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A New Water Snake from Mexico, with Notes on Anal Plates and Apical Pits in *Natrix* and *Thamnophis*

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Striped specimens of the Mexican west coast water snake, *Natrix valida*, which strongly resemble a garter snake of the genus *Thamnophis*, have been known from the vicinity of Tepic, Nayarit, for a number of years. The first was obtained on July 28, 1934, by Edward H. Taylor, one of the earliest of the more recent collectors to work in western Mexico. Others have since been taken in the same general area, but, significantly, were not recognized as water snakes in the field, and their true identity was discovered only when preserved "garter snakes" were being catalogued at a later date.

The acquisition of population samples of striped natricine snakes from near Tepic was a major objective of field work undertaken during the summer of 1959 with the support of the National Science Foundation. Twenty-four adult specimens of *Natrix* were caught alive, and three of these subsequently gave birth to litters of young. Concurrently, 18 adults of *Thamnophis eques* were collected, many in apparently identical habitats with the water snakes. The latter are members of a previously unrecognized race for which I propose the name that follows:

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***Natrix valida thamnophisoides*, new subspecies**

Figure 1

HOLOTYPE: A.M.N.H. No. 84091, an adult female collected July 3 or 4, 1959, along the Río San Cayetano (Río de Tepic on some maps and also known locally as the Río Mololoa), approximately 3½ miles southeast of Tepic, Nayarit, Mexico, by Roger Conant.

DIAGNOSIS: A *Natrix* of medium size characterized by (1) a prominent light middorsal stripe and (2) a light area on the first two or three rows of scales that imparts the effect of a light lateral stripe on each side of the body. Longitudinal stripes are lacking in *valida* and *isabelleae*, the other "mainland" races of the species. In *celaeno*, the subspecies inhabiting the Cape Region of Baja California, there is no middorsal stripe, and lateral light stripes, if present, have highly irregular borders (see fig. 1 in Conant, 1946). In *Natrix erythrogaster* and *Natrix rhombifera*, the only other species of the genus known to occur in Mexico, the number of scale rows at or near midbody is 23 or more, in contrast with 19 (occasionally 21) in the several races of *valida*.

DESCRIPTION OF HOLOTYPE: The dorsal cephalic shields are the same in number and arrangement as in other races of *valida*. There are two nasals; the anterior contains the nostril entirely within it. The loreal is slightly wider than high. There is one preocular, and there are two postoculars on the left side of the head and three on the right. The temporals number one in the first row, two in the second, and three in the third. The supralabials are eight in number, with the sixth the largest; the fourth and fifth enter the orbit. There are 10 infralabials, with the sixth the largest; the first pair meet on the midventral line posterior to the mental, and the first five on each side are in contact with the corresponding anterior chin shield. The chin shields are arranged in two pairs, and all are subequal in length.

Scale row counts are 21 - 19 - 21 - 19 - 17; all dorsal scales are carinate throughout the length of the body and tail, except that those of the lowermost row are smooth on the neck. The decrease from 21 to 19 on the neck results from the fusion of the fourth and fifth rows above the tenth ventral on the right side of body and the fusion of the third and fourth rows above the ninth ventral on the left. The reduction to 17 rows results from the fusion of the third and fourth rows of scales above the seventy-seventh ventral on the right and above the seventy-sixth on the left. The irregular insertion of a left and a right paravertebral row of scales a short distance anterior to the midbody region results in a count of 21, which can be made continuously from the level of the forty-eighth to the fifty-seventh ventral.

Faint indications of paired apical pits are evident on some of the scales of the fifth, sixth, and seventh dorsal rows from about the level of the fifth to the tenth ventral scute.

There are 134 ventrals (including three smaller, less widened scales on the throat); a half ventral is wedged in on the left side of the body between ventrals 34 and 35. The anal plate is divided. The subcaudals are in 68 pairs. The tail is terminated by a short, sharp spine.

Measurements and proportions are as follows: Total length, 605 mm.; tail length, 145 mm.; tail length divided by total length, 24 per cent.

The dorsal ground color is brown (*Sepia*¹), the middorsal stripe tan (*Isabella* Color), and the lateral "stripes" are Light Brownish Olive. The pale middorsal stripe, originating on the second scale posterior to the common suture of the parietals, is one scale in width for the distance of a few scales, but then widens to include a portion of the scales of each of the paravertebral rows, and continues without interruption to the base of the tail, where it terminates. The two rows of scales on each side of the middorsal stripe are darker brown than the ground color below them. The lateral light "stripe" involves the three lowermost rows of scales plus the lateral edges of the ventrals. A longitudinal row of very dark (almost black) spots is situated on the fourth row of scales, with each spot less than one scale in width and separated from the adjacent spots by a distance of one or two scales. A similar, but less well-defined, row of dark spots occurs on the seventh and eighth scale rows. Connecting each dark spot on the fourth row of scales with each adjacent dark spot is a narrow, slightly curved, pale yellowish line, but this is confined to the skin between the scales. The dark spots on rows seven and eight are connected by *pairs* of narrow yellowish lines. (These pale longitudinal markings are not discernible in the photograph, fig. 1, but could be seen when the skin was stretched in the live animal. They are prominent in the preserved specimen, which increased perceptibly in girth by virtue of feeding well during the several months it was maintained in captivity.) The dorsal surface of the tail is brown and virtually unmarked.

The top of the head is Brownish Olive. The labials are pale yellowish brown, with the dark markings on the sutures between them varying from light brown on the lower labials to black on the upper. The chin and throat are cream-colored, and this tint gradually merges into the belly coloration, which is a pale yellow that gradually darkens posteriorly. The ventrals on the posterior two-thirds of the belly are lightly

¹ Capitalized color names are in accordance with Ridgway (1912). All color descriptions in this paper are from life.

washed with pale grayish brown, except for the posterior edge of each ventral, which is yellowish. The anal plate is pale yellow and unmarked, except for its lateral edges which match the coloration of the lateral "stripe." The subcaudals are mottled with light grayish brown and pale yellow; a narrow, irregular, grayish brown line extends down the center of the under surface of the tail.

The pupil of the eye is black and very narrowly ringed with yellow; the iris is brown (Bister). The tongue is pink at its base; the tips are black; the upper surface is dusted with dark stippling and is thus slightly darker than the under surface.

PARATYPES: A.M.N.H. Nos. 84092–84100, collected at the same locality and on the same days as the holotype; A.M.N.H. Nos. 84101–84122, a litter of young born to A.M.N.H. No. 84100 on July 8, 1959; A.M.N.H. Nos. 84123–84133, 84146, from a tributary of the Río San Cayetano, 14 miles southeast of Tepic, July 7, 1959; A.M.N.H. Nos. 84134–84145, a litter of young born to A.M.N.H. No. 84133 on July 11, 1959; A.M.N.H. Nos. 84147–84150, a litter of young born to A.M.N.H. No. 84146 on August 4, 1959; C.N.H.M. Nos. 115617, 115618, Tepic, July 28, 1934; A.M.N.H. No. 68539, Tepic, August 2, 1947; A.M.N.H. No. 75751, Hacienda de Garcia, 3.2 miles southeast of Tepic, January 12, 1956. All localities are in the state of Nayarit.

VARIATION AMONG THE PARATYPES: The light middorsal stripe is clearly evident in all paratypes except two that were preserved many years ago, viz.: A.M.N.H. No. 68539, a female, $575 \pm$ mm. in total length, in which the stripe is conspicuous on the neck but faint throughout the remainder of the body; and C.N.H.M. No. 115618, also a female, 759 mm. in total length, in which the stripe is virtually absent, although it can vaguely be detected when the specimen is immersed. In two additional paratypes (A.M.N.H. No. 75751 and C.N.H.M. No. 115617) that also were preserved by others, the stripe is prominent throughout the length of the body.

With the exception of the four specimens mentioned above, all paratypes, as well as the holotype, were seen in life. The following summary is based in part on color notes made in the field, and part while several of the specimens were under observation in captivity: The pale middorsal stripe is usually one scale wide, but frequently it also involves the edges of the adjacent rows of scales, rarely as much as one-half of each. The lateral light "stripe" normally includes all the lowermost three rows of scales, but dark pigment from the dark spots on the fourth scale row in some specimens extends downward to involve part of the third row, thus interrupting the "stripe" along its upper edge. Small black spots

are present in some individuals on the edges of the scales of the first three rows of scales. All males and young adult females approached the type closely in general coloration, although the shade of brown of the ground color and the tint of tan of the middorsal stripe varied from specimen to specimen. In two large females with incomplete tails, but both with head-body lengths in excess of 600 mm. (A.M.N.H. Nos. 84094, 84095), the coloration was dull, the ground being grayish brown and the middorsal stripe pale grayish brown. Among the newly born young there was less contrast between the light stripes and the dorsal ground color; individuals varied in general coloration and were described variously in the field notes as "gray, gray-brown, or slightly orange-brown."

Some specimens tend to be more conspicuously striped than others. This is especially apparent in the mother (A.M.N.H. No. 84100) of the litter of 22 young born July 8, 1959. The pattern in this snake, which measures 713 mm. in total length, may be described as follows: The light middorsal stripe is strongly pronounced and is one scale wide. Flanking it on each side is a row of bold black spots, on the eighth and ninth scale rows, which are joined with one another by dark brown pigment, producing an over-all effect of a dark stripe. Below each of these is a light brown longitudinal area about three scales wide that is virtually unmarked. Next below is another row of bold black spots, on the fourth scale row, which are also joined together by dark pigment. The lowermost three rows of scales are light brown, with numerous, but scattered, small black spots that are situated at the lower edges of the scales. In essence this specimen has nine longitudinal "stripes"—two dark and two light ones on each side of the body, plus the pale middorsal stripe. The young of this snake are similar in pattern and markings, although the individual "stripes" are in far less contrast with one another than are those of the mother.

The anal plate is divided in all specimens. Variations in scutellation among the type series are summarized in table 1. No important differences are noticeable when scale counts for this series are compared with counts from populations of the subspecies *valida*, the race occurring on the Pacific coastal plain from Nayarit to Sonora. Statistical analyses are reserved for a later paper on the water snakes of Mexico.

Paired apical pits were found in only two adult specimens, in addition to the holotype, and in these they were faint and confined to only a few scales in the nuchal region. Faint pits were also noted on a few scales of the neck in four of the litter of 22 young.

INTERGRADATION WITH *Natrix valida valida*: Seven specimens of the *Natrix valida* complex (A.M.N.H. Nos. 84084–84090) were collected in a

TABLE 1
VARIATION IN SCUTELLATION AND TAIL LENGTH PROPORTIONS
IN *Natrix valida thamnophisoides* FROM NEAR TEPIC, NAYARIT

	Adult Males (11) ^a	Captive-born Males (22)	Adult Females (17)	Captive-born Females (16)
Scale rows	19-17 (11)	19-17-16 (2) 19-17 (18) 21-19-17 (1) 19-21-19-17 (1)	19-17 (11) 21-19-17 (2) 19-21-19-17 (1) 21-19-21-19-17 (3)	19-17-15 (2) 19-17 (10) 21-19-17 (3) 19-21-19-17 (1)
Ventrals	134-141 (11) M ^b = 137.4	132-142 (21) M = 137.0	129-138 (17) M = 134.8	131-140 (16) M = 135.8
Subcaudals	69-80 (7) M = 75.1	69-79 (22) M = 74.0	67-73 (9) ^c M = 68.9	63-72 (16) M = 68.3
Supralabials	8 (22)	7 (2) 8 (40) 9 (2)	7 (2) 8 (27) 9 (5)	7 (1) 8 (30) 9 (1)
Infralabials	9 (1) 10 (20) 11 (1)	9 (2) 10 (42)	9 (3) 10 (31)	10 (31) 11 (1)

TABLE 1—Continued

	Adult Males (11) ^a	Captive-born Males (22)	Adult Females (17)	Captive-born Females (16)
Preoculars	1 (22)	1 (43) 2 (1)	1 (33) 2 (1)	1 (16)
Postoculars	2 (5) 3 (7)	2 (1) 3 (43)	2 (3) 3 (31)	2 (4) 3 (27) 4 (1)
Temporals, 1st row	1 (22)	1 (44)	1 (34)	1 (32)
Temporals, 2d row	2 (9) 3 (13)	2 (31) 3 (13)	2 (13) 3 (21)	2 (15) 3 (17)
Tail length/total length	26% (2) 27% (4) 28% (1)	25% (7) 26% (8) 27% (3) 28% (3) 29% (1)	24% (4) 25% (2) 26% (2) ^c	24% (3) 25% (7) 26% (5) 27% (1)

^a Figures in parentheses indicate sizes of samples.

^b M_j mean.

^c An aberrant female with 81 subcaudals is excluded. If the specimen were included, the mean would be 70.1, and the tail would be 28 per cent of the total length.

small stream near Rosamorada, Nayarit, during the evening of July 10, 1959. These show considerable variation in pattern and coloration, and I interpret them as intergrades between *valida* and *thamnophisoides*. Mid-dorsal light stripes occur in four as follows: prominent in the two smallest (male, 312 mm.; female, 387 mm.—all measurements are total lengths); barely perceptible in the third (male, 504 mm.); and present on the neck only, for a distance of about 25 scales, in the fourth (female, 594 mm.). Lateral "stripes" occur in the two smallest specimens and the largest, and they are faintly suggested in two other adults. One snake (female, 544 mm.) has no indication of stripes and is marked with relatively large and conspicuous black spots. The largest specimen of the seven (male, 648 + mm., with a small part of the tail tip missing) has a bold, narrow, black stripe along the common suture of the ventrals and the first row of scales, and approximately the central half of the belly is occupied by jet black pigment that is virtually continuous from the throat to and under the tail. The general dorsal coloration of these seven specimens was variable in life (Olive-Brown, Cinnamon-Brown, Chestnut-Brown, Sepia, and so on). The middorsal stripe in the two smallest specimens was Russet. Those lacking stripes are identical in appearance with many specimens of *Natrix valida valida* from farther north along the coast, as is also the only other *Natrix* available from near Rosamorada (female, 612 mm.), taken near Chilapa, Nayarit (A.M.N.H. No. 75752).

Water snakes, from the vicinity of San Blas, Nayarit, which lies at sea level almost directly west of Tepic but in a different watershed, show evidence of mixed affinities. Among the nine specimens available (L.B.S.C. No. 660711-1; F.A.S. Nos. 12485, 12941, 12947, 12952, 14079, 14080; U.M.M.Z. Nos. 114638, 118914) there are no middorsal stripes. Five fall within the range of color pattern variation of typical *valida*, but all the others are dark, both above and below, especially on the ventral surfaces. One is comparable with the black-bellied specimen from Rosamorada, another has the venter almost completely black, but in the remaining two the dark ventral markings are considerably less evident, being grayish in one and reduced to a dusky dark line down the center of the belly in the other. In all four dark snakes, however, the lowermost two and one-half to three rows of scales are noticeably paler than the rest of the dorsal surface, thus imparting the effect of a light lateral "stripe." In one adult (female, 600 + mm.) the head is black, both above and below, except for a few irregular dark gray areas on the throat; in another (female, 497 mm.) the top of the head is dark brown.

DISTRIBUTION: As indicated by the data accompanying the holotype and paratypes, *thamnophisoides* is known from Tepic and 3.5 and 14 miles southeast of the same city. These localities, which vary from 3000 feet (Tepic) to 3350 feet above sea level, are by far the highest stations known to be inhabited by *Natrix valida*, an essentially lowland species.¹ All are from the Río San Cayetano (otherwise known as the Río de Tepic or Río Mololoa; see p. 2) or one of its tributaries. This stream, which passes through Tepic, is part of the drainage system of the Río Grande de Santiago, a large and important river that has its source in the Lago de Chapala, Jalisco, and reaches the Pacific a short distance northwest of San Blas, Nayarit. With the lack of evidence to the contrary, it may be speculated that the species ascended the escarpment to the plateau by working upstream along the Santiago and one or more of its tributaries. An alternate, but improbable, hypothesis is that *valida* may have moved headward along the small, fast-flowing streams that descend from the uplands near San Blas, and then crossed overland to the Río San Cayetano. A detailed interpretation of stream history of the region, if such were available, would be illuminating.

The basin in which Tepic and the two other localities are situated exhibits only moderate relief, and even when the Río San Cayetano is in flood, as it was during July, 1959, its flow is sufficiently sluggish to have little effect upon *Natrix* and other riparian species. Many of the specimens of *thamnophisoides*, including three that were on the prowl after dark, were collected along the banks of the San Cayetano itself; others were taken in a complex of springs and seepage runs 50 to 100 yards from the river. Still others, in the tributary upstream, were found in emergent vegetation or near mats of floating hyacinths. Such habitats strongly resemble those in which the species occurs in the coastal lowlands.

The Rosamorado locality, from which a population sample is available that may be designated as *Natrix valida valida* \times *thamnophisoides*, is not in the drainage of the Río Grande de Santiago, nor, strictly speaking, is it even in the drainage of the Río San Pedro, the next large stream (about 10 miles) farther north. But the area is in contact, at least during the rainy season, with a large marshy region paralleling the

¹ A possible but dubious exception involves the type specimen (U.S.N.M. No. 1309) of *Natrix valida valida*, collected more than a century ago and said to be from Durango, state or city not indicated. On the basis of the known range of the species, it was presumed to be from a low elevation in the western part of the state (Conant, 1946, p. 260). Field work in the Durango (city) basin (elevation *circa* 6200 feet) in the summers of 1959 and 1960 failed to produce specimens.

coast for a distance of approximately 60 miles in Nayarit and southern Sinaloa. This is known as the Marismas Nacionales (National Swamps) and is associated with the complex delta system involving not only the Santiago and San Pedro but also the Río de Acaponeta and other rivers farther north. Movement of water snakes and hence some gene exchange must occur with relative facility throughout much of this region. It is also possible that the *Natrix* populations in the San Blas area have (or previously had) contact with populations to the north at or near the mouth of the Río Grande de Santiago.

There is little variation in color pattern in *Natrix valida valida* except in the extreme southern part of the range of that subspecies. This is exemplified by the material from Rosamorada and near San Blas. The sample from Rosamorada includes some specimens with light middorsal stripes (as in *thamnophisoides* from the uplands), and the samples from both Rosamorada and San Blas include individuals with black bellies. The coastal plain north of the escarpment near San Blas might be likened to a long narrow peninsula throughout most of the length of which the water snakes are quite similar in appearance. But extensive variation is encountered at the southern extremity of the "peninsula," where the mixed color patterns exhibit a striking parallel with the populations of a related subspecies, *Natrix valida celaeno*, indigenous to the Cape Region of Baja California. Specimens of *celaeno* may be sorted into four pattern variations among what appears to be a freely interbreeding population (Conant, 1946, pp. 266-268).

The coastal plain, which is relatively wide in Sonora, Sinaloa, and much of Nayarit, is greatly narrowed and even interrupted south of San Blas where the plateau descends sharply to the Pacific, forming rocky headlands that jut into the ocean. This constriction serves as a barrier against movements of such semi-aquatic animals as water snakes, as indicated by the differentiation of *Natrix valida* into two coastal races, *valida* to the north and *isabelleae* to the south, with the break between them occurring at or near the point of constriction.

Other cold-blooded vertebrates, including at least two fishes, are similarly limited by the same barrier. The eleotrid *Gobiomorus polylepis* occurs in coastal rivers from southwestern Nayarit to southern Oaxaca (Miller, 1959, p. 2) and thus closely parallels the range of *isabelleae*, which as yet, however, has not been taken east of the Acapulco region. The anchovy *Anchoviella analis* occurs northward from the vicinity of Tuxpan, Nayarit, to near the mouth of the Río Yaqui (Miller, 1960, p. 252), a range like that of the subspecies *valida*. This race of the water snake is now known to occur far to the north of Culiacán, Sinaloa, the

northernmost station when the species was first reviewed (Conant, 1946, p. 259). Frederick A. Shannon has taken it in the Río Mayo, I have found it in the Mayo and the Ríos Fuerte and Sinaloa, and McCoy, Branson, and Sisk (1960) report it from the Río Yaqui.

The toad *Bufo mazatlanensis*, known from northern Sonora to Banderas Bay, has a similar distribution (Zweifel, 1960, p. 118). So also, in part, does the attenuated snake *Imantodes gemmistratus latistratus*, which occurs in the coastal plain from southern Sonora to southern Nayarit, but thence ranges inland to occupy upland localities as far east as Morelos and Guerrero (Zweifel, 1959, p. 11). It is replaced in coastal regions farther south by the related subspecies, *I. g. gracillimus*, which has a range rather closely matching that of *Natrix valida isabelleae*.

Zweifel (1960, p. 107) suggests the possibility of a three-way split in races of *Lampropeltis triangulum* (= *doliata*) in the general region comprising southern Nayarit, neighboring portions of Jalisco, and Colima, with one, "a distinct form currently referred to *nelsoni*," extending northward along the coast.

I may have overlooked other examples of comparable ranges. Also, it is predictable that several additional species or subspecies of reptiles and amphibians, as well as of other animals and plants, will eventually show similar breaks in speciation and distribution in the region where the coastal plain is constricted. Although it is tempting to speculate upon which forms might be so listed, it is premature to do so in view of our present fragmentary knowledge concerning their distributions. Much field work will be needed in the relatively inaccessible coastal and adjacent areas from San Blas to Manzanillo before the ranges of many organisms can be plotted with reasonable accuracy.

In summary, in so far as *Natrix valida* is concerned, the material presently available indicates that this water snake, although essentially a lowland species, has ascended the escarpment and achieved an outlier of the Mexican plateau in the vicinity of Tepic, Nayarit. There it has become differentiated from coastal *valida* to the extent of acquiring a longitudinally striped pattern. An intergrading population exists near Rosamorada in a lowland locality lying not far north of the mouth of the Río Grande de Santiago, which drains the Tepic basin and may have served as the avenue of migration. Another population with pronounced variations in pattern occurs at or near sea level in the vicinity of San Blas. Until more material and information accrue from a reconnaissance of the region, conclusions concerning the relationships of the several lowland populations near and immediately to the north of San Blas must remain tentative.

*Thamnophis eques*¹

Figure 2

As indicated above, 18 adult specimens of *Thamnophis eques* (including A.M.N.H. Nos. 83953–83969) were collected 3.5 miles southeast of Tepic, Nayarit, on July 3–4, 1959, where and when 12 *Natrix valida thamnophisoides* also were obtained. All the garter snakes, however, were found in or near the seepage runs or the marshy areas near and between them; none was along the river. Also, all were diurnal, in contrast with three of the *Natrix* and with other specimens of the *Thamno-*

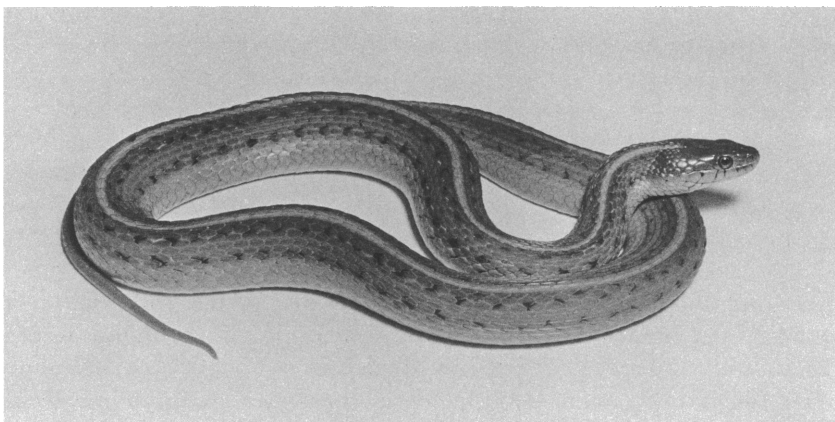


FIG. 1. *Natrix valida thamnophisoides*, female, holotype, A.M.N.H. No. 84091, from the Río San Cayetano, 3½ miles southeast of Tepic, Nayarit, Mexico, July 3 or 4, 1959. Length, 605 mm.

phis eques complex, which were seen actively prowling at night in the Lago de Chapala, Jalisco, about a week later.

The light stripes in freshly shed *eques* are more strongly evident than in freshly shed *thamnophisoides* (fig.1), but when either is approaching ecdysis or has the markings obscured, as, for example, after crawling in mud, the two are surprisingly similar in appearance. I confess to checking the anal plate (see below) to be sure of the identification of several of them in the field.

Among this series of *eques* there was relatively little variation in coloration or pattern in living examples except that the larger specimens were

¹*Sensu* Smith (1951). I avoid the use of trinomials in view of studies pending on this species complex.

duller and darker than the smaller ones, and the dark spots in the areas between the light stripes were more prominent in some than in others. The coloration in a more or less typical individual (A.M.N.H. No. 83961, male, 507 mm.) was recorded in life, as follows: The middorsal stripe is Olive-Ocher anteriorly, gradually darkening posteriorly, especially on the tail; this light stripe is narrowly bordered by black. The lateral stripes are Amber Yellow anteriorly, gradually changing to Straw Yellow near the tail. The dark stripe between the light ones is brown (Raw Umber), and the dark stripe on the lowermost row of scales

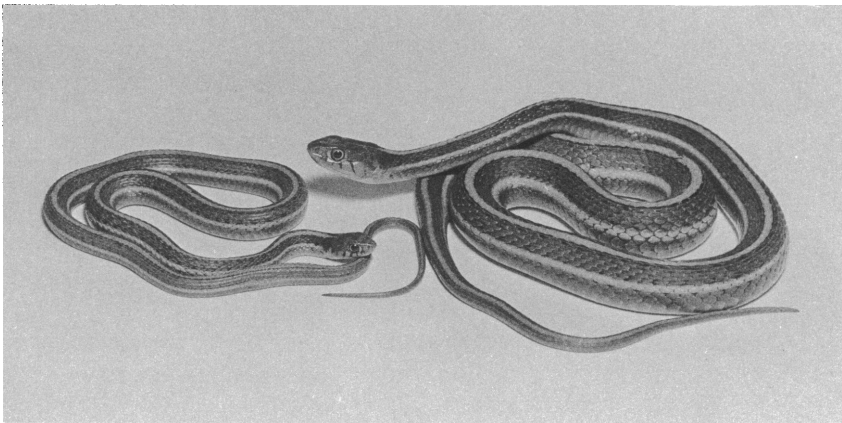


FIG. 2. *Thamnophis eques*, adult male (left) and adult female from the Río San Cayetano, 3½ miles southeast of Tepic, Nayarit, Mexico, July 3 or 4, 1959.

is bright brown (Sudan Brown). The top of the head is olive (Medal Bronze). The labials are dull yellow (Primuline Yellow), and the chin and throat pale yellow. The belly is pale olive, except that the base of each ventral (often hidden by the scale overlapping it) is black, and the posterior part of each ventral is edged with yellow. The subcaudals are also pale olive and yellow, but are without any black.

The pupil of the eye is black, margined with yellow, and the iris is dark chestnut. The tongue is pink at its base, but the tips are black.

Anteriorly, the light lateral stripe in these snakes involves the third and fourth rows of scales. The central stripe occupies the middorsal and more than half of the adjacent row on each side.

Paired apical pits are present in the nuchal region of 14 of the 18 snakes of this series. They are discernible on several scale rows opposite the fifteenth scale in the middorsal row, the rows and the number of scales in-

TABLE 2
VARIATION IN SCUTELLATION AND TAIL LENGTH PROPORTIONS
IN *Thamnophis eques* FROM NEAR TEPIC, NAYARIT

	Adult Males (11) ^a	Adult Females (8)
Scale rows	21-19-17 (10) 23-21-19-17 (1)	21-19-17 (7) 23-21-19-17 (1)
Ventrals	164-169 (11) M ^b = 167.1	153-158 (8) M = 155.6
Subcaudals	79-88 (4) M = 84.5	62-74 (6) M = 69.8
Supralabials	7 (11) 8 (11)	7 (2) 8 (14)
Infralabials	9 (2) 10 (20)	9 (2) 10 (14)
Preoculars	1 (22)	1 (16)
Postoculars	3 (22)	3 (11) 4 (5)
Temporals, 1st row	1 (22)	1 (16)
Temporals, 2d row	1 (1) 2 (21)	2 (12) 3 (4)
Tail length/total length	25% (1) 26% (3)	22% (3) 24% (2) 25% (1)

^a Figures in parentheses indicate sizes of samples.

^b M, mean.

volved varying from snake to snake. In one they are present on the fifth row and on all rows upward to and across the back to the fifth row on the opposite side of the body. The middorsal row bears pits in only one other snake, but lateral rows are involved in all the others to and including the fifth row in nine specimens, but descending only to the sixth, seventh, or eighth rows in the remaining ones.

The scutellation, summarized in table 2, includes data for a specimen collected at Tepic in 1940 (U.I.M.N.H. No. 18836). The anal plate is single in all.

“KEY” CHARACTERS FOR THE SEPARATION OF
NATRIX AND *THAMNOPHIS*

The two genera, *Natrix* and *Thamnophis*, represented by the species *valida* and *eques*, respectively, in the descriptions and discussions above,

are closely related and frequently have been lumped together, especially by Boulenger (1893, pp. 192–265) and his followers who assigned them and various other natricine snakes to the genus *Tropidonotus*. The two genera share many characteristics but are usually separated in keys on the basis of the anal plate, which is stated to be divided in *Natrix* and single in *Thamnophis*. Diagnoses by earlier authorities also referred to the presence of paired apical pits in *Natrix* and their absence in *Thamnophis*.

The specimens of *Natrix valida thamnophisoides* and of *Thamnophis eques* from the vicinity of Tepic would all key out correctly on the basis of the anal plate, but on apical pits they would not. In the samples at hand, scale pits occur more frequently and more prominently among the garter snakes than among the water snakes. Deviations have been noted in other species. Many individuals of *Thamnophis* have apical pits or divided anal plates, and many of *Natrix* have single anal scutes or apparently lack apical pits.

It might be instructive and perhaps stimulate further observations to review such data on the subject as are currently at hand.

ANAL PLATES

SINGLE ANAL IN *Natrix*

Among North American members of the genus *Natrix* a divided anal is remarkably constant, except in one species. Among 757 specimens of the *Natrix erythrogaster* complex from the United States, on which I have made detailed scale counts, 71 specimens (9.4%) have the anal plate single instead of divided, and this aberration occurs in all races and in widely scattered localities. In addition, 12 specimens have the anal plate “grooved,” with the imbrication represented merely by a groove across what is essentially a single scale. Thus, approximately 11 per cent of all specimens of *erythrogaster* from the United States would not key out to *Natrix* on the basis of the anal plate. Studies now in progress on the water snakes of Mexico indicate that this condition also occurs in *erythrogaster* in that country.

Evidently *erythrogaster* is unique in this respect, for among several thousand other specimens of North American *Natrix* for which scale counts have been assembled, a single anal has been encountered only six times—thrice in *sipedon* and once each in *insularum*, *confluens*, and *rhombifera*.

DIVIDED ANAL IN *Thamnophis*

Divided anal scutes are known to occur in at least four species of garter snakes, these being:

Thamnophis elegans vagrans: Cope (1900, p. 986) recorded a snake of this

species from Rabeh Valley, Utah (U.S.N.M. No. 4650), as *Natrix valida*, the misidentification resulting from its possession of a divided anal. As a consequence, the range of *valida* was repeatedly misstated in the literature until Van Denburgh (1922, p. 786) called attention to the error and deleted *valida* from the list of species known to occur in the United States. Tanner (1950, pp. 195–196) showed that a divided anal is not rare in populations of *vagrans* from Utah and southern Idaho; 30.3 per cent of all specimens collected in a marshy area east of Provo, Utah, had the anal scute divided.

Thamnophis radix radix: Robert F. Inger (personal communication) informs me that scale counts, accumulated during and since the preparation of the Davis (1932) paper on *Thamnophis butleri*, indicate that one specimen of *radix* among 225 from the Chicago area has a divided anal plate.

Thamnophis rufipunctatus: Lowe (1955) proposed the transfer of *Thamnophis angustirostris* (= *rufipunctatus*) to the genus *Natrix*, basing his conclusions in part on the occurrence of a divided anal in approximately half of a small sample of specimens from Oak Creek, Yavapai County, Arizona. More recently Thompson (1957, p. 8) and Tanner (1959, p. 166), on the basis of much larger series of specimens, rejected Lowe's action and retained *rufipunctatus* in the genus *Thamnophis*. They determined the percentage of divided anals among the Oak Creek snakes to be considerably lower than indicated by Lowe. Among 102 specimens from all parts of the range, Thompson found only eight with divided anals.

Thamnophis sirtalis sirtalis: A female from Tannersville, Pennsylvania, with a divided anal plate, gave birth to 25 young at the Philadelphia Zoo. Among these one had a divided anal, in five the division was represented by a groove, and in 19 the scale was single.

APICAL PITS

The presence of apical pits on most specimens of *Thamnophis eques* and their absence on nearly all those of *Natrix valida* from the vicinity of Tepic, as noted above, may not seem significant to persons unfamiliar with some of the older literature. Nevertheless apical pits at one time were employed to distinguish the two genera; *Natrix* was supposed to possess and *Thamnophis* to lack them. In the diagnosis of the genus *Eutaenia* (= *Thamnophis*) in Cope's great work on the reptiles of North America (1900, p. 1014), the following terse statement appears: "scales keeled, without pores." In the diagnosis of *Natrix* (*op. cit.*, p. 957), Cope states "scales keeled; scale-pits double." Brown (1901), in his review of the genera and species of Amer-

ican snakes north of Mexico, states that *Eutaenia* is "without pits" (p. 18); whereas *Tropidonotus* (= *Natrix*) has "double pits." Even Ruthven, in his monograph on the garter snakes (1908, p. 8), asserts that *Thamnophis* "differs from its nearest American relative, *Natrix*, by the absence of scale pits and the presence of an undivided anal plate." As recently as 1922, Van Denburgh (p. 797), in diagnosing *Thamnophis*, stated "there are no scale pits."

The appearance of Blanchard's key to the snakes (1925), which subsequently formed the basis for a large number of state and regional keys, probably marked the approximate time when apical pits went out of fashion, so to speak. Reliance on the condition of the anal plate in dichotomous keys made it unnecessary to refer to the pits, and mention of the presence or absence of apical pits virtually disappeared from the literature on both *Natrix* and *Thamnophis*.

The authors who denied the presence of scale pits in *Thamnophis* were largely dependent on old, long-preserved material in which it is difficult to find these miniscule depressions or from which the epidermis had been shed. "Shedding in the bottle" is a common phenomenon, particularly if specimens are handled frequently or carelessly or if the animal was approaching ecdysis when preserved. Apical pits, if present, can be clearly seen in fresh material if the surface layer of an individual scale is removed and held against a light (a lens may be needed), but usually no indication of pits is discernible on the portion of the same scale that remains attached to the snake. Denuded specimens may be virtually worthless, especially if several have been stored in the same bottle, making it impossible to trace the origin of the loose scales at the bottom of the container. The problem of finding pits is complicated in other ways. They are often difficult to demonstrate in juveniles or very old individuals. In *Thamnophis* (as well as in *Natrix valida* and some other water snakes) the pits may be confined to the scales of the nuchal region or the sides of the neck; usually they are not distributed over a large portion of the dorsal surface of the body as they commonly are in most North American species of *Natrix*. Also, the pits may be numerous in some specimens, but few or even lacking in other snakes of the same species, even among those of approximately the same dimensions.

At least some of these facts were responsible for my failure to find pits among the several series of *Natrix valida* studied while data were being assembled for my first report on the species (Conant, 1946, pp. 271–272). The later acquisition of live material enabled me to make a correction, at least for a specimen from Guerrero (Conant, 1953, p. 8), and, although I did not attempt to search for apical pits in every individual specimen, I

can now record the following observations:

Examination of *Natrix* material recently collected in Mexico, from Sonora to Guerrero, indicates that the frequency of occurrence of scale pits varies from one locality to another. They were found in only a few specimens of *thamnophisoides* from the uplands (as shown above) and occurred only sparingly in some of the lowland populations. On the other hand they were noted in the nuchal region among 13 of 16 specimens of *isabelleae*, varying from 226 mm. to 847 + mm. in total length, from Pie de la Cuesta, near Acapulco, Guerrero. In four of these the pits were numerous and involved all or virtually all scales down to and including those of the second row; in six they involved only a few scales; in three there were very few, being noted, for example, on only two scales in one specimen; in the remaining three, measuring 226 mm., 403 mm., and 568 mm., respectively, no pits were found. In a series of seven specimens of the nominate subspecies from the Río Piaxtla, at Ixpalino, Sinaloa, pits were present in the nuchal region of most of them. Pits also were noted on the neck of a specimen from the Río Sinaloa, at Guasave, Sinaloa, and another from the Río Yaqui, near Ciudad Obregon, Sonora.

Although, again, I made no exhaustive examination, the presence or absence of paired apical pits may be reported among the species and subspecies of *Thamnophis* in the annotated list below. Pits have been observed by the examination of: (1) live specimens, (2) individual scales removed from recently preserved material, and (3) shed skins. In the last case, freshly shed skins were mounted and dried on pieces of white cardboard, a method that makes the scale pits stand out clearly, with the extent of the pitting and the number of scale rows involved quickly evident. During 1959 and 1960 Mrs. Conant and I brought many garter and water snakes home alive from Mexico, and, as they shed, their skins were mounted and stored.

Unexpectedly I have had the welcome assistance of Mr. Neil D. Richmond, of the Carnegie Museum, who became interested in apical pits in *Thamnophis* about the same time that I did. He has given me permission to publish his data, as indicated by his initials in the following list:

Thamnophis brachystoma: None is present (N.D.R.).

*Thamnophis dorsalis dorsalis*¹: Faint pits occur on a few scales of the neck in an adult from Chihuahua; none is evident in another from Durango.

*Thamnophis dorsalis cyclides*¹: None is visible in one from Michoacán.

Thamnophis elegans hydrophila: Pits are present in the nuchal region in two (N.D.R.).

¹ For the use of *dorsalis* instead of *cyrtopsis*, see Fitch and Milstead (1961).

Thamnophis eques: Pits occur in 14 of 18 snakes from near Tepic, Nayarit (see above). They are present but confined to the nuchal region in three large adults from the Lago de Chapala, Jalisco: prominent and numerous in one, prominent but scant in the second, and few and faint in the third. In a fourth specimen from the same locality, pits are present on most of the dorsal scales from head to anus. Pits are prominent in the nuchal region and well back on the body in three from the Lago de Cuitzeo and one from the Lago de Pátzcuaro, Michoacán. Pits are present in the nuchal region in two from Durango, and also on scales well back on the body in one of these.

Thamnophis marcianus marcianus: There are a few in the nuchal region in one from Nuevo León.

Thamnophis melanogaster canescens: Among five snakes from Durango and Michoacán, pits occur on a few to many of the neck scales in four specimens but are absent from the fifth.

Thamnophis rufipunctatus: Among four specimens from Durango, pits occur on some scales in two and are numerous in two others, but all are confined to the nuchal region. None is present in two other specimens (N.D.R.).

Thamnophis sauritus sauritus: None is present (N.D.R.).

Thamnophis sauritus proximus: Pits are prominent in the nuchal region of an exceptionally large female (1092 mm. in total length) from Coahuila.

Thamnophis sirtalis sirtalis: Over half of those examined have scale pits in the nuchal region, and an occasional one has distinct pits throughout its length. Specimens with pits have been seen from the following states: Alabama, Arkansas, Florida, Pennsylvania, Virginia, and West Virginia (N.D.R.).

In view of the information presented above, it is rather startling to read about the "absence of apical pits in *Natrix valida* and all *Thamnophis*" in a recent paper by Smith and Huheey (1960, p. 162). Perhaps they relied on statements in the literature instead of examining recently caught or newly preserved specimens.

Scale pits have been found among all species and subspecies of North American *Natrix* for which fresh material is available, although in some species, such as *valida* and *kirtlandi*, they are apparently absent in many individuals and difficult to find in others. No freshly acquired material is at hand from Baja California (*Natrix valida celaeno*). Also I have not checked any specimens of the snake described by Barbour (1943) as *Natrix sipedon engelsi*, which, in my opinion, is a synonym of *Natrix sipedon fasciata*. Dark specimens comparable with Barbour's *engelsi* are now avail-

able from several localities along the Atlantic coast.

Apical pits are worthless as "key" characters for separating *Natrix* from *Thamnophis*. Contrariwise, the condition of the anal plate is useful within limits. Users of keys and diagnoses should bear in mind that some specimens of *Thamnophis* (especially *vagrans* and *rufipunctatus*) have a divided anal plate and that some of *Natrix* (especially members of the *erythrogaster* complex) have a single anal scute.

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SUMMARY

A new striped race of the Mexican west coast water snake, which bears a remarkable resemblance to a garter snake (*Thamnophis*), is diagnosed and described as *Natrix valida thamnophisoides*. Populations of this form are the only members of the species complex known to occur at fairly high elevations. Their distribution is compared with the ranges of the lowland

populations, and intergradation between *thamnophisoides* and subspecies *valida* is discussed.

It is shown that paired apical pits occur on the dorsal scales, especially of the nuchal region, in many *Thamnophis*, thus refuting the statement of several authorities that such pits are absent in all garter snakes. It is also shown that pits may be absent in some water snakes, especially in the *Natrix valida* complex. The condition of the anal plate, whether single or divided, although widely used in keys for the separation of the genera *Natrix* and *Thamnophis*, also varies, at least in a few species.

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