PROBLEMS WITH SUCCESSFUL DOUBLE CLUTCHING IN CAPTIVE GWARDARS, *PSEUDONAJA NUCHALIS* (SERPENTES, ELAPIDAE)

Brian Bush
9 Birch Place, Stoneville WA 6081

This paper was presented at the One Day Theme held on 29.12.1993 to coincide with the Second World Congress of Herpetology in Adelaide.

ABSTRACT

Pseudonaja nuchalis from the south-west of Western Australia show marked sexual dimorphism in size: females are much more slender than similar length males. Also there are obvious differences between the sexes in the behaviour of wild caught adults maintained in captivity: males are unintimidated and feed voraciously while females are very timid and feed sparingly.

This species may lay two clutches in a breeding season producing a second clutch 43-65 days after the first. Its small size and timidity are believed responsible for the lack of success experienced by this breeder in obtaining viable second clutches from wild caught adults. To date the only successful second clutch obtained is from a captive raised female collected as a hatchling. The eggs in all other second clutches recorded were not fully developed.

INTRODUCTION

There is considerable ambiguity surrounding the taxonomy of *Pseudonaja nuchalis* (see Mengden, 1985 and Bush, 1989 a & b), it may ultimately prove to be polymorphic, composite or both. Two or more species could be involved, with hybrids common within any population (Bush, 1989a). If *nuchalis* is composite then it is likely convergent interspecific polymorphism occurs, both within and between composite populations.

Ken Aplin (pers. comm.) of the Western Australian Museum is of the opinion that in the south-west there are at least two species involved, one being larger than the other. I have recorded the weight to length ratios of a sample of adult *P. nuchalis* from the south-west of Western Australia, and if Aplin's hypothesis is correct, it may include *P. nuchalis*, one or more composite species and possibly hybrids of these. However at this point this is of little significance from a husbandry perspective. The purpose of this paper is to document the problems I have encountered in keeping and breeding western brown snakes. The information presented here could well be applied to other *Pseudonaja* spp. also.

In captivity female *P. affinis* are similar in behaviour to *P. nuchalis,* although I have not recorded it double clutching, and *P. textilis* may double clutch (Shine, 1989).

Anyone experienced with *Pseudonaja* in Western Australia (pers. comm. with Paul Orange, Brad Maryan, Robert Browne-Cooper, Gayne Doyle and present study) all agree that in most instances female *P. nuchalis* can be identified from males on body shape and size.

Captive female *Pseudonaja* that I have kept *(affinis, nuchalis* and *textilis)* are also inclined to be much more fiery and nervous than males. I find this typical of many elapid species. Approach a cage when the female is out of the hide-box and she dances on her tail and strikes at you from behind the glass. Males are quick to settle down in captivity, females not so readily.

DOUBLE CLUTCHING WITH NON-VIABLE 2ND CLUTCH

To date I have successfully bred this species ten times. On five occasions a second clutch of eggs were deposited, however, in four the eggs were not viable. These "eggs" were small, yellowish and weighed between 1.3 and 4.92g, or less than half that of the eggs in the viable first-clutches. The second clutches were deposited 43, 45, 45, 50 and 65 days after the first.

A RECORD OF SUCCESSFUL DOUBLE CLUTCHING

A female collected as a hatchling from 20K south of Trayning, WA on 4 March 1989, in colouration what I would describe as a black and yellow banded morph with black head. Delineation of black on head and neck underwent an ontogenetic change from typical neonate to nuchal chevron, then to complete hood (as illustrated in Bush, 1989b pg 26: C1, A3, C3).
Mated on 28 February 1993 with "orange with black head" male.
Fed voraciously on mice (mean weight 22g) until 12 days prior to depositing 16 eggs on 2 May (63 days post mating).
The following day ate two mice, consuming in total 9 mice weighing 198g prior to depositing second clutch.
Final feed on 5 June, 11 days before depositing 13 eggs on 16 June, 45 days after the first clutch.
Eggs from both clutches successfully incubated at 28°C.
First clutch hatching after 65-67 days, second after 85-91 days. Second clutch larger than first (mean 7.97g v. 8.36g). A summary of data appears in Table 1.

Table 1 Data on eggs and neonates for both clutches of a successful double clutching in *Pseudonaja nuchalis*.

1st CLUTCH 2-5-93				2nd CLUTCH 16-6-93			
1 *	35mm x	17mm x	6.06mm	1	42mm x	16mm x	8.15mm
2	33	12	3.46	2	35	19	8.76
3	28	15	3.48	3	36	19	8.91
4 *	32	20	7.51	4	34	20	8.57
5 *	31	20	7.75	5	33	17	7.26
6	21	17	3.50	6	32	18	7.46
7 *	40	20	9.18	7	33	20	8.70
8 *	36	20	8.78	8	33	21	8.30
9 *	32	20	8.03	9	35	21	9.05
10	26	16	3.87	10	40	17	9.13
11 *	31	20	8.38	11	34	21	8.57
12 *	32	21	8.63	12	32	20	7.82
13	27	18	4.07	13	33	19	8.06
14 *	33	19	7.33				
15	28	15	3.58				
16	28	17	4.92				
Mean for 9 eggs*	33.6	19.7	7.97	Mean	34.8	19.1	8.36
Female Reprod. Effort 51.3% (if all fully developed 66.4%) Hatched 7-9 July 93 (65-67 days) Neonate weight (gm) 4.96-5.24 (mean 5.14) Postnatal slough 26-29 July (19-20 days)				Female Reprod. Effort 56.64% Hatched 9-15 Sept 93 (85-91 days) Neonate weight (gm) 4.52-5.41 (mean 4.97) Postnatal slough 19-24 Sept 93 (9-10 days)			

None of the neonates had bands. All can be placed to either Mengden's (1985) "orange with black head" morph or "pale head, grey nape" morph with nuchal chevron.

An egg from the second clutch that failed after 67 days incubation was opened and revealed two dead embryos. They both had the typical neonatal head markings and extremely short bodies. It is not uncommon for twins to successfully hatch from one egg. However in this case, I do not believe they would have had sufficient room to fully develop.

DISCUSSION

Figure 1 is a graph comparing male and female weight to length ratios. Sample sizes are small (13 male , 7 female + 2 gravid and 1 post-parturition) and from a limited area in the south of Western Australia. Both sexes obtain equivalent ratios when their SVL is 95cm or less. This may be because females at this length have not commenced reproduction, or males are sexually inactive. Shine (1989: 197) lists mean adult SVL's for both sexes in each morph. I have included his data for the morphs and recalculated the mean SVL's: males = 93.4 v. 107.5cm in present study, females = 87.5 v. 97cm. From this one would assume that males and females between 80-95cm would be reproductively active. Shine mentions a south to north clinal reduction in size, at least in the "southern morph". My data is for *P. nuchalis* from the south where they are larger, and the measurements include live and fresh roadkilled snakes, whereas Shine examined pickled specimens which may have shrunk over the years. Gravid females attain equivalent ratios to males and non-gravid females in excess of 95cm have lower ratios. As can be seen by the graph, the males really put on the "middle-age spread"! I have noticed when handling live males they definitely appear to be stronger than females. Maybe in females, muscle is sacrificed to make way for fat bodies and the development of eggs, whereas the muscular body in males has evolved as a response to male/male combat.

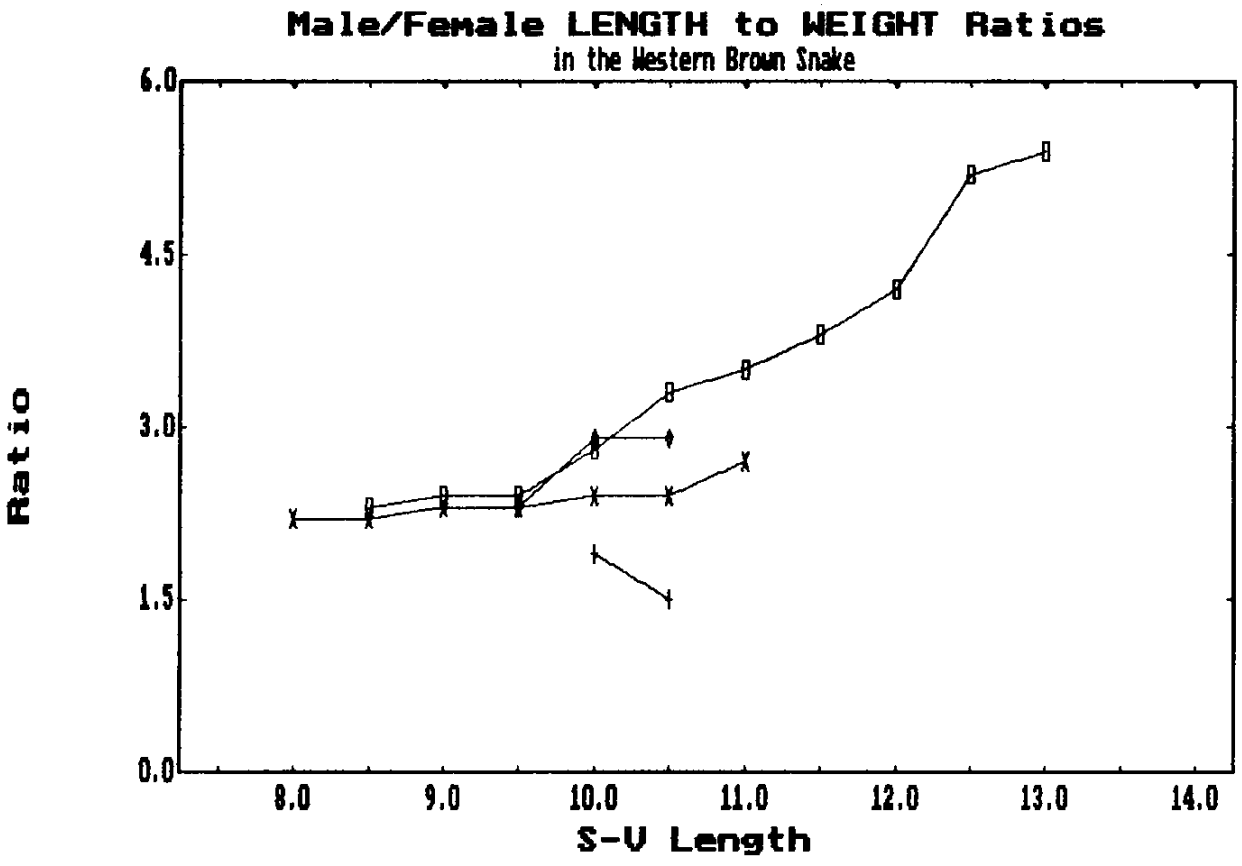

Figure 1. Graph comparing weight to length ratios of male (o) and female (x) Western Brown Snakes *(Pseudonaja nuchalis)*. Note comparable ratios in both sexes up to 95cm snout-vent length (SVL), after which males become much heavier than similar length females.
Post parturition (+) and gravid (♦) females are included also. Above SVL's of 95cm it is only a gravid female's increased weight which brings her in line with similar length males.

The females that were "unsuccessful" in the second clutches were all collected from the wild as adult snakes, and were of very nervous temperament. They were timid in feeding behaviour and reluctant to take freshly thawed mice. This may have resulted in a lack of nutrients required to sustain the oviducal eggs to complete development. In the first clutch there is an investment of 50-60% of the female's body-weight, which can cause a reduction in a female's weight to 152g in a 102cm SVL snake. In the short time interval in which the second clutch has to develop, the energy intake to produce this clutch has to be both rapid and large. The small body-size observed in female *P. nuchalis* (Fig. 1) does not allow the storage of sufficient nutrients to sustain successful development of more than a single clutch in a season. In some cases females fed until 10-15 days prior to depositing the first clutch. Once this has occurred, all energy reserves are exhausted. The female that laid the successful second clutch was exceptional in that it fed the day after the first clutch was laid and continued feeding until 198g total weight of mice had been consumed. I believe a gravid female's metabolism is higher than non-gravid females and males, estimated by how quickly the mouse-lumps in her body disappeared and the increase in rate of defecation. The second clutch weighed 108.74g, or a reproductive effort (RE) of 56.6% of her body-weight, which when combined with the first clutch (RE 51.3%), equalled 108% of her body-weight in offspring in one season.

It would appear the best stock for a breeding program for *Pseudonaja nuchalis*, in fact all *Pseudonaja* spp., are females bred, or at least raised in captivity. Another problem I experience with this species is the inability to breed an individual female more than two consecutive years in a row, the snake usually dies within 6 months of depositing the final clutch in the second year. It appears they are unable to recoup sufficient energy after the second reproductive effort. Feeding and vitamin supplements do not help as the animal does not appear to absorb anything from the food and weight loss continues to the point where it is nothing more than skin and bones. If this is a response related to change of environment after capture, it hopefully may not occur in captive raised individuals.

REFERENCES

Bush, B. 1989a. Polymorphism in captive bred siblings of the snake, *Pseudonaja nuchalis*. Herpetofauna 19 (20): 28-32.

Bush, B. 1989b. Ontogenetic colour change in the Gwardar, *Pseudonaja nuchalis*. West. Aust. Nat. 18 (2): 25-29.

Mengden, G.A. 1985. A chromosomal and electrophoretic analysis of the genus *Pseudonaja*. In The Biology of Australasian Frogs and Reptiles (Eds. G. Grigg, R. Shine & H. Ehmann), pp. 193-208. Surrey Beatty & Sons, Sydney.

Shine, R. 1989. Constraints, allometry and adaptation: food habits and reproductive biology of Australian Brownsnakes (*Pseudonaja:* Elapidae). *Herpetologica* 45 (2): 195-207.