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DISCOVERY OF A LIVING GIANT LIZARD, GENUS *GALLOTIA* (REPTILIA: LACERTIDAE), FROM LA GOMERA, CANARY ISLANDS

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ABSTRACT: We describe the external morphology of a new giant lizard found alive on La Gomera Island (Canarian Archipelago), which had been previously described from subfossil bones. Adult size (SVL 135–190 mm) is comparable with the two largest living species (*G. simonyi* and *G. stehlini*) of the genus. It differs from the other species of *Gallotia* in the low number of temporal scales (21–27), presence of one elongate interprefrontal scale (linearly depressed in center) that is very infrequent in most of its congeners (small when it is present), having two distinctive lateral lines of small blue spots, and in having a blackish-brown dorsum and ventral parts ivory white. According to subfossil data, based on tooth morphology and body size, this lizard seems to correspond to the putatively extinct subspecies (*G. simonyi gomerana*). This taxon is sufficiently distinct to be treated as a full species, *G. gomerana*. Molecular data analysis from mtDNA sequences (cytochrome *b* and 12S rRNA) indicate that *G. gomerana* is closely related to *G. simonyi* and *G. intermedia*. After prospecting 70 localities in La Gomera, we only found a very small and threatened population of this species in Valle Gran Rey, in the western part of the island and living in an area of less than 1 ha. A small population size (only six individuals are known) and a large number of feral cats in their habitat makes this lizard the most endangered vertebrate of the Canaries and Europe and one of the most threatened in all the world. The species is suspected to be on the brink of extinction, so conservation measures are urgently needed, including a captive breeding plan at Valle Gran Rey, close to the natural habitat.

Key words: Reptilia; Lacertidae; *Gallotia gomerana*; La Gomera; Canary Islands; External Morphology; Taxonomy

ADAPTIVE radiation of animals and plants is a characteristic phenomenon of oceanic islands (Cox and Moore, 1993; Gorman, 1979; Whittaker, 1998). Among reptiles, lizards of the genus *Gallotia*, endemic to the Canary Islands (Arnold, 1973), constitute a well known case of this phenomenon. At present, six living species are known (Fig. 1): *G. atlantica* on the eastern islands of Fuerteventura, Lanzarote and their surrounding islets, also introduced on Gran Canaria; *G. stehlini* on Gran Canaria, and introduced on Fuerteventura; *G. galloti* on Tenerife and La Palma; *G. caesaris* on La Gomera and El Hierro; *G. simonyi* on El Hierro; and *G. intermedia* on Tenerife (Bischoff, 1998*a*; Hernández et al., 2000).

Studies of subfossil bones indicated that two species of giant lizards, *Gallotia goliath* (considered as a synonym of *G. maxima*: Gasc, 1971; Izquierdo et al., 1989; López-Jurado, 1991) and *G. simonyi*, inhabited the western islands of this archipelago, namely Tenerife, La Gomera, La Palma, and El Hierro (García-Talavera et al., 1989). However, these two forms may be conspecific (Barahona et al., 2000; Mateo et al., 1999; Mertens, 1942).

Until the middle of the twentieth century, the only known living giant lizards of the western islands was the population of *G. simonyi* from Roque de Salmor, an offshore islet of El Hierro. These lizards disappeared about 65 yr ago, but a small endangered population of *G. simonyi* was found in 1975 on some cliffs (Risco de Tibataje) on El Hierro (Böhme and Bings, 1975). In May 1996, a completely new lacertid (*G. intermedia*) was discovered on some remote coastal cliffs of the westernmost part of Tenerife (Hernández et al., 2000). Molecular data indicate that this lizard is closely related to *G. simonyi* (Rando et al., 1997), and so hereafter we will refer to all the large lizards from the western islands as "*simonyi* group". This last discovery alerted us to the possibility that an-

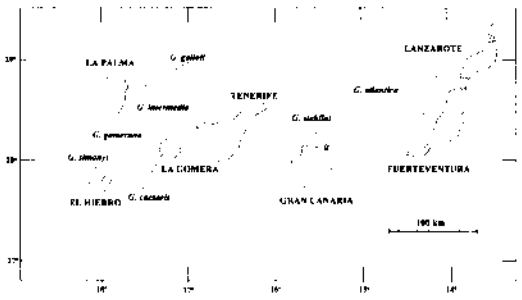

FIG. 1.—Map of the Canary Islands showing the natural distribution of living species of *Gallotia*.

other giant living lizard might still survive on La Gomera. On this island, living lizards, presumably of this general type, were seen alive in the second half of the nineteenth century (Fritsch, 1870). Furthermore Hutterer (1985) described two Gomeran taxa (*G. goliath bravoana* and *G. simonyi gomerana*) based on subfossil bones and indicated that the latter, of which some remains had been found in an archaeological site dated at about 500 yr BP, could have survived and may still be alive somewhere on this island.

In 1999, we started a systematic search in the coastal areas of La Gomera, an island of 370 km^2 and with a geological age of more than 10 my (14.6–19.3 in the "basal complex") (Cantagrel et al., 1984). At last, a few large and recent lizard fecal pellets were discovered in June at Valle Gran Rey. Subsequent trapping at this locality produced six living lizards different from any other living species of *Gallotia*. This paper describes their morphology and discusses their taxonomic status.

MATERIAL AND METHODS

We systematically prospected most of the coastal zones (to an elevation of 400 m) of the Island of La Gomera as well as some localities inland. For this task, we used fishing boats, helicopters, and expeditions on foot, visiting a total of 70 suitable localities in the period June–September 1999.

Nine meristic characters (see Arnold, 1973, for details) and four measurements were taken from each of the six specimens, which are now maintained in captivity by the Canarian Government (Table 1). The meristic characters were the number of temporals (TR); supratemporals (ST); gulars (GL), number of scales counted from the anterior edge of the collar to the submaxillary symphysis; dorsals in a transverse row at midbody (MD); femoral pores (FP); longitudinal rows of ventrals (LV), counted in the last third of the body; perianals (PA); subdigital lamellae on the fourth toe (SL); and collar scales (CL). This ensemble of meristic variables has been traditionally used in the taxonomy of the Lacertidae (Arnold, 1973; Bischoff, 1985*a*; Boulenger, 1920, 1921; Hernández et al., 2000). The following measurements were also taken for all specimens: snout–vent length (SVL); head length (HL), distance between the tip of the snout and the posterior border of the parietal scales; head width (HW), measured from the external edge of one parietal scale to the nub of the other; and total length (TL).

Comparative data were taken from a total of 113 specimens representing all living, nominal species of *Gallotia* (*G. atlantica*: 20; *G. galloti*: 20; *G. caesaris*: 20; *G. stehlini*: 17; *G. simonyi*: 15; *G. intermedia*: 21) (Table 2; Appendix I).

After intensive trapping over four months, we caught only six lizards (five adults, three males and two females, and one juvenile) in Valle Gran Rey (western part of La Gomera) (27° 52′ N, 16° 51′ W), elevation 150 m.

SYSTEMATIC ACCOUNT

Meristic characters distinguish *G. gomerana* from the other species of *Gallotia*, chiefly the low number of scales in the temporal region (<28) and the presence of an elongated interprefrontal scale. Furthermore, the coloration is very distinctive, the main distinguishing traits being the blackish-brown dorsum, the ivory white ventral parts, and the two lines of small blue ocelli on the flanks. Quantitative data on meristic characters indicate that *G. gomerana* is morphologically more similar to *G. simonyi* and *G. intermedia*, differing in only two of the nine characters studied (number of temporals and number of femoral pores) (Table 2). The other species

TABLE 1.—Meristic and morphometric variation in *Gallotia gomerana*. See material and methods for abbreviations and Barbadillo et al. (1999) for scale names. Measurements are given in millimeters and ranges for measures consider only adults.

		Measurements				Meristic variables								
Sex	Capture date	TL	SVL	HL	HW	TR	ST	CL	GL	IV	MD	PA	FP	SL
Male	25/VI/99	460	190	46.7	22.3	22	4	10	28	17	83	7	29	29
Male*	15/VIII/99	490	180	43.8	20.8	24	4	9	27	18	83	6	28	33
Male	8/VIII/99	337	135	31.8	15.0	27	4	9	29	17	83	5	28	31
Female	25/VII/99	295	155	33.7	16.2	22	3	11	25	16	80	6	31	30
Female	29/IX/99	450	150	35.5	16.4	22	4	10	26	18	80	5	31	28
Juv.	9/VI/99	310	112	26.1	11.1	21	3	10	24	17	76	6	29	30
	Mode	—	—	—	—	22	4	10	—	17	83	6	—	30
	Range	295–490	135–190	31.8–46.7	15.0 22.3	21–27	3–4	9–11	24–29	16–18	76–83	5-7	28–31	28–33

* During the preparation of this manuscript, this male died on 5 July 2000 in the Captivity Center of the Viceconsejeria de Medio Ambiente (Canarian Government) and in summer 2000 this Institution captured a new adult male.

(*G. stehlini*, *G. galloti*, *G. caesaris*, and *G. atlantica*) differ from *G. gomerana* with respect to several different traits.

Hutterer (1985) described two giant lizards from La Gomera based on subfossil bones, *G. goliath bravoana* (estimated SVL about 380 mm) and the smaller *G. simonyi gomerana* (about 214 mm); bones from both species appeared together in the same deposits and level of some sites, the last one still living no more than 500 yr ago. The characters used by Hutterer to distinguish these two taxa mainly involved the skull; the longer and more open parietal apophyses with respect to the parietal bones in *G. g. bravoana* than in *G. s. gomerana*; a different number of pterygoid teeth (5–6 in *G. g. bravoana* versus eight in *G. s. gomerana*); number of maxilla teeth (21–24 in *G. g. bravoana* versus 18–20 in *G. s. gomerana*); number of dentary teeth (25–26 in *G. g. bravoana* versus 21–22 in *G. s. gomerana*); and different tooth morphology, *G. g. bravoana* having one large central cusp and two lateral ones that are very small and sharp, in contrast to the two lateral cusps of *G. s. gomerana* (larger and rounded in shape).

In the particular case of the subfossil bones from La Gomera, Bischoff (1998*b*) commented that the different skull forms distinguished by Hutterer (1985) deserve at least a revision suggesting that only a single giant species could have existed. It would be convenient to analyze the problem in the future by molecular studies. It seems very improbable that the new lizard corresponds to a taxon other than that described by Hutterer (1985). Some authors such as Barahona et al. (2000), Bischoff (1998*b*), and Mateo et al. (1999) mentioned that the different characters that have been traditionally used to identify fossil giant lizards from the western islands (*G. simonyi* and *G. goliath*) show a high variability (see also papers of Bischoff, 1985*b*; Gasc, 1971; Hutterer, 1985; Izquierdo et al., 1989).

Currently, for imperative conservation reasons, the bones of the six living lizards cannot be compared with those described by this author. We can only compare tooth morphology, number of teeth, and body size, whose characters are clearly nearer to

TABLE 2.—Data for the scale variables for living species of *Gallotia*.

Scale characters	Statistical parameters	Species						
		G. atlantica	*G. stehlini*	*G. galloti*	*G. caesaris*	*G. simonyi*	*G. intermedia*	*G. gomerana*
Temporals	Mean	42.10	77.12	99.80	101.45	42.66	57.85	23.00
	SD	8.99	12.61	19.93	19.47	8.35	13.22	2.19
	Min.	27	60	61	70	32	38	21
	Max.	65	97	138	138	58	90	27
Supratemporals	Mean	4.00	2.18	5.30	5.00	2.26	3.61	3.83
	SD	0.85	0.40	0.73	0.92	0.45	0.58	0.40
	Min.	2	2	4	3	2	3	3
	Max.	6	3	7	7	3	5	4
Collar	Mean	6.25	12.65	11.05	9.90	11.20	10.57	9.83
	SD	0.71	1.58	1.70	1.12	1.08	1.12	0.75
	Min.	5	10	8	8	10	8	9
	Max.	7	17	15	12	14	13	11
Gulars	Mean	25.35	43.76	44.80	43.10	31.40	31.28	26.50
	SD	2.03	4.56	4.87	4.33	2.29	1.95	1.87
	Min.	22	37	38	38	29	29	24
	Max.	28	52	54	52	35	37	29
Middle dorsals	Mean	46.00	88.53	92.00	98.20	91.53	79.95	80.83
	SD	2.84	8.27	6.01	8.98	6.67	4.05	2.78
	Min.	42	77	79	85	72	72	76
	Max.	54	103	104	116	99	86	83
Longitudinal ventrals	Mean	8.50	18.29	11.85	11.15	17.53	16.14	17.16
	SD	0.82	1.49	0.81	1.09	0.83	0.85	0.75
	Min.	8	16	10	10	16	14	16
	Max.	10	21	13	14	19	18	18
Perianals	Mean	7.00	6.24	6.00	5.25	5.26	5.85	6.16
	SD	0.72	1.23	0.86	1.29	0.45	0.72	0.40
	Min.	6	4	5	4	5	5	5
	Max.	8	9	7	8	6	8	7
Femoral pores	Mean	19.00	26.68	27.70	28.15	24.66	24.85	29.33
	SD	1.58	1.92	1.98	2.08	1.63	1.49	1.36
	Min.	15	25	23	23	22	20	28
	Max.	21	32	31	32	27	27	31
Subdigital lamellae	Mean	29.05	32.82	34.00	34.75	31.46	33.85	30.16
	SD	2.11	2.59	2.53	1.68	1.68	1.79	1.72
	Min.	24	27	29	30	28	32	28
	Max.	34	38	40	38	34	38	33
	N	20	17	20	20	15	21	6

G. simonyi gomerana (18–20 teeth in the maxilla and 21–22 in the dentary versus 21 and 22 in living lizards respectively; estimated size SVL 214 mm versus 190 mm in living lizards). Differences in external morphology (meristic and color characters) with respect to the other species, qualify this taxon as a distinctive species, *G. gomerana*.

Gallotia gomerana Hutterer, 1985

Gallotia simonyi gomerana Hutterer, 1985 (*syn. hoc loco*)

Holotype.—A dentary deposited in the Museum Alexander Koenig, Germany (number: ZFMK 42399; label B/G1).

Paratypes.—Bones from the cranial and post-cranial skeleton (number: ZFMK 42400–42403). This material was collected in Barrancos de Chingiiarime and Santiago in July/August 1982.

Proposed common name.—English: Gomeran giant lizard. Spanish: Lagarto Gigante de La Gomera.

Diagnosis.—A large species of *Gallotia* (males to 190 mm SVL), of approximately the same size of the other two giant living lizards of the Canaries (*G. stehlini* and *G. simonyi*) and larger than the rest of the species. *Gallotia gomerana* differs from the other congeners in having a distinctive ivory–white color in ventral parts (body,

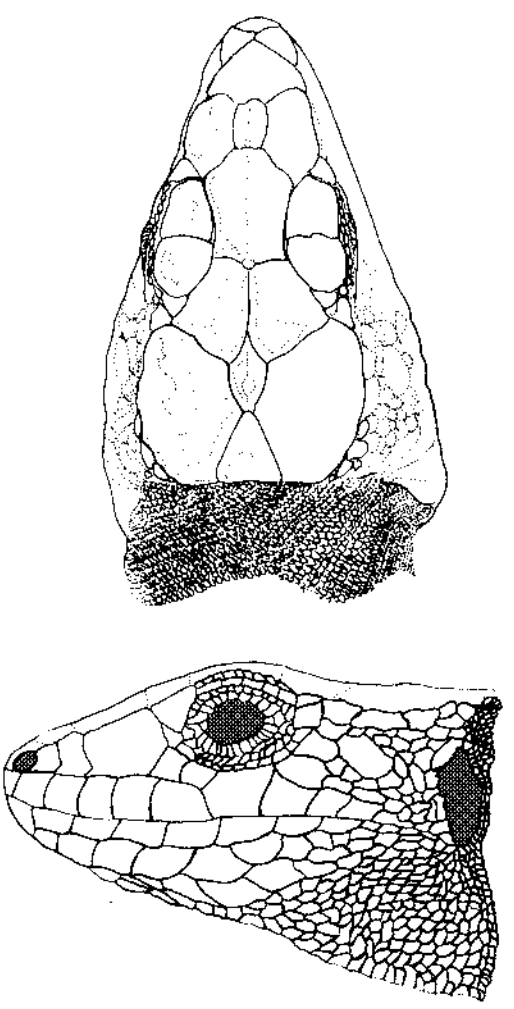

FIG. 2. Dorsal and lateral views of the head of *Gallotia gomerana*.

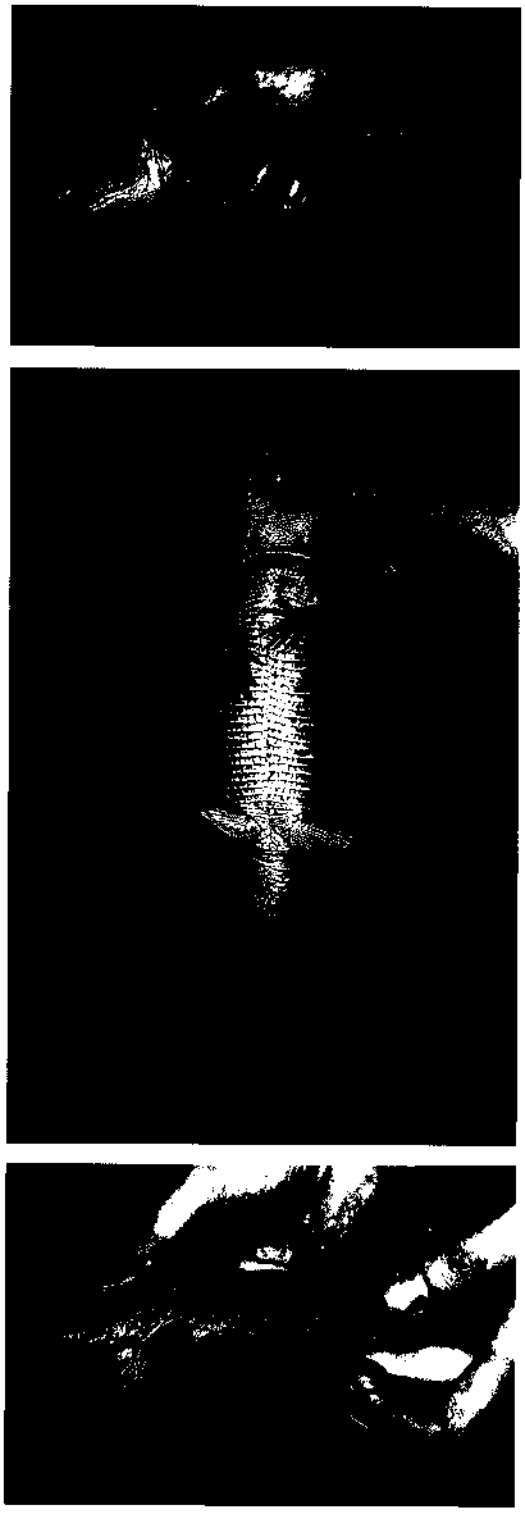

FIG. 3.—*Gallotia gomerana*. Adult male (top), adult female (middle) and juvenile (bottom).

limbs, and tail) and the presence of an elongated interprefrontal scale (Fig. 2), absent in the rest of species except in *G. intermedia* where they are generally smaller in size (see Fig. 3 (A) in Henández et al., 2000). This lizard also differs from the smaller species (*G. galloti*, *G. caesaris*, and *G. atlantica*) in having a higher number of longitudinal rows of ventrals (16–18 versus 8–14). *Gallotia gomerana* shows an uniform blackish-brown dorsum, ivory–white gular region, large tympanic scale, a lower

number of temporals (21–27), and tricuspid teeth; *G. stehlini* has a brown dorsum, orange gular region, divided tympanic scale, a higher number of temporals (60–97), and teeth with a higher number of cusps (often 4–6); *G. intermedia* has a dense network of small yellow dots or pale gray reticulations in the dorsum, over a brown ground color, pale gray gular region, a higher number of temporals (38–90), and lower femoral pores (20–27 versus 28–31 in *G. gomerana*); *G. simonyi* shows distinctive large lateral yellow spots on the dorsolateral region (small blue ocelli in *G. gomerana*), darker gular region and ventral parts, and a higher number of temporal scales in the living individuals from Fuga de Gorreta (32–58). However, the specimens from Roque de Salmor present some overlapping for this character (25–39) (Rodríguez-Domínguez et al., 1998*a*).

The extinct *G. goliath*, known only from skeletal and mummified material, can be distinguished from *G. gomerana* by its larger body size [maximum SVL 546 mm (Castillo et al., 1994)], fewer supratemporals (only two in *G. goliath* and 3–4 in *G. gomerana*), gular scales extending anteriorly to the mental scale (in *G. gomerana* and the rest of species, the gulars only reach the third or fourth submaxillary scales), and absence of interprefrontal scale. No details on coloration of *G. goliath* are available from the two mummified individuals found in Tenerife.

Description in life.—**Pholidosis and teeth:** (based on all six individuals). Details of the lizards are presented in Table 1 and Figs. 2 and 3. Rostral barely visible from above, wider than high, in contact with supranasals and first supralabial; internasal roughly rhomboidal, wider than long; presence of one interprefrontal scale in all individuals (linearly depressed in center); prefrontals two, elongated, irregular in shape but symmetrical between them; frontal roughly hexagonal; frontoparietals two, symmetrical; interparietal irregularly elongated; occipital large, triangular; parietals two, separated by the occipital and interparietal; supraoculars four, the central scales larger than those anterior and posterior; 4–6 supraciliares; supraciliary granules 6–9. Nostril elliptical, surrounded by rostral, postnasal, supranasal and first supralabial scales; five supralabials anterior to subocular; loreals two, the second clearly the largest; 1–3 frenoculars; subocular wider dorsally than ventrally and can be divided both transversally and longitudinally; 22–27 temporal scales irregular in shape; masseteric not divided and well differentiated; supratemporals large, 3–4 on each side and often having the last divided; tympanic scale small, elongated and not divided; mental broad convex anteriorly; infralabials 6–8; submaxillaries seven; there is one line composed by 2–4 scales located between the infralabials and submaxillaries; gulars 24–29, counted between the collar and the third or fourth pair of submaxillaries; gular fold absent or slightly present in adults and clearly present in the juvenile; collar with 9–11 scales, slightly serrated; symmetrical tricuspid teeth with central cusp clearly larger than laterals in the central part of the maxila and jaw.

Dorsal scales small, triangular and slightly keeled on the central part, granular on neck; 76–83 dorsal scales across the midbody; ventrals imbricate anteriorly, flat, trapezoidal in middle and rectangular at sides; 16–18 longitudinal rows and 32–35 transverse series from collar to perianal border; perianal scales 5–7; tail with 94 and 118 whorls of scales in the two adult individuals that do not have a regenerated tail. Forelimbs and hind limbs with irregular smooth scales; femoral pores 28–31; digital scales granular to tuberculate; subdigital lamellae under fourth toe 28–33.

Color Pattern; Adults: Dorsal ground color homogeneous blackish-brown in males and dark brown in females; overlain with one longitudinal line of 15 black ocelli on each side of the vertebral region, frequently covering 16–18 scales, and one row of transverse lines (9–10) of cream color located at each side of the vertebral region in females; nuchal region often paler than the dorsum; lateral ground color brown, paler than the dorsum tone, overlain with two longitudinal lines of small blue ocelli (7–9 in the dorsal line and 4–6 in the ventral one), each often covering

about nine scales; dorsal surface of head dark brown and temporal region brown; gular region ivory white that reaches the submaxillaries, most of posterior infralabials and often the sixth and seventh supralabials; this color covers the lateral sides of the neck especially in males; ventral surface also ivory white, including body, limbs and tail; dorsal forelimbs and hind limbs black in males and brown in females, palm, toes and fingers black; pupil black, iris yellowish orange. **Juvenile:** (based on the only individual). A general aspect is presented in Fig. 3. Dorsal ground color brownish gray; overlain with one longitudinal line on each side of vertebral region, composed by about 18 black ocelli in each, and one row of transverse cream lines (11 on each) on each side of vertebral region; nuchal region as dorsum; lateral ground color paler than dorsum; overlain on the flanks with five longitudinal lines of ocelli that show different tones of blue: the upper line, the third and the fourth are composed by nine, seven and four sky blue ocelli respectively, while the second and the lowest lines show eight and four blue ocelli respectively, the fourth line forms a narrow sky blue stripe; dorsal part of the head brownish green and temporal region brown, second loreal, frenocular, subocular and sixth and seventh supralabials brownish blue, second, third and fourth supralabials and infralabials brownish green, submaxillaries of roseate tones; gular region and ventral surface of body, limbs and tail cream with some green tones; dorsal forelimbs brownish green reticulate pattern as the hind limbs but with brown color, toes and fingers black with the palms cream and overlain black scales well differentiated; dorsal part of the tail as dorsum; pupil black, iris yellowish orange.

Distribution and habitat.—Fossil records show that the species had a wider distribution in the past throughout the island (Hutterer, 1985). However, all specimens were captured in the same locality, Valle Gran Rey in the western part of La Gomera. Several other localities in the vicinity of this zone were systematically searched, but unfortunately none produced additional populations of the new lizard. Furthermore, we did not find any other population in the rest of La Gomera after prospecting 70 potential localities.

The substrate of the area is composed of a great quantity of volcanic boulders fallen from a high cliff of about 600 m elevation where the lizards are also present. The new lizard is sympatric in this area with the smaller *G. caesaris*, which is much more abundant. Similar to other lowlands of the Canaries, the temperature of the area ranges around 20 C and rainfall reaches about 145 mm year. The vegetation of this area (elevation about 150 m) corresponds to the characteristic xeric shrub of the Canary Islands, which is made up of an ensemble of sparse xerophytic phanerogams. The most abundant plants at the base of the cliff are *Plocama pendula* (Rubiaceae) and *Hyparrhenia hirta* (Poaceae); also common are *Cenchrus ciliaris* and *Tricholaena teneriffae* (Poaceae), *Lavandula canariensis* (Labiatae), *Argyranthemum frutescens*, *Schizogyne sericea*, and *Launaea arborescens* (Compositae), *Lycium intricatum* and *Nicotiana glauca* (Solanaceae). The vegetation of the cliffs is quite similar, but other plants include *Juncus acutus* (Juncaceae), *Veronica anagallis-aquatica* (Scrophulariaceae), and cf. *Phragmites australis* (Poaceae).

Threats and conservation.—*Gallotia gomerana* occurs only within a very restricted area (<1 ha). At this site, we managed to catch only six lizards after 4 mo of intensive trapping. All of them are maintained alive in captivity for imperative conservation reasons; one of the main threats in the area are introduced mammals (cats, rats, and goats). Furthermore, there is an urban nucleus (Valle Gran Rey) that is located at about 350 m from this site in which area are a large number of cats. After 2 mo of trapping at the reduced lizard area, we removed eight cats. It has been reported that cats consume a high number of lizards belonging to other related species (*G. simonyi*, *G. intermedia*, *G. galloti*, and *G. caesaris*) in open and xeric habitats of the Canaries (García-Márquez et al., 1999; Hernández et al., 2000; Medina and

Nogales, 1993; Nogales et al., 1988; Nogales and Medina, 1996; Rodríguez-Domínguez et al., 1998*b*). Another threat consists in the continuous change of the habitat due to the high instability of the material that composes the cliff, being frequent sediment landslides that fall violently, altering the vegetation and the substrate structure.

Its very reduced population, small geographic range, and threats to its existence qualify *G. gomerana* as the most endangered vertebrate of the Canaries and Europe, and one of the most threatened in all the world. Therefore, it is urgent to start an integral recovery plan that includes breeding in captivity at Valle Gran Rey (Valido et al., 2000). The other two giant species of the western islands, *G. simonyi* and *G. intermedia*, are also threatened, but in both cases the populations are much larger.

Discussion

From an evolutionary perspective, morphological and molecular data indicate that the genus *Gallotia* constitutes a monophyletic group (Arnold, 1989; González et al., 1996; Mayer and Bischoff, 1991). Adaptive radiation of this genus has involved an eastern–western colonization through the Canaries from the mainland (González et al., 1996; Thorpe et al., 1994). The discovery of this new lizard in La Gomera helps to clarify the evolution and distribution of the genus *Gallotia* in the westernmost islands of the Canarian Archipelago. Data from mtDNA studies provide clear evidence that western species, *G. intermedia*, *G. simonyi*, *G. galloti*, and *G. caesaris*, are part of the same clade (Rando et al., 1997). Nucleotide sequence data from the mitochondrial 12S rRNA and cytochrome *b* genes confirm that the new lizard is closely related to *G. simonyi* and *G. intermedia* (M. Hernández, N. Maca-Meyer, J. C. Rando, A. Valido, and M. Nogales, unpublished data).

The current relict distribution of the "*simonyi* group" species could be explained by a number of different factors. Bones of large lizards have also been found in archaeological sites of all islands where nowadays species of this group are present: Tenerife (Acosta and Pellicer, 1976), La Gomera (Hutterer, 1985), and El Hierro (Jiménez-Gómez, 1993), and even in La Palma (J. C. Rando, personal observation) where it is considered extinct. These data indicate that these large lizards were more widely distributed, and exploited by humans in the past on each island. However, the main reason for the critical situation of these species is the introduction of predators to the islands after the arrival of humans, around 2500 yr ago (Navarro et al., 1990). The large lizards of the western islands ("*simonyi* group") could have suffered greater predation (mainly by feral cats) than the smaller ("*galloti-caesaris* group"), and consequently declined more rapidly (Machado, 1985). Therefore the number of reproductive giant lizards decreased while the smaller species of the "*galloti-caesaris* group" became more abundant, replacing the giant ones (Bischoff, 1998*b*). This decrease of the "*simonyi* group" populations was also facilitated by the delay in reaching sexual maturity (5–8 yr versus 2 yr in the "*galloti-caesaris* group" species) (Barahona et al., 2000). In this respect, it is worthwhile noting the case of Gran Canaria, where a giant species (*G. stehlini*) is very abundant. This species has better tolerated the human impact than has *G. simonyi*, showing a lower vulnerability, probably as the result of different factors as sexual maturity, behavior, and competition. *Gallotia stehlini* reaches sexual maturity sooner (3 yr versus 5–8 yr in *G. simonyi*) (Romero-Belviá et al., 1999), *G. stehlini* shows a more aggressive behavior which could have facilitated defense against predators, and the species of the "*simonyi* group" have suffered higher competition during the immature stage against the smaller species of the "*galloti-caesaris* group" (Barahona et al., 2000), which are absent from Gran Canaria. In addition, the historical introduction of large herbivores (primarily goats and sheep) has depleted the vegetation from the habitats of these vegetarian lizards. For these reasons, currently the "*simonyi* group" lizards have only been able to survive in very steep, isolated, and in-

accessible places where the effect of these introduced mammals (both herbivores and predators) have been cushioned.

Finally, La Palma Island, despite the fact that some giant lizard subfossil bones have been found (Bravo, 1953; García-Talavera et al., 1989; F. Covantes and J. C. Rando, personal communication), is currently the only western Canary Island where living giant lizards have not been reported. As occurred with the recent discoveries of the three taxa belonging to the "*simonyi* group" in El Hierro (*G. simonyi*: summer, 1975), Tenerife (*G. intermedia*: spring, 1996), and La Gomera (*G. gomerana*: summer, 1999), we expect that a giant lizard still survives somewhere in the remote areas existing in La Palma. However, we have explored 68 potential localities without success.

Resumen

En el presente trabajo se describe la morfología externa de un nuevo lagarto gigante hallado en la isla de La Gomera (archipiélago canario), el cual había sido descrito a partir de huesos fósiles. Su talla (LHC: 135–190 mm) es comparable con la de los otros dos lagartos gigantes del género (*G. simonyi* y *G. stehlini*). Difiere en general de las otras especies de *Gallotia* en el bajo número de escamas de las regiones temporal (21–27), presencia de una escama alargada interprefrontal (deprimida linealmente en el centro) muy poco frecuente en la mayoría de las otras especies (reducida cuando existe), además de presentar dos líneas de pequeños ocelos azules en los flancos del cuerpo, un dorso marrón-negruzco y partes ventrales de color blanco marfil. De acuerdo con los datos presentados por Hutterer (1985), basados en la morfología de los dientes y la talla del animal, este lagarto parece corresponder con una de las dos subespecies extintas descritas por este autor (*G. simonyi gomerana*). Después de estudiar la morfología externa del nuevo lagarto, y teniendo en cuenta las claras diferencias existentes con las restantes especies, este lagarto debe ser considerado como una especie (*G. gomerana*). Datos moleculares, basados en las secuencias de ADN mitocondrial (citocromo *b* y 12S rARN), indican que *G. gomerana* está íntimamente emparentado con *G. simonyi* y *G. intermedia*. Después de prospectar 70 localidades en La Gomera solamente se pudo detectar una pequeña población de esta especie en Valle Gran Rey (extremo Oeste), la cual se encuentra muy amenazada y ocupa menos de 1 ha. El reducido tamaño de su población y el gran número de gatos asilvestrados presentes en este lugar hacen que este lagarto sea en la actualidad el vertebrado más amenazado de las islas Canarias y Europa, siendo además uno de los que presenta una situación de conservación más delicada en todo el mundo. Estos datos indican que la especie se encuentra al borde de la extinción por lo que se han de tomar medidas urgentes de conservación que incluyan un plan de cría en cautividad en Valle Gran Rey, en las inmediaciones de su hábitat natural.

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Literature Cited

Agosta, P., and M. Pellicer. 1976. Excavaciones arqueológicas en la Cueva de la Arena (Barranco Hondo, Tenerife). Anuario de Estudios Atlánticos 22:122–184.

ARNOLD, E. N. 1973. Relationships of the palearctic lizards assigned to the genera *Lacerta*, *Algyroides* and *Psammodromus* (Reptilia: Lacertidae). Bulletin of the British Museum (Natural History) Zoology 25:1–366.

———. 1989. Towards a phylogeny and biogeography of the Lacertidae: relationships within an Old-World family of lizards derived from morphology. Bulletin of the British Museum (Natural History) Zoology 55:209–257.

BARAHONA, F., S. E. EVANS, J. A. MATEO, M. GARCÍA-MÁRQUEZ, AND L. F. LÓPEZ-JURADO. 2000. Endemism, gigantism and extinction in island lizards: the genus *Gallotia* on the Canary Islands. Journal of Zoology 250:373–388.

BARBADILLO, L. J., J. I. LACOMBA, V. PÉREZ-MELLADO, V. SANCHO, AND L. F. LÓPEZ-JURADO. 1999. Anfibios y reptiles de la peninsula ibérica. Baleares y Canarias. Planeta. Barcelona, Spain.

BISCHOFF, W. 1985*a*. Die Herpetofauna der Kanarischen Inseln. V. Die Rieseneidechsen der Gattung *Gallotia*. Herpetofauna 7(38):11–21.

———. 1985*b*. Die Herpetofauna der Kanarischen Inseln. I. Allgemeine Bemerkungen über den Archipel und seine Herpetofauna. Herpetofauna 7(34):11–22.

———. 1998*a*. Handbuch der Reptilien und Amphibien Europas. 6. Die Reptilien der Kanarischen Inseln, der Selvagens-Inseln und des Madeira-Archipels. Aula-Verlag Wiesbaden, Bonn, Germany.

———. 1998*b*. Bemerkungen zu den "fossilen" Rieseneidechsen der Kanarischen Inseln. Pp. 387–407. *In* W. Bischoff (Ed.). Handbuch der Reptilien und Amphibien Europas. 6. Die Reptilien der Kanarischen Inseln, der Selvagens-Inseln und des Madeira-Archipels. Aula-Verlag Wiesbaden, Bonn, Germany.

BÖHME, W., AND W. BINGS. 1975. Zur Frage des Überlebens von *Lacerta* s. *simonyi* Steindachner (Sauria: Lacertidae). Salamandra 11:39–46.

BOULENGER, G. A. 1920. Monograph of the Lacertidae. Vol. I. Trustees of the British Museum (Natural History). London, U.K.

———. 1921. Monograph of the Lacertidae. Vol. II. London: Trustees of the British Museum (Natural History). London, U.K.

BRAVO, T. 1953. *Lacerta maxima* n. sp. de la fauna continental extinguida en el Pleistoceno de las Islas Canarias. Estudios Geológicos 9:7–34.

CANTAGREL, J. M., A. CENDRERO, J. M. FÚSTER, E. IBARROLA, AND C. JAMOND. 1984. K-Ar chronology of the volcanic eruptions in the Canarian Archipelago: Island of La Gomera. Bulletin of Volcanology 47:597–609.

CASTILLO, C., J. C. RANDO, AND J. F. ZAMORA. 1994. Discovery of mummified extinct giant lizards (*Gallotia goliath*, Lacertidae) in Tenerife, Canary Islands. Bonner zoologische Beiträge 45:129–136.

COX, C. B., AND P. D. MOORE. 1993. Biogeography. An Ecological and Evolutionary Approach. Blackwell, London, U.K.

FRISCH, K. V. 1870. Ueber die ostatlantischen Inselgruppen. Bericht der Senckenbergischen naturforschenden Gesellschaft in Frankfurt a. M. 1870: 72–113.

GARCÍA-MÁRQUEZ, M., A. CAETANO, I. BELLO, L. F. LÓPEZ-JURADO, AND J. A. MATEO. 1999. Ecología del gato cimarrón en el ecosistema termófilo de El Hierro (Islas Canarias) y su impacto sobre el Lagarto Gigante (*Gallotia simonyi*). Monografías de Herpetología 4:207–222.

GARCÍA-TALAVERA, F., R. PAREDES, AND M. MARTÍN. 1989. Catálogo-inventario yacimientos paleontológicos. Instituto de Estudios Canarios. Monografía 46. La Laguna, Tenerife, Spain.

GASC, J. P. 1971. Les variations columnaires dans la région présacrée des sauriens. Applications à la reconstitution de *Lacerta goliath* Mertens. Annales de Paléontologie 57:133–155.

GONZÁLEZ, P., F. PINTO, M. NOGALES, J. J. JIMÉNEZ-ASENSIO, M. HERNÁNDEZ, AND V. M. CABRERA. 1996. Phylogenetic relationships of the Canary Islands endemic lizard genus *Gallotia* (Sauria: Lacertidae), inferred from mitochondrial DNA sequences. Molecular Phylogenetics and Evolution 6: 63–71.

GORMAN, M. L. 1979. Island Ecology. Chapman and Hall, London, U.K.

HERNÁNDEZ, E., M. NOGALES, AND A. MARTÍN. 2000. Discovery of a new lizard in the Canary Islands, with a multivariate analysis of *Gallotia* (Reptilia: Lacertidae). Herpetologica 56:63–76.

HUTTERER, R. 1985. Neue Funde von Rieseneidechsen (Lacertidae) auf der Insel Gomera. Bonner zoologische Beiträge 36:365–394.

IZQUIERDO, I., A. L. MEDINA, AND J. J. HERNÁNDEZ. 1989. Bones of giant lacertids from a new site on El Hierro (Canary Islands). Amphibia-Reptilia 10: 63–69.

JIMÉNEZ-GÓMEZ, M. C. 1993. El Hierro y los bimbaches. Centro de la Cultura Popular Canaria. Santa Cruz de Tenerife, Spain.

LÓPEZ-JURADO, L. F. 1991. Synopsis of the Canarian herpetofauna. Revista Española de Herpetología 6: 107–118.

MACHADO, A. 1985. Hypothesis on the reasons for the decline of the large lizards in the Canary Islands. Bonner zoologische Beiträge 36:563–575.

MATEO, J. A., L. F. LÓPEZ-JURADO, AND M. GARCÍA-MÁRQUEZ. 1999. ¿Cuántas especies del género *Gallotia* había en la isla de El Hierro? Monografías de Herpetología 4:7–16.

MAYER, W., AND W. BISCHOFF. 1991. Artbildung auf Inseln: Theorie zur Evolution der Eidechsen der Gattung *Gallotia* (Reptilia: Lacertidae) anhand albumin-immunologischer Analysen und geologischer Daten zur Entstehungsgeschichte des Kanarischen Archipels. Mitteilungen aus dem Zoologischen Museum in Berlin 67:69–79.

MEDINA, F. M., AND M. NOGALES. 1993. Dieta del gato cimarrón (*Felis catus* L.) en el piso basal del macizo de Teno (Noroeste de Tenerife). Doñana Acta Vertebrata 20:193–199.

MERTENS, R. 1942. *Lacerta goliath* n. sp., eine ausgestorbene Rieseneidechse von den Kanaren. Senckenbergiana 25:330–339.

NAVARRO, J. F., E. MARTÍN, AND A. RODRÍGUEZ.

1990. Las primeras etapas del programa de excavaciones en Cuevas de San Juan y su aportación a las dicronías de la prehistoria de Canarias. Investigaciones arqueológicas en Canarias 2:189–201.

NOGALES, M., A. MARTÍN, C. DELGADO, AND K. W. EMMERSON. 1988. Food spectrum of the feral cat (*Felis catus* Linnaeus, 1758) in the juniper woodland on El Hierro (Canary Islands). Bonner zoologische Beiträge 39:1–6.

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

RANDO, J. C., E. HERNÁNDEZ, M. LÓPEZ, AND M. GONZÁLEZ. 1997. Phylogenetic relationships of the Canary Islands endemic lizard genus *Gallotia* inferred from mitochondrial DNA sequences: incorporation of a new subspecies. Molecular Phylogenetics and Evolution 8:114–116.

ROMERO-BELNIÁ, M., J. A. MATEO, AND V. PÉREZ-MELLADO. 1999. Morfometría y estructura de edades y sexos de la población natural de *Gallotia simonyi*. Monografías de Herpetología 4:43–53.

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

RODRÍGUEZ-DOMÍNGUEZ, M. A., J. J. COELLO, AND C. CASTILLO. 1998*b*. First data on the predation of *Felis catus* L., 1758 on *Gallotia simonyi machadoi* López-Jurado, 1989 in El Hierro, Canary Islands (Sauria, Lacertidae). Vieraea 26:167–170.

THORPE, R. S., D. P. M. GREGOR, A. M. CUMMING, AND W. C. JORDAN. 1994. DNA evolution and colonization sequence of island lizards in relation to geological history: mtDNA RFLP, cytochrome *b*, cytochrome oxidase, 12s rRNA sequence, and nuclear RAPD analysis. Evolution 48:230–240.

VALIDO, A., J. C. RANDO, M. NOGALES, AND A. MARTÍN. 2000. 'Fossil' lizard found alive in the Canary Islands. Oryx 34:75–76.

WHITTAKER, R. J. 1998. Island Biogeography. Oxford University Press, Oxford, U.K.

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APPENDIX I

Specimens Examined

All specimens belong to the collection of the Departamento de Biología Animal (Zoología) de la Universidad de La Laguna (DZUL) and the Museo de Ciencias Naturales de Santa Cruz de Tenerife (TFMC-VR).

Gallotia atlantica: LANZAROTE: Haría: DZUL 0844; Guatiza: DZUL 0884, 0886, 0889, 0891; Femés: DZUL 0895, 0896, 0897; Tabayesco: DZUL 0899; Jameos del Agua: DZUL 1135; FUERTEVENTURA: Tuineje: DZUL-P 0005, 0006, 0007, 0008, DZUL 0481, 0482, 0483, 0484, 0486; Pájara: DZUL 1209.

Gallotia stehlini: GRAN CANARIA: Arinaga: DZUL-P 0001, 0002, 0003, 0004, 5000, DZUL 0115, 0127, 0129, 0440, 0443, 0444, 0445, 0446, 0449; Teror: DZUL 0124, Maspalomas: DZUL 0451, 1169.

Gallotia galloti: TENERIFE: Roque de Fuera de Anaga: DZUL 0155, 0156, 0158, 0177, 0178; Roque de Garachico: DZUL 0437; La Orotava: DZUL 0505; San Andrés: DZUL 0506, 0507; La Laguna: DZUL 1591; Güímar: DZUL 0198, Acantilado de Los Gigantes: DZUL-P 0009, 0010, 0011, El Médano: 5025; LA PALMA: Breña Alta: DZUL 0497, Los Sauces: DZUL 0516, 1412; Los Llanos: DZUL 1415, Fuencaliente: DZUL 1422.

Gallotia caesaris: LA GOMERA: Barranco de Avalo: DZUL 0818, San Sebastián: DZUL 0820, Hermigua: DZUL 1118, 1119, Vallehermoso: DZUL-P 5019, Valle Gran Rey: DZUL-P 5020, 5021, 5022, 5023, 5024. EL HIERRO: Las Puntas: DZUL 0110, 1206, 1207, 1208, DZUL-P 0017, 0018, Fuga de Gorreta: DZUL 0491, El Pinar: DZUL 0748, 0751, El Julan: DZUL 0756.

Gallotia goliath: TENERIFE: Barranco de Las Moraditas: TFMC-VR 0113, 0114.

Gallotia simonyi: EL HIERRO: Fuga de Gorreta: DZUL-P 0025, 0027, 0028, 0029, 0030, 0031, 0032, 0033, 0034, 0035, 0036, 0037, 0038, 0039, 5031.

Gallotia intermedia: TENERIFE: All 21 living individuals correspond with those included in Hernández et al. (2000).