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NOTES ON THE ECOLOGY AND NATURAL HISTORY OF THE RARELY RECORDED GEKKONID LIZARD *HETERONOTIA BINOEI* IN THE GREAT VICTORIA DESERT OF WESTERN AUSTRALIA

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ABSTRACT

Ecological data on the uncommonly encountered terrestrial gecko *Heteronotia binoei* are presented and discussed. Although *Heteronotia* is widespread in Australia occurring in many different habitats, it is rarely found in semi-pristine desert habitats. *Heteronotia* is composed of a complex of both sexual and asexual populations which may help explain its rarity. Sex ratio is biased towards females. *Heteronotia* exploit burrows of other animals for shelter and daytime retreats. Compared to other species of desert lizards, *Heteronotia* is a dietary generalist with a relatively broad dietary niche. These geckos reproduce in the Austral spring and have fixed clutch sizes of two eggs. Relative clutch mass averaged 9.9%.

INTRODUCTION

Heteronotia binoei is widespread in Australia (Cogger 1992) and like most geckos, *Heteronotia* is nocturnal, but it can often be found in diurnal retreats such as under objects in rubbish tips (the first stop for many herpetologists). However, it is seldom found in semi-pristine outback desert habitats (Pianka 2014).

This gecko is a species complex consisting of both sexual and parthenogenetic populations (Fujita and Moritz 2009, Moritz 1983, 1991a, 1991b, Moritz and Heideman 1993). Asexuality appears to have arisen multiple times: both bisexual and unisexual forms can occur in sympatry (Fujita *et al.* 2007), where they hybridize (Strasburg and Kearney 2005). A population of this gecko in the Pilliga scrub in New South Wales was studied by mark and recapture by Bustard (1968) who found the geckos below bark at the base of dead trees or stumps. He reported data on movements, growth, tail loss and regeneration as well as on diet.

METHODS

During 11 separate expeditions to the Great Victoria Desert (GVD) of Western Australia from 1966 through 2008, my assistants and I spent 41 months (1256 days) in the field primarily during Austral springs collecting and studying lizards (Pianka 1969a,b, 1982, 1986, 1994, 1996; Pianka and Goodyear 2012). Extensive data were gathered at ten major study areas in the GVD (for exact locations, see Pianka 1986 and Pianka and Goodyear 2012) as well as at other non-study sites nearby. Lizards were collected by any means possible using a wide variety of different techniques including turning over rubbish and fallen logs, exhuming, grabbing, shooting, eyeshine, body shine and pit trapping. Out of a total of more than 20,000 lizards, only 66 individual *Heteronotia binoei* were encountered, 13 of which were juveniles. This species was found at 8 of the 10 study areas and might well be present on the two other areas but was not encountered due to small sample sizes.

We recorded air and body temperatures, times of activity, microhabitat, fresh snout-vent length (SVL), tail length, and weight for as many lizards as possible. Stomach contents were identified and prey volumes estimated for all lizards collected. Reproductive condition was also recorded: for males, lengths of testes were measured; for females, egg sizes were measured and numbers were counted, and whether eggs were ovarian or oviductal was noted [some of these data were summarized in appendices in Pianka (1986)]. Niche breadths were calculated using the inverse of Simpson's (1949) index of diversity [$D = 1/\Sigma p_i^2$] where p_i is the proportion of resource state *i*.

RESULTS

Sex Ratios and Presence of Males. Among the 25 adult individuals collected on the 8 study areas with *Heteronotia*, six males were present at four of the eight areas (B 3 , E 1, N 1, and R 1) but only females were found at the other four study areas (A 6, G 2, L 3, and Y 3) (numbers represent number of individuals of a given sex). Four other females were found on sites with males. Thus overall sex ratio on the eight study areas is 6/25 or 0.24. Samples are too small to argue that no sexual forms were present on the four sites without males. Among 28 other adult specimens collected incidentally on 15 non-study sites, six other males were also found, a sex ratio of 6/28 or 0.214. Combining samples yields a significantly female-biased sex ratio of 12/53 = 0.226.

Habitat and Microhabitats. *Heteronotia* exploit burrows of other animals for shelter and daytime retreats. They are sometimes found while exhuming burrows of *Liopholis* (formerly *Egernia*) *striata*. They also dig their own small burrows off to the sides of larger burrows such

as those dug by monitor lizards or rabbit warrens. Of 66 geckos, all but two were found on desert flats and sandplains, one was caught at the base/slope of a sandridge and another was captured on a sandridge crest. Six individuals were dug up in various burrows mostly those dug by *Liopholis*. Of 24 individuals found active at night, one was at the mouth of such a burrow, two were found emerging at dusk from the mouth of a rabbit warren, two were in hollow termite mounds, one was about 7 cm above ground at the base of a termite mound, one was 60 cm above ground in a rock crevice, nine were out in the open, two were close to spinifex tussocks, two near bushes, and four were in litter beneath Marble Gum trees.

Thermal Relations. Like all nocturnal geckos, *Heteronotia* are thermoconformers, with body temperatures positively correlated with ambient air temperatures (Figure 1). No statistical thermal difference exists between active geckos versus those found in diurnal retreats. Body temperatures of these geckos tend to be slightly above ambient temperature especially when they are cold.

Diet. *Heteronotia* are dietary generalists, consuming a wide variety of arthropods, especially spiders, grasshoppers and crickets (Table 1). Based on these data, dietary niche breadth is 7.72.

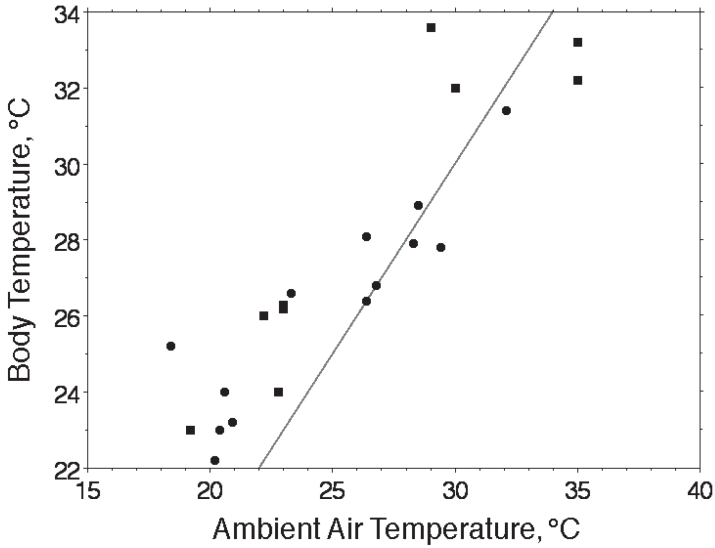

Figure 1. Body temperatures plotted against ambient air temperature for 24 *Heteronotia*. Circles are active geckos at night whereas squares are those in diurnal retreats. The line represents body temperature equal to ambient air temperature.

Table 1. Summary of stomach contents of 66 *Heteronotia*.

	Number	Volume	Proportion
Centipedes	1	0.05	0.020
Spiders	21	0.69	0.282
Scorpions	1	0.01	0.001
Ants	5	0.09	0.037
Wasps	1	0.01	0.004
Locustids	6	0.36	0.147
Thysanurans	2	0.02	0.008
Roaches	1	0.17	0.069
Mantids/Phasmids	2	0.05	0.020
Beetles	6	0.11	0.045
Termites	42	0.13	0.053
Hemipterans	9	0.13	0.053
Lepidopterans	2	0.14	0.057
Larvae	5	0.09	0.037
Other Insects	8	0.14	0.057
Vertebrates	4	0.18	0.074
Vegetation	1	0.04	0.016
Other Unidentified	1	0.05	0.02
Totals	119	2.46	1.00

Reproduction. Ten females had either enlarged yolked ovarian eggs or shelled eggs in their oviducts from September to January. All had clutches of two eggs. Relative clutch mass (egg volume over female fresh body weight) averaged 9.9% for three females with shelled eggs in their oviducts. Average snout vent length (SVL) of gravid females is 44.1 mm. Average SVL of 12 adult males is 46 mm.

DISCUSSION

When I assembled data for my 1986 book, I was puzzled by the rarity of *Heteronotia* — this species was present on 8 of my 10 study areas but only as singletons at 5 sites and only in very small numbers at other sites where this gecko was present. Only 19 geckos were collected at ten study areas over the course of two years of field work. I wondered how it could be a dietary generalist and occur at most sites but still be so uncommon. Craig Moritz's discovery of parthenogenetic forms offered an answer to this dilemma: an all female unisexual does not require males and females could persist at near vanishingly low densities. I remain baffled about how this rare gecko manages to disperse so effectively across the vast desert landscape.

Extensive pit trapping from 1989 to 2008 (over 62,000 pit trap

days) at 3 study sites yielded only 22 additional specimens, confirming the rarity of *Heteronotia*.

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