

# Reproduction in Four Species of *Dendrophidion* from Costa Rica (Serpentes: Colubridae)

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## ABSTRACT

Gonadal tissues from 43 museum specimens of four species of *Dendrophidion*: *D. nuchale*, *D. paucicarinatum*, *D. percarinatum* and *D. vinitor* were examined histologically. Four gravid *D. paucicarinatum* contained 3 to 12 eggs ( $\bar{X} = 9.0 \pm 4.2$  SD); six gravid *D. percarinatum* contained 4 to 5 eggs ( $\bar{X} = 4.7 \pm 0.55$  SD); and three gravid *D. vinitor* contained 4 to 5 eggs ( $\bar{X} = 4.3 \pm 0.58$  SD). One *D. paucicarinatum* female collected in April contained oviductal eggs and was also undergoing yolk deposition in ovarian follicles for a subsequent clutch, which suggests *Dendrophidion paucicarinatum* females may produce more than one clutch a year. The smallest gravid female (*D. vinitor*) measured 553 mm SVL. *Dendrophidion* males were found to undergo spermiogenesis during April to December suggesting year-round sperm production. The smallest spermiogenic male (*D. vinitor*) measured 420 mm SVL.

## INTRODUCTION

*Dendrophidion* is a genus of diurnal, semiarboreal snakes (racers) that range from southern Veracruz, Mexico, to northeastern Brazil and, in the Amazon basin, to northern Bolivia and Ecuador (Savage, 2002). Little information is available on their reproductive biology. Campbell (1998) and Lee (2000) reported that *Dendrophidion nuchale* produces a clutch of about six eggs and *D. vinitor* is oviparous. The biology of *D. nuchale*, *D. paucicarinatum*, *D. percarinatum* and *D. vinitor* are summarized by Lieb (1991a, 1991b, 1991c, 1996). The purpose of this paper is to report information on the ovarian and testicular cycles from a histological examination of museum specimens of four species of *Dendrophidion*.

## METHODS

Forty-three snakes from Costa Rica from the Natural History Museum of Los Angeles County (Appendix) were examined: *Dendrophidion nuchale* (N = 4), 1 female (780 mm snout-vent length, SVL), 1 male (671 mm SVL), 2 juveniles ( $\bar{X} = 390$  mm SVL  $\pm$  21 SD, range = 375-405 mm); *Dendrophidion paucicarinatum* (N = 8), 5 females ( $\bar{X} = 853$  mm SVL  $\pm$  109 SD, range = 735-960 mm), 3 males ( $\bar{X} = 703$  mm SVL  $\pm$  109 SD, range = 618-826 mm); *Dendrophidion percarinatum* (N = 13), 9 females ( $\bar{X} = 601$  mm SVL  $\pm$

48 SD, range = 515-683 mm), 4 males ( $\bar{X}$  = 557 mm SVL  $\pm$  20 SD, range = 540-585 mm) and *Dendrophidion vinitor* (n = 18) 8 females ( $\bar{X}$  = 587 mm SVL  $\pm$  34 SD, range = 543-642 mm), 8 males ( $\bar{X}$  = 534 mm SVL  $\pm$  57 SD, range = 420-600 mm), 2 juveniles ( $\bar{X}$  = 364 mm SVL  $\pm$  55 SD, range = 325-402). The snakes had been collected from 1966-1996. They were initially fixed in 10% formalin and preserved in 70% ethanol. The left testis, vas deferens and a portion of the kidney were removed from males, and the left ovary was removed from females for histological examination. Tissues were embedded in paraffin, sectioned at 5  $\mu$ m, and stained with Harris' hematoxylin followed by eosin. Sections mounted on slides were examined to determine stage of the testicular cycle and for yolk deposition (secondary vitellogenesis *sensu* Aldridge, 1979).

## RESULTS

Clutch sizes for *Dendrophidion* (enlarged ovarian follicles > 12 mm length or oviductal eggs) are presented in Table 1. A female *D. nuchale* from September was not undergoing yolk deposition. Four gravid *D. paucicarinatum* contained 3 to 12 eggs,  $\bar{X}$  = 9.0  $\pm$  4.2 SD. One *D. paucicarinatum* (LACM 149219) collected in April (Table 1) had 3 oviductal eggs and was undergoing secondary vitellogenesis in ovarian follicles (*sensu* Aldridge, 1979) for a subsequent clutch. One female collected in June was not undergoing yolk deposition. Six gravid *D. percarinatum* contained 4 to 5 eggs,  $\bar{X}$  = 4.7 eggs  $\pm$  0.55 SD. Three females (2 collected in July, 1 in October) were not undergoing yolk deposition. Three gravid *D. vinitor* contained 4 to 5 eggs,  $\bar{X}$  = 4.3  $\pm$  0.58 SD, range 4-5. One *D. vinitor* female collected 26 April was undergoing yolk deposition, but, some follicles were too small for estimating clutch size. One *D. vinitor* collected in June, 2 in August and 1 in October were not undergoing yolk deposition. The smallest gravid *Dendrophidion* (553 mm SVL) was a *D. vinitor* with five yolked follicles > 12 mm length (Table 1).

All adult *Dendrophidion* males were undergoing spermiogenesis (Table 2). The smallest reproductively active male (spermiogenesis in progress) was a *D. vinitor* (LACM 148610) that measured 420 mm SVL. All vasa deferentia contained sperm and all kidney sexual segments were hypertrophied in adult males of *D. nuchale*, *D. paucicarinatum*, *D. percarinatum* and *D. vinitor*. The following four males were considered as juveniles since the body size at which sperm would have been produced is unknown. Two *D. nuchale* (LACM 148554) SVL 405 mm and collected in July, and (LACM 148555) SVL 375 mm and collected in March, contained spermatogonia but no spermatocytes or spermatids in their seminiferous tubules. One *D. vinitor* (LACM 148604) 325 mm SVL and collected in November had a recrudescing testis (primary and secondary spermatocytes and some spermatids), none of which were metamorphosing into sperm. The testis of another *D. vinitor* (LACM 148602) 402 mm SVL and collected in July contained small clusters of metamorphosing spermatids, but no sperm.

## DISCUSSION

Clutch sizes for *D. paucicarinatum*, *D. percarinatum* and *D. vinitor* are in Table 1. The finding of one female *D. paucicarinatum* (LACM 149219) with eggs in the oviducts and concurrent yolk deposition in ovarian follicles suggests more than one egg clutch may be produced in the same year. This contrasts with colubrid snakes in the north temperate

zone, which apparently are limited to a single clutch per year (see Goldberg, 2000, 2001, 2002).

All adult males examined were undergoing spermiogenesis. The small sample sizes do not allow description of the testicular cycle. However collectively, spermiogenic males of *Dendrophidion* were collected during April to December suggesting an extended period of sperm formation. Goldberg (2003) found that males of the colubrid snake *Drymobius margaritiferus* from Mexico and Central America undergo spermiogenesis throughout the year.

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**APPENDIX**

Specimens of *Dendrophidion* from Costa Rica examined from the Natural History Museum of Los Angeles County (LACM).

*Dendrophidion nuchale* ( $N = 4$ ) Puntarenas Province 148553-148556.

*Dendrophidion paucicarinatum* ( $N = 8$ ) Alajuela Province 149215; Heredia Province 149219; Puntarenas Province 149213, 149214, 149216, 149217, 149220, 149222.

*Dendrophidion pericarinatum* ( $N = 13$ ) Alajuela Province 148580; Cartago Province 148579; Heredia Province 148585, 148586; Limón Province 148581, 148582, 148587; Puntarenas Province 114102, 114104, 148560, 148562, 148564, 148565.

*Dendrophidion vinitor* ( $N = 18$ ) Guanacaste Province 148589; Heredia Province 148593, 148595, 148598, 148600, 148604, 148605, 148609, 148610; Puntarenas Province 114106, 114107, 148590, 148592, 148596, 148599, 148602, 148606, 148608.

Table 1. Clutch sizes of three species of *Dendrophidion* from Costa Rica estimated from counts of yolked ovarian follicles > 12 mm length or oviductal eggs\*.

| Date of Collection                  | SVL (mm) | Clutch size | Province   | LACM No. |
|-------------------------------------|----------|-------------|------------|----------|
| <i>Dendrophidion paucicarinatum</i> |          |             |            |          |
| 18 April                            | 735      | 3*          | Heredia    | 149219   |
| 15 July                             | 923      | 12*         | Alajuela   | 149215   |
| 23 July                             | 960      | 12          | Puntarenas | 149213   |
| 13 August                           | 910      | 9           | Puntarenas | 149222   |
| <i>Dendrophidion percarinatum</i>   |          |             |            |          |
| 16 March                            | 575      | 4           | Limón      | 148582   |
| 25 May                              | 638      | 5*          | Puntarenas | 114102   |
| 27 May                              | 580      | 5*          | Heredia    | 148586   |
| 31 May                              | 621      | 5           | Puntarenas | 114104   |
| 5 July                              | 627      | 4           | Puntarenas | 148562   |
| 25 September                        | 585      | 5*          | Heredia    | 148585   |
| <i>Dendrophidion vinitor</i>        |          |             |            |          |
| 24 May                              | 602      | 4*          | Puntarenas | 114107   |
| 24 July                             | 600      | 4*          | Puntarenas | 114106   |
| 11 December                         | 553      | 5           | Heredia    | 148598   |

Table 2. Male *Dendrophidion* from Costa Rica undergoing spermiogenesis.

| Date                                | SVL (mm) | Province   | LACM No. |
|-------------------------------------|----------|------------|----------|
| <i>Dendrophidion nuchale</i>        |          |            |          |
| 26 April                            | 671      | Puntarenas | 148553   |
| <i>Dendrophidion paucicarinatum</i> |          |            |          |
| 21 July                             | 618      | Puntarenas | 149220   |
| 22 July                             | 665      | Puntarenas | 149216   |
| 3 October                           | 826      | Puntarenas | 149217   |
| <i>Dendrophidion pericarinatum</i>  |          |            |          |
| 5 July                              | 557      | Limón      | 148587   |
| 5 August                            | 540      | Limón      | 148581   |
| 19 September                        | 585      | Alajuela   | 148580   |
| 4 October                           | 545      | Cartago    | 148579   |
| <i>Dendrophidion vinitor</i>        |          |            |          |
| 16 April                            | 483      | Heredia    | 148600   |
| 20 April                            | 571      | Puntarenas | 148608   |
| 3 May                               | 420      | Heredia    | 148610   |
| 4 June                              | 600      | Puntarenas | 148590   |
| 26 August                           | 555      | Puntarenas | 148606   |
| September                           | 526      | Puntarenas | 148599   |
| November                            | 557      | Heredia    | 148595   |
| 9 December                          | 562      | Heredia    | 148593   |