

## SOME OBSERVATIONS ON FORAGING BEHAVIOUR IN THE SOUTHERN NINGAUI, *NINGAUI YVONNEAE*

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THE southern ningai (*Ningaui yvonneae*) is a small dasyurid inhabiting semi-arid regions of southern Australia. It is a nocturnal predator, feeding mainly on small invertebrates (Woolnough and Carthew 1996; Fisher and Dickman 1993). During a larger research project examining population dynamics, habitat selection and diet, I observed and documented aspects of the foraging behaviour of *N. yvonneae*. These observations, which are difficult to quantify, provide insight into the ecology of this poorly studied species.

Pitfall trapping was undertaken in a semi-arid mallee community, located in the Middleback Ranges, Eyre Peninsula, South Australia (137° 07'E 33° 09'S). The understorey vegetation was dominated by hummock grass (*Triodia irritans*). Captured *N. yvonneae* were held during the day for release 1 – 2 hrs after dusk. On release, individuals were observed from a distance of 3 – 5 m with the aid of red light and chemiluminescent tags attached to the animals rump (see Bos (1999) for details). Information on foraging behaviour was collected during 59 field trials conducted between October 1996 and December 1998. Where noted, information recorded while individual *N. yvonneae* were held in captivity is also presented.

*Ningaui yvonneae* was an adaptable predator, catching prey in a range of habitats (e.g., under bark, from soil) and via an array of methods (e.g., digging, pouncing). Individuals foraged actively, with most prey found whilst moving at a walking pace. While foraging, animals frequently investigated the substrate and regularly paused to 'scan' their surroundings (possibly for prey or predators). This typical behaviour was termed 'foraging walking'. Captive animals were heard to issue an 'investigatory twitter' (Fanning 1982) during this type of movement. Unlike Woolnough and Carthew (1994), *N. yvonneae* in this study was never observed to adopt 'sit-and-

wait' foraging behaviour, nor the ambush behaviour described by Andrew and Settle (1982) for *Planigale* sp.

*Ningaui yvonneae* displayed excellent climbing ability, and climbed many substrates including *T. irritans*, shrubs and the stems of mallee eucalypts. On two occasions, *N. yvonneae* was observed climbing on the underside of a near horizontal mallee stem. After one of these climbs the individual jumped into a clump of *Triodia*, a distance of ~ 1m. Such agility was often used to capture prey. For example, three *N. yvonneae* were observed jumping from the ground into a clump of *Triodia* to attack prey. Similar behaviour has been recorded for *P. gilesi* (Andrew and Settle 1982). Two of these leaping attacks were to capture moths, the third a grasshopper. Both prey types are mobile and have effective defensive/escape mechanisms (flight and jump). The speed and urgency of the attack on these three occasions may indicate prey recognition ability by *N. yvonneae*. The ability to recognise the type of prey from a distance would allow *N. yvonneae* to adopt appropriate attack techniques.

*Ningaui yvonneae* appeared to use olfaction, vision and hearing to locate and capture prey. Sniffing was regularly observed. Individual *N. yvonneae* would often pause from foraging, raise their heads and sniff the air, sometimes adopting a bipedal stance as observed in *Planigale* sp. (Andrew and Settle 1982). Air sniffing occasionally involved the animal climbing the seed stems of *Triodia*. In leaf litter, individual *N. yvonneae* would often submerge their noses beneath litter, sometimes continuing to move with a 'furrowing' type motion. Animals were often observed locating prey from deep within leaf litter, consuming them only after extensive digging. Huang (1986) found olfaction to be the single most important sense for prey detection by *N. ridei* and *Sminthopsis griseoventer*. However, Huang (1986)

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also stated that a combination of senses provided the most successful hunting in these species. Woolnough and Carthew (1996) came to a similar conclusion for *N. yvonneae*, suggesting that a combination of olfaction and vision were the most common methods for detecting prey. In particular, they considered vision important for detection of movement. I made similar observations, with captive animals often ignoring stationary prey. The same behaviour was recorded for *Planigale* sp. and *Dasyercus byrnei* (Aslin 1974; Andrew and Settle 1982). The importance of each sense in the detection or capture of prey is difficult to determine from these observations only. For example, while *N. yvonneae* used their noses in a furrowing motion in leaf litter, it is possible that hearing was also used, detecting the high frequency sounds made by invertebrates (Andrew and Settle 1982). However, I suspect that different senses were used at different stages of the prey capture sequence or for particular situations. For example, in leaf litter, hearing might have been used to identify any prey in the immediate area and smell used to pinpoint and capture prey.

Two styles of foraging were observed during field trials. The first was an intensive search, involving continuous use of the 'foraging walk' and thorough investigation of a habitat patch. For example, an individual spent over 30 minutes within two adjoining clumps of *Triodia* (~2 m wide), capturing four prey items. The second foraging mode was an extensive foraging style, during which the 'foraging walk' was used for brief periods, interspersed by rapid movement through the habitat. Both styles appear to involve regular captures of prey. The choice of either strategy may be based on the productivity of a particular habitat patch, the amount or frequency of prey catches or the influence of predation (e.g., McNair 1982; Bell 1991; Benhamou 1992; Kotlet 1997). Abiotic factors such as weather or moon phase may also influence the decision. However, in two successive trials on one night, two *N. yvonneae* displayed both types of foraging styles. Additionally, numerous animals were observed to switch between the two styles within the one trial. I suspect that extensive foraging is adopted when the animal has a set destination (e.g., a refuge site), and foraging is a secondary concern.

As recorded by Woolnough and Carthew (1996), prey captured during foraging were almost always killed by bites to the anterior, then consumed head first. Forepaws were used extensively to manipulate prey into position, as previously reported in *Phascogale tapoatafa* (Cuttle 1982) and *N. yvonneae* (Woolnough and Carthew 1996). Most prey caught were invertebrates ~ 10–15 mm long. On only one occasion was capture of a vertebrate (*Ctenotus atlas*)

observed, although the remains of small reptiles were often found in pit-fall traps containing *N. yvonneae*. Not all invertebrates were available for consumption by *N. yvonneae*. On one occasion, a large black beetle was attacked, but after three attempts to subdue the prey, the ningauai retreated. I suspect the shell of the beetle was too hard for the ningauai to penetrate (Fisher and Dickman 1993). Carrion was consumed by *N. yvonneae*, including a large praying-mantis and flies in captive holding cages. After consumption of prey, ningauis would often self groom, especially their heads, with the aid of licked forepaws, as described for *Planigale* sp. (Andrew and Settle 1982).

Some prey types involved specific techniques of capture or consumption. For example, on two occasions the internal body organs of grasshoppers were removed and discarded. This was done by consuming the grasshopper's head and then using the mouth to pull the organ sack from the body cavity whilst anchoring the exoskeleton with the forepaws. After discarding the offal, the remainder of the body and legs were consumed. One of these observations was of a captive *N. yvonneae*, with the offal remaining uneaten overnight. A quick and agile style of attack was used by *N. yvonneae* for capturing large (and more dangerous) prey. Two animals were observed to capture trap-door spiders (body size ~10–15 mm) from within the spider's burrow. On both occasions, the spider was dragged out of the burrow by a rapid series of 'bite-pull-release' movements. Once outside the burrow, the spider was subdued with bites to the anterior in a series of 'lunge-bite-retreat' manoeuvres, although these attacks were cautious. After disabling the spiders, killing bites were administered to the spiders' anterior. The 'lunge-bite-retreat' attack was also observed on two other occasions, when *N. yvonneae* were observed attacking large centipedes. The first centipede was 6 cm long and was attacked (lunge-bite-retreat) from the rear, with most bites directed to its posterior and occasionally the mid-section. This appeared to be a disabling manoeuvre. With the centipede disabled, the ningauai initiated killing bites to its anterior. The second centipede was ~10 cm long and was the largest living prey observed to be taken by *N. yvonneae*. Again the lunge-bite-retreat method was used, however this time the initial attacks focussed on the head. Disabling bites were then directed to the mid-section followed by the final killing bites to the head.

Large prey items captured in open habitats (e.g., leaf litter) would often be carried to and consumed in a habitat offering greater cover. The most frequently used habitat for prey consumption were the margins of *Triodia* hummocks, although woody

debris, inner *Triodia* and shrubs were also used. For example, the larger centipede described above was consumed in *Triodia* margins after being captured on bare ground. Similar behaviours were observed for *Planigale* sp. (Andrew and Settle 1982).

Burrows were regularly used as rest sites during foraging bouts, especially during winter. Time spent in burrows resting varied from a few minutes to > 1 hr (this was the maximum time spent waiting for animals to exit). The most commonly used burrows for refuge were those made by moths (Hepialidae). Animals always entered and emerged from burrows head first. Observations of *N. yvonneae* in human made burrows revealed their ability to turn around without aid of a wider burrow chamber. Individuals were observed to rest with their heads facing upwards, with forepaws pointing up and resting at either side of the head. The ease and speed at which *N. yvonneae* located burrows (which are visually difficult to detect) suggests that some individuals had intimate knowledge of their surrounding habitat. For example, on three occasions, animals were observed to move directly towards a burrow, often running, with little deviation in path. One of these observations occurred after the ningai had eaten two large sized prey in succession. This burrow was covered with leaf litter and was difficult to locate visually.

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#### REFERENCES

- ANDREW DL AND SETTLE GA, 1982. Observations on the behaviour of species of *Planigale* (Dasyuridae: Marsupialia) with particular reference to the narrow-nosed planigale (*Planigale tenuirostris*). Pp. 311-324 in *Carnivorous marsupials* ed by M. Archer. Royal Zoological Society of NSW: Sydney.
- ASLIN H, 1974. The behaviour of *Dasyuroides byrnei* (Marsupialia) in captivity. *Zeitschrift für Tierpsychologie* **35**: 187-208.
- BELL WJ, 1991. *Searching behaviour: The behavioural ecology of finding food*. Chapman and Hall: London.
- BENHAMOU S, 1992. Efficiency of area-concentrated searching behaviour in a continuous patchy environment. *Journal of Theoretical Biology* **159**: 67-81.
- BOS DG, 1999. Observations of the response of *Ningai yvonneae* (Marsupialia: Dasyuridae) to pit-fall drift fences. *Australian Mammalogy* **21**: 143-147.
- CUTTLE P, 1982. A preliminary report on aspects of behaviour of the dasyurid marsupial, *Phascogale tapoatafa* Pp. 325-332 in *Carnivorous marsupials* ed by M. Archer. Royal Zoological Society of NSW: Sydney.
- FANNING FD, 1982. Reproduction, growth and development in *Ningai* sp. (Dasyuridae, Marsupialia) from the Northern Territory. Pp. 23-37 in *Carnivorous marsupials* ed by M. Archer. Royal Zoological Society of NSW: Sydney.
- FISHER DO AND DICKMAN CR, 1993. Diets of insectivorous marsupials in arid Australia: selection for prey type, size or hardness? *Journal of Arid Environments* **25**: 397-410.
- HUANG C, 1986. Detection of prey by captive *Ningai ridei* and *Sminthopsis griseoventer* (Marsupialia: Dasyuridae). *Australian Mammalogy* **10**: 23-26.
- KOTLER BP, 1997. Patch use by gerbils in a risky environment – manipulating food and safety to test four models. *Oikos* **78**: 274-282.
- McNAIR JN, 1982. Optimal giving-up time and the marginal value theorem. *American Naturalist* **119**: 511-529.
- WOOLNOUGH AP AND CARTHEW SM, 1994. Notes on the feeding behaviour of *Ningai yvonneae* in captivity. *Australian Mammalogy* **17**: 121-122.
- WOOLNOUGH AP AND CARTHEW SM, 1996. Selection of prey by size in *Ningai yvonneae*. *Australian Journal of Zoology* **44**: 319-326.