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Extent of racial divergence in the eastern Canary Island lizard, *Gallotia atlantica*

by

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Introduction

At the time of writing the two widely distributed extant species of *Gallotia* differ markedly in the extent to which subspecies are recognised. Whilst the *Gallotia galloti* has 5 subspecies*, one for each main western island, Hierro, Gomera, La Palma and two for Tenerife (Boettger & Müller 1914, Bischoff 1982), *G. atlantica* has no trinomials*. This is inspite of the fact that it is widely distributed across all the eastern islands composed of two large islands, Fuerteventura and Lanzarote, and several smaller islands and islets including Lobos, Graciosa, Montana Clara and Alegranza (Fig. 1).

Whilst the western lizard, *galloti* shows obvious inter-island variation in size and colouration the variation in the eastern lizard, *G. atlantica*, is not so obvious. Nevertheless, there are some clear inter-island differences in *G. atlantica*. For example, the male specimens from northern Lanzarote can grow much larger than those on some other eastern islands. This paper attempts to quantitatively compare the extents of racial divergence in *atlantica* to that of *galloti*. Also a preliminary attempt is made at analysing the pattern of racial differentiation in *atlantica*.

Materials and Methods

The six collecting sites for *atlantica* were on Fuerteventura, Lobos, Lanzarote, Graciosa, Montana Clara and Alegranza (Fig. 1). They were single locality sites, thereby avoiding the potential problem of heterogeneity being introduced by intra-island geographic variation. The collecting site for each of the five *galloti* subspecies were also single localities and are figured in Thorpe et al. (1985) and Thorpe (1985 b).

To compare the extent of racial variation a Mahalanobis D^2 was computed between each pair of populations (keeping sexes separate) based on the 23 scalation characters and the 24 adjusted body proportions that could be recorded from all species and as used in Thorpe et al. (1985).

To portray the pattern of geographic variation in *G. atlantica*, 27 adjusted body proportions were used to compute Mahalanobis D^2 and canonical variates. The statistical significance of the D^2 between populations was also computed. As a check on the reliability of the pattern the raw body proportions plus SVL were also used to compute D^2 and canonical variates.

* In this volume further subspecies are described.

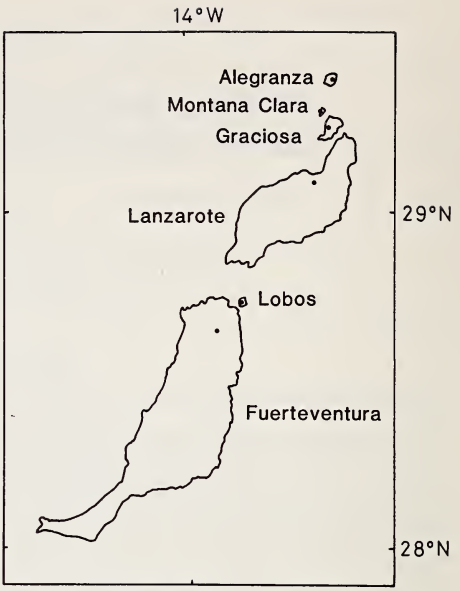

Fig. 1. Map of the eastern Canary Islands occupied by *G. atlantica*. Collection localities indicated by a solid circle.

Results and Conclusions

It is evident from Fig. 2 that although the extent of racial variation in *atlantica* overlaps that of *galloti* it is, on average, always greater in *galloti* irrespective of sex or character type. Nevertheless there still appears to be some racial variation in *atlantica* and the extent of this inter-island divergence in *atlantica* is in some cases as great, or greater, than that between *galloti* subspecies.

The pattern of racial variation in *atlantica* is not consistent between character types in these preliminary analyses and only the results of the analyses of body proportions are presented here. The canonical analyses of adjusted body proportions (males Fig. 3, females Fig. 4) shows that the Lanzarote population tends to be quite divergent from the other populations. These canonical analyses are supported by equivalent analyses using raw body proportions and SVL which also tend to show the divergence of the Lanzarote population from a loose cluster composed on Fuerteventura, Lobos, Graciosa, Montana Clara and Alegranza.

The Lanzarote population is also divergent in its body size insofar as the max SVL in Lanzarote males ($>$90mm) is noticeably greater than other islands ($<$76mm), (Thorpe 1985a).

Discussion

The lower level of phenetic divergence found in *atlantica*, compared with *gal-*

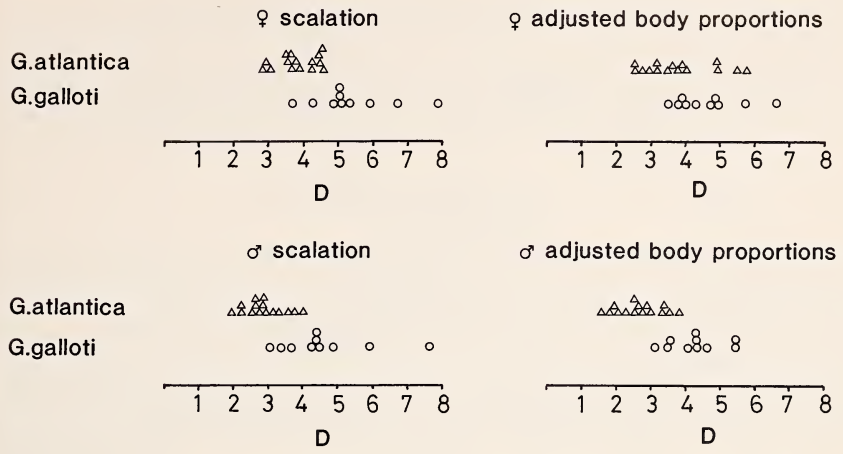

Fig. 2. Relative extent of racial divergence within *galloti* and within *atlantica*. Horizontal axis is Mahalanobis D between populations within *G. atlantica* (triangles) and between populations within *G. galloti* (circles). The populations are from single localities on each island except Tenerife where both subspecies are represented by samples.

loti, conforms to the preliminary numerical phylogenetic analysis presented in Thorpe et al. (1985).

The pattern of distribution and the extent of racial differentiation suggest genetic continuity between the populations until relatively recently due to either rapid and recent spread between islands and/or recent vicariance of the populations. The former facet of the explanation involves a recent origin of *atlantica* in the Canaries and its rapid spread through the eastern islands. Insofar as *atlantica* has a widespread and complete distribution in the eastern Canaries but shows relatively little racial divergence between islands it appears to have some of the features that typify an early stage in Wilson's (1961) taxon cycle. The spatial arrangement of the eastern islands in a closely linked chain separated by only short distances of sea is commensurate with this facet of the explanation as it would facilitate rapid inter-island colonisation.

However, the sea between the islands in the eastern chain is only shallow and they could have been joined in Pleistocene and perhaps recent times when the sea level was lower than at present. Consequently, there could have been genetic continuity between the various island populations until their recent vicariance due to the post-Pleistocene rise in sea level. This could also explain the relatively low level of inter-island divergence but it may not be the sole explanation. It is possible that both factors (recent colonisation evaluation, recent vicariance) play a part in the relatively low levels of divergence because recent vicariance of island populations due to recent rises in sea level can still lead to substantial geographic variation in lizards (Gardner 1984).

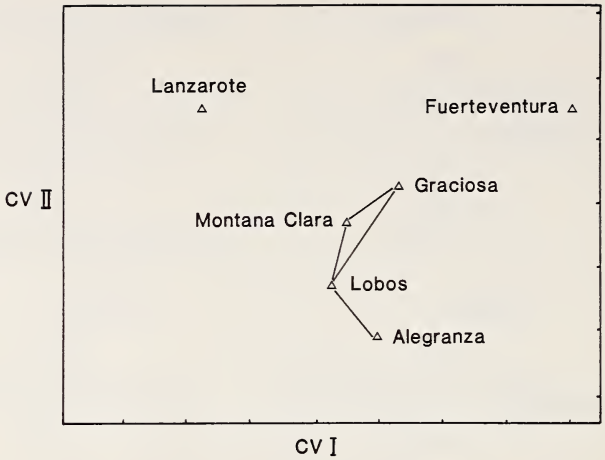

Fig. 3. Canonical analysis of male adjusted body proportions. Triangles indicate population centroids. When the D^2 values are insignificant they are joined by the lines. The canonical variates are marked in units of 2 within-group standard deviations and express 67 % of the variation.

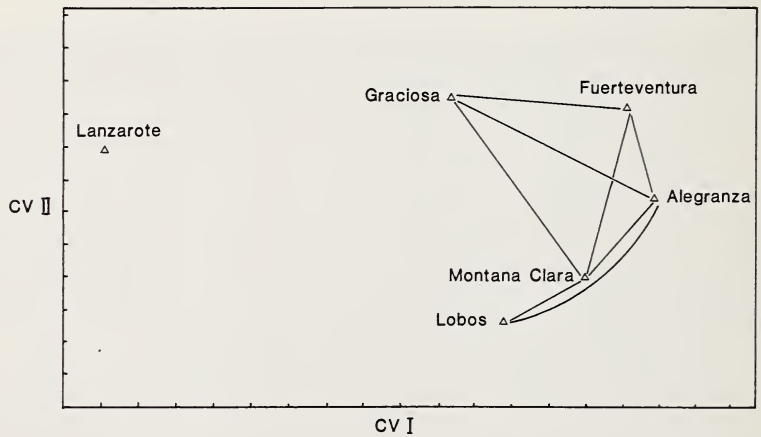

Fig. 4. Canonical analysis of female adjusted body proportions. Symbols as for Fig. 3. The first two canonical variates express 78 % of the variation.

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Zusammenfassung

Bisher sind für *Gallotia atlantica* keine Unterarten beschrieben, während *G. galloti* mehrere aufweist. Die Streuung von 23 Beschuppungsmerkmalen und 24 Körperproportionen wurde bei *G. atlantica* mit Hilfe des verallgemeinerten Abstands (Mahalanobis D^2) untersucht. Die Unterschiede zwischen *atlantica*-Populationen von verschiedenen Inseln sind im Durchschnitt geringer als bei solchen von *galloti*. Die Kanonische Analyse von Beschuppung und Körperproportionen ergibt kein einheitliches Bild von Unterschieden in beiden Merkmalskomplexen. Männchen und Weibchen von Lanzarote sind jedoch größer als solche von anderen Inseln und weichen von diesen auch in einigen Körperproportionen ab.

Resumen

Mientras que *G. galloti* tiene muchas subespecies, *G. atlantica*, a la hora de escribir, no tiene ninguna. El grado de divergencia racial en *G. atlantica* se analiza empleando Mahalanobis D^2 basado en 23 caracteres de las escamas y 24 dimensiones corpóreas. Por término medio, el nivel de divergencia racial entre las islas en *atlantica* es mas bajo que en *galloti*. Hay poca consistencia en el cuadro de divergencia fenética manifestado por análisis canónico entre el escamado y las dimensiones corpóreas. Sin embargo, tanto para los machos y las hembras como para distintos tratamientos de los caracteres, los análisis canónicos demuestran que el lagarto grande de Lanzarote también tiene tendencia a ser divergente de forma.

Literature

Bischoff, W. (1982): Die innerartliche Gliederung von *Gallotia galloti* (Dumeril & Bibron 1939) (Reptilia: Sauria: Lacertidae) auf Teneriffa, Kanarische Inseln. — Bonn. zool. Beitr. 33 (2—4): 363—382.

Boettger, C.R. & L. Müller (1914): Preliminary notes on the local races of some Canarian lizards. — Ann. Mag. nat. Hist. (8) 14: 67—78.

Gardner, A.S. (1984): The evolutionary ecology and population systematics of day geckos (*Phelsuma*) in the Seychelles. — Univ. Aberdeen Ph.D. Thesis.

Thorpe, R.S. (1985a): Body size, island size and variability in the Canary Island lizards of the genus *Gallotia*. — Bonn zool. Beitr. 36: 481—487.

— (1985b): Relative similarity between subspecies of the western Canary Island lizard, *Gallotia galloti*. — Bonn. zool. Beitr. 36: 529—532.

— , K. Watt & M. Baez (1985): Some interrelationsships of the Canary Island lizards of the genus *Gallotia*. — Bonn. zool. Beitr. 36: 577—584.

Wilson, E.O. (1961): The nature of the taxon cycle in the Melanesian ant fauna. — Am. Nat. 95: 169—193.

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