| VIERAEA | Vol. 27 | 217-222 | Santa Cruz de Tenerife, diciembre 1999 | ISSN 0210-945X |
|---|---|---|---|---|

# Preliminary data on the structural relationships in two lacertid species of the genus *Gallotia* (Reptilia: Lacertidae) based on the skeleton

MANUEL NOGALES & ALFREDO VALIDO

*Departamento de Biología Animal (Zoología), Universidad de La Laguna, 38206 Tenerife, Canary Islands, Spain.*

NOGALES, M. & A. VALIDO. Preliminary data on the structural relationships in two lacertid species of the genus *Gallotia* (Reptilia: Lacertidae) based on the skeleton. *Vieraea 27*: 217-222.

RESUMEN: En el presente trabajo se presentan los resultados de un análisis de regresión que relaciona el tamaño corporal frente a ocho caracteres osteológicos de *G. galloti* y *G. atlantica*. Se observa una relación estadística positiva y significativa entre ellas, aunque los coeficientes de determinación ($R^2$) indican niveles de ajuste más elevados en el caso de *G. galloti* que en *G. atlantica*. Además, se aportan datos preliminares sobre la relación: tamaño corporal vs. peso. Los distintos modelos propuestos pueden ser utilizados en estudios alimentarios de vertebrados depredadores que incluyen selección tallas (presas) de ambas especies, además de investigaciones paleontológicas.

ABSTRACT: In this paper we present the regression analysis between SVL and eight osteological variables in *G. atlantica* and *G. galloti*. Positive significant relationships can be observed among them, although coefficient of determination ($R^2$) indicate better fits in the case of *G. galloti* than *G. atlantica*. Furthermore, preliminary data on the weight-lenght relationships are shown. The proposed models can be used in predator vertebrate alimentary studies that include lizards size selection of both mentioned species and also in paleontological surveys.

## INTRODUCTION

Lizards from the genus *Gallotia* are endemic to the Canary Islands and are represented by four living species: *G. atlantica* (Peters & Doria, 1882), *G. galloti* (Oudart, 1839), *G. stehlini* (Sckenkel, 1901) and *G. simonyi* (Steindachner, 1889) (Machado *et al.*, 1985; González *et al.*, 1996) and at least one extinct species *G. goliath* (Mertens, 1942) which reached about 358 mm, in snout vent length – SVL (Castanet &

Báez, 1991). Among the extant species, *G. atlantica* is the smallest (SVL: 60.8 mm; range: 47-96), *G. galloti* shows an intermediate size (SVL: 70-121 mm depending on the subspecies), and *G. stehlini* (SVL: 142 mm, range: 88-248) and *G. simonyi* (SVL: 198 mm; range: 182-199) (Márquez *et al.*, 1997) are the largest ones.

In the Canarian Archipelago, the various species of lizards are common prey of predator birds such as kestrels *Falco tinnunculus* (L., 1758) (Carrillo *et al.*, 1994), shrikes *Lanius excubitor* (L., 1758) (Nogales *et al.*, 1998) or buzzards *Buteo buteo* (L., 1758) (V. Quilis, pers. obs.), and mammals such as feral cats *Felis catus* (L., 1758) (Nogales & Medina, 1996). Therefore, the study of a series of structural equations would be very useful to predict the total length and weight of the prey eaten by these predator vertebrates. Similar studies have been carried out about insects (Rogers *et al.*, 1976; Díaz & Díaz, 1990) and vertebrates (Morris, 1979; Steenhof, 1983; García-Márquez *et al.*, 1997) as prey. However, generalised regressions made in groups of prey cannot supplant restricted regressions within specific taxa (Rogers *et al.*, 1976).

Furthermore, the knowledge of these equations could also be used in paleontological surveys. In this respect, bone remains belonging to the different species of the genus *Gallotia* have been found in paleontological and aboriginal deposits, as well as in vertebrate droppings and pellets in the Canary Islands.

The aim of the present note is to show the relationships among different lengths of the main skeletal elements, the SVL and the body weight of the two smallest extant species of *Gallotia* (*G. atlantica* and *G. galloti*).

## MATERIAL AND METHODS

The studied lizards (adults from both sexes), also used for physiological digestive studies (Valido & Nogales, in prep.) and ecotoxicology (Sánchez *et al.*, 1997), were mainly captured in four localities: *G. atlantica* in Fuerteventura Island (Valle de Tetir – 400 m a.s.l.) and *G. galloti* in three other sites in the Island of Tenerife (Barranco de Las Cuevas, in Punta de Teno – 150 m a.s.l.; Barranco de Vargas, in Bajamar – 110 m a.s.l., and Corral del Niño, in Izaña – 2,293 m a.s.l.).

Animals were weighed by using a balance (0.1 mg) and measured by a digital caliper (0.1 mm) after being captured. Length variables taken can be classified in two types: 1) external body feature: Snout Vent length (SVL); and 2) osteological traits: Maxillary length, Jaw length, Parietal length, Parietal width, Pelvic girdle length, Femoral length, Humeral length and Tibial length (Fig. 1). This last variable was only measured in *G. galloti* due to the extreme weakness of this bone in *G. atlantica*.

Although dependent and independent variables are subject to random error, structural relations among variables (log-transformed) were calculated by using least square regression (LSR). This method was preferred to others (Radinsky, 1985; McArdle, 1988; LaBarbera, 1989), since the majority of the relationships presented high correlation and determinant coefficients (Table I). These structural equations permit estimations of the snout vent length (SVL) and the weight from the length of the most frequent bones found in paleontological deposits and vertebrates droppings. In this regard, it is interesting to note that characters such as weight can be very variable and subject to environmental factors which can influence physical condition in the animal.

## RESULTS AND DISCUSSION

Results of the regression analysis among SVL and the different osteological variables are presented in Table I showing positive relationships among them with high significance levels. However, the coefficients of determination ($R^2$) indicate better fits in the case of *G. galloti* than of *G. atlantica*. While all relationships showed values higher than 0.80 for *G. galloti*, three of the main osteological variables were lower than 0.50 for *G. atlantica*. This fact could be due to the different sample sizes.

The weight-length regression model has a high significance level ($P < 0.01$), the determination coefficients ($R^2$) being 0.62 for *G. atlantica* and 0.77 for *G. galloti* (Figure 2).

Despite the lack of contributions on weight-length relationships in other species of the genus *Gallotia*, some authors as García (1978), Mateo & López-Jurado (1992) and Rodriguez-Domínguez *et al.*, (1998), have found some positive relationships among the length of several morphological variables from *G. goliath, G. stehlini* and *G. simonyi* respectively.

In conclusion, our analyses revealed that the bones studied in this work can be considered as good predictors of the size and weight of *G. atlantica* and *G. galloti*, and the proposed models can be used in future studies on lizards size selection by different predator species and paleontological surveys.

## ACKNOWLEDGEMENTS

Félix M. Medina and Juan C. Sánchez captured some of the lizards studied. P. Jordano assessed us with the statistical analyses. J. A. Mateo and two anonimous referees gave us useful suggestions. Collecting was facilitated by permits issued by the Viceconsejería de Medio Ambiente del Gobierno de Canarias.

## BIBLIOGRAPHY

CARRILLO, J., E.C. HERNÁNDEZ, M. NOGALES, G. DELGADO, R. GARCÍA & T. RAMOS (1994). Geographic variations in the spring diet of *Falco tinnunculus* L. on the islands of Fuerteventura and El Hierro (Canary Islands). *Bonn. zool. Beitr.* 45: 39-48.

CASTANET, J. & M. BÁEZ (1991). Adaptation and evolution in *Gallotia* lizards from the Canary Islands: age, growth, maturity and longevity. *Amphibia-Reptilia* 12: 81-102.

DÍAZ, M. & J. DÍAZ (1990). Estimas de tamaños y biomasas de artrópodos aplicables al estudio de la alimentación de vertebrados insectívoros. *Doñana Acta Vert.* 17: 67-74.

GARCÍA, C. (1978). Características anatómicas y biométricas de *Lacerta maxima* Bravo 1953 (Reptilia: Lacertidae). Tesina de Licenciatura. Universidad de La Laguna.

GARCÍA-MÁRQUEZ, M., L.F. LÓPEZ-JURADO & J.A. MATEO (1997). Predación de *Gallotia simonyi* por gatos cimarrones. *Bol. Asoc. Herpetol. Esp.* 8: 20-23.

GONZÁLEZ, P., F. PINTO, M. NOGALES, J. JIMÉNEZ-ASENSIO, M. HERNÁNDEZ & V. CABRERA (1996). Phylogenetic relationships of the Canary Islands endemic lizard genus *Gallotia* (Sauria: Lacertidae), inferred from mitochondrial DNA sequences. *Mol. Phyl. Evol.* 5: 63-71.

LABARBERA, M. (1989). Analyzing body size as a factor in ecology and evolution. *Ann. Rev. Ecol. Syst.* 20: 97-117.

MACHADO, A., A. MARTÍN & L.F. LÓPEZ-JURADO (1985). Conservation status of reptiles in the Canary Islands. *Bonn. zool. Beitr.* 36: 585-606.

MÁRQUEZ, R., D. CEJUDO & V. PÉREZ-MELLADO (1997). Selected body temperatures of four lacertid lizards from the Canary Islands. *Herpetol. J.* 7: 122-124.

MATEO, J.A. & L.F. LÓPEZ-JURADO (1992). Study of dentition in lizards from Gran Canaria Island (Canary Islands) and its ecological and evolutionary significance. *Biol. J. Linn. Soc.* 46: 39-48.

MCARDLE, B.H. (1988). The structural relationship: regression in biology. *Can. J. Zool.* 66: 2329-2339.

MORRIS, P. (1979). Rats in the diet of the Barn Owl (*Tyto alba*). *J. Zool.* 189: 540-545.

NOGALES, M. & F.M. MEDINA (1996). A review of the diet of feral domestic cats (*Felis sylvestris* f. *catus*) on the Canary Islands, with new data from the laurel forest of La Gomera. *Z. Säugetierkunde.* 61: 1-6.

NOGALES, M., J.D. DELGADO & F.M. MEDINA (1998). Shrikes, lizards and *Lycium intricatum* fruits: a case of indirect seed dispersal on an oceanic island (Alegranza, Canaries). *J. Ecol.* 86: 866-871.

RADINSKY, L.B. (1985). Approaches in evolutionary morphology: A search for patterns. *Ann. Rev. Ecol. Syst.* 16: 1-14.

RODRÍGUEZ-DOMÍNGUEZ, M.A., C. CASTILLO, J.J. COELLO & M. MOLINA-BORJA (1998). Morphological variation in the lacertid *Gallotia simonyi machadoi* and a comparison with the extinct *Gallotia simonyi simonyi* from El Hierro (Canary Islands). *Herpetol. J.* 8: 85-91.

ROGERS, L.E., W.T. HINDS & R.L.BUSCHBOM (1976). A general weight vs. length relationship for insects. *Ann. Ent. Soc. Amer.* 69: 387-389.

SÁNCHEZ, J.C., M.C. FOSSI & S. FOCARDI (1997). Serum B esterases as a nondestructive biomarker in the lizard *Gallotia galloti* experimentally treated with parathion. *Environ. Toxicol. Chem.* 16: 1954-1961.

SOKAL, R.R. & F.J. ROHLF (1969). *Biometría.* Blume, Madrid. 832 pp.

STEENHOF, K. (1983). Prey weights for computing percent biomass in raptor diets. *Raptor Res.* 17: 15-27.

Table I. Regression models found between the SVL and the main osteological variables measured in *Gallotia atlantica* and *G. galloti*. Pearson correlation coefficients ($r_p$) are included and data were log-transformed. * $P<0.05$; ** $P<0.01$.

| Independent variables | Species | Regression models | $R^2$ | $r_p$ | $N$ | $P$ |
|---|---|---|---|---|---|---|
| Maxillary length | *G. atlantica* | $Y = 1.32 + 0.52\,X$ | 0.48 | 0.69 | 18 | ** |
| | *G. galloti* | $Y = 1.11 + 0.80\,X$ | 0.88 | 0.94 | 41 | ** |
| Jaw length | *G. atlantica* | $Y = 1.43 + 0.35\,X$ | 0.30 | 0.55 | 19 | * |
| | *G. galloti* | $Y = 1.04 + 0.83\,X$ | 0.91 | 0.95 | 41 | ** |
| Parietal length | *G. atlantica* | $Y = 1.48 + 0.36\,X$ | 0.43 | 0.65 | 19 | ** |
| | *G. galloti* | $Y = 1.37 + 0.60\,X$ | 0.89 | 0.94 | 38 | ** |
| Parietal width | *G. atlantica* | $Y = 1.30 + 0.61\,X$ | 0.68 | 0.82 | 18 | ** |
| | *G. galloti* | $Y = 1.26 + 0.73\,X$ | 0.84 | 0.91 | 37 | ** |
| Pelvic girdle length | *G. atlantica* | $Y = 1.18 + 0.58\,X$ | 0.75 | 0.86 | 15 | ** |
| | *G. galloti* | $Y = 1.32 + 0.54\,X$ | 0.81 | 0.90 | 27 | ** |
| Femoral length | *G. atlantica* | $Y = 1.21 + 0.58\,X$ | 0.64 | 0.80 | 19 | ** |
| | *G. galloti* | $Y = 1.00 + 0.82\,X$ | 0.89 | 0.94 | 43 | ** |
| Humeral length | *G. atlantica* | $Y = 1.36 + 0.48\,X$ | 0.58 | 0.76 | 18 | ** |
| | *G. galloti* | $Y = 1.21 + 0.72\,X$ | 0.85 | 0.92 | 43 | ** |
| Tibial length | *G. galloti* | $Y = 1.07 + 0.86\,X$ | 0.89 | 0.94 | 43 | ** |

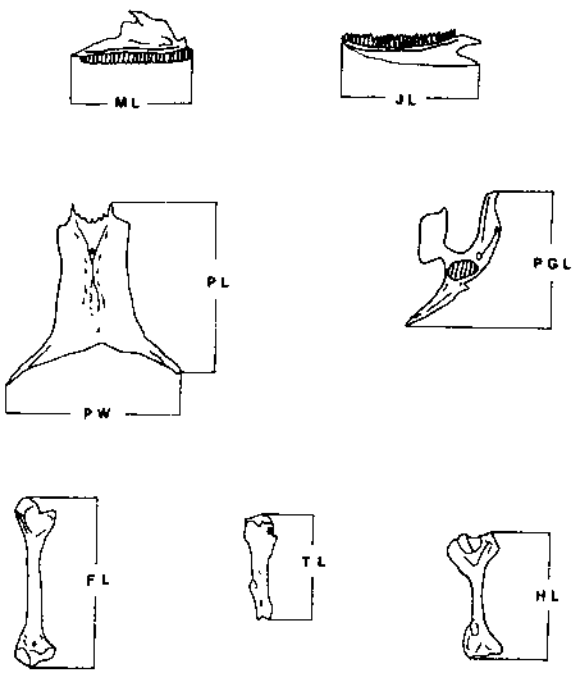


Fig. 1. Principal measures taken from the different studied bones: Maxillary length (ML), Jaw length (JL), Parietal length (PL), Parietal width (PW), Pelvic girdle length (PGL), Femoral length (FL), Humeral length (HL) and Tibial length (TL).

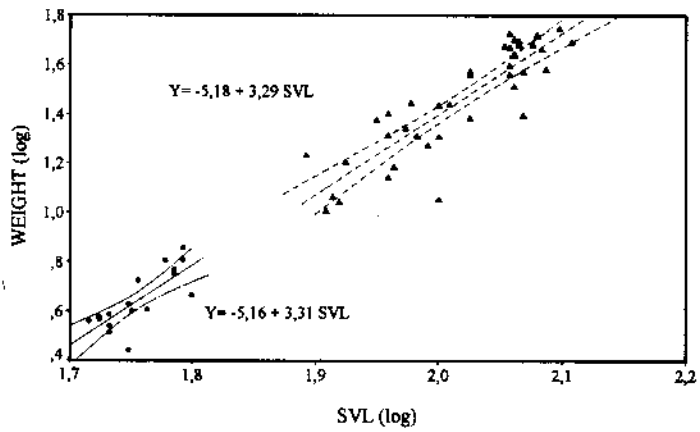


Fig. 2. Relationships between weight and body length (SVL) in *Gallotia atlantica* and *G. galloti*. Triangles indicate individuals of *G. galloti* and dots *G. atlantica*. Confidence interval levels at $P = 0.05$ are shown.

Fecha de recepción: 16 marzo 1999 Fecha de aceptación: 30 mayo 1999