

*Coluber mormon*, a Species Distinct from *C. constrictor*

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## ABSTRACT

For more than 100 years *Coluber constrictor mormon* has been recognized as a subspecies of the eastern racer. However, trenchant differences exist between *mormon* and the neighboring *C. c. flaviventris* in numbers of maxillary and dentary teeth, and there are even greater differences in ecological traits including relative size of egg and number of eggs per clutch. Also, there are average differences in body size, proportions, color, numbers of juvenile blotches, and numbers of supralabials, subcaudals and ventrals, but individual variation results in some overlap in each of these characters. The geographic ranges are widely separated by the physical barrier of the Rocky Mountains, and there is no intergradation. The Western Yellow-bellied Racer should be restored to its original status of a full species, *Coluber mormon*.

## HISTORICAL REVIEW

*Coluber mormon* Baird and Girard (1852) was named as a distinct species, from "Valley of the Great Salt Lake, Utah," and was subsequently found to be widely distributed over the Pacific Coast and Great Basin states. The close relationship of *C. mormon* with the eastern racers (*C. constrictor*) was early recognized. From 1863 onward (Jan, 1863), the trinomial was generally applied to *C. mormon* with use of various synonyms in different combinations (generic names *Bascanion*, *Bascanium*, *Coryphodon* and *Zamenis*; subspecific name *vetustum*). Some authors applied the subspecific (or specific) name, *flaviventris* to both Eastern and Western Yellow-bellied Racers. Van Denburgh (1922) defended the subspecific validity of *Coluber*

*constrictor mormon* against those contemporaries who synonymized it under *C. c. flaviventris* (e.g., Ditmars, 1907; Stejneger and Barbour, 1917) and wrote: "The fact that more than half the specimens from west of the Rocky Mountains have eight labials while those from farther east usually have seven, causes us to continue to regard them as different subspecies." This judgment has remained the *status quo* for the past 59 years.

On the basis of accumulating evidence concerning distribution and ecology, Fitch (1963) wrote: ". . . the range of *mormon* seems to be entirely west of the Continental Divide, well separated from that of *flaviventris* by desert and mountain barriers. The conspecificity of *mormon* with the other subspecies needs to be more thoroughly investigated . . ." Populations of *mormon* and *flaviventris* are sparse and scattered in the regions where they approach each other most closely and no series have been available for comparison of taxonomic characters. Our respective field studies of populations of *C. c. flaviventris* in northeastern Kansas (HSF) and *C. c. mormon* in northwestern Utah (WSB, WSP) reveal hitherto unrecognized additional differences that have definite bearing on their systematic relationships.

#### DISTINCTIVE CHARACTERS

The drab and nondescript appearance of the racers has doubtless tended to mask the fact that there are important differences between *mormon* and *flaviventris*, some of which are subtle. Table 1 shows differences of many kinds and degrees. Individual variation bridges the gap between the two kinds in some characters, including all those of lepidosis. In other characters, however, the two are discrete entities.

The farming of a decisive statement setting forth the differences between *mormon* and *flaviventris* is complicated by the fact that both have extensive ranges and vary geographically, but this variation has not been analyzed. Superimposed on geographic variation are sexual and ontogenetic differences in many characters. Smith (1961) studied the geographic variation in three characters of *C. constrictor* in Illinois. He found evidence of north-to-south clines as shown by the following means: 176.7, 176.5, 179.1, 176.2, 178.7 (number of ventrals); 79.6, 83.6, 85.6, 87.7, 90.9 (number of caudals); and 21.7, 23.8, 23.5, 24.1, 24.4 (relative tail length). Series of males and females were combined to obtain the figures in Smith's samples, but the sexes also have average differences in each of these characters. In several characters such as size and color, *mormon* is more like *flaviventris* than like *Coluber c. constrictor* and other eastern subspecies. However, *mormon* cannot be considered the end form of an east-west cline. Both *mormon* and *flaviventris* seem to be remarkably homogeneous throughout their ranges in some of their distinctive characters. The clutch size of 5 or 6 eggs reported by Brown and Parker (1981) for Tooele County, Utah, is the same as that found for a West Coast sample (Museum of Vertebrate Zoology

Table 1. Diagnostic characters of *Coluber mormon* and *C. constrictor flaviventris*.

Characters	<i>C. mormon</i>			<i>C. c. flaviventris</i>			Source*
	Mean, or typical number or condition	N	Range	Mean, or typical number or condition	N	Range	
Number of teeth							
Dentary			14-16			18-19	Ort.
Maxillary			13-14			15-16	Ort.
Eggs							
Number per clutch	6.44 ± 0.26	43 cl	4-11	11.8	82	5-26	B&P, F <sup>2</sup>
Egg wt. as % ♀ wt.	11.4			3.68	150 eggs 50 ♀♀		B&P, F <sup>2</sup>
Dimensions (mm)	37.8 ± 18.0	54		29.4 × 19.6	150		B&P, F <sup>2</sup>
Size							
♂ S-V (mm)	537 ± 6.10	131	395-695	721 ± 8.34	181	513-1110	B&P, F <sup>1</sup>
♀ S-V (mm)	578 ± 6.70	114	405-735	795 ± 11.16	177	538-1210	B&P, F <sup>1</sup>
♂ Weight (g)	55.6 ± 1.67	136	23.5-97.2	123.14 ± 7.56	50	55-224	B&P, F <sup>1</sup>
♀ Weight (g)	68.6 ± 2.15	114	24.4-128.6	155.33 ± 11.44	50	53-350	B&P, F <sup>1</sup>
Proportions							
Ratio tail/total lgth. ♂	26.76 ± .11	73	23.9-28.9	23.2	360		B&P, F <sup>2</sup>
Ratio tail/total lgth. ♀	25.07 ± .09	72	23.1-27.0	20.9	376		B&P, F <sup>2</sup>
Habitus	stockier (see Fig. 1)			more slender (see Fig. 1)			B&P, F <sup>1</sup>
Color and pattern							
Juv. dorsal blotches			70-85			65-80	Ort.
Adult dorsal color	pale olive gray			dark slaty gray			Ort.
Lepidosis							
Supralabial pairs	8			7			Ort.
Subcaudal pairs	88.7			84.0			Ort.
Ventrals	171.1		160-184	174.3		163-194	Ort.

\*B & P—Brown and Parker ms, F<sup>1</sup>—Fitch mss, F<sup>2</sup>—Fitch 1963, Ort.—Ortenberger 1928.

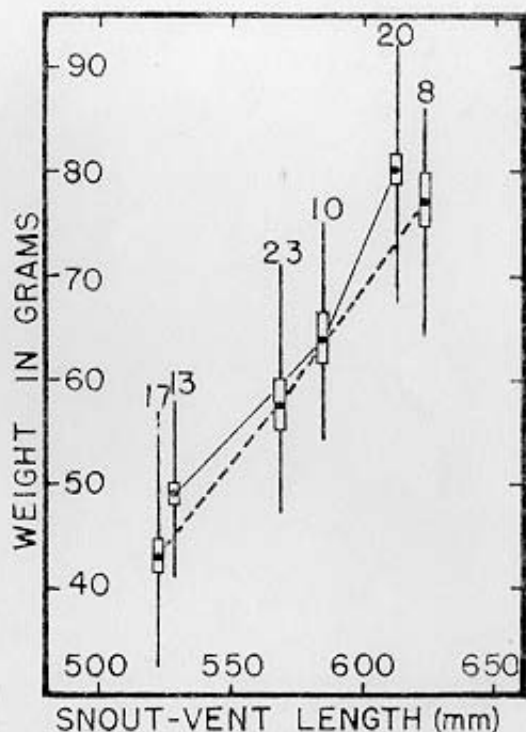


Fig. 1. Length vs. weight plotted for similar sized series of *C. mormon* (upper series of each pair, connected by solid line) and *C. c. flaviventris* (lower series, connected by broken line) showing that *C. mormon* averages heavier for each length. Mean, standard error, range and number of specimens are shown for each sample.

specimens,  $n = 43$ ; Fitch, 1970) and is only about half the mean clutch of *flaviventris*.

#### RANGE RELATIONSHIPS

Differences such as those indicated in Table I do not in themselves demonstrate the specific distinctness of the two western racers. Geographic intergradation is the standard criterion of subspecific status in adjacent differentiated populations. Conversely, the existence of allopatric ranges that come in contact without intergradation (either with no interbreeding, or with production of occasional anomalous hybrids) is acceptable evidence of full species status. Where a barrier separates the ranges so that no contact between individuals of the two kinds is possible in nature, subjective judgments become involved and *potential* interbreeding may be cited as a basis for conspecificity. But, depending on the degree of differentiation, specific status is usually indicated.

The range relationships of *mormon* and *flaviventris* have long been poorly understood. Their ranges have often been mapped as widely contiguous (Behler and King, 1979; Shaw and Campbell, 1974; Stebbins, 1954, 1966; Wright and Wright, 1957) and there are statements in the literature to the effect that geographic intergradation occurs. However, Wilson's (1978) more detailed map of actual localities suggests that there is a broad and continuous hiatus of uninhabitable terrain which separates the range of *flaviventris* on the east from that of *mormon* on the west. This general pattern is broken by just one anomalous specimen (Stuart, 1930) as explained below. In the past it seems to have been generally assumed that gaps between the known ranges could be attributed to lack of collecting, and that these gaps would be filled by further fieldwork. In several recent decades, however, no progress in bridging the hiatus has been made. Racers are not rare or secretive and no extensive areas of the continental United States remain unexplored herpetologically. The accumulated locality records certainly should reflect the actual ranges fairly well.

The distribution of *Coluber* in Wyoming has recently been clarified by Baxter and Stone (1980), who showed that *mormon* does not reach the western edge of the state, although it occurs in nearby eastern Idaho and northern Utah. The many Wyoming records of *flaviventris* are all substantially to the east of the Continental Divide, mostly in the eastern half of the state. The westernmost occurrences are in the vicinity of Lander, Fremont County, near the east base of the Wind River Mountains. In an early account of the fauna and life zones of Wyoming, Cary (1917) listed *Bascanion* [= *Coluber*] *constrictor* as characteristic of the upper Sonoran Life Zone, i.e., of the lower and warmer areas of the state. In general, the many locality records shown by Baxter and Stone (1980) bear out this correlation, but a few are within the Transition Zone. The Wind River Range and Red Desert constitute obvious physical barriers barring *flaviventris* from the western parts of Wyoming and from contacts with *mormon* in adjacent eastern Idaho and northeastern Utah.

Maslin (1959) and Smith et al. (1965) listed Colorado localities and indicated the range of *flaviventris* within the state to be the Great Plains extending to the base of the Rocky Mountains. Racers were shown to be absent from the mountainous western half of the state, except for records of *mormon* along the Colorado River near the Utah border in Mesa County (Grand Junction; 3 miles east of Fruita and 2 miles west of Grand Junction) and Garfield County (Roan Creek Road). South of the Colorado-Utah border both *flaviventris* and *mormon* seem to be present only in relict and widely separated populations, *mormon* at Lake Meade, Nevada, and Eagar, Apache County, east-central Arizona; *flaviventris* in the upper Rio Grande Valley of New Mexico.

Racers (*Coluber constrictor oaxaca*) have been found in small numbers

and at widely scattered localities over much of Mexico (Chiapas, Coahuila, Colima, Durango, Oaxaca) and southeast into Guatemala. Smith (1971) examined all available Mexican material, checking the specimens especially for *mormon* characters, but found that all were assignable to *oaxaca* (formerly *C. c. stejnegerianus*, best known from the lower Rio Grande Valley). Intergradation between *oaxaca* and *flaviventris* occurs in southern Texas where their ranges meet, but *oaxaca* does not intergrade with *mormon*. Their known ranges are separated by hundreds of miles of generally uninhabitable terrain.

The few records in Montana are mostly of *flaviventris* and are mainly in the eastern and southern parts. Three records are of particular interest. Mossiman and Rabb (1952) recorded one specimen of *flaviventris* in the Tiber Reservoir region near the Canadian border to the north and near the east base of the Rocky Mountains to the west, remote from other known occurrences. On the western edge of the state, Rodgers and Jellison (1942) recorded *mormon* near Hamilton (Skalkaho Canyon, Ravalli County) in the Columbia River drainage, and not far from other known occurrences in adjacent northern Idaho. Lastly, Stuart (1930) noted a specimen which he identified as *mormon*, from 8 miles east of Big Timber, Sweet County, Montana, far to the east of the Continental Divide in the valley of the Yellowstone River. The identification as *mormon*, in an area where *flaviventris* might be expected, was made on the basis of supralabials (8), maxillary teeth (13) and dentary teeth (16). The specimen was an adult female, and contained seven large eggs, suggesting affinity to *mormon* rather than *flaviventris*. This single and anomalous specimen seems to confuse rather than clarify the relationship between the two forms. It may be an abnormal "mormon-like" example of *flaviventris*. Or it may represent a small and well isolated relict population of *mormon* surviving from a past time of warmer climate when that species was able to cross the Continental Divide and establish itself east of the Rocky Mountains.

The distribution of racers in Canada has been reviewed by Froom (1972) and Cook and De Jong (1975). Cook stated that *mormon* occurs in the dry interior of British Columbia in the Okanagan, Similkameem and Fraser Valleys, from Seton Lake and Kamloops east to Midway. For *flaviventris* the only records are from Saskatchewan, Val Marie, a few kilometers north of the Montana border and approximately 880 km east across the Rocky Mountains from the nearest *mormon* locality in Canada, and near Big Muddy Lake, approximately 234 km farther east.

It appears that racers are almost entirely absent from the Rocky Mountain region. The mountains constitute a barrier much broader than shown on published range maps, across the western parts of Montana, Wyoming, Colorado and New Mexico, separating the range of *mormon* on the west from that of *flaviventris* on the east. There are important morphological,

physiological and ecological differences between the two taxa and intergradation does not occur. In summary, we believe that the evidence here presented provides a strong case for the recognition of *Coluber mormon* as a full species. However, we suggest the need for a thoroughgoing study of geographic variation in many external and internal characters (e.g., enzyme polymorphism, karyotypes, osteology, scutellation). We believe that a systematic revision at the species level will support our conclusion regarding the specific distinctions of *C. mormon*.

Many more or less parallel cases could be cited of closely related eastern and western species partly or completely separated by a barrier in the Rocky Mountain region. Among reptiles the eastern *Lampropeltis triangulum*, *Sceloporus undulatus* and *Crotaphytus collaris* with their western counterparts *L. pyromelana-multicincta*, *S. occidentalis* and *C. insularis* come to mind.

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