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DISCOVERY OF A NEW LIZARD IN THE CANARY ISLANDS, WITH A MULTIVARIATE ANALYSIS OF *GALLOTIA* (REPTILIA: LACERTIDAE)

EFRAÍN HERNÁNDEZ, MANUEL NOGALES, AND AURELIO MARTÍN

Departamento de Biología Animal (Zoología),Universidad de la Laguna, 38206, Tenerife, Canary Islands, Spain

ABSTRACT: We describe a new species of *Gallotia* from Tenerife (Canary Islands). This lizard is intermediate in size between the two smaller (*G. atlantica* and *G. galloti*) and the two larger (*G. simonyi* and *G. stehlini*) species. Furthermore, it differs from the two similar larger *Gallotia* in the number of supratemporal scales (mode 4 instead of mode 2), usually 16 longitudinal ventral scale rows, and having distinctive dorsal yellow spots, and small lateral yellow or blue spots. Individuals from a small population located in La Hábiga show a pale gray reticulation on dorsum and absence of ocelli in the lateral region. Univariate and multivariate analyses of nine meristic variables of each extant species within the genus *Gallotia* revealed significant variation. Principal component analyses support the existence of three main morphological clusters within the genus, the new lizard being nearest to *G. simonyi* and *G. stehlini*. Molecular data from mtDNA sequences (cytochrome *b* and 12S ribosomal RNA) indicate that *G. intermedia* is closely related to *G. simonyi*.

Key words: Reptilia; Lacertidae; *Gallotia*; Tenerife; Canary Islands; Morphometrics; Multivariate analysis

LIZARDS of the genus *Gallotia*, endemic to the Canary Islands, represent an oceanic island radiation of six species (Arnold, 1989) with 10–13 subspecies (Bischoff, 1985; López-Jurado, 1991). Four of the six species are extant (Fig. 1): *G. atlantica* on the eastern islands of Fuerteventura and Lanzarote, in addition to a small apparently introduced population on Gran Canaria (Arinaga; Barquín and Martín, 1982); *G. galloti* on the western islands of Tenerife, La Gomera, El Hierro, and La Palma; *G. simonyi* on El Hierro (Fuga de Gorreta); and *G. stehlini* on Gran Canaria and on a restricted area of Fuerteventura (Barranco de La Torre) where it has been introduced (González et al., 1996; Naranjo et al., 1991). Fossils from the extinct *G. goliath* (Mertens, 1942) and *G. maxima* (Bravo, 1953), considered by some authors to be a synonym of *G. goliath* (Gasc, 1971; Izquierdo et al., 1989; López-Jurado, 1991), are known from the western islands of Tenerife, La Gomera, La Palma, and El Hierro (García-Talavera et al., 1989).

On Tenerife, *Gallotia* is represented by the relatively small *G. galloti* and the large extinct *G. goliath*. In addition, several subfossil bones from Tenerife were assigned to *G. simonyi* (Acosta and Pellicer, 1976; Bravo, 1953; Hutterer, 1985), a relatively large species currently extant only on El Hierro. No large, extant species of *Gallotia* were known from Tenerife until June 1995, when one of us (E. Hernández) found a number of large lizard fecal pellets from a precipitous region of the island. Because the pellets are much larger than those of *G. galloti*, it suggested the presence of either *G. simonyi* or a surviving population of *G. goliath*. Subsequent trapping produced several living specimens not assignable to either of these forms, or to any other species of *Gallotia*. We describe this recently discovered lizard as a new species.

Although variation of scalation, size, shape, and coloration has been analyzed within some *Gallotia* (Thorpe and Báez, 1987, 1993; Thorpe and Brown, 1989*a,b*, 1991; Thorpe et al., 1985), no analysis has yet been carried out among all recognized species and subspecies. In this study, univariate and multivariate statistics are used to analyze meristic variables among the new species and the four other extant species to determine their taxonomic utility.

MATERIALS AND METHODS

We captured a total of 21 individuals (15 adults and six juveniles) of the new lizard

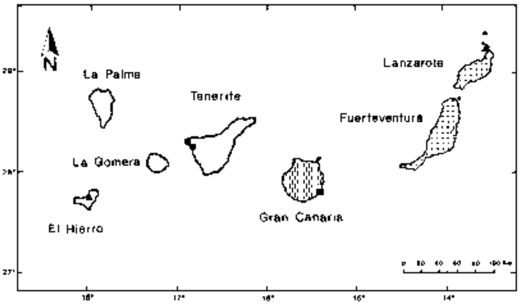

FIG. 1.—Map of the Canary Islands showing the distribution of living species of *Gallotia*. Thick cross shadows and black squares: *Gallotia atlantica*; Vertical cut line shadows and open circle: *G. stehlini*; Gray shadow: *G. galloti*; Black triangle: *G. simonyi*; Black circle: *G. intermedia*. Data taken from Machado et al. (1985) and partially modified.

using live traps, of which 17 were then released. We examined preserved specimens from the 10 currently recognized subspecies of *Gallotia* (Appendix I). In most cases, we analyzed 15 specimens for each subspecies, except for *G. galloti insulanagae* (n = 11), *G. stehlini stehlini* (n = 17), and the new species (n = 21). A total of 169 specimens were included in a principal component analysis (PCA), while ANOVA's and MANOVA analyses used the same sample sizes, except for *G. atlantica* and *G. galloti*. From the latter two species, we randomly selected a total of 20 specimens from each that represented all the different subspecies considered in the PCA. This reduction in the sample size was made in order to maintain balanced models for the different taxa as recommended by Manly (1994).

Nine meristic characters (see Arnold, 1973, for details) and four measurements were taken from each specimen (Table 1). The meristic characters were number of: temporals (TR); supratemporals (ST); gulars (GL), rows of scales counted from the anterior edge of the collar to the submaxillary symphysis; middle dorsals (MD); femoral pores (FP); longitudinal ventrals (LV), counted in the last third of the body; perianals (PA); subdigital lamellae on the fourth toe (SL); and collar (CL). This ensemble of meristic variables has been traditionally used in the taxonomy of the family Lacertidae (Arnold, 1973; Bischoff, 1985). The following measurements were taken for all specimens using a dial caliper: snout–vent length (SVL); head length (HL), distance between the tip of the snout and the posterior border of the pa-

TABLE 1.—Meristic and morphometric variation in *Gallotia intermedia*. See Materials and Methods for abbreviations. Measurements are given in millimeters.

	Measurements				Meristic variables								
Sex	TL	SVL	HL	HW	TR	ST	CL	GL	LV	MD	PA	FP	SL
Male	432	149	35.5	27.8	90	5	11	33	17	86	6	26	33
Male	—	145	34.9	27.0	78	3	11	30	16	84	8	25	33
Male	427	150	—	—	71	4	11	37	16	74	6	25	38
Male	455	147	36.1	30.0	59	3	8	31	16	80	6	24	33
Male	432	146	39.5	27.0	63	4	10	31	16	82	6	26	33
Male	400	148	38.6	25.3	38	3	11	31	16	73	5	25	32
Female	401	137	30.3	21.7	70	4	10	30	16	85	6	20	33
Female	380	146	30.5	23.9	63	3	11	35	16	82	6	25	35
Female	446	150	32.7	24.0	40	4	12	29	15	75	6	24	33
Female	—	122	28.2	20.0	40	3	12	32	18	76	6	26	33
Female	412	140	31.7	21.6	43	4	11	31	16	79	6	25	37
Female	421	148	32.5	24.2	51	4	10	30	18	84	6	26	32
Female	385	143	31.9	20.0	58	4	11	31	16	80	5	25	36
Female	412	121	29.0	19.8	47	4	9	30	16	82	5	26	35
Female	380	122	31.3	23.9	57	3	13	29	16	—	6	27	—
Juv.	350	96	22.4	15.9	60	4	10	32	16	82	6	25	32
Juv.	291	110	24.2	17.0	50	4	11	32	16	80	5	25	33
Juv.	372	112	25.0	17.1	47	3	10	30	16	78	6	25	32
Juv.	292	100	23.0	16.1	42	3	10	32	17	85	7	23	34
Juv.	381	112	25.0	16.9	59	4	9	32	14	80	5	23	34
Juv.	295	92	22.0	12.7	59	3	11	29	16	72	5	26	37

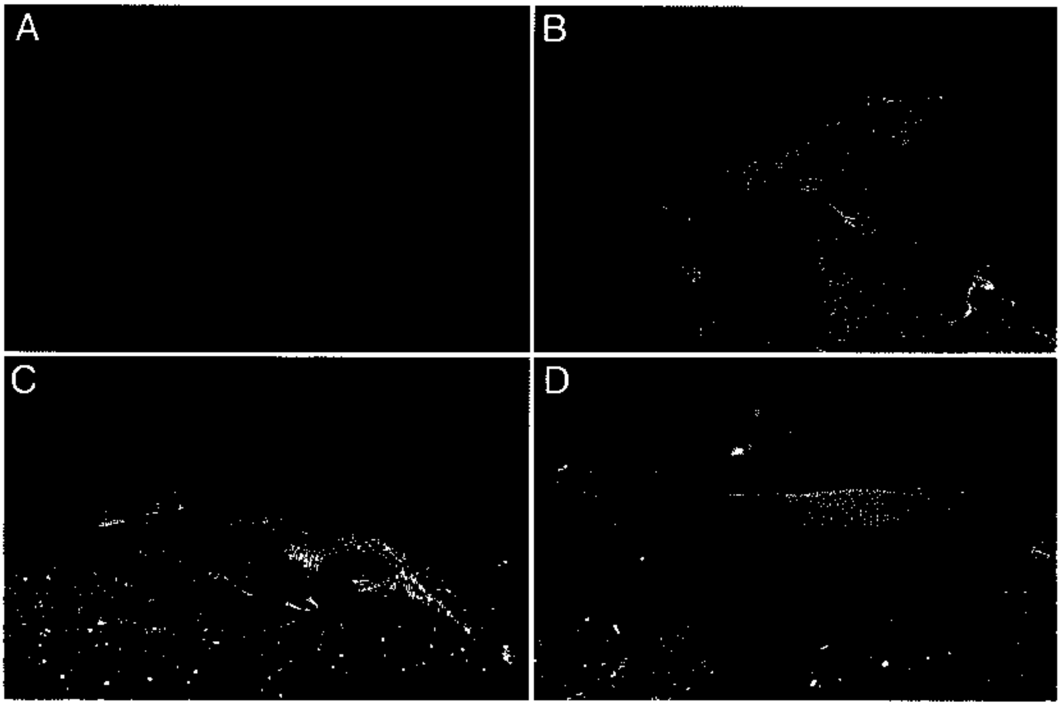

FIG. 2. *Gallotia intermedia* (Top left) Holotype, adult male (DZUL 2450), (top right) adult female, (bottom left) adult male, and (bottom right) adult female.

rietal scales; head width (HW), measured from the external edge of one parietal scale to mib of the other; and total length (TL) which is the sum of the SVL and the tail length.

We performed a principal component analysis (PCA), using varimax rotation, in order to identify the contributions of the nine meristic characters to discrimination of the various species and subspecies. Data were log-transformed in order to meet better the assumptions of normality. The PCA included specimens from the 10 currently recognized subspecies of *Gallotia* and was used to help to define the groups used in the ANOVA's and MANOVA. Furthermore, we also consider to define these groups of allopatric populations of previously recognized species. One way ANOVA's (Scheffé test) and MANOVA were performed to test the statistical significance of differences in means between species for the nine meristic variables. All significance levels were less than $P < 0.001$. Analyses were performed using the SPSS statistical package (version 7.5; 1997).

Gallotia ***intermedia*** sp. nov.

Common name.—English: Canarian spotted lizard. Spanish: Lagarto canario moteado.

Holotype.—Departamento de Zoología, Universidad de La Laguna (DZUL) 2450, an adult male (Fig. 2) captured at Risco de La Jaqueta in the Acantilado de Los Gigantes, elevation 25 m, (westernmost part of Tenerife) (28° 15′ N, 16° 50′ W) on 1 May 1996 by E. Hernández and M. Siverio. It is kept in captivity at the G.I.E.B. (Grupo de Investigaciones Etológicas Binjawack; La Laguna) under the custody of the Viceconsejería de Medio Ambiente del Gobierno de Canarias. After its death, it will be deposited in the collection of the Departamento de Biología Animal (Zoología), Universidad de La Laguna.

Paratypes.—Two females and one male. DZUL 2451, an adult female with the

TABLE 2.—Comparison of the major diagnostic features of the different species of *Gallotia* in the Canary Islands. Coloration features are based on males. Maximum SVL from *G. simonyi* was taken from Rodríguez-Domínguez et al. (1998).

Feature		*G. atlantica*	*G. stehlini*	*G. galloti*	*G. simonyi*	*G. intermedia*	*G. goliath*
Maximum	Males	95	250	145	226	150	—
SVL (mm)	Females	61	119	107	204	150	—
Dorsum		brown	brown	uniformly blackish-brown background or with the presence of transverse discontinuous yellow bars	blackish-brown	blackish-brown background with a dense network of small yellow dots, or pale gray reticulation in the individuals from La Hábiga population	—
Dorsolateral region		brown background with ocelli absent or presence of green or blue spots	brown background with ocelli absent	blackish-brown background with ocelli absent or presence of blue spots	blackish-brown background with ocelli present: large lateral yellow spots	blackish-brown background with ocelli present: irregular blotches gray and brown; ocelli absent in the individuals from La Hábiga population	—
Fore- and hind-limb region		ocelli absent or presence of a row of green ocelli	ocelli absent	ocelli absent or presence of a row of yellow ocelli	ocelli absent or presence of a row of small yellow ocelli in the ventrolateral region	ocelli present; two rows of small ocelli, the lower yellow and the upper blue; ocelli absent in the individuals from La Hábiga population	—
Gular region		black	pale orange	gray	gray	gray	—
Longitudinal ventral scales		8–10 (mode = 8)	16–21 (mode = 18)	10–14 (mode = 12)	16–19 (mode = 17)	14–18 (mode = 16)	—
Supratemporals		2–6 (mode = 4)	2–3 (mode = 2)	4–6 (mode = 5)	2–3 (mode = 2)	3–5 (mode = 4)	2
Gular scales		22–28 (mode = 20)	37–52 (mode = 45)	38–57 (mode = 41)	29–35 (mode = 29)	29–37 (mode = 32)	—
Dorsals		42–54 (mode = 44)	77–103 (mode = 86)	84–116 (mode = 90)	72–99 (mode = 92)	72–86 (mode = 82)	—

TABLE 2.—Continued.

Feature	G. atlantica	G. stehlini	G. galloti	G. simonyi	G. intermedia	G. goliath
Nostril in contact with the rostral plate	yes	no	yes	yes	yes	yes
Masseteric scale	absent	present	present	present	present	present
Size of the tympanic scale	large	small	large	large	large	large
Posterior margin of the collar scales	serrated	non or slightly serrated	non serrated	non or slightly serrated	non or slightly serrated	—
n	20	17	20	15	21	2

same collection and locality data as the holotype. Zoologisches Forschungsinstitut und Museum Alexander Koenig (Bonn) (ZFMK) 62798, an adult female, and Museo Insular de Santa Cruz de Tenerife (TFMC V-R) 110, an adult male, both collected in La Hábiga (Acantilado de Los Gigantes, elevation 30 m) (28° 19′ N, 16° 53′ W) on 15 June 1996. These paratypes are maintained alive together with the holotype and will be included, after their death, in the collections previously mentioned. In addition, 17 specimens (some photographs of them can be seen in Fig. 2), captured on the Acantilado de Los Gigantes between 1 May and 10 July 1996, were examined and released for conservation reasons.

Diagnosis.—[Coloration based on adult living males.] *Gallotia simonyi* differs from *G. intermedia* in its uniform blackish-brown dorsal coloration, presence of large lateral yellow spots, absence of ocelli between the limbs or presence of a row of small yellow ocelli in the ventrolateral region, and by its larger size (Table 2); *Gallotia intermedia* has a dorsum with a dense network of small yellow dots or pale gray reticulation (from the individuals of La Hábiga population), presence of irregular gray and brown blotches in the dorsolateral region, ocelli absent (from La Hábiga) or presence of two rows of small ocelli (lower yellow and the upper blue) in the region between the fore and hind limbs, and smaller body size. *Gallotia stehlini* differs from *G. intermedia* in its uniform brown dorsal coloration, pale orange gular region, nostril not in contact with the rostral plate, reduced tympanic scale, and by its larger body size; *Gallotia intermedia* has a gray gular region, nostril in contact with the rostral scale, large tympanic scale, and smaller body size. *Gallotia galloti,* with which *G. intermedia* is sympatric, differs in its uniform blackish-brown dorsal coloration and often having discontinuous transverse yellow bars. *Gallotia atlantica* differs from *G. intermedia* in its brown dorsum and characteristic black gular region, with ocelli absent or presence of green or blue spots on the scales of the lateral body, lower numbers of longitudinal

TABLE 3.—Data for the scale variables for the species of *Gallotia*.

Scale characters	Statistical parameters	Species				
		C. atlantica	*G. stehlini*	*G. galloti*	*G. simonyi*	*G. intermedia*
Temporals	$\bar{x}$	42.10	77.12	99.95	42.66	57.85
	SD	8.99	12.61	15.00	8.35	13.22
	Min.	27	60	70	32	38
	Max.	65	97	128	58	90
Supratemp.	$\bar{x}$	4.00	2.18	5.30	2.26	3.61
	SD	0.85	0.40	0.65	0.45	0.58
	Min.	2	2	4	2	3
	Max.	6	3	6	3	5
Collar	$\bar{x}$	6.25	12.65	10.40	11.20	10.57
	SD	0.71	1.58	1.31	1.08	1.12
	Min.	5	10	9	10	8
	Max.	7	17	13	14	13
Gulars	$\bar{x}$	25.35	43.76	46.10	31.40	31.28
	SD	2.03	4.56	5.52	2.29	1.95
	Min.	22	37	38	29	29
	Max.	28	52	57	35	37
Middle dorsals	$\bar{x}$	46.00	88.53	95.65	91.53	79.95
	SD	2.84	8.27	9.16	6.67	4.05
	Min.	42	77	84	72	72
	Max.	54	103	116	99	86
Longitudinal ventrals	$\bar{x}$	8.50	18.29	11.75	17.53	16.14
	SD	0.82	1.49	1.06	0.83	0.85
	Min.	8	16	10	16	14
	Max.	10	21	14	19	18
Perianals	$\bar{x}$	7.00	6.24	5.40	5.26	5.85
	SD	0.72	1.23	1.14	0.45	0.72
	Min.	6	4	4	5	5
	Max.	8	9	7	6	8
Femoral pores	$\bar{x}$	19.00	26.68	27.95	24.66	24.85
	SD	1.58	1.92	2.18	1.63	1.49
	Min.	15	25	24	22	20
	Max.	21	32	32	27	27
Subdigital lamellae	$\bar{x}$	29.05	32.82	34.40	31.46	33.85
	SD	2.11	2.59	2.32	1.68	1.79
	Min.	24	27	30	28	32
	Max.	34	38	40	34	38
	n	20	17	20	15	21

ventral, gular and dorsal scales, absence of the masseteric scale, and smaller size; *Gallotia intermedia* has a gray gular region, presence of irregular gray and brown blotches in the flanks (or absence of ocelli as in the La Hábiga population), higher number of longitudinal ventrals, gulars and dorsal scales, presence of the masseteric scale, and a larger body size. The extinct *G. goliath*, which is known only from skeletal and mummified material, can be distinguished from *G. intermedia* by its larger body size [maximum SVL 546 mm (Castillo et al., 1994) versus 150 mm in *G. intermedia*], 21–25 temporals (38–90 in *G. intermedia*), a lesser number of supratemporals (only two in *G. goliath* and 3–5 in *G. intermedia*), and gular scales extending anteriorly to the mental scale (in the other species, the gulars only reach the third submaxillary scales). No details on coloration of *G. goliath* are available from the two mummified individuals found. Further comparisons of scalation characters among extant *Gallotia* are provided in Tables 3 and 4.

TABLE 4.—Univariate statistical comparison of nine scale characters among the species of *Gallotia*. See Materials and Methods for variable abbreviations. *F* statistic correspond with one way ANOVA test and χ^2 statistic with Kruskal-Wallis test. Nomenclature of species is as follows: *Gallotia atlantica* (AT), *G. stehlini* (ST), *G. galloti* (GA), *G. simonyi* (SI), and *G. intermedia* (IN).

Meristic scales variables	*G. atlantica*	*G. stehlini*	*G. galloti*	*G. simonyi*	*G. intermedia*	ANOVA test *F*	χ^2	*P*	Differences among species
TR	42.10	77.11	99.95	42.66	57.85	74.88	—	<0.001	AT vs. ST, GA, IN SI vs. ST, GA, IN IN vs. ST, GA ST vs. GA
ST	4.00	2.17	5.30	2.26	3.61	77.72	—	<0.001	ST vs. AT, GA, IN SI vs. AT, GA, IN GA vs. AT, IN
CL	6.25	12.64	10.40	11.20	10.57	77.79	—	<0.001	AT vs. ST, GA, SI, IN ST vs. GA, SI, IN
GL	22.35	43.76	46.10	31.40	31.28	—	80.30	<0.001	AT vs. ST, GA, SI, IN IN vs. ST, GA SI vs. ST, GA
MD	46.00	88.52	95.65	91.53	79.95	—	68.13	<0.001	AT vs. ST, GA, SI, IN IN vs. ST, GA, SI ST vs. GA
LV	8.50	18.29	11.75	17.53	16.14	309.06	—	<0.001	AT vs. ST, GA, SI, IN GA vs. ST, SI, IN IN vs. ST, SI
PA	7.00	6.23	5.40	5.26	5.85	—	32.88	<0.001	AT vs. GA, SI, IN
FP	19.00	26.76	27.95	24.66	24.85	73.83	—	<0.001	AT vs. ST, GA, SI, IN SI vs. ST, GA IN vs. ST, GA
SL	29.05	32.82	34.40	31.46	33.85	20.35	—	<0.001	AT vs. ST, GA, SI, IN SI vs. GA, IN
n	20	17	20	15	21				

Description of holotype.—(Figs. 2, 3) Rostral barely visible from above, wider than high, in contact with supranasals and first supralabials; internasal roughly rhomboidal, longer than wide; prefrontals two, symmetrical; frontal pentagonal, as wide as long; frontoparietals two, longer than wide, symmetrical, with rounded posterior border; interparietal pentagonal, longer than wide; occipital large, trapeziform; parietals two, longer than wide, separated by the occipital and interparietal; supraoculars four, the central scale larger than those anterior or posterior; six supraciliaries; supraciliary granules seven on left, eight on right. Nostril elliptical, surrounded by rostral, postnasal, supranasal and first supralabial scales; five supralabials anterior to subocular; loreals two, the second the largest; one frenocular over the fourth and fifth supralabials; subocular wide dorsally, narrow ventrally; temporal scales rounded, 85 on left and 90 on right; masseteric divided into two large, well differentiated scales; supratemporals small, four on left, five on right; tympanic small, elongate and divided; mental broad, convex anteriorly; infralabials six; submaxillaries six; gulars 33, counted between the collar and the third pair of submaxillaries; gular fold absent; collar with 11 scales, slightly serrated; head length to back of parietal scales: 35.5 mm, width: 27.8 mm; tricuspid teeth with central cusp well developed.

Dorsal scales small, triangular and keeled on flanks, granular on neck and vertebral region; 86 dorsal scales across the midbody; ventrals imbricate, flat, trapeziform or triangular in middle, and rectangular at sides; 17 longitudinal rows and 34 transverse series from collar to perianal border; perianal scales six; tail with 115 whorls of scales, not regenerated; caudal scales rectangular and imbricate; large and vertically grooved; total length: 432 mm; SVL: 149 mm; tail: 283 mm (measurements taken when captured).

Forelimbs with large smooth scales, tri-

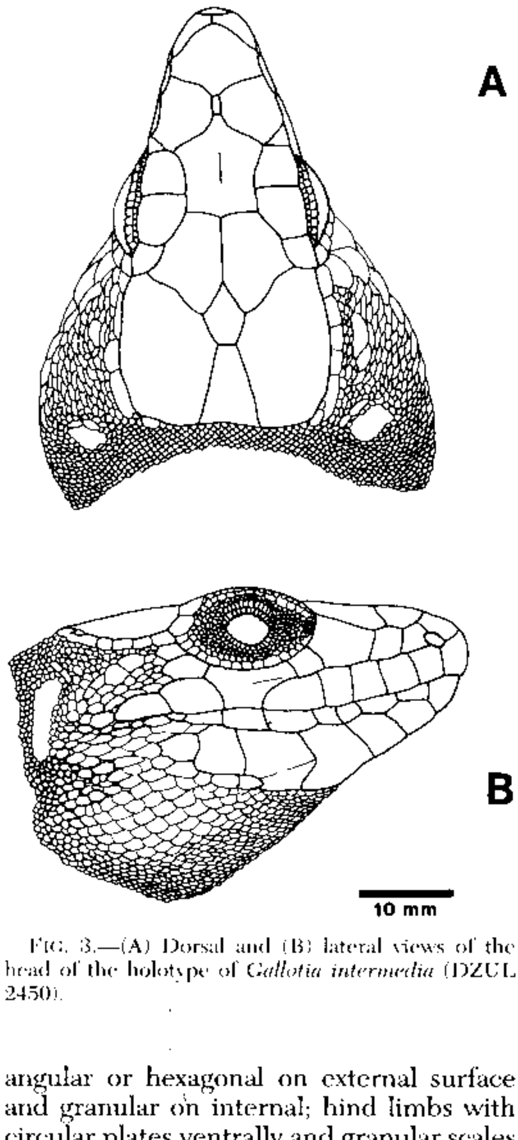

FIG. 3.—(A) Dorsal and (B) lateral views of the head of the holotype of *Gallotia intermedia* (DZUL 2450).

angular or hexagonal on external surface and granular on internal; hind limbs with circular plates ventrally and granular scales elsewhere. Femoral pores 26 per each hind limb. Digital scales granular to tuberculate. Subdigital lamellae under fourth toe 33.

In life, dorsal ground color brown, almost black on vertebral region; overlain with some yellowish-gray ocelli, and a dense network of yellow spots, frequently limited to individual scales; nuchal region with conspicuous pale green–yellow spots with a black border; lateral body with nine small pale yellow ocelli between fore and hind limb, above a narrow, irregular dark bar; a dorsolateral row of small blue spots above the yellow ones, each covering one to four scales; dorsal part of the head and temporal region black with a few yellow dots; tail uniform gray–brown with some irregular black blotches; forelimbs blackish brown, with scattered yellow spots on dorsal surface; hind limbs dark gray with a brown reticulate pattern; venter yellowish gray; gular region pale gray bordered laterally by two dark gray stripes on each side that converge forwards to meet on the third pair of submaxillaries; toes of hind limb brownish gray; black on forelimb; pupil black, iris orange.

Variation.—Adult males are similar in coloration to the holotype; sometimes with irregular gray and brown blotches on the flanks. Adult females same as males, but with dorsolateral line of seven large blue ocelli; ocelli absent on males or very reduced in size. Juveniles differ from adults in having dorsal ground color brownish-gray with more distinct pale yellow spots; lateral blue ocelli are also present. The dorsal surface of the head is pale brown or gray with a slight orange tinge, especially on the most anterior plates, and the supralabials, infralabials, submaxillaries, and loreals are blotched with yellow.

Color variation has been observed in a small population on the cliff of La Hábiga, located at the westernmost part of the known distribution of *G. intermedia*. Here both sexes are brown-gray with little or no yellow on the dorsum or forelimbs, and no lateral yellow or blue spots.

Variation is present in the number of supratemporals, longitudinal rows of ventrals, and the plates in the collar (meristic and morphometric data are presented in Table 1). The greatest variation occurs in the number of temporals (range: 38–90; Table 3). Males have a greater SVL than females ($\bar{x}$ = 147.5 mm, SE = 0.762, n = 6; and $\bar{x}$ = 136.5 mm, SE = 3.943, n = 9 respectively; Mann-Whitney test, Z = 1.95, $P < 0.05$) as in all members of *Gallotia*. Sexual dimorphism is present in the head length (mean of 36.9 mm, SE = 1.545, n = 5 in males; mean of 30.9 mm, SE = 2.012, n = 9 in females) (Z = 3.00, $P < 0.01$). This section is based on individuals from the type series and other released ones.

Etymology.—The specific epithet refers to the intermediate size, meristic characters, and color of this species between *G. galloti* and *G. simonyi.*

Habitat and distribution.—*Gallotia intermedia* occurs in a few relatively inaccessible places in the Acantilado de Los Gigantes in the extreme western portion of Tenerife. This region is associated with the oldest volcanic series of the island, dated at 7.3 million years (Ancochea et al., 1990). The species is confined to small inclined ledges, on steep cliffs. The new lizard is sympatric in this area with the smaller *G. galloti*, which is more abundant.

Owing to the xeric condition of the habitat, the soil structure, and frequent landslides, the vegetation is very scarce and plant diversity low. Dominant species include *Hyparrhenia hirta, Cenchrus ciliaris, Tricholaena teneriffae, Astydamia latifolia, Lotus sessilifolius* and *Lavandula buchii.* Other vascular plants include *Neochamaelea pulverulenta, Euphorbia balsamifera, E. obtusifolia, Kleinia neriifolia, Rubia fruticosa, Plocama pendula,* and *Echium aculeatum.* In some places, *Gallotia intermedia* is found in areas devoid of vegetation, where even *G. galloti* does not occur. At such localities, the lizards probably feed on insects and windborne plant remains.

Threats and conservation.—*Gallotia intermedia* probably had a wider distribution on the island in the past, but it is now scarce, endangered, and confined to a few small fragmented populations. Machado (1985) hypothesized that after the arrival of humans on the western Canary Islands (around 2000 years ago: González and Tejera, 1990) the larger lizards suffered greater predation by introduced mammals than the smaller species and consequently declined differentially. Other authors suggest that aboriginal inhabitants may have used large lizards as a food source (Castillo et al., 1994; Pellicer and Acosta, 1971), although archaeological research in Tenerife has documented only isolated lizard remains in just a few pre-Hispanic occupation sites (Diego Cuscoy, 1979; González and Tejera, 1990). It is very probable that introduced predators are one of the main threats of *Gallotia intermedia.* At Acantilado de Los Gigantes, we have found fecal droppings of feral cats containing remains of the new lizard. This is consistent with the findings of Nogales and Medina (1996) who reported high predation on lizards by feral cats in the low xerophytic scrub ecosystem where *G. intermedia* is present.

Key to the Species of the Genus *Gallotia*

1. Masseteric scale absent; ventrals in 8–10 longitudinal rows; collar serrated . . . . *G. atlantica*
   Masseteric scale clearly defined; ventrals in ten or more longitudinal rows; edge of collar smooth or only sligthly serrated 2
2. Ventrals in 10–14 longitudinal rows . . . . *G. galloti*
   Ventrals generally in more than 14 longitudinal rows 3
3. Tympanic scale not clearly differentiated; 35–52 gulars; orange tinge on gular region; lateral and/or dorsal yellow spots absent on body . . . . . . *G. stehlini*
   Tympanic scale clearly differentiated and elongated; 26–37 gulars; gular region not orange; lateral yellow spots (large or small) generally present on body 4
4. Two to three supratemporal scales; uniform blackish-brown dorsal coloration; a lateral series of large yellow spots . . . . *G. simonyi*
   Three to five supratemporal scales; distinctive pattern of yellow or pale gray reticulation on dorsum; lateral yellow spots absent or small . . . *G. intermedia*

Results

Statistical Analysis

Descriptive statistics for meristic characters of the different species are listed in Tables 2 and 3. Univariate one-way ANOVAs demonstrate that there is significant variation for all the variables studied ($P < 0.001$; Table 4). The MANOVA revealed significant variation among the five species (Wilks' $\lambda = 0.00056$, df $= 36$, $P < 0.001$). According to these results, *G. simonyi* is most morphologically similar to *G. intermedia,* showing statistical differences in

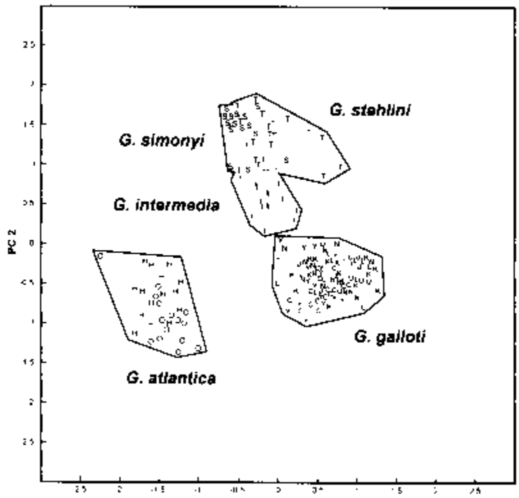

FIG. 4.—Plot of the location of specimens of the main subspecies recognized of *Gallotia* on the principal component axes: *G. intermedia* (I), *G. simonyi* (S), *G. stehlini* (T), *G. atlantica atlantica* (H), *G. a. mahoratae* (O), *G. galloti galloti* (N), *G. g. insulanagae* (U), *G. g. eisentrauti* (L), *G. g. palmae* (Y), *G. g. gomerae* (K), and *G. g. caesaris* (C).

TABLE 5.—Principal components analysis of the correlation matrix among meristic variables.

Meristic variables	Factors	
	F1	F2
	Factor loadings	
Collar	0.638	0.647
Middle dorsals	0.774	0.191
Gulars	0.899	0.004
Perianals	−0.507	−0.097
Temporal region	0.876	−0.263
Supratemporals	0.466	−0.804
Longitudinal ventrals	0.297	0.902
Subdigital lamellae	0.797	0.026
Femoral pores	0.866	0.222

five of the nine characters studied (temporals, supratemporals, middle dorsals, longitudinal ventrals, and subdigital lamellae on the fourth toe).

The principal component analysis (PCA) scatterplot revealed three main groups (Fig. 4) with the first two principal components explaining 73.1% of the variation (PC1 = 51.4%; PC2 = 21.7%). These groups correspond to *G. atlantica*, *G. galloti*, and a third one that includes the other three larger species (*G. stehlini*, *G. simonyi*, and *G. intermedia*). Furthermore, within this group the plot of the three species can be distinguished, although there is an area of overlap between them. The first axis separates *G. galloti* from *G. atlantica* with five variables (GL, TR, FP, SL, and MD) having high positive loadings and one (PA) having a high negative loading (Table 5). This pattern is the result of the correlation between the high counts in *G. galloti* with the low counts in *G. atlantica* for the variables GL, TR, FP, SL, and MD and the low PA counts in *G. galloti* with the high PA counts in *G. atlantica*. The second axis separates *G. simonyi* and *G. stehlini* from *G. atlantica* and *G. galloti*. The variation along the second axis is the result of high positive loadings for LV and CL and high negative loadings for ST. This pattern is the result of the correlation between the high LV and CL counts in *G. simonyi* and *G. stehlini* with the low LV and CL counts in *G. atlantica* and *G. galloti* and the low ST counts in the former two and high ST counts in the latter two. PC3 and PC4 explained an additional 8.9% and 5.1% of the variation, respectively.

DISCUSSION

Multivariate statistical analyses have proven to be powerful tools for studying morphological variation in reptiles (e.g., Bezy, 1989; Carr, 1996; Daugherty et al., 1990; Taylor and Buschman, 1993) and have been used for studying geographic variation in Canary Island lizards (Thorpe and Báez, 1987, 1993; Thorpe and Brown, 1989*a*,*b*, 1991; Thorpe et al., 1985). In this study, PCA separates *Gallotia intermedia* from the larger *G. simonyi* and *G. stehlini* and the smaller *G. atlantica* and *G. galloti*. However, there is a slight overlap between the individuals of *G. stehlini*, *G. simonyi*, and *G. intermedia* where a low percentage (15.1%) of them coincide in morphospace. Despite that, the ensemble of qualitative and quantitative characters permit the separation of *G. intermedia*.

Gallotia represents a monophyletic group of species supported by morphological, molecular and inmunological data (Arnold, 1989; González et al., 1996; Mayer and Bischoff, 1991). Nucleotide se-

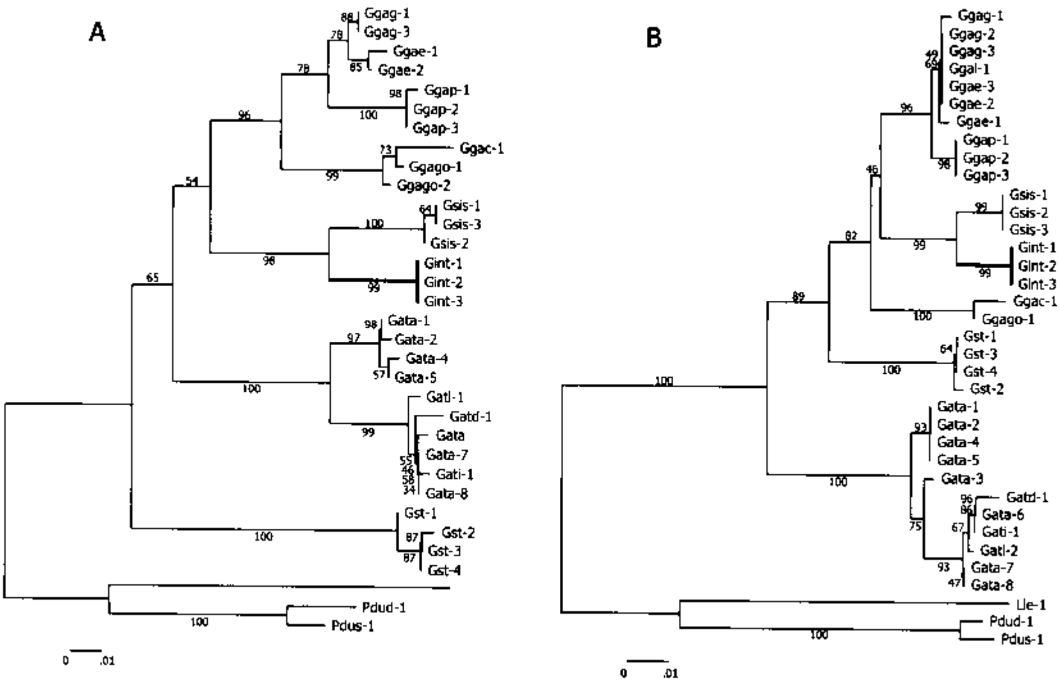

FIG. 5.—Neighbor-joining phylogenetic trees (Saitou and Nei, 1987) of the genus *Gallotia* in the Canaries based on Kimura 2N-parameter distance (Kimura, 1980) for partial sequences of (A) cytochrome *b* and (B) 12S rRNA (taken from Rando et al., 1997). Nomenclature is as follows: *Gallotia galloti galloti* (Ggag); *Gallotia galloti insulanagae* (Ggai); *Gallotia galloti eisentrauti* (Ggae); *Gallotia galloti palmae* (Ggap); *Gallotia galloti caesaris* (Ggac); *Gallotia galloti gomerae* (Ggago); *Gallotia simonyi* (Gsis); *Gallotia intermedia* (Gint); *Gallotia atlantica atlantica* (Gata); *Gallotia atlantica laurae* (Gatl), *Gallotia atlantica delibesi* (Gatd); *Gallotia atlantica ibagnezi* (Gati); *Gallotia stehlini* (Gst); *Lacerta lepida* (Lle); *Podarcis dugessi dugessi* (Pdud); and *Podarcis dugessi selvagensis* (Pdus). Numbers of individuals correspond with those in González et al. (1996). The new species is highlighted with bold lines.

quences data from the mitochondrial 12S ribosomal RNA and cytochrome *b* genes indicate that the new lizard has a relatively low genetic distance from *G. simonyi*, suggesting a very close relationship (Fig. 5; Rando et al., 1997). Although these distances are within the range estimated for subspecies of *G. atlantica* and *G. galloti* (González et al., 1996), the use of genetic distance measures in making species-level decisions has been criticized by some (Frost and Hillis, 1990).

The radiation of the genus *Gallotia* has involved an eastern-western colonization through the Canary Islands (González et al., 1996; Thorpe et al., 1994). The molecular studies provide strong evidence that western species, *G. intermedia, G. simonyi,* and *G. galloti,* are part of the same clade, their relationship being supported by very high bootstrap values (Rando et al., 1997). These authors suggested that this group of species could have originated from a common ancestor as a pre-*G. stehlini* or a pre-*G. atlantica* form. According to geological studies (Ancochea et al., 1990), it is possible that speciation of these three species came about in allopatry, as there is evidence for the long-term existence of several separate islands in the western Canaries (Rando et al., 1997). The two oldest island in the area are La Gomera (~14–19 mya; Cantagrel et al., 1984) and Tenerife (~11 mya; Ancochea et al., 1990). For six million years, Tenerife consisted of three independent volcanic edifices corresponding to the Teno massif in the northwest, Roque del Conde in the south, and the Anaga massif in the northeast. These volcanic edifices later become connected when the central part of the island arose between them (Ancochea et al., 1990). An origin on Tenerife with radiation to the other western islands has been suggested for *G. galloti* (Thorpe et al., 1993, 1994).

As deduced from fossil deposits (Bravo, 1953; Hutterer, 1985) there was coexistence in the past of large and small forms of *Gallotia* on the western islands of the Canaries. This is still the case on El Hierro, and the recent discovery of *G. intermedia* in Tenerife shows this is also the case there. We need to ask whether this situation still persists on the other western islands of La Gomera and La Palma. A relatively small form of *G. simonyi* (*G. s. gomerana*) in La Gomera has been described on the basis of bone remains from La Gomera (Hutterer, 1985). This lizard was still alive no more than 500 yr ago as demonstrated by radiometric techniques (Hutterer, 1985), and we speculate that it might still be alive in some of the numerous inaccessible places on this island.

According to Castillo et al. (1994), based on morphological features (dentary tooth shape, and low number of temporal and supratemporal scales), the discovery of two mummified individuals of the extinct giant lizard *G. goliath* in Tenerife seems to confirm its close relationship between this species and *G. simonyi* from El Hierro. Although the relationship of *G. intermedia* to *G. goliath* is still unclear, they have clear morphological differences. Therefore it does not seem likely that *G. intermedia* is simply a dwarfed version of *G. goliath*. However, reduction in size of large-bodied island species during the Holocene as a result of climatic and vegetational changes and human colonization has been documented previously (Pregill, 1986; Pregill and Dye, 1989).

Resumen

Se describe una nueva especie de lagarto de la isla de Tenerife (Archipiélago Canario). Difiere de las otras especies de *Gallotia* por presentar una talla intermedia entre las dos menores (*G. atlantica* and *G. galloti*) y las dos mayores (*G. simonyi* and *G. stehlini*), además del número de escamas supratemporales (generalmente 3–4) y una marcada tendencia a presentar 16 escamas ventrales longitudinales. El patrón de coloración es muy diferente, caracterizándose por presentar manchas amarillentas en el dorso, así como una reducción en la talla de los ocelos amarillos laterales característicos de *G. simonyi*. Los individuos de la población de La Hábiga poseen, en la región dorsolateral, manchas irregulares de color gris y carecen de ocelos. El análisis univariante y multivariante de nueve variables merísticas de cada especie del género *Gallotia* y el nuevo lagarto revela una significativa variación entre los taxones. El análisis de componentes principales apoya la existencia de tres grupos morfológicos dentro de este género, siendo *G. simonyi* y *G. stehlini* los taxones más próximos al nuevo lagarto. Los caracteres merísticos considerados en este trabajo constituyen una herramienta importante en la identificación de las especies de *Gallotia*. La nueva especie presenta una estrecha relación filogenética con *G. simonyi*, según evidencian los análisis moleculares.

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APPENDIX I

Specimens Examined

All specimens belong to the collections 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).

G. atlantica: LANZAROTE: *Gallotia atlantica atlantica*, Haría: DZUL 0844; Guatiza: DZUL 0884, 0886, 0889, 0890, 0891; Femés: DZUL 0895, 0896, 0897; Tabayesco: DZUL 0899; Jameos del Agua: DZUL 1135; Montaña Clara: DZUL 1138, 1140, 1142, 1143; FUERTEVENTURA: *G. a. mahoratae*, Tuineje: DZUL-P 0005, 0006, 0007, 0008, DZUL 0481, 0482, 0483, 0484, 0486; Corralejo: DZUL 0509; Pájara: DZUL 1209; Lobos: DZUL 5001, 5002, 5003, 5004.

G. galloti: TENERIFE: North (*G. galloti insulanagae*, Roque de Fuera de Anaga: DZUL 0155, 0156, 0158, 0177, 0178, 0194, 0195, 0196, 1161, 1162, 1163; *G. g. eisentrauti*, Roque de Tierra de Anaga: DZUL 0180, 0181; Roque de Garachico: DZUL 0183, 0187, 0188, 0189, 0437,1165; Las Cañadas: DZUL 0202: La Orotava: DZUL 0505; San Andrés: DZUL 0506, 0507; La Laguna: DZUL 428, 1591, 5032); South (*G. g. galloti*, Acantilado de Los Gigantes: DZUL-P 0009, 0010, 0011, 0012, 0013, 0014, 0015, 0016; El Médano: DZUL-P 5025, 5026, 5027, 5028, 5029, 5030; Güímar: DZUL 0198); LA PALMA: *G. g. palmae*, Breña Alta: DZUL 0497, 0498; Los Sauces: DZUL 0512, 0516, 0518, 0828, 0830, 1047, 1408, 1410, 1412, 1413; Los Llanos: DZUL 1415, 1418; Fuencaliente: DZUL 1422; LA GOMERA: *G. g. gomerae*, Hermigua: TFMC-VR 0027, 0028, 0029, 0030, 0031, DZUL 1118, 1119; Barranco de Avalo: DZUL 0818; San Sebastián: DZUL 0820; Vallehermoso: DZUL-P 5019; Valle Gran Rey: DZUL-P 5020, 5021, 5022, 5023, 5024; EL HIERRO: *G. g. caesaris*, El Sabinar: TFMC-VR 0019, 0020, 0021; El Pinar: DZUL-P 0017, 0018, 5017, DZUL 0748, 0751, 0756; El Golfo: DZUL-P 5018, DZUL 0110, 1206, 1207, 1208; Fuga de Gorreta: DZUL 0491.

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

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

G. stehlini: GRAN CANARIA: *G. stehlini stehlini*, 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.