/14	2	4/3	67	19	86	68	0.161	1	0
Stanford No. 1166	do	♀	29-22-23	231	69	300	8	13	2	4	75	23	98	78	0.166	1	0
Stanford No. 1122	do	♂	29-33-23	220	76	296	8	13	1	3	66	25	91	43	0.162	1	0
Stanford No. 4008	do	♂	29-31-23	230	75	305	8	13/12	1	3	76	26	102	43	0.162	1	0
Stanford No. 4093	San Diego, Calif.	♂	29-31-23	231	77	308	8/9	12	2	3	79	24	103	55	0.163	1	0
Stanford No. 1155	do	♀	29-33-23	236	74	311	9	12	1	3	73	21	94	45	0.155	1	0
Stanford No. 1162	Agua Caliente, San Diego County, Calif.	♀	29-31-23	235	73	308	9	12	2	3	86	27	103	123	0.162	1	0

TABLE 14.—*Specimens of* Pituophis catenifer annectens *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
Stanford No. 4050	Cahuilla Valley, San Diego County, Calif.	♂	29-31-23	226	72	298	8	12/13	1	3/4	78	24	102			1	0
Stanford No. 1149	San Diego County, Calif.	♂	31-33-23	228	75	303	9/8	14/15	2	3/5	81	29	110	53	0.160	1/2	0
Stanford No. 4291	Ontario, Calif.	♀	31-33-23	224			9	14	2	4/5	82					1	0
Stanford No. 4268	do	♀	31-33-23	234	70	304	8	13	2	4	82	24	106	88	0.159	1	0
Stanford No. 1160	No data	♂	29-33-23	231	83	314	8	13	2	4/3	80	28	108	145	0.165	1	2
Stanford No. 6464	San Bernardino Mountains, Calif.	♂	31-33-23	225	78	303	9	13	1	3	78	22	100	80	0.175	1	0
C.A.S. No. 43589	San Martin Island, Lower California.	yg.	29-33-25	236	67	303	9	12/13	2	4	55	14	69	34	0.147	1	0
C.A.S. No. 43588	do	yg.	31-33-25	229	74	303	8	13	1	5	60	18	78	36	0.166	2	0
C.A.S. No. 59679	do	♂	29-33-25	226	73	299	9/8	12	1	4	67	22	89	51	0.166	1	1
C.A.S. No. 59678	do	♂	31-35-25	233	77	301	9	12	1	5/4	55	18	73	114	0.166	1	0
C.A.S. No. 8678	do	♂	29-31-23	234	78	312	9/8	13	1	3	69	20	89	139	0.165	1	0
C.A.S. No. 8575	Ensenada, Lower California.	♂	29-31-23	228	75	303	8/9	13/14	2	4/3	87	24	111	104	0.173	1	0
C.A.S. No. 43379	Soledad, Calif.	♀	29-33-23	231	71	302	8/9	12/13	2	3	68	23	91	76	0.151	1	0
C.A.S. No. 43520	Pine Creek, Calif.	♂	29-33-23	226	79	305	8	13	2	3/4	81	25	106	124	0.161	1	0
C.A.S. No. 58054	Wynola Grade, Calif.	♀	29-33-25	230	71	301	8	13	2	3	74	23	97	50	0.160	1	0
C.A.S. No. 40080	Campo, Calif.	♂	31-33-23	230	75	305	8	12/13	1	3	74	24	98	130	0.161	1	0
C.A.S. No. 40076	do	♂	31-33-25	232	81	313	9/8	14/13	1/2	4	79	26	105	90	0.172	1	0
C.A.S. No. 40073	do	♂	31-33-23	225	76	301	8	13	2	4	70	21	91	117	0.170	2	0
C.A.S. No. 40082	do	♀	31-37-25	234	67	301	9	14/13	3	5	80	19	99	113	0.150	1	1
C.A.S. No. 40068	do	♂	31-31-21	233	78	310	8	13	1	3	79	27	106	101	0.168	1	0
C.A.S. No. 40075	do	♀	31-35-25	236	71	307	8	13	2	5/4	70	21	91	61	0.155	1	0
C.A.S. No. 40077	do	♀	31-35-23	227	82	309	8/9	13	2	3	79	26	105	60	0.166	1	0
C.A.S. No. 40074	do	♂	29-33-23	231	74	305	8	13	2	5	77	26	103	54	0.160	1	0
C.A.S. No. 40081	do	♀	31-35-25	226	78	304	8	14/13	2	5/4	79	25	104	57	0.166	1	0
C.A.S. No. 27806	Sierra Madre Mountains, Calif.	♀	31-33-23	229	71	300	9/8	14	2	3/4	77	26	103	100	0.165	1	0

C.A.S. No. 27534	do	♀	31-33-23	235	69	304	9/8	14/13	2	4	65	21	86	149	0.154	1	0
C.A.S. No. 13588	South Coronado Island, Lower California.	♀	31-35-25	234	69	303	8	12/13	2	5	71	22	93	49	0.142	2	0
C.A.S. No. 13589	do	♀	33-35-25	229	70	299	8	13/11	2	4	68	21	89	77	0.155	1	0
C.A.S. No. 57733a	Irvine, Calif.	♂	31-33-25	232	75	307	8	13	1	3	72	26	98	104	0.163	1	0
C.A.S. No. 57623	San Antonio del Mar, Lower California.	♀	31-33-23	238	70	308	8	12/13	2	4	72	23	95	82	0.151	1/2	1
C.A.S. No. 58124	Escondido, Calif.	♂	29-31-23	228	73	301	7/8	13/12	1	3	80	23	103	57	0.166	1	0
C.A.S. No. 58123	do	♂	31-33-25	223	78	301	8	13	2	3	76	24	100	63	0.173	1	0
C.A.S. No. 36285	Hesperia, Calif.	♀	29-33-23	234			8	14/13	2	4/5	69					1	0
C.A.S. No. 58118	Santa Ysabel, Calif.	♀	33-35-25	237	72	309	8	13	2	3/4	81	22	103	53	0.150	1	0
C.A.S. No. 40003	La Crescenta, Calif.	♀	29-33-25	231	68	299	9/8	14	2	4/5	87	24	111	60	0.150	1	3
C.A.S. No. 57733b	South of Irvine, Calif.	♂	33-33-25	231	75	306	8	13	1	3	75	25	100	105	0.161	1	2
C.A.S. No. 58135	Rattlesnake Park, Calif.	♂	31-33-25	228	72	300	8	12	2	3	80	23	103	117	0.162	1	0
C.A.S. No. 43382	San Miguel, Calif.	♂	29-31-23	227	73	300	8	11/12	2	3	75	24	99	162	0.154	1	0
A.N.S.P. No. 10846	Pasadena, Calif.	♂	29-31-23	230	77	307	8	13	2	3	80	27	107	143	0.160	1	0
U. Mich. No. 57039	Claremont, Calif.	♂	29-33-23	220	80	300	9/8	14	1	4/3	78	27	105	57.5	0.156	2	0
Klauber No. 209	La Mesa, San Diego County, Calif.	yg.	29-31-23	225	79	304	8	12	1/2	3	82	27	109	48.5	0.175	1	0
Klauber No. 201	San Diego, Calif.	yg.	31-33-23	219	75	294	9/8	12	1	3	77	22	99	38	0.166	1	0
Klauber No. 207	do	yg.	31-35-25	233	67	300	8/9	12/14	2	3	75	20	95	42.5	0.152	2/1	0
Klauber No. 431	do	♂	31-33-23	231	77	308	8	12/11	1	3	87	27	114	47	0.159	1	0
Klauber No. 202	Vista, San Diego County, Calif.	yg.	29-33-23	228	62	290	8	13	2	3	66	20	86	37	0.148	1	0
Klauber No. 69	Campo, Calif.	yg.	31-31-23	230	71	301	8	13/14	2	3	82	24	106	39	0.153	1	0
Klauber No. 110	San Diego County, Calif.	♀	31-33-25	232	71	303	9	13	2	3	72	21	93	54	0.157	1	0
Klauber No. 295	El Cajon, San Diego County, Calif.	♂	31-33-23	232	82	314	8	12/13	2	3	64	24	88	45.5	0.164	1	1
Klauber No. 567	Ramona, San Diego County, Calif.	♀	33-37-25	230	71	301	8/9	14	2	4	66	20	86	70	0.157	2/1	1
Klauber No. 668	San Onofre, San Diego County, Calif.	♀	29-31-23	229	67	296	9/8	13	1	3/4	81	24	105	67	0.156	1	0
Klauber No. 669	Lakeside, San Diego County, Calif.	♂	31-33-23	225	80	305	8/9	13	2/3	5/4	89	30	119	50	0.170	2/1	1
Klauber No. 644	La Posta, San Diego County, Calif.	♀	31-33-25	234	72	306	8	12/13	2	3	67	21	88	43	0.162	1	0
Klauber No. 569	Deerhorn Flat, San Diego County, Calif.	♀	31-35-25	232	71	303	8	13	2	4/3	84	27	111	44	0.159	1	0
Klauber No. 568	do	♂	29-33-23	229	77	306	8	12	1/2	3	60	22	82	47	0.170	1	0

TABLE 14.—*Specimens of* Pituophis catenifer annectens *examined*—Continued

Specimen	Locality	Sex	Scale rows	Ventrals	Caudals	Ventrals plus caudals	Labials		Oculars		Spots			Length		Loreal	Azygos
							Supra	Infra	Pre	Post	Body	Tail	Total	Total	Tail / Total		
														Cm.			
Klauber No. 739	Hesperia, San Bernardino County, Calif.	♀	31-33-23	239	67	306	9	13	2	5	60	17	77	54	0.148	2/1	0
San Diego No. 1364	San Jacinto, Calif.	yg.	29-31-23	223	76	299	8	12	2	4/3	64	22	86	35	0.171	3/2	1
San Diego No. 1363	San Diego, Calif.	yg.	31-35-23	231	71	302	8	14/12	2	4	81	25	106	46	0.152	2	0
San Diego No. 1362	Santa Ysabel, Calif.	♂	29-33-23	226	78	304	8	13	2	3	-------	28	-------	61	0.163	1	0
San Diego No. 1366	----do----	♂	29-33-23	229	73	302	9	13	2	3	72	25	97	81	0.160	1	0
San Diego No. x	No data	♂	31-35-25	228	76	304	9/8	15	2	4	80	29	109	116	0.163	2/3	0
San Diego No. 1365	Coronado Island, Lower California.	yg.	31-33-23	224	82	306	10/8	13/14	3/2	4/5	68	23	91	36	0.166	1	0
Carnegie No. 4011	Antelope Valley, Calif.	yg.	29-31-23	227	78	305	8	13/12	2	3/4	75	25	100	53	0.169	1	0
Carnegie No. 4012	Santa Barbara, Calif.	yg.	29-31-23	231	76	307	8	12	1	4/3	81	28	109	57	0.157	1	0
Carnegie No. 4014	----do----	yg.	31-33-23	228	67	295	8	13	2	5	82	24	106	-------	-------	1	0
Field No. 2927	Sorrento, Calif.	------	29———	-------	-------	-------	8	13	2	4	-------	-------	-------	-------	-------	1	0
Field No. 2928	San Diego, Calif.	yg.	31-33-23	228	64	292	8/9	14/13	2	3	77	20	97	52	0.153	1	0
Field No. 8044	----do----	♀	29-35-25	230	71	301	8	12/13	2	4	69	20	89	136	0.154	1	0
Field No. 674	San Jacinto, Calif.	♀	31-33-25	230	71	301	8	13	2	4	71	19	90	115	0.156	1	0
Field No. 8145	No data	♂	29-31-23	225	75	300	8	13	2	3	77	26	103	141	0.163	1	0
Field No. 2909	Pacific Beach, Calif.	♂	29-31-23	227	78	305	9/8	13	1	3	81	25	106	106	0.169	1	0
Field No. 8429	Flynn Springs, Calif.	♂	31-35-25	229	75	304	9	13	1	4	73	23	96	59	0.161	1	0
M.C.Z. No. 17673	Santa Barbara, Calif.	♂	29-31-23	227	82	309	8	12	1	4/3	90	29	119	47	0.170	1	0
M.C.Z. No. 18926	----do----	♂	29-31-23	225	73	298	8/9	12	1	3	79	23	102	140	0.167	1	0
M.C.Z. No. 20454	Cottonwood, San Diego County, Calif.	♀	31-33-25	236	71	307	9/8	13/12	2	4	77	25	102	80	0.162	1	0
M.C.Z. No. 21205	Glen Lonely, San Diego, Calif.	♂	29-31-23	225	73	298	8	12	2	5/3	80	24	104	89	0.168	1	0
M.C.Z. No. 20455	----do----	yg.	31-33-25	234	73	307	8	13	1	4	79	23	102	45	0.155	1	0
M.C.Z. No. 21204	Clayton, Contra Costa County, Calif.	♀	29-31-23	230	76	306	8	13	2	4	78	23	101	79	0.164	1	0
M.C.Z. No. 9107	Near Santa Cruz City, Calif.	yg.	29-31-23	227	74	301	8	13	2	4/3	86	25	111	37.5	0.173	1	0

A. M. N. H. No. 9197	Boquet Canyon, Sangers, Calif.	♀	31-35-23	241	70	311	8	13	2	3	88	23	111	149	0.154	1	2
A. M. N. H. No. 9133	Seeley Flats, San Bernardino Mountains, Calif.	♂	29-31-23	230	81	311	8	12	2	4/3	72	25	97	62	0.145	1	0
A.M.N.H. No. 20661	San Bernardino, Calif.	♂	29-33-23	225	76	301	8	13/14	1	3	78	26	104	45	0.155	1	0
A.M.N.H. No. 20662	do	♂	29-33-23	229	77	306	8	13	2/1	4/3	92	26	118	46	0.163	1	1
A.M.N.H. No. 20660	do	♂	28-31-22	228	80	308	9/8	13	2	3	72	24	96	52	0.173	1/2	0
A.M.N.H. No. 20659	do	♀	31-35-25	231			9	14	2	4	70					3/2	0
A.M.N.H. No. 20567	Campo, Calif.	♀	29-33-24	236	70	306	8	13/14	2	3	73	22	95	68	0.154	1	0
A.M.N.H. No. 20568	do	♀	31-35-23	240	72	312	9	13	2	4	82	26	108	55	0.154	1	0
A.M.N.H. No. 9045	Near San Pedro, Calif.	♂	29-31-22	223	76	299	9/8	14/13	2	3	69	22	91	74	0.162	1	0
A.M.N.H. No. 9044	do	♀	29-33-23	224	70	294	9	13/12	2	4/3	75	24	99	65	0.153	1	0

GENERAL CONCLUSIONS

Six species and thirteen forms may be recognized in the genus *Pituophis*. Three of these, *d. deppei*, *d. jani*, and *lineaticollis*, form a natural group characterized by the presence of two prefrontals, a broad low rostral, and the entrance of two supralabials into the orbit on each side. The other forms all have four prefrontals and a single supralabial entering the eye on either side, but differ widely in the shape of the rostral plate. The four subspecies of *melanoleucus* form a natural group in the common possession of a very long and narrow rostral, the two subspecies of *sayi* have a moderately long rostral, longer in *s. sayi* than in *s. affinis*, and the other three forms, *vertebralis* and the three subspecies of *catenifer*, are characterized by a low broad rostral. *P. vertebralis*, however, must be considered separately from the forms of *catenifer* since it obviously represents a distinct evolutionary line with an independent origin.

Thus, two major groups are distinguishable, the latter of which may be further subdivided into four minor groups, as follows:

deppei group
- *deppei deppei.*
- *deppei jani.*
- *lineaticollis.*

sayi group
- *melanoleucus melanoleucus.*
- *melanoleucus mugitus.*
- *melanoleucus lodingi.*
- *melanoleucus ruthveni.*
- *sayi sayi.*
- *sayi affinis.*
- *catenifer catenifer.*
- *catenifer deserticola.*
- *catenifer annectens.*
- *vertebralis.*

The variation found to occur in the genus has been discussed in detail, in the description of the genus as a whole, as well as in the discussions of the various forms. The main conclusions in regard to variational tendencies in the genus may be summarized here as follows:

1. Three types of variation are found to exist—individual, sexual, and geographic.

2. The most striking variation is individual, and most of the characters show an extremely wide range of variation not only for the genus as a whole, but in each separate form as well.

3. Sexual variation is marked in several characters. Scale rows and ventrals are consistently higher in females throughout the genus, while caudals, the proportionate tail length, and the number of tail spots are universally higher in males. No other tendencies in sexual variation are consistent for the genus.

4. When an evident geographic variation is present it is in general continuous from the probable center of distribution for the form to the periphery of its range.

5. In every form represented by a sufficient series of specimens the variational tendency in scale rows, ventrals, and caudals is similar; and in labials and oculars, as well, when these show a recognizable geographic variation. When an evident geographic variation occurs in the proportionate tail length, it is the reverse of that observable in the scale characters. The number of tail spots varies in correlation with the number of caudals, but the body spots show a continuous variation only in exceptional and contradictory cases.

6. In all forms of the genus a general decrease in scale characters from the probable center of dispersal to the periphery of the range of the form is evident, and is accompanied by an increase in proportionate tail length.

7. Within a given form a general tendency to decrease the scale characters is indicative of and correlated with a general dwarfing of the form. Between forms, however, a general decrease in the scale characters may be correlated with a general dwarfing, but is not necessarily so, as is shown by the decrease from *sayi* to the subspecies of *melanoleucus*, which latter forms are on the average the largest of the genus.

In the foregoing generalizations a knowledge of the center of origin for the various forms is assumed. The first step in the task of attaining this knowledge is the determination of the probable center of dispersal for the genus as a whole. Various rules for the determination of the center of dispersal for a group of related forms have been proposed by different authors.

The ten criteria of Adams (1902, p. 115) have been given a wide application, and the repetition of them here seems unnecessary. Only three of them can be considered to be of value in this study, since of the others one applies only to the migration of birds, and of the other six "none of them would necessarily hold true for the place of origin after the time of origin" (Dunn, 1926, p. 8). These three tests are:

1. Continuity and convergence of lines of dispersal.
2. Continuity and directness of individual variations or modifications radiating from the center of origin along the highways of dispersal.
3. Direction indicated by biogeographical affinities.

A brief discussion of each of these in relation to this genus may be of value.

1. Continuity and convergence of lines of dispersal.—The several evolutionary lines leading to *s. sayi* and the forms of *melanoleucus* in the east, to the *deppei* group in the south, to *vertebralis* in Lower California, and to the three subspecies of *catenifer* in the west and

northwest obviously converge in the southwest in the range of *sayi affinis*. The series of forms in each of these lines is not linear, however, and in each case except that of *vertebralis* a subsidiary center of dispersal for the group may be determined. Thus, in the *deppei* group, *d. deppei* is clearly ancestral to *d. jani* and *lineaticollis*, in the eastern line *s. sayi* leads to *m. ruthveni*, from which the other three subspecies of *melanoleucus* obviously have been derived independently of one another, and *c. catenifer* and *c. annectens* undoubtedly have arisen separately from *c. desertícola*.

2. Continuity and directness of individual variations or modifications radiating from the center of origin along the highways of dispersal.—As has been stated above, the characters showing any pronounced geographic variations vary in general along the lines of radiation from the center of origin for the form, if *affinis* is accepted as the central form of the genus, to the periphery of its range. A complete continuity of variation from form to form is impossible in a genus in which the evolutionary series are not strictly linear, and where the lines of dispersal fork on the periphery of the range into two or more diverging branches. In such a case, if the variational trend is continuous into one of the diverging lines of each branching, as in each of the evolutionary series of *Pituophis*, the requirement may be considered to be fulfilled.

3. Direction indicated by biogeographical affinities.—The geographic probability that *affinis* is the form nearest the evolutionary center of the genus is clearly indicated by a consideration of the distribution of the included forms. Thus *affinis* is near the geographic center of the genus, and has a range contiguous with or overlapping that of the form of each radiating evolutionary line which is nearest to it in scale and pattern characters, and thus obviously most closely related.

It is evident that in accordance with these three criteria *affinis* must be accepted as located at the probable center of origin for the genus.

The main principle of dispersal propounded by Matthew (1915, p. 180) is as follows:

> Whatever agencies may be assigned as the principal cause of evolution of a race, it should be at first most progressive at its point of original dispersal, and it will continue this progress at that point in response to whatever stimulus originally caused it, and spread out in successive waves of migration, each wave a stage higher than the previous one. At any one time, therefore, the most advanced stages should be nearest the center of dispersal, the most conservative farthest from it.

Since every animal is dependent for its existence upon a favorable environment, this factor must be accepted as of the utmost importance in its relation to evolutionary change. Whether a changed environment affects the animal directly, or only indirectly as the agent of natural selection, is immaterial in this connection. In either case, it

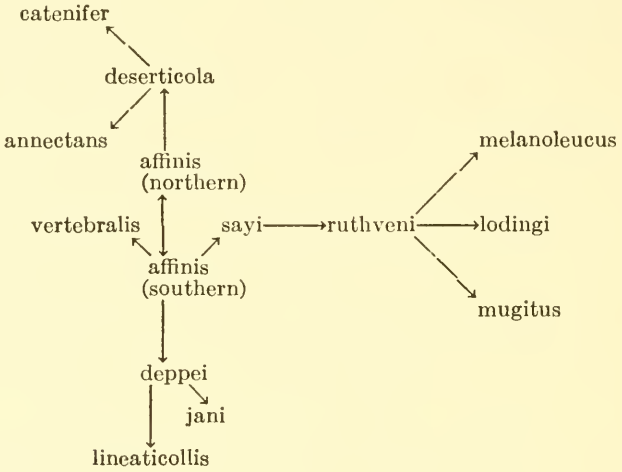
is obvious that however variations may arise they cannot become established in one or the other of two groups unless they are separated by an environmental difference, however slight. Such an environmental difference may be due either to an actual change in the environment in the original habitat, or by the migration of the animals to a different habitat. In the latter case the animals affected will be those that have migrated and are found on the periphery of the range, since the animals in the center would be in the original habitat and already adapted to the environment, and whatever variations arose would be unlikely to persist; while in the periphery of the range such variations as proved favorable, whether induced by the changed environment according to the Lamarckian idea, or selected by it according to the Darwinian theory, could become established. If the change were in the environment itself, it seems probable that such animals as migrated in order to retain their association with the original environment would remain little changed, while those which remained in the area of environmental change would evolve in correlation with the changing conditions. In such a case, the "most advanced stages," as Matthew says, "should be nearest the center of dispersal, the most conservative stages farthest from it." In its application to this group, where several distinct evolutionary lines radiate from a common center, this principle is of questionable value, since it is evident that in this genus environmental change has not advanced in concentric circles from a central point, but has rather been encountered along several different lines of dispersal or migration routes, which are represented by the four evolutionary series radiating from the range of *affinis* in the southwestern United States and northern Mexico.

There remains for consideration the other possibility, that the animals migrate to a different environment, with the result that the most conservative and generalized forms occur at the center of the range in the original habitat, while the more specialized forms are found at the periphery. This is undoubtedly the case in *Pituophis*, where the most generalized form, *affinis*, is in the geographic center of the genus, where the various evolutionary trends and lines of dispersal originate, and the most specialized forms, such as *lineaticollis* and the three most eastern subspecies of *melanoleucus*, are found on the periphery of the range of the genus.

We may conclude, therefore, that the genus arose in or near the range of *affinis*, presumably in northern Mexico, where *affinis* intergrades with *s. sayi* and overlaps *d. deppei* in range. From this central point the genus spread over every possible migration route, and as a result, the *melanoleucus* group was developed in the east, with *m. ruthveni* ancestral to the three eastern subspecies, and *s. sayi* phylogenetically as well as geographically intermediate between *ruthveni*

and *affinis*; *d. deppei* became separated from *affinis* in the south and in turn gave rise to *d. jani* and *lineaticollis*; *vertebralis* was separated from the southern group of *affinis* by the invasion of the Gulf of California, and spread north through Lower California and southern California; and the subspecies of *catenifer*, with *c. deserticola* as the stem form, appeared to the north and west of *affinis*.

The probable affinities and lines of dispersal of the various forms of the genus, in accordance with this explanation of the evolutionary development of the genus, may be illustrated by the following diagram:



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