THE DUGITE or SPOTTED BROWN SNAKE
(*Pseudonaja affinis*)

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INTRODUCTION

Pseudonaja affinis affinis Günther 1872 is a very common elapid snake in the highly populated south-west of Western Australia. As is the case with many of the common species little published data is available on the nominal race and even less on the subspecies, *exilis* and *tanneri*. Storr (1983) included *inframacula* as a subspecies also, however we have followed Cogger (1994), Ehmann (1992) and Mengden (1985), all of which consider *inframacula* a full species. Here we review all available literature and include both published and previously unpublished information on the morphology, colour variability, distribution, habitat, size, growth, longevity, reproduction, seasonality and prey of the Dugite.

TAXONOMIC HISTORY

***Pseudonaja affinis affinis* Günther, A. 1872**. 7th account of new species of snakes in the collection of the British Museum. *Ann. Mag. Nat. Hist* 4 (9): 13-37.

***exilis* Storr, 1989**

***tanneri* (Worrell, 1961)**

Demansia nuchalis affinis Kinghorn, J.R. 1929. *The Snakes of Australia*. 2nd Edition 1956. Angus & Robertson, Sydney.

Demansia textilis affinis Loveridge, A. 1934. Australian reptiles in the Museum of Comparative Zoology *Bull. Mus. Comp. Zool. Harv.* 77 (6): 243-283.

Demansia nuchalis tanneri Worrell, E. 1961. A new insular brown snake. *Proc. Roy. Zool Soc NSW.* 1958-59: 56-58.

Pseudonaja affinis tanneri Storr, G.M. 1983. *List of WA Frogs & Reptiles.* 4th Edition distributed by WA Museum.

Pseudonaja affinis exilis Storr, G.M. 1989. A new *Pseudonaja* (Serpentes: Elapidae) from Western Australia. *Rec. West. Aust. Mus.* 14 (3): 421-423.

MORPHOLOGY AND COLOUR VARIABILITY

A large slender to moderately stout snake: young individuals tend to be quite slender while the stoutest specimens are usually the older snakes. This is consistent with their foraging behaviour: young snakes actively hunt lizards while adults tend to feed on mammals. These are often in burrows or similarly restricted places where a slender form for speed and agility is of less benefit than the strength of a stout body.

Body with matt to moderately glossy scales. Midbody scale rows 19 (rarely 17 or 18). Anal scale divided, rarely undivided. Subcaudals divided; however a few undivided subcaudals are common. Scale abnormalities occur in most snakes, particularly when examining a large series of the one species. Annable (1985) recorded this in *P. textilis*, and suggests it is normal in species that occur in a wide range of habitats. Osgood (1978) stated that extreme temperature during incubation often resulted in scale abnormalities. The range of ventrals and subcaudals are subspecies specific. The insular races have smaller spreads and lower maximum numbers than the mainland population; ie *affinis* 203-242, 48-66 (Storr *et al*, 1986 & pers rec N27v, 32s); *exilis* 207-219, 48-57 (Storr, 1989 N16); *tanneri* 201-216, 56-60 (Worrell, 1961 N7 & pers rec N2). Two juvenile *affinis* from the Perth suburb of Canning Vale had aberrantly low ventral counts of 142 and 156. Collected within a week of each other they are possibly siblings. The low ventral counts could be a result of temperature extremes during incubation as mentioned above. Eggs deposited in areas exposed to human development may have covering soil disturbed during incubation allowing a rapid increase or decrease in temperature at the deposition site.

Storr (pers comm) initially believed that *affinis* was consistently brown to olive-green in colour. It was only when examining WA Museum specimens, during the preparation of the book *Snakes of Western Australia*, that he came to realise the wide colour and pattern variation in this species. Residents of the south-west popularly consider the Dugite to be a plain brown snake. When observing *affinis* other than brown, they refer to them by different names, ie mungi snake, grass snake, sand snake, etc. Although it is a member of the 'brownsnake' genus, like its congener *nuchalis*, it displays considerable variation in colour and pattern. The following authors have generally simplified this in their respective descriptions: Cogger, 1994; Ehmann, 1992; Glauert, 1950; Gow, 1982; Storr, 1979 and Storr *et al*, 1986. Cogger (loc cit) may have mistakenly described *nuchalis* when referring to an inverted "V or W" on the nape in some *affinis*. We have never observed this in any Western Australian *Pseudonaja* other than *nuchalis*. Wilson and Knowles (1988) mention how variable the colour is but do not attempt to illustrate this by describing 'morphs'. Chapman (1995) describes typical *affinis* similar to Plate 15 (2) in Storr *et al* (1986) and smaller very dark individuals that were presumably *Pseudonaja* from the Fitzgerald area on the south coast. Bush (1981) was aware of the divergence in this species and defined several morphs, ie brown, black, mottled and yellow. The monotonal, carinata and banded morphs described here later are convergent with *nuchalis* and serve to demonstrate the close phylogenies of the two species.

Dugites maintained in captivity darken with age, while those with spots have a corresponding increase in the density of these. Orange (1992) observed the dorsal colour darkening to black on two separate occasions in *affinis*.

Adults of the insular subspecies, *exilis* and *tanner,* are immaculate chestnut brown to black above. The belly is marginally lighter than the dorsum to immaculate black. Worrell (1961), in his description of *tanneri* from Boxer Island, states some indistinct dark blotches at the posterior edge of the ventrals ventrolaterally and distributed over most of ventral surface. Specimens from Figure of Eight Island range from that described by Worrell to immaculate gunmetal blue or black on the belly.

We find the only satisfactory way to describe colour and pattern in mainland *affinis* is to partition the consistent forms and describe them as morphs, as follows:

a) Monotonal (Figure 1) - upper surface uniform cream, yellow, brown, green, brick-red, grey or black; no colour differentiation of head. The paler monotonal forms with or without herringbone pattern.

b) Sparsely spotted (Figure 2) - upper surface sparsely spotted and blotched with black. The spots vary in size from as small as a portion of a scale to as large as several scales. Ground colour pale cream, yellow, brown, green, grey or brick-red.

c) Densely spotted (Figure 3) - upper surface densely spotted and blotched with black. The spots vary in size as in the previous morph but density is so great in some as to cause a 'mottled' appearance. It only occurs in the larger and heavily bodied individuals, hence the density of the spots is age related. Glauert (1950) refers to this form by the aboriginal name 'kabarda'.

d) Pale head, grey nape (Figure 4) - upper body and tail monotonal yellow, brown or green with a much paler head (almost white in some individuals) and darker neck band 10 or more scales wide. This morph is most prevalent in the Darling Range within the species' distribution.

e) Carinata (Figures 5 & 6) - upper body and tail with 9-15 obvious to weakly defined broad, dark bands. The interspaces with 3-5 narrow (1-1.5 scales wide) evenly spaced ragged bands caused by a transversely aligned darkening of the anterior and (to a lessor extent) posterior margins of dorsal scales. In many individuals this patterning is only obvious when the snake inflates its body. With age the anterior bands fade being replaced by sparse spots. Ground colour yellow, brown or green. We consider this to be the rarest morph.

f) Banded (Figures 5 & 6) - up to 15 obvious to weakly defined broad, dark bands; the widest bands occur on those individuals with the fewest neonatal bands and vice versa. This relates to banding on entire body, not to a reduction of bands caused by the fading of the anterior ones that occurs with age. Ground colour cream, yellow, brown or green. This morph is not abundant and is only marginally more common than the 'carinata' morph.

Ventrally there is also a large degree of variation often correlating with the morphs described above. The paler snakes tend to vary from pale cream, yellow or green with dark, random spots. These spots are most obvious anteriorly. The very dark and black individuals may have heavily mottled or blotched blackish variegations and these may coalesce into a uniform dark grey to black belly in some. This condition is typical in adult *exilis* and *tanneri*. Often the dorsal pattern extends onto the margins of ventrals and where these are wide may be broken medially (Storr *et al, supra cit*).

Juveniles, with or without bands, are olive-green, yellow or brown with a uniform herringbone pattern, caused by dark (in descending order of frequency) anterior, lower, posterior and upper margins of dorsal scales. Upper parts of the head matt black. In *exilis* and *tanneri* the dorsum is pale brown and there is a rapid ontogenetic spread over the remainder of each scale by the dark pigment responsible for the herringbone pattern. The bands in mainland *affinis*, when present, are most obvious in resting juveniles however, some that do not appear banded at rest may exhibit a weak indication of bands when they inflate the body. The belly is usually pale with random spots. These may be darker or paler than surrounding colour.

DISTRIBUTION AND HABITAT

Distribution - *Pseudonaja affinis* is widespread through south-western Australia. Following Storr *et al* (1986) it occurs within Western Australia north to Cervantes, Beermullah, Wooroloo, Darkin, Corrigin, Mt Hampton, 23km south Woolgangie, Higginsville, Jyndabinbin Rocks, 50km north-east Balladonia, Cocklebiddy and Eucla. It also extends east into South Australia to the western edge of Eyre Peninsula. The distribution maps in Cogger (1992), Ehmann (1992), Wilson & Knowles (1988) and Longmore (1986) vary little from this geographic range. Mirtschin & Davis (1992), Gow (1989) and Underhill (1987) show the range as including most of the Eyre Peninsula. Gow (1982) and Mirtschin & Davis (1982) show its distribution as extending just into South Australia. Longmore (*supra cit*) suggests *affinis* is sparse on the Nullarbor Plain in both WA and SA however this may reflect poor sampling. Greg Harold's observations (pers comm) suggest it is common near Eucla.

On 3 September 1983, BB collected four brown snakes on the Nullarbor. Two *P. a. affinis* from 5km west of Mundrabilla Roadhouse (WAM R85118) and 17km east of the WA/SA border, and two *P. inframacula*

from 60km west of the Nullarbor Roadhouse (R85111) and 5km east of that roadhouse (R85110). On 8 April 1987 he also liberated two *affinis* from a concrete lined well at the old Madura homestead. The Nullarbor *affinis* were dark to rich brown with sparse dorsal spotting and orange belly, whereas the two specimens of *inframacula* were almost black and lacked dorsal spotting with immaculate lead-grey to black bellies.

The northerly-most *affinis* we have observed were from near Southern Cross, and Paul Orange (pers comm) has recorded road-kills near Wiggiemooltha. Where the range of *affinis* overlaps that of *nuchalis* in the central wheatbelt and southern goldfields regions, the former is much less common. Museum records of *nuchalis* from the wheatbelt more than double the sample of *affinis* (Chapman & Dell, 1985). This situation also occurs in the cooler parts of the south-west where *Notechis scutatus* is much more common due to the damper conditions and higher rainfall.

Confined to Rottnest Island (1625 ha), about 20km west of Fremantle, is the subspecies *exilis*. The other subspecies, *tanneri* occurs on Boxer (192 ha) and Figure of Eight Islands (283 ha), 25-30km from Esperance, in the Recherche Archipelago. These are the only insular records for this species.

Habitat - Mainland *affinis* occupies virtually all habitats, including coastal dunes, semi-arid woodlands, shrublands and wet sclerophyll forests (Wilson & Knowles, 1988). Also coastal and inland plains, slopes and ranges, especially in areas with sandy soil such as coastal dunes. It occurs in vegetation of shrubland (including heath), woodland (including mallee) and sclerophyll forest (Ehmann, 1992). A reflection of its preference for dry sandy areas is its scarcity around wetlands, swamps and other extensive damp habitats. It is also uncommon in closed forests. Like its congeners, *nuchalis* (some populations) and *textilis*, it displays a strong predilection for disturbed habitats such as industrial areas, golf courses, road verges, etc in close association with agricultural development (Shine, 1989). A flexibility in its ecological requirements allows *affinis* to successfully inhabit these areas. Its numbers have greatly increased due to our modifications to the land and especially to the introduction of one feral animal, the house mouse (*Mus musculus*), that constitutes the main diet of the adults. This ecological shift has, of course, occurred in the past century in Australia because of European settlement and agriculture. Storr *et al* (1978) noted a similar cycle of abundance. “Relatively low population densities in undisturbed bushland remote from settlement, increasing densities as settlement approaches, decreasing densities from the beginning of development to local extinction as area becomes completely built up”. Our observations support this; we have recorded large numbers of *affinis* in habitats altered by humans but rarely come across it in undisturbed bushland. Maryan (1993) made 112 separate observations of this species during an extended survey in some southern suburbs of Perth.

Areas combining both remnant bushland and cleared land contain the highest concentrations of *affinis* on the mainland. Favourable areas where we have found this species in abundance are human-made grasslands around sheds and rubbish strewn areas. In the Perth area one of the dominant introduced grass species is the perennial veldtgrass (*Enrharta calycina*) which, during the warmer months, forms a low dense covering over the ground. In suitable habitats where mice are abundant, population densities can be very high. In these areas we have found 5-7 adult *affinis* near each other. Its ability to persist and avoid detection in developed, densely populated areas is amazing, particularly for a large nomadic foraging elapid. Occurrences within the inner suburbs are infrequent however and there is usually a patch of remnant bush or an undeveloped housing block nearby; snakes inhabiting these briefly advance into backyards in search of mice. One gets the impression that they know every bird aviary, chook run and old shed within their area, and visit each in turn before moving back to the bush. We have removed dugites from sheds and aviaries that have lived within or nearby for some time. In these cases it would appear the snake has taken up semi-permanent habitation there because food is plentiful and there is suitable cover.

Elsewhere the density of *affinis* appears greatest in coastal areas that include rock formations (usually granite and limestone in the south-west) and undulating dunes with low heath including medium sized shrubs such as *Acacia* spp. The coastal areas that remain relatively undisturbed usually contain some evidence of human habitation such as camp sites and holiday shacks. There is an apparent increase in the number of *affinis* near these.

We have recorded juveniles and adults beneath a wide variety of surface debris; ie logs (in hollows also), rocks, concrete slabs, plastic sheeting, cardboard, corrugated iron, car bodies, tyres, fibro sheeting, animal

carcasses, rolls of poly-pipe, etc. We have also unearthed it from grader spoil-heaps, abandoned termite mounds and stick-ant nests, as well as inside rodent, rabbit and lizard burrows. Bush (1981) lists a few shelter sites and succinctly states, "anywhere else it can squeeze". This is more than true for this species, however we have found it most often in disturbed areas beneath corrugated iron or similar; usually surrounded by dense grass that provides an ideal escape route for the snake when disturbed. Mice are also abundant at these sites and *affinis* will retreat down their burrows to both avoid capture and over-heating during summer. We have excavated torpid individuals from burrows during winter.

P. a. exilis, like its mainland counterpart, has probably increased in numbers due to human alteration of the island habitat and introduction of the house mouse. The vegetation has changed considerably since settlement with an increase in fires and grazing by the Quokka, *Setonix brachyurus* (System 6 Report, 1983). Rottnest Island had an almost impenetrable low closed forest that has gradually become dominated by an *Acacia* species. Today its topography consists of undulating sand hills with a low coastal heath of varying densities and numerous limestone exposures. Considering the island's size, degree of disturbance, human settlement (concentrated at the eastern end) and thousands of visitors monthly, *exilis* is surprisingly common. We have found juveniles and adults beneath limestone rocks, deadfall vegetation, sheet and corrugated iron and other discarded rubbish. In September 1990 we found five adults, including a mating pair beneath corrugated iron at the one site. During spring (especially) and summer it is active on roads, tracks and amongst vegetation. One of us has seen adults basking on piles of seaweed on the beaches, eluding capture by entering the labyrinth within the tangled kelp.

P. a. tanneri occurs on two relatively remote, undisturbed and uninhabited islands in the Recherche Archipelago. The habitat on Boxer and Figure of Eight Islands is mainly low dense heath with varying densities of *Acacia* spp. and extensive granite outcrops. These outcrops are a stunning feature of the islands. The areas of vegetation most exposed to the elements become more open and wind-pruned. David Knowles, after visiting Figure of Eight on 26 October 1994, has provided the only data we have on this subspecies in the wild. He observed nine adults active on a large rocky outcrop with two of these being males involved in combat. The adults shelter beneath the exfoliated rock and down crevices. He also uncovered four juveniles beneath a single granite slab embedded in the soil away from the outcrop. The numbers recorded on a one day visit by Mr Knowles suggest it is common. There is ample shelter and food, and predators are few on these islands. Two other elapids inhabiting islands in this archipelago are the Death Adder (*Acanthophis antarcticus*) and the Crowned Snake (*Drysdalia coronata*). Both are very common on some of the islands.

SIZE, GROWTH AND LONGEVITY

Size - A large, *Pseudonaja* to 2.13 metres total length. A very large male Dugite displayed at the Perth zoo until its death in December 1992 measured 212.5 cm. It arrived at the zoo on 2 November 1980 as an adult of 135 cm. There is no record of the locality it came from but probably Perth. Large individuals occasionally occur in the metropolitan area however for consistently larger snakes you need to visit the southern coastal farming areas between Albany and Israelite Bay. Sightings of large Dugites on the southern coast west of Esperance are common. Three roadkills recorded by one of us near Lort River measured 2 metres total length. The average adult snout-vent length (SVL), when excluding individuals less than 60 cm and including both sexes in the sample, is 118.5 cm (60-184.5; N43). Males are larger than females, 127 (70-184.5; N22) v. 113.1 (70-140; N13). Shine (1989) found little difference in the adult size of *P. affinis*, ie males 108.5 (58.1-163; N49), females 108.8 (74.6-149, N35). He did record larger adult males in *P. inframacula, P. nuchalis* and *P. textilis* and suggests (1978) this has evolved as a result of male-male combat. In the remaining three species, *P. guttata, P. ingrami* and *P. modesta* the females get marginally larger. The adult size recorded here is greater than Shine's (1989) however this discrepancy occurred previously in similar data. Bush (1994) suggests shrinkage in pickled specimens causes this. Our measurements came from fresh roadkilled and living specimens. Another factor contributing to the difference in size recorded by Shine could be the inclusion of the smaller *exilis* in his sample. According to Storr (1989) this subspecies has an SVL range of 223mm to a maximum of 1005mm. Smaller still is *tanneri*. We have recorded a maximum SVL of 859mm (TL 1000) in this subspecies.

Neonatal SVL 194-226mm and weight 4.75-6.82g (Bush, 1992 & pers rec); the mean SVL and weight respectively based on 60 neonates from 3 clutches is 214mm and 5.92g.. The smallest wild caught juvenile measured 242mm.

The common anecdotal stories on Dugites, referring to the "six footer", are typical Aussie yarns. They originate with the belief that you should not let the truth get in the way of a good story. We found Dugites of this size to be quite rare, with the "four footer" being more likely the size met!

Growth - Graph 1 depicts inferred growth from hatchling to adult. For this we considered snakes from 60-70cm SVL as young adults. Shine (1989) includes the minimum size of adult *P. a. affinis* as males 58.1cm and females 74.6cm. Sexual maturity attained at 18-24 months. Although we have not maintained neonatal *affinis* to adulthood, we have maintained large numbers of *nuchalis* during this period of their life. Females are reproductively viable as young as 17 months of age or as small as 68cm SVL. Male mainland *affinis* display sexual activity from as small as 50cm but may not necessarily be sexually mature at this size. Worrell (1961) reports observing *tanneri* as small as 70cm copulating.

A partial indicator of growth is the frequency of sloughing. Juvenile snakes kept by us and given plenty of food have sloughed initially every 18-24 days. It is so often that there appears to be only time for a quick feed before going into pre-slough condition again. At 6 months of age the frequency has reduced to about 30 day intervals and progressively decreases, minus a few 'hiccups', to as few as 3-6 times each year. Even the old snakes keep up a regular sloughing rate: a male collected in 1980, 15 years ago, sloughs at 2-2.5 monthly intervals. During the past 5 years it has averaged 5.2/year compared with a 3.25/year mean for 4 other males..

Longevity - There is surprisingly little data on longevity in Australian reptiles and frogs. Currently there are a few long-term captive Dugites in Western Australia. They are all alive at the time of writing this article except for one kept at the Perth Zoo from 1980 to 1992 and mentioned above. We have 3 males collected on the Esperance sandplain in 1979, 1980 and 1983. They were all guesstimated at 110cm SVL when collected and now measure 173, 165 and 157 respectively. These snakes could not have been any less than 3 years old when obtained. Therefore a conservative estimate of their age is 20 years; it is quite probable that *affinis* may live for 30 years.

REPRODUCTION & SEASONALITY

Reproduction - *P. affinis* is oviparous with the nominal race producing clutches of 11-35 eggs. The average clutch based on eleven records is 21 (data from Bush, 1992 and personal records of Brian Barnett, Brian Bush, Brad Maryan & Rico Schmidiger). Shine (1989) recorded 3-25 eggs (14.6, N11), however his sample may have included at least one of the smaller insular subspecies. We have no reproductive data on either insular race, however we would expect these to have lower fecundities due to their smaller size than the mainland race. A 108 cm SVL captive mainland Dugite inseminated on 28 July deposited 13 healthy eggs 46 days later. The reproductive effort of the female (clutch mass as a percentage of female mass immediately post-parturition) was 37%. This is quite low when compared to its congener *P. nuchalis*, 49.6-78.1% (pers rec). Also, from a single mating *P. nuchalis* can produce two clutches of eggs 43-65 days apart (Bush, 1994), but there are no records of this in *affinis* or any other *Pseudonaja*. Shine (loc sit) suggests it may occur in *P. textilis* because of the long period (Oct-Jan) in which he recorded oviductal eggs in females. To date it has only been confirmed in *nuchalis.*

Based on egglaying in wild-caught gravid females, this occurs from mid-December to the end of January. Egg size (mm) in seven clutches was, length 25-46, width 15-25 and mass (g) 4.6-13.9. Respective means for clutches we have recorded are 30.5 x 16.5 x 6.1 (N4 of 16), 30.2 x 20 x 6.33 (N23), 32.4 x 19.5 x 7.92 (N20), 37.9 x 21.5 x 11.35 (N13), and from Bush (1992): 29.4 x 20.9 x 7.3 (N27), 40.7 x 19.7 x 9.4 (N11) & 40 x 22 x 11.1 (N13). Incubation periods of 91 days at 28°C, and from Bush (loc sit): 53-61 days at 30°C & 105 days at 23°C. Hatchling SVL (mm) 194-226 (mean 214, N60) and weight (g) 4.75-6.82 (5.92, N60).

Male/male combat occurs in October in the wild and from August to December in captivity. For a photograph of combat in *affinis* see Shine (1991: 65). Mating in the wild occurs during the corresponding period combat is ongoing. In captivity mating will occur throughout the year in heated snakes. Copulation causes bleeding in females resulting in a considerable bloody fluid residue on the floor of the terrarium as an indicator of the event. We have not observed multiple matings in the Dugite; after copulation further attempts by the male are unsuccessful in stimulating the female to respond again.

Seasonality - Graph 2 illustrates comparative monthly captures for a) total sample excluding juveniles, b) adult females, c) adult males and d) juveniles. The mainland Dugite displays a seasonal pattern of behaviour generally expected in a snake exposed to warm summers and cool winters. Apart from juveniles we recorded almost nil captures in winter (one record for August or 0.9% of sample) and had the highest number in late spring (November 27%).

When we individually examine the sexes we find there is a skewed commencement of activity after winter. The males and subadult snakes display much activity in October. Male/male combat occurs at this time in the wild, however females do not appear to be active. Maybe the males locate and inseminate females before they become active. Once inseminated, they hunt vigorously throughout November to lay down, in a very short time, the required nutrients for the embryos. We know how hungry inseminated females can become. Female *Pseudonaja* in captivity, and not intimidated by their keeper, will take on board very large amounts of food (Bush, 1994). A Captive female *P. a. affinis* weighing 309g when inseminated on the 28 July weighed 580g only 27 days later, at which time she finally refused a feed and went into a post-egglaying pre-slough condition. Related to this increased need to hunt is the peak in female captures in November. The total captures for the remainder of the year only just exceed the number for that month alone.

In summary: i) males begin moving earlier in spring and are generally active throughout the warmer months; and ii) females, after mating, are very active for a brief time in late spring and then do not move much at all for the remainder of the warmer months. The juveniles are most active immediately after hatching with a peak in March corresponding to an increase in captures for that month.

PREY

P. affinis is an opportunistic foraging hunter as described by Fearn (1994) for *Austrelaps superbus* in Tasmania. This hunting strategy is typical of most of the large Australian elapids. Apart from the limitations of prey size being dependant on the snake's size it feeds on all mammals and reptiles. Juvenile and subadults feed primarily on the smaller lizard species and baby mammals of the smaller species, while the adults take the larger lizards and mature mammals of the larger species. We have observed adult *affinis* investigating holes, crevices, grass tussocks and surface debris for prey. The diets of the larger *Pseudonaja* spp. are generally similar (Shine, 1989).

Various authors list small mammals, lizards, frogs, birds and occasionally snakes as the prey taken by *P. affinis* (Bush, 1981; Ehmann, 1992; Garnet, 1981; Gow, 1989; Mengden & Fitzgerald, 1987; Mirtschin & Davis, 1992; Storr, 1979; Sutherland, 1981 and Wilson & Knowles, 1988). Shine (1989) recorded 101 prey items in the stomachs of 68 *affinis*. They were birds 1, snakes 1, frogs 2, lizards 46 and mammals 49. Of the latter, 46 were exotic mice.

We have attempted to feed *affinis* the Slender Tree Frog (*Litoria adelaidensis*) in captivity. A snake would grab the moving frog and immediately release it again when the inner parts of its mouth contacted the frog. It would appear the secretions on the frog's skin were unpleasant to the snake.

Before the introduction of the house mouse, *affinis* occurred in a region inhabited by numerous small native mammals in the families Dasyuridae, Muridae and Peramelidae (Storr, 1989). The high number of exotic mice recorded by Shine suggests the majority of his sample of snakes came from human disturbed areas where they are most common, such as the Perth metropolitan area. We expect *affinis* in areas isolated from development to feed more on native mammals.

We have noted the prey eaten by adult mainland *affinis* after examining both human- and road-killed snakes, regurgitated remains and opportunistically observing feeding in progress during snake removal calls and field work. Reptiles recorded are the Bobtail (*Tiliqua rugosa*), Ornate Dragon (*Ctenophorus ornatus*) and Bardick (*Echiopsis curta*). A roadkilled male of 1455mm SVL from Perth contained two adult Bobtails (Robert Browne-Cooper, pers comm). The only bird recorded was a brown quail regurgitated in a bag by a snake removed from a backyard aviary. We believe it was probably mistaken for a mouse. The only native

mammal taken was a Southern Brown Bandicoot (*Isoodon obesulus*). All other prey recorded were house mice.

Juvenile *affinis* feed primarily on small, diurnal lizards and occasionally nocturnal species. It is possible, from experience with immature snakes in captivity, that they also take "pinkie" mice. Many of the lizards recorded by Shine (loc cit) are common sympatric species.

No subspecific stomach contents analysis has been done to date therefore the following relates to the prey available to *exilis* and *tanneri*. Juvenile and adult *exilis* probably feed on all fifteen species of lizard (Bush *et al*, 1995) known to occur on Rottnest Island. Apart from the recently introduced *Mus* (Storr, 1989) and Black Rat, *Rattus rattus* (A. Burbidge, pers comm) there are no small native mammals on the island. Like their mainland counterparts, we would expect the adults to take mice also.

Boxer and Figure of Eight Islands have four and three lizard species respectively (WA Museum, unpubl notes). Lizard densities on both islands are high and, as there are no recorded native mammals, we suspect that *tanneri* like *exilis* until recently fed solely on lizards. There are two introduced mammals recorded (A. Burbidge, Pers comm), ie black rats on Boxer and house mice on Figure of Eight. Our experience with this subspecies from the latter island in captivity indicates that it feeds on mice. Our specimens had little hesitation in taking them. One individual showed a particular liking for hairless rats, suggesting the Boxer Island population probably feeds on these also.

DISCUSSION

Here we briefly summarise information from further published and unpublished sources on *Pseudonaja affinis*.

Medical - Due to its abundance in high human density areas the Dugite is responsible for most snakebites in Perth. Jelinek and Breheny (1990) present an analysis of suspected and actual bites for the 10 year period 1980 -1990 treated at Fremantle Hospital. This species was involved in 70% of these. The majority of bites occurred in suburban bush or backyards. We are unaware of any fatalities positively confirmed as resulting from *Afghanis* envenomation in the past 15 years (Bush, 1995; Sutherland, 1992). This may be related to the close proximity of metropolitan medical facilities and subsequent rapid treatment.

Conservation - It is obvious from this paper that there is a lack of information on the insular subspecies, *exilis* and *tanneri*. Our knowledge of these dwarf Dugites is almost nil. It was only recently (Oct. 1994) that we acquired specimens of *tanneri* for private study. Before this the only published data available was Worrell's (1961) description. As far as we know there are no *exilis* currently in captivity. One of us has unsuccessfully applied for a licence to keep it. Cogger *et al* (1993) lists both subspecies as 'rare or insufficiently known' as does CALM by including them on the WA Reserve List. We suspect they are listed because of their respectively restricted distributions. We consider neither subspecies to be rare but, as with many WA taxa, they are definitely insufficiently known. To rectify this partly, we are planning to visit the Recherche islands shortly to collect adult female *tanneri* for breeding. This will allow us to determine fecundity and ontogeny for comparison with the nominal race. Negotiations with the authorities to privately study *exilis* will continue.

As is obvious from perusing this article, mainland *affinis* is safe, however a review of this status may be required if it is found to be composite (Ken Aplin, pers comm).

Hybridism - For some time now it has been suggested informally that there exists *affinis*/*nuchalis* hybrids. This assumption was generally applied to the banded morph. however, as these occur at the extreme south of its range, where *nuchalis* is absent, this can not be the case. Also, in areas of sympatry no evidence of hybridism has been observed by us. We have observed a distinct divergence in the neonates of the two species: *affinis* has a broader, deeper head and thicker body than *nuchalis*, SVL 194-226 (214, N60) v. 152-240 (203.6, N53) and mass 4.74-6.82 (5.92, N60) v. 2.32-6.8 (4.99, N114).

The only published references to hybridism in *Pseudonaja affinis* that we are aware of are in Storr *et al* (1986: 95) suggesting it may hybridise with *nuchalis* and Mengden (1985) concerning a snake from Penong,

South Australia, see Plate VIII (H). We believe it to resemble our 'densely spotted' morph and, therefore, is hardly aberrant.

Other observations - Although *affinis* is primarily terrestrial, we have observed it active in low shrubs and have removed the occasional individual from the roofs of houses.

During the warmer months the juveniles especially and to a lessor extent the adults are nocturnal.

Maryan & Robinson (1987) recorded an adult *affinis* and an adult *Varanus rosenbergi* sheltering beneath the same cover.

De Rebeira (1981) notes the predation of a juvenile *affinis* by a Red-back Spider (*Lactrodectus mactans*).

The name *affinis* refers to the Dugite's affinities with *P. nuchalis*. In body colour and pattern it is convergent with this species, however, we intuitively believe it to be a western sibling species of *P. textilis*. Considering size, build, fecundity and ability to exist in the cooler south-western and south-eastern climates, it is difficult not to recognise them as ecological equivalents at least.

In captivity *affinis* is a hardy, long-lived, placid snake that is a pleasure to maintain. The males rapidly become human tolerant, while the females usually require a little more patience before they gain your trust.

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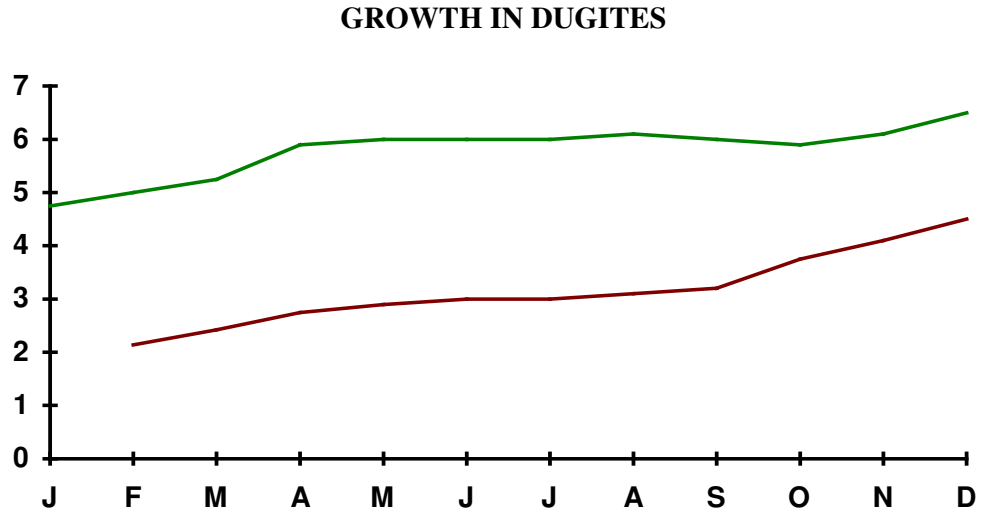
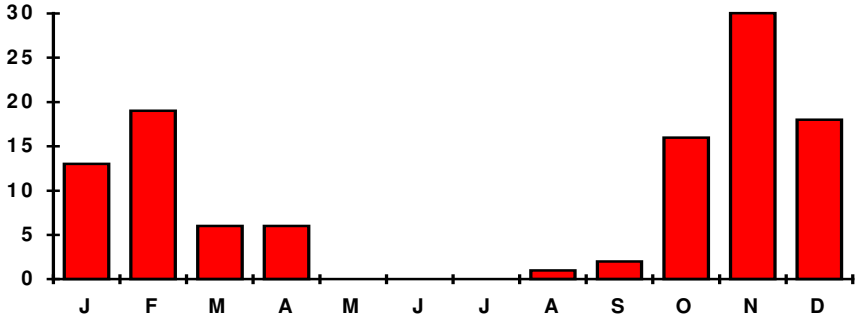


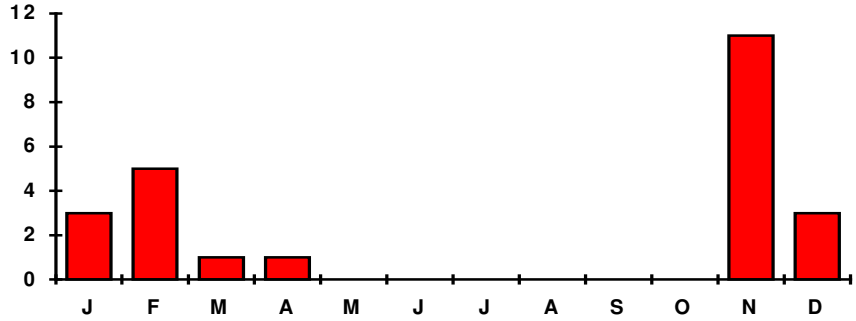
Graph 1. Inferred growth from birth to 24 months in *Pseudonaja affinis affinis* based on monthly mean SVL recorded at time of capture. Subadult and young adult snakes to 700mm included in sample.

SEASONAL ACTIVITY IN DUGITES

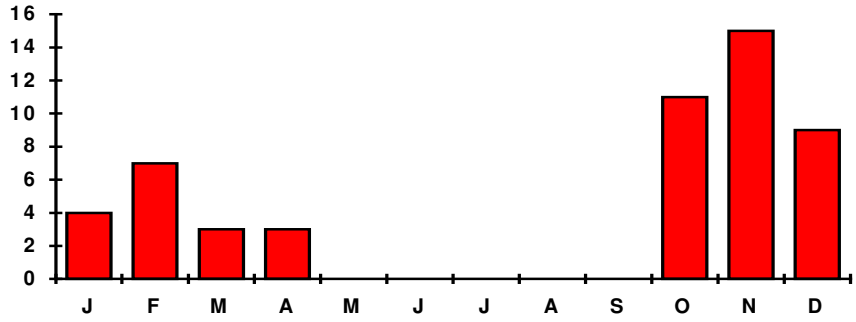
A) Total Sample Excluding Juveniles (N111)



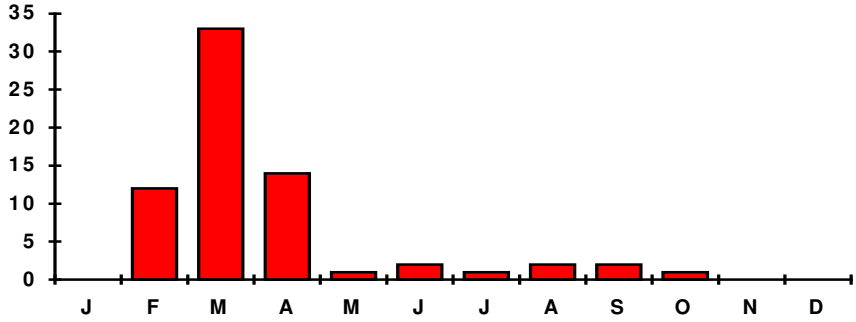
B) Females (N24)



C) Males (N53)



D) Juveniles (N68)



Graph 2 Graphs comparing monthly captures of female, male and juvenile *Pseudonaja affinis affinis* suggesting marginally skewed seasonal activity periods in the three groups. The uppermost graph includes data from subadult captures also.

Figure 1 Monotonal adult. Clarkson, Perth suburb.Photo: B. Maryan

Figure 2 Sparsely spotted adult. Swan view, Perth suburb. Photo: B. Maryan

Figure 3 Densely spotted adult. Lort River near Esperance. Photo: B. Bush

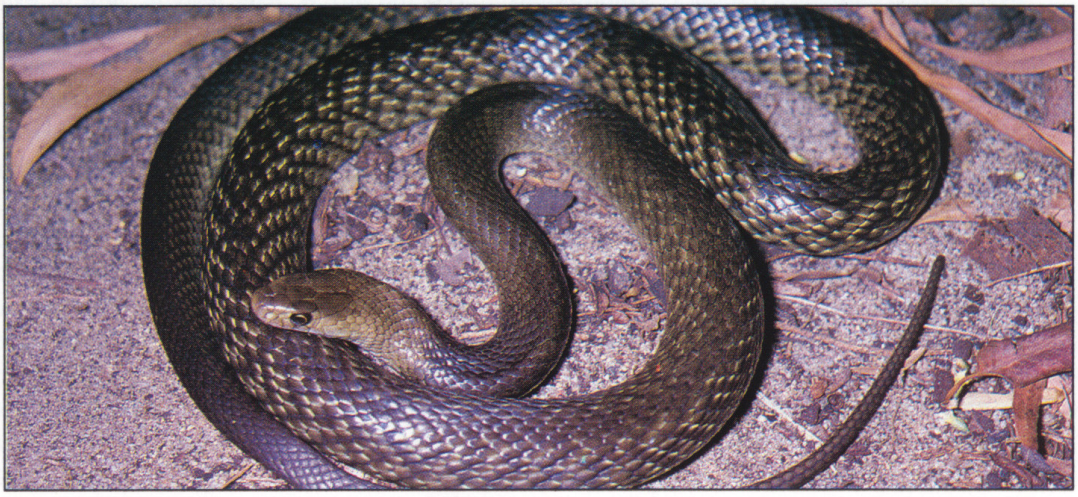


Figure 4 Pale head, grey nape adult. City Beach, Perth suburb. Photo: R. Browne-Cooper

Figure 5 Banded adult. Lort River near Esperance. Photo: B. Bush

Figure 6 Dual banded sub-adult. Kalamunda, Perth suburb. Photo: P. Orange.