TRANSACTIONS OF THE KANSAS ACADEMY OF SCIENCES
84(1), 1981, pp. 39–49

Miscellaneous Notes on the Reproductive Biology of Reptiles. 4. Eight Species of the Family Boidae, Genera *Acrantophis, Aspidites, Candoia, Liasis* and *Python*

JAMES B. MURPHY, WILLIAM E. LAMOREAUX AND DAVID G. BARKER
Department of Herpetology, Dallas Zoo, 621 East Clarendon Drive
Dallas, Texas 75203

ABSTRACT

Sequences of courtship and copulation, egg-laying and parturition, with data on the neonates are presented for eight boid taxa: *Acrantophis dumerili, A. madagascariensis, Aspidites melanocephalus, Candoia bibroni, Liasis boa, L. childreni, L. mackloti* and *Python boeleni*. The functional use of spurs during courtship is recorded in *Acrantophis dumerili, A. madagascariensis, Aspidites melanocephalus, Candoia bibroni* and *Python boeleni*. Combat preceding courtship between males occurs in *A. melanocephalus* and *A. dumerili*.

In an earlier contribution, Murphy et al. (1978) described sequences of courtship and copulation, egg-laying and parturition with data on the neonates for eleven boid taxa. These authors provided some descriptions for spur usage in boid snakes. Combat between male boid snakes has been reported in *Sanzinia madagascariensis* (Carpenter et al., 1978), *Aspidites melanocephalus* and *Python molurus* (Barker et al., 1979). In captive *P. molurus*, a linear social hierarchy was formulated which was reinforced by male combat, and breeding sequences were accomplished according to the hierarchial position of a male. This paper provides additional reproductive data and combat sequences in some snakes mentioned by Murphy et al. (1978), and incorporates information on other taxa of captive boids.

MATERIALS AND METHODS

All observations were carried out at the Dallas Zoo with captive snakes. Taxonomic allocations follow McDowell (1975, 1979) and Guibé (1949, 1958).

Thermal environments were established for the specimens observed on the basis of studies by Cogger and Holmes (1960), Hutchison et al. (1966), Vinegar et al. (1970), Webb and Heatwole (1971), Johnson et al. (1975),

Johnson (1972, 1973, 1977) and Van Mierop and Barnard (1976, 1978). Ambient temperature varied between 27–34°C. Thermal gradients were made available to all snakes by using infra-red bulbs to create "hot spots" which reached 34.0 ± 2.0°C in temperature. Impregnated females regularly used these basking sites. Skylights provided a natural photoperiod, and fluorescent lights (cool white, 25–40 watt/110 volt) were used to provide additional illumination. Artificial light durations were altered to correspond to a natural photoperiod.

Eggs were measured with a vernier caliper to the nearest 1.0 mm and weighed with a triple-beam balance to the nearest 0.1 gram. Neonates were measured to the nearest 1.0 mm (Quinn and Jones, 1974). Hiding boxes with damp sphagnum moss were provided for gravid females, and eggs were hatched using the method of Tryon (1975). The incubation temperature was 32 ± 1.0°C for the eggs. Relative humidity averaged 50 percent. All snakes were fed freshly killed laboratory rodents and chicks, and drinking water was available *ad libitum*. Courtship terminology follows Gillingham (1974, 1976) and Gillingham et al. (1977).

Species Accounts

Acrantophis dumerili. Two male and two female snakes of this species were housed in a glass-fronted fiberglass unit measuring 71 × 81 × 117 cm high, with decorative branches and a gravel substrate. Both males were from unknown localities and were available on temporary breeding loan. The males measured 158 and 155 cm in total length. The females were collected at Manja, Malagasy, on 9 March 1970 and 5 August 1973, and measured 151 and 142 cm, respectively. Sequences of male combat and courtship were recorded on 9 and 23 July 1979. Additional courtship without male combat was observed on 16 September.

The following account is based on behavior which occurred on 9 July and the males are designated according to final status:

1130 hours: Subdominant male (S) and both females were in the enclosure.

1131: Dominant male (D) was introduced into the unit. In less than one minute, D pursued S. D bit S on the trunk 30 cm anterior to his vent, then constricted the subdominant's trunk by encirclement with two coils. D vibrated his spurs at a frequency of 2 strokes/second. Spurs often operated independently and at different speeds. When operating at the same speed, spurs usually moved alternately. Speed of vibration seemed to be determined by resistance of the object against which the snake's tail was resting (i.e., the side of the unit stimulated vigorous spur activity). Spurs were extended *ca.* 6 mm and moved in an anterior direction. When D was moving spur usage continued, but the spurs occasionally stopped when the snake was

quiescent. S did not vibrate its spurs. During biting episodes, D first tested the dorsum of S with his tongue, then slowly opened his mouth in a very wide gape and attempted to bite. After immobilization by biting, D attempted to constrict S if the latter snake was unable to escape. Females were never bitten. S withdrew by crawling into decorative branches in the unit.

1215: D encountered S as the latter snake was descending from the branches. D bit S in the region of the vent, then encircled the subdominant snake with two coils.

1218: D released bite hold: S escaped.

1231: D bit S, then pressed the latter snake's head against the substrate with a midbody coil. S pulled away.

1240: D pressed the trunk of S against the substrate for 20 minutes. S unsuccessfully tried to escape.

1300: S was removed from cage for fear of injury.

1340: D prowled the unit with spurs continuing to vibrate.

1430: D began to court the larger female (tactile-chase).

1500: D continued to court the female by using spurs to position the female's vent. He used the spurs to probe the interstitial skin which often stimulated the female to crawl forward. This behavioral sequence closely duplicated the description of courtship in *Candoia bibroni* (Murphy et al., 1978), but the vibration of the male's spurs averaged one stroke per second.

1600: D tried to align by crawling anteriorly along the female's dorsum. A light rhythmic vibration of the spurs was applied to the trunk and tail of the female, especially along the lateral surfaces.

1615: Female began to move more rapidly with the male pursuing. Spur speed increased to 2 per second. Tongue flick frequency averaged one per 2 seconds as D moved anteriorly along the female's dorsum.

1616: Other female was removed.

1630: D tried to align by crawling anteriorly along the female's dorsum; she began to crawl rapidly. Both snakes used rectilinear locomotion, but occasionally an undulating movement was used to build coils for rapid progression.

1635: D aligned on the female's dorsum by using short radius coils. The female remained quiescent. The male rotated his tail 90° and pressed his vent region in apposition to the female's cloaca by aligning against the lateral margin. The male jerked convulsively four times in five minutes (tactile-alignment).

1640: The male jerked convulsively twice. The left hemipenis was inserted (intromission and coitus). He continued to press his vent region against the female's vent and continued occasional spur vibration. The female remained immobile. The heads were separated *ca.* 25

cm. The posterior one-third of the bodies were aligned but the anterior portions were separated.

1706: D retracted his hemipenis from the female's cloaca; his vent remained slightly agape for 2 minutes.

1708: The male began to crawl and continued his spur action.

1800: Spur action ceased. Observations discontinued.

Male combat was also observed on 23 July during a 50 minute encounter; behavior was similar to that described above. Copulation between the dominant male and the other female occurred on 16 September 1979.

Comparisons of literature reports (Carpenter et al., 1978; Barker et al., 1979) suggest that male combat in *A. dumerili* more closely duplicates behavior observed in *Python molurus* than in *Sanzinia*. Physical encounters may be less ritualized than either *Sanzinia* or *P. molurus*, since biting and constriction are often apparent in *A. dumerili*. Behavioral components listed for *P. molurus*, but not seen in *Acrantophis*, include evacuation of cloacal contents, hissing, tail raising and excretion of musk. Adpression of the combatant's trunk on the substrate occurred regularly in *Acrantophis*, and this behavior seemed to be an important element for immobilization of subdominant specimens.

Acrantophis madagascariensis. A male specimen measuring 185 cm in total length was available to us on temporary breeding loan; the snake was from an unknown locality. Two females were acquired by us on 20 July 1969; one from Soalala, Malagasy and the other from an unknown locality. They measured 168 and 170 cm total length, respectively. The snakes were maintained in an exhibit enclosure which was decorated with branches and plastic foliage, and which measured 100 × 80 × 113 cm high. The substrate was small gravel. Precoital behavior was observed on 9 July 1979. When discovered at 0850 hours, the male was aligned upon the dorsum of the larger female. Intermittent use of the male's spurs occurred to align with the female's vent, as in *Candoia bibroni* (Murphy et al., 1978). The male attempted to place the cloacae in apposition by crawling either backwards or forwards with rectilinear movement as the female slowly moved; he also placed loosely draped coils over the female's coils when she remained quiescent. The male on occasion would probe the female's interstitial skin violently with his spurs, causing her to move rapidly. Alignment and position of the vents approximated that of *A. dumerili*. At 1015 hours the male placed his head on the female's dorsum *ca.* 45 cm posterior to her head; then he violently convulsed and quickly everted his left hemipenis against the right lateral margin of the female's vent. The extruded organ was *ca.* 38 mm in length; the basal portion was *ca.* 7 mm in diameter. The female did not move or tongue flick during the entire precopulatory sequence. The male everted his hemipenis twice during unsuccessful attempts at intromission. No rhythmic vibration of spurs or tongue-flicking occurred when the male

was immobile. For 30 minutes both snakes remained quiescent. At 1601 hours the male convulsed and extruded the right hemipenis without penetration. Intromission was unsuccessful and courtship ceased at 1200 hours.

Aspidites melanocephalus. Two male snakes of this species, acquired 22 September 1968 and 13 April 1970, measured 188 and 200 cm total length, respectively. A female was acquired on 12 March 1973 and measured 209 cm in total length. All were from unknown localities. They were maintained in a glass-fronted exhibit unit measuring 78 × 81 × 117 cm high, and decorated with rocks, stumps and plastic foliage. The substrate was small gravel. The males were kept together from September through January. When the female was introduced in January, the males were rotated at roughly one week intervals. The unit was sprayed with water four or five times per week from July through December, and all snakes raised heads in a vertical plane during these sprayings. Vertical head positioning suggests thermoregulatory behavior (Johnson, 1973).

Combat between males has been described earlier (Barker et al., 1979). Spur movement varied with as many as 8–10/5 seconds flexion-extension sequences to as slow as one stroke/2 seconds. Tails were tightly intertwined, but heads and anterior trunks appeared to have no particular orientation. No constriction of objects in the enclosure or pulling with heads or anterior trunks was observed as in *Sanzinia* (Carpenter et al., 1978). Biting never occurred and we were unable to determine how dominance was achieved.

Copulation in this species was observed on 5 March 1979. During the gestation period, the female was often lying with her dorsum contacting the substrate, and occasionally all but her head would be in contact. All three snakes regularly excavated the substrate extensively, usually near an object in the enclosure. Excavation was accomplished by forming the head and anterior trunk into a "J" configuration, moving sideways, then pulling the gravel entrapped by the head-neck angle toward the posterior trunk. The female dug continuously from the time of copulation until oviposition.

Six adherent off-white eggs were laid on 25 March 1979 in damp sphagnum moss which was provided for oviposition. Measurements and weights of the eggs are as follows: length 100–112 mm, $\bar{x}$ = 104; diameter 47–51 mm, $\bar{x}$ = 49; weight of adherent clutch 820 g, $\bar{x}$ = 136. All eggs hatched on 16 June 1979 and the measurements and weights of the neonates are as follows: total length 58.0–62.0 cm, $\bar{x}$ = 60.0; tail length 6.4–7.2 cm, $\bar{x}$ = 6.7; weight 76.5–83.5 g, $\bar{x}$ = 81.3. The young resembled the parents in coloration (Fig. 1). They were dark brown to black above, lighter on the sides (tan) with numerous reddish-brown or blackish crossbands which exhibited an orange hue toward the venter and were narrower than the interspaces. Head, neck and throat jet black. Belly cream to yellow, occasionally with darker blotches.

Our data differ in some respects from Boos (1979) in that our clutch size

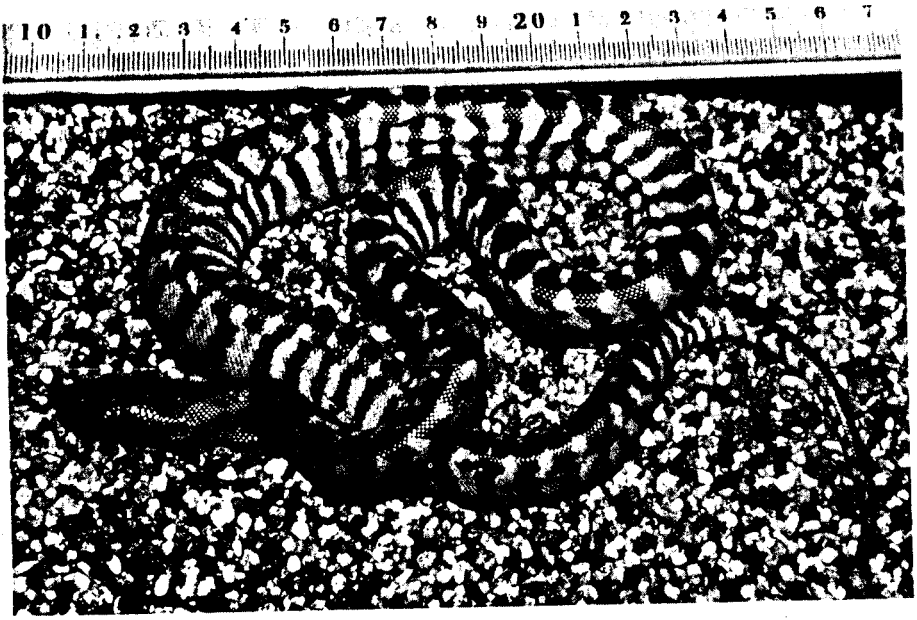

Fig. 1. Hatchling *Aspidites melanocephalus*.

was smaller, eggs and hatchlings were larger, and the female did not twitch after oviposition. The differences in dates of oviposition and hatching could be explained by seasonal reversal.

The young were offered freshly killed laboratory mice (7.5 g), but these were refused. The snakes were assistance-fed by gently opening the mouths and placing heads of mice therein. The snakes swallowed the mice without mishap and began feeding voluntarily four to five weeks later.

Candoia bibroni. Courtship behavior for this species has been described earlier (Murphy et al., 1978). On 22 August 1978 a female gave birth to three young and passed three infertile egg masses. One of the young exhibited fused portions of the vertebral column (KU 182375). Measurements and weights of the two survivors are as follows: total length 275–300 mm, $\bar{x}$ = 287; tail length 43–45 mm, $\bar{x}$ = 44; weight 10.0–10.5 g, $\bar{x}$ = 10.2. The smaller neonate had a slightly deformed jaw and later died (KU 182376).

Coloration and pattern of the adults and young are as follows (McDowell, 1979:22): smaller male—D. Blotched pattern with median throat stripe; larger male—C. Blotched pattern with throat stripe; female—E2. Blotched pattern without stripes; neonates—C and D. Unlike the adults, the ground color of the neonates was reddish.

On 15 September 1979 the smaller male was copulating with the female at 0815 hours. The male's tail encircled the female's trunk with three coils.

Disengagement occurred at 1130 hours. Both males remained active for three hours, and the smaller male intermittently contacted the trunk of the larger male with his spurs moving in a scratching action. No entwining of the tails or trunks was apparent.

Liasis boa. Four snakes of this species were available for study: male A, acquired 23 February 1973 and measuring 126 cm total length (from New Ireland Island); male B, acquired 7 September 1971 and measuring 145 cm (from an unknown locality); female A, acquired during June 1973 and measuring 1220 mm (from Rabaul, New Britain Island) (KU 180255); female B, acquired on a temporary breeding loan and measuring 145 cm (from an unknown locality). All snakes exhibited a banded color phase.

Both males were introduced during early January 1978 into an exhibit unit measuring 100 × 80 × 113 cm high. Plastic plants and branches were arranged throughout the enclosure. The substrate was small gravel and a pool with running water was available. Male A often pursued the larger male, but no physical contact was observed. Intermittent courtship occurred on 23 February 1978 and 31 January, 27 February and 3 March 1979 but complete courtship sequences were not seen. In all instances, male A crawled after the slowly crawling female B. Rhythmic vibrations of the spurs averaged two strokes per second. Oviposition occurred on 31 May which consisted of nine fertile and four infertile egg masses. Measurements and weights of the fertile eggs are as follows: length 34–50 mm, $\bar{x}$ = 45; diameter 26–31 mm, $\bar{x}$ = 29; weight of ivory, slightly granular adherent clutch 187.0 g, $\bar{x}$ = 20.7. On 5–6 August 1978 all fertile eggs hatched and the neonates were weighed and measured as follows: total length 260–334 mm, $\bar{x}$ = 312; tail length 35–43 mm, $\bar{x}$ = 40; weight 7.4–13.4 g, $\bar{x}$ = 11.2.

Total number of orange bands (including incomplete bands) varied between 31–36, $\bar{x}$ = 33; tail bands 5–7, $\bar{x}$ = 6. One of the young expired (KU 182377).

Coloration of the young has been described by Rooij (1917) and Schmidt and Inger (1957). The orange bands were vivid and according to the color standard of Maerz and Paul (1930), were Sungod (plate 2, H 12).

On 17 April 1979, female B laid 16 adherent eggs which were measured and weighed as follows: length 42–50 mm, $\bar{x}$ = 45, diameter 29–33 mm, $\bar{x}$ = 32; weight of adherent clutch 357 g, $\bar{x}$ = 22. Hatching occurred on 3–5 July and all young emerged. Measurements and weights are as follows: total length 304–333 mm, $\bar{x}$ = 325; tail length 35–42 mm, $\bar{x}$ = 38; weight 11.2–14.6 g, $\bar{x}$ = 13.0. Total number of orange bands (including incomplete bands) varied between 29–37, $\bar{x}$ = 33; tail bands 5–7, $\bar{x}$ = 6. Grand means across both clutches are as follows: eggs—length 45 mm, diameter 32 mm, weight 21.7 g; neonates—total length 320 mm, tail length 39 mm, weight 12.3 g.

Ontogenetic color change was recorded, and within three months the vivid

orange color was greatly subdued. In six months, no traces of orange were noticeable; the color was olive brown and yearlings were virtually indistinguishable from adults.

Young from the first brood were difficult to feed and many would only accept small lizards (*Leiolopisma*). Gradually, the snakes began feeding upon newborn mice. All snakes from the second brood accepted newborn mice voluntarily.

Liasis childreni. Two males of this species were acquired during January 1968 and on 23 November 1976, and two females were acquired on 20 December 1972 and 23 November 1976. The larger male measured 115 cm total length, the smaller male measured 89 cm, and the females measured 121 and 96 cm, respectively. All were from unknown localities. The snakes were maintained in an exhibit unit measuring 77 × 50 × 37 cm high. Plastic plants, branches and rocks were arranged throughout the enclosure and the substrate was small pebbles.

Courtship was recorded on 20 November 1977, 19 February 1978 and 23 January 1979. The smaller male bred the larger female on 23 February 1978. In all instances, males aligned the cloacae and encircled the tails of females with their tails; when intromission was accomplished, occasional pulsations occurred at the rate of *ca.* one per minute. Complete courtship sequences were not seen.

A clutch of twelve adherent eggs was laid on 5 April 1978 by the larger female, but the eggs were not weighed and measured. All eggs hatched between 31 May and 2 June and the neonates were measured and weighed as follows: snouth-vent length 218–247 mm, $\bar{x}$ = 231; tail length 24–30 mm, $\bar{x}$ = 27; weight, 7.7–10.5 g, $\bar{x}$ = 8.7.

Coloration and pattern of the young resembled the adults in that the ground color was the same as the parents, but the pattern was lighter. One of the young later died (KU 182378).

Reproduction has been treated by Ross (1973), Dunn (1979) and observed by S. Chiras (pers. comm.).

Liasis mackloti. A male measuring 1.85 m total length and a female measuring 1.9 m were acquired on 29 November 1969. Both were from unknown localities. Coloration of the snakes conforms most closely to McDowell's (1975:36) description of individuals of this taxon from New Guinea and Australia.

These snakes were discovered copulating on 9 March 1979 at 0830 hours. No spur activity was evident. The female was often lying with her dorsum contacting the substrate prior to oviposition.

Deposition of twelve off-white adherent eggs occurred on 9 April and measurements and weights are as follows: length 50–70 mm, $\bar{x}$ = 63; diameter 38–42 mm, $\bar{x}$ = 40; weight of clutch 685 g, $\bar{x}$ = 57. All eggs hatched on 22 June and the measurements and weights of nine full term young are as follows: total length 370–490 mm, $\bar{x}$ = 441; tail length 60–73 mm,

$\bar{x}$ = 74; weight 23.0–36.7 g, $\bar{x}$ = 30.6. Three young were fully formed but dead at birth (KU 182379–381). The young resembled the adults in having dark brown coloration vertebrally, coral blush venter (Maerz and Paul, 1930, plate 1, F. 10), unmarked white chin extending to first ventral; tail dark, slightly lighter than vertebral color.

Reproduction has been treated by Ross (1977, 1978) and Boos (1979).

Python boeleni. Courtship behavior in this taxon has been described earlier (Murphy et al., 1978). Two additional specimens from the Wissel Lakes region in West Irian were available for study. The original male measured 2.70 m total length, the newer male measured 2.75 m, the original female measure 2.9 m and the newer female measured 2.80 m. The snakes were maintained in a glass-fronted enclosure measuring 3.7 × 1.6 × 3.5 m high. The walls were covered with ornamental rock and vines were arranged throughout the unit. A large tree stump was placed on the floor of the enclosure. The snakes were arboreal and their tails were strongly prehensile.

Courtship and copulatory sequences were recorded on 21 January, 12 February, 25, 26 May, 17 July, and 14 September 1979 in addition to those mentioned by Murphy et al. (1978). The following account is a compilation of behaviors involving the newer male and older female. Female ecdysis often stimulated male courtship episodes. If the female was in a resting coil, the male nudged her body with his snout to provoke her to move. If this behavior was unsuccessful, the male crawled away from her until his vent region was aligned above her coils; then he turned and crawled back toward the female until both his head and tail were in contact with her. When the female's trunk was touched by the male's tail, he began vigorous rhythmic vibrations with the spurs. As the female began to move, the male aligned his head with hers, then aligned the bodies as the female continued to crawl.

On three occasions, the snakes were visually separated by the stump. The female was in a resting coil and the male crawled around the stump until visual contact was made *ca.* 50 cm from her head. If the female was in a position to see the male, he immediately withdrew his head behind the stump. At intervals of 15 seconds–2 minutes, he extended his head and neck until visual contact was made. This head extension-withdrawal behavior was seen as many as twenty times. If the female's head was either pointing away from the male or if she turned her head away from him, he crawled rapidly toward her, aligned his head and tail on her coils, and began the rhythmic spurring described earlier. Spur cadence varied between 1–2 strokes/second. When the smaller female was approached by the male, the former invariably withdrew. The coital duration in one instance was 50 minutes. The male's tail did not encircle the female's tail. No spur movement or pulsations were evident. The pair remained motionless during coitus and the snakes were copulating in the branches in one instance. Combat between males was not seen as the smaller male always fled.

Between 0800–1230 hours, the smaller female laid nine eggs and passed

five infertile egg masses on 20 May 1979. The eggs were measured and weighed: length 74–96 mm, $\bar{x}$ = 83; diameter 42–54 mm, $\bar{x}$ = 45; weight 73–126 g, $\bar{x}$ = 107. On 26 May the eggs began to deteriorate and only one egg remained by 13 June. Twenty days later the remaining egg collapsed; dissection revealed a dead embryo lacking pigment but scales were formed.

Acknowledgments

For supplying specimens for our study we thank David Jardine and Edward J. Maruska of the Cincinnati Zoo, Warren D. Thomas and Harvey M. Fischer of the Los Angeles Zoo, John E. Werler and Hugh Quinn of the Houston Zoo, Michael Blakely and Lawrence Curtis of the Oklahoma City Zoo and Louis R. DiSabato and Joseph Laszlo of the San Antonio Zoo. For various courtesies extended to us, we thank John W. Banks, Hans E. A. Boos, Larry O. Calvin, Stan Chiras, Joseph T. Collins, Richard Ross and Wayne Seifert. Members of the Department of Herpetology, David A. Blody, Janice Perry and especially Lyndon A. Mitchell assisted us in many ways. Samuel McDowell and Joseph T. Collins kindly read the manuscript and offered many helpful comments. Ann Moore and Wanda Weaver typed several drafts of the manuscript.

Many of the snakes upon their death have been or will be placed in the vertebrate collections of the University of Texas at Arlington (UTA) and the University of Kansas at Lawrence (KU).

Literature Cited

Barker, D. G., J. B. Murphy, and K. W. Smith. 1979. Social behavior in a captive group of Indian pythons, *Python molurus* (Serpentes, Boidae) with formation of a linear social hierarchy. Copeia 1979:466–471.

Boos, H. E. A. 1979. Some breeding records of Australian pythons. Int. Zoo Yearb. 19:87–89.

Carpenter, C. C., J. B. Murphy, and L. A. Mitchell. 1978. Combat bouts with spur use in the Madagascan boa (*Sanzinia madagascariensis*). Herpetologica 34:207–212.

Cogger, H. G., and A. Holmes. 1960. Thermoregulatory behavior in a specimen of *Morelia spilotes variegata* Gray (Serpentes, Boidae). Proc. Linn. Soc. (New South Wales) 85:328–333.

Dunn, R. W. 1979. Breeding Children's pythons *Liasis childreni* at Melbourne Zoo. Int. Zoo Yearb. 19:89–90.

Gillingham, J. C. 1974. Reproductive behavior of the western fox snake *Elaphe v. vulpina* (Baird and Girard). Herpetologica 30:309–313.

Gillingham, J. C. 1976. Reproductive behavior of the ratsnakes of eastern North America, genus *Elaphe*. Doctoral thesis, Univ. Oklahoma, Norman. 62 pp.

Gillingham, J. C., C. C. Carpenter, B. J. Brecke, and J. B. Murphy. 1977. Courtship and copulatory behavior of the Mexican milksnake, *Lampropeltis triangulum sinaloae* (Colubridae). Southwest. Nat. 22:187–194.

Guibé, J. 1949. Révision des Boidés de Madagascar. Mém. Inst. Sci. Madag. A. 3:95–105.

Guibé, J. 1958. Les Serpentes de Madagascar. Mém. Inst. Sci. Madag. A. 12:189–260.

Hutchison, V. H., H. G. Dowling, and A. Vinegar. 1966. Thermoregulation in a brooding female Indian python, *Python molurus bivittatus*. Science 151:694–696.

Johnson, C. R. 1972. Thermoregulation in pythons—I. Effect of shelter, substrate type and posture on body temperature of the Australian carpet python, *Morelia spilotes variegata*. Comp. Biochem. Physiol. 43A:271–278.

Johnson, C. R. 1973. Theremoregulation in pythons—II. Head-body temperature differences and thermal preferenda in Australian pythons. Comp. Biochem. Physiol. 45A:1065–1087.

Johnson, C. R. 1977. Thermoregulation in pythons—IV. Theremoregulation in the Papuan-New Guinean pythons within the genera *Python, Liasis* and *Chondropython*. Zool. J. Linn. Soc. 60:189–195.

Johnson, C. R., G. J. W. Webb, and C. Johnson. 1975. Thermoregulation in pythons—III. Thermal ecology and behavior of the black-headed rock python, *Aspidites melanocephalus*. Herpetologica 31:326–332.

Maerz, A., and M. R. Paul. 1930. A dictionary of color. McGraw-Hill, Inc. New York. vii + 207 pp.

McDowell, S. B. 1975. A catalogue of snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum. Part II. Anilioidea and Pythoninae. J. Herp. 9:1–79.

McDowell, S. B. 1979. A catalogue of snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum. Part III. Boinae and Acrochordoidea. (Reptilia, Serpentes). J. Herp. 13:1–92.

Murphy, J. B., D. G. Barker, and B. W. Tryon. 1978. Miscellaneous notes on the reproductive biology of reptiles. 2. Eleven species of the family Boidae, genera *Candoia, Corallus, Epicrates* and *Python*. J. Herp. 12:385–390.

Quinn, H., and J. P. Jones. 1974. Squeeze box technique for measuring snakes. Herp. Rev. 5(2):35.

Rooij, N. de. 1917. The reptiles of the Indo-Australian Archipelago. II. Ophidia. Leiden: E. J. Brill. 331 pp.

Ross, R. 1973. Successful mating and hatching of Children's python, *Liasis childreni*. HISS News-Journal 1(6):181–182.

Ross, R. 1978. The python breeding manual. Published privately by Institute for Herpetological Research, Stanford, California. pp. 1–51.

Ross, R., and R. Larman. 1977. Captive breeding in two species of python *Liasis albertisii* and *L. mackloti*. Int. Zoo Yearb. 17:133–136.

Schmidt, L. P., and R. F. Inger. 1957. Living reptiles of the world. Garden City, New York: Doubleday. 287 pp.

Tryon, B. 1975. How to incubate reptile eggs; a proven technique. Bull. N. Y. Herp. Soc. 11:33–37.

Van Mierop, L. H. S., and S. M. Barnard. 1976. Thermoregulation in a brooding female *Python molurus bivittatus* (Serpentes, Boidae). Copeia 1976:398–401.

Van Mierop, L. H. S., and S. M. Barnard. 1978. Further observations on thermoregulation in the brooding female *Python molurus bivittatus* (Serpentes, Boidae). Copeia 1978:615–621.

Vinegar, A., V. H. Hutchison, and H. G. Dowling. 1970. Metabolism, energetics, and thermoregulation during brooding of snakes of the genus *Python* (Reptilia, Boidae). Zoologica 55:19–48.

Webb, G., and H. Heatwole. 1971. Patterns of heat distribution within the bodies of some Australian pythons. Copeia 1971:209–220.