Memoirs of the Queensland Museum | **Nature**

56 (2)

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National Library of Australia card number
ISSN 0079-8835

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A Queensland Government Project
Typeset at the Queensland Museum

CLUTCH TRAITS AND CLUTCH SIZE-BODY SIZE RELATIONSHIPS IN THE GECKO *OEDURA MONILIS*

Memoirs of the Queensland Museum – Nature 56(2): 579–580. 2013:- Resources allocated to reproduction are determined by costs and benefits associated with current versus future reproductive potential. Life history theory posits that the optimal balance between egg size and number should maximize offspring survivorship, and in turn, female life-time reproductive success (Stearns 1992). In most squamate reptiles, larger females produce both larger and more offspring (Dunham *et al*. 1988). However, for invariant clutch species, which produce a fixed clutch size, this relationship may break down, because females are unable to change clutch size even as body size increases. As an invariant clutch is phylogenetically constrained for geckos (Doughty 1997), they provide an excellent opportunity to examine relationships between maternal body size (snout-vent length and post-oviposition mass) and egg-size and clutch mass. This paper reports clutch traits, and examines the relationship between maternal size (snout-vent length and post-oviposition mass) and egg size (mass) in the gecko Oedura monilis de Vis, 1888, a medium-sized (snout-vent length to 85 mm) arboreal and rock-inhabiting gecko that occurs in dry timber habitats from northern New South Wales to northern Queensland (Bustard 1971). Gravid O. monilis were sampled intermittently from October–December 1995 from the Townsville district of north-east Queensland, Australia. Individuals were maintained separately in plastic containers (350 L x 130 W x 100 H mm), with a potting mix substrate, bark refuge, water bowl and a heating element that produced a thermal gradient within each box (range 45–23° C) and enabled lizards to thermoregulate. Lizards were fed 2–3 mealworms or crickets three-four times weekly; water was always available. All females and their eggs were weighed (± 0.1 g) and measured (females: snout-vent length, SVL; eggs, length and width; ± 0.1 mm), within eight hours of oviposition. All gravid females laid eggs within 3 weeks of collection. We calculated relative clutch mass (RCM) as the ratio of total wet clutch mass to post-oviposition mass (Shine 1980). Maternal size-clutch trait relationships were examined using regressions and correlations. All data were log-transformed to achieve normality. Female body condition (mass per unit length) and reproductive investment (as clutch mass) were assessed by comparing wet clutch mass against residuals of the regression of post-oviposition mass against snout-vent length.

All females produced clutches of two eggs (Table 1). Total wet clutch mass was significantly correlated with maternal post-oviposition mass ($r = 0.64$, $n = 11$, $P < 0.035$), indicating that heavier females produced heavier clutches. However, snout-vent length was unrelated to total wet clutch mass ($r = 0.15$, $P > 0.65$), indicating that longer females did not produce heavier clutches. Maternal body condition was significantly positively related to clutch mass ($r = 0.72$, $P < 0.05$), suggesting females in better condition produce heavier clutch masses.

The relationship between post-oviposition mass and clutch mass indicates that egg size and maternal mass increase as abdominal space and/or resources become available. The lack of a relationship between snout-vent length and pelvic aperture, between snout-vent length and clutch mass, and between snout-vent length and egg size may indicate egg diameter is less than that of the pelvic aperture (Congdon & Gibbons 1987), and is therefore, unconstrained. However, it must be acknowledged that the size range of females examined in this study was relatively small, therefore, to definitively test this idea would warrant a larger sample of females. The relationship between maternal body condition and clutch mass suggests that females in better condition produce heavier clutches, and have a higher reproductive investment. Mixed reports on relationships between body size and clutch mass (Vitt 1986; Doughty 1997), suggests other factors (e.g. food availability) may determine egg size, and therefore, clutch mass. Moreover, species that produce multiple clutches per season, as has been shown for a population of *O. monilis* (Bustard 1971), may show considerable variation in such traits as clutch size. For instance, clutch size is reduced and egg size is increased in clutches produced later in the season in several North American lizard species (Nussbaum 1981; Demarco 1989). However, it is difficult to assess whether this is likely to be an issue for invariant clutch-size species, such as the species examined in this study, as all females were collected over a two month period (Mid-October to mid-December).

The relationship between body condition and clutch mass may suggest that females in better condition increase their allocation to reproduction. This pattern of condition-dependent reproductive investment is more frequently observed in relatively long-lived species that are likely to experience more than a single reproductive season within a lifetime (Tinkle *et al*. 1970). Clearly, more data on seasonal variation in food availability, longevity, demography and age-specific reproductive investment in *O. monilis* is required (e.g. Bustard 1967), to determine whether *O. monilis* shows a pattern of condition-dependent reproductive investment.

Acknowledgments

This work was funded by the Peter Rankin Trust Fund in Herpetology, and a JCU supplemental IRA.

Literature cited

Bustard, R.H. 1967. Reproduction in the Australian gekkonid genus *Oedura* (Gray 1842). *Herpetologica*. **23**:276-284.

1971. A population study of the eyed gecko, *Oedura ocellata* Boulenger, in Northern New South Wales, Australia. *Copeia* **1971**: 658-669.

Congdon, J.D. & Gibbons, J.W. 1987. Morphological constraint on egg size: a challenge to optimal egg size theory? *Proceedings of the National Academy of Science USA*. **84**:4145-4147.

Demarco, V.G. 1989. Annual variation in the seasonal shift in egg size and clutch size in *Sceloporus woodi*. *Oecologia*. **80**: 525-532.

Doughty, P. 1997. The effects of "fixed" clutch sizes on lizard life-histories: reproduction in the Australian velvet gecko, Oedura lesueurii. *Journal of Herpetology*. **31**:266-272.

Dunham, A.E., D.B. Miles, & D.N. Reznick. 1988. Life history patterns in squamate reptiles. Pp. 441-522. *In*, Gans, C. & Huey, R.B. (eds) *Biology of the Reptilia*. (Alan R. Liss, Inc.: New York).

Nussbaum, R.A. 1981. Seasonal shifts in clutch size and egg size in the side-blotched lizard, *Uta stansburiana* Baird and Girard. *Oecologia* **49**:8-13.

TABLE 1. Clutch traits for *Oedura monilis*. Shown are mean ± 1 standard error (N = 11).

TRAIT	Mean ± S.E.	Range
Snout-vent length (mm)	95.18 ± 0.829	90.0 — 99.0
Post-oviposition mass (g)	13.07 ± 0.387	11.01 — 14.81
Clutch size	2	2
Clutch mass (g)	2.50 ± 0.095	2.049 — 3.083
Relative clutch mass	0.192 ± 0.006	0.175 — 0.244
Egg length (mm)	19.35 ± 0.330	17.3 — 21.5
Egg width (mm)	10.56 ± 0.150	9.60 — 11.55

Shine, R. 1980. 'Costs' of reproduction in reptiles. *Oecologia*. **46**:92-100.
Stearns, S.C. 1992. *The evolution of life histories*. (Oxford University Press: Oxford).
Tinkle, D.W., Wilbur, H.M. & Tilley, S.G. 1970. Evolutionary strategies in lizard reproduction. *Evolution*. **24**:55-74.
Vitt, L.J. 1986. Reproductive tactics of sympatric Gekkonid lizards with a comment on the evolutionary and ecological consequences of invariant clutch size. *Copeia*. **1986**:773-786.

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