

Discovery of mummified extinct giant lizards (*Gallotia goliath*, Lacertidae) in Tenerife, Canary Islands

Carolina Castillo, Juan C. Rando & José F. Zamora

Abstract. Two mummified specimens of the extinct giant lizard *Gallotia goliath* have recently been discovered in the island of Tenerife (Canary Islands). For the first time they allow the study of the species' external morphology. It is characterized by its large size (estimated length >1,5 m) and a low number of temporal scales. Pholidotic characteristics and the dentition provide evidence for a closer relationships between *G. goliath* and *G. simonyi*, a species which has recently disappeared from the Roque Chico de Salmor but has survived on the island of El Hierro. *Gallotia goliath* probably became extinct in Tenerife as a consequence of habitat perturbations resulting from human impact and the introduction of new predators. Also, competition between juvenile giant lizards and adults of the smaller species *G. galloti* may have contributed to the decline of the giant lizard.

Key words. Lacertidae, *Gallotia goliath*, extinction, taxonomy.

Introduction

Lizards of the genus *Gallotia* are endemic to the Canary Islands. The largest species of the family Lacertidae belong to this genus. The recent discovery of two specimens of mummified giant lizards in the Barranco de las Moraditas in Tenerife was an unexpected event in the Canarian archipelago (Fig. 1). The remains studied were contained within the fill-in of a small cavity in basaltic materials of the volcanic Series III dating from the Quaternary (Ancochea et al. 1990). The mummified specimens allow, for the first time, the description of the external morphological characteristics of the extinct species *Gallotia goliath* (Mertens 1942). A tendency to gigantism is observed in this group of lacertids, both in the fossil record and in some extant populations. This tendency is likewise observed in the current small-sized species living under conditions of maximum isolation and in a small habitat (Martín 1985, López-Jurado & Mateo 1992).

External morphology

The mummified specimens of *Gallotia goliath* are large in size (Table 1), with flattened head, cheeks very broad and snout slender, with estimated snout-vent length based on the length of the head 463 and 546,4 mm, respectively. The rostral scale is in contact with the nostril, and a single postnasal in contact with the first and second upper labials; there are five upper labials anterior to the subocular. Four supraocular scales, six supraciliaries and at least six supraciliar granules are present. Two frenoculars, posterior loreal larger than the anterior. Scales of the temporal region generally large, numbering 22—25 in one specimen and 21 in the other. Masseteric and tympanic shields large. Two supratemporal scales are observed, the anterior very elongated and larger than the posterior (Figs 2 and 4a). An occipital scale of triangular-trapezoidal shape is present dorsally. The frontal scale is square-

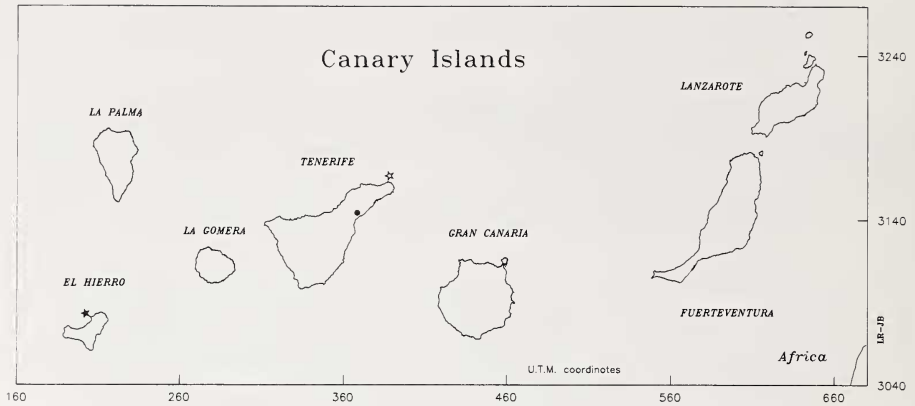


Fig. 1: Geographical location of the Barranco de Las Moraditas (BM) fossil site from the Canary Islands. This archipelago comprises seven larger islands and some islets in the Atlantic Ocean west of the coast of southern Morocco. — (1) Location where the mummified lizards were found. (2) Roque Chico de Salmor. (3) Roque de Fuera de Anaga.

shaped (Fig. 3 b). On the ventral face there are six submaxillars on either side, totally separated (Fig. 3 a). The collar is present. The number of gular scales is greater than thirty-four since these can extend from the collar to the mental scale (Fig. 3 a). The dorsal scales are keel-like. Some square-shaped, large (6,98 x 5,10 mm) ventral scales are present. The teeth are tricuspidal, with the central cusp well developed. The number and form of the premaxillary, maxillary and dentary teeth of the mummified specimens correspond with those described for *Gallotia goliath* by other authors (Mertens 1942, Bravo 1953, Hutterer 1985).

Table 1: Quantification of some morphological characteristics of the extinct and extant giant lizards of the genus *Gallotia*. BM-1 and BM-2 are the mummified lizards studied. The other data are from the following sources: *G. goliath*, Hutterer 1985; *G. maxima*, Bravo 1953, Hutterer 1985; *G. s. simonyi*, Hutterer 1985, Machado 1985 a, Salvador 1971; *G. s. machadoi*, Machado 1985 a; *G. stehlini*, López Jurado 1985, Mateo & López Jurado 1992, Salvador 1985, Bischoff 1985. The data separated by a bar (/) correspond to individual specimens, those separated by a dash (—) correspond to means. SVL: snout-vent length (mm). PL: pileus length (mm) from snout to end of parietal bones. SPG: supraciliar granules. SPC: supraciliar scales. TEM: temporal scales. PREM: premaxillary teeth. MAX: maxillary teeth. DEN: dentary teeth.

	BM-1	BM-2	<i>Gallotia goliath</i>	<i>Gallotia maxima</i>	<i>G. simonyi simonyi</i>	<i>G. simonyi machadoi</i>	<i>Gallotia stehlini</i>
SVL	463	546,40	—	—	255, 224	162,50	<280
PL	76,84	90,62	—	—	60, 50,40	35,66	45—33
SPG	6/7	—	—	—	12/14	7—12	11—12
SPC	6/—	—	—	—	8/8	5—8	5—7
TEM	22/25	21/—	—	—	23—39	54—66	>70
PREM	9	9	9	11—12	7	—	7—11
MAX	25	25	24—28	33	16—20	—	15—25
DEN	32/31	30/31	31	36	20—26	—	16—29



Fig. 2: Photograph of the mummified specimen (BM-2) of *Gallotia goliath* from Tenerife. Lateral view of the head showing the temporal scales and the dentary-maxillary teeth.

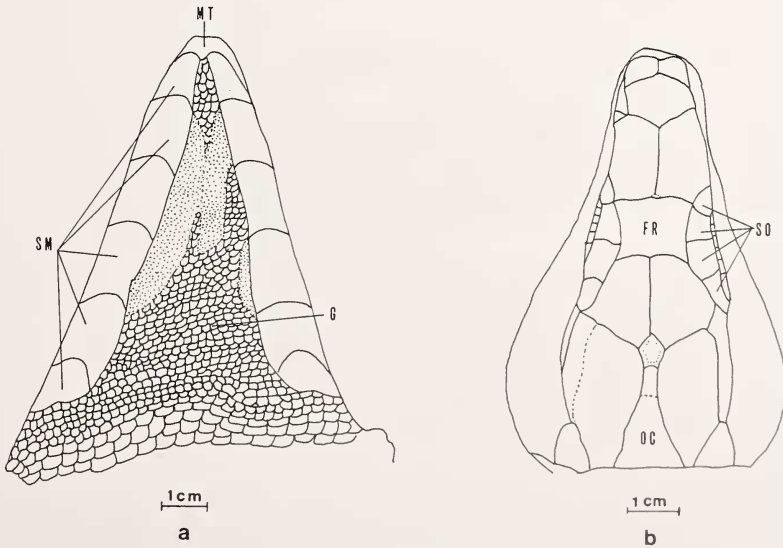


Fig. 3: Ventral (a) and dorsal (b) view of the head of mummified specimen BM-1, SM: sub-maxillary scales; MT: mental scale; G: gular scales (reconstructed); FR: Frontal; OC: occipital; SO: supraocular.

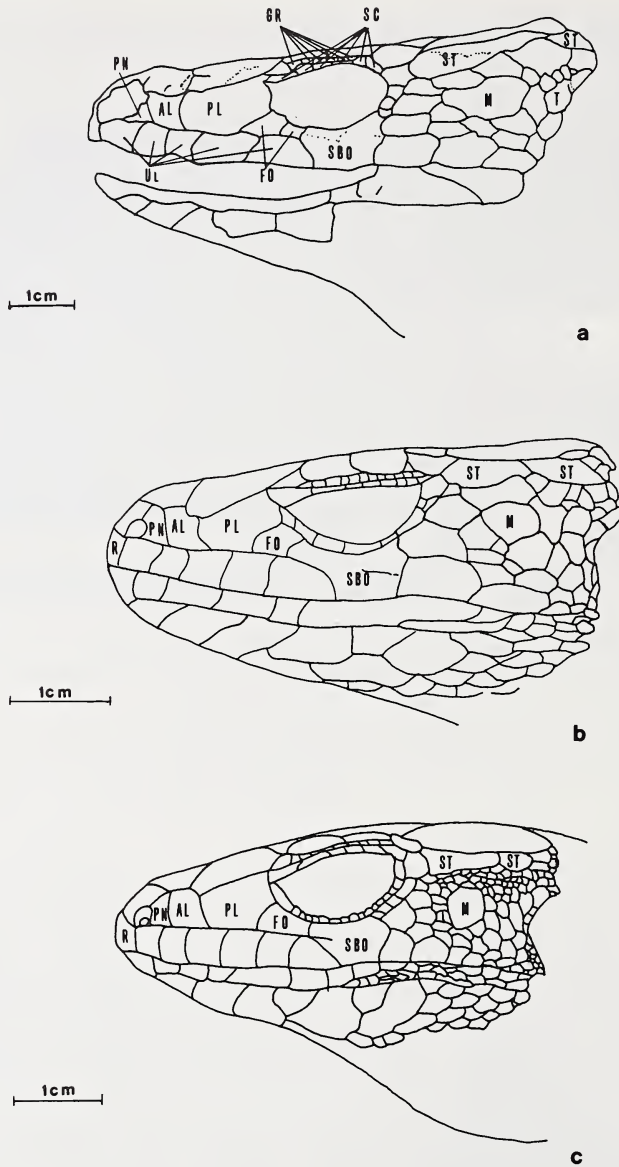


Fig. 4: Comparisons of the pholidotic traits in the large extinct and extant lizards of the Canary Islands. a: *Gallotia goliath*, mummified specimen BM-1. b: *Gallotia s. simonyi*, recently extinct species of the Roque Chico de Salmor (from Machado 1985 a). c: *Gallotia stehlini*, extant species of Gran Canaria (from Barbadillo Escriva 1987). AL: anterior loreal scale; FO: frenocular; GR: supraciliar granules; M: masseteric; PL: posterior loreal; PN: postnasal; R: rostral; SBO: subocular; SC: supraciliaries; ST: supratemporal; T: tympanic.

Comparisons

The number of temporal scales in the mummified specimens is smaller or overlaps the lower limit of the variation in *Gallotia s. simonyi* (Table 1). The number of premaxillary, maxillary and dentary teeth is larger than in the Roque de Salmor species. The small number of temporal scales, the presence of both a large masseteric and tympanic scale are also observed in *Gallotia simonyi* (Machado 1985a) (Fig. 4b), although the body size and the relative size of the scales are greater in the extinct species.

The large-sized *Gallotia stehlini* from Gran Canaria (and Fuerteventura) differs from the mummified giant lizards inasmuch as the rostral scale is separated from the nostril, the scales of the temporal area are smaller and higher in number (>70), and the number of dentary cusps is greater in the maxillary and mandibular teeth (Fig. 4c and Table 1).

In the extinct species *Gallotia maxima* (Bravo 1953) the numbers of premaxillar, maxillar, dental and pterygoid teeth are larger than in the mummified specimens. In specimen BM-1 there are two parallel rows of pterygoid teeth (approximately 18 teeth) but in specimen BM-2 they are not present. The body size of *Gallotia maxima* is larger than in the lizards described in this paper (Bravo 1953, Hutterer 1985).

Discussion

The giant lizards from Barranco de las Moraditas resemble the recently extinct lizard of El Hierro (*Gallotia simonyi*) in external morphology and dentary tooth shape, although the mummified *Gallotia goliath* had a higher number of teeth, a lower number of temporal scales and a larger body size (Table 1), suggesting a close relationship between these two forms.

Differences in size and number of teeth exist between the mummified remains and the fossil *Gallotia maxima*. This species and *Gallotia goliath* have been considered to be synonymous by Gasc (1971) and Castanet & Baez (1991), but no evidence has been put forward. We believe that an exhaustive revision of this group of fossil lizards is necessary before such conclusions can be drawn. Also the variation of pterygoid teeth, as observed in the two mummified specimens and noted also by Izquierdo et al. (1989), requires further study.

It would seem that, due to osteological and dentary similarities between the extinct and extant giant lizards of Tenerife, La Gomera, El Hierro and La Palma (pers. observ.), as well as the external morphological similarities between the mummified specimens of Tenerife and *G. simonyi simonyi* of El Hierro, the taxonomic situation of these animals in the past could have been similar to that of the small-sized lizards *Gallotia galloti* currently inhabiting these islands (Tab. 2), that is, a species with several geographic subspecies (Bischoff 1982).

Differences in body size of about 15%, as observed in the two mummified specimens, also exist in fossil and extant forms of *Gallotia stehlini* (López Jurado 1985) and *G. simonyi* from the island of El Hierro (Machado 1985) and in the present-day populations of *Gallotia galloti* in Tenerife, La Palma, La Gomera and El Hierro (Bischoff 1982, 1985), and may be due to sexual dimorphism. A similar variation has been observed in *Gallotia atlantica* in the island of Lanzarote (López Jurado

Table 2: Geographical distribution of living and recently extinct* species and subspecies of the genus *Gallotia* in the Canarian archipelago.

Species	Subspecies	Islands
<i>G. galloti</i>	<i>galloti</i>	S Tenerife
	<i>eisentrauti</i>	N Tenerife
	<i>insulanagae</i>	Roque de Fuera de Anaga (Tenerife)
	<i>palmae</i>	La Palma
	<i>gomeræ</i>	La Gomera
	<i>caesaris</i>	El Hierro
<i>G. atlantica</i>	<i>atlantica</i>	Lanzarote except NE
	<i>laurae</i>	NE Lanzarote
	<i>ibanezi</i>	Alegranza
	<i>delibesi</i>	Gran Canaria
	<i>mahoratae</i>	Fuerteventura and Lobos
<i>G. stehlini</i>		Gran Canaria (and Fuerteventura)
<i>G. simonyi</i>	<i>simonyi</i> *	Roque Chico de Salmor (El Hierro)
	<i>machadoi</i>	NW El Hierro

& Mateo 1992). A tendency towards gigantism is known in *Gallotia* when the inhabited area is small, as in the islet of Roque Chico de Salmor (approx. 800 m²) (*G. s. simonyi*), the Roque de Fuera de Anaga (Martín 1985) (3.600 m²) (*G. gallotia insulanagae*), and in different habitat islands ("malpaís" and "islotes") of Lanzarote (López Jurado & Mateo 1992) (*G. atlantica*).

The causes for the extinction of the giant lizards in Tenerife may be complex. The Canarian aborigines may have used them as a source of food. New predators like cats and dogs, first introduced by the aborigines (Hutterer 1990) and subsequently followed by the Europeans, had a negative impact on the populations of giant lizards, the size of which rendered them a suitable prey (Machado 1985b). A comparable impact was concluded by Pregill (1981) in his studies of the fossil reptile fauna of Puerto Rico. A further factor that may explain the disappearance or relict distribution of the giant lizards in the Canaries may have been competition between juvenile giant lizards and adult small-bodied lizards (Arnold 1993). In most islands where the large-sized lizards have become extinct or are in danger of disappearing, there exists a small-sized species. The island of Gran Canaria is an exception as besides the large *G. stehlini* the small *G. atlantica* is present, although the latter occurs very localized and may have been recently introduced (Barquín & Martín 1982).

Acknowledgements

We would like to express our most sincere thanks to J. D. Delgado for his photographs, to R. Hutterer, A. Martín and M. Nogales for their bibliographic advice and to M. López for her help with the figures.

Zusammenfassung

Es wird über die Entdeckung zweier mumifizierter Rieseneidechsen auf der Insel Teneriffa (Kanarische Inseln) berichtet. Die weitgehende Erhaltung des Schuppenkleides gestattet zum erstenmal eine genauere Beschreibung der ausgestorbenen Art *Gallotia goliath*. Diese Rieseneidechse zeichnet sich durch ihre Größe (geschätzt über 1,5 m) und eine niedrige Anzahl

von Temporalschuppen aus. Merkmale der Beschuppung und der Zahnmorphologie belegen eine nähere Verwandtschaft zwischen *G. goliath* und *G. simonyi*, einer Art, deren Population auf dem Roque Chico de Salmor vor kurzem ausgestorben ist und von der noch eine Reliktpopulation auf der Insel Hierro existiert. Rieseneidechsen sind wahrscheinlich auf Teneriffa als Folge menschlicher Eingriffe in den Lebensraum und von Verfolgung sowie des Einflusses von neuen Prädatoren ausgestorben. Auch Konkurrenz zwischen juvenilen *G. goliath* und Adulten der kleineren Art *G. galloti* könnte den Populationsrückgang der Rieseneidechse beeinflusst haben.

Literature

- Ancochea, E., J. M. Fuster, E. Ibarrola, A. Cendrero, J. Coello, F. Hernán, J. M. Cantagrel & C. Jamond (1990): Volcanic evolution of the island of Tenerife (Canary Islands) in the light of new K-Ar data. — *J. Volcanol. Geotherm. Res.* 44: 231–249.
- Arnold, E. N. (1973): Relationships of the Palaearctic lizards assigned to the genera *Lacerta*, *Algyroides* and *Psammodromus* (Reptilia: Lacertidae). — *Bull. Brit. Mus. (Nat. Hist.) Zool.* (25) 8: 291–366.
- Barbadillo Escriva, L. J. (1987): La Guía de Incafo de los Anfibios y Reptiles de la Península Ibérica, Islas Baleares y Canarias. Incafo S. A. Madrid: 380 pp.
- Barquín, J. & A. Martín (1982): Sobre la presencia de *Gallotia* (= *Lacerta*) *atlantica* (Peters y Doria 1982) en Gran Canaria (Rep. Lacertidae). — *Doñana, Acta Vertebrata* 9: 377–380.
- Bischoff, W. (1982): die innerartliche Gliederung von *Gallotia galloti* (Duméril & Bibron 1839) (Reptilia: Sauria: Lacertidae) auf Teneriffa, Kanarische Inseln. — *Bonn. zool. Beitr.* 33: 363–382.
- Bischoff, W. (1985): Die Rieseneidechsen der Gattung *Gallotia*. — *Herpetofauna, Weinstadt* 38: 11–21.
- Bravo, T. (1953): *Lacerta maxima* n. sp. de la fauna continental extinguida en el Pleistocene de las Islas Canarias. — *Estud. Geol.* 17: 7–34.
- Castanet, J. & M. Baéz (1991): Adaptation and evolution in *Gallotia* lizards from the Canary Islands: age, growth, maturity and longevity. — *Amphibia-Reptilia* 12: 81–102.
- Gasc, J. P. (1971): Les variations columnaires dans la région présacrée des sauriens. Application à la reconstitution de *Lacerta goliath* Mertens. — *Annal. Paléont.* 57: 133–155.
- Hutterer, R. (1985): Neue Funde von Rieseneidechsen (Lacertidae) auf der Insel Gomera. — *Bonn. zool. Beitr.* 36: 365–394.
- Hutterer, R. (1990): Remarks on a presumed record of *Felis margarita* from Tenerife, Canary Islands. — *Vieraea* 19: 169–174.
- Izquierdo, I., A. L. Medina & J. J. Hernández (1989): Bones of giant lacertids from a new site on El Hierro (Canary Island). — *Amphibia-Reptilia* 10: 63–69.
- López Jurado, L. F. (1985): Los reptiles fósiles de la Isla de Gran Canaria (Islas Canarias). — *Bonn. zool. Beitr.* 36: 355–364.
- López Jurado, L. F. & J. A. Mateo (1992): Two models of evolution in Canary lizards based on the use of spatial resources. — *Biol. J. Linn. Soc.* 46: 25–37.
- Machado, A. (1985a): New data concerning the Hierro Giant lizard and the Lizard of Salmor. — *Bonn. zool. Beitr.* 36: 429–470.
- Machado, A. (1985b): Hypothesis on the reasons for the decline of the large lizards in the Canary Islands. — *Bonn. zool. Beitr.* 36: 563–575.
- Martín, A. (1985): Los lagartos de los roques del norte de Tenerife. — *Bonn. zool. Beitr.* 36: 517–528.
- 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.
- Mertens, R. (1942): *Lacerta goliath* n. sp., eine ausgestorbene Rieseneidechse von den Kanaren. — *Senckenbergiana* 25: 330–339.
- Pregill, G. (1981): Late Pleistocene herpetofaunas from Puerto Rico. *Univ. Kansas Mus. Nat. Hist., Misc. Publ.* 71: 1–72.

- Pregill, G. (1986): Body size of insular lizards: a pattern of Holocene dwarfism. — *Evolution* 40: 997—1008.
- Salvador, A. (1971): Nota sobre el lagarto negro gigante de Canarias, *Lacerta simonyi*. — *Bol. R. Soc. Esp. Hist. Nat. (Biol.)* 69: 317—320.
- Salvador, A. (1985): Guía de campo de los anfibios y reptiles de la Península Ibérica, Islas Baleares y Canarias. Santiago García (Edit): 212 pp.

Carolina Castillo, Juan C. Rando, Departamento de Biología Animal, Universidad de La Laguna, 38206 La Laguna, Tenerife, Canary Islands, Spain. — José F. Zamora, C/El Mollero, nº 21, 38291 Tenerife, Canary Islands, Spain.