Bull. Chicago Herp. Soc. 35(2):17-19, 2000

A Case of Parthenogenesis in the Plains Garter Snake, *Thamnophis radix*

John C. Murphy
Division of Amphibians and Reptiles
Field Museum of Natural History
Chicago, IL 60605

Russell M. Curry
1360 N. Grove Avenue
Palatine, IL 60067

Parthenogenesis in vertebrates was first recognized by science in 1932 when Hubbs and Hubbs discovered the live-bearing fish species, *Poecilia formosa*, was composed exclusively of females. But even before this, rumors of all-female species circulated among fish hobbyists at the turn of the twentieth century (Breder and Rosen, 1966). The first snake shown to be parthenogenetic was the Brahminy blind snake, *Ramphotyphlops braminus*. McDowell (1974) first suggested this, when he discovered that of 114 specimens in which he could determine the sex, all were females. Nussbaum (1980) lent more support to this idea, and Ota et al. (1991) demonstrated that this was a triploid, all-female species by determining its karyotype.

The literature on parthenogenesis in squamate reptiles was reviewed by Dawley (1989) and he noted that all known parthenogenetic squamates had a population structure that was unisexual (all-female) and of hybrid origin, and that if males occurred, they were extremely rare. Schuett et al. (1997) presented four cases of parthenogenesis in bisexual, diploid snakes. [The term bisexual refers here to populations that are composed of both males and females.] In each of these four cases they ruled out the possibility that the births were the result of long term sperm storage because males were never present, or males had been absent for long period of time. They reported parthenogenesis in two colubrids (the wandering garter snake, *Thamnophis elegans vagrans*; and the checkered garter snake, *Thamnophis marcianus*), and in two pit vipers (the timber rattlesnake, *Crotalus horridus horridus*; and the Aruba Island rattlesnake, *Crotalus unicolor*). In the cases of *T. e. vagrans* and *C. h. horridus*, DNA fingerprinting demonstrated that the parent and offspring were indeed genetically similar. Additionally, Dubach et al. (1997) reported parthenogenesis in the completely aquatic Australian Arafuran file snake, *Acrochordus arafurae*, in a female shown to be diploid. In three of five of these cases, the female snakes produced offspring that were positively identified as males.

The mechanism to explain this phenomenon given by Schuett et al. (1997) and Dubach et al. (1997) is automictic parthenogenesis. Ova are produced by meiosis, however during meiosis II the secondary polar body fuses with the nucleus of the ovum in the absence of sperm. This allows a female snake to produce both male and female offspring asexually. Snakes have a ZW sex chromosome system (females are ZW and males are ZZ). Thus, a secondary oocyte with a Z-chromosome in the nucleus and a Z-chromosome in the polar body nucleus that undergoes automictic parthenogenesis will be a male. Whereas a secondary oocyte with a W-chromosome in the nucleus and a Z-chromosome in the secondary polar body nucleus (or the reverse) will produce a female offspring should they fuse. See Schuett et al. (1998) for an illustration and further discussion of this process.

One of us (RC) purchased a neonate garter snake at Zoological Pets, in Arlington Heights, Illinois, in August 1993. The female snake was in a 20-gallon aquarium with about 30 other neonate garter snakes. The snake stood out because of its yellow coloration; the others were darker in color. At the time of purchase she was 15 to 17 cm long. The snake was fed small guppies and worms, and as she grew she was fed on nightcrawlers and goldfish. The last few years rat pinkies have been added to her diet. In May 1996 the female garter snake produced a litter of three live young and two stillborn young, despite the fact that it had never been in contact with a male snake. The offspring had the same unusual pattern as their mother and were about 15 cm long. The three young were housed with their mother for a few weeks and one day they disappeared. Presumably the female cannibalized them since there was no way they could have escaped. In June 1997, a single offspring was produced with several infertile eggs. This neonate died the day it was born. It was frozen, then preserved

Figure 1. The adult female plains garter snake, *Thamnophis radix*, purchased by RC. Compare the dorsal pattern on this animal to its asexual offspring in Figure 2. Photograph by John C. Murphy.

Figure 2. The offspring of the female snake in Figure 1. Photograph by John C. Murphy.

Table 1. A comparison of the adult female garter snake and her male offspring to *Thamnophis marcianus* and *Thamnophis radix*.

Character	Adult female	Neonate male	Range for *Thamnophis m. marcianus*	Range for *Thamnophis radix*
anterior scale rows	20	20	21	19 or 21
midbody scale rows	19	19–21	19	19
posterior scale rows	17	17	17	17
ventrals	148	147	F 134–166; M 136–173	F 135–174; M 138–175
subcaudals	58	69	F 56–77; M 64–82	F 54–74; M 64–88
upper labials	9-8	7-7	7–8 (usually 8)	6–8 (usually 7)
lower labials	11-12	10-10	9–11 (usually 10)	8–11 (usually 9 or 10)
relative tail length	25%	20.6%	F 18.9–26.9%; M 21.3–26.8%	F 17.6–27.5%; M 20.5–27.8%
lateral stripe	3rd scale row, barely onto 4th	none	3rd scale row only	3rd and 4th scale rows
vertebral stripe	even-edged: 0.5+1+0.5	even-edged: 1 row	jagged-edged	even-edged
ventral pattern	black spots on outer edges of ventral scales	same as female	immaculate venter	black spots on outer edges of ventral scales

in 95% ethanol and it is now cataloged into the Field Museum collection (FMNH 257839).

Description of Adult Female

The adult female has a snout–vent length (SVL) of 640 mm, and the tail is 160 mm. This specimen is alive at this writing. Traditional scale count data are provided in Table 1. The dorsal scales have exceptionally heavy keels, so much so that the snake has a texture comparable to rough sandpaper when handled. It has an orange vertebral stripe that is on scale row 11 at midbody (the vertebral row) and extends onto the adjacent half of the paravertebral scale rows 10 and 12. This stripe has an even edge. The ventral scales are unusual in that they have a light orange center with a small black dot on the outer edges of each ventral scale. The lateral stripe is difficult to detect in this specimen, but it is present as a very light, white stripe on scale row three and at some locations extends just onto scale row four. There are three rows of black spots on each side of the vertebral stripe; these are on dorsal scale rows 1-2, 5-6 and 8-9. The rest of the dorsal coloration is yellow.

Description of Offspring

The male offspring has an SVL of 142 mm, the tail is 37 mm. The dorsal scales are keeled and in 20-21-17 rows. The ventral scales number 147. The umbilical scar is on ventrals 132 and 133. The subcaudals number 69. There are seven upper labials on both sides, and labials 3 and 4 enter the orbit on both sides of the head. The lower labials number 10 on both sides. There is one preocular, one supraocular, and three postoculars. The temporal formula is 1:1:2/1:2:3. The gulars number two. There is no trace of a lateral stripe on scale rows 1–4. The vertebral stripe involves only one row of scales and becomes less distinct posteriorly, but is still visible. The belly is uniform in color except that each ventral has a small black spot on the outer edge of each scale; these are larger than those in the female. Three rows of dark spots on each side make up the rest of the dorsal pattern. The spots occur on scale rows 1-2, 5-6, and 8-9. The scales on the crown have some round dark spots; these are most obvious and numerous on the parietals.

Thus the offspring is very similar to the female in overall appearance, except it lacks any trace of a lateral stripe and it has 19–21 scale rows at midbody. The row counts of 21 at midbody are due to extra, smaller scales, not entire rows.

The Taxonomic Identity of These Garter Snakes

Using the key to the species and subspecies of *Thamnophis* in Rossman et al. (1996), the adult female keys directly to the checkered garter snake, *Thamnophis marcianus*. However, because the snake has an unusual color pattern making it quite different in overall appearance from *T. marcianus* we investigated further. The small black spots on the ventral scales are not characteristic of *T. marcianus marcianus*, but they do occur in the other two recognized subspecies of *T. marcianus* (*T. m. bovallii*, and *T. m. praeocularis*), and they also occur in *Thamnophis radix*. In fact, an inspection of Table 1 shows that the specimens agree most closely with *Thamnophis radix*, and the female keys to *marcianus* only because the lateral stripe is mostly restricted to the third row of dorsal scales instead of the third and fourth rows. An alternative hypothesis to this snake being *T. radix*, is that it is a hybrid *marcianus* × *radix*. Smith (1946) reported on a specimen from Meade County, Kansas, he believed may have been a *marcianus* × *radix* hybrid, but he does not mention the dominant yellow coloration or the unusual scale keels present in these specimens. We are currently re-

jecting this hypothesis because of the number of characters in Table 1 that suggest that it is an aberrant *radix* and not a hybrid. Additionally, we have reason to believe that the pet shop that sold the snake obtained them from a local population, or at least a local collector. *Thamnophis marcianus* does not occur in Illinois. *Thamnophis radix* and *T. marcianus* share an incredible number of character states that are identical or greatly overlap, yet we doubt that there are any herpetologists who would consider them conspecific. These two specimens appear to be yellow color morphs of *Thamnophis radix*.

Literature Cited

Breder, C. M., and D. E. Rosen. 1966. Modes of reproduction in fishes. Jersey City: TFH Publications.

Dubach, J., A. Sajewicz and R. Pawley. 1997. Parthenogenesis in the Arafuran filesnake (*Acrochordus arafurae*). Herpetological Natural History 5:11-18.

Dawley, R. M. 1989. An introduction to unisexual vertebrates. Pp. 1-18. *In*: R. M. Dawley and J. P. Bogart, editors, Evolution and ecology of unisexual vertebrates. The New York State Museum, Museum Bull. 466:1-302.

Hubbs, C., and L. Hubbs. 1932. Apparent parthenogenesis in nature, in a form of fish of hybrid origin. Science 76:628-630.

McDowell, S. 1974. A catalogue of the snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum, Part 1. Scolecophidia. J. Herpetology 8:1-57.

Nussbaum, R. A. 1980. The Brahminy blind snake (*Ramphotyphlops braminus*) in the Seychelles Archipelago: Distribution, variation, and further evidence of parthenogenesis. Herpetologica 36:215-221.

Ota, H., T. Hikida, M. Matsui, A. Mori and A. H. Wynn. 1991. Morphological variation, karyotype and reproduction of the parthenogenetic blind snake, *Ramphotyphlops braminus*, from the insular region of East Asia and Saipan. Amphibia–Reptilia 12:181-193.

Rossman, D. A., N. B. Ford and R. A. Seigel. 1996. The garter snakes, evolution and ecology. Norman: University of Oklahoma Press.

Schuett, G. W., P. J. Fernandez, W. G. Gergits, N. J. Casna, D. Chiszar, H. M. Smith, J. B. Mitton, S. P. Mackessy, R. A. Odum, and M. J. Demlong. 1997. Production of offspring in the absence of males: Evidence for facultative parthenogenesis in bisexual snakes. Herpetological Natural History 5:1-10.

Schuett, G. W., P. J. Fernandez, D. Chiszar, and H. M. Smith. 1998. Fatherless sons: A new type of parthenogenesis in snakes. Fauna 1(3):20-25.

Smith, H. M. 1946. Hybridization between two species of garter snakes. Univ. Kansas Publ. Mus. Nat. Hist. 1:97-100.

Bull. Chicago Herp. Soc. 35(2):19-24, 2000

New Distributional and Variational Data on Some Species of Snakes from Chihuahua, Mexico

Julio A. Lemos-Espinal[1], Hobart M. Smith[2] and David Chiszar[2]

Abstract

Locality records for 16 species and subspecies of snakes from Chihuahua, most accompanied by GPS coordinates and altitude, obtained during summer 1999 by JLE, include a range extension for *Bogertophis s. subocularis*; resurrection, range extension and a new, possibly diagnostic character for *Conopsis nasus labialis*; a range extension for *Hypsiglena torquata jani*; the first record in Chihuahua of an intergrade between *Masticophis flagellum lineatulus* and *M. f. testaceus*; the first precise locality of occurrence in the state for *Crotalus l. lepidus*; a range extension for *C. l. klauberi*; a range extension in the state for *C. m. molossus*; and data on all specimens, including position of the umbilicus in both species of garter snakes, *Crotalus atrox, C. p. pricei* and *C. s. scutulatus*.

Among the specimens obtained by JLE during the summer of 1999 in Chihuahua are 51 snakes of 16 species and subspecies. Most are from areas never sampled herpetologically before, and therefore are of special interest and are here reported. Because of the remoteness of most localities, coordinates determined by GPS are provided to aid in their fixation, and altitudes are also given. We here cite JLE field numbers, but all specimens are ultimately to be deposited, about equally, in the University of Colorado Museum and in the collections of Unidad de Biotecnología y Prototipos of the Escuela Nacional

1. Laboratorio de Ecología, Unidad de Biotecnología y Prototipos, Escuela Nacional de Estudios Profesionales Iztacala, UNAM, Apartado Postal 314, Avenida de los Barrios s/n, Los Reyes Iztacala, Tlalnepantla, Estado do México, 54090 México.

2. University of Colorado Museum, Boulder, CO 80309-0334.