# Reproduction in the False fer-de-Lance, *Xenodon rabdocephalus* (Serpentes: Colubridae) from Costa Rica

STEPHEN R. GOLDBERG

*Whittier College, Department of Biology, Whittier, CA 90608, U.S.A.* sgoldberg@whittier.edu

THE False fer-de-lance, *Xenodon rabdocephalus* (Wied) is a moderate-sized snake that occurs in the lowlands of tropical Mexico south through Central America to Ecuador and the upper portions of Brazil, Peru and Bolivia where it ranges from 1–1200 m; it feeds almost exclusively on toads (Savage, 2002). There is little information known regarding the reproductive biology of *X. rabdocephalus*. Clutches of 9 to 10 eggs are laid in the rainy season (Campbell, 1998; Savage, 2002) and Solórazano (2004) reported clutches of up to 15 eggs. The purpose of this paper is to provide additional information on the ovarian cycle and to report the first information on the testicular cycle from a histological examination. Comparisons are made with the testicular cycles of other snakes from Costa Rica.

Thirty four *X. rabdocephalus* from Costa Rica in the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA were examined (Appendix). Samples consisted of 21 males: mean snout-vent length (SVL) = 473 mm ± 87 SD, range: 294-614 mm; 13 females, SVL = 701 mm ± 99 SD, range: 545–840 mm. Snakes were collected 1959–1983. An unpaired *t* test was used to compare male and female mean body sizes (SVL) (Instat vers. 3.0b, Graphpad Software, San Diego, CA).

Counts were made of enlarged ovarian follicles (> 8 mm length) or oviductal eggs. The left testis, and vas deferens were removed from males and the left ovary was removed from females for histological examination. Tissues were embedded in paraffin, sectioned at 5 µm and stained with hematoxylin followed by eosion counterstain. Testes slides were examined to determine the stage of the testicular cycle and ovary slides were examined for the presence of yolk deposition (secondary vitellogenesis *sensu* Aldridge, 1979).

Testicular histology was similar to that reported by Goldberg & Parker (1975) for two colubrid snakes, *Masticophis taeniatus* and *Pituophis catenifer*. All testes examined were undergoing spermiogenesis with metamorphosing spermatids and sperm present. Vasa deferentia also contained sperm. The following monthly samples of *X. rabdocephalus* exhibited spermiogenesis: January (2), February (2), April (1), June (3), July (1), August (7), September (1), November (2), December (2). The smallest spermiogenic male measured 294 mm SVL (LACM 154459) and was collected in June.

Females were larger than males (unpaired *t*-test, $t = 7.0$, $df = 32$, $P < 0.0001$). Monthly distribution of stages in the ovarian cycle of *X. rabdocephalus* are in Table 1. Reproductively active females were found in all months except March. Most of the females (12/13) 92% were reproductively active. Females in early yolk deposition included those that commenced vitellogenesis as indicated by vitellogenic granules = secondary vitellogenesis (*sensu* Aldridge, 1979) to those with yolking follicles reaching 5 mm diameter. Because it was not possible to know if all follicles of 5 mm diameter would have completed yolk deposition they were not considered as the number of eggs in an egg clutch. However, the likelihood is that some of these yolking follicles would have culminated in a clutch of unknown number later in the year. One August female in Table 1 contained enlarged follicles (>12 mm) that were fused (presumably a preservation artifact) and could not be reliably counted. Mean clutch size for five females with enlarged ovarian follicles (>12 mm diamater) or oviductal eggs was 13.0 ± 5.5 SD, range 6–19. Clutch sizes of 18 (LACM 154498) collected 21st November and 19 (LACM 154479) collected 2nd October are new maximum clutch sizes for *X. rabdocephalus*. The smallest

| Month | *n* | No yolk deposition | Early yolk deposition | Enlarged follicles > 12 mm length | Oviductal eggs |
|---|---|---|---|---|---|
| February | 1 | | 1 | | |
| March | 1 | 1 | | | |
| May | 1 | | 1 | | |
| July | 1 | | | | 1 |
| August | 1 | | | 1* | |
| September | 1 | 1 | | | |
| October | 5 | 1 | 2 | 1 | 1 |
| November | 2 | | | 1 | |

**Table 1**. Monthly distribution of stages in the ovarian cycle of *Xenodon rabdocephalus* from Costa Rica. Values shown are the numbers of females exhibiting each of the four conditions.*Enlarged follicles > 12 mm length are fused (preservation artifact) and cannot be counted.

reproductively active female measured 545 mm SVL (LACM 154481) and was collected 27th October. It contained 6 oviductal eggs. There was no vitellogenesis in the ovaries of the two females with oviductal eggs which would have suggested more than one egg clutch in the same year.

My data suggest *X. rabdocephalus* males produce sperm throughout the year. Extended testicular cycles have been reported in other snakes from Costa Rica: *Drymobius margaritiferus* (Goldberg, 2003a); *Dendrophidion* sp. (Goldberg, 2003b); *Ninia maculata* (Goldberg, 2004a); *Erythrolamprus bizona* and *E. mimus* (Goldberg, 2004b); *Micrurus nigrocinctus* (Goldberg, 2004c); *Hydromorphus concolor* (Goldberg, 2006a); *Mastigodryas melanolomus* (Goldberg, 2006b); *Geophis godmani* (Goldberg, 2007a); *Coniophanes fissidens* (Goldberg, 2007b). It will be necessary to conduct histological examination of the testicular cycles of additional snakes before one can ascertain if year-round sperm production is typical of snakes from Costa Rica. Moreover, since Solórzano (2004) reports there are 137 species of snakes in Costa Rica, the snakes I have examined represent less than 10% of the Costa Rican snake fauna.

Although the two females with oviductal eggs were not undergoing vitellogenesis for a subsequent clutch, in view of the extended period in which reproductively active females were collected (Table 1), it appears plausible that some females may produce multiple egg clutches in the same year. Goldberg (2003b) reported one *Dendrophidion paucicarinatum* from Costa Rica with oviductal eggs that was concurrently depositing yolk in ovarian follicles for a subsequent clutch. Stafford (2003) indicated that *Dendrophidion pericarinatum* and *D. vinitor* females likely produced multiple clutches. Based on his observations of *X. rabdocephalus* neonates appearing from March to December, Solórzano (2004) suggested *X. rabdocephalus* followed a continuous reproductive pattern throughout the year. The reproductive cycle of *X. rabdocephalus* appears to fit the "polyestrous with continued reproduction" category of Saint Girons (1982).

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**Appendix**. *Xenodon rabdocephalus* examined by Costa Rica province from LACM.

Alajuela 154458, 154459, 154475, 154484, 154487, 154492, 154493, 154502; Cartago 154478, 154479, 154481, 154482, 154490; Guanacaste 154486, 154491, 154503; Heredia 154474; Limón 131132–131134, 154473, 154477, 154489, 154501; Puntarenas 154480, 154483, 154497, 154500 ; San José 154472, 154494–154496, 154498, 154499.