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SHORT COMMUNICATION

EXTREME LONGEVITY OF THE COMMON GECKO (*HOPLODACTYLUS MACULATUS*) ON MOTUNAU ISLAND, CANTERBURY, NEW ZEALAND

Summary: The longevity of common geckos (*Hoplodactylus maculatus*) on predator-free Motunau Island, North Canterbury, was investigated. Sixteen of 133 individuals marked between 1967-75 were re-captured in the summer of 1996/97. A growth curve was generated to estimate the age of these geckos at first capture, and from this their age in 1996/97; 10 were estimated to be at least 36 years old. In this cool-temperate habitat, *H. maculatus* matures late and has a low annual reproductive output over an extended lifespan. This suggests that nearby mainland populations would be particularly slow to recover from the impacts of introduced mammalian predators.

Keywords: Common gecko; *Hoplodactylus maculatus*; *Hoplodactylus duvaucelii*; longevity; life history; Motunau Island.

Introduction

New Zealand has a temperate climate and its lizards have adapted accordingly. The endemic common gecko (*Hoplodactylus maculatus* is cold-adapted and has a low reproductive output (Cree, 1994). Longevity records for captive individuals suggest that they are long-lived in comparison to geckos found in tropical regions (M. Meads, *pers. comm.*).

Longevity of free-living lizards in New Zealand is difficult to assess as few field studies have followed individually marked lizards for decades. Motunau Island, off the coast of Canterbury, presents an opportunity to study longevity of *H. maculatus*. During ecological surveys carried out there by the then Department of Scientific and Industrial Research (DSIR) between 1967-1975, a total of 133 *H. maculatus* was individually marked. In the summer of 1996-97, the island was revisited and the lizard population re-trapped. Longevity of *H. maculatus* on Motunau Island was then assessed by calculating the ages of geckos marked between 1967-75 and re-caught in 1996-97.

Methods

Motunau Island (43°08´S, 173°10´E) lies 1 km off the Canterbury coast, 64 km north of Christchurch. The island's vegetation has been highly modified by fires, introduced plants and the presence of rabbits (*Oryctolagus cuniculus*, L.) from 1852 to 1962 (Cox, Taylor and Mason, 1967), but the island has remained free of mammalian predators. Six seabird species breed on the island as do three species of lizard: the spotted skink (*Oligosoma lineoocellatum*, Dumeril and Dumeril), common skink (*O. nigriplantare polychroma*, Peters), and common gecko (*Hoplodactylus maculatus*, Gray) (Beach, Wilson and Bannock, 1997). *Hoplodactylus maculatus* is now recognised as comprising a cryptic species complex (Daugherty, Patterson and Hitchmough, 1994). Pending formal revision of this complex we have not attempted to identify the Motunau Island geckos further.

From 1967 to 1975 DSIR staff carried out annual surveys on the island between November and February. Tony Whitaker sampled lizards on a 20 x 20 m grid of 25 pitfall traps, spaced at 5 m intervals. Lizards caught had their snout-vent length (SVL), vent-tail length (VTL) and length of tail regeneration recorded (nearest 1 mm). Individuals were sexed and permanently marked by toeclipping, each being given a unique 4-toe combination.

From December 1996 to February 1997 Carol Bannock revisited the island and re-established the lizard grid at its original location (identified from surviving survey pegs). Lizards caught had the same measurements taken as on earlier surveys. If they had not already been toe-clipped, they were given a 4-toe combination that had not been used in any previous surveys.

To estimate each gecko's age at first capture, a growth curve was obtained using Ebert's (1980) method for calculating growth curves from mark-recapture data. This method is applicable where individuals are of unknown age, but growth increments (in this case of SVL) have been recorded over a standard interval (i.e., the 12 months between each DSIR survey). For each gecko caught in two successive surveys, the SVL in the second survey (L2) was regressed against its length in the first (L1) to generate a linear regression equation of the form:

$$L2 = B' + B'' (L1)$$

Using B' and B'' (the intercept and slope coefficients of the regression) a monomolecular (i.e., uninflected) growth curve was generated using Ebert's (1980) method:

Length (L) $= K(1 - e^{-bt})$
where: b $= -\log_e B''$
K $= B'/(1-B'')$
t = age (in years)

The location of the resulting curve on the age abscissa was then estimated by calculating the mean SVL of the three 1-year-old geckos caught during the surveys (these could be identified as a distinct cohort from their small size).

The age of *H. maculatus* when first caught between 1967 and 1975 was estimated using the growth curve (the age of large geckos could not be determined accurately so these were categorised as being 6+ years of age). Each gecko's age in 1996-97 was then calculated by adding the number of years between first and last capture to its estimated age at first capture (for geckos estimated to be 6+ when first caught the method was used to estimate their minimum age).

Results

Age estimation

Geckos' SVLs in successive surveys were highly correlated, with the relationship well-described ($R^2 = 0.94$, $P < 0.001$) by the linear regression equation:

$$L2 = 22.78 + 0.679L1$$

Applying this to Ebert's equations provided monomolecular growth curve parameter estimates of:

$$b = -\log_e (0.679) = 0.3873$$
$$K = 22.78 / (1 - 0.679) = 70.93$$

Mean SVL at year 1 was 26.7 mm (n = 3), providing a growth equation of:

$$SVL = 70.93*(1 - e^{-0.3873 (T + 0.220)})$$

where T = age in years

Table 1: *Expected relationship between snout-vent length (SVL) and age of* H. maculatus *on Motunau Island.*

Snout - vent length	Age (years)
26.7*	1
40.9	2
50.5	3
57.1	4
61.5	5
64.5	6+

* measured in the field (n = 3)

Age at first capture (in whole years) was then assigned to each lizard based on which value in Table 1 its SVL was closest to.

Survival and longevity

A total of 133 geckos was toeclipped between 1967 to 1975. Of these, 16 (12%) were recaptured in 1996-97, all of which were at least 29 years of age. Fewer geckos that were under the age of 10 in 1975 survived to 1996-97 (n = 4, 25 %) than did geckos that were 10 years and over in 1975 (n = 12, 75%) although this difference was not statistically significant ($\chi^2 = 2.04$, $P = 0.15$).

A total of 61 geckos that had not previously been marked were caught in 1996-97. Fifty-six of these were estimated to be at least 6 years old.

A total of 339 *O. n. polychroma* and 48 *O. lineoocellatum* were toe-clipped between 1967 and 1975. None of these were recaught in 1996-97.

Ten of the 16 geckos recaught in 1996-97 had a minimum estimated age of 36 years; the remain six were estimated to be 29, 30, 31, 32, 33 and 34 years of age, respectively.

Discussion

Longevity of the genus *Hoplodactylus* in the wild has previously been studied only at Turakirae Head, south of Wellington, and on North Brother Island. At Turakirae Head, two *H. maculatus* were estimated to be a minimum of 17 years (Anastasiadis and Whitaker, 1987). On North Brother Island one Duvaucel's gecko (*H. duvaucelii*) was recaptured 29 years after first capture as an adult, making it approximately 36 years old (Thompson *et al.,* 1992).

H. maculatus has been reported living for at least 37 years in captivity (M. Meads, *pers. comm.*). Ebert's (1980) method for determining age/length relationships from data from annual surveys (i.e., SVL at year T and year T+1) allowed us to assess longevity in the field. Ebert's method allows estimation of various types of growth curve, including ones with a point of inflection. The non-inflected monomolecular curve is the simplest of these curves and requires the smallest number of parameters to be estimated, making it the most robust to sampling error. Since our regression model provided an excellent fit to the field data ($R^2 = 0.94$) we concluded that the monomolecular curve was appropriate to use for our age-estimation purposes.

The results from Motunau Island confirm that geckos in the wild can live as long as in captivity, at least on a predator-free island. All 16 of the geckos recaught from 1967-75 were aged 29 years or more. This is markedly longer than the 20 year lifespan suggested by Anastasiadis and Whitaker (1987). An age of 17 years for *H. maculatus* was considered high by Anastasiadis and Whitaker (1987) when compared to other small, free-living lizards, thus 36 years is even more so. In comparison, the longest-lived captive gecko in America is the leopard gecko (*Eublepharis macularius*) which has a maximum recorded lifespan of 21 years (K. Slavens, *pers. comm.*).

A long lifespan appears characteristic of the genus *Hoplodactylus* in New Zealand. A study on the reproductive output of New Zealand reptiles showed that *H. maculatus* has annual reproduction, with evidence in at least some populations of biennial reproduction (Cree, 1994; Cree and Guillette, 1995). Compared to lizards elsewhere in the world both *H. maculatus* and *H. duvauceli* have a low annual reproductive output (producing ≤ 2 offspring per female per year) and are late to mature (Dunham, Miles and Reznick, 1988; Cree, 1994). Cree (1994) suggested that the low annual reproductive output by New Zealand reptiles reflects the country's relatively cool climate. A long lifespan for *H. maculatus* thus may be necessary to balance their low reproductive output (Anastasiadis and Whitaker, 1987) in this cool- temperate climate. This implies that mainland populations of this lizard would be slow to recover from predation by introduced mammals.

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References

Anastasiadis, J.M.; Whitaker, A.H. 1987. Longevity of free-living *Hoplodactylus maculatus* (Reptilia: Gekkonidae). *New Zealand Journal of Ecology 10:* 141-142.

Beach, G.S.; Wilson, K-J.; Bannock, C.A. 1997. A survey of the birds, lizards and mammals of Motunau Island, Canterbury, New Zealand. *Lincoln University Wildlife Management Report No. 14*. Lincoln University, Lincoln, New Zealand. 17 pp.

Cree, A. 1994. Low annual reproductive output in female reptiles from New Zealand. *New Zealand Journal of Zoology 21:* 351-372.

Cree, A.; Guillette, L.J. 1995. Biennial reproduction with a fourteen-month pregnancy in the gecko *Hoplodactylus maculatus* from southern New Zealand. *Journal of Herpetology 29:* 163-173.

Cox, J.E.; Taylor, R.H.; Mason, R. 1967. Motunau Island Canterbury, New Zealand: an ecological survey. *New Zealand Department of Scientific and Industrial Research Bulletin No. 178.* Wellington. 110 pp.

Daugherty, C.H.; Patterson, G.B.; Hitchmough, R.A. 1994. Taxonomic and conservation review of the New Zealand herpetofauna. *New Zealand Journal of Zoology 21:*317-323.

Dunham, A.C.E.; Miles, D.A.B.; Reznick, D.N. 1988. Life history patterns in squamate reptiles. *In:* Gans, C.;Huey, R. B. (Editors), *Biology of the Reptilia. Vol. 16*, pp. 441-522. Alan R. Liss, New York.

Ebert, T.A. 1980. Estimating parameters in a flexible growth equation, the Richards function. *Canadian Journal of Fisheries and Aquatic Science 37:* 692-697.

Thompson, M.B.; Daugherty, C.H.; Cree, A.; French, D.C.; Gillingham, J.C.; Barwick, R.E. 1992. Status and longevity of the tuatara, *Sphenodon guntheri,* and Duvaucel's gecko, *Hoplodactylus duvaucelii*, on North Brother Island, New Zealand. *Journal of the Royal Society of New Zealand 22:* 123 - 130.