POLYMORPHISM IN CAPTIVE BRED SIBLINGS OF THE SNAKE, *PSEUDONAJA NUCHALIS*

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Pseudonaja nuchalis is widespread across most of mainland Australia being absent only from the extreme east, south-east and south-west. It includes a confusing variety of morphs which display little or no geographic isolation and considerable intergrading. Mengden (1985) pioneered the first study of the various colour/pattern morphs using biochemical techniques and clarified this complex situation. He classified the morphs and described chromosomal variations correlating with these, suggesting separate species may be involved. However, he was aware of the considerable ambiguity still surrounding the *nuchalis* problem and suggested the need for data on clutches to help clarify this. The problem is further compounded by the radical colour and pattern changes that occur in neonate and subadult *P. nuchalis* (Bush, 1989). These changes allow an individual snake to be placed in different colour morphs at different ages, and these morphs resemble some of Mengden's karyotypic morphs. This paper describes 2 cases of polymorphism in colour in siblings bred in captivity from adult *P. nuchalis* collected in the wheatbelt of Western Australia.

PARENTS (1)

Female collected October 18, 1986 at Shackleton (31°50'S, 117°50'E). Colour – pale brown with indistinct nuchal chevron. Ventrals 222, subcaudals 55. *Male* collected October 27, 1986 near Wongan Hills (30°43'S, 116°43'E). Colour – yellowish-brown with distinct broad nuchal chevron and bright lemon-yellow throat extending onto sides of head. This snake has darkened considerably since capture. Ventrals 212, subcaudals 56.

MATING/EGGLAYING/HATCHING

The adult male and female were first housed together in early November, 1987 and mating was observed at 12.14pm on December 1. Considerable bleeding from the female's cloaca was noticed and, after examining the bony recurved spines on the hemipenes in this species, was expected. These resemble medieval implements of torture rather than male sex organs. The pair were joined for almost 3 hours (to 2.55pm). Mating photographed (Fig. 1). No further mating was observed.

Egglaying commenced at 2.35pm on January 14, 1988 (Fig. 2) and was completed by 5.40pm the same day. 13 eggs measuring (mm) 36 x 19 – 44 x 22 (mean 40 x 20) and weighing (gm) 8.32 – 10.66 (mean 9.8) were deposited. Several of the eggs were heavily speckled with 1 – 2mm clear 'windows'. The period from recorded mating to egglaying was 45 days – although there may have been an earlier unobserved mating.

Eight eggs were placed on dampened vermiculite (verm. to water ratio 2-1 by weight) and incubated at 30°C. On April 4, 81 days after deposition, hatching commenced. Hatching in this sample completed by 6pm on April 6.

Five eggs were placed as above but incubated at room temperature (ca. mean 23°C). These commenced hatching on April 13, 90 days after deposition, and continued hatching until April 16.

NEONATES

All emerged with the typical neonatal head markings in this species (see Bush, 1989 Fig. 2) but, after the completion of the second slough 33-36 days post hatching, could be placed to one of 3 distinct colour morphs: pale brown with nuchal chevron (5), yellow with 14-17 broad black bands and nuchal chevron (4) and reddish-brown with black head (2). Two of the banded morphs hatched from the eggs incubated at 30°C and 2 from the eggs incubated at the lower temperature. With the exception of a single banded morph all the hatchlings were males. Ventral and subcaudal counts for this clutch are 210 – 226 (mean 219),\ 56 – 60 (mean 59). Figure 3 shows banded and non-banded neonates.

A sample of banded and non-banded neonates are lodged in the Western Australian Museum (WAM R 100563-4).

This male and female were again mated towards the end of 1988 resulting in 20 eggs being deposited over the period November 7-13. Of these 12 failed, possibly as a result of lying in fecal matter for some time prior to being removed. These measured (mm) 36 x 17 – 41 x 21 (mean 38.5 x 19) and weighed (gm) 8.96 – 9.63 (mean 9.3). Eight eggs were successfully incubated at 30°C hatching on January 9 after 63 days. The neonates in this sample were banded (1) and non-banded (7).

PARENTS (2)

Female collected October 26, 1987 at Ballidu (30°37'S, 116°46E). Colour – bright orange dorsally with strong 'herringbone' pattern caused by dark edges on some scales forming obscure bands; head and neck black. Ventrals 222, subcaudals 57. *Male* collected November 25, 1987 at Shackleton (31°56'S, 117°50'E). Colour – greyish-brown to pale olive with ill-defined 'herringbone' pattern; nose, sides of head and sides of neck black. Black absent from the supraoculars, frontal and parietals. Distinct nuchal chevron present followed by dark neck (see Fig. 4). Ventrals 211, subcaudals 55.

MATING/EGGLAYING/HATCHING

The male was placed with the female immediately after capture and mating was observed at 5.30pm on November 27, 1987. The pair were joined for 3 hours 20 minutes (to 8.50). Egglaying commenced 52 days later on January 18. These eggs were of various sizes, 15 x 12 – 29 x 17, yellow in colour, and may be the result of reabsorption of the nutrients from the eggs by the female.

This pair were again mated towards the end of September, 1988 and, although mating was not observed, 12 fully developed eggs were laid on November 11. These measured (mm) 35 x 19 – 41 x 20 (mean 37.3 x 19.5) and weighed (gm) 8.27 – 9.42 (mean 9.15). All were successfully incubated at 30°C. Hatching commenced on January 11 after 61 days and was completed on January 16 after 66 days.

NEONATES

All emerged with similar head markings to those in the previous example. Dorsally there was some variation in colour between individuals. The two extremes of this were reddish-brown and very pale brown or straw-coloured. All displayed the strong herringbone pattern typical in the sub-adults and young adults of this species (pers. obs.). None emerged with bands. After the postnatal slough, 11-14 days later, this clutch could be divided into two distinct colour morphs: orange with black head (3) and pale brown with nuchal chevron (9).

DISCUSSION

The snakes from the 3 clutches demonstrate polymorphism, not only in neonatal colour between siblings but also relative to the age of the individual snake. The herringbone pattern occurs in all the young snakes, being represented by the very narrow bands in the banded morphs mentioned above. This pattern is uncommon in old snakes allowing the banded morph to be split in two, ie hatchlings through to young adults display the 'carinata' pattern while old adults lack the narrow bands between the broad bands and are simply banded morphs. The number of bands often decreases with age due to a fading of the anterior bands in some individuals. This has already occurred to some extent in the banded hatchlings retained alive from the first clutch described here. These are 17 months old now (sept. '89). The black head and neck frequently occurs in this species irrespective of back pattern or colour. As illustrated by Bush (1989), this can develop differently between individual snakes allowing the one snake to appear as separate colour morphs relative to age. Figure 4 illustrates an adult male *P. nuchalis* that could be described as an intergrade between 4 morphs as categorised by Mengden (1985) viz. a) brown with black head; b) southern; c) southern with black head and d) pale head-grey nape. This same snake, 2 years after being photographed, has changed considerably. The black on the head is as it was but the ground colour has changed to dark brown.

This study further highlights the ambiguity surrounding this highly variable species however, it does suggest one should err on the side of conservatism when considering the taxonomic dismemberment of *Pseudonaja nuchalis*.

In conclusion, these points need to be noted –

(1) Polymorphism in neonatal colour is now documented in the following morphs: "orange with black head"; "pale head, grey nape"; "southern"; "carinata" and "banded".

(2) The correlation between colour and karyotype is unlikely to be as close as suggested by Mengden (1985).

(3) Either species-barriers are breaking down (so hybrids are common) or there is a greater range of colour morphs *within* species, and greater colour overlap *between* species, than suggested by Mengden's initial results.

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REFERENCES

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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.

Figure 1. Mating of *Pseudonaja nuchalis* which resulted in 3 distinct colour morphs in offspring.
Note monotonal dorsum of mating pair.

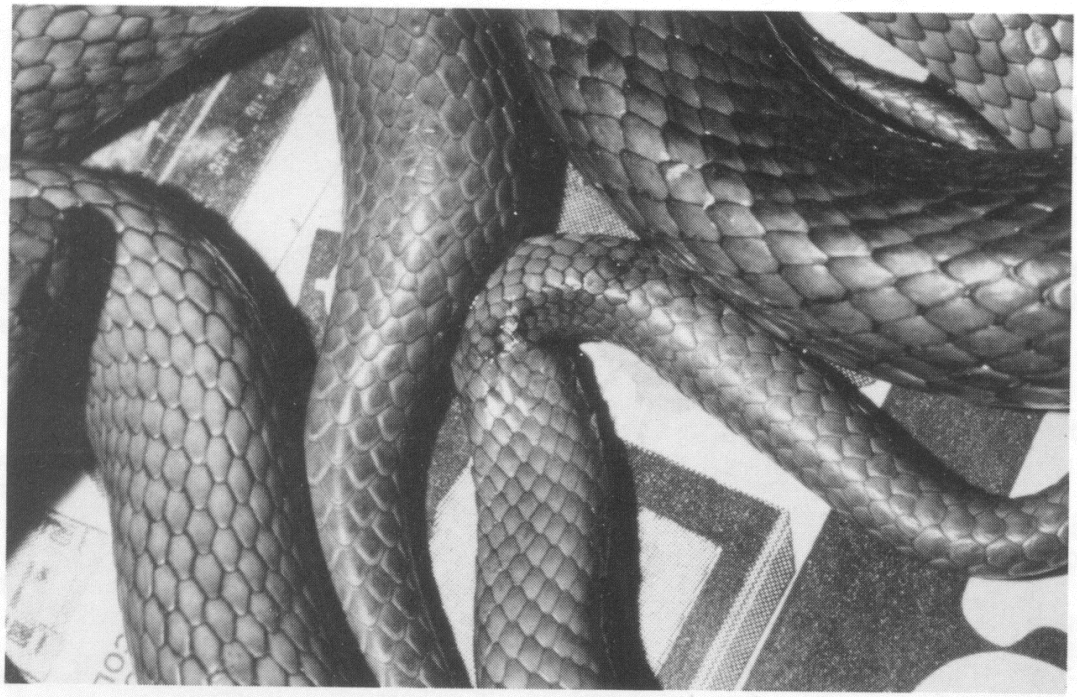

Figure 2. Egglaying in *Pseudonaja nuchalis* which commenced 45 days after mating depicted in Fig. 1.

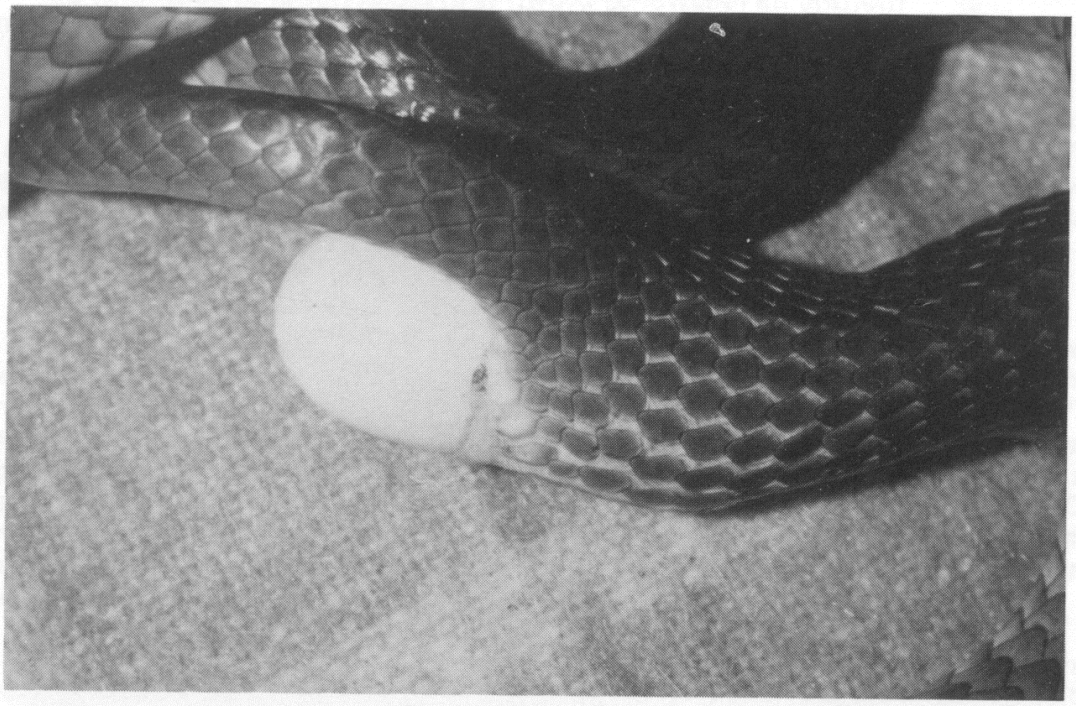

Figure 3. *Pseudonaja nuchalis* neonates immediately after emergence from egg. Note 2 distinct colour morphs. The third morph recorded is not detectable until after the second slough: the black on head will progressively fade highlighting the nuchal chevron.

Figure 4. *Pseudonaja nuchalis* adult male from Shackleton, Western Australia that could be described as an intergrade between 4 morphs as follows: a) brown with black head; b) southern; c) southern with black head and d) pale-head grey-nape.