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TITLE A TAXONOMIC STUDY OF THE AMERICAN REPRESENTATIVES OF THE GENUS ELAPHE FITZINGER, WITH PARTICULAR ATTENTION TO THE FORMS OCCURRING IN MEXICO AND CENTRAL AMERICA

AUTHOR HERNDON GLENN DOWLING

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# A TAXONOMIC STUDY OF THE AMERICAN REPRESENTATIVES OF THE GENUS ELAPHE FITZINGER, WITH PARTICULAR ATTENTION TO THE FORMS OCCURRING IN MEXICO AND CENTRAL AMERICA

by

Herndon G. Dowling

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of the requirements for the degree of
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Committee in charge:

Assistant Professor Norman E. Hartweg, Chairman
Professor William H. Burt
Associate Professor Claude W. Hibbard
Professor J. Speed Rogers
Associate Professor Frederick H. Test

# PREFACE

This group of snakes has held my interest since some years before World War II, when it came to my notice that there were no Banded Chickensnakes (Elaphe quadrivittata) in my home state of Alabama, although it was included in the range given for this snake in the various books on herpetology which I had available.

After the war, while a student at the University of Florida, my interest in these snakes continued to the extent of gathering local material and plotting the geographic distributions of the various species of Elaphe then recognized from the southeast: E. obsoleta with its single subspecies, E. o. confinis; E. quadrivittata and its subspecies; E. williamsi; E. guttata, and E. rosacea. It was found that the distribution of these forms as demonstrated by the specimens available in the collection of the University of Florida and that of the Alabama Museum of Natural History was quite different from that given in the standard references (i.e., Stejneger and Barbour, 1943). At the same time it became clear that at least the southeastern members of this genus could be separated into two distinct groups: one consisting of large, long-tailed snakes which lost their juvenile head pattern during ontogeny, and had distinctly keeled dorsals (E. obsoleta, E. quadrivittata, and E. williamsi); the other a smaller, shorter-tailed group which retained at least some vestige of the original head pattern throughout life, and had

dorsals which were less distinctly keeled (E. guttata and E. rosacea). Discussion with workers at the University of Florida and the comparison of information with workers in other areas of the southeast failed to disclose any information which would tend to break down a theory of subspecific relationship between the members of each group, but rather all information tended to confirm this idea.

Upon my arrival at the University of Michigan in February of 1948, a survey of the Elaphe material in the Museum of Zoology was begun with the idea of further checking the hypothesis of subspecific relationships, and the possibility of extending it to the other members of the genus in North America. This overall survey was completed for the Obsoleta and Guttata groups the following year and a paper of these preliminary results was presented at the Washington meeting of the American Society of Ichthyologists and Herpetologists in June 1949. The encouragement and material offered by the members of the Society was greatly appreciated and the latter was extensively used in the completion of this study.

The remainder of the work, which has included the further examination of relationships within the genus and the continued gathering of data to prove or disprove the original hypothesis, has been carried on in the Museum of Zoology, University of Michigan.

A number of papers derived from the present study have already appeared or are now in press. These include one

concerned with a question of nomenclature (Dowling, 1951a), the description of a new subspecies (Dowling, 1951d), and two proposing standard methods of obtaining or presenting data on snake scutellation (Dowling, 1951b, 1951c).

Acknowledgments. A large number of persons have aided immeasurably in my work on this problem. For the courteous responses to my requests for material, information, and other data, I am greatly indebted to the following persons and institutions: (the initial letters are those used in referring to specimens from these institutions in this paper).

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ANSP Dr. Emmett R. Dunn, Mr. James A. Fowler, Mr. Robert Sutcliffe; Academy of Natural Sciences of Philadelphia.

CalAS Mr. Joseph R. Slevin; California Academy of Sciences, San Francisco.

CAS Dr. Howard K. Gloyd; Chicago Academy of Sciences.

ChM Mr. E. Burnham Chamberlain; Charleston Museum, South Carolina.

CM Mr. M. Graham Netting, Dr. Grace L. Orton; Carnegie Museum, Pittsburgh.

CNHM Mr. Clifford H. Pope, Mr. K. P. Schmidt; Chicago Natural History Museum.

DBUF Dr. Arnold B. Grobman, Mr. Edwin H. McConkey; University of Florida, Gainesville.

DZTU Dr. Fred R. Cagle; Tulane University, New Orleans, Louisiana.

KUMNH Dr. Edward H. Taylor; Kansas University, Lawrence.

MCZ Mr. Arthur Loveridge; Museum of Comparative Zoology, Cambridge, Mass.

MVZ Dr. Robert C. Stebbins; Museum of Vertebrate Zoology, Berkeley, California.

MZUU Dr. Angus M. Woodbury, University of Utah, Salt Lake City.

PSM Dr. James R. Slater; Puget Sound Museum, Takoma, Washington.

TNHC Dr. W. Frank Blair, Mr. David L. Jameson, Mr. William W. Milstead; University of Texas, Austin.

UMMZ Dr. Norman Hartweg; University of Michigan Museum of Zoology, Ann Arbor.

UOMZ Dr. A. I. Ortenburger; Museum of Zoology, University of Oklahoma, Norman.

USNM Dr. Doris M. Cochran; U. S. National Museum, Washington.

Mr. Roger Conant, Philadelphia Zoological Gardens, who has done previous work on this genus of snakes, kindly turned over to me several highly desirable specimens, plus his notes on Elaphe guttata. Mr. Raymond Porter, Miami, Florida, sent me valuable specimens from southern Florida. Mr. E. Ross Allen, Silver Springs, Florida, sent many valuable specimens from various localities. Mr. John Werler, San Antonio Zoological Society, Texas, sent a large number of interesting snakes from

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My friends, fellow students, and members of the staff at the University of Michigan have aided in this study in too many ways to mention. Drs. Charles F. Walker and J. Speed Rogers, of the Museum of Zoology, have been especially helpful. Mr. William L. Brudon, Staff Artist of that institution, has used his skill to give clarity to the difficult descriptions at the expense of his own free time, for which I will be forever grateful.

Dr. Norman Hartweg, who has been in charge of my work here, is one of those rare individuals who is able to encourage confidence in one's own work, rather than allowing him to become dependent upon the advice and suggestions of others. To him and to the other members of my committee, I wish to express my appreciation for their encouragement and informed discussion.

I am most indebted to my wife, Peggy P. Dowling. In addition to her help in the field, in the accumulation and sorting of data, and in the preparation of the manuscript, she has encouraged and inspired me to continue this work which has consumed such a large part of my time and energy during these years.

Thanks are due to the Museum of Zoology, University of Michigan, and especially to the Division of Herpetology which

has provided the facilities for this work. The facilities and services required have placed a heavy burden upon the staff and finances of this institution, and I wish to express my greatest appreciation.

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# INTRODUCTION

There has been no monographic treatment of the genus Elaphe Fitzinger to date, nor any comprehensive treatment of the American representatives. This lack of comprehensive treatment is especially noticeable in the uneven taxonomic treatment of the various forms: those which are well known having many small, closely related population-groups which bear names, while those which are less well known are still confused at the species level. The interrelations of the forms are almost unknown, and intergradation between subspecies has been demonstrated in only a few. The knowledge of the group has improved very little since 1922 when Barbour pointed out in his review of Blanchard's "King Snakes" that "Elaphe, Natrix, and Pituophis still await biographers..."

The present work is an attempt to obtain a comprehensive survey of the various forms which make up the American portion of the genus Elaphe, to bring together all of the important information concerning the members of this genus, to establish their relationships, and to put the nomenclature on a firm basis. The item of relationship, since it is the least known and perhaps the most important, has been given the primary emphasis.

The concept of species and subspecies expressed herein is not a conventional one, since no single individual's ideas have been strictly adhered to. Mayr's concept (1948: 233-35) of the polytypic species has been found acceptable to a

certain degree, but not to the extent of assuming that similar allopatric forms are necessarily subspecifically related. However, if geographically replacing forms overlap in their characters, or are no more distinct than are members of their group which intergrade along their common borders when they meet, these forms are considered subspecies whether or not an actual area of intergradation with neighboring forms can be demonstrated. From the other direction, clinal trends in numbers of scales, teeth, and other serially replacing parts are not considered to be indicators of linearly related subspecies. These trends are pointed out where they occur, but subspecies are recognized only when there is a sudden steepening of the cline(s), or when there is a definite break in other characters which seems to indicate an interference with the gene flow between the two kinds.

One of the greatest hinderances to the progress of herpetology has been the lack of definitive methods of making scale counts, tooth counts, measurements, etc. This lack of consistency has made it necessary for revisors to reexamine the specimens for these data, and while some rechecking is assuredly a good thing, the enormous unnecessary waste of time and effort in this field has greatly outweighed any advantage gained thereby. I have attempted to be as consistent as possible in taking these data and, in addition, have explained fully the methods used in obtaining and recording them.

In addition to such characters as scutellation, proportions, and pattern, others, more subtle have been studied. These include ontogenetic history of color pattern, structural responses to environmental conditions, and amount of sexual dimorphism. Characteristics of the hemipenis (not heretofore described) are diagnosed, described, and utilized as indicators of basic relationship.

This study has necessitated considerable changes in nomenclature in this genus: some nominal forms have been considered not to be taxonomically recognizable, and are placed in synonymy; others are reduced to subspecific level; and a few have been rescued from synonymy as available names for otherwise unnamed population groups. It has been found necessary to describe only a single form, and misapplication of names has been demonstrated but twice. The differences in nomenclature between that of the most recent check-lists of this region, left column, (Stejneger and Barbour, 1943: 136-40, and Smith and Taylor, 1945: 58-61) and the present work, right column, are listed below.

Elaphe bairdi (Yarrow) = E. obsoleta bairdi (Yarrow)

Elaphe chlorosoma (Günther) = E. triaspis chlorosoma (Günther)

Elaphe guttata (Linné) = E. g. guttata (Linnaeus)

Elaphe laeta laeta (Baird and Girard) = Elaphe guttata emoryi (Baird and Girard), [vide Dowling, 1951a].

Elaphe laeta intermontanus Woodbury and Woodbury = E. guttata emoryi (Baird and Girard).

Elaphe obsoleta confinis (Baird and Girard) = E. o. spiloides (Dumeril, Bibron, and Dumeril).

Elaphe quadrivittata quadrivittata (Holbrook) = E. obsoleta quadrivittata (Holbrook).

Elaphe quadrivittata deckerti Brady = E. obsoleta quadrivittata (Holbrook).

Elaphe quadrivittata parallela Barbour and Engels = E. obsoleta quadrivittata (Holbrook).

Elaphe rosacea (Cope) = E. guttata rosacea (Cope).

Elaphe sclerotica Smith = E. subocularis (Brown).

Elaphe triaspis (Cope) = E. t. triaspis (Cope).

Elaphe vulpina vulpina (Baird and Girard) = E. vulpina (Baird and Girard).

Elaphe vulpina gloydi Conant = E. vulpina (Baird and Girard).

Elaphe williamsi Barbour and Carr = E. obsoleta quadrivittata X spiloides.

Forms named by other workers since the publication of the above check lists which are listed under other names here are:

Elaphe obsoleta rossalleni Neill = E. o. quadrivittata (Holbrook).

Elaphe quivira Burt [nomen nudum] = E. guttata emoryi (Baird and Girard).

The new form recognized herein is:

Elaphe flavirufa yucatanensis Dowling.

Historical summary. The taxonomic history of the genus Elaphe in America began with the description of Coluber guttatus Linnaeus (1766: 385-6), which was based upon specimens sent to Linnaeus by Dr. Alexander Garden from "Carolina." Catesby (1731, and 1754: 55) had previously described and figured this snake, but in addition to being pre-Linnaean, he used non-binomial nomenclature. He characterized the "Corn Snake" as "ANGUIS e rubro & albo varius." Nevertheless, his description and figure were the bases for at least one (C. carolinianus Shaw, 1802: 460) of the four redescriptions of this snake which appeared under different names by 1803.

No other valid American species of this genus was described until Say (1823: 140) drew up a description of Coluber obsoletus, first known from the Missouri River. Shortly after this time Harlan (1827: 124, 360) again described C. guttatus (as C. floridanus) and the next real contribution to the knowledge of the group was presented by Holbrook (1836: 113) who described C. quadrivittatus in the first edition of his North American Herpetology.

Baird and Girard were apparently the first workers to recognize the natural group of American species now known as Elaphe and to separate them from the other, less closely related forms. They placed these snakes in their new genus Scotophis (1853: 73) with a definition which was sufficient to separate them from other North American snakes. In addition they described several new forms now recognized as valid, besides adding to the already overlarge synonymies of the well-

known species. The works of Dumeril, Bibron, and Dumeril, which appeared the following year added to this growing list of synonymy, added a new form, Elaphis spiloides, and at the same time indicated the similarity of these forms to Eurasian species by placing them in the same genus (and subgenus): Elaphis Bonaparte (1831: 79).

In the same way that Baird and Girard's work had coincided with the era of westward expansion in our own country, so did the time of Cope correspond to the time of exploration in Mexico and Central America. He described the majority of forms from that region which are now recognized: Coluber triaspis (1866: 128), C. flavirufus (1867: 319), and C. mutabilis (1885: 175-76), as well as C. rosaceus (1888: 388) from the southeastern United States. The main descriptive work on this genus was completed near the end of the nineteenth century; the descriptions of Coluber chlorosoma Günther (1894: 115), C. rosaliae Mocquard (1899: 321), and C. subocularis Brown (1901: 492) appeared in rapid succession.

Since that time only a few forms have been described in this genus, and without exception they may be allocated to previously described species. These include E. quadrivittata deckerti Brady (1932: 5), E. williamsi Barbour and Carr (1940: 340), E. vulpina gloydi Conant (1940: 2), E. quadrivittata parallela Barbour and Engels (1942: 103), E. laeta intermontanus Woodbury and Woodbury (1942: 133), and E. quivira Burt [nomen nudum] (1946: 116).

## TAXONOMY OF THE GENUS ELAPHE

Since there are no objective criteria for taxonomic categories higher than the species, there will probably always be some dispute as to what diversity of types should be included in any one category. Most systematists are agreed that the genus should indicate a common relationship between the included species, but just how close this relationship should be and how to determine it is a question usually decided by the individual. The "practical" worker, one who deals mainly with specimens and bibliographies, believes that for convenience (a) the genus should contain between five and twenty species (see Mayr, 1942: 280-89, for discussion). Workers with different philosophies believe either (b) that the genus should include all forms which show obvious relationship, or (c) that a certain standard of generic separation should be formulated (usually also an individual idea) and species which exceed a certain amount of difference be placed in different genera.

The second concept (b) is employed here, although it is far from clear what should be considered as "obvious relationship" in this group of snakes. The genus Elaphe is, unfortunately, one of the more generalized groups of colubrid snakes, and the characters which are used as indicators of close genetic relationship between the species may be merely relics of a generalized nature.

The entire structure of ophidian taxonomy is open to question, from the generic level to that of the families. Many

of the genera cannot be accurately defined, the subfamilies of the "Colubridae" cannot be applied on a world-wide basis, and even the number of families varies from time to time, and from author to author. For these reasons it appears best to place the present genus in its taxonomic position as herein understood. This may be done by a definition of the higher categories.

Family Colubridae Cope ("auctorum," nec. Cope)

Colubridae Cope, 1886: 480.

Diagnosis. A family of snakes distinguished from others by the following characters: an ectopterygoid and a scale-like squamosal bone present; pelvic elements, coronoid bone, and premaxillary teeth absent; prefrontal and nasal bones not meeting in a suture; and no anterior maxillary fangs.

Subfamily Colubrinae Cope

Colubrinae Cope, 1886: 480, 484. -- Dunn, 1931: 20.

Diagnosis. Colubrid snakes with vertebral hypapophyses absent posteriorly and with a single sulcus spermaticus on the hemipenis.

Genus Elaphe Fitzinger

Coluber Linnaeus, 1756: 216 [partim].

[?] Elaphis Bonaparte, 1831: 79 [nomen nudum].

Elaphe Fitzinger, in Wagler, 1833: text to, and plate 27 (type species, E. parreysii Fitzinger [=Coluber quatuorlineatus Lacepede]).

Pantherophis Fitzinger, 1843: 25 (type species, Coluber guttatus Linnaeus).

Scotophis Baird and Girard, 1853: 73 (type species, Coluber alleghaniensis Holbrook [=C. obsoletus Say]).

[?] Paleoelaphe Gilmore, 1938: 63 (type species, P. kansensis Gilmore)

Pseudoelaphe Mertens and Rosenberg, 1943: 61-2 (type species, Elaphe flavirufa [Cope]).

Diagnosis. A genus of colubrine snakes with the following characters: anal plate divided; dorsals with two scale pits, keeled at least posteriorly, and in 23 or more rows; nostril between two nasals; posterior chin shields separated by two or more scales.

## Discussion of Relationships

Regardless of other considerations, the above diagnoses give a much firmer basis for discussion of the genus Elaphe. The diagnosis of the family effectively distinguishes it from other snake families; the diagnosis of the subfamily apparently is not so definitive in the Old World (Bogert, 1940: 7-13), but in this hemisphere it, almost certainly, distinguishes a group of closely related genera. The generic diagnosis, also, (although it includes the type species) is definitive only for New World species. Elaphe in Eurasia is a much more comprehensive and poorly defined genus, and species now included will be placed in other genera (i.e., Coluber, Gonyosoma, etc.) on the basis of further study, and some now outside the genus may be included. At present the genus as recognized by European workers (i.e., Robert Mertens, Malcolm Smith, and others) is absolutely indefinable.

Of American colubrine genera, only Pituophis appears to be closely related to Elaphe, and this relationship is only recognizable between the former genus and the Rosaliae Section of the latter. These snakes are so closely approximated in numerous characters (those of the hemipenis, of body form, and scutellation) that a simple fusion of the two halves of the anal plate in E. subocularis would place it, as a distinct species, in the Deppei Group of Pituophis if only the usual key-characters were observed. The long pointed nasal bones of Pituophis, however, are very distinctive and are not approached by any species of Elaphe. Nevertheless, since the Deppei Group includes the most primitive (generalized) members of

the genus (notwithstanding the statements of Stull, 1940: 35-42), this may be an indication that the genus Pituophis of North America has evolved from the Rosaliae Section of Elaphe.

The relationships with other genera are by no means so clear. The Doliata Group of Lampropeltis, especially L. doliata triangulum, approaches the Guttata Group of Elaphe in a number of characters: coloration, pattern, and scutellation, but the distinctively smaller head and the entire anal plate show no evidence of a generic breakdown between these groups. The genus Arizona, also, while elaphe-like in in appearance, shows no evidence of close relationship: the absence of paired scale pits is a distinctive character which separates it from the genera previously mentioned. Other genera appear to be even farther removed: the racers, Masticophis and Coluber, in addition to a much lower number of scale rows (and a different mode of reduction ?), have three basal spines on the hemipenis (the only Elaphe with basal spines having two), and a characteristic subpreocular which never appears in Elaphe (but is not always found in the masticophis-like Salvadora either).

The main difficulty with such comparisons is that none of the forms have been described well enough to be sure whether apparent similarities are reinforced or invalidated by more important characters. The fact that most of the taxonomic work on snakes has been mainly concerned with variations in scutellation has contributed to this situation. Each generic

revision has indicated more clearly that such variation is independent of specific (and higher) relationships, and is primarily useful in tracing geographic trends within a single species. The type of color pattern also is best suited to this kind of work. Other characters such as those of the hemipenis, of the skull, and of other hard and soft parts are so little known that no comparisons, except rarely, can be drawn at present.

The relationships between the Eurasian Elaphe and those in North America are equally poorly defined and tested, and are thus highly theoretical. The only American snake genera with undoubted palearctic representatives are Natrix and Agkistrodon, and even in these it is not yet possible to point to the most closely related species. Of the many species of Elaphe recognized in Eurasia, certainly a large number of them have only a vague similarity to American forms, and when better known will, no doubt, be placed in separate genera. At present we cannot point to a single palearctic representative of any of the three sections of Elaphe, which are so clearly defined in North America.

## Description of American Forms

The genus Elaphe is represented in North America by eighteen forms. There are no representatives in South America. By way of comparison, there are nine forms (six species) recognized in Europe (Mertens and Müller, 1940: 50-51), about thirty in Asia (Malcolm Smith, 1943: 141), and none in Africa (Bogert, 1940: 11-13).

The eighteen American forms are divided among seven species (of which three are monotypic) which are herein allocated to three sections. The arrangement is as follows:

Pantherophis Section

Guttata Group

Elaphe guttata

E. g. guttata

E. g. rosacea

E. g. emoryi

Elaphe vulpina

Elaphe flavirufa

E. f. flavirufa

E. f. matudai

E. f. yucatanensis

E. f. rodriguezi

Obsoleta Group

Elaphe obsoleta

E. o. obsoleta

E. o. quadrivittata

E. o. spiloides

Elaphe obsoleta (continued)

E. o. lindheimeri

E. o. bairdi

Triaspis Section

Elaphe triaspis

E. t. triaspis

E. t. mutabilis

E. t. chlorosoma

Rosaliae Section

Elaphe subocularis

Elaphe rosaliae

It should be pointed out that the above sections are completely distinct and there is no indication of a common origin in this hemisphere. Similarities in scutellation and habits (which may be correlated) are the bases upon which the species have been placed in a single genus. Upon the basis of scutellation, the members of the Rosaliae Section appear to be the most closely related to the genotype (palearctic) species, E. quatuorlineata. The characters used, however, have proven in this study to be unreliable as indicators of close specific relationship, and other characters (hemipenial, skeletal, etc.) must be examined to substantiate this supposed relationship.

The three sections could be described as separate genera (two have no other names available), but it seems preferable to leave them grouped as they are until the Eurasian forms can be studied, with the hope that related, or annectent, forms will be found there. Together, the sections have a range that

includes North America from Vermont, Ontario, and Wisconsin, southward to Florida and Costa Rica, and westward to Sonora, Utah, and Minnesota (Map 1). This range is similar to that of other holarctic snake genera.

The three sections may be separated by use of the following key:

1 Hemipenis with two large basal hooks . . . . . Triaspis Section

1' Hemipenis without large basal hooks . . . . . 2

2 Hemipenis with scattered small spinules on its basal half . . . . . Rosaliae Section

2' Hemipenis without small spinules .Pantherophis Section

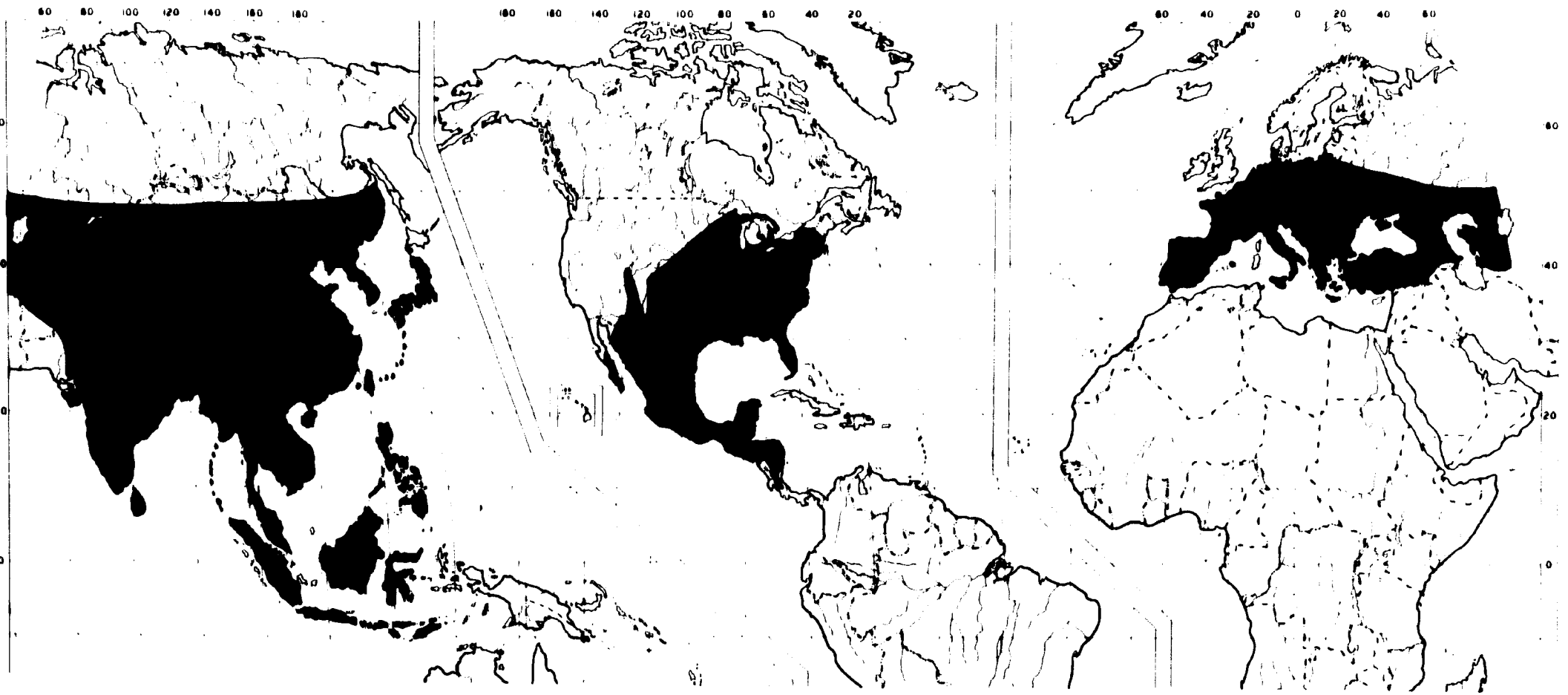
They may be further diagnosed as follows:

Pantherophis Section. Hemipenis of moderate size, extending ten to fifteen caudals in the inverted position, having two large distal lobes, without proximal spinules or basal hooks; no lorilabial scales; usually eight (seven to ten) upper labials; great variation in ventrals (190 to 265) and caudals (60 to 120), both having a moderate sexual dimorphism.

Triaspis Section. Hemipenis of large size, extending for fifteen to nineteen caudals in the inverted position, without distal lobes or proximal spines, having two large basal hooks; no lorilabial scales; usually nine (eight to ten) upper labials; typically three anterior temporals; ventrals 241 to 282 and caudals, 87 to 127, with a large amount (15± scales) of sexual dimorphism.

Rosaliae Section. Hemipenis small, extending to the ninth or tenth caudal in the inverted position, without basal hooks

Map 1. Showing the holarctic distribution of the genus Elaphe.


60 80 100 120 140 160 180
160 140 120 100 80 60 40 20
60 40 20 0 20 40 60
60
40
20
0

or distal lobes, with the proximal portion covered with very fine spinules; a lorilabial row of three to six scales; ten or eleven supralabials; ventrals 260 to 286 and caudals 69 to 89, without any appreciable sexual dimorphism.

The treatment of the various forms is rather irregular. As indicated by the title, primary emphasis has been given the rare and little known forms of Mexico and Central America. These include the Rosaliae and Triaspis sections, and the species E. flavirufa of the Guttata Group of the Pantherophis Section. Skeleton synonymies and diagnoses have been worked out for the remaining forms for the purpose of indicating their relationships.

## Key to the American Snakes of the Genus *Elaphe*

The following key is based upon easily observable characters of scutellation and pattern, rather than upon the basic differences between the forms. As such, it is "artificial" in that the forms most closely related are not necessarily approximated in the key. Nevertheless, it is the only satisfactory method of identifying *individuals* of this genus. For any one area, such as the southeastern United States or northern Mexico, a key to the forms would be much shorter and more easily used. The key for all representatives of a genus in such a large area as North America, however, is necessarily cumbersome.

| | | |
|---|---|---|
| 1 | Ventrals more than 240 in males; 250 in females . . . . . | 2 |
| 1' | Ventrals fewer than 241 in males; 251 in females . . . . . | 11 |
| 2 (1) | Three labials entering eye . . . (*E. flavirufa*) . . . . . | 3 |
| 2' | One or two labials (or none) entering eye. . . | 6 |
| 3 | Dorsal blotches extending laterally to scale rows II or III at midbody . . *E. f. matudai* | |
| 3' | Dorsal blotches not extending below scale row V . . . . . | 4 |
| 4 (3') | A single preocular . . . . . | 5 |

4' Preocular divided horizontally . E. f. rodriguezi

5 (4) Fewer than 33 dorsal body blotches . . . . . .E.f. yucatanensis

5' More than 32 dorsal body blotches . . . . . E. f. flavirufa

6 (2') A lorilabial row of scales (between the labials and loreal) . . (Rosaliae Section) . . . . . 7

6' No lorilabial row. . . . . 8

7 (6) Dorsal surface unicolor tan; ventrals usually more than 278 . . . . . E. rosaliae

7' Dorsal surface with large distinct dark blotches; ventrals usually fewer than 279 . . . . . E. subocularis

8 (6') Dorsal surface unicolor or more than 42 dorsal body blotches . (E. triaspis) . . . . . 9

8' Fewer than 43 dorsal body blotches . . . (E. flavirufa). . . . . 3

9 (8) Median frontoparietal band present, and with a small round opening at about the middle of the parietal suture (Figure 9a) . . . . . E. t. triaspis

9' Frontoparietal band absent (dorsal surface unicolor) or with an elongate opening (often breaking through the band) which extends to the posterior end of the frontal . . . . 10

10 (9') Dorsal surface uniform tan or (in juveniles) total (body + tail) blotches fewer than 80 . . . . . E. t. mutabilis

10' Dorsal surface green (gray or bluish in alcohol) or (in juveniles) total dorsal blotches more than 79 . . . E. t. chlorosoma

11 (1') Postorbital band passing over both upper and lower labials and often extending to lateral row of blotches. . . . . (E. guttata) . . . . . 12

11' Postorbital band obscured, absent, or distinct but extending only onto supralabials . . . . . 14

12 (11) Ventral blotches of large (2-3 ventrals) black squares, alternating with an almost equal amount of light color . . . . E. g. guttata

12' Ventral blotches diffuse or smaller and alternating with much larger areas of ground color. . . . . 13

13 (12') Ventral blotches large, but with such intrusion of light color as to be made up of stippled areas or absent except along lateral edges; dorsal coloration distinctly red . . . . . E. g. rosacea

13' Ventral blotches small, made up of spots or squares one or two ventrals in length surrounded by a much greater amount of light ground color; dorsal coloration brownish . . . . . E. g. emoryi

14 (11') Dorsal blotches reddish or light brown with distinct and contrasting black edges . . . . . (E. guttata) . . . . . 12

14' Dorsal blotches, if present, black, gray, or dark brown, without distinct, contrasting black edges. . . . . 15

15 (14') Ventrals fewer than 218 . . . . . *E. vulpina*

15' Ventrals more than 217 . .(*E. obsoleta*). . . 16

16 (15') Dorsal blotches present. . . . . 17

16' Blotches absent, dorsal surface unicolor or striped . . . . . 22

17 (16) More than 45 dorsal body blotches (juvenile) . . . . . *E. o. bairdi*

17' Fewer than 40 blotches . . . . . 18

18 (17') Total temporals (primary+secondary+tertiary, on both sides) more than 19 . *E. o. lindheimeri*

18' Total temporals fewer than 20. . . . . 19

19 (18') Dorsal blotches fewer than 31. . *E. o. spiloides*

19' Dorsal blotches more than 30 (juvenile). . . 20

20 (19') Caudals more than 89 in males; 83 in females; body blotches usually more than 32. . . . . *E. o. quadrivittata*

20' Caudals fewer than 90 in males; 84 in females; body blotches usually fewer than 33 . . . . . *E. o. obsoleta*

21 (16') Dorsal surface unicolor dark brown or black; often with faint indication of blotches . . . . . *E. o. obsoleta*

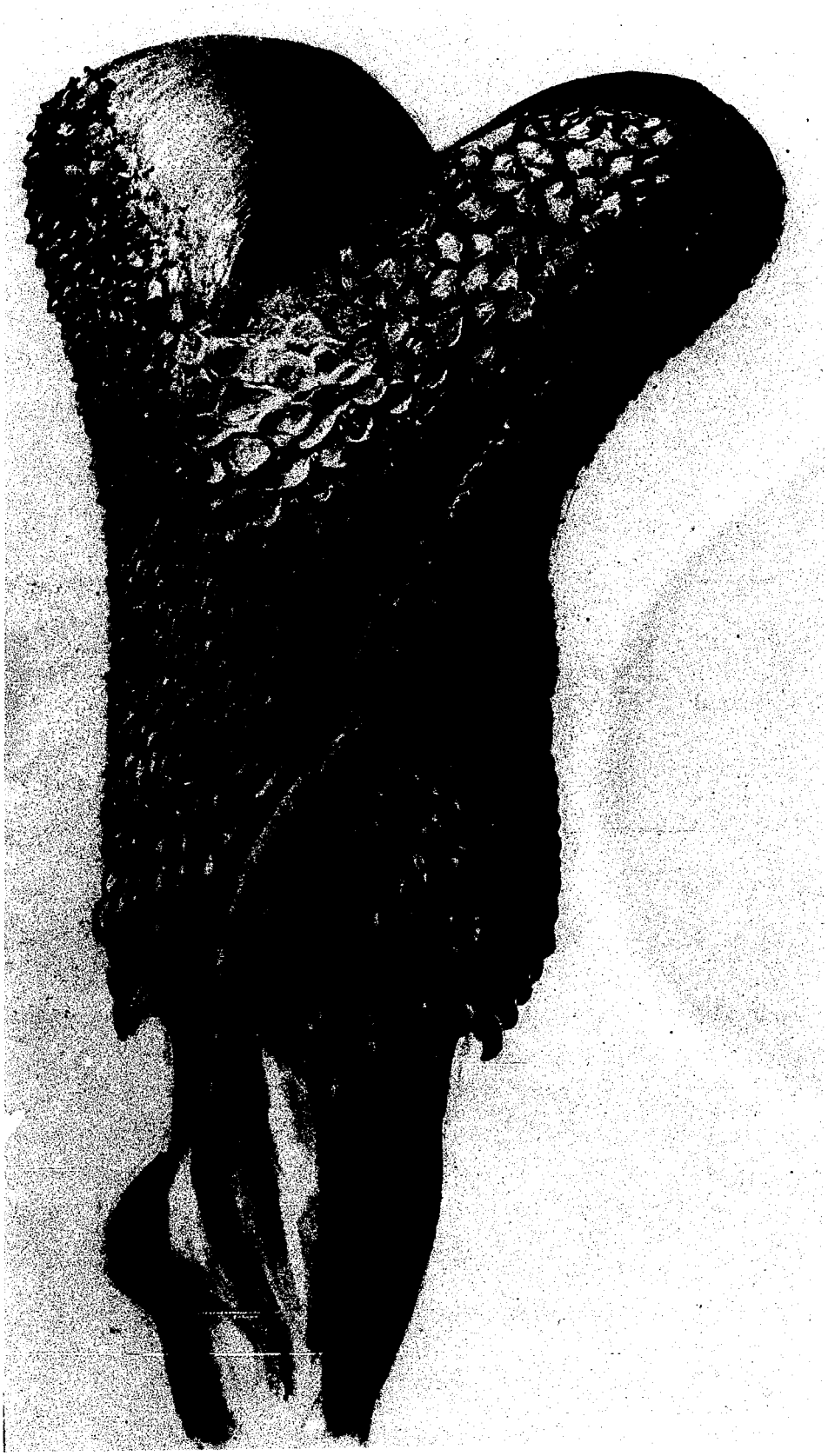
21' Dorsal surface striped . . . . . 22

22 (21') Head bluish gray, contrasting with ground color of body . . . . . *E. o. bairdi*

22' Head yellowish, orange, or reddish (light tan in alcohol), not contrasting with ground color. . . . . *E. o. quadrivittata*

The above key should correctly allocate all but intergrading or very unusual specimens. All specimens should key correctly to species; subspecific determination may then be made by reference to the maps.

Plate I. Hemipenis of Elaphe o. obsoleta, showing the characters of the Pantherophis Section. Note the presence of large distal lobes, and the absence of proximal spinules and basal hooks. [Drawn from an everted hemipenis of UMMZ 101067 by William L. Brudon.]



## THE PANTHEROPHIS SECTION

The present section is made up of two species groups; one a single species with its five subspecies; the other three species, one monotypic, one with three subspecies, and the other with four (see pp. 13-14 for list). Within each species group, the forms are allopatric or have extremely narrow overlap.

This is believed to be the most primitive (generalized) of the three sections. This conclusion is based upon the lack of any special scutellation, as the lorilabial row in the Rosaliae Section, and also upon the lack of differentiated spines (basal hooks) on the hemipenis, as in the Triaspis Section. The two distal lobes of the hemipenis, also, may be considered as a primitive character since most primitive snakes (i.e., boas) have two lobes as well as a forked sulcus, and the situation here may be the retention of the lobe, after loss of its sulcus, in contrast to the situation in the other two sections which lack both.

Definition of Pantherophis Section. Species of the genus Elaphe which have a distinctly bilobed hemipenis, without basal hooks or proximal spinules (Pl. I). No lorilabial row of scales; usually eight supralabials, but sometimes reduced to seven or increased to ten in end-forms. A moderate amount of sexual dimorphism (±ten scales) in both ventrals and caudals, with the females having more ventrals and the males more caudals. The total range in ventrals is from 190 to 265.

Discussion. The two species groups which make up this section (herein called the Guttata and Obsoleta groups) are

essentially sympatric. Although these two groups appear to be quite closely related, no evidence has been found in this study to indicate intergradation or hybridization between members of the two groups; such hybridization has been reported in the literature, however, by previous workers (Neill, 1949: 10, and Lederer, 1950: 235-42).

On the other hand, the two groups do overlap in characters of scutellation, and there is no single character nor group of characters which will differentiate all members of one group from all of the members of the other. In any one area, however, the representatives of the two groups are readily distinguishable by characters of scutellation, pattern, and body proportions. I have seen no evidence to the contrary, although if single characters are used, they will be found to converge and overlap in one or more areas within the range.

Nevertheless, the groups are completely distinct if only the area of overlap is considered. Within this area the Obsoleta Group has a consistently higher number of caudal scutes and it is only when E. flavirufa (outside the range of E. obsoleta) is included that this character breaks down. Although the two groups cannot be completely separated on the basis of scutellation, therefore, they may be diagnosed and certain trends pointed out (Table I).

Diagnosis of the Guttata Group. A group of eight allopatric forms, including three species, one of which is monotypic. The members are all blotched, and except in two end forms

TABLE I

LATITUDINAL RESPONSE IN THE GUTTATA AND OBSOLETA GROUPS

| DEGREES OF LATITUDE | CHARACTERS | MIDWESTERN REGION (IOWA TO TEXAS) | | ATLANTIC REGION (NEW JERSEY TO NORTH CAROLINA | |
|---|---|---|---|---|---|
| | | GUTTATA | OBSOLETA | GUTTATA | OBSOLETA |
| 37-42 | Ventrals | 208.4 | 227.9 | 206.7 | 233.4 |
| | Caudals | 70.0 | 80.0 | 62.0 | 79.2 |
| | Blotches | 46.8 | 34.3 | 31.5 | 35.0 |
| 31-36 | Ventrals | 212.1 | 229.7 | 218.7 | 239.5 |
| | Caudals | 72.7 | 85.7 | 67.4 | 90.5 |
| | Blotches | 50.3 | 31.5 | 30.6 | 36.0 |
| 25-30 | Ventrals | 222.1 | 228.7 | 230.5 | 234.8 |
| | Caudals | 81.0 | 83.7 | 75.0 | 98.0 |
| | Blotches | 38.0 | 30.9 | 36.7 | 37.7 |

NOTE: The general decrease in ventral and caudal scales is quite evident in the GUTTATA group, and is in contrast to the situation in the OBSOLETA group (the apparent correlation of caudals with latitude in the east coast populations of the OBSOLETA group is due to the presence of a long-tailed subspecies in the south, and is thought not to be latitudinal in nature). While there is no direct correlation of blotch number with latitude in either group, the general trends of increasing numbers of blotches in the GUTTATA group (northward in the midwest, southward on the Florida Peninsula) does not appear in the OBSOLETA group.

(E. vulpina and E. flavirufa yucatanensis) the blotches have distinct black borders. The original pattern is retained during ontogeny in all forms, although it may become somewhat obsolete in very large individuals. The juvenile head pattern is retained to some extent in all forms, but becomes very obsolete in one (E. vulpina).

As a group these forms are characterized by a marked response to the environment, which is demonstrated by clinal trends within all three species. These trends are observable latitudinally and include reductions to the north in ventrals, caudals, dorsals, labials, and other scales, as well as reductions in tail length, number of maxillary teeth, and size of eye. These trends parallel or complement one another in the different forms and seem to indicate a close similarity of response to latitudinal changes.

Diagnosis of the Obsoleta Group. This group is made up of five subspecies of a single species, E. obsoleta. The various forms are all blotched in youth, but only two of them retain the blotches in the adult; the others becoming striped or unicolor with age. None of the forms have blotches with distinct black borders, although the blotches are often lighter in their centers. All of the members lose the original juvenile head pattern upon attaining maturity. These snakes have longer tails than do the corresponding members of the Guttata Group throughout the area of overlap.

The variation observable in this group appears to be without latitudinal correlation.

## The Guttata Group

This group is made up of a wide-ranging species, E. guttata, found throughout most of the southern and eastern United States and northern Mexico, together with a related species, E. vulpina, to the north and another, E. flavirufa, to the south. Both of the related species are entirely distinct from E. guttata in one or more characters, but the latter displays a convergence toward both forms in the areas where their ranges join, and further material from critical areas may demonstrate that the three forms herein recognized as allopatric species are actually subspecifically related.

As indicated above, one of the most striking characteristics of this group is the presence of north-south clines, in general showing reduction in scutellation to the north in all of the members. A general indication of some of these trends has been shown (Table I), but the trend in ventrals is shown more accurately by means of graphs (Figures 1 and 3). The ventral number (in males) in E. flavirufa decreases from above 260 in Nicaragua and Honduras, to about 255 in southern Mexico, and is further reduced to 247 in the single specimen available from central Mexico. There is a gap of some 20 ventrals between the northernmost E. flavirufa and the southernmost representatives of the adjoining form, E. guttata emoryi, but the trend is continued. The representatives in Tamaulipas have an average of about 223 ventrals; in central Texas, about 215, and this is further reduced to about 210 in Kansas. Further, when the line between the species E. guttata and E.

*vulpina* is crossed, there is a distinct change. There are not enough specimens of *E. vulpina* available from high latitudes to indicate whether or not the trend continues within the species, but there is no question but what the trend of reduction in the species as a whole continues from the northernmost representatives of *E. guttata emoryi*.

Similar trends may be shown in other characters, in addition to the above; trends in size of eye, length of tail, and number of maxillary teeth have been already demonstrated (Table I). One other interesting observation is that the various characters tend to be parallel in their reduction within the various subspecies of *E. guttata*, although they are separated by hundreds of miles. This is further considered in the discussion of those forms.

Figure 1. Latitudinal variation in ventrals in the three species of the Guttata group.

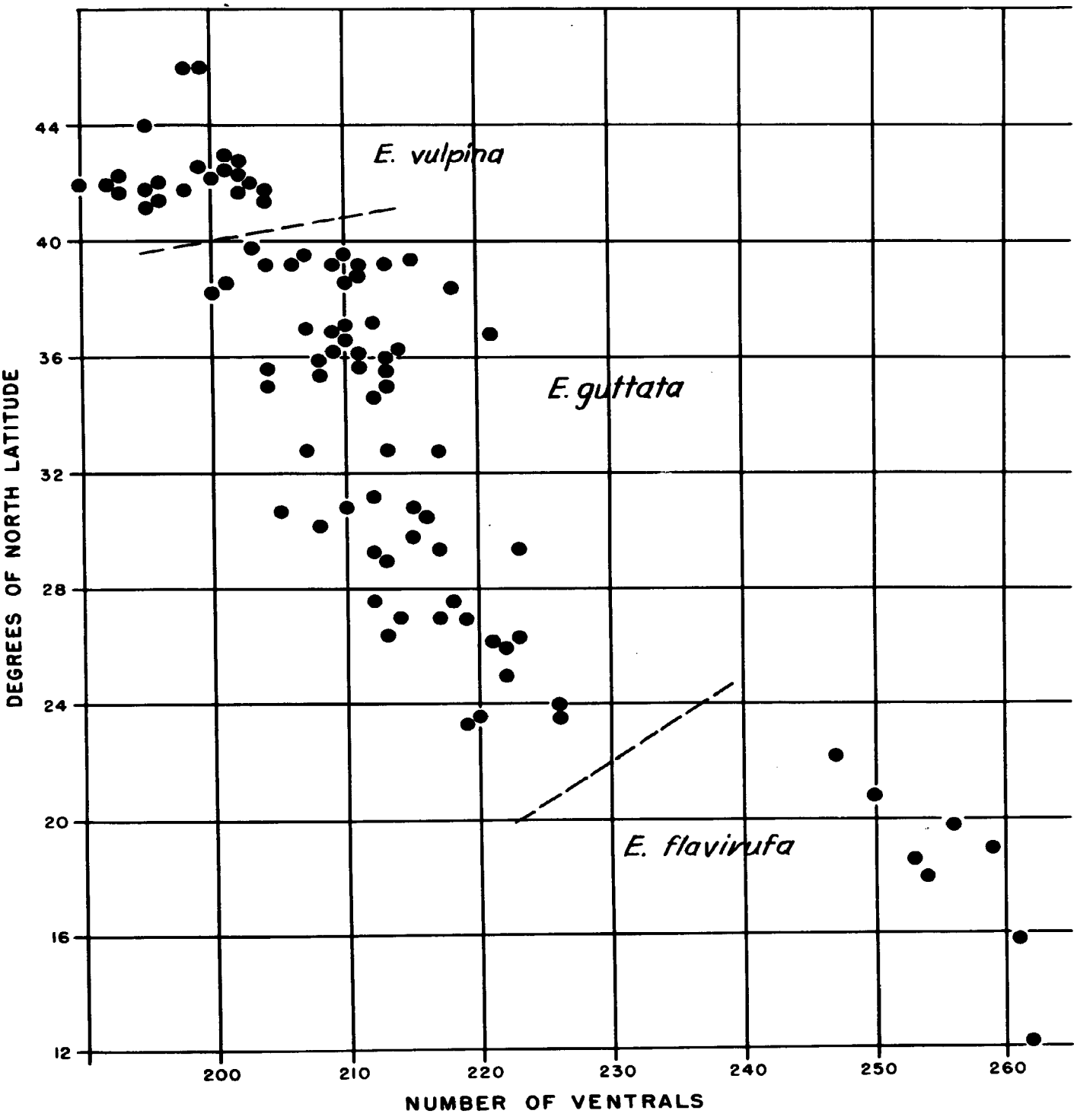
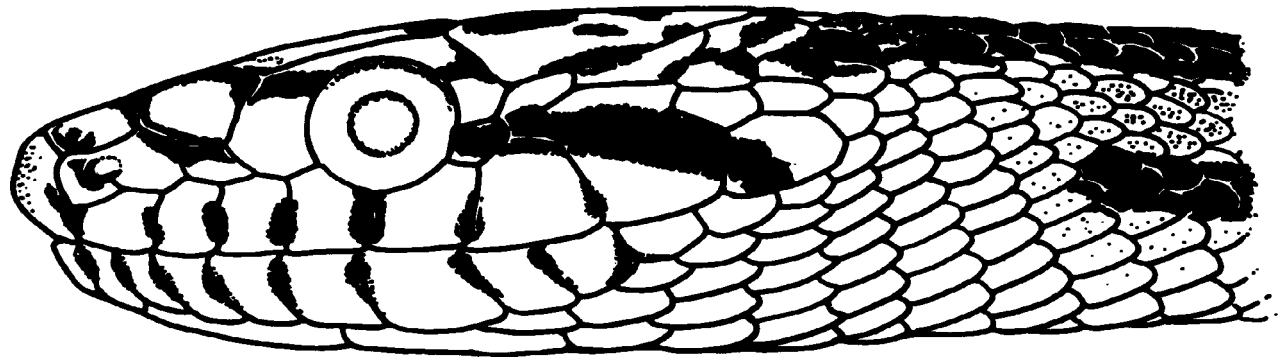
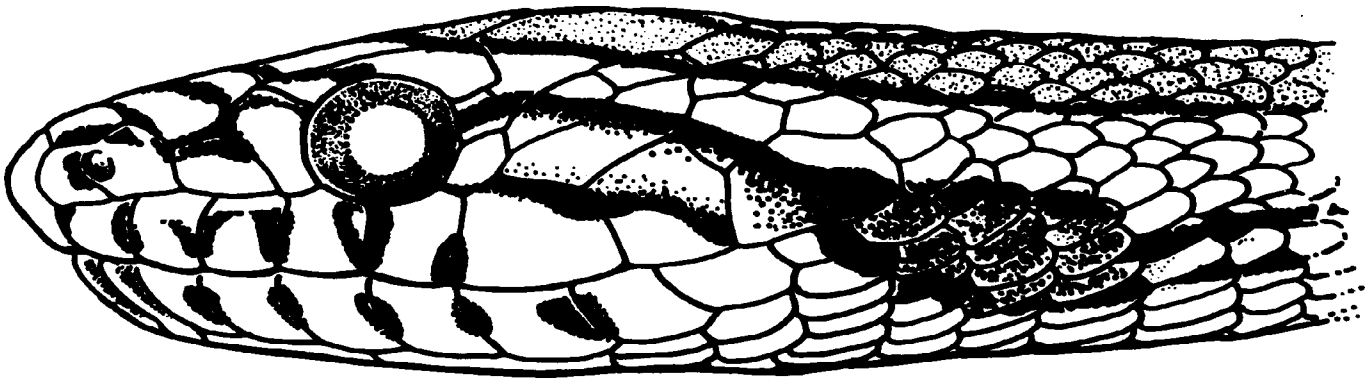

E. vulpina
E. guttata
E. flavirufa
DEGREES OF NORTH LATITUDE
NUMBER OF VENTRALS
44
40
36
32
28
24
20
16
12
200
210
220
230
240
250
260

Figure 2. Lateral view of the head in juvenile specimens of Elaphe o. obsoleta (upper figure) and Elaphe g. guttata (lower figure), showing the extent of the postorbital band in the two species.





## Elaphe guttata (Linnaeus)

Coluber guttatus Linnaeus, 1766.

Scotophis emoryi Baird and Girard, 1853.

Coluber rosaceus Cope, 1888.

Diagnosis. A species of the Pantherophis Section with distinctly black-bordered dorsal blotches, and in which the postorbital band characteristically (in all but a few individuals of E. g. emoryi from eastern Texas) passes across both the supra- and infralabials and onto the gular scales (Figure 2); the head pattern, with black-bordered markings, is retained throughout life; ventrals ca. 200 to ca. 235.

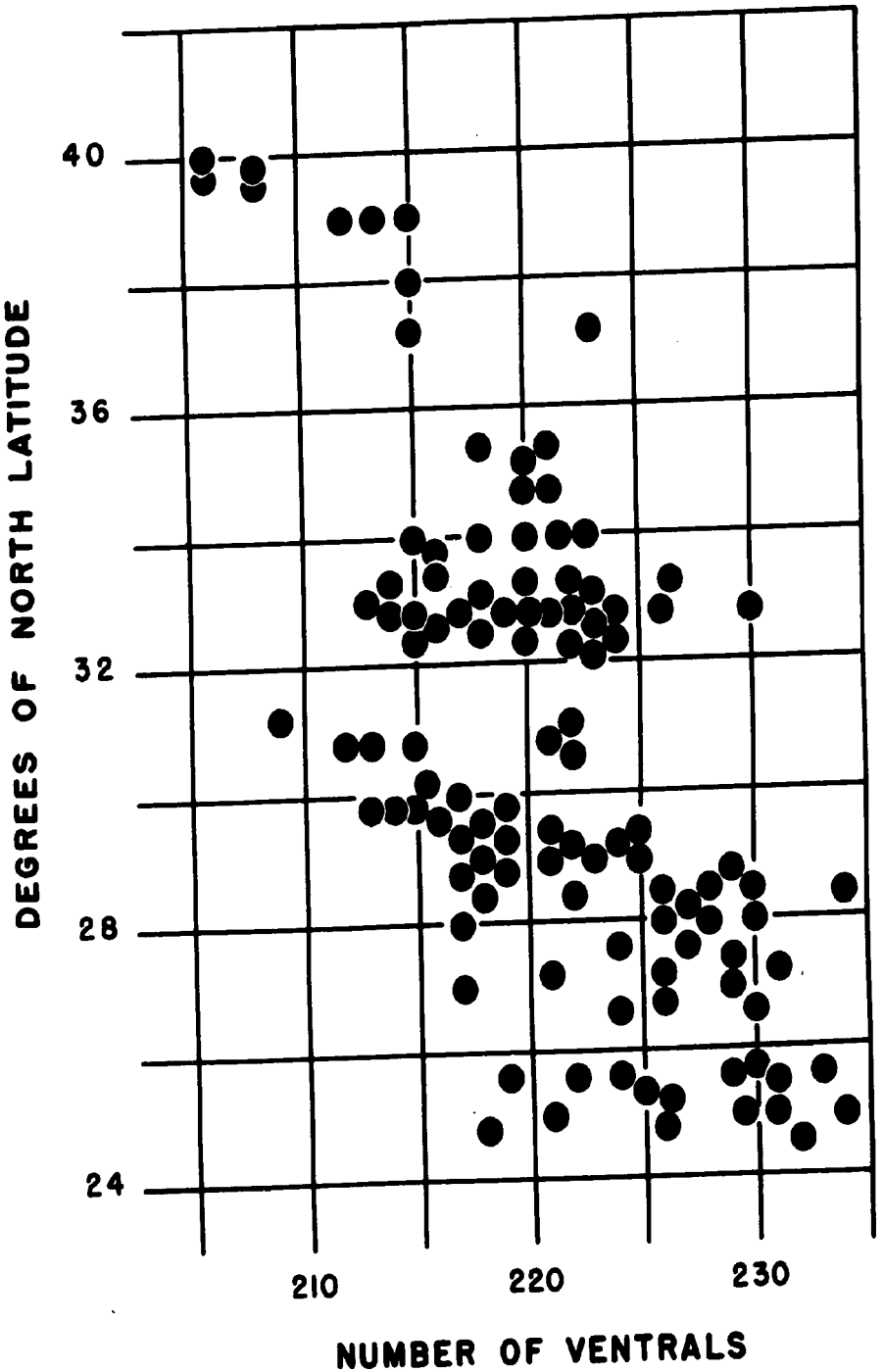
As indicated in the synonymy, E. guttata, as herein understood, contains the forms previously known as E. rosacea and E. emoryi (E. laeta, auct.), together with other nominal forms which are synonymized with them.

Geographic variation. As previously indicated, a great amount of clinal variation occurs in this species, making scutellation of little value in distinguishing the various subspecies, although it is of great value in tracing the evolutionary trends. A parallel reduction to the north, in the various forms, in almost all items of scutellation is observable. In this respect, a plot of the ventrals in E. g. guttata along the Atlantic Coast (Figure 3) may be compared with the similar plot of the ventrals of E. guttata emoryi, of the Great Plains (Figure 1). Although they do not correspond exactly in all details, the general trend is the same. The northern-

most representatives (near 39 degrees north latitude), E. g. guttata in New Jersey, E. g. emoryi in Kansas, and (west of the Rockies) in Utah, all average (in males) near 205 ventrals. At the latitude of Gainesville, Florida (30 degrees north latitude), they are again about equal at around 215; at the level of Miami (ca. 26 degrees) E. g. guttata again has approximately the same number, ca. 224 as compared with the 223 of E. g. emoryi in southern Texas and northern Tamaulipas.

Thus there is a remarkable correlation in latitudinal variation between the three widely separated areas which are connected only at the middle latitudes, and which are entirely separate for most of their north-south extensions (Tables I and II; Figures 1 and 3).

Figure 3. Latitudinal variation in ventrals in Elaphe g. guttata along the Atlantic Coast of the United States. Compare with Figure 1 which shows E. g. emoryi within the same latitudes.


40
36
32
28
24
DEGREES OF NORTH LATITUDE
210
220
230
NUMBER OF VENTRALS

Map 2. Geographic distribution of the members of the Guttata group.

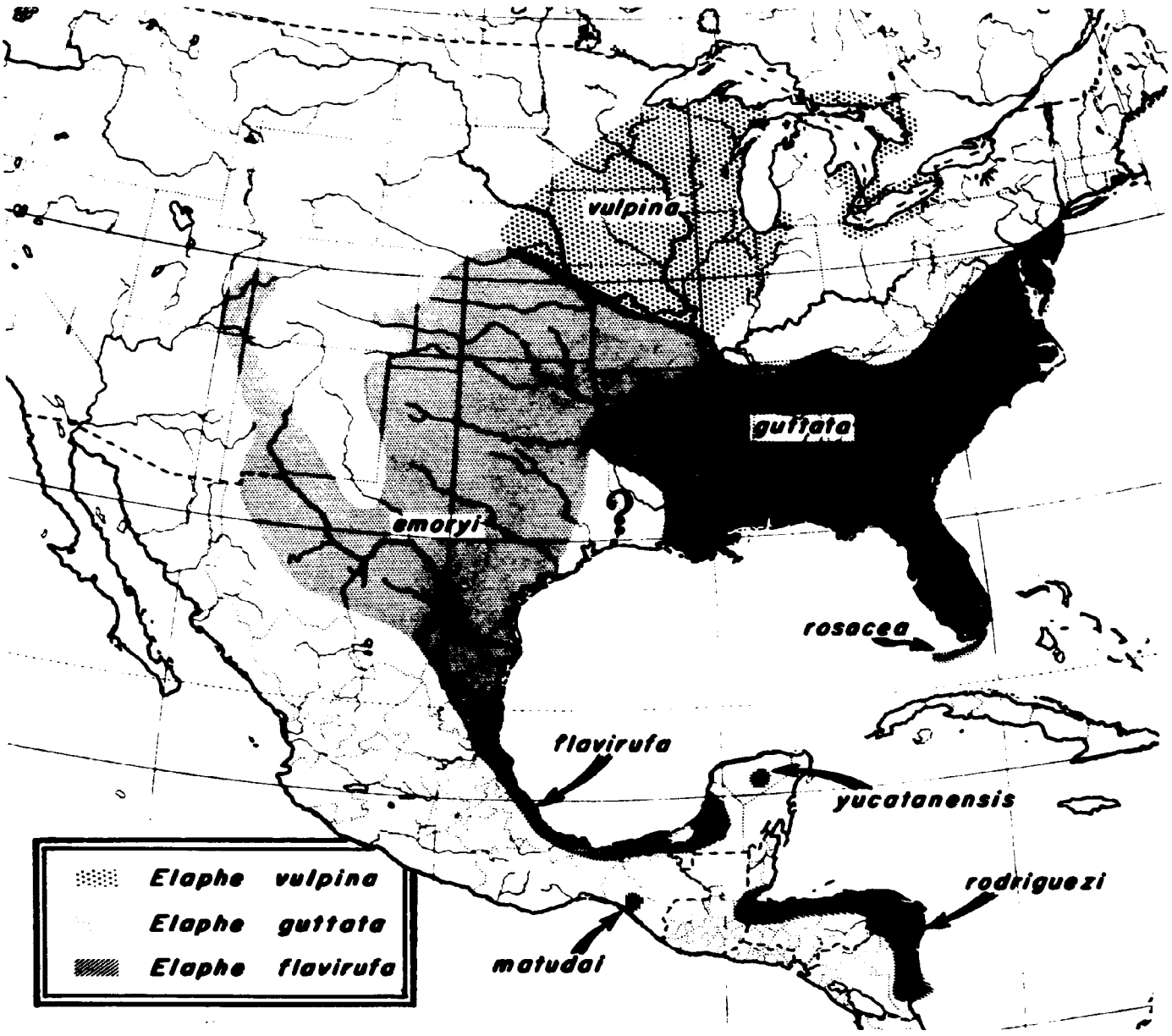

vulpina
guttata
emoryi
?
rosacea
flavirufa
yucatanensis
rodriguezi
matudai
Elaphe vulpina
Elaphe guttata
Elaphe flavirufa

TABLE II

PARALLEL GEOGRAPHIC VARIATION IN ELAPHE GUTTATA

| | SOUTHWEST | GREAT PLAINS | ATLANTIC COAST |
|---|---|---|---|
| | Utah | Kansas | New Jersey |
| Ventrals | 205.50(201-10) | 208.42(200-15) | 206.67(206-08) |
| Caudals | 68.50(68-69) | 70.00(65-73) | 62.00(60-64) |
| Body Blotches | 46.00(42-50) | 46.83(39-53) | 31.50(30-33) |
| | New Mexico + West Texas | Northern Texas + Oklahoma | South Carolina |
| Ventrals | 204.50(204-05) | 212.07(204-21) | 218.74(213-30) |
| Caudals | 71.00(70-72) | 72.73(68-76) | 67.44(62-75) |
| Body Blotches | 56.00(55-57) | 50.30(39-59) | 30.57(26-36) |
| | Chihuahua | Tamaulipas and Nuevo Leon | Southern Florida |
| Ventrals | ? | 222.08(219-26) | 230.50(229-34) |
| Caudals | ? | 81.00(79-83) | 75.00(68-86) |
| Body Blotches | ? | 38.00(33-44) | 36.67(33-40) |

Elaphe guttata guttata (Linnaeus)

Coluber guttatus Linnaeus, 1766: 385-86 (original description; Carolina).

[?] Coluber maculatus Bonnaterre, 1790: 19 (original description; "la Louisiane").

[?] Coluber compressus Donndorff, 1798: 206 (original description; [no type locality]).

Coluber carolinianus Shaw, 1802: 460-61 (original description; Carolina).

Coluber molossus Daudin, 1803: 269 (original description; Caroline).

Coluber pantherinus Daudin, 1803: 318 (original description; [no type locality]).

Coluber floridanus Harlan, 1827: 124, 360 (original description; "East Florida").

Coluber guttatus sellatus Cope, 1888: 387 (original description; Arlington, and Palatka, Florida).

Coluber guttatus guttatus Linnaeus, Cope, 1888: 387 (listed).

Elaphe guttatus (Linnaeus), Dunn, 1915: 6 (listed).

Elaphe guttata (Linné), Stejneger and Barbour, 1917: 82 (listed).

Diagnosis. A subspecies of Elaphe guttata characterized by the red color of the 25 to 35 dorsal blotches, and by the size of the black ventral blotches, which cover 2+ ventrals.

Location of type specimen, and type locality. Lönnberg (1896: 36) in speaking of the Linnaean type-specimens in the Zoological

Museum of the Royal University in Upsala, Sweden, says, "A very good specimen of Coluber guttatus Linnaeus, probably the type specimen." No further information is available.

The type specimen was one of many specimens sent to Linnaeus by Dr. Alexander Garden, and the type locality was given as "Carolina." However, the snakes of the east coast vary geographically and it appears best to restrict the type locality still further. Dr. Garden is known to have lived in Charleston and to have done most of his collecting in that vicinity. Since the scale counts are those that would be expected from there, I hereby restrict the type locality to the vicinity of Charleston, South Carolina.

Description of type specimen. The original description is quoted below:

"284. [Coluber] guttatus. 227 -- 60. C. D. Garden. Catesb. car. 2. p. 60. t. 60 ? Habitat in Carolina.

Lividus maculis dorsalibus rubris nigrisque. Litura nigra lateralis. Abdomen maculis nigris quadratis alternis. Scuta abdominis variant 223 f. 230. Cauda 1/6. "

The type specimen is probably a female. The ventral count (227) is typical for females and high for males of this locality; the caudals (60) typical for females and low for males.

Description of subspecies. About 200 specimens of this subspecies have been studied, plus the data for a large number of

others (not available to me) which were taken by a number of workers including F. N. Blanchard, Richard Hoffman, and Roger Conant. These other data have been used sparingly, and were rechecked when possible, but certain outlying localities (i.e., New Jersey) are represented only in this form.

These snakes are of moderate size. Individuals have been reported which were over five feet in length (total length), but most are below this figure. An average adult female (ChM 46.76) from Charleston, South Carolina, has a body length of 781 mm.; tail length, 134; head length, 26.1; eye, 3.4. The body proportions are quite constant in this subspecies, and the proportionate tail length averages about 19.5 per cent in adult males, and about 17 per cent in adult females; the proportional tail length is somewhat greater in juvenile individuals. The head is quite small, especially so in large individuals, and averages somewhat less than 3.5 per cent of body length in adults. The eye also is reduced in size (when compared with the other two subspecies) and is less than 15 per cent of head length in adults.

The color pattern consists of a dorsal series of large red, black-bordered blotches on a light brown or light gray background. The blotches are five or six scales long (reduced to ca. four on the posterior quarter) and extend laterally to scale row VI (±2 scales). They are squarish in outline and the anterior four or five have their corners extended longitudinally to connect with the adjacent blotches. A series

of smaller blotches on scale rows IV to VI alternates with the dorsal series; they are narrow and rather linear anteriorly (ca. 2 scales high) and widen posteriorly to four or five scales. Alternating with and opposing the lateral row is a third (ventrolateral) series of spots on the outer edges of the ventrals which extends upward for about one and one-half scale rows. It often fuses with the lateral row, forming lateral blotches some six scales in height and three (±1) scales long. The ventral pattern is made up of alternating squares of black, two or three ventrals in length, which are contrasted with an almost equal amount of cream or white background. The black coloration is usually continued on the tail as a pair of lateral lines, interspaced with the lighter color.

There appears to be a clinal change in coloration. The northern individuals from New Jersey and the Del-Mar-Va Peninsula have brownish or dull red blotches, while the snakes from southern Georgia and Florida have blotches which are brilliant red. This is continued in E. g. rosacea of the Florida Keys, where the red has also invaded the ground color. In the southern part of the range (i.e., southern Georgia and Florida) there is a tendency for the lateral blotches to get out of phase with the dorsal series, and to fuse with them, thus bringing the dorsal blotches down to dorsal scale row III (or lower) and excluding the lateral series as a separate row. This variation was the basis for Cope's description of Coluber guttatus sellatus (1888: 387) from northeastern Florida, but as he

points out himself, it does not appear to be diagnostic of any population but appears erratically through the southern part of the range. It may be pointed out in this respect that the "subspecies" named by Cope are not geographic entities, as they are described today, but were merely variations which he did not consider to be sufficient for specific rank. There is also a clinal response in the number of body blotches in peninsular Florida, with a distinct increase toward the south (Figure 4).

The dorsal scales are very lightly keeled in this form, as in the other members of this species. The lower seven or eight lateral rows are smooth, even in adults, and small individuals may have all of the scales smooth at midbody. There is usually some keeling above the anus, however, even in the baby snakes. The midbody dorsal count varies from 25 to 29; a full scale formula is given below for a male (ChM 33.202) from the vicinity of Charleston, South Carolina.

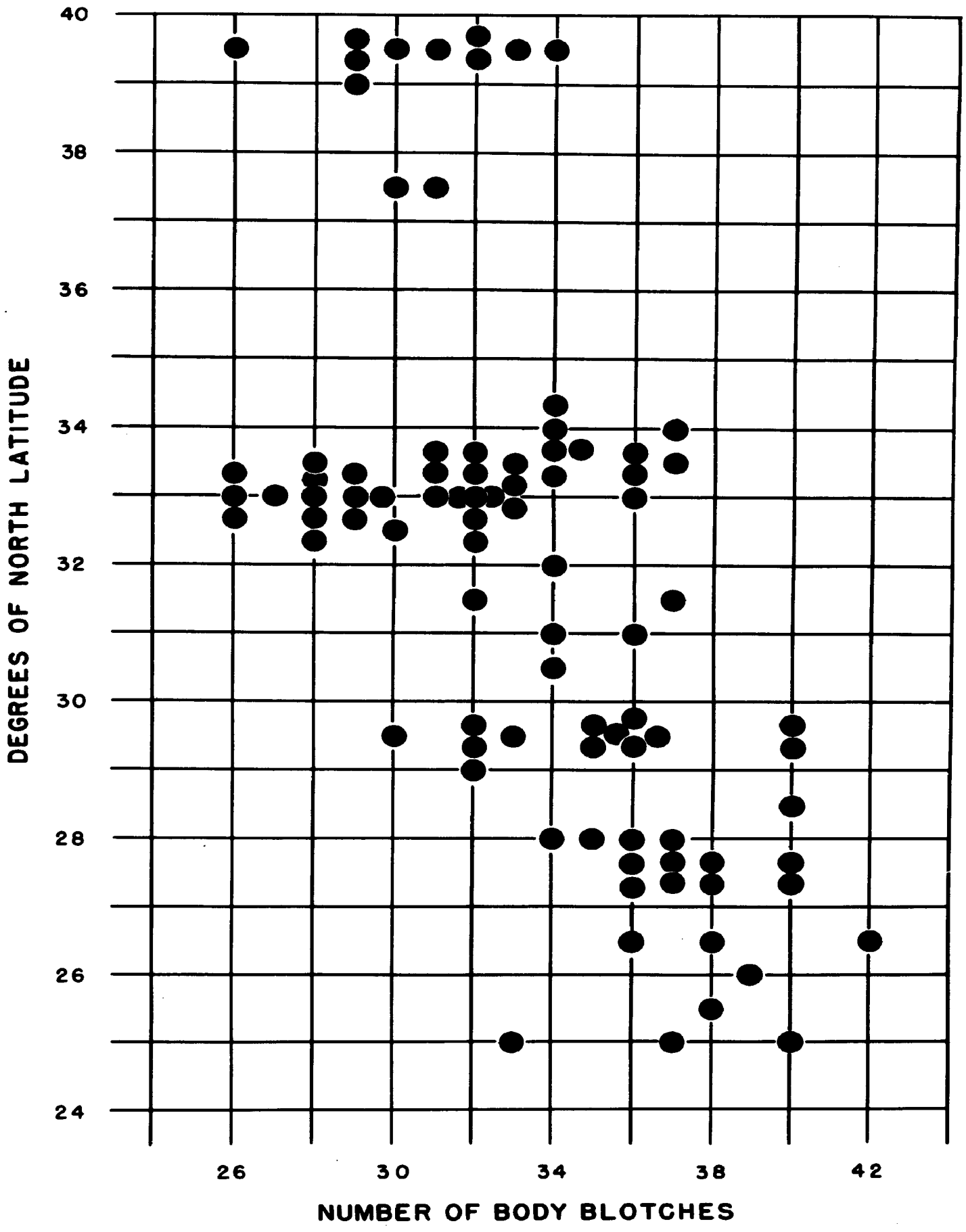
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   -6(18)    +6(44)    +7(85)    -7(127)    4+5(138)
25--------23--------25--------27---------25----------23--
   -6(16)    +6(40)    +7(80)    -7(129)    4+5(136)

          -6(144)    4+5(189)
--23---------21----------19 (230)
          -6(145)    4+5(188)
```

The above specimen has an unusually large number of ventrals for this latitude, but the scale formula follows the typical pattern.

The ventrals show considerable geographic variation. Not only are they reduced in number in the northern part of the range, but also the amount of sexual dimorphism demonstrated

Figure 4. Geographic variation in blotches in *Elaphe g. guttata*.


40
38
36
34
32
30
28
26
24
DEGREES OF NORTH LATITUDE
26
30
34
38
42
NUMBER OF BODY BLOTCHES

varies. At the northern end of the range, in New Jersey, the three available males average 207 and the four females, 211. Both the number of ventrals and the amount of sexual dimorphism are greater in South Carolina, where the males average 218 and the females 226 ventrals. Approximately the same numbers are continued through Gainesville, Florida, but the next series of any size, from Manatee County, Florida, has a much higher count, the males averaging 229, the females, 238 (Table III).

Range. From southern New Jersey southward along the coast to the tip of the Florida Peninsula. It extends westward to the Blue Ridge Mountains in Virginia, and farther south extends across the mountains into Tennessee, whence it extends westward into Arkansas and Louisiana. There are two records from southern Kentucky, where it occurs sparingly.

TABLE III

VARIATION IN ELAPHE GUTTATA

| | Sex | Ventrals | Caudals | Supra-labials | Infra-labials | Body Blotches |
|---|---|---|---|---|---|---|
| E. g. guttata New Jersey | ♂♂ | 206.67(206-08) | 62.00(60-64) | 16(3)<br>17(1) | 22(4) | 31.50(30-33) |
| | ♀♀ | 209.40(208-13) | 58.60(57-60) | 14(2)<br>16(1) | 22(1)<br>23(1)<br>24(1) | 32.00(29-34) |
| Southeastern U. S. | ♂♂ | 217.52(209-30) | 68.44(62-73) | 14(1)<br>15(2)<br>16(37) | 20(1)<br>21(4)<br>22(30)<br>23(4)<br>25(1)<br>26(1) | 31.14(26-40) |
| | ♀♀ | 225.84(221-35) | 63.44(60-67) | 14(2)<br>16(26) | 21(2)<br>22(17)<br>23(2)<br>24(2)<br>26(1) | 32.38(28-40) |
| Southern Florida | ♂♂ | 229.67(229-31) | 74.67(68-76) | 16(3) | 22(1)<br>23(2) | 36.66(36-37) |
| | ♀♀ | 238.40(236-41) | 65.20(64-66) | 16(5) | 22(2)<br>23(2)<br>24(1) | 38.40(36-40) |
| E. g. rosacea | ♂♂ | 231.33(229-34) | 86.00 | 16(3) | 22(1)<br>23(1) | 36.66(33-40) |
| E. g. emoryi Kansas | ♂♂ | 208.42(200-15) | 70.00(65-73) | 16(12) | 22(6)<br>24(4)<br>25(1)<br>26(1) | 46.83(39-53) |
| | ♀♀ | 217.50(216-19) | 63.00 | 16(2) | 22(1)<br>24(1) | 43.00(39-47) |
| N. Texas + W. Oklahoma | ♂♂ | 212.07(204-21) | 72.73(68-76) | 16(13) | 22(4)<br>23(3)<br>24(2)<br>25(5)<br>26(1) | 50.30(39-59) |
| | ♀♀ | 219.78(211-24) | 64.38(59-67) | 15(1)<br>16(8) | 22(3)<br>23(1)<br>24(2)<br>25(1)<br>26(2) | 48.40(42-54) |
| Southeastern Texas | ♂♂ | 216.45(212-23) | 78.75(73-82) | 16(7)<br>17(3) | 24(2)<br>25(2)<br>26(1)<br>27(1) | 38.36(32-44) |
| | ♀♀ | 223.20(217-30) | 71.75(67-78) | 16(4)<br>17(1) | 24(1)<br>25(2)<br>26(2) | 37.00(32-42) |

## Elaphe guttata rosacea (Cope)

Coluber rosaceus Cope, 1888: 388, pl. 36, fig. 3.

Coluber laetus (Baird and Girard), Boulenger, 1894: 49-50 [partim].

Elaphe rosacea (Cope), Barbour, 1920: 68-9.

Diagnosis. A subspecies of Elaphe guttata in which the ventral blotches are reduced to the lateral borders of the ventrals, or in which the black has been greatly invaded by the ground (light) color, giving only an outline or faint gray blotches. Dorsal blotches and head pattern faded; entire dorsal surface suffused with red coloration in adults.

Location of type specimen, and type locality. USNM 14418, collected on Key West, Monroe County, Florida, by Henry Hemphill.

Description of type. The type is soft, and bleached somewhat so that the [red] blotches are now lighter than their interspaces. It is an adult female with the following characters: oculars, 1+2; temporals, 2+3+4; supralabials, 8-8; infralabials, 12-11; ventrals, 239; anal divided; caudals (tip of tail lost), 49+. The dorsal scale counts are 25+27+19 (see full formula below), and there are 32 dorsal blotches. The ventral blotches are much reduced (compared with typical E. guttata) and are dark only along their lateral edges, otherwise faintly indicated with lightly stippled black spots. The specimen is difficult to measure accurately due to its condition, but has a body length of about 920 mm.; tail length, 140+; head length, 31.5; eye, 4.9.

Description of subspecies. This subspecies is very similar to the typical one in form and size. The largest specimen available, (UMMZ 98648) has a body length of 970 mm., part of the tail is lost. The only available specimen that can be measured accurately is a juvenile (DBUF 2554) male with the following measurements: body length, 426; tail length, 97; head length, 18.5; eye, 3.2. The proportion of tail length to body length is 22.8 per cent, probably somewhat higher than in adult individuals.

The ventral and caudal counts are higher than the average for E. g. guttata, but are quite similar to individuals of that subspecies from the southern half of peninsular Florida. The ventrals range from 218 to 232 (M = 223.80) in the five males, and 229 to 239 (M = 234.25) in the four females. The supralabials are 16 (total, right and left) in all specimens, and the infralabials 22 (seven individuals) or 23 (two). The dorsal scale counts are usually 25+27+19 or 23+27+19. The scale formula of a female (USNM 14418, type) is given below:

```
                                  +7(73)     -7(75)     +7(79)
25--------24--------25--------27--------26--------27--
    -5(28)     +6(35)     +7(72)

        -7(126)     -5(136)     -6(145)     4+5(177)
  --27---------25---------23---------21----------19   (239)
        -7(129)     5+6(136)    -6(145)     4+5(172)
```

The above individual demonstrates a not-unusual type of irregularity in its reductions and additions. Such irregularities would be overlooked in conventional scale counts.

Discussion. It is difficult to determine the true status of

this form with so few specimens available. With a greater amount of material available for comparison, it may be found that the range of this form extends northward on the peninsula to include the Manatee County population (p. 43) or even farther north, on the basis of similarity in scutellation. On the other hand, should future study prove the variation to be a straight cline, then E. guttata rosacea (Cope) would become a synonymy of E. g. guttata.

Range. As presently recognized, the range includes the Florida Keys, from Key Largo, southward and westward to the Marquesas Keys, Monroe County, Florida.

## Elaphe guttata emoryi (Baird and Girard)

Scotophis emoryi Baird and Girard, 1853: 157-58.

Scotophis calligaster Kennicott, 1859: 98-99 [in error; non Coluber calligaster Say, 1823].

Coluber rhinomegas Cope, 1860: 255.

Coluber guttatus Linnaeus, Boulenger, 1894: 39-41 [partim].

Coluber laetus (Baird and Girard), Boulenger, 1894: 49-50 [partim; non Scotophis laetus Baird and Girard, 1853].

Elaphe laeta (Baird and Girard), Stejneger and Barbour, 1917: 82 [non Scotophis laetus Baird and Girard, 1853].

Elaphe laeta laeta (Baird and Girard), Woodbury and Woodbury, 1942: 133-40.

Elaphe laeta intermontanus Woodbury and Woodbury, 1942: 133-42.

Elaphe emoryi emoryi (Baird and Girard), Dowling, 1951a: 39-44.

Diagnosis. A subspecies of Elaphe guttata with brown dorsal blotches and numerous small blotches on a predominantly light ventral surface.

Location of type specimen, and type locality. The type was formerly in the U. S. National Museum, but has apparently been lost. It was collected at Howard Springs, about 20 miles southwest of Ozona, Crockett County, Texas, by John H. Clark.

Description of type specimen. The only information available is that from the original description. The type was an adult (probably a male) with the following characters: supralabials, 8; infralabials, 11; ventrals, 217; caudals, 72; dorsals, 29 at midbody. There were 50 body blotches, and 20 on the tail. The body length was 870 mm.; tail length, 178.

Plate II. *Elaphe guttata emoryi*.

Upper figure: general color pattern.

Lower figure: extent of postorbital band.





Description of subspecies. This wide-ranging form shows a great deal of geographic variation. In addition to the northward decrease in number of scales, which is also shown by the typical subspecies, there is also an increase in number of blotches in that direction, a decrease in eye size, and some darkening of the coloration. Any of the end forms compared with the others might be named as different subspecies, or even species; in fact much of the synonymy is based upon such comparison (i.e., Coluber rhinomegas Cope, and the more recently described Elaphe laeta intermontanus Woodbury and Woodbury). Nevertheless, if adjacent populations rather than extremes are studied, the change in scutellation, coloration, and body form are found to be gradual and continuous, and thus clinal. The naming of subspecies based upon continuous variation tends to obscure the relationships rather than to illuminate them and for this reason those subspecies are not recognized herein.

To facilitate description of this highly variable subspecies, a series of snakes from near the center of the range (from the vicinity of Austin, Texas) is first described, and then compared with series from other parts of the range.

These snakes grow to approximately the same size as E. g. guttata. The largest individual available is a male (TNHC 948) with a body length of 924 mm. and a tail length of 201. The proportions differ somewhat from those of the typical subspecies. The tail is longer, averaging about 22 per cent of body length in males and a little over 19 per cent in females;

the head is larger (ca. 4 per cent of body length in adults) and more distinct from the neck. The eye is larger also, averaging about 16 per cent of head length.

The coloration is grayish tan with a dorsal series of about 45 (40 to 51) large, transverse, subovate blotches and three lateral series of similar, but smaller, spots. The dorsal blotches are from three to three and one-half scales long, and extend laterally to scale rows VII or VIII, thus being about twice as broad as they are long. The first series of lateral spots are two to three and one-half scales long and (at midbody) extend from scale rows III to IX. The second lateral series of still smaller spots, about one and one-half to two scales long, occupies scale rows II and III, and occasionally fuses with the third lateral series which occupies scale row I and the outer one-fourth of the ventrals. The ventrals also have an almost continuous row of small semilunar markings along their lateral edges, and a few scattered spots. Also, in the adults the posterior edge of each ventral is clouded with gray, especially on the posterior part of the body. The ventral surface of the tail has a double row of black spots, which may fuse into two lateral black lines on the posterior half.

The ventrals and caudals are distinctly sexually dimorphic, and most of the other scale characters appear to be at least slightly so. The males have from 207 to 215 ventrals and 69 to 74 caudals (four specimens); the females have comparable counts of 215 to 223 (M = ca. 218) and 64 to 71 (five specimens).

The dorsals range from 23+27+19 in almost every combination to 25+29+21, with the males tending to have the smaller numbers. A typical scale formula of an adult female (CAS 13821) is given below:

```
   6+7(4)     6+7(12)     +7(38)     +8(88)     7+8(111)
29--------27----------25---------27---------29-----------27--
   7+8(4)     6+7(17)     +6(41)     +8(83)     7+8(108)

         -7(124)     6+7(133)     5+6(165)
  --27----------25-----------23-----------21  (218)
         -8(124)     5+6(132)     -6(169)
```

The oculars are 1+2; the temporals vary from 2+3+4 to 3+4+5. The supralabials are usually 8, but three individuals (all females) have 9 on one side; the infralabials vary from 11 to 13, with the latter number the more common. The smooth lateral scales vary (at midbody) from 8 to 11 in adults, and all rows may be smooth in juveniles.

As previously mentioned, the populations to the south differ in several ways. The specimens from the vicinity of San Antonio, Texas, have larger (and thus fewer) blotches, 32 to 44 in number (M = ca. 38). The ventrals average about 215 in males (OR = 212 to 223) and the caudals about 77. The snakes from near Brownsville, Texas, show a further increase in ventrals (Figure 1) and caudals (ca. 80 in males), and some indication of an increased number of labials (14 infralabials in one) and temporals, 3 being the common anterior count. The snakes from farther south, Nuevo Leon and Tamaulipas, are quite similar but show some indication of a continuation of the above trends.

Northward from Austin, on both sides of the Rockies, the numbers of scales become fewer and the number of blotches increases. A male from New Mexico has 204 ventrals, 70 caudals, and 55 blotches. Farther north, in Utah, two males have ventrals numbering 201 and 210; caudals 68 and 69; and blotches 42 and 50. Two females from the same region have ventrals 211 and 212; caudals 64 and 65; and blotches 53 and 55. On the eastern side of the Rocky Mountains a similar reduction is evident. In western Oklahoma the males have ventrals averaging ca. 212 (OR = 204 to 221), caudals about 72, and blotches, about 48 (OR = 45 to 59). The trend continues into Kansas where the males have about 210 ventrals (OR = 200 to 215), about 70 caudals, and about the same number of blotches (OR = 39 to 53) (Table II).

Few intergrading specimens (E. g. guttata x emoryi) are available. This is mainly due to the fact that the areas where intergrades would be expected are among the least known (herpetologically) regions of the eastern United States (i.e., northern Louisiana, Arkansas, and southern Missouri). Two specimens from the southeastern corner of Oklahoma (McCurtain County) show definite signs of intergradation, as do some from southern (especially southeastern) Missouri. The two Oklahoma individuals both tend considerably more toward E. g. guttata than do the Missouri ones. One of the Oklahoma individuals (UMMZ 86540), from "3 miles west of Eagletown," has square ventral blotches, small number (31) of red dorsal blotches, and low infralabial count (10-10) characteristic of E. g. guttata. The only indication of intergradation with E. guttata emoryi is the caudal

count (65), which is higher than other females of E. g. guttata known from that latitude, and well within the range (63-66) of the females of E. g. emoryi from farther west in Oklahoma. This would probably have gone unnoticed, however, if the other specimen (DZTU 5526 from Smithville) did not show even more indication of intergradation. It is a male with 213 ventrals (about average for E. g. emoryi from this latitude and a little low [?] for E. g. guttata), 73 caudals (average for E. g. emoryi, high for E. g. guttata), and 12-12 infralabials (within the range for E. g. emoryi and high for E. g. guttata). The spots were definitely red, as in E. g. guttata, but have a slight brownish tinge and there are 36 on on the body and 16 on the tail. This is more (4 more on the body and 5 more on the tail) than in any E. g. guttata from adjoining states (maximum 32 + 11), and is between them and the number (42 to 59 + 18 to 25) possessed by the nearest E. g. emoryi. The ventral blotching, although squarish anteriorly, breaks down into the small spots typical of E. g. emoryi posteriorly. The coloration and number of blotches, and the number of caudals places this specimen as an undoubted intergrade between the two forms.

The Missouri specimens have usually been allocated to E. g. emoryi in past literature (i.e., Hurter, 1911: 179, 182-3) when the relationships of the two forms was not understood. Their resemblance to E. guttata has been previously noted although not reported in the literature. The specimens from the western part of the state (Stone and Barry counties) show

little approach to E. g. guttata, but one from Jefferson County (CAS 8509) had blotches which were red in life (P. D. Evans in litt.) and are fewer (41 + 14) than in E. g. emoryi from farther west. The specimens from southeastern Missouri (Wayne and Carter counties) approach E. g. guttata even more. In two individuals (CAS 8890-91) the scale counts are typical of Kansas E. g. emoryi (but not greatly different from E. g. guttata of western Tennessee) but differ greatly in blotch number. The Kansas snakes have blotches which range from 39 to 53 (M = 46.3) and tail blotches from 22 to 26 (M = 23.3) but the two from southeastern Missouri each have 36 body blotches; the tail blotches being 14 and 15 respectively. In the latter two specimens the ventral blotches are squarish anteriorly and break up into smaller spots posteriorly. These two may also be considered undoubted intergrades.

Range. From coastal San Luis Potosi and central Chihuahua northward on the western side of the Rocky Mountains to southeastern Utah and adjacent parts of Colorado, and on the eastern side to Missouri, Kansas, and southern Nebraska.

## Elaphe vulpina (Baird and Girard)

[?] Coluber ovivorus Linnaeus, 1756: 223 (original description; "America").

Scotophis vulpinus Baird and Girard, 1853: 75-76.

[?] Elaphis rubriceps Dumeril, Bibron, and Dumeril, 1854: 270-72 (original description; "de l'Amerique du Nord").

Elaphis guttatus var. vulpinus (Baird and Girard), Garman, 1883: 56, 153.

Elaphe vulpinus (Baird and Girard), Ruthven, 1909: 116.

Elaphe vulpina (Baird and Girard), Stejneger and Barbour, 1917: 84.

Elaphe vulpina vulpina (Baird and Girard), Conant, 1940: 10, Pl. 1, fig. 23.

Elaphe vulpina gloydi Conant, 1940: 2-10, Pl. 1, figs. 1-2. (original description; Little Cedar Point, Jerusalem Township, Lucas County, Ohio).

Diagnosis. A species of the Pantherophis Section characterized by dark brown dorsal blotches and large black ventral blotches, the ground color of the head being suffused with a coppery color, and fewer than 218 ventrals.

Location of type specimen, and type locality. The type specimen was originally in the U. S. National Museum, but has since been lost. A neotype, USNM 9969, was designated by Conant (1940: 10). Both of these specimens were collected at Racine, Racine County, Wisconsin, by P. R. Hoy.

Description of type specimen. The original specimen (USNM ?) was described as having 202 ventrals, 68 caudals, and 25 scale rows at midbody. The supralabials were 8; infralabials, 10. The dorsal blotches numbered 44 on the body, and about 16 on the tail.

The neotype (USNM 9969) is an adult male with the following characters: ventrals, 201; caudals, 65; supralabials, 8-8; infralabials, 11-12; oculars, 1+2; temporals, 2+3+4; gulars, 4. Dorsal row V is the lowest showing keels. The dorsal scale formula is as follows:

$$25\text{---}\overset{5+6(16)}{24}\text{---}\overset{+5(27)}{25}\text{---}\overset{5+6(112)\ 5+6(111)}{23}\text{---}\overset{5+6(125)\ -6(132)}{21}\quad (201)$$

There are 45 dorsal blotches and 18 (± 1) on the tail. The body length is about 1070 mm.; tail length, 191; head length, 37.2; eye, 4.8.

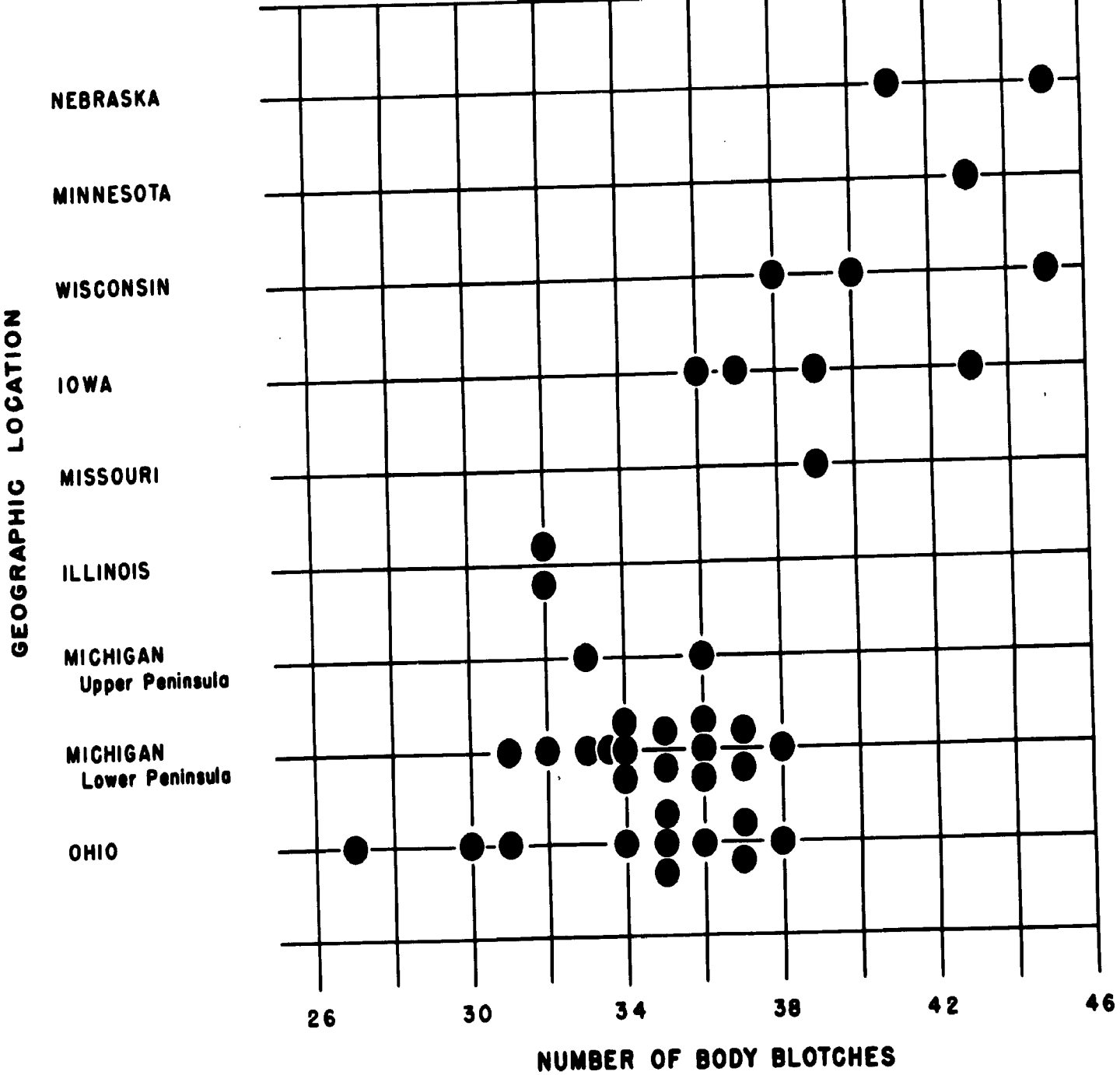
Description of species. This species differs from other species of American Elaphe in having a stout, rather cylindrical body with a comparatively narrow head which is not very distinct from the neck. It grows to a large size; specimens as large as 1648 mm. (total length) have been reported (Conant, 1940: 8). A specimen of average size is a female (USNM 56609) with a body length of 820; tail length, 135; head length, 31.7; eye, 3.9. The tail is rather short, averaging about 20.5 per cent of the body length in males, and about 16 per cent in females. It appears shorter than its actual measurement due to its tumid appearance, not tapering gradually as in other forms but coming to an abrupt, almost conical point. As mentioned

above, the head is not greatly widened over the thickness of the neck. It is also somewhat shorter than in other species, averaging between 3.5 and 4 per cent of the body length.

The dorsal color pattern is made up of large, dark brown blotches, which are often heavily infused with black. These blotches are in the pattern which is typical for this genus: a large dorsal series, a lateral series of smaller blotches alternating with it, and (in this species) a still smaller series of ventro-lateral blotches alternating with the lateral one. The pattern is continued ventrally with an alternating pair of ventral blotches. There is a definite reduction in blotch number from west to east. The blotches range from about 42 in Nebraska to about 33 in Ohio (Figure 5). This was used as the key character for the description of a new subspecies (E. vulpina gloydi Conant), but since the slight differences in scutellation may be accounted for by differences in latitude, and since no large segment of the species may be definitely allocated by the number of blotches, it is not recognized herein. The reduction in blotch number appears to be clinal from west to east, rather than a low number being characteristic for an isolated, eastern population group.

As indicated above, the scutellation in this species appears to have a trend similar to the ones observed in the other species of the Guttata Group. Since there is so little latitudinal spread, and so few specimens available from the

Figure 5. Geographic variation in blotches in *Elaphe vulpina*.


GEOGRAPHIC LOCATION
NEBRASKA
MINNESOTA
WISCONSIN
IOWA
MISSOURI
ILLINOIS
MICHIGAN
Upper Peninsula
MICHIGAN
Lower Peninsula
OHIO
26
30
34
38
42
46
NUMBER OF BODY BLOTCHES

northern part of the range, however, it is only indicated by the specimens from the extremes of the range, and not definitely proven to exist (Table IV). The dorsal count varies from 23+23+20 to 25+27+23, and a typical scale formula is the following, from a female (ANSP 21650, holotype, E. v. gloydi):

$$\begin{array}{ccccccccccccc} & \frac{6+7(8)}{6+7(7)} & & \frac{+7(59)}{+7(62)} & & \frac{6+7(104)}{-7(102)} & & \frac{5+6(122)}{5+6(122)} & & \frac{5+6(151)}{5+6(150)} & & & \\ 27 & - & 25 & - & 27 & - & 25 & - & 23 & - & 21 & & (204) \end{array}$$

The dorsals are more heavily keeled in this species than in any of the others. The keeled scales usually extend laterally to scale row V in adults, and may extend to scale row III. As in the other species, the juveniles have the keels well developed, and may have all of the scales smooth at midbody.

The considerable differences in scutellation, coloration, and body form between this species and the others of the Pantherophis Section might lead to some question of its disposition here. Study of the hemipenis (Plate III), however, indicates the close relationship of this species with the others of this section.

Range. From northern Missouri and eastern Nebraska northward to central Minnesota and the Upper Peninsula of Michigan, eastward to northwestern Indiana, and along the shores of Great Lakes Huron and Erie to the vicinity of Buffalo, New York.

Plate III. Hemipenis of Elaphe vulpina, showing the similarities between species in the Pantherophis Section. Compare with the hemipenis of Elaphe obsoleta (Plate I). [Drawn from the everted hemipenis of UMMZ 101312 by William L. Brudon.]



## TABLE IV

## VARIATION IN ELAPHE VULPINA

| | MALES | Ventrals | Caudals | SL | IL | FEMALES | Ventrals | Caudals | SL | IL |
|---|---|---|---|---|---|---|---|---|---|---|
| Nebraska | 2 | 191.0(190-192) | 63.5(62-65) | 16 | 20 [1]<br>21 [1] | 1 | 201.0 | 60.0 | 16 | 23 |
| Minnesota | 1 | 195.0 | 67.0 | 16 | 20 | 0 | - | - | - | - |
| Wisconsin | 2 | 199.5(198-201) | 65.5(65-66) | 16 | 23 | 1 | 204.0 | 56.0 | 16 | 20 |
| Iowa | 4 | 201.0(199-202) | 64.3(62-66) | 16 | 22 | 0 | - | - | - | - |
| Missouri | 0 | - | - | - | - | 1 | 203.0 | 57.0 | 15 | 19 |
| Illinois | 1 | 195.0 | 66.0 | 15 | 22 | 1 | 200.0 | 54.0 | ? | ? |
| Michigan<br>U. P. | 1 | 199.0 | 60.0 | 15 | 23 | 0 | - | - | - | - |
| L. P. | 7 | 199.7(193-204) | 67.7 (64-70) | 15[1]<br>16[5] | 22 | 8 | 207.5(203-215) | 58.1(56-60) | 16 | 21[1]<br>22[7] |
| Ohio | 4 | 196.3(195-198) | 66.5(65-68) | 16 | 19 [2]<br>22 [2] | 8 | 205.0(201-208) | 53.3(47-59) | 16 | 18[1]<br>20[2]<br>22[2]<br>23[4] |

SL = supralabials; IL = infralabials; U. P. = Upper Peninsula; L. P. = Lower Peninsula. Labials from both sides of head added.

## Elaphe flavirufa (Cope)

This species ranges from the lowlands of Tamaulipas southward along the Caribbean Coast to include the Yucatan Peninsula, and reaches its (known) southern limit on Corn Island, Nicaragua. In the north E. flavirufa abuts on, or overlaps, the southernmost representatives of E. guttata emoryi, but so few specimens are known from this area that neither intergradation nor lack of it can be demonstrated. There is little question that E. flavirufa is the southern representative of the Guttata Group: the general body coloration, the possession of black-bordered blotches, the extent of dorsal keeling, and the geographic relationships all point to this. In addition, the trends observable in E. guttata emoryi are continued, increasing numbers of ventrals and caudals, increasing tail length and eye size.

Diagnosis. A species of the Pantherophis Section with more than 245 ventrals in males (5 to 10 ventrals more in females); usually three labials entering eye; postorbital band ending on supralabials; ventral surface immaculate white (or slightly mottled with gray posteriorly in old specimens).

Discussion. Although there is an approach in characters, from both directions, between this species and E. guttata emoryi to the north, there are extensive differences between the specimens of each which are the nearest geographically. These include a difference of about 20 ventrals, of three or more maxillary teeth, and the entrance (in E. flavirufa) of a third labial into the orbit. None of the specimens so far available

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This species ranges from the lowlands of Tamaulipas southward along the Caribbean Coast to include the Yucatan Peninsula, and reaches its (known) southern limit on Corn Island, Nicaragua. In the north E. flavirufa abuts on, or overlaps, the southernmost representatives of E. guttata emoryi, but so few specimens are known from this area that neither intergradation nor lack of it can be demonstrated. There is little question that E. flavirufa is the southern representative of the Guttata Group: the general body coloration, the possession of black-bordered blotches, the extent of dorsal keeling, and the geographic relationships all point to this. In addition, the trends observable in E. guttata emoryi are continued, increasing numbers of ventrals and caudals, increasing tail length and eye size.

Diagnosis. A species of the Pantherophis Section with more than 245 ventrals in males (5 to 10 ventrals more in females); usually three labials entering eye; postorbital band ending on supralabials; ventral surface immaculate white (or slightly mottled with gray posteriorly in old specimens).

Discussion. Although there is an approach in characters, from both directions, between this species and E. guttata emoryi to the north, there are extensive differences between the specimens of each which are the nearest geographically. These include a difference of about 20 ventrals, of three or more maxillary teeth, and the entrance (in E. flavirufa) of a third labial into the orbit. None of the specimens so far available

show any intergradation in these characters.

Eighteen specimens of this species have been available for study, and perhaps ten more have been reported in the literature. This is a very poor representation for a species of such wide geographic range. The scarcity of material may be accounted for in part by its restricted range on the Gulf and Caribbean coasts where comparatively little collecting has been done. This does not fully explain it, however, since only five specimens are available from Chichen Itza, Yucatan, a locality where more than 30 specimens of Elaphe triaspis have been found. The main explanation appears to be the nocturnal habits of the species, a habit that has been well described by Mertens (1950: 75-6).

With so few specimens, the recognition of four subspecies may seem injudicious. However, the differences are so pronounced that they might lead (and sometimes have led) workers to describe them as distinct species. Each of the described forms is distinct from the others, a situation not improbable on the basis of inadequate material; in none (with the possible exception of E. flavirufa matudai) does it appear that a mere local variation has been recognized nominally, nor one within a clinal pattern. Some of the characteristics of the four subspecies are given elsewhere (Table V).

Map 3. The known distribution of the subspecies of Elaphe flavirufa. Note their restriction to low altitudes, and their almost complete restriction to the Gulf and Caribbean coasts.


Brownsville
Ciudad Victoria
Veracruz
Valladolid
Guatemala
Tegucigalpa
Managua
Elaphe flavirufa
E. f. flavirufa
E. f. meludai
E. f. yucatanensis
E. f. rodriguezi
Hollow symbols = Literature records

TABLE V

VARIATION IN ELAPHE FLAVIRUFA

| | Number | Ventrals | Caudals | Oculars | Body Blotches | Tail Blotches | Maxillary Teeth |
|---|---|---|---|---|---|---|---|
| E. f. flavirufa | 6 | 247-59 | 106-20 | 1+2 | 33-42 | 15-24 | 21-22 |
| E. f. matudai | 1 | 255 | 105 | 1(2)+2 | 35 | 15± | ? |
| E. f. yucatanensis | 5 | 250-56 | 96-101 | 1+2 | 29-30 | 12-16 | 22-24 |
| E. f. rodriguezi | 6 | 261-65 | 111-22 | 2+2 | 36-46 | 17-22 | 19-21 |

## Elaphe flavirufa flavirufa (Cope)

Coluber flavirufus Cope, 1867: 319.

Elaphe flavirufa (Cope), Gaige, 1936: 299 [partim].

Elaphe flavirufa flavirufa (Cope), Smith, 1941: 132, fig. 2.

Elaphe (Pseudoelaphe) flavirufa (Cope), Mertens and Rosenberg, 1943: 60-63.

Diagnosis. A subspecies of Elaphe flavirufa characterized by 33 to 42 light (reddish ?) brown, black-bordered blotches which extend laterally to the seventh or eighth dorsal row (Fig. 6); a single preocular; scale counts varying from 25+27+19 to 27+31+21; dorsals smooth to row VIII.

Location of type specimen, and type locality. The holotype is USNM 6566, collected in "Yucatan" [vide infra] by Arthur C. V. Schott. There is also a paratype, USNM 6626, which was collected in "Tabasco" by Dr. H. Berendt.

The type locality of "Yucatan" was apparently merely an indication that the specimen was collected somewhere on the peninsula. Smith and Taylor have recently (1950: 352) restricted the type locality to Chichen Itza, Yucatan, but I find this allocation to be untenable since the form found there (of which I have seen five specimens) is not the one named by Cope. Instead it appears advisable to provisionally restrict the type locality to the vicinity of Campeche, Campeche. Schott is known (Kellogg, 1932: 8) to have collected in this area, and there is a specimen (UMMZ 73224) known from the vicinity of Tuxpeña, some 100 miles to the south-southwest, which compares favorably with the type in all respects.

Description of type specimen. The holotype is a juvenile male with the following characters: supralabials, 9-10 (labials IV to VI, and V to VII entering eye); infralabials, 13-13; oculars, 1+2; temporals, 2+3+5; gulars, 3. The dorsal scale formula is:

$$27\text{-}\frac{5+6(8)}{5+6(7)}\text{-}25\text{-}\frac{+7(60)}{+7(60)}\text{-}27\text{-}\frac{-7(149)}{7+8(151)}\text{-}25\text{-}\frac{4+5(160)}{-6(159)}\text{-}23\text{-}\frac{-5(181)}{-6(182)}\text{-}21\ (256)$$

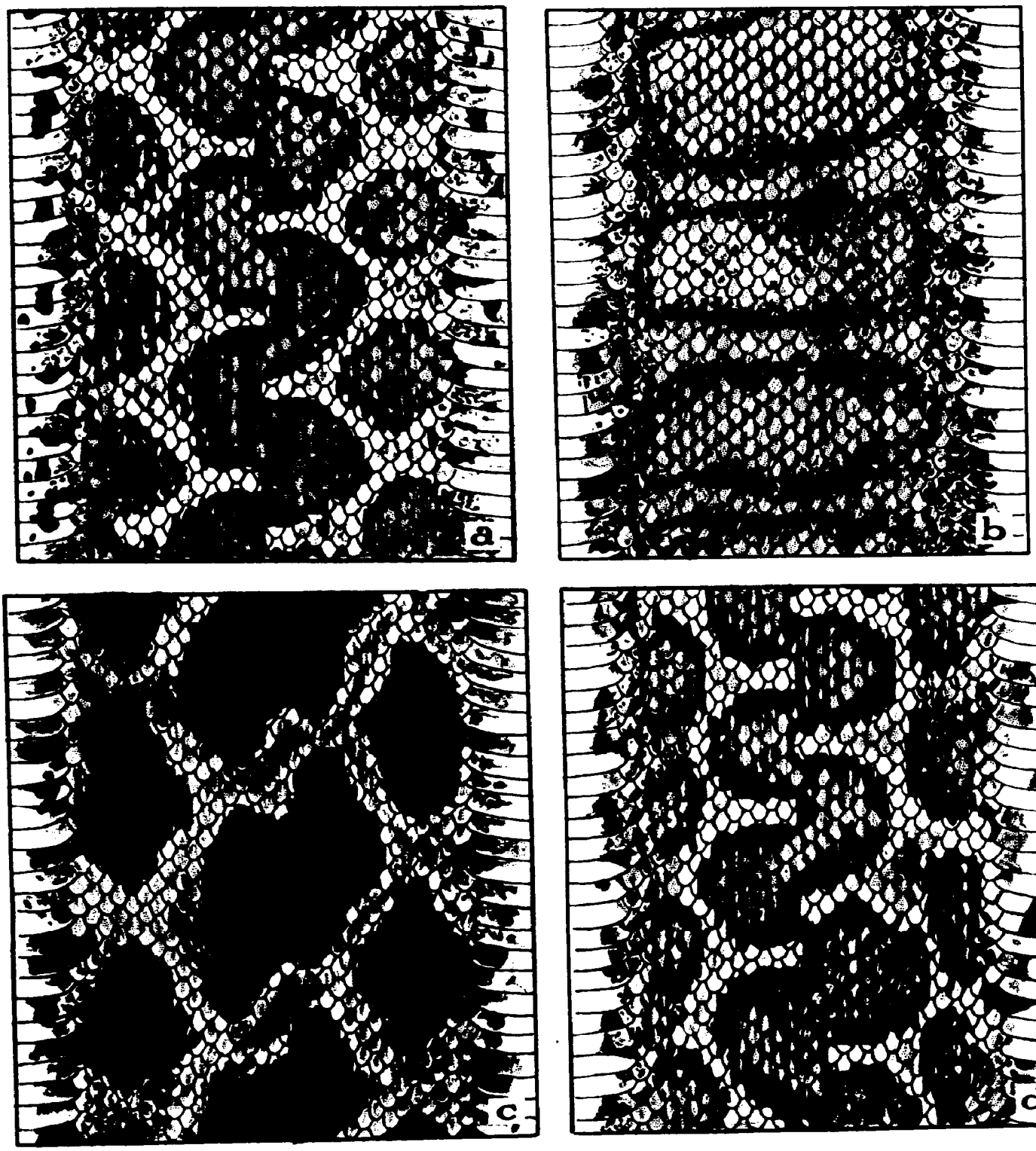
The first eight lateral rows are smooth; caudals, 120; body blotches, 41; tail blotches, 24. The body length is about 440 (twisted); tail length, 125; head length, 19.3; eye, 3.9.

Description of subspecies. Very few specimens are known of this form, and only six, including the types, have been available for this study. The specimens are from widely scattered localities; Campeche, Tabasco, Veracruz, and San Luis Potosi, but are rather constant in their characters. The only recognizable indication of geographic variation is the fact that the northernmost individual has fewer ventrals than the others. Even so, it is well within the expected range of variation within a single population.

The body is of moderate thickness and tapers distinctly toward either end. The tail is long (24 to 28 per cent of body length) and the head is distinct from the slender neck. The largest specimen (KUMNH 24078) is an adult male with a body length of 1225 mm. and a tail length of 292. The smaller specimens appear to have longer tails than do the adults.

The ground color (in alcohol) is light tan. There is a dorsal series of 33 to 42 dark brown- or black-bordered blotches

Figure 6. Color patterns in the four subspecies of Elaphe flavirufa; a, E. f. flavirufa; b, E. f. matudai; c, E. f. yucatanensis; d, E. f. rodriguezi.


a
b
c
d

which are somewhat darker than the ground color, and are probably red or reddish-brown in life. These blotches are six to eight scales in length with interspaces of one to three scales. They extend laterally to scale rows VI to VIII and are often joined in zig-zag fashion to form an interrupted dorsal band. Alternating with the dorsal series are lateral blotches of similar coloration, oval in shape, which extend upward from the ventrals to scale rows VII to IX. A smaller series on the ventral edges and the first one or two scale rows, one to two ventrals in length, both alternates with and opposes the lateral row. In the young and in individuals of moderate size, the ventral surface is immaculate below the angle of the ventrals except for a very few scattered spots. In larger and older individuals, however, the posterior ventral surface is mottled with gray. The head pattern is visible but broken into small spots in the specimens at hand. A narrow postorbital band is present but breaks up and ends on the supralabials.

The dorsal scales are quite smooth and keels are not visible below scale row VII in any of the specimens. The dorsal counts are variable, but the minimum anterior count is 25 in five of the specimens; 27 in the other one. The posterior count is 19 or 21. The scale formula of the type specimen (given above) differs from others only in that the maximum count is lower.

Range. From southern Tamaulipas southward in the lowlands of the Gulf Coast to Campeche.

## Elaphe flavirufa matudai Smith

[?] Coluber flavirufus Cope, Ferrari-Perez, 1886: 185 (listed; Chiapas ?).

Elaphe flavirufa matudai Smith, 1941: 132-34.

Diagnosis. A subspecies of Elaphe flavirufa characterized by having blotches (35 in the single known individual) of the dorsal series which extend laterally to dorsal scale row III.

Location of type, and type locality. USNM 110303, collected at Salto de Agua (1200 feet altitude) on Cerro Ovando, four miles northeast of Escuintla, Distrito Soconusco, Chiapas, by Hobart M. Smith on May 19, 1940.

Description of type (and subspecies). The unique specimen of this form is an adult female. It is distinguished from other known specimens of E. flavirufa by the appearance of the 35 dorsal blotches, which are broadened so that they extend to the second or third lateral rows of scales. This specimen has 105 caudals and 15± tail blotches. The preoculars are 2-1; postoculars, 2-2; temporals, 3+3+3 and 2+3+4; supralabials, 10-10; infralabials, 13-?, the right side scarred. The dorsal scale formula is as follows:

```
   5+6(10)    +7(53)    +8(87)    -6(137)    -7(146)
27---------25--------27--------29---------27---------25--
   5+6(9)     +6(49)    +8(94)    -6(136)    -7(147)

    -5(157)     5+6(228)
--25---------23---------21---------22---------21--
    5+6(156)    5+6(228)    +5(232)    -5(237)

          +5(249)    -5(253)
     --21---------23---------21  (255)
          +5(249)    -5(253)
```

The body is stiff and cannot be measured accurately, but has a length of about 1135 mm.; tail length, 295; head length, 38.6; eye, 5.9. Other data are contained in the original description.

Discussion. This is the only specimen of the entire Pantherophis Section known from the Pacific Coast, and it is impossible to say at present whether either the division of the left preocular or the extraordinary width of the dorsal blotches is unusual in the population from which it came. If the divided preocular is unusual, then this population may be retained as a separate subspecies on the basis of pattern differences. If the width of the blotches is an unusual character in the population, however, then the population is probably an intergrading one between E. f. flavirufa and E. flavirufa rodriguezi and should not be accorded separate recognition. In this respect it should be noted that occasional specimens of E. g. guttata from the southern part of the range display a pattern similar to E. f. matudai. This is caused by fusion of the dorsal series to the lateral spots (vide pp. 39, 40) and occurs erratically in the population, being characteristic of none. More material is needed before this problem may be settled.

Range. Known only from the type locality.

## Elaphe flavirufa yucatanensis Dowling

Elaphe flavirufa (Cope), Gaige, 1936: 299 [partim].
Elaphe flavirufa yucatanensis Dowling, 1951: [ms.].

Diagnosis. A subspecies of Elaphe flavirufa characterized by the small number (29 or 30 in the five known specimens) and dark color (dark chocolate brown in adults) of the dorsal blotches, and by the large number of dorsal scales: minimum anterior count, 29; minimum posterior count, 23 (male) or 25 (females).

Location of types, and type locality. The holotype is UMMZ 73074, collected at Chichen Itza, Distrito Valladolid, Yucatan, by Edwin Creaser on June 23, 1932. There are four paratopotypes; MCZ 29241, UMMZ 73072-3, and USNM 46578.

Description of type specimen. The holotype is a young female with the following characters: oculars, 1+2; temporals, 2+4+4, and 2+3+4; supralabials, 9-9 (V and VI entering orbit); infralabials, 14-13; caudals, 99. There are 29 body blotches, and 13 on the tail. The maxillary count is 24. The first four lateral rows of dorsals are smooth, and the scale formula is as follows:

$$33\text{---}\overset{6+7(17)}{\underset{7+8(14)}{\text{---}}}\text{---}31\text{---}\overset{-8(22)}{\underset{-8(23)}{\text{---}}}\text{---}29\text{---}\overset{+8(77)}{\underset{+8(74)}{\text{---}}}\text{---}31\text{---}\overset{?}{\underset{6+7(151)}{\text{---}}}\text{---}29\text{---}\overset{?}{\underset{6+7(159)}{\text{---}}}\text{---}27\text{---}\overset{4+5(170)}{\underset{?}{\text{---}}}\text{---}27\text{---}25\ (256)$$

The questioned reductions are in scarred areas. The body length is 601 mm.; tail length, 143; head length, 26.7; eye, 4.7.

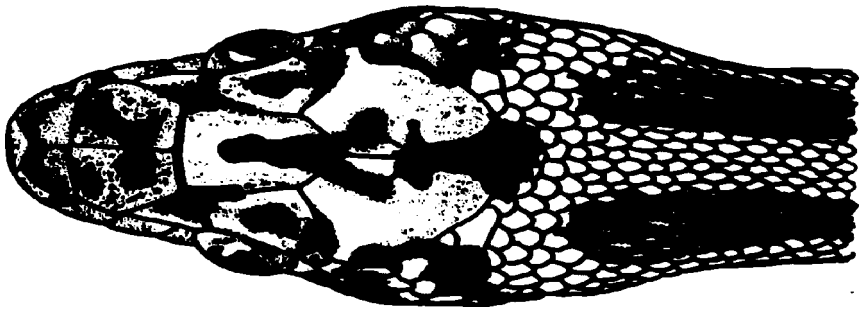
Description of subspecies. The five known specimens of this form include one adult male (which, unfortunately, has the head crushed) and four juvenile females.

The body form is similar to that of the typical subspecies, except that the tail is somewhat shorter, averaging about 24.5 per cent of body length. The adult male (UMMZ 73073) has a body length of about 965 mm., and a tail length of 237. The other specimens range in body length from 492 to 601.

The coloration is quite different from that of the other three subspecies. The adult has dark chocolate-brown blotches on a grayish-tan ground color. In the juveniles the blotches are not so dark (though much darker than in the other forms) but each scale within the blotch is outlined with brown; the lighter centers of the blotches grade into an ill-defined dark border about two scales wide. The blotches of the dorsal series are elongate, especially anteriorly, and the midbody blotches are 9 to 11 scales long and extend downward to about scale row IX. On the anterior portion of the body (and sometimes on the posterior portion as well) the dorsal blotches have longitudinal extensions from each side, giving them a concave appearance rather than the rounded oval shape of the blotches in the other subspecies (Figure 6). The head pattern is similar to that of the other forms, but less broken up (Figure 7).

The dorsal scales are more strongly keeled than in the other forms. Only the first three scale rows are smooth in the adult; the first four to seven in the juveniles. As

Figure 7. The head pattern in Elaphe flavirufa yucatanensis.



previously indicated, this form has more scale rows than the others, the scale counts being 29+31+23 in the male and 29+31+25 in the four females (Table V).

Range. This form is known only from the type locality. It probably replaces the typical form in the outer, dryer portion of the peninsula, E. f. flavirufa being restricted to the wet-forest region near the base.

## Elaphe flavirufa rodriguezi (Bocourt)

[?] Elaphis pardalinus Peters, 1868: 642 (original description; [no type locality]).
Elaphis rodriguezi Bocourt, 1887: 168.

Diagnosis. A subspecies of Elaphe flavirufa characterized by a horizontally divided preocular, and a large number of ventrals (260+ ?).

Location of type specimen, and type locality. The type is in the Museum National d'Histoire Naturelle, Paris. It was collected at "Santa Rosa de Pansos" [=Panzos], Alta Verapaz, Guatemala, by the "Mission Scientifique."

Description of type specimen. The type is described as having the following characters: ventrals, 265; caudals, 111; supralabials, 9; infralabials, 14; oculars, 2+2; gulars, 5. The body length is 630 mm., and the tail length, 160.

Description of subspecies. Only six specimens are available, four of these are from Honduras, one from Corn Island, Nicaragua, and one is without locality data.

All of the specimens have the preocular divided into two by a horizontal suture. This character appears in other forms of Elaphe with the utmost rarity (a single specimen of E. triaspis is the only specimen found, other than this subspecies, with both preoculars divided) and thus is highly characteristic of this subspecies. Three of the present specimens have the ventral series interrupted (two are head and neck only), but

the counts in the specimens of known provenance are 261 and 262 in the two males, and 265 in the type (a female?). This is consistently above the ventral counts of the other three subspecies, and although they would probably overlap in larger series, a higher average number is certainly indicated.

The two above characters, number of preoculars and number of ventrals, appear to be the only differences between this subspecies and E. f. flavirufa. The body form and coloration are almost identical in the two forms. The dorsal scale formula for the Corn Island individual (which does not appear to differ from those of mainland origin) is given below (AMNH 23887).

```
   8+9(7)    5+6(13)    +7(56)    +9(94)    -8(128)
31--------29---------27--------29--------31---------29--
   7+8(7)    5+6(17)    +7(55)    +7(91)    -8(128)

    5+6(144)    -6(151)    5+6(162)    5+6(226)
--29---------27---------25---------23---------21  (262)
    5+6(143)    -6(151)    5+6(160)    5+6(217)
```

Other items of scutellation and coloration are given elsewhere (Table V).

Range. The known distribution of this form is from the type locality at Panzos, Alta Verapaz, Guatemala, southward along the Caribbean coast of Central America to Corn Island, Nicaragua.

## THE OBSOLETA GROUP

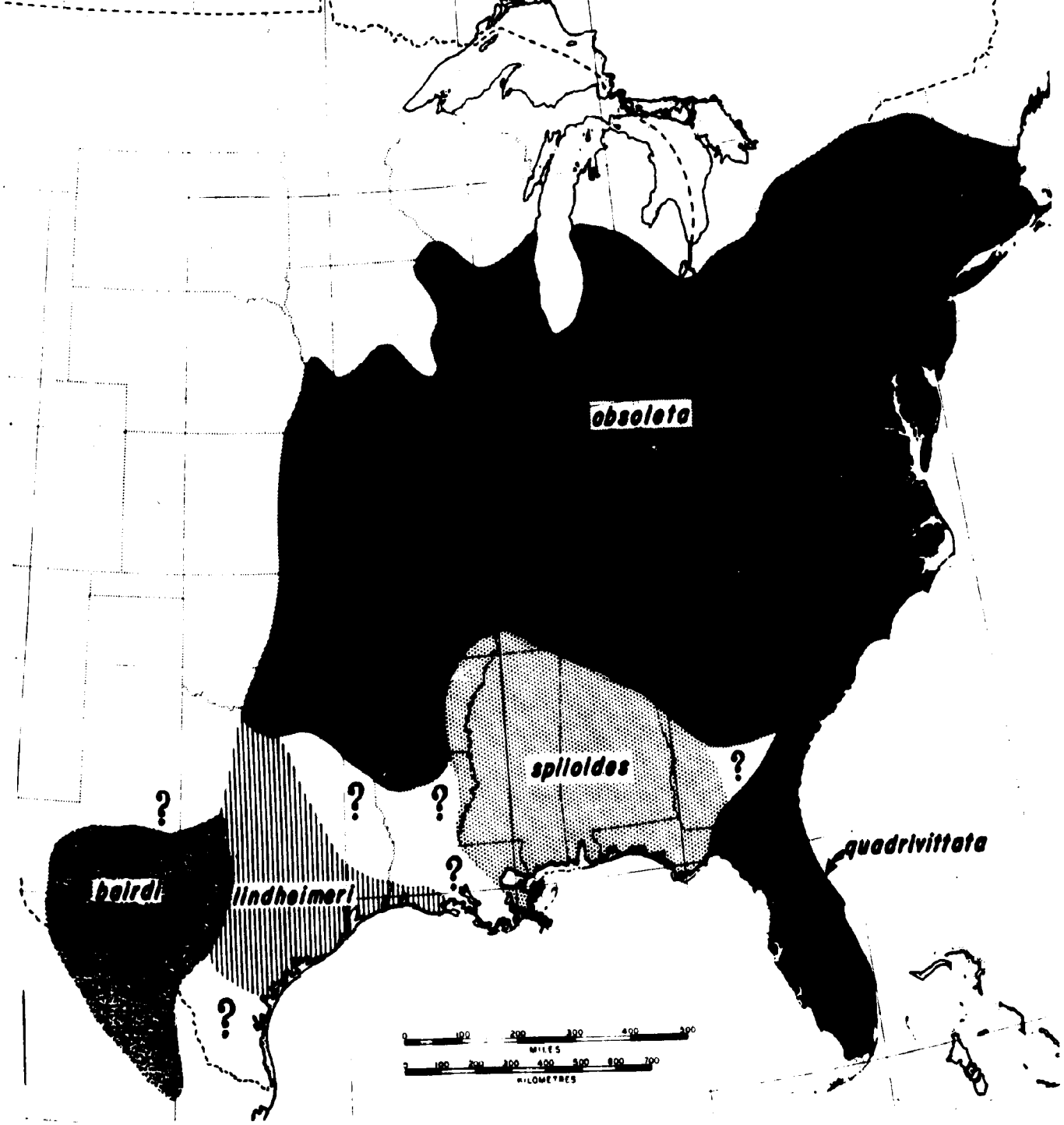
Three members of this group had, up to the time of this study, been considered distinct species: Elaphe obsoleta, E. quadrivittata, and E. bairdi. Since the preliminary results of this study were presented at the 1949 meetings of the American Society of Ichthyologists and Herpetologists, however, two works (Neill, 1949, and Milstead, Mecham, and McClintock, 1950: 554-5) have appeared which together present essentially the same conclusions that I had drawn: that the three forms are subspecifically related. These three, and two other forms are herein recognized as subspecies of a single wide-ranging species, E. obsoleta. Further consideration of the group will be carried on under the specific name.

### Elaphe obsoleta (Say)

Coluber obsoletus Say, in James, 1823: 140.
Coluber quadrivittatus Holbrook, 1836: 113.
Scotophis lindheimeri Baird and Girard, 1853: 74.
Elaphis spiloides Dumeril, Bibron, and Dumeril, 1854: 269.
Coluber bairdi Yarrow, in Cope, 1880: 41.

Diagnosis. A species of the Pantherophis Section with the following characters: juvenile head pattern lost in adults; headbands (in young), black, not black-bordered, often irregular or broken, postorbital band not extending onto gulars; body blotches, 25 to 60; ventrals, 220 to 235 in males, 225 to 240 in females; caudals, 65 to 110.

Map 4. Geographic distribution of the subspecies of *Elaphe obsoleta*.


obsoleta
spiloides
quadrivittata
bairdi
lindheimeri
?
?
?
?
?
?
0 100 200 300 400 500
MILES
0 100 200 300 400 500 600 700
KILOMETRES

Discussion. This species ranges from Vermont to Minnesota, and southward through the entire eastern United States to Florida, Nuevo Leon, and West Texas (Map 4). With such a wide distribution it is not surprising that it breaks up into a number of subspecies.

The most wide-spread of these subspecies is E. o. obsoleta, a form which is unicolor black (or nearly so) in the adult, and which occupies the entire northern half of the range of the species. The southeastern representatives include E. o. quadrivittata, a long-tailed, striped form with a "Florida Island" type of distribution similar to that of Pseudacris ocularis and Seminatrix pygaea (i.e., Peninsular Florida northward along the coast to the vicinity of Cape Lookout, North Carolina), and E. o. spiloides (E. o. confinis, auct.), a shorter-tailed, blotched form ranging from the area of intergradation with E. o. quadrivittata westward to the Mississippi River. The intergrades of these two subspecies are striking in appearance, having blotches and stripes on a light silvery gray background, and have been named as a distinct species (E. williamsi Barbour and Carr). The "specific characters," however, are merely a combination of the characters of the two subspecies which they join, plus the apparent suppression of the gray ground color of E. o. spiloides without the simultaneous addition of the yellow coloration of E. o. quadrivittata. In addition to the specimens from Levy County, Florida, labeled "E. williamsi" in the various institutions, known intergrades between the forms include specimens from

Madison (UMMZ 72808) and Leon (USNM 1604) counties, Florida, and probably (not seen) the specimens in the Chicago Academy of Science from Thomas and Grady counties, Georgia. Known intergrades, E. o. obsoleta x quadrivittata include specimens from Carteret County, North Carolina (UMMZ 81107-08).

The form of eastern Texas, E. obsoleta lindheimeri, also extends eastward along the coast into Louisiana, but many more specimens are needed from this state and Arkansas before the faunal and ecological relationships of the three forms which meet in that area (E. o. obsoleta, E. o. spiloides, and E. o. lindheimeri) may be determined. Along the edge of the Edwards Plateau, E. o. lindheimeri intergrades with the remaining subspecies, E. o. bairdi. Here, the change from a blotched and mottled form (E. o. lindheimeri) to a striped one (E. o. bairdi) does not appear to be so abrupt nor so striking. The yellow coloration and increase in number of labials characteristic of E. o. bairdi has already occurred in the western representatives of the other subspecies, and the stripes are merely added to this, with a loss of blotches in the adults. That a definite change occurs in the genetic makeup of the species in this area cannot be doubted, however; the number of blotches in the juveniles, alone, is sufficient evidence. The 25 to 35 blotches (M = ca. 30) characteristic of E. o. lindheimeri is abruptly raised to the mid-forties at the plateau edge, and to fifty or more in typical E. o. bairdi. A small series of specimens in my personal collection (to be presented to UMMZ) from the vicinity of Kerrville, Kerr County,

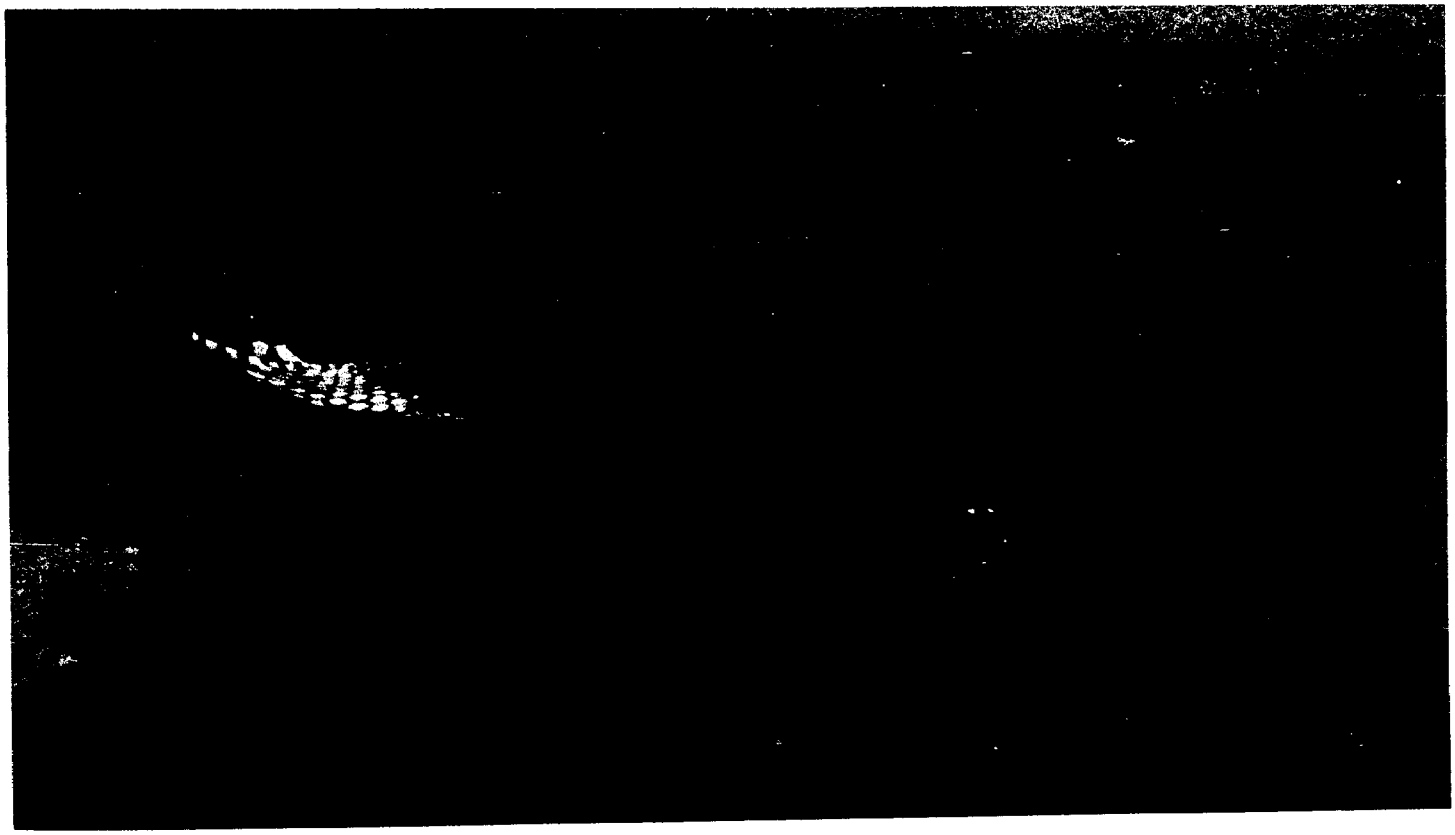
Texas, apparently represents a population from the "bairdi-side" of the area of intergradation, exhibiting the scutellation and stripes of E. o. bairdi, but retaining the blotches (an intermediate number) in larger specimens than is evident in typical E. o. bairdi.

Plate IV. *Elaphe obsoleta*.

Upper figure: adult *E. o. obsoleta*. Note the absence of dorsal blotches and head pattern.

Lower figure: juvenile *E. o. quadrivittata*. Note the blotched pattern and the extent of the postorbital band.





## Elaphe obsoleta obsoleta (Say)

[?] Coluber fulviventer Rafinesque, 1820: 6 (original description; "Found in Kentucky, Ohio, Indiana, etc.")

Coluber obsoletus Say, in James, 1823: 140.

Coluber alleghenienses Holbrook, 1836: 111, pl. 20 (original description; "summit of the Blue Ridge in Virginia" and "Highlands of the Hudson").

Scotophis confinis Baird and Girard, 1853: 76 (original description; Anderson, South Carolina).

Scotophis laetus Baird and Girard, 1853: 77-8 (original description; "Red River, Ark." [vide Dowling, 1950a]).

Coluber obsoletus obsoletus (Say), Cope, 1900: 844, fig. 194.

Elaphe obsoletus (Say), Dunn, 1915: 6.

Elaphe obsoleta obsoleta (Say), Stejneger and Barbour, 1917: 83.

Diagnosis. A subspecies of Elaphe obsoleta in which the 27 to 38 dorsal body blotches become obsolete in the adult, which is dark brown or black, usually with only faint indication of blotches. Supralabials usually 8; temporals usually 2+3+4; caudals fewer than 90 in males, 84 in females.

Location of type specimen, and type locality. No type specimen is known of this form. The type locality is given as "on the Missouri River from the vicinity of Isle au Vache to Council Bluff." Cow Island is near Leavenworth, Leavenworth County, Kansas, and is somewhat over 100 miles downriver from Council Bluffs. At present it appears unnecessary to further restrict the type locality, but it could be reasonably

restricted to the vicinity of Cow Island (where Say spent several weeks) should it seem necessary at some later date.

Description of type specimens. There is little diagnostic information in the original description. There were three cotypes characterized as having the dorsal surface black with small marginal white dashes on "many scales" laterally, occurring in groups; skin between the scales marked with a lateral series of "continuous dilated dull red large circles;" ventral surface "white slightly tinged with yellowish red, irrorate with black points, and spotted with large oblong quadrate marks, which gradually become more continuous, confluent and plumbeous toward the tail." The ventrals were 228, 223, and 228; caudals 67?, 84, and 84. The measurements of one specimen were given: total length, 4 feet 11 5/8 inches; tail length 10 1/8 inches.

Range. Vermont and southern Ontario southward to northern Georgia and the northern part of the Gulf States, and westward to northeastern Texas and southeastern Minnesota.

## Elaphe obsoleta quadrivittata (Holbrook)

Coluber quadrivittatus Holbrook, 1836: 113-14, pl. 21.

Elaphe quadrivittata (Holbrook), Stejneger and Barbour, 1917: 83.

Elaphe quadrivittata deckerti Brady, 1932: 5 (original description; Lower Matecumbe Key, Monroe County, Florida).

Elaphe quadrivittata quadrivittata (Holbrook), Brady, 1932: 5.

Elaphe williamsi Barbour and Carr, 1940: 340-42 (original description; near Lebanon, Levy County, Florida).

Elaphe quadrivittata parallela Barbour and Engels, 1942: 103-04, pl. 17 (original description; Sam Windsor's Lump, 3 miles from Beaufort Inlet on the Shackelford Banks, Carteret County, North Carolina).

Elaphe obsoleta rossalleni Neill, 1949: 1-12, 1 fig. (original description; 22 miles northwest of Fort Lauderdale, Broward County, Florida).

Elaphe obsoleta quadrivittata (Holbrook), Neill, 1949: 4.

Diagnosis. A subspecies of Elaphe obsoleta in which the adults have a color pattern of four longitudinal bands on a yellowish background and a yellowish or orange head; a large number of caudals, 90 or more in males, 84 or more in females. The juveniles have 32 to 42 dorsal body blotches.

Location of type specimen, and type locality. The disposition of the type was not given but most of Holbrook's material is now in the collection of the Academy of Natural Sciences of Philadelphia. Among the snakes is one of this species (ANSP

3773) donated by him from "South Carolina" which has the approximate dimensions and almost exactly the scutellation given for the type in the original description. In the absence of any evidence to the contrary, it appears reasonable to assume this to be the type specimen of this form. The description of the coloration and scutellation in the original description leave no doubt that Holbrook had a specimen from the northern part of the range before him, and with the evidence at hand it appears possible to certainly restrict the type locality to the state of South Carolina. Four other forms have been described from within the range of this subspecies, and it seems advisable to further restrict the type locality to the vicinity of Charleston, South Carolina. Since this snake ranges over only a narrow belt of the coastal plain in South Carolina, and since Holbrook is known to have done much of his work at Charleston, the type specimen almost certainly came from that vicinity.

Description of type specimen. According to the original description the type had 233 ventrals and 90 caudals. The total length was 4 feet 5 inches; tail length, 10 inches; head length 1 1/8 inches. The characters of the present specimen, an adult male, are as follows: ventrals, 230; caudals, 90; oculars, 1+2; temporals, 2+3+? and 2+3+2; supralabials, 8-8; infralabials, 11-11; gulars, 4; anal, divided. The dorsal scale formula is as follows:

$$\begin{array}{ccccccccccccc} & 6+7(12) & & +7(45) & & 7+8(116) & & 5+6(128) & & -6(138) & & & \\ 27- & & -25- & & -27- & & -25- & & -23- & & -21- & \\ & 6+7(13) & & +7(48) & & 7+8(121) & & 6+7(127) & & -6(137) & & & \end{array}$$

$$--21-\begin{array}{c} 4+5(166) \\ \\ 4+5(160) \end{array}-19 \quad (230)$$

The body is soft and greatly twisted, making accurate measurement impossible. The body length is ca. 1060 mm.; tail length, 258. The head is crushed. There are 18 maxillary teeth. There is a faint suggestion of blotches anteriorly, the stripes are on scale rows (at midbody) III to V, and X to XII.

Range. From Carteret County, North Carolina, southward along the coast to include all of peninsular Florida except for the northeastern part.

Plate V. *Elaphe obsoleta quadrivittata*.

Upper figure: an individual from Lower Matecumbe Key, Florida.

Lower figure: an individual from the vicinity of Charleston, South Carolina.







## Elaphe obsoleta spiloides (Dumeril, Bibron, and Dumeril)

Elaphis spiloides Dumeril, Bibron, and Dumeril, 1854: 269-70.

Coluber obsoletus confinis (Baird and Girard), Cope, 1875: 39 [non Scotophis confinis Baird and Girard, 1853: 76-77].

Coluber obsoletus lemniscatus Cope, 1888: 386 [partim; non Coluber lemniscatus Linnaeus, 1758: 224].

Coluber obsoletus spiloides (Dumeril, Bibron, and Dumeril), Cope, 1888: 387.

Elaphe obsoleta confinis (Baird and Girard), Stejneger and Barbour, 1917: 83 [non Scotophis confinis Baird and Girard, 1853: 76-77].

Diagnosis. A subspecies of Elaphe obsoleta which retains the blotched pattern in the adult; ground color gray; blotches 25 to 30; temporals usually 2+3+3.

Location of type specimen, and type locality. The type was in the collection of the Museum d'Histoire Naturelle, Paris. Its present status is unknown. The type locality was given as "il provient de la Nouvelle-Orleans."

Description of type specimen. The type was described as possessing the following characters: dorsals (at midbody), 25; ventrals, 234; gulars, 3; anal, divided; caudals, 80; oculars, 1+2. Tooth counts were: maxillary, 16; mandibular, 19; palatine, 10; pterygoid, 19. The body length was 930 mm; tail length, 210; head length, 36. The dorsal blotches were quadrangular, the specific character being the longitudinally ovate

shape of the lateral blotches.

Range. From Tallahassee, Florida, and Macon, Georgia, northwestward to western Tennessee and eastern Arkansas, including the greater part of Alabama and Mississippi, and eastern Louisiana.

## Elaphe obsoleta lindheimeri (Baird and Girard)

Scotophis lindheimeri Baird and Girard, 1853: 74-5.

Coluber obsoletus obsoletus (Say), Cope, 1900: 844-48 [partim; non C. obsoletus Say, 1823: 140].

Coluber obsoletus lindheimeri (Baird and Girard), Brown, 1901: 48.

Elaphe obsoleta lindheimeri (Baird and Girard), Stejneger and Barbour, 1917: 83.

Diagnosis. A subspecies of Elaphe obsoleta in which the juvenile blotches are retained in the adult, but become more or less confluent and are invaded by reddish ground color; blotches, 25-35; temporals, usually 3+3+4 or more.

Location of type specimen, and type locality. The specimen marked "Type of Scotophis lindheimeri Baird and Girard: 74" in the U. S. National Museum (USNM 1733) is almost certainly misidentified as such. It is bleached almost white so that the number of blotches may be made out only with difficulty; this probably partially accounts for the error of identification. It is about the same length as the type (36 + 7 inches) but differs in scutellation, having 218 ventrals rather than 227, supralabials 9-8 rather than 8-8, infralabials 14-13 rather than 12-12. It also differs in the number of dorsal blotches, having about 31 rather than 34. The dorsal scales of the type are described as being smooth to row X, while in the present specimen only the first three rows are smooth.

It appears that Stejneger attempted to identify many of

the older type specimens, which had not previously been marked as types. In the present case he found a specimen from the type locality, collected by the correct person, Dr. F. Lindheimer, which resembled the type in length and some scale counts (i.e., caudals and dorsals). The differences given above, however, are sufficient to demonstrate that he was wrong in assuming this to be the type. This is made further evident by the actual identity of the specimen. It not being an E. obsoleta but instead E. guttata emoryi. Thus the coloration given for the type specimen (Baird and Girard, 1853: 74-5) could not have been obtained from the present specimen. The type of Scotophis lindheimeri Baird and Girard must, therefore, be assumed to be lost.

The paratype, USNM 1734, collected at Indianola, Calhoun County, Texas, by Col. J. D. Graham, appears to be correctly identified and compares favorably with the original description in all respects.

The type locality is New Braunfels, Comel County, Texas.

Description of type specimen. The type was described with the following characters: dorsals (at midbody), 29, outer 10 rows smooth; ventrals, 227; caudals, 81; supralabials, 8; infralabials, 12. There were "about 34" blotches on the body, which were about 15 scales wide. "The entire system of coloration is very difficult to define, the general appearance being that of a black snake with irregular obsolete mottlings of white [in alcohol]." The specimen was 36 inches in length

(total length); the tail 7 inches.

Range. Western coastal Louisiana northwestward to the vicinity of Dallas, Texas, and skirting the edge of the Edwards Plateau southward at least to San Antonio and Corpus Christi.

Plate VI. *Elaphe obsoleta*. A subadult individual from the vicinity of Kerrville, Kerr County, Texas, which shows the numerous blotches (*ca*. 45) and an indication of longitudinal bands which are characteristic of *E. o. lindheimeri* x *bairdi* intergrades.



## Elaphe obsoleta bairdi (Yarrow)

Coluber bairdi Yarrow, in Cope, 1880: 41.

Elaphe bairdi (Yarrow), Stejneger and Barbour, 1917: 82 (listed). Milstead, Mecham, and McClintock, 1950: 554 ("future work may prove Elaphe bairdi to be a western subspecies of Elaphe obsoleta.").

Diagnosis. A subspecies of Elaphe obsoleta commonly possessing nine supralabials, and with more than 45 dorsal body blotches in the young. Adult pattern of four dark longitudinal stripes on a yellowish or reddish ground color and a gray head.

Location of type specimen, and type locality. USNM 10403, collected near Fort Davis, Jeff Davis County, Texas, by William von Manteufel in 1878.

Description of type specimen. A juvenile male in good condition except for a soft spot in the posterior part of the body. It has the following characters: oculars, 1+2; temporals, 2+3+4, and 2+4+4; supralabials, 9-9 (IV and V entering eye), labial VIII apparently split into two; infralabials, 14-13; caudals, 98. There are 53 body blotches and 26 on the tail. The body blotches are each about one and one-half scales in length and extend laterally to dorsal rows IX or XI; the interspaces are about three to three and one-half scales in length. The ventral surface is almost entirely chocolate brown, somewhat mottled with cream anteriorly, and with some cream spots laterally throughout. The head pattern is much broken and the

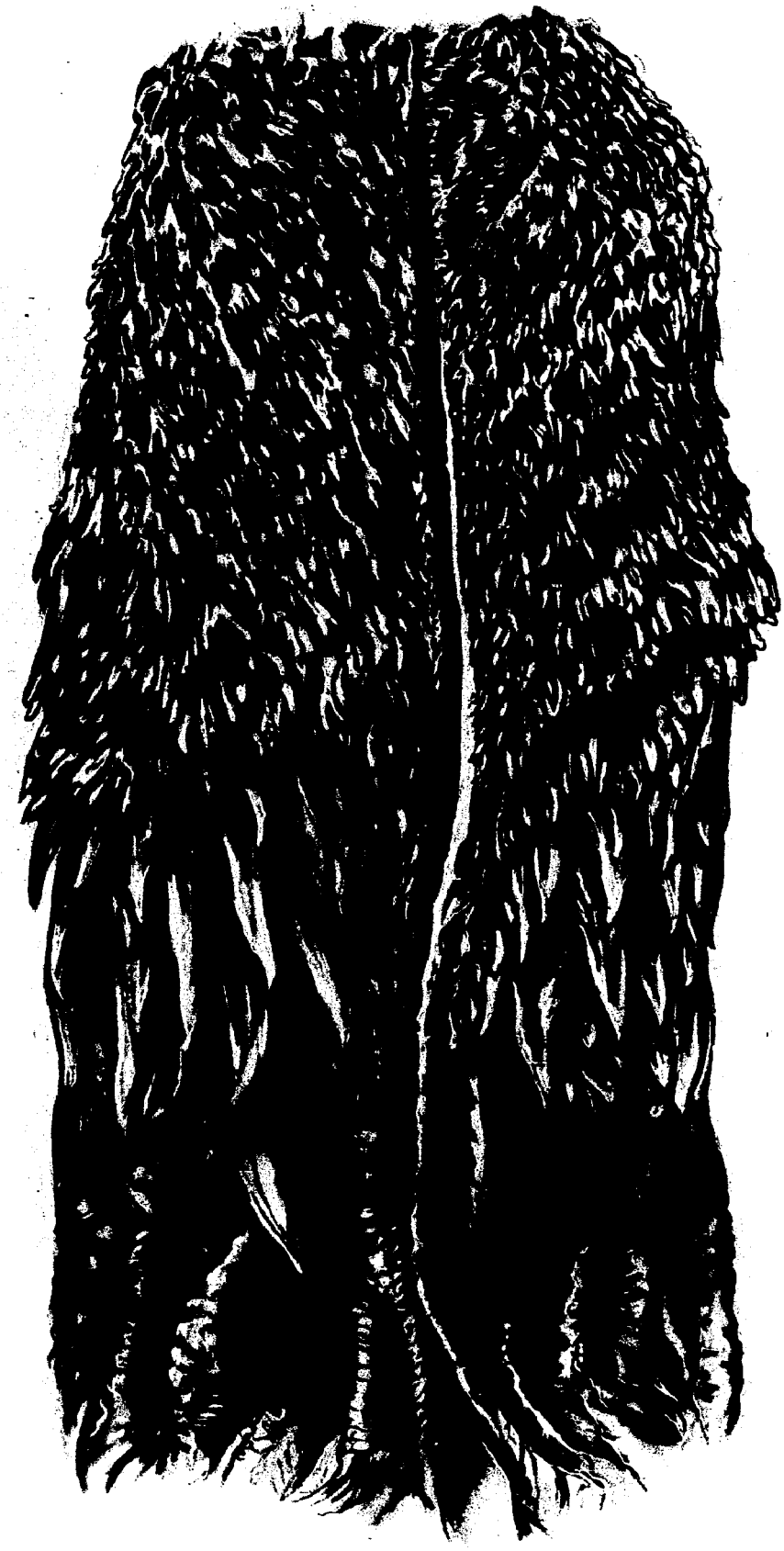
postorbital band is irregular, but ends on the supralabial border. The specimen is quite slender and has a body length of 375 mm.; tail length, 93; head length, 17.9; eye, 3.5. The dorsal scale formula is:

$$\begin{array}{ccccccccccccc} & \frac{6+7(7)}{7+8(6)} & & \frac{+7(99)}{+7(85)} & & \frac{-7(122)}{6+7(116)} & & \frac{5+6(134)}{6+7(135)} & & \frac{6+7(147)}{6+7(151)} & & & \\ 27- & & -25- & & -27- & & -25- & & -23- & & -21- & -21- & -19 \end{array} \quad (238)$$

$$\frac{4+5(175)}{5+6(164)}$$

Range. From the eastern edge of the Edwards Plateau, Texas, westward to the Davis Mountains, and southward at least to the vicinity of Monterrey, Nuevo Leon.

Plate VII. Hemipenis of *Elaphe triaspis chlorosoma*. The presence of two basal hooks and the absence of proximal spinules and distal lobes are characteristic of the Triaspis Section. [Drawn from a dissected and spread hemipenis of UMMZ 80210 by William L. Brudon.]



## THE TRIASPIS SECTION

This section differs from the other two in that only a single species, Elaphe triaspis (Cope), is included. This species, however, differs from others to the same extent that the other two sections differ from one another, and more so than do the species within any one section. Since it shows no approach to any other American species, it is recognized as a separate section.

Definition of the Triaspis Section. Snakes of the genus Elaphe in which the males have a large hemipenis which extends at least to caudal XV, and often to caudal XIX; two large basal hooks; without spines proximally and without lobes distally (Plate VII). There are no lorilabial scales; eight to ten supralabials; usually three elongate primary temporals (fig. 8). There is a large amount of sexual dimorphism in ventral number, the females having 15+ more than the males; total range of ventrals from 241 (male) to 282 (female). The caudals exhibit a similar amount of sexual dimorphism, the males having 13+ more than the females; total range, 87 (female) to 127 (male).

Since the Triaspis Section and the species Elaphe triaspis are equivalent, further discussion will be carried on under the latter name.

### Elaphe triaspis (Cope) 1866

This species ranges from the Santa Rita Mountains of southern Arizona along the edge of the Mexican Plateau, and

southward in the highlands of Central America to Costa Rica. It is also found on the eastern rim of the plateau and in the lowlands of the Yucatan Peninsula. With such an extensive range and variety of habitats, it is not surprising that E. triaspis breaks up into geographic races.

Key to the subspecies of Elaphe triaspis. Although there are average differences in ventral number, number of dorsal blotches, etc., the main distinguishing features between the subspecies are in coloration and pattern. While preserved specimens do not always exhibit these characters to the best advantage, they are, nevertheless, the only ones by which individuals may be allocated to their correct subspecies (for other characters of use in identification, see Table VI).

1 Dorsal pattern present, made up of 42 to 70 rectangular blotches, some of which may be connected in a zig-zag fashion. . . . . 2

1' Dorsal surface unicolor . . . . . 4

2 (1) Head pattern with a median frontoparietal band which has a small round opening at about the middle of the parietal suture (Figure 9a). . . . . E. t. triaspis

2' Opening of the frontoparietal band elongate, and extending forward to near the anterior edge of the parietals; often broken at the posterior edge of the frontal (Figures 9b, c) . . . . . 3

3 (2') Dorsal blotches brownish, tending to blend with ground color. Body + tail blotches less than 80 . . . . . E. t. mutabilis (juv.)

3' Dorsal blotches black, or at least black-edged. Body + tail blotches more than 80. . . . . E. t. chlorosoma (juv.)

4 (1') Dorsal coloration brownish (light tan in alcohol). . . . . E. t. mutabilis

4' Dorsal coloration green (olive to slate-gray in alcohol) . . . . . E. t. chlorosoma

Figure 8. Lateral view of the head of a juvenile specimen of Elaphe t. triaspis. The three elongate primary temporals are characteristic of this specimen.



Map 5. Geographic distribution of the subspecies of *Elaphe triaspis*.

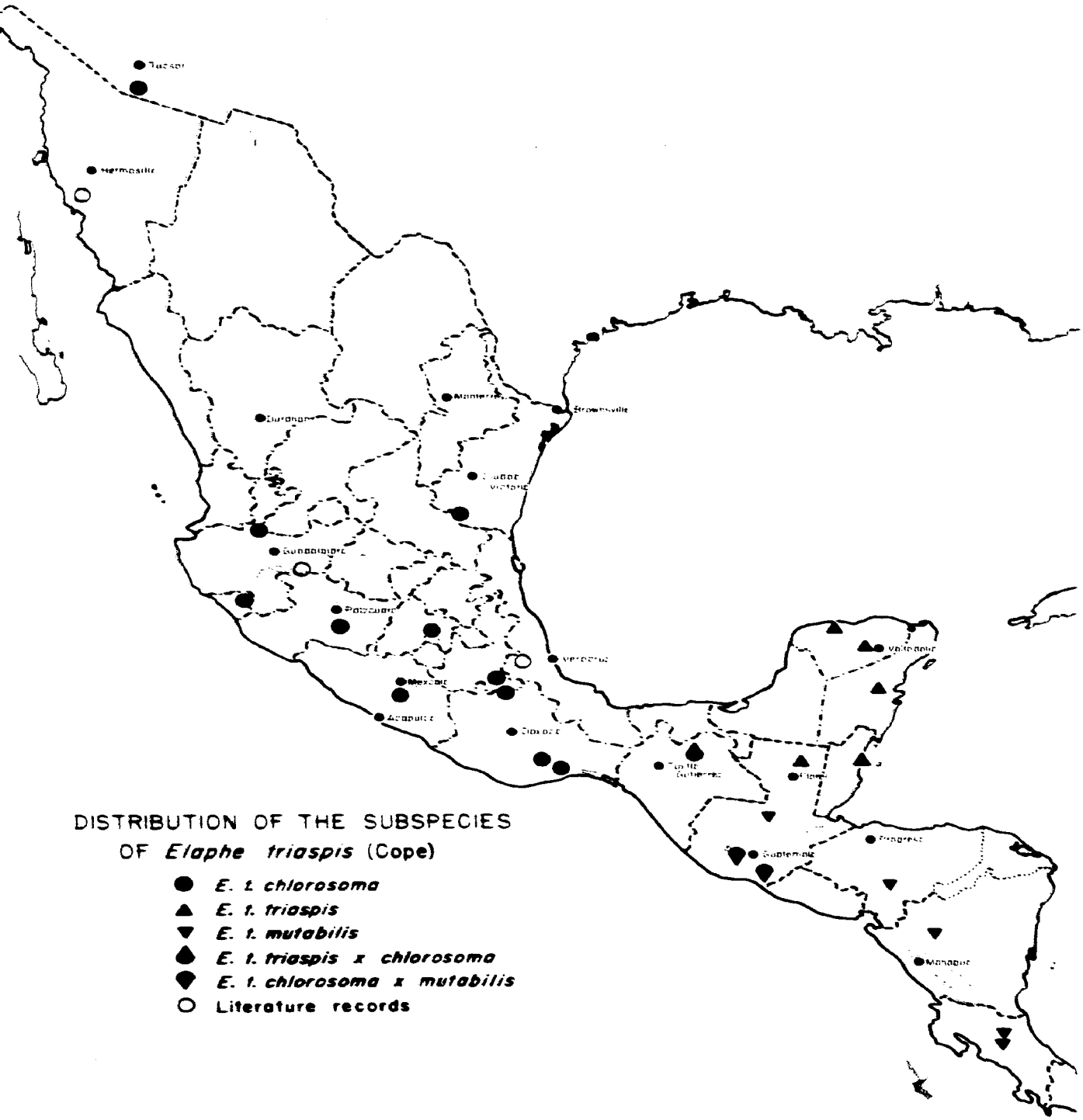

DISTRIBUTION OF THE SUBSPECIES
OF *Elaphe triaspis* (Cope)
*E. t. chlorosoma*
*E. t. triaspis*
*E. t. mutabilis*
*E. t. triaspis x chlorosoma*
*E. t. chlorosoma x mutabilis*
Literature records

TABLE VI

VARIATION IN ELAPHE TRIASPIS

| | | Ventrals | Caudals | Supra-labials | Infra-labials | Max. teeth | Body Blotches | Tail Blotches |
|---|---|---|---|---|---|---|---|---|
| E. t. triaspis | ♂♂ | 253.77(247-62) | 106.54(100-12) | 16(4)<br>17(5)<br>18(3)<br>19(2) | 20(2)<br>21(3)<br>22(9) | 21(5)<br>22(4)<br>23(2)<br>24(1) | 48.80(42-52) | 26.64(23-31 |
| | ♀♀ | 269.87(261-81) | 96.90(87-97) | 16(4)<br>17(6)<br>18(7)<br>19(1)<br>20(1) | 21(3)<br>22(11) | 21(6)<br>22(6) | 48.86(43-57) | 19.50(17-22) |
| E. t. mutabilis | ♂♂ | 255.00(249-64) | 111.83(107-15) | 16(6)<br>17(2)<br>18(1) | 20(1)<br>22(6)<br>24(1) | 21(2)<br>22(3)<br>23(2) | 51.80(50-56) | 24.50(20-27) |
| | ♀♀ | 280.33(279-82) | 103.66(100-10) | 16(3) | 22(3) | 24(1) | 45.00 | 19.00 |
| E. t. chlorosoma | ♂♂ | 250.50(241-60) | 118.14(108-27) | 16(9)<br>17(5)<br>18(1) | 20(2)<br>21(3)<br>22(10) | 21(8)<br>22(4) | 56.00(55-57) | 36.66(25-44) |
| | ♀♀ | 268.25(261-79) | 95.60(89-105) | 16(8)<br>17(8)<br>18(1) | 19(1)<br>20(1)<br>21(3)<br>22(8)<br>23(3) | 19(2)<br>20(1)<br>21(4)<br>22(3) | 62.33(56-70) | 27.40(25-30) |

## General Description

The known specimens of this species total less than one hundred, and there is not an adequate sample from any one locality. However, several small series are available and give some information on the variation within the species.

The northernmost subspecies, E. triaspis chlorosoma, ranges from southern Arizona and central Tamaulipas southward to eastern Chiapas and southern Guatemala where it intergrades with the other two races (Map 5). E. triaspis mutabilis ranges from central Guatemala southward in the highlands to Costa Rica. E. t. triaspis is found in the lowlands of the Yucatan Peninsula.

No general survey of the species has previously been attempted and in most general and faunal works only two forms, E. triaspis and E. chlorosoma, are recognized, and they are accorded full specific rank. Stuart (1948: 68-70) appears to have been the only worker to recognize their true relationships.

Size and proportions. The members of all three subspecies appear to be snakes of medium size, although the small number of adults known may give an erroneous impression. In each subspecies the largest specimens are females and they seem to attain a considerably greater length than the males. The largest male specimen, an E. t. chlorosoma (AMNH 65891), has a body length of 902 mm. and a tail length of 311 mm. Comparable measurements on the largest female specimen (UMMZ 99893) are about 980 mm. and 242 mm. The above male is the

only one with a length of 900 mm. or more, most of them being between 600 and 800 mm. in body length. On the other hand over one-third of the adult females exceed 900 mm. in body length.

The body proportions, also, are similar in the three subspecies, although the typical subspecies has a slightly shorter tail than the others. The general habitus is that of an elongate, cylindrical snake, with a narrow head, a rather pointed snout, and a long tapering tail. The ventrals are distinctly angulated laterally. The eye is small (M = ca. 13.5 per cent of head length in adults), and this together with the body proportions and small scales gives the snake a distinctly bold appearance which is accentuated by its narrow head. The head is rather long and makes up three to four per cent of the body length in adults, and an even greater proportion in the young. The tail length shows a considerable degree of sexual dimorphism and ranges from 23 to 26 per cent of body length in adult females up to 30 to 35 per cent in males. The juveniles have shorter tails than the adult members of their sex; the juvenile females range upward from 19 per cent and the males from 25 per cent.

Hemipenis. As indicated in the diagnosis, the hemipenis is distinctive in this species, and many of its features are found in no other form of North American Elaphe. Although strict measurement is not possibl in such an extensile organ, it is considerably larger than those of snakes of

comparable size in other sections of the genus, ranging between caudals XV and XIX.

Unfortunately, no completely extruded hemipenis of this species are avilable so the inverted hemipenis of an adult male (body length = 726 mm.) from the city of Colima, Colima (UMMZ 80210), was split longitudinally and spread flat and is used for the description which follows.

The hemipenis (Plate VII) extends to caudal XV. The proximal one-fifth of the organ has neither spines nor calyces; it is folded and somewhat rugose, but this may be due to the preservation. At the distal end of the naked area are a pair of large straight fleshy spines (basal hooks), one on either side of the sulcus. Distal to these are three or four rows of similar, but smaller spines which decrease rapidly in length and disappear on the proximal half of the organ. The spines are replaced distally by 21 or 22 oblique rows of papilose calyces which decrease in size distally, but apparently continue to the end of the organ. The calyces are lozenge-shaped and each of the four sides has from three to five stiff papillae. The lips of the sulcus are not conspicuously raised and have no special ornamentation, being calyculate distally also.

Skull and teeth. A single skull of this species is available, that of an adult E. t. chlorosoma from near Tehuantepec, Oaxaca (UMMZ S-1082). It differs from the skulls of other species of American Elaphe mainly in that the anterolateral edges of the nasals are extended forward and outward, giving

the nasal bones a quadrangular appearance rather than a rounded one. The tooth counts are: maxillary, 21-21; mandibular, 26-26; palatine, 12-11; pterygoid, 19-18. The teeth decrease in length toward the posterior end of the bones.

The maxillary counts of other specimens show very little variation, and no obvious sexual or geographic differences (Table VII).

Scutellation. These snakes have large numbers of ventrals, caudals, and dorsals, but have no distinctive features of scutellation to separate them from certain members of other sections of the genus. One characteristic which is found in E. triaspis that seldom appears in other species is the presence of three elongate primary temporals. These scutes slant downward anteriorly and often one of them is excluded at the anterior end, giving a strict temporal count of two, although the third one is present farther back.

TABLE VII

VARIATION IN THE NUMBER OF MAXILLARY TEETH IN *ELAPHE TRIASPIS*

| | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|
| Chilpancingo | | | 5 | 3 | | |
| Tehuantepec | | | 6 | 2 | | |
| Total *E. t. chlorosoma* | 2 | 1 | 12 | 7 | | |
| Chichen Itza | | | 8 | 10 | 1 | 1 |
| Total *E. t. triaspis* | | | 11 | 10 | 2 | 1 |
| Total *E. t. mutabilis* | | | 2 | 3 | 2 | 1 |

## Sexual Dimorphism

The number of snakes is too few from any one locality to demonstrate any possible sexual dimorphism in characters with little variation, such as labials, temporals, maxillary teeth, etc. Certain characters, however, vary to an observable extent even in small series; ventrals, caudals, dorsals, and proportionate tail length being in this category. The species is too wide-ranging and variable to consolidate and make general statements concerning the extent of this variation but examples to demonstrate its presence are given below.

Ventrals. The sexual dimorphism in ventrals in Elaphe triaspis is greater than in any of the other American members of the genus. In the Chichen Itza series of E. t. triaspis (22 specimens), the ventrals have a mean of 253.40 ± 1.45 in males and 268.83 ± 1.06 in females; a difference of 15.43 ventrals. An even greater difference is shown by the smaller series (13 specimens) of E. t. chlorosoma from Chilpancingo. In this series the males have a mean ventral number of 244.33 ± 0.95 and the females of 264.00 ± 1.83; a difference of 19.67 ventrals. As indicated by the standard errors, some of these means may be in error to the extent of five ventrals but even so there is considerable sexual dimorphism. This is in contrast to the situation in E. subocularis, of the Rosaliae Section in which no sexual dimorphism in ventrals can be demonstrated with the series at hand, and in which such dimorphism, if present, cannot exceed about

two ventrals.

Caudals. Sexual dimorphism in caudals is not an unusual character in snakes, but is usually more pronounced in short-tailed species. However, this type of dimorphism in E. triaspis, a long-tailed species, is only slightly less pronounced (if at all) than the difference in ventral number. The Chichen Itza series, the only one with sufficient specimens with complete tails for statistical treatment, shows a difference of 13.24 caudals between the sexes; the males having a mean of 106.80 ± 1.41 and the females having 93.56 ± 1.11. Specimens from other areas also show a consistent difference between the sexes, with little or no overlap. In the Chilpancingo series, for example, the males range from 108 to 111, and the females from 89 to 93.

Dorsals. These snakes have a large number of dorsal scales (29 or more at midbody) and there is great individual variation. The females tend to have a greater number of dorsals than the males (Table VIII).

Proportionate tail length. This measurement is difficult to use due to the ontogenetic and geographic variation which occurs in addition to the sexual dimorphism. Also a large proportion of the snakes have incomplete tails, or broken or twisted bodies which makes accurate measurement impossible. Nevertheless, the sexual dimorphism is great enough so that the few specimens available are sufficient to indicate its

## TABLE VIII

## VARIATION IN DORSAL SCALES OF *ELAPHE TRIASPIS*[1)]

| | Anterior Count | | | | | | Midbody Count | | | | | | Posterior Count | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23 | 25 | 27 | 29 | 31 | 33 | 29 | 31 | 33 | 35 | 37 | 39 | 17 | 19 | 21 | 23 | 25 |
| Chichen Itza | | | | | | | | | | | | | | | | | |
| Males | | | | 9 | 1 | | | | 7 | 3 | | | | | 9 | 1 | |
| Females | | | | 2 | 9 | 1 | | | 1 | 5 | 5 | 1 | | | | 11 | 1 |
| Chilpancingo | | | | | | | | | | | | | | | | | |
| Males | | | 2 | 3 | | | | 1 | 3 | 1 | | | | 1 | 4 | | |
| Females | | | 1 | 3 | 2 | 1 | | | 2 | 4 | 1 | | | | 3 | 4 | |
| Tehuantepec | | | | | | | | | | | | | | | | | |
| Males | | | 2 | 4 | | | | | 6 | | | | | | 6 | | |
| Females | | | | 2 | 1 | | | | | 2 | 1 | | | | 1 | 2 | |
| *E. t. mutabilis* | | | | | | | | | | | | | | | | | |
| Males | 1 | 1 | 5 | 1 | | | 1 | 3 | 4 | | | | | | 8 | | |
| Females | | | 2 | 1 | | | | 1 | 1 | 1 | | | | | 1 | 2 | |

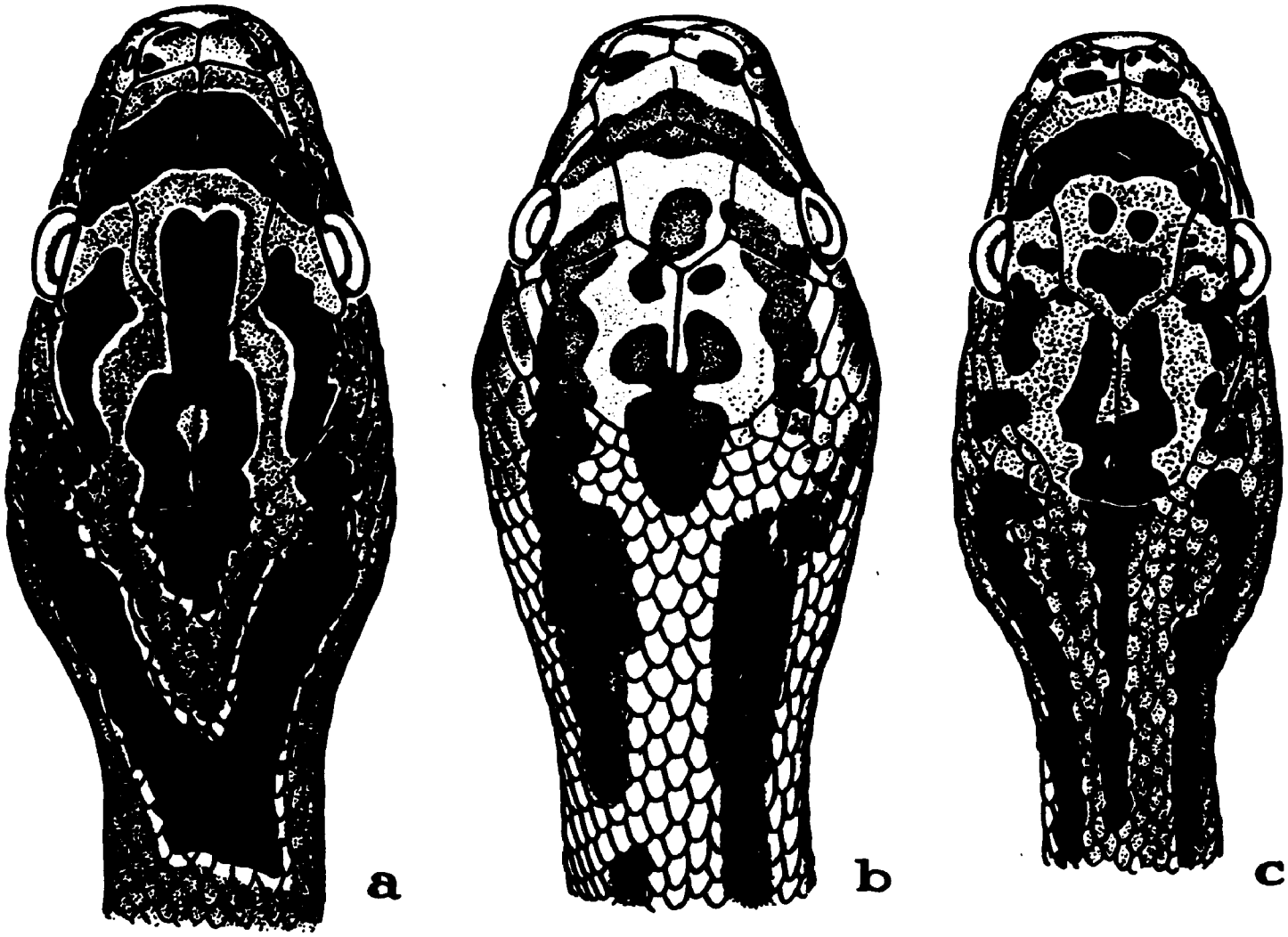
[1)] In this table an even number of scales around the body is given as the next higher odd number (i.e., a scale count of 28 is given as 29).

presence, if not its extent.

The Chilpancingo series has nine measurable specimens (four males and five females). The males show an average proportional tail length (tail length/body length) of 30.34 per cent, with a range of 26.28 to 32.18. The females have a mean of 21.60 and a range of 18.85 to 23.62.

The Chichen Itza series has 16 measurable specimens (9 males and 7 females). The males have a mean proportional tail length of 26.61 and an observed range of 24.65 to 29.49; the females a mean of 22.41 and an observed range of 21.07 to 23.89. The apparently lesser dimorphism in the Chichen Itza series may be in fact, a difference between the two subspecies represented. However, it may also be due (at least in part) to a greater number of juvenile specimens in this series, since juveniles have a smaller proportional tail length than do the adults.

Figure 9. Juvenile head patterns in the three subspecies of Elaphe triaspis. a, E. t. triaspis; b, E. t. mutabilis; c, E. t. chlorosoma. Note the extent and configuration of the median fronto-parietal band, especially of the opening in its center.


a
b
c

## Elaphe triaspis triaspis (Cope)

Coluber triaspis Cope, 1866: 128 (original description; "Belize"). Günther, 1894: 115. Boulenger, 1894: 37 (description).

Natrix triaspis, Cope, 1887: 71.

Elaphe triaspis (Cope), Amaral, 1929: 159. Schmidt and Andrews, 1936: 172-73. Andrews, 1937: 358. Smith and Taylor, 1945: 60-61 (range in Mexico). Smith, 1941: 134, [part] (synonymizes C. mutabilis Cope, 1885). Schmidt, 1941: 500. Smith, 1943: 427. Smith and Taylor, 1950: 316 (restrict type locality to city of Belize, British Honduras).

Diagnosis. A subspecies of Elaphe triaspis which is characterized by a median frontoparietal band which has a small round light spot at about the middle of the parietal suture (Figure 9a) , and which retains the pattern of blotches throughout life.

Location of type specimen, and type locality. The type specimen (USNM 24903) was collected at "Belize" by Dr. Parsons. He is not known to have done any collecting in British Honduras except in the vicinity of the town of that name, and the specimen was probably collected there. For this reason the restriction of the type locality to the vicinity of the town of Belize, British Honduras (by Smith and Taylor, 1950: 316) is considered valid.

Description of type specimen. The type specimen of Coluber triaspis Cope is a juvenile male. It possesses the following characters: head scutes normal, except left loreal divided into three; right into two. The oculars are 1+3 on the left side; 1+2 on the right. The temporals are 3+4+5 and 3+4+6; supralabials, 8-8; infralabials, 11-10; gulars, 4. The dorsal scale count is 29+35+21; ventrals, 260; caudals, 109. All dorsal rows are smooth at midbody; the nine middorsal rows are faintly keeled above the anus. There are 50 dorsal blotches, and 30± on the tail. The body is almost cut in two anteriorly, making an exact measurement impossible. The body length is about 359 mm.; tail length, 95; head length, 18.3; eye, 2.6 mm.

Description of subspecies. There are now about 35 specimens of this race known, of which 30, representing five localities on the Yucatan Peninsula have been available to me. The following description is drawn from a study of these specimens.

These snakes appear to be the smallest of the three races. The largest individual studied is a female (AMNH 38844) with a body length of 912 mm. The three next smaller specimens are also females, and the largest male (UMMZ 68235) is only 790 mm. in body length. It should be pointed out, however, that the majority of specimens seen are juveniles, and the small number of adults may give an erroneous impression of the maximum size. The tail length in males ranges from 24.6 to 29.5 per cent, with a mean of about 27 per cent. In females the proportional tail length is less, ranging from 21.1 to

23.9 per cent, with a mean about 22.5 per cent. The head is rather long (ca. 4.5 per cent of body length) and narrow, with a small eye (ca. 13 per cent of head length).

The ground color (in alcohol) is a light brown, and there is a dorsal series of 43 to 57 dark-brown, dark-edged, rectangular blotches which average three to four scales in length and extend laterally to dorsal rows X or XI. A lateral row of roundish spots alternates with the dorsal series, and in many individuals there is a third, ventrolateral row alternating with the lateral series. In most adults, however, the edges of the ventrals lateral to the angle are almost uniform gray. Ventrally, median to the ventrolateral angle of the scutes, the surface is immaculate cream or mottled with gray posteriorly (especially so in older individuals). The head pattern of these snakes may be distinguished from those of the other two subspecies by the appearance of the median frontoparietal band. In the present form this band has a round opening at about the middle of the parietal suture, while in the others this opening is elongate and extends forward to the posterior end of the frontal.

The dorsal scales are weakly keeled above scale rows XI to XVI in adult snakes but may be entirely smooth at midbody in juvenile individuals. Even the smallest specimens, however, have the seven middorsal rows over the anus keeled. The number of dorsal rows is highly variable, ranging from 29+33+21, in almost every combination, to 33+39+23. The rows almost always occur in odd numbers, a single individual

in which the dorsal row IX was added on the left side, but not on the right, has a scale count of 31+36+23. A detailed scale formula is given below for a typical male individual from Chichen Itza, Yucatan (UMMZ 68235).

```
   7+8(12)    +7(52)    +8(92)    -7(142)     -7(153)
31---------29--------31--------33----------31---------29--
    -7(12)    +7(52)    +8(93)    7+8(143)    -7(152)

     5+6(160)    -6(172)    4+5(204)    4+5(244)
--29----------27---------25----------23----------21  (256)
     5+6(159)    -6(173)     -4(200)     -5(244)
```

The ventrals range from 247 to 262 in males (M = 254) and from 261 to 282 in females (M = 270). The caudals show a similar amount of sexual dimorphism, and range from 100 to 112 in males (M = 106.5), and from 87 to 97 in females (M = 93) (Table VI). The anal is divided in all specimens.

## Elaphe triaspis mutabilis (Cope)

Coluber triaspis Cope, Cope, 1879: 271 (listed; "the plateau near San Jose," Costa Rica) [non. C. triaspis Cope, 1866: 128 ].

Coluber mutabilis Cope, 1885: 175-76 (original description; "Vera Paz," Guatemala).

Natrix mutabilis (Cope), Cope, 1887: 71 (listed).

Scotophis mutabilis (Cope), Bocourt, 1888: 680-82, pl. 46, figs. 2-2f [part] (description; Vera Paz, Guatemala).

Coluber mutabilis Cope, 1900: 855-57 [part] (description).

Elaphe triaspis (Cope), Smith, 1941: 134 (C. mutabilis Cope, 1885 a synonym of C. triaspis Cope, 1866) [non C. triaspis Cope, 1866] .

Elaphe triaspis mutabilis (Cope), Stuart, 1948: 68-70 (description, relationships).

Diagnosis. A subspecies of Elaphe triaspis which is characterized by the median frontoparietal band (in the young) being broken at the posterior end of the frontal (Figure 9b); fewer than 80 total (body + tail) blotches; adults uniform light brown dorsally.

Location of type specimens, and type locality. The holotype is USNM 6745 (not 6735, as given in the original description), collected in "Vera Paz," Guatemala, by Henry Hague. The paratypes are USNM 24729-30 and 61066, also from Vera Paz, and USNM 9777, from "Costa Rica" according to the catalogue of the U. S. National Museum, but with the more precise "Plateau near

San Jose," (nec. Cope, 1879: 271). Also included in the type series were two other specimens, a Sumichrast specimen from the "Central or elevated part of the State of Tehuantepec," and a specimen from "Guanajuato" in the Duges collection. Neither of these specimens is available (the Duges specimen now in the U. S. National Museum, USNM 11354, may be the same), but both fall into the geographic range of E. triaspis chlorosoma and should be removed from the list of type specimens.

Although the exact provenience of the "Vera Paz" specimens cannot be demonstrated, there is good reason to believe (Stuart, 1948: 10) that they were collected from the Caribbean slope of the highlands, north of Coban (? between Coban and Chisec), Alta Verapaz.

Description of holotype. An adult female with the following characters: oculars, 1+2; temporals, 2+3+5; supralabials, 8-8 (IV and V in contact with the ocular); infralabials, 11-11; gulars, 4. The dorsal scale count is 29+35+23 (see full formula below); ventrals, 282; caudals, 110. The first 12 lateral rows of dorsals are smooth, the remainder faintly keeled. The dorsal coloration has faded to a uniform light yellowish tan (Probably originally light brown) but the head pattern is visible and shows the characteristic (Figure 9b) broken median frontoparietal band. The body is twisted, but is about 900 mm. in length; tail length, 241; head length, 30.3; eye, 4.0.

Description of subspecies. There are eleven specimens available of this form, representing five localities ranging from Guatemala to Costa Rica. With such a small number of specimens of

a form which differs only slightly in scale counts from its northern relative (E. triaspis chlorosoma), I would probably not consider this race sufficiently defined for taxonomic recognition were it not for the fact that its name antedates the better known E. t. chlorosoma. Since there does appear to be a difference in adult coloration, and since the young have a lower number of body and tail blotches, this solution of the problem may be upheld by the inference that more material will make possible a better definition.

The body form is slender and elongate, as in E. triaspis chlorosoma. Little idea of maximum size may be obtained; the holotype female is the largest specimen known (body length ca. 900 mm.) The largest male (USNM 9777) has a body length of 795 and a tail length of 250 mm. The proportions are similar to those of E. t. chlorosoma: proportionate tail length in five males ranges from 26.76 to 31.45 per cent (M = 28.41), and 22.68 and 24.86 in the two females. The head is elongate and averages about 4 per cent of body length in adults, and 5 to 6 per cent in juveniles. The eye is small, but apparently somewhat larger than in the typical subspecies, averaging about 13.5 per cent of head length in adults.

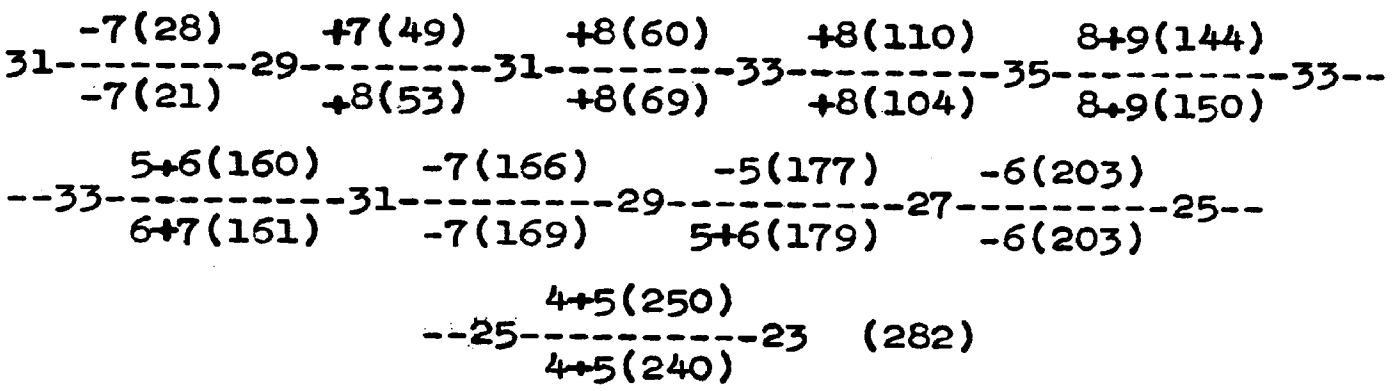
The ground color is lighter than that of E. t. triaspis and fades to a very light tan or yellowish-white in preservative. The adults are unicolor dorsally, and immaculate light cream below, but many retain a trace of the dorsal head pattern.

The young have well developed blotches as well as a distinctive head pattern. The blotches are present in about the same numbers as in E. t. triaspis but differ in being a rather dilute brown with narrow black edges, rather than the dark brown or black blotches in the young of the latter. The blotches have begun to fade in a male 564 mm. long, and are so faintly indicated that they cannot be counted in a male with a body length of 638. There is a single lateral series of smaller spots alternating with the dorsal row. The head pattern is basically the same as in E. t. triaspis but differs in that the opening of the median frontoparietal band extends forward to the posterior end of the frontal, and the band (in all specimens examined) is broken at that point (Figure 9b).

The juvenile pattern of blotches is shown by six specimens. The single female has 45 dorsal body blotches, while the males range from 50 to 56 (M = 51.80). This may not actually be an indication of sexual dimorphism in blotches, and more material is needed to demonstrate the true situation. When the body and tail blotches are added, the variation is between 64 and 78.

The dorsal scales are even less keeled than in the typical subspecies. In most adults they are keeled dorsal to row XIII, but all are smooth at midbody in some. At least the five middorsal rows over the anus show some sign of keeling. The variation in dorsal scale counts was shown previously (Table VIII). The full scale formula is given below for a

typical female specimen (USNM 6745, holotype).




The ventrals show considerable sexual dimorphism, as in the other subspecies; the eight males range from 249 to 264 (M = 255.00) and the three females from 279 to 282 (M = 280.33). The extent of the dimorphism (25 ventrals) is probably erroneous due to the small sample, but its presence cannot be doubted. The caudals show less dimorphism, but the samples are even smaller; the six males range from 107 to 115 (M = 111.83) and the three females from 100 to 110 (M = 103.66). The anal is divided in all specimens.

The variation in maxillary teeth is presented elsewhere (Table VII).

## Elaphe triaspis chlorosoma (Günther)

[?] Pityophis intermedius Boettger, 1883: 148 (original description, type in Heidelberg Museum; type locality, "Mexico").

Coluber chlorosoma Günther, 1894: 115-16, pl. 41 (original description; type localities, Atoyac, Veracruz; Amula, Guerrero; San Ramon, [Jalisco]). Boulenger, 1894: 38 (description).

Elaphe chlorosoma (Günther), Stone, 1911: 231 (range extension; Santa Rita Mountains, Arizona). Stejneger and Barbour, 1917: 82 (listed). Van Denburgh, 1922: 700-01 (description). Taylor, 1939: 461 (description, new localities; El Sabino, Uruapan, Michoacan; near Chapala, Jalisco). Taylor and Knoblock, 1940: 129 [?] (listed; Moguarichic, Chihuahua). Smith, 1941: 134-35 (identification of young); 1943: 426 (new localities; Tres Cruces, Oaxaca; and [?] Guanajuato). Stejneger and Barbour, 1943: 137 (listed). Smith and Taylor, 1945: 59 (range in Mexico). Taylor, 1949: 170 [?] (listed, San Luis Potosi). Smith and Taylor, 1950: 334 (listed).

Elaphe mutabilis (Cope), Taylor, 1939: 459-60 (description of juvenile; El Sabino, Uruapan, Michoacan).

Elaphe triaspis (Cope), Smith, 1943: 427 (listed; Chilon, Chiapas).

Diagnosis. A subspecies of Elaphe triaspis in which the juveniles have more than 80 total (body + tail) dorsal

blotches, and have a median frontoparietal band with the central opening extending forward to the posterior end of the frontal scute (Figure 9c). The adults are green dorsally (bluish or gray in alcohol).

Location of type specimens, and type locality. The three cotypes of Coluber chlorosoma Günther are in the collection of the British Museum (Natural History). One of them is from Atoyac, Veracruz (vide infra), one from Amula, Guerrero, and the third (head and anterior body only) from San Ramon, Jalisco.

The primary specimen was recorded from Atoyac, Veracruz, in the original description, but given as Atoyac, Guerrero, in Boulenger (1894: 38), and the latter locality is that usually given by recent authors. I have been unable to find any reason for this change (there are villages named Atoyac in both states), and Kellogg (1932: 13) also found that Herbert H. Smith (the collector of the questionable specimen) collected amphibians at "Atoyac in Vera Cruz, [etc.]." Unless some reason is found to contradict these statements, it seems preferable to consider the "Atoyac" of H. H. Smith to be in the state of Veracruz.

Description of type specimens. These specimens have not been available for this study and the following is drawn from the original description (Günther, 1894: 115-16, pl. 41) and from Boulenger (1894: 38), who examined the type specimens.

The dorsals are 33 in all specimens. The male from Atoyac (Boulenger's specimen "a") has 260 ventrals

and an incomplete tail; specimen "b" (Amula), also a male, has 247 ventrals and 112 caudals; specimen "c" (San Ramon) is incomplete. These are the only separate counts available.

Assuming that the sex determination and ventral count of the Atoyac specimen are correct, it appears even more likely that it did not come from Guerrero. The males available from that state (six from Chilpancingo) have a mean ventral number of 244.33 ± 0.95, and an observed range of 241 to 248. As indicated by the standard deviation (2.34 ± 0.67) it is extremely unlikely that a ventral number of 260 would appear in the population. The possibility should not be overlooked, however, that the snakes along the coast (at Atoyac, Guerrero) may belong to a different population which has a higher ventral count.

Description of subspecies. There are two small series of this subspecies available, besides other scattered specimens. The total number of specimens studied is 35 and there are about ten others recorded in the literature which have not been seen.

The body is long and slender, with perhaps a longer tail than either of the other two forms. There are more large specimens known of this subspecies, which may indicate a larger adult size, or merely a greater number of known adult specimens. The largest specimen which may be measured with any accuracy is a female (MCZ 42656) with a body length of 957 mm. and a tail length of 226 mm. An even larger speci-

men (UMMZ 99893), a female which is so twisted as to make accurate measurement impossible, has a body length of about 980 and a tail length of 242 mm. The largest male has a body length of 902 mm. and a tail length of 311 mm. The proportionate tail length in 11 males ranges from 26.28 to 35.40, with a mean of 31.59; in 8 females from 18.85 to 25.17, with a mean of 22.22. The head averages about 3.7 per cent of body length in adults; and the eye is small, about 14 per cent of the head length.

The adult coloration is uniform green dorsally, and only upon close examination is it seen that the bases of most scales are black, and many have one or two tiny dashes of white along their edges. The dorsal coloration extends onto the lateral edges of the ventrals, ending at the angle. The green fades to olive, bluish-gray, or gray in alcohol. The ventral surface is light (yellowish ?) with a faint mottling of gray posteriorly.

The juvenile coloration is much like that of E. t. triaspis. The dorsal blotches are smaller and more numerous (55 to 70) and when added to the tail blotches range from 80 to 101, with a mean (in nine specimens) of 90.4. These blotches are black-edged with light centers, the latter sometimes little darker than the ground color. The head pattern differs from that of the typical subspecies in that the opening in the median frontoparietal band extends forward to the posterior end of the frontal scute, and the band is often broken at this point.

The dorsal scales are smooth at midbody in juvenile specimens, and in some adults. Most adults, however, have the rows above XIV or XVI weakly keeled, and even the juveniles have the median five to seven rows over the anus keeled to some degree. The variation in the number of dorsal rows has already been given (Table VIII). A typical scale formula for this subspecies is the following, which is taken from an adult male (UMMZ 82570) from near Tehuantepec, Oaxaca.

```
                  +7(57)    +8(85)    6+7(140)   -7(146)
30---------29--------31--------33----------31---------29--
    6+7(9)     +7(55)    +8(86)    6+7(139)   -7(146)

      4+5(152)     5+6(160)     4+5(188)     4+5(237)
--29-----------27-----------25-----------23-----------21   (251)
      5+6(153)     6+7(161)     4+5(194)     5+6(233)
```

The ventrals vary from 241 to 260 in males and from 256 to 279 in females. The caudals vary from 108 to 127 in males and from 89 to 105 in females (Table VI).

Plate VIII. Hemipenis of Elaphe subocularis. The presence of proximal spinules and the absence of basal hooks and distal lobes are characteristic of the Rosaliae Section.



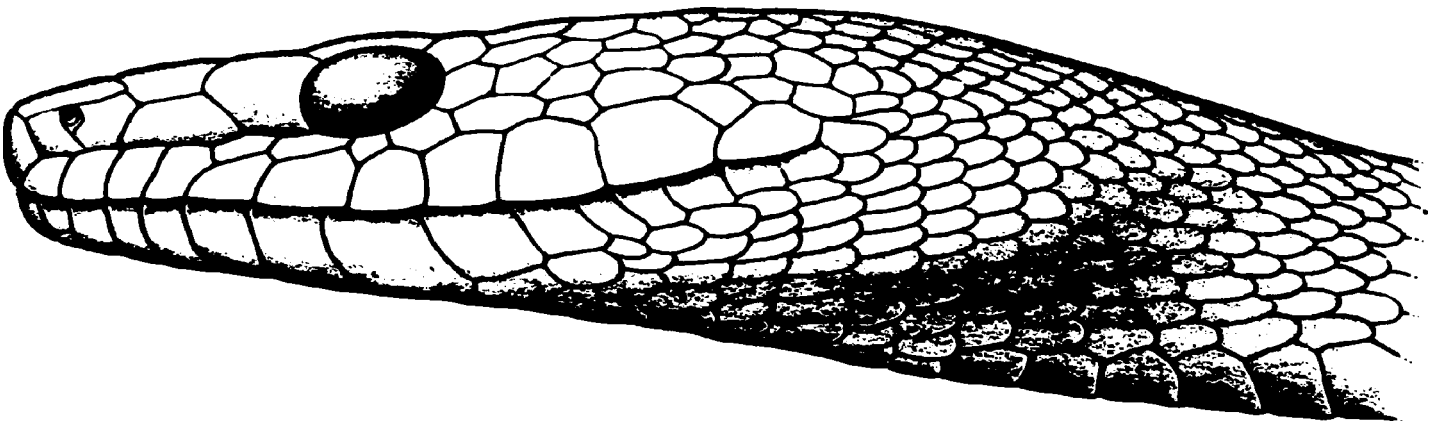
## THE ROSALIAE SECTION

The present section is the smallest, least known, and most highly specialized of the three sections of the genus. The two species which are included are Elaphe rosaliae (Mocquard), which is found in southern Baja California, and E. subocularis (Brown), which ranges through Coahuila, western Texas, and southern New Mexico (Map 6). The known specimens of both species total less than 50 and no comprehensive work has been done on them since their original descriptions some fifty years ago.

Definition of the Rosaliae Section. Snakes of the genus Elaphe with a small hemipenis which extends to the ninth or tenth caudal in the inverted position, without basal hooks or distal lobes, and with the proximal portion covered with very fine spinules (Plate VIII). There is a lorilabial row of three to six scales, and ten or eleven supralabials (Figure 10). The ventrals range from 260 (E. subocularis) to 286 (E. rosaliae); the caudals from 69 (E. subocularis) to 89 (E. rosaliae). There is no appreciable sexual dimorphism in any character of scutellation or pattern, although it may exist to a slight degree.

Key to the species. The following key will identify correctly all known specimens of this section of Elaphe. However, it appears possible that intermediate individuals may be found in the large and almost unknown area between the known ranges of these forms (Map 6), and that these specimens may not be correctly allocated by the key. Also, since the young of E.

Figure 10. Lateral view of the head of Elaphe rosaliae, showing the large number of supralabials and the presence of the lorilabial row of scales.



rosaliae are not known, it may be that they are unlike the adults in having a pattern (as occurs in other species) and this would preclude the use of this character in the key. However, they may be identified by the large number of ventrals and caudals.

1 No dorsal pattern; five, or fewer dorsal rows keeled at midbody. . . . . E. rosaliae

1' Dorsal pattern of distinct, dark, H-shaped blotches; seven or more dorsal rows keeled . . . . . .E. subocularis

Relationships. The two species included in this section differ from all other American species of Elaphe in the type of hemipenis and in the presence of a lorilabial row of scales. They also differ in a number of quantitative characters from most other forms, although this is not necessarily an indication of more distant relationship. They have more labials, usually ten or eleven in contrast to the usual eight or nine (a number as great as ten occurs in a few individuals of E. flavirufa and E. triaspis); and also more ventrals, ranging upward from 260. Due to their large number of ventrals and small number of caudals, they may also be distinguished from all other American species by the high figure (190+) obtained by subtracting the number of caudals from the number of ventrals.

The above combination of characters, three of which are

distinctive for the section, together with the lack of any appreciable sexual dimorphism sets this section apart from the other American members of the genus Elaphe.

The characters which this section shares with the other two sections of the genus (weakly keeled scales, high numbers of scales, etc.) are also shared with many other colubrine snakes, and in themselves, may not be an indication of close relationship. However, the large number of common characters probably bespeaks a relationship which is closer than that between these snakes and members of other genera and a change in the generic status of Elaphe does not appear advisable at this time. Instead, it is hoped that the close relationship of this section with an Old World (and probably already named) group may be demonstrated at a later time.

## Elaphe rosaliae (Mocquard)

Coluber rosaliae Mocquard, 1899: 321-23, pl. 12, figs. 1-1b (original description; Santa Rosalia, Distrito Sur, Baja California).

Elaphe rosaliae (Mocquard), Stejneger and Barbour, 1917: 84 (listed). Nelson, 1921: 114 (listed). Van Denbergh and Slevin, 1921: 66-7 ("second known specimen," scutellation; San Bartolo, Baja California). Van Denburgh, 1922: 698-700 (description). Schmidt, 1925: 88 ("... evident relationship with [E. subocularis]").

Coluber rosaliae Mocquard, Werner, 1929: 80, 85 (key, listed).

Elaphe rosaliae (Mocquard), Linsdale, 1932: 376 ("third and fourth known [specimens]", scutellation; San Ignacio and Comondu, Baja California). Ditmars, 1940: 234 (listed). Smith and Taylor, 1945: 60 (listed); 1950: 323 (listed).

Diagnosis. A light brown, unicolor species of Elaphe with a lorilabial row of five or six scales; 33 to 35 dorsals, of which five or less are keeled; 276 to 286 ventrals.

Type. An adult female in the Museum Histoire Naturelle de Paris, collected at Santa Rosalia, Distrito Sur, Baja California, by M. Leon Diguet.

Description of type specimen. The type has not been available for study, but is described as having the following characters: oculars 1+2; supralabials, 10; infralabials, 13; dorsals, 33 (smooth); ventrals, 277; caudals, 83; anal, divided; maxillary teeth, 17 or 18; body length, 718 mm.; tail, 135.

Description of species. Unfortunately, I have been able to see only two of the four known specimens. However, both of the others have been reported in the literature, with some descriptive material, and that information is included in the description given below.

Of the two available specimens, the larger (MVZ 10672) has a body length of 945 mm. and a tail length of 188. The body form is similar to that of other American elaphes, a moderately stout body tapered toward either end, with the head distinct from the slender neck and a rather short, rapidly tapering tail (ca. 19.5 per cent of body length). The head is of moderate size, when compared with other species of Elaphe, making up about 3.5 per cent of the body length. The eye occupies about 13 per cent of the head length.

There is no indication of a dorsal color pattern in any of the known specimens. All of these are of adult size, however, and the young may be found to have blotches. Since this snake is closely related to E. subocularis, it appears likely that the young of E. rosaliae, also, will lack the head pattern. The general coloration (in alcohol) is a light brown dorsal surface which fades to a very light tan ventrally. Since the skin between the scales is darker than the scales themselves, the alignment of the scale rows is accentuated.

The dorsal scales appear quite small when compared with the size of the snake. They are smooth or very lightly keeled, convexly rounded, and (the original description notwithstanding) have two faint apical pits. The scale reduction is rather

irregular (which seems to be typical of snakes with large numbers of scale rows) but is not outstandingly different from that in other species of Elaphe. The scale formula of the male from Comondu (MVZ 13767) is given as an example.

```
    -5(9)      6+7(21)    +8(58)    +9(79)    7+8(148)
33---------31---------29--------31--------33----------31--
   7+8(10)    6+7(16)    +8(61)    +9(87)    7+8(147)

     7+8(156)     -6(163)    -7(170)    4+5(191)
--31----------29----------27---------25----------23--
       -8(157)    5+6(164)    -7(171)    5+6(187)

                    -5(248)
                --23---------21  (276)
                    -5(255)
```

As shown, there are two additions anterior to midbody and six reductions posteriorly.

The ventrals range from 277 to 286, the caudals from 83 to 89. Neither of them shows any obvious sexual dimorphism. The head shields are normal for the genus, with the addition of the lorilabial row, which both this and the following species have. The rostral is rounded and wider than high; internasals subtriangular and much shorter than the pentagonal prefrontals; frontal longer than wide; supraoculars rather short; parietals reduced and broken into small scales along their posterior borders, only a little longer than the frontal; the posterior one-third of the head covered by small scales. Nostril between two approximately equal nasals; loreal twice as long as high; preocular large and in broad contact with the frontal; two postoculars, the lower slightly larger, the upper inserted between the supraocular and parietal for about one-half its height; temporals in about



five irregular rows of approximately 3+4+4+5+6; lorilabial row made up of five or six scales; supralabials 10 or 11; infralabials 12 to 15, averaging about 13. Anterior chin shields larger than posterior, the latter separated by a pair of small scales anteriorly and two or three scales posteriorly; five to seven gulars between the posterior chin shield and the first ventral.

The hemipenis (Plate IX) is quite similar to that of E. subocularis.

Certain characters of the four known specimens are compared with those of E. subocularis elsewhere (Table IX).

## VARIATION

The small number of specimens does not justify predictions as to the extent or direction of any variation beyond that indicated above.

TABLE IX

SCUTELLATION IN MEMBERS OF THE ROSALIAE SECTION

| | Sex | Lorilabials | Supralabials | Infralabials | Ventrals | Caudals | Dorsals |
|---|---|---|---|---|---|---|---|
| *Elaphe rosaliae* | ♂ | | | | | | |
| MVZ 10672 | ♂ | 11 | 22 | 29 | 286 | 89 | 35 |
| MVZ 10767 | ♂ | 11 | 20 | 25 | 276 | 83 | 33 |
| MHNP (Type) | ♀ | 10? | 20 | 26 | 277 | 83 | 33 |
| CalAS 45982 | ♀? | ? | 21 | 25 | 286 | 84 | 34 |
| *Elaphe subocularis* | | | | | | | |
| New Mexico | ♀♀ | 9(7-10) | 22(1) | 28(1)<br>29(1) | 265.50(263-68) | 69 | 33 |
| Davis Mts. (Texas) | ♂+♀ | 11(10-12) | 20(4)<br>21(2)<br>22(3) | 26(1)<br>27(2)<br>28(3)<br>30(1) | 266.00(260-74) | 72.67(69-77) | 33(31-35) |
| Sierra Vieja | ♂+♀ | 9(6-12) | 20(3)<br>21(7)<br>22(2) | 28(9)<br>30(2)<br>31(1) | 267.83(261-75) | 73.67(70-78) | 33(31-35) |
| Chisos Mts. | ♂+♀ | 12(11-14) | 20(2)<br>21(1)<br>22(1)<br>23(1) | 28(1)<br>29(2)<br>30(1)<br>32(1) | 271.50(263-75) | 76.00(72-79) | 33(31-35) |
| Terrell Co. (Texas) | ♂♂ | 10(7-13) | 20(1)<br>22(1)<br>23(1) | 28(2)<br>30(1) | 273.7(270-77) | 75 | 33(33-35) |
| Coahuila | ♂ | 9 | 21 | 26 | 279 | + | 33 |
| | ♀ | 6 | 22 | 29 | 266 | 76+ | 35 |

## NATURAL HISTORY

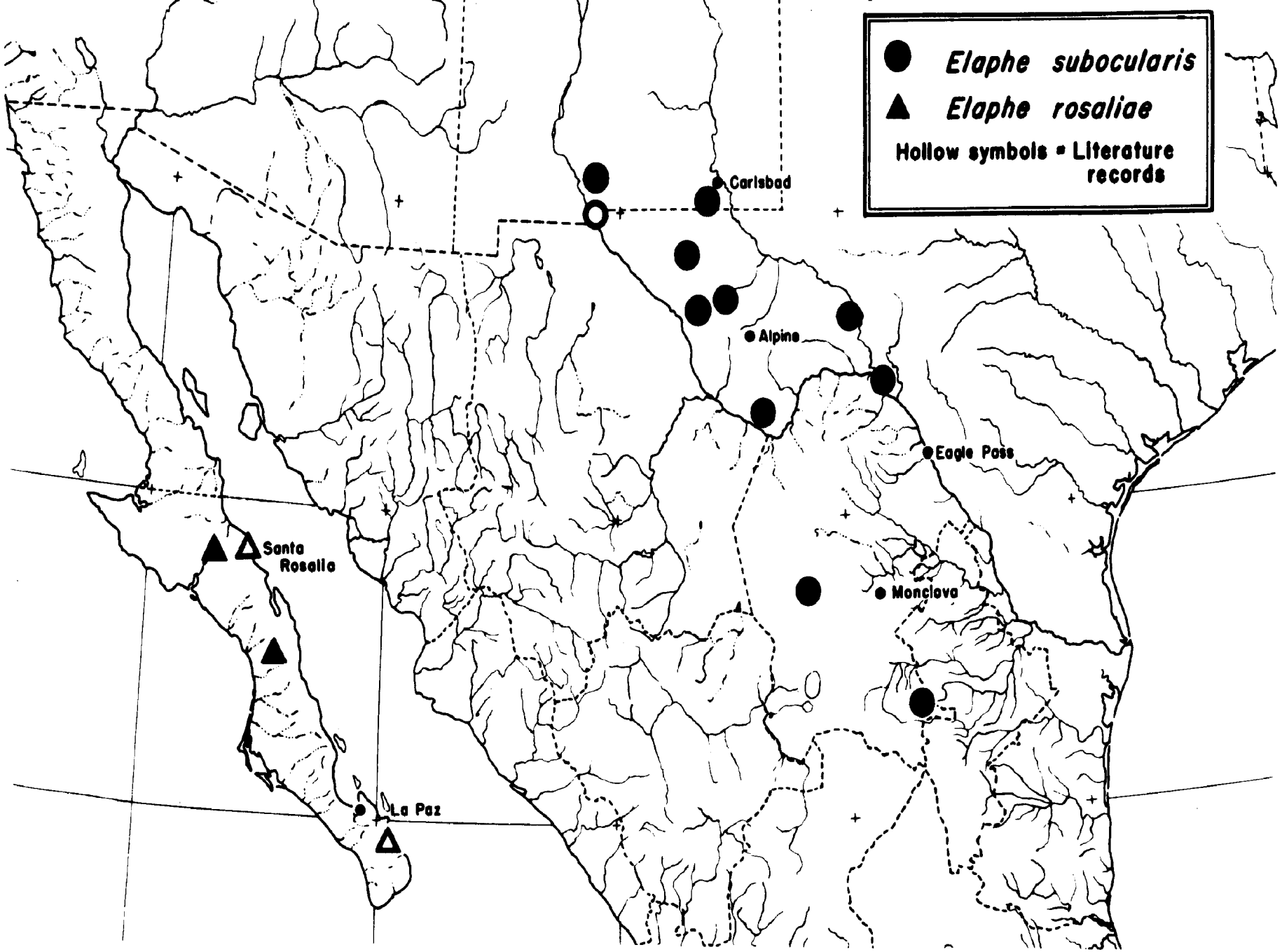
Range and Habitat. The known geographic distribution is restricted to the southern half of Baja California (Map 6). The town of Santa Rosalia is the only coastal locality and it seems possible that the type specimen actually originated from farther inland and was brought there. The information that I have from Mr. Kenneth S. Norris (in litt.), who has spent considerable time in Baja California and visited this locality, makes this even more probable. He writes as follows: "...the territory at and near Santa Rosalia is one of the most arid sections of the peninsula. There are few trees, these mostly mesquite and palo blanco (Lysiloma candida). Much of the vegetation is creosote bush (Larrea divaricata) covered desert hills. Both [Charles H.] Lowe and I find it hard to believe that an Elaphe could be found at this location."

The four localities from which this snake has been recorded are in the "Arid Tropical Zone" of Nelson (1921: pl. 32) and (with the exception of the type) are in areas with permanent water. The localities for the three more recent specimens are deep valleys or barrancas with the permanently flowing water of large springs. Two of the localities, San Ignacio and Comondu, have a heavy growth of introduced date palms which takes the place of much of the native vegetation. The San Bartolo locality, in the Cape region, is also watered by a large spring and described as being heavily vegetated.

Formerly, during the pluvial times of the Pleistocene, these snakes must have had an almost continuous distribution

Map 6. Known geographic distribution of the members of the Rosaliae Section.

Map 6. Known geographic distribution of the members of the Rosaliae Section.


Elaphe subocularis
Elaphe rosaliae
Hollow symbols = Literature records
Carlsbad
Alpine
Eagle Pass
Monclova
Santa Rosalia
La Paz

over their range, and probably were found on the mainland, as well as on peninsular Baja California. Now, however, according to the few specimens known, they are entirely restricted to these tiny oases on this dry and barren peninsula.

Habits and life history. None of the field notes give any information on the habits of these snakes. The scarcity of specimens in collections, correlated with the capture of (at least) two of them by ornithologists, may be an indication of arboreal habits. The smaller size of the eye (ca. 13.5 per cent of head length) may indicate that E. rosaliae is more diurnal than the closely related E. subocularis.

## RELATIONSHIPS

Elaphe subocularis (Brown) is the closest relative of E. rosaliae in the Americas. Although these two snakes differ from one another in several ways, it is not unprobable that additional material will show them to be subspecifically related.

Two specimens of E. subocularis from Coahuila and one of unknown origin tend toward E. rosaliae in increased tail length, greater number of ventrals and caudals, reduced dorsal keeling, and loss of color pattern. These characteristics are treated further in the Geographic Variation section of the account dealing with E. subocularis (p. 155).

## REMARKS

Due to its recent discovery (1899), isolation, and rarity in collections, this snake has retained its original nomenclatoral identity throughout its history. It was described as a Coluber by Mocquard (1899: 321) and remained so until Stejneger and Barbour (1917: 84) revived the genus Elaphe for this group of snakes.

Elaphe subocularis (Brown)

Coluber subocularis Brown, 1901: 492-5, pl. 29 (original description; Davis Mountains, Jeff Davis County, Texas); 1903: 549 ("Eight specimens...have been collected...All seem to have come from the Davis Mountains"). Ditmars, 1907: 299 (food in captivity).

Elaphe subocularis (Brown), Stejneger and Barbour, 1917: 84 (listed). Schmidt, 1925: 87-8 ("evident relationship of this species with Elaphe rosaliae...," range extension; McKilligon's Canyon, Mt. Franklin, El Paso County, Texas).

Coluber subocularis Brown, Werner, 1929: 80, 85 (key, listed).

Elaphe subocularis (Brown), Smith, 1939: 317 (range extension; 28 miles east of Saltillo, Coahuila). Ditmars, 1940: 221 (color pattern). Schmidt and Davis, 1941: 153, fig. 41 (description and range).

Elaphe sclerotica Smith, 1941: 135-6 (substitute name for Coluber subocularis Brown, 1901; a secondary homonym of Bascanion suboculare (Cope, 1866). Stejneger and Barbour, 1943: 139 (listed).

Elaphe subocularis (Brown), Schmidt and Owens, 1944: 111 (new locality; Cuatro Cienegas, Coahuila). Schmidt and Smith, 1944: 91-2 (new localities; Chisos Mountains, Brewster County, Texas). Smith and Taylor, 1945: 60 (range).

Elaphe sclerotica Smith, Lewis, 1948: 223 (range extension; "near the eastern slope of the Organ Mountains, a few miles from San Augustine Pass...," Dona Ana County, New Mexico).

Elaphe subocularis (Brown), Jameson and Flury, 1949: 67 (ecology; Miller Ranch, Presidio County, Texas). Flury, 1949: 293 (new locality; 12 miles west of Comstock, Val Verde County, Texas). B. C. Brown, 1950: 151-2 (range in Texas). Lewis, 1950: 9(ecology, Organ Mountains, New Mexico). Smith and Taylor, 1950: 362 (listed).

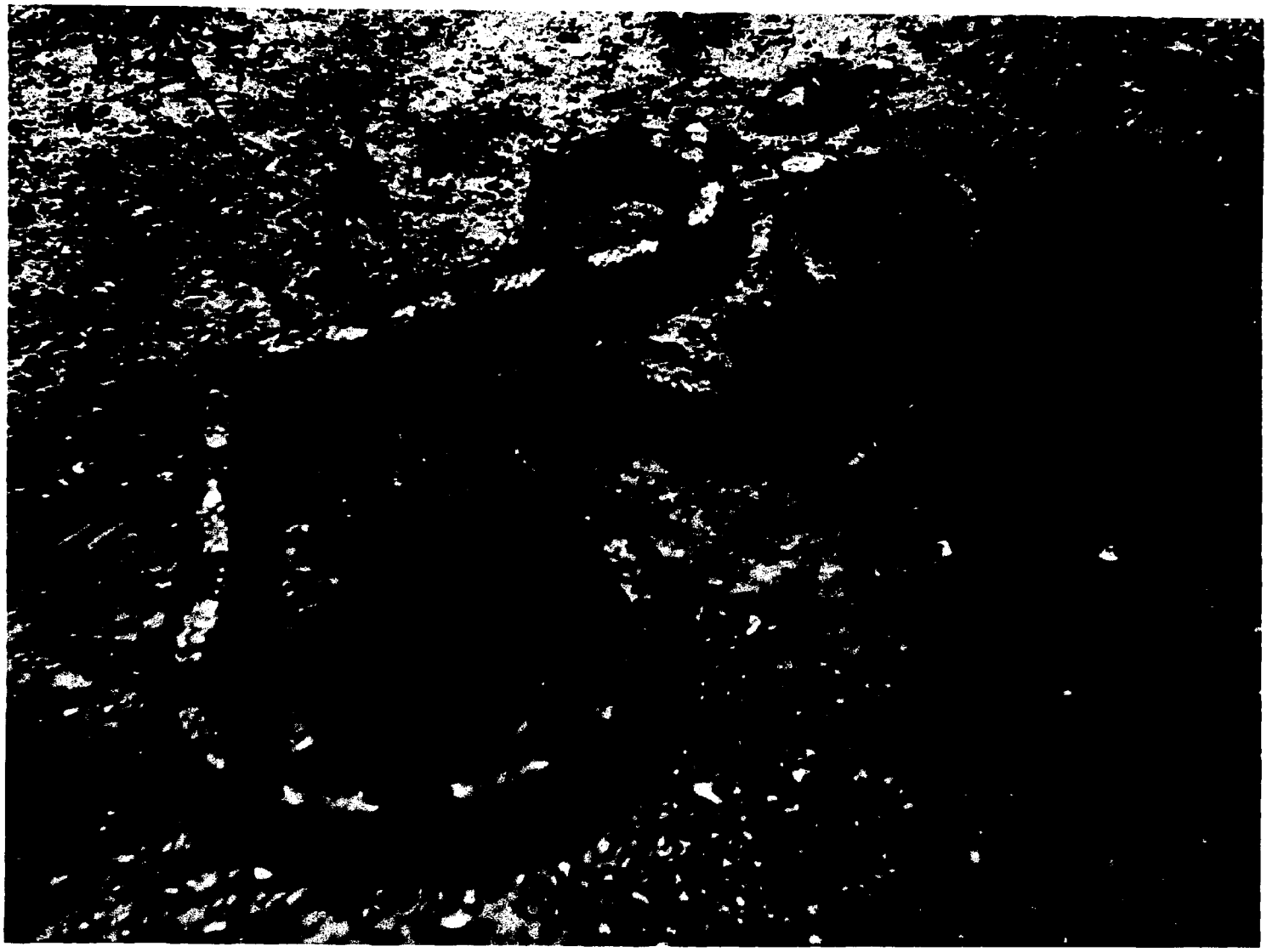
Diagnosis. A yellowish-colored species of Elaphe with 24 to 26 distinct brown or black H-shaped blotches on the body; a lorilabial row of three to six scales; 33 to 35 dorsals, of which at least the seven middorsal rows are weakly (but distinctly) keeled at midbody; and 260 to 280 ventrals.

Location of type specimens, and type locality. The holotype is ANSP 13733, collected "fifty miles southwest of Pecos, near the head of Toyah creek," in the Davis Mountains, Jeff Davis County, Texas by Mr. E. Meyenburgh. There are three paratopotypes, ANSP 13734-36.

Description of the types. The holotype is an adult male with the following characters: oculars, 1+2; temporals, 3+4+6; lorilabials, 6-5; supralabials, 9-11; infralabials, 14-14; gulars, 7; ventrals, 264; caudals, 71+. There are 25 body blotches, and 8 (+?) on the tail. The body length is 1367 mm.; tail length, 192 ; head length, 44.0; eye, 6.0.

The paratypes prove to have ventral counts of 274 (male), 261 (female), and 264 (male, rather than "about 240..., 245... [and] 240...," which was estimated from the live specimens by Brown (1901: 494-95).

Plate X. *Elaphe subocularis*. Body form and distinct pattern. [From a color photograph by W. W. Milstead.]



Description of the species. Including the type series, there are now known a total of 41 specimens of Elaphe subocularis, representing twelve different localities. All of the specimens except two have been made available to me for this study. The following description is based on the specimens from Presidio, Jeff Davis, and Culbertson counties, Texas, and Dona Ana and Eddy counties, New Mexico; none of these appear to differ appreciably from the type series.

This is one of the larger snakes of the genus; the largest specimen seen, a male from Terrell County, Texas (TNHC 7680), has a body length of 1471 mm. and an incomplete tail of 199 mm. (about 10 mm. missing). The body form is similar to that of the preceeding species: moderately stout at midbody and tapering distinctly toward either end. The tail is comparatively short (ca. 15 per cent of body length) and tapers to an abrupt point. The head appears large in comparison with the slender neck, but makes up only about 3.5 per cent of the body length. It is flat dorsally with a broad, abruptly rounded snout and a distinctly angular canthal region. The temporal area is massive and broadly rounded; the supralabial region extends outward to beyond the level of the eye. The latter is large (ca. 16 per cent of head length), as would be expected in an animal of nocturnal habits (Plate X).

The dorsal coloration of the body in life is a bright yellowish buff with an orange tinge anteriorly (these colors fade to gray in alcohol). The head is light ash-gray without any markings whatsoever; the eye is described as golden-colored.

The dorsal pattern is very distinctive and differs from that of all other North American snakes in appearance. It is approached most closely by Pituophis deppei lineaticollis (Cope) in its general aspect, but differs in detail. The pattern is made up basically of a dorsal series of large, well-defined, black or dark brown H-shaped blotches, which are about 15 scale rows in width and eight to ten scales long. The middle part of the lateral bar of the blotch has an open appearance due to the dark color being restricted to the center of each scale; the crossbar has a similar appearance due to the dark color being restricted to the edges of the scales. Anteriorly the lateral longitudinal extensions of the first few blotches are connected by a black line which is about one scale in width. Often the anterior one or two blotches have lost the crossbar almost completely, but their positions are usually indicated by a widening of the parallel longitudinal lines at regular intervals. The posterior blotches are also connected, but with a faint maroon line which often disappears completely in preserved specimens. The blotches become smaller posteriorly as the body diminishes in size, but remain distinct even on the tail, which usually has eight or nine.

The lateral markings begin on the neck as a series of short, and very narrow, dark lines which both alternate with and oppose the dorsal blotches. Farther posteriorly these lines broaden to blotches with a height of about five scale rows but remain irregular and faint, the darker coloration

being restricted to the edges of the scales. In the area of greatest development the lateral blotches extend from the eighth or ninth scale rows downward to the ventral border, often splitting there and extending outward to form a pair of ventrolateral blotches about two scales wide and separated by about the same distance. The ventral surface of the body is immaculate yellowish white anteriorly, but posteriorly the lateral blotches extend onto the lateral edges of the ventrals as described above.

The dorsal scales above the fifth row are weakly, but distinctly, keeled in all of the adult specimens from Texas and New Mexico. In the juvenile individuals the keels are less distinct and may not be visible ventral to the seventh or eighth rows. The scale reduction, although involving a large number of rows, does not show any significant difference from other species of American Elaphe. The scale formula of the holotype (ANSP 13733) is given below.

| | | |

anal was divided in all specimens examined.

The head scutes are normal for the genus, with the addition of the lorilabial row of scales above the supralabials. This row is present in only one other species, the other member of this section, Elaphe rosaliae. The rostral is rounded and slightly wider than high. It possesses a rather shallow but well defined tongue groove, and is in narrow contact with the internasals. The latter are subtriangular and less than half the size of the prefrontals. The frontal is almost twice as long as broad with a wide curving anterior end and a rather obtusely pointed posterior end. The supraoculars are longer than the frontal and are usually in narrow contact with the prefrontals, though sometimes separated from them by an upward extension of the preocular. The parietals are rather short, the interparietal suture being shorter than the frontal. The nostril is between two large unequal nasals; the anterior one is the longer, while the posterior is the higher. The loreal is large with its anterior end squarish, the lower and posterior corner is acute and extends well under the large preocular. The latter is usually separated from the frontal but may be in narrow contact with it. There are two postoculars, of which the lower is the larger; the upper extends for more than half its height between the supraocular and the parietal. The temporals are in about five irregular rows of approximately 3+3+4+5+6, but there is considerable variation. The lorilabial row usually extends from the posterior end of the loreal to the anterior corner of the ninth labial, and is composed of three to six scales. This row often separates the eye from the labial border

but this is not true in 18 of the individuals where the ocular is in contact with the labials on one or both sides. The supralabials range in number from nine to twelve (M = 10.5); the infralabials from thirteen to seventeen (M = 14.5). The anterior chin shields are somewhat longer and much broader than the posterior. The latter are separated anteriorly by a pair of small scales and posteriorly by three or four scales. There are five to seven gular scales between the posterior chin shield and the first ventral plate.

The hemipenis (Plate IX) is small and resembles that of the genus Pituophis (Stull, 1940: 10). In the inverted position it extends posteriorly to the ninth or tenth caudal, and extends to about the eighth when everted. The proximal third of the organ has tiny spines scattered over an otherwise smooth surface. The middle half is covered with about 17 irregular longitudinal rows of spines, most of which are connected in one direction by a series of low membranes which run obliquely and give a spiral appearance to the spiny portion. Membranes which run perpendicularly to the first ones appear distally (by the fourth to seventh transverse row of spines) and connect with the others to form irregularly hexagonal calyces with a spine at each corner (and some intermediate ones). The spines decrease in size abruptly from this point and by the second or third distal row of calyces have disappeared completely, leaving two to six rows of low papillate irregular, distal calyces. The lips of the sulcus are not conspicuously raised; they are ornamented with small spines in the middle area and calyces in the more distal part.

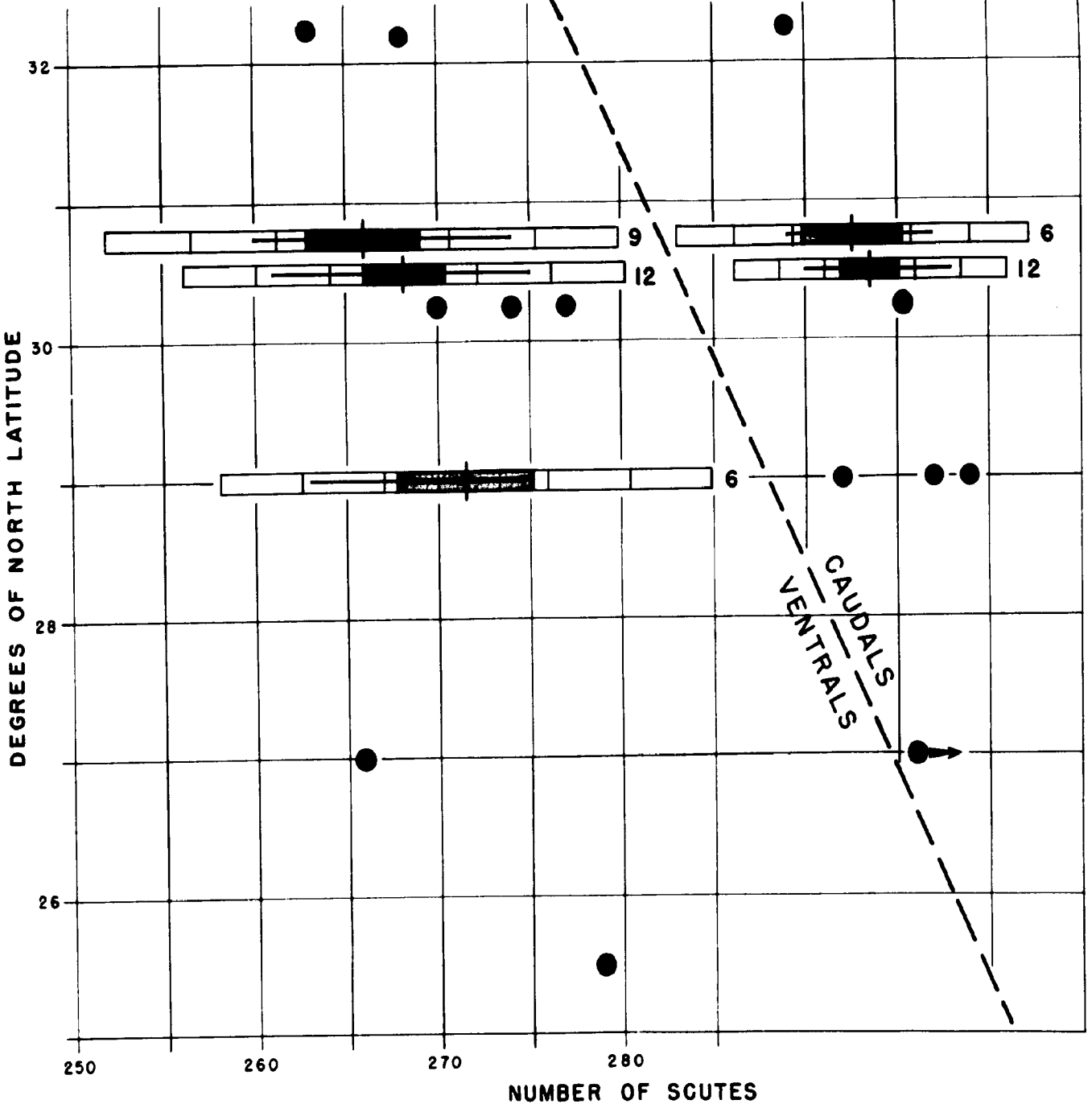
In the only available cleaned skull (UMMZ S-1081) the tooth counts are as follows: maxillary, 20-20, subequal in length; mandibular, 24-25, decreasing greatly posteriorly; palatine, 11-11, decreasing in length posteriorly; and pterygoid, 15-16, decreasing posteriorly. The maxillaries were examined in all available adult specimens and the teeth were found to range from 19 to 21 (M = 20) except in a single individual (TNHC 8453) which had a gap (perhaps an old wound ?) just anterior to the third tooth from the posterior end, and had a count of only 18.

## VARIATION

### Sexual Dimorphism

These snakes are most unusual in that not a single character exhibits sexual dimorphism in the series available. The males may have a few (less than five) more caudals than the females, and the same is faintly indicated in the ventrals, but in neither can this variation be demonstrated statistically.

Figure 11. Geographic variation in ventrals and caudals in *Elaphe subocularis*.


32
30
28
26
DEGREES OF NORTH LATITUDE
250
260
270
280
NUMBER OF SCUTES
9
12
6
6
12
CAUDALS
VENTRALS

## Geographic Variation

Small series of specimens are available from three localities and a comparison of these with one another and with the other scattered individuals gives an indication of the presence of some geographic trends, although mostly the series are too small to make the results statistically significant. The statistics of the ventral and caudal counts are given graphically (Figure 10) for the series and certain outlying specimens and the labial counts for the series are given in tabular form (Table X). Other information is given in the following paragraphs.

Davis Mountain Series. Including the type specimens there are nine (five males and four females) available from this mountain range. The body blotches range from 22 to 28, with a mean of 25.33 ± 0.55; the tail blotches are 7 (three individuals) or 8 (four). The dorsal scales range from 29+31+20 to 31+35+23, with 29+33+23 occurring most frequently. The maxillary teeth are 19 (one individual), 20 (three), or 21 (one).

Sierra Vieja Series. This group of snakes (nine males and three females) was obtained by members of the Department of Zoology, University of Texas, and is the largest representation of E. subocularis from any one locality. The entire series is from near the mouth of ZH Canyon, on the C. E. Miller Ranch, 11 miles west of Valentine (Jeff Davis County). The body blotches range from 23 to 26 with a mean of 24.67 ±

0.33; the tail blotches are 7 (one individual), 8 (eight), or 9 (three). The dorsals are usually 31+33+23, being 29+31+21 in one individual, 31+33+25 in another, and 31+35+23 in four. The maxillary teeth are 19 (three individuals), 20 (six), or 21 (three).

Chisos Mountains Series. The six specimens (four males and two females) which make up this series are from several localities within the mountain range. Only three have complete tails. The body blotches range from 24 to 27, with a mean of 25.67; the tail blotches are 8 (one specimen) or 9 (two). The dorsal range is included within those of the other two series. The maxillary teeth are 20 (three) or 21 (one) in the four adult specimens.

Discussion. The three series show an indication of a trend of increasing scale number to the south. This trend is not demonstrated by statistically significant results, but the combined weight of increased numbers of ventrals and caudals, together with the same increase in supra- and infralabials appears too great to be mere coincidence. It should also be noted that the two specimens from New Mexico, the northernmost ones, have 263 and 268 ventrals, while four specimens from Terrell and Val Verde counties (Texas), south and east of the Davis Mountains have 270, 274, 276, and 277 ventrals. This apparent trend is continued in the single specimen from near Saltillo, Coahuila, which has 279 ventrals, the largest number possessed by any specimen of known prevenience. The only

apparent break in the trend is shown by the single specimen from Cuatro Cienegas, Coahuila, with 266 ventrals. The weight of other evidence (i.e., large number of caudals) is against it, however, and its ventral count is probably low for its population.

Other than the slight trends noted above, the specimens from West Texas and southern New Mexico are quite homogeneous and show little sign of differentiation. A single specimen without locality data (CNHM 38043), therefore, holds unusual interest in that it tends to break down the differences in characters which separate Elaphe subocularis from E. rosaliae, and this tendency is shown in other ways by the two specimens from Coahuila.

The two Coahuila specimens do not differ greatly from others and they only appear so upon close comparison with E. subocularis from other areas. The one from near Saltillo (CM 9781) differs mainly in the increased number of ventrals; 279 as compared with a mean of 268.4 (OR = 264-75) in the Sierra Vieja series. The Cuatro Cienegas specimen (CNHM 47048), an adult female, differs in two main characters: the dorsals show less keeling, there being 10 smooth lateral scale rows at midbody as compared with 2 to 5 in other adults; and the tail is longer (even though the tip is broken off), being 18.3 per cent of body length as compared with an observed range of 15.9 to 16.9 in other snakes of the same size and sex. The caudals, also, indicate the longer tail, there being 76+ in this individual as compared with an observed upper limit of 73 in others.

Both the scales and tail length, thus, show an approach toward the smooth-scaled, long-tailed E. rosaliae.

The above-mentioned specimen without data shows an even greater approach toward E. rosaliae. It is an adult male with a total length of 1609 mm. The tail is slightly longer (15.9 per cent of body length as compared with a maximum of 15.4 in snakes of comparable size), with more caudals (81 as compared with the observed upper limit of 79 in other males), and more than the average number of ventrals, equalling the observed upper limit of 277. The dorsals are smoother than average, there being 8 smooth rows at midbody. The most striking change, however, is in the body pattern. In other specimens the only observed variation was in the number of blotches. This one differs from all others in that the dorsal pattern is distinct only on the anterior part of the body. None of the more posterior blotches have the longitudinally parallel lines of the usually H-shaped pattern, and the crossbar itself is very faint at the posterior end of the body. Were the locality data for this individual known, and correct geographically, I would not hesitate to regard E. subocularis and E. rosaliae as conspecific.

It is to be hoped that further field work in the area between the known ranges of these two forms will bring specimens to light. The structural gap between the two forms has almost been bridged by these three specimens, and further material from the great geographic gap may afford evidence as to their true relationships. The keeling of the dorsal scales, or lack

of it, appears to be a quantitative difference, in the genus Elaphe, rather than a qualitative one.

TABLE X

GEOGRAPHIC VARIATION IN LABIALS

| Locality | Supralabials | | | | Infralabials | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 | 21 | 22 | 23 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| Davis Mountains | 4 | 2 | 3 | | 1 | 2 | 3 | 0 | 1 | | |
| Sierra Vieja | 3 | 7 | 2 | | | | 9 | 0 | 2 | 1 | |
| Chisos Mountains | 2 | 1 | 1 | 1 | | | 1 | 2 | 1 | 0 | 1 |

## NATURAL HISTORY

Habitat and range. This species is one of the northern plateau forms which inhabits the slightly more humid mountain areas of this arid region. The known distribution extends from the Organ and Guadeloupe Mountains of southern New Mexico, through the Franklin, Davis, and Sierra Vieja mountains of western Texas, and the Chisos Mountains and Stockton Plateau of the Big Bend region, southward through outliers of the Sierra Madre Oriental to near Saltillo, Coahuila (Map 6).

A synthesis of the descriptions of the various habitats which have been ascribed to this snake gives very little idea of what factors may influence its distribution. The Organ Mountain specimen (PSM 6063) was taken in an outbuilding standing in a yucca-mesquite-ephydra-grassland association at an altitude of about 4100 feet. The Sierra Vieja individuals were taken in a variety of associations, but mainly in catclaw-cedar and catclaw-grama. It should be pointed out, however, that all of the specimens have been collected from mountainous or otherwise rough country and are usually found in or near rocky situations. Most of those from Texas appear to have been collected from situations not far from permanent water, but this is not true of the Organ Mountains individual, nor for some of the others.

Habits and life history. Almost nothing is known of the habits of Elaphe subocularis. The series of specimens from the Sierra Vieja was taken "between sunset and about 10 p.m." which corroborates the supposition that they were nocturnal, as evidenced by their large eyes. Since none of the snakes had "obvious

food lumps" at that time, it may be further assumed that the greater part of the night is spent foraging, unless the temperature drops too low. The fact that one of the specimens was located by the reflection of light from its eyes is probably nothing more than another indication of large eyes, since size appears to be one of the primary qualifications for "eye shine" in amphibians and reptiles.

These snakes have been little known and nothing appears to have been described of their food habits in the wild. Ditmars (1907: 300) recorded that the three young captive specimens under his observation ate mice and young birds readily. One of the specimens of this museum (UMMZ 91471) had the feet of a Roadrunner (Geococcyx californianus) in its stomach, and another (TNHC 7680) the remains of a small mammal. If these snakes can catch and eat as large a bird as a Roadrunner, then they must be able to feed on many of the mammals and birds within their range.

## REMARKS

The status of secondary homonyms has not yet been satisfactorally settled by the "International Commission." When this question is finally settled, it may lead to a name change in this species, since, as Hobart M. Smith pointed out in 1941, the name Bascanion suboculare Cope (1866) antedates Coluber subocularis Brown (1901). He proposed a substitute name, Elaphe sclerotica, for the latter at this time but returned to the former usage later (Smith and Taylor, 1945: 60).

## SUMMARY AND CONCLUSIONS

A taxonomic study of the American members of the colubrid snake genus Elaphe Fitzinger was made, with especial reference to the relationships of the included forms. The species of Mexico and Central America, which are the least known were given the most attention. A definition of the genus which includes the type species (European) and all American members, and diagnoses of the family and subfamily to which the genus belongs were given. A key to the sections, and to all American members of the genus recognized herein was prepared, and the exact methods used in obtaining and recording the data used in the study was presented.

Investigation of the status of the generic name Elaphis Bonaparte (1831), which predates Elaphe Fitzinger (1833), proves it to be a nomen nudum. Other generic names postdate Elaphe Fitzinger and it is not believed advisable to recognize subgenera at this time. The recently proposed subgeneric name Pseudoelaphe Mertens and Rosenberg is based upon Elaphe flavirufa (Cope). Since this species is a member of the Pantherophis Section, it has two older generic names available, Pantherophis Fitzinger (1843) and Scotophis Baird and Girard (1853), if the group to which it belongs were recognized as a subgenus. For this reason the name Pseudoelaphe is placed in synonymy. The generic name Paleoelaphe Gilmore (1938) is tentatively placed in the synonymy of Elaphe Fitzinger. This name is based upon a few vertebrae which were distinguished from those of Elaphe mainly on the basis of size

(and size-correlated characters), but do not actually exceed the observed limit of this genus.

Resemblances in scutellation form, and pattern should not be used as indicators of relationship in non-interbreeding forms, since these characters tend to converge in distantly related forms. This phenomenon of convergence is probably due to similar responses to environmental conditions and may occur in forms which are not even generically related. Thus, the supposed relationship of American forms to Eurasian forms, and thus to the genotype, is open to question.

The American members of the genus fall into three distinct categories (herein called sections) on the basis of hemipenial and other characters. They are herein named the Pantherophis Section, containing four species; the Triaspis Section, containing one; and the Rosaliae Section, containing two species. There is no indication of a common origin of these sections in this hemishpere, nor have representatives of the sections been identified in the comprehensive and poorly-defined "genus Elaphe" of the Old World.

Within the sections the relationships are more evident. The PANTHEROPHIS SECTION contains two sympatric species-groups, herein called the Guttata and Obsoleta groups. The Guttata Group is made up of eight allopatric forms: a monotypic species, E. vulpina; one species, E. guttata, with three subspecies (E. g. guttata, E. g. rosacea, and E. g. emoryi); and one species, E. flavirufa, with four subspecies (E. f. flavirufa, E. f. matudai, E. f. yucatanensis, and E. f.

rodriguezi). The Obsoleta Group is made up of a single species, E. obsoleta, with five subspecies (E. o. obsoleta, E. o. quadrivittata, E. o. spiloides, E. o. lindheimeri, and E. o. bairdi). The TRIASPIS SECTION contains a single species, E. triaspis, with three subspecies (E. t. triaspis, E. t. mutabilis, and E. t. chlorosoma). The ROSALIAE SECTION contains two allopatric and monotypic species, E. rosaliae and E. subocularis.

The snakes of this genus are moderate to large size, adults ranging from about 700 mm. (body length) in Elaphe t. triaspis to more than 1400 mm. in E. subocularis. They are found in the forested and plains areas of North America from Ontario to Costa Rica, and from Florida to Baja California.

# APPENDIX A

## NAMED FORMS NOT RECOGNIZED HEREIN

The present section deals with names which have appeared in the literature which, for various reasons, are not recognized in this paper. Some of these names predate those which are currently in use, or those which are recognized herein, and a discussion of the reasons for the action taken appears necessary. They are taken up in alphabetical order.

## Coluber fulviventer Rafinesque, 1820

The original description of this form (Rafinesque, 1820: 6) [as taken from the facsimile edition, 1908] is as follows:

"33. Coluber fulviventer. Entirely black above and brick red beneath, throat yellow; dorsal scales carinated; about two hundred abdominal scales, and seventy pairs of caudal; tail one fifth of the total length. -- Length nearly three feet; it has large teeth, but no fangs. Vulgar name chicken snake [.] Found in Kentucky, Ohio, Indiana, etc."

Although the intention of Rafinesque, almost without a doubt, was to name the "Chickensnake" of Kentucky, the species now known as Elaphe obsoleta (Say) (1823), the description is so vague and contains so many characters which are atypical for E. obsoleta as to throw doubt upon the identity of the species actually described. The "brick red" ventral coloration and "yellow" throat are, at best, most misleading if applied to E. obsoleta of this area, and are more nearly applicable to Farancia abacura or Abastor erythrogrammus. The specimens of E. o. obsoleta that I have observed have a yellowish-white abdomen (occasionally showing a slight pinkish tinge) which is heavily mottled and blotched with black anteriorly, and often uniform black posteriorly. The ventral count in E. obsoleta ranges from 220 to 240 (never approaching 200) with an average of about 230; the caudal count is more than 75 (rather than "70"). Both of the counts given, however, are open to question and may be only estimates, since one of the gartersnakes

described in the same paper (Coluber Kentukensis, p. 5) is also credited with 200 ventrals, while actually the ventrals in these snakes never exceed 160 in number.

For the above reasons, and the fact that Rafinesque often described animals which were purely imaginary (i.e., Necturus phosphoreus, p. 4: described as having "its gills shine in the night of a firy red colour"), I prefer to consider this name unidentifiable, as Dunn and Allen (1935: 180-81), and Conant (1949: 9-10) have indicated previously.

## *Coluber ovivorus* Linnaeus, 1756

The brief diagnosis, which is the original description of this form (Linnaeus, 1756: 223) is quoted below:

"276. [*Coluber*] ovivorus. 203 - 73 Kalm

*Pis. bras.* 279. Guinpuaguara

*Habitat in* America."

Conant (1940: 1) found this name to be unidentifiable, and Klauber (1948: 12) has discussed it with the same conclusion. The reference to Peter Kalm as the collector rather definitely restricts the type locality to the area of New York, New Jersey, Pennsylvania, and Ontario. Of these areas, *Elaphe vulpina* (Baird and Girard), which the description most resembles is positively known only from Ontario (there are two specimens in the ANSP labeled "near Buffalo," [New York] but which may have come from across the river in Ontario also). Klauber tended to discount the possibility of this name referring to *E. vulpina* (which it predates) due to the high caudal count (73, while Conant found the maximum to be 71 in the snakes that he examined). However, it should be pointed out that some of the older workers (Baird and Girard, for example) counted *all* of the scales under the tail (not beginning with the first one which meets its fellow), which gives higher counts than those which modern workers would obtain.

Since there is no description except for the two counts, however, and since this snake has not been recognized since its description, it seems best to continue to consider it unidentifiable, rather than disturb the established nomenclature with a dubious name.

Elaphis pardalinus Peters, 1868

The original description of this form (Peters, 1868: 642) is quoted below:

"4. Elaphis pardalinus n. sp.

"Körperschuppen in 29 Reihen, die des Rückens gekielt 9 Supralabialia, von dened das 4., 5., und 6. ans Auge stossen; 2 Anteorbitalia, 2 Postorbitalia; 3+3+4+4 Temporalia; 12 Infralabialia, von denen 7 an die Submentalia stossen. Anale getheilt. 266 Abdominalia, 119 Paar Subcaudalia.

"Diese Schlange, von welcher unser Sammlung (Nr. 3790) ein Exemplar ohne Fundort besitzt, schliesst sich dem E. quadrilineatus var. leopardinus in jeder andern Beziehung so nahe au, dass, wen die Beschildung des Kopfes nicht so verschieden erschiene und auch das Auge merklich grösser wäre als bei dieser Art, ich sie nur für eine Varietat derselben halten würde."

The type (Königlich zoologischen Museums zu Berlin 3790) must be examined to determine the true status of this form. The description fits the form herein called Elaphe flavirufa rodriguezi (Bocourt) very well, but since the provenance of the type specimen was not known, and since it is compared with an Old World species, it appears unwise to substitute this name (which predates Elaphis rodriguezi Bocourt, 1887) for one which has a known type locality. It is possible that the name actually relates to a Eurasian species. If the type is extant, and proves to belong to the species Elaphe flavirufa (Cope), however, then the southernmost subspecies of this form should be known as Elaphe flavirufa pardalinus (Peters).

# APPENDIX B

## METHODS

The methods given below were used as standard ones for obtaining the various data used in this work. It is hoped that the data presented and the explanation of methods will allow similar studies to be strictly comparable with the present one.

The coloration of the few live specimens available was recorded by reference to Ridgway (1912).

The color pattern varies greatly in these snakes and it is extremely difficult to obtain fully comparable counts of spots, bands, and bars. However, where the dorsal blotches had become divided longitudinally (and medially) and alternated with one another to form a zig-zag middorsal band, the blotches were counted first on one side and then on the other, and the lesser figure recorded as the dorsal blotch number. In some the size of the blotches was recorded by reference to the number of scales covered; it is well to remember, when visualizing the appearance of such blotches, that the dorsal scales (especially the middorsal ones) are considerably longer than broad, and that the blotches are "stretched" in a longitudinal direction.

Body length was measured from the end of the snout to the middle of the anal plate, and tail length from the latter point to the tip of the tail. A new measure of head length was employed: the measurement was taken from the posterior angle of the jaw to the tip of the snout (= middle of the

rostral plate). This measurement proved to be much more consistent than would be expected in so flexible an object as the head of a snake; not only is the measurement equal for both sides of the head, but the proportions obtained (head length/body length) show that it is at least as accurate as the other measurements taken. The eye size was measured in a longitudinal direction.

Most of the characters of scutellation were taken in the usual ways (as in Schmidt and Davis, 1941: 26-30, for example), but some of the methods used here differ. The ventral count was begun with the first ventral scute bordered on both sides by the first row of dorsal scales, and ended with the scute just anterior to the anal plate. The reasons for this method and a more exact explanation of it have been given elsewhere (Dowling, 1951b). In those individuals where the full dorsal scale formula was obtained, the method of notation previously explained (Dowling, 1951c) was employed. In the formulae the upper figures refer to the right side of the snake, the lower to the left. Where anterior, midbody, and posterior dorsal counts were taken, there were no standard points on the body for the various counts except in those snakes which showed no addition of rows at midbody (in these the anterior count was taken one head-length behind the angle of the jaw). In the majority of snakes the anterior count is the minimum count anteriorly, usually in the vicinity of the 25th ventral; the midbody count is the maximum scale count encountered on the body, and is usually found between the 100th

and the 125th ventrals; the posterior count is the minimum count on the posterior part of the body, and is usually just anterior to the anal plate. The caudals were counted from the anteriormost plate which met its fellow, and included the terminal spine.

Except in dorsal scale formulae, counts which are connected by a plus sign (+) are similar counts which are longitudinally separated: i.e., "oculars, 1+2" means that there is one preocular and two postoculars on either side of the body; the same being true of temporal counts. On the other hand, the counts separated by a dash (-) are identical counts taken on opposite sides of the body: "preoculars 1-2" means that there is a single preocular on the left side, and two on the right. This orientation is held throughout the paper, the number before the dash indicating the left side and the number after the dash, the right.

The temporals are quite irregular in this genus and the counts may not be fully consistent. Wherever possible, three counts were taken: that of the anteriormost row (diagonal in some forms), a posterior count extending from the last supralabial to the parietal, and a medial count between the two (and usually above an intermediate labial). The minimum number of scales between the labials and parietals was counted. Labials were counted only if they reached the edge of the mouth, and were counted from the posterior one forward to reduce the subjective element in case of doubt. An exact gular count could be obtained, due to the above method of counting

ventrals: they were counted from the anterior edge of the first ventral anteriorly to the posterior end of the posterior chin shield. The minimum number of scales was recorded.

The tooth count of the maxillary (and other bones) was made by removing, cleaning, and drying the bone, and counting all empty sockets as well as the teeth actually present at the time of preservation.

## APPENDIX C

### LIST OF SPECIMENS EXAMINED
### *Elaphe g. guttata*

ALABAMA, Baldwin (UMMZ 83253);Lee (UMMZ 83199-200); Mobile (UMMZ 84451); Montgomery (UMMZ 98666); Morgan (UMMZ 82040); Talladega (UMMZ 99391).

FLORIDA, (ANSP 3875); Alachua (DBUF 523, 524, 1989, 2059, 2118, 2128a-b; UMMZ 57755-56, 98646); Broward (UMMZ 80530); Duval (ANSP 24481; USNM 9692); Lake (UMMZ 77481); Lee (ANSP 16056); Leon (UMMZ 57373); Manatee (UMMZ 75817a-g); Marion (UMMZ 52258); Putnam (USNM 5507).

GEORGIA, Baker (ChM 51.1.3); Cobb (DBUF 2481); Thomas (ANSP 16322-23); Warren (UMMZ 84450).

LOUISIANA, Grant (UMMZ 92830); St. Tammany (UMMZ 68436).

MISSISSIPPI, (ANSP 3878); Harrison (UMMZ 76793-94, 93980-84); Lauderdale (UMMZ 90121); Montgomery (UMMZ 99351); Lafayette (UMMZ 53650, 53655).

SOUTH CAROLINA, Charleston (Rec'd. 100 ChM, 27.254, 27.260, 28.193, 29.296, 30.254, 33.202, 33.213.1-4, 34.250, 34.361, 36.175, 46.74, 46.76, 49.104.22; UMMZ 90186); Dorchester (UMMZ 94939-40), Horry (UMMZ 94933); Lexington (UMMZ 68435, 84133-41, 92324); Richland (ChM 30.216.2); Williamsburg (ChM Rec'd. 86); York (UMMZ 44576).

TENNESSEE, Hardeman (UMMZ 84452); Sevier (UMMZ 84332, 87311).

### *Elaphe guttata rosacea*

FLORIDA, Monroe (DBUF 1917, 2554; UMMZ 96761, 98648, 99691; USNM 14418).

Elaphe g. guttata x emoryi

MISSOURI, Carter (CAS 8891); Wayne (CAS 8890).

OKLAHOMA, McCurtain (DZTU 5526; UMMZ 86540).

Elaphe guttata emoryi

ARKANSAS, (USNM 1707).

KANSAS, Anderson (USNM 2259); Douglas (USNM 51554-55); Cowley (CAS 7732); Franklin (UMMZ 85561); Marshall (UMMZ 66946, 67025, 88485); Riley (CAS 12235; UMMZ 64422-23, 66943-44, 66953, 97942).

MISSOURI, Barry (CAS 8615); Jefferson (CAS 8509); Stone (ANSP 3771).

NEW MEXICO, Eddy (UMMZ 102434); San Miguel (UMMZ 101581).

OKLAHOMA, Alfalfa (UOMZ 25291); Beaver (UOMZ 13742); Comanche (UOMZ 8213); Cotton (UMMZ 86541); Greer (UOMZ 25825); Kay (UOMZ 25976); Major (UOMZ 22890); Okmulgee (UOMZ 394); Roger Mills (UOMZ 26438); Seminole (UOMZ 10289); Tulsa (UMMZ 92325).

TEXAS, Atascosa (TNHC 5796; UMMZ 97941); Bexar (ANSP 20873; UMMZ 74059, 74143); Brooks (UMMZ 92772); Burnet (TNHC 948, 4518, 4521, 4522, 4579); Cameron (CAS 6354; MVZ 12707; UMMZ 74778); Culberson (UMMZ 70497); Dallas (ANSP 10835-36, 10838-39); Hidalgo (CAS 6353; UMMZ 74777); Hutchinson (TNHC 10420, 10466, 10536, 10560, 10665, 11188, 11205, 11389); Jeff Davis (UMMZ 49977); Lampasas (CAS 13821); Medina (UMMZ 76799); Nueces (ANSP 3765); Potter (UMMZ 69006); Presidio (TNHC 3581-82); Reeves (UMMZ 49978); Travis (ANSP 10831; TNHC 4291, 4520); Val Verde (UMMZ); Webb (UMMZ); Williamson (TNHC 4517); Zapata (UMMZ).

UTAH, Grand (CAS 3760, 4691; DZUU 270-71; UMMZ 84334).

MEXICO, Nuevo Leon (MCZ 45553; MVZ 36738; USNM 110434); Tamaulipas (MCZ 17474-75; UMMZ 95202-03, 101261).

## Elaphe vulpina

ILLINOIS, Cook (UMMZ 3745); LaSalle (UMMZ 71658).

IOWA, Buchanan (UMMZ 71644); Hardin (UMMZ 52513); Pocahontas (UMMZ 60173); Woodbury (UMMZ 52512).

MICHIGAN, Dickinson (UMMZ 82905); Huron (UMMZ 37745); Marquette (UMMZ 63418); Monroe (UMMZ 70756a-1); Wayne (UMMZ 42495; USNM 1570).

MINNESOTA, Olmstead (USNM 56608).

MISSOURI, St. Charles (USNM 56609).

NEBRASKA, Boyd (USNM 36985); Burt (UMMZ 71657; USNM 83957); Holt (USNM 82007).

OHIO, Erie (UMMZ 31723); Lucas (ANSP 21650-61).

WISCONSIN, Burnett (USNM 115609); Racine (USNM 7269, 9969).

## Elaphe f. flavirufa

MEXICO, Campeche (UMMZ 73224); San Luis Potosi (KUMNH 24078); Tabasco (USNM 6626); Veracruz (USNM 24998, 110302); "Yucatan" (USNM 6566).

## Elaphe flavirufa matudai

MEXICO, Chiapas (USNM 110303).

## Elaphe flavirufa yucatanensis

MEXICO, Yucatan (MCZ 29241; UMMZ 73072-74; USNM 46578).

## Elaphe flavirufa rodriguezi

HONDURAS, Atlantida (MCZ 29609); Yoro (MCZ 21181, 22025, 26853).

NICARAGUA, Corn Island (AMNH 23887).

Elaphe o. obsoleta

ARKANSAS, Greene (UMMZ 71946, 71970-71, 77664, 78180); Lawrence (UMMZ 76798); Monroe (UMMZ 77434).

GEORGIA, Whitfield (USNM 4710).

IOWA, Jackson (UMMZ 93058, 94202); Lee (UMMZ 93057); Madison (UMMZ 93056); Van Buren (UMMZ 93053-54); Winneshick (UMMZ 93055).

LOUISIANA, East Baton Rouge (UMMZ 97927a-b, 97928a-b); Rapides (UMMZ 92840).

NEW YORK, (ANSP 16792).

NORTH CAROLINA, Avery (UMMZ 76415); Graham (UMMZ 72834); Haywood (UMMZ 97588); Transylvania (UMMZ 97593).

OKLAHOMA, Carter (UOMZ 9073); Cleveland (UOMZ 6430, 13755, 20155, 25547, 26239, 26972; UMMZ 77124); Hughes (UOMZ 22926, 22930); McCurtain (UMMZ 77543); Murray (UOMZ 854, 856, 23142); Okmulgee (UOMZ 12369-70, 12374; UMMZ 64629-30); Pawnee (UOMZ 7973); Pottawatomie (UOMZ 13620, 13623, 13977, 18798, 18802); Tulsa (UMMZ 88571, 97936-38).

SOUTH CAROLINA, Anderson (USNM 1563); Laurens (UMMZ 97922); Lexington (UMMZ 84143).

TENNESSEE, Cumberland (UMMZ 97921); Lawrence (UMMZ 97919); Obion (UMMZ 53227).

TEXAS, Jasper (UMMZ 68437).

Elaphe o. obsoleta x quadrivittata

NORTH CAROLINA, Hyde (UMMZ 81107-08); Onslow (UMMZ 91456)

Elaphe obsoleta quadrivittata

FLORIDA, Alachua (UMMZ 57028, 57754, 57355, 57767-68, 77213, 98647); Dade (UMMZ, UMMZ 84087, 91916-17); Hendry (UMMZ 99249); Hillsboro (UMMZ 61657); Indian River (UMMZ 54094a-c); Lake (UMMZ 77473-74); Marion (UMMZ 40656); Monroe (UMMZ 67703; USNM 84295); Palm Beach (UMMZ 90181); Pinellas (UMMZ 40653).
SOUTH CAROLINA, "probably Charleston" (ANSP 3773); Berkeley (ChM 35.3.6); Charleston (ChM Rec'd. 426, 27.271, 31.213, 33.369, 38.310, 49.71.2); Dorchester (UMMZ 94938).

Elaphe obsoleta quadrivittata x spiloides

FLORIDA, Levy (UMMZ 91918-19); Madison (UMMZ 72808).

Elaphe obsoleta spiloides

ALABAMA, Lee (UMMZ 86157; USNM 102597).
FLORIDA, Jefferson (USNM 63276).
MISSISSIPPI, Desoto (UMMZ 84449); Harrison (UMMZ 76795-97); Lauderdale (UMMZ 90120a-b); Webster (UMMZ 97924-25).

Elaphe obsoleta spiloides x obsoleta

TENNESSEE, Hardeman (UMMZ 97917-18, 97920); Madison (UMMZ 72478, 74701, 78511-13).

Elaphe obsoleta spiloides x lindheimeri

LOUISIANA, Orleans (UMMZ 71454, 97931); St. Charles (UMMZ 97930); St. Tammany (UMMZ 70721); West Carroll (UMMZ 36056-57).

Elaphe obsoleta lindheimeri

LOUISIANA, Iberia (UMMZ 97929).

TEXAS, Bandera (TNHC 1607); Bexar (UMMZ 88482-84); Calhoun (USNM 1734); Comal (UMMZ 69704); Comanche (UMMZ 70482-83); Montague (UMMZ 92771); Travis (TNHC 1632, 5245, 5949); Wharton (UMMZ 92770); Williamson (TNHC 4523).

Elaphe obsoleta lindheimeri x bairdi

TEXAS, Kerr (DZTU 3534).

Elaphe obsoleta bairdi

TEXAS, Jeff Davis (USNM 10403).

MEXICO, Nuevo Leon (UMMZ 99758).

Elaphe t. triaspis

BRITISH HONDURAS, Belize (USNM 24903).

GUATEMALA, Peten (USNM 64906).

MEXICO, Quintana Roo (B. F. Osorio, 5 spec.); Yucatan (AMNH 7866, 38842-45; CNHM 20624, 26970, 40723, 49345; MCZ 7250, 28751-52; UMMZ 68234-35, 83293, 83929-30; USNM 46398, 46574-77, 46579).

Elaphe triaspis mutabilis

COSTA RICA, (ANSP 22376); Herida (MCZ 15270); San Jose (MCZ 28068; USNM 9777).

GUATEMALA, (USNM 6745, 24729-30, 61066).

HONDURAS, Tegucigalpa (MCZ 49804-05).

NICARAGUA, Matagalpa (UMMZ 56496).

Elaphe triaspis mutabilis x chlorosoma

GUATEMALA, Chimaltenango (UMMZ); Santa Rosa (UMMZ).

Elaphe t. triaspis x chlorosoma

MEXICO, Chiapas (USNM 46512).

Elaphe triaspis chlorosoma

ARIZONA, Santa Cruz (ANSP 17895).

MEXICO, Colima (CNHM 16161; MCZ 11417, 37156; UMMZ 80210); Distrito Federal (AMNH 19838); Guerrero (CNHM 38293-94; MCZ 42656; MVZ 45076-85); Jalisco (AMNH 19770); Michoacan (UMMZ 99759); Oaxaca (AMNH 65117-19, 65738, 65891, 66850; UMMZ 82569-70; USNM 110299-301); Puebla (UMMZ 99891, 99893); Tamaulipas (UMMZ 101274).

Elaphe rosaliae

BAJA CALIFORNIA, (MVZ 10672, 13767).

Elaphe subocularis

NEW MEXICO, Dona Ana (PSM 6063); Eddy (KUMNH 8436).

TEXAS, Brewster (CAS 7823, 12242-43; CNHM 27702; UMMZ 90634; USNM 103664); Culberson (UMMZ 91470-71); Jeff Davis (AMNH 28372; ANSP 17049-50, 13733-36, 22179; MCZ 6652; UMMZ 50002); Presidio (TNHC 3284, 3286, 3290, 3348, 3492, 3522, 3883-85, 3904, 3920-21); Terrell (TNHC 7680, 8130, 8453); Val Verde (TNHC 4771).

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