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NUMBER OF OVARIOLES AND DEGREE OF DEPENDANCE WITH RESPECT TO THE UNDERGROUND ENVIRONMENT IN THE CANARIAN SPECIES OF THE GENUS *LOEOPTERA* BRUNNER (BLATTARIA, BLATTELLIDAE)

by

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I - INTRODUCTION

The genus *Loboptera* includes a total of 14 species, distributed throughout the Southwestern Paleartic Region (HARZ & KALTENBACH, 1976 ; MARTIN & OROMI, 1987 ; MARTIN & IZQUIERDO. 1987). This genus is represented in the Canary Islands by 7 species, 6 of which have a marked tendency to occupy the underground environment.

L. canariensis Chopard is an epigean species, small in size, strongly pigmented and with a distribution in Tenerife island within the low and intermediate zones (GANGWERE et al., 1972) (Fig. 1). This species as well as the close relative *L. decipiens* Germ., have a more extensive distribution and can be found in some Mediterranean localities. The presence of *L. decipiens* in the Canary Islands is doubtful and probably the previous records corresponded to *L. canariensis* (MARTIN, comm. pers.).

L. fortunata Krauss is endemic to La Palma and widely spread in the hypogean environment, as well in caves as in the superficial underground compartment or "mesocavernous shallow stratum" (MSS), although it can also be found under stones or in the litter in the hurnid laurel forest (MARTIN et al., 1986). It is bigger than *L. canariensis*, slightly depigmented and with well developed eyes.

L. anagae Martin & Oromi is endemic to the Anaga Peninsula in Tenerife. It lives in the MSS but, as *L. fortunata*, it can occasionally be found under stones in the laurel forest. From the morphological point of view it is very similar to *L. fortunata*, being completely oculated and somewhat depigmented.

L. ombriosa Martin & Izquierdo is endemic to El Hierro Island and shares the same basic morphological features as the last two mentioned species. It lives in the volcanic MSS localized under the hurnid woods in the north of the island (OROMI et al., 1986). It can inhabit the caves as well, although in this habitat, specimens are found in a few number.

In addition, the hypogean subspecies *L. ombriosa meridionalis* Martin & Izquierdo inhabits the lava tubes in the southern half of El Hierro, being and it is morphologically more modified than *L. ombriosa ombriosa* (MARTIN & IZQUIERDO, 1987).

L. cavernicola Martin & Oromi has a very restricted distribution, since the only known population lives in a volcanic pit in the southern slope of Macizo de Anaga (Tenerife). MARTIN & OROMI (1987) not only suggest a close relationship with *L. anagae*, but also postulate that differentiation cannot be very old. However, *L. cavernicola* is less pigmented than the latter, and shows a certain degree of ocular reduction.

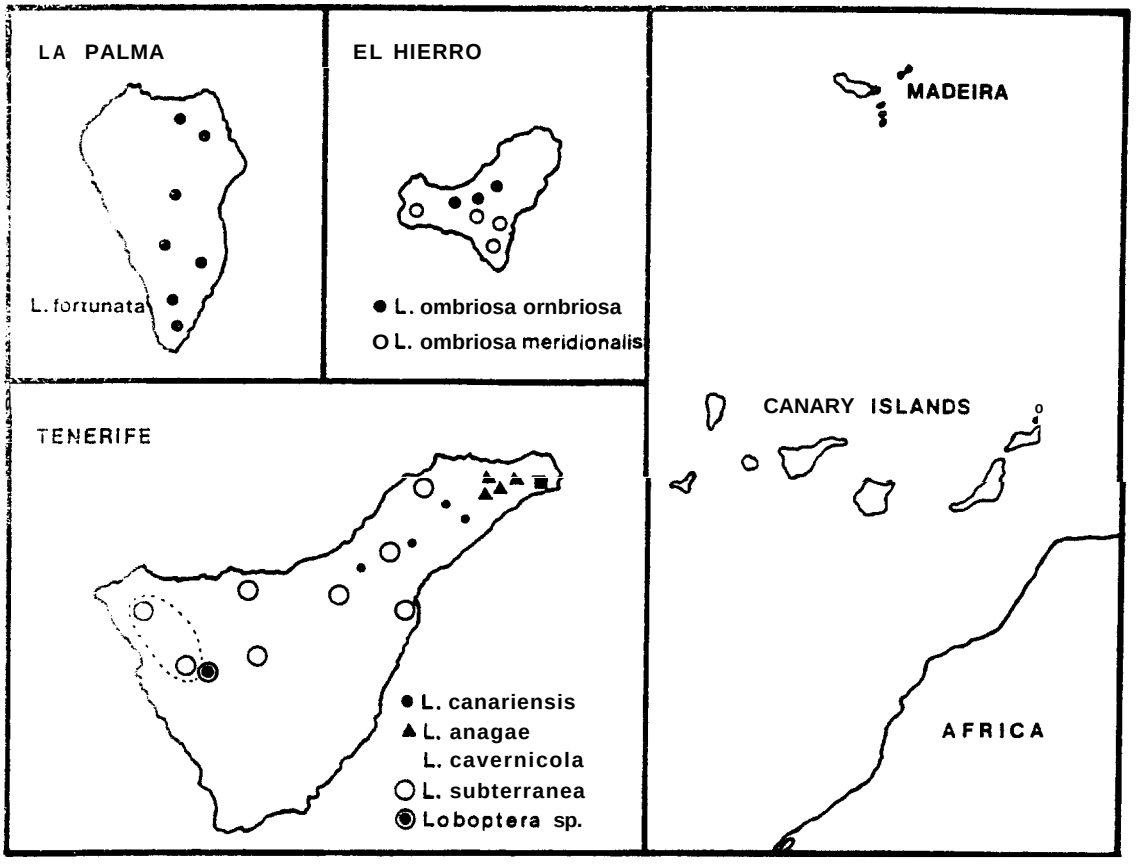

Fig. 1 - Distribution of the Loboptera species in the Canary Islands. The western populations of L. subterranea occupy the area within dashed lines.

L. subterranea Martín & Oromí is one of the most troglomorphic species known in the genus (cee the classification of CHRLSTIANSEN, 1962, and BARR & HOLSINGER, 1985). It is anophthalmous, slightly pigmented and lives both in the MSS and in lava tubes in Tenerife (MARTIN & OROMI, 1987).

Loboptera sp. is a new species recently discovered in a cave in the western zone of Tenerife. Certainly, it is the most modified species in the genus, and probably in the whole order Blattaria. It is almost unpigmented, shows no eyes and displays very slow movements. This species is going to be described by one of us (IZQUIERDO).

The species above mentioned show a gradual rnorphological modification related to their dependance to the underground environment, thus suggesting the possible occurence of a parallel phenomenon in their reproductive physiology. It is well known that hypogean insects show a tendency towards specialist reproductive K strategies (see MARGALEF, 1976 ; **BELLES,** 1987), which usually implies a reduction in the number of ovarioles and/or in the number of eggs growing simultaneously. In this sense, VANDEL (1964) has recorded examples of this in many species of insects and other invertebrates, and more recently POULSON (1985) describes a parallelism between the reduction of egg laying and the underground specialization degree in amblyopsid fishes.

It is in this context that we have studied the ovarian system of the Canarian species of *Loboptera*. As in all the blattids, the ovaries are composed by panoistic ovarioles whose number can vary in different species (ROTH, 1968).

II - MATERIAL AND **METHODS**

The specimens were from various localities in three different islands. ***L. fortunata*** from Cueva de Tacande (La Palma) ; ***L. ombriosa ombriosa*** from the volcanic MSS at Pista del Derrabado (El Hierro) ; ***L. canariensis*** from crop fields in La Laguna (Tenerife) ; ***L. anagae*** from the MSS at El

Bailadero (Tenerife) ; *L. cavernicola* from Sima Robada cave (Tenerife) ; *L. subterranea* from Cueva Felipe Reventon, Cueva del Viento, Cueva Grande de Chío and the MSS in Monte del Agua (Tenerife) ; and *Loboptera* sp. from Cueva Grande de Chío (Tenerife).

Specimens were collected by means of either visual search or by using traps especially designed for the capture of alive insects. The traps consisted in plastic trays set down at ground level with small stones placed inside. A mixture of beer and some drops of acetic acid was poured in small jars, which were covered by a net to prevent the insects fall in. The jars were set in the trays and blue cheese was spread over as a complementary bait.

Some specimens were dissected on arriving at the laboratory, while others were kept in containers at 15 ± 1" C, 90-100 % RH and in complete darkness until dissection. They were fed with dog food and water ad lib.

The dissection of females was carried out under a binocular microscope, with continuous supply of Ringer solution. For a better observation of the ovarioles, ovaries were stained with aqueous solution of methylene blue.

III - RESULTS AND DISCUSSION

A total of 34 specimens from seven different species were studied (Table 1). It is worth noting that the number of specimens analyzed is still low to establish certain conclusions, as for example the variability in the number of ovarioles. A moderate variability in this sense is quite common in blattellids. For example in *Blattella germanica* each ovary is constituted by a number of ovarioles which vary between 24 and 30 (TANAKA, 1973). Among our species, we observe that in *L. canariensis* - with a total of 10 specimens studied - this variability ranges between 8 and 9 ovarioles per ovary ; on the other hand in *L. subterranea,* a difference of one ovariole per ovary is observed between the two populations corresponding to the two studied areas, with n = 5 each. In the remaining species, the study of a larger number of specimens could show such kind of deviations, related to the mean number of ovarioles.

Species	Habitat	N	ovarioles
Loboptera canariensis	E	10	16-18
Loboptera fortunata	HE	1	12
Loboptera ombriosa s.str.	HE	4	12
Loboptera anagae	HE	5	12
Loboptera subterranea (N)	H	5	12
Loboptera subterratiea (W)	H	5	10
Loboptera cavernicola	H	1	10
Loboptera sp.	H	3	6

Table 1 - **Number of ovarioles in the Canarian species of Loboptera. E : exclusively epigean ; HE : mainly hypogean but occasionaiiy epigean ; H : exclusively hypogean ; N : number of specimens studied ; (N) : northern population : Icod ; (W) : western population : Teno and Chío.**

Another question to comment is the symetry in the number of ovarioles in each ovary. In blattellids it is quite frequent to observe a difference of one or two ovarioles between both ovaries ; this has been seen, for example, in the already mentioned species *B. germanica* (BELLES & BENITO, unpublished results). This is not the case of the *Loboptera* species herein studied, in which both ovaries always showed the same number of ovarioles, being perfectiy symetric in this sense.

Xnyway, the differences in terms of number of ovarioles observed on the seven species are obvious. Three models can be distinguished considering both the number of ovarioles and the species habitat :

1) species with exclusive epigean life and 16-18 ovarioles (*L. canariensis*).

2) species with hypogean life but occasionally undertaking incursions into humid and shady zones on the surface ; with 12 ovarioles (*L. fortunata, L. ombriosa* s. str. and *L. anagae).*

3) species with exclusive hypogean life and 6 to 10 ovarioles *(Loboptera* sp., *L. cavernicola,* and the western population of *L. subterranea*).

Only the northern population of *L. subterranea* in Tenerife remains out of these three models, since it is exclusively subterranean but possesses twelve ovarioles.

It is interesting to point out the large potential egg production of *L. canariensis*. This species is morphologically and ecologically very similar to *L. decipiens* Germ., which should also possess at least 18 ovarioles as inferred from its ootheca (LEFEUVRE, 1966).

Regarding our results (Table 1) in the context of the distribution, ecology and relationships of certain species, some comments can be added. As suggested by MARTIN & OROMI (1987), *L. anagae* and *L. cavernicola* seem to have split not very long ago. According to these authors, *L. cavernicola* could derive from ancestral populations which took refuge in caves while the forests moved to higher zones on Tenerife. At the present time *L. anagae* continues to share the MSS with the epigean environment, while *L. cavernicola* is confined to underground habitats.

Concerning the still undescribed *Loboptera* sp., it can be considered as the most troglobitic species of the genus in the sense given by JUBERTHIE (1983). In addition to the high degree of troglomorphism, the very low reproductive potential must be pointed out, being only comparable to that of *Alluaudellina cavernicola*, whose ootheca contains no more than 4 or 5 embryas (GINET & DECOU, 1977).

In conclusion, the Canarian species of the genus ***Loboptera*** provide not only a paradigmatic example of ovarian reduction related to progressive adaptation to underground habits, but also a suitable model to study this phenomenon in deep and in a quantitative manner. Work along this line is now in progress.

SUMMARY

The reproductive system of several Canarian species of the genus Loboptera Brunner is studied. The number of ovarioles is reduced in the species strictly inhabiting subterranean habitats. The only epigean species, L. canariensis Chopard has 18 ovarioles, while a new trogiobitic species recently discovered in Tenerife has only 6 ; other hypogean species show an intermediate condition. The adaptive significance of this phenomenon is discussed.

RESUME

On analyse l'appareil reproducteur de plusieurs espèces canariennes du genre Loboptera Brunner. Le nombre d'ovarioles est réduit chez les espèces confinées au milieu souterrain. La seule espèce strictement épigée, L. canariensis Chopard, possède 18 ovarioles, tandis qu'une nouvelle espèce trogiobie récemment découverte a Ténérife n'en a que 6 ; d'autres espèces hypogées montrent une situation intermédiaire. La signification adaptive de ce phénomene est discutée.

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BIBLIOGRAPHY

BARR, T. C. and J. R. HOLSINGER - 1985 - Speciation in cave faunas. Ann. Rev. Ecol. Syst., 16, p. 313-337.

BELLES, X. - 1987 - ***Fauna*** *cavernícola i intersticial de la Península Ibèrica i les Illes Balears.* C. S. I. C. - Ed. Moli. Palma de Mallorca, 207 pp.

CHRISTIANSEN, K. - 1962 - Propasition pour la classification des animaux cavernicoles. Spelunca, 2, p. 76-78.

GANGWERE, S. K., MORALES MARTIN, M. and E. MORALES AGACINO - 1972 - The distribution of the Orthopteroidea in Tenerife, Canary Islands, Spain. Contrib. Amer. Entomol. Inst., 8, 1, p. 1-40.

GINET, R. et V. DECOU - 1977 - *Initiation à la biologie et à l'écologie souterraines.* Ed. Delarge. Paris, 345 pp.

HARZ, K. and KALTENBACH - 1976 - *The Orthoptera of Europe.* Vol. III. Junk. Publ. The Hague, 434 pp.

JUBERTHIE, C. - 1983 - Le milieu souterrain : étendue et composition. Mém Biospéol., 10, p. 17-65.

LEFEUVRE, J. C. - 1966 - Contribution à l'étude de la biologie de *Loboptera decipiens* Germ.

Cahier Natural, 22, p. 25-34.

MARGXLEF, R. - 1976 - Paralelismo entre la vida de las cavernas y la de las grandes profundidades marinas. Bol. Soc. Hist. Nat. Balears, 21, p. 10-20.

MARTIN, J. L., IZQUIERDO, I. and P. OROMI - 1986 - The genus *Loboptera* Brunner W. (Blattaria, Blattellidae) in the Canary Islands and its distribution in the underground compartment. Act. IX Congr. Int. Espeleol. Barcelona, 2, p. 142-145.

MARTIN, J. L. y P. OROMI - 1987 - Tres nuevas especies hipogeas de *Loboptera* Brunn. W. (Blattaria, Blattellidae) y consideraciones sobre el medio subterráneo **de** Tenerife (Islas Canarias). **Annls. Soc. Entomol. Fr. (N.S.),** 23, p. 315-326.

MARTIN, J. L. y I. IZQUIERDO - 1987 - Das nuevas formas hipogeas de *Loboptera* Brunn. W. (Blattaria, Blattellidae) en la isla de El Hierro. **Fragm. Entomol.,** 19, **2,** p. 301-310.

OROMI, P., MEDINA, **A.** L. and M. L. TEJEDOR - 1986 - On the existence of a superficial underground compartment in the Canary Islands. Act. IX Congr. Int. Espeleol. Barcelona, 2, p. 147-151.

POULSON, T. L. - 1985 - Evolutionary reduction by neutral mutations : plausibility arguments and data from amblyopsid fishes and linyphiid spiders. **NSS Bull.,** 47, 2, p. 109-117.

ROTH, L. M. - 1968 - Ovarioles of the Blattaria. Ann. **Entomol. Soc.** Amer., 61, 1, p. 132-140.

TANAKA, S. - 1973 - General accounts on the oocyte growth and the identification of vitellogenin by means of immunospecificity in the cockroach, *Blattella germanica* (L.). Develop. Growth Differentiation, 15, 3, p. 153-168.

VANDEL, A. - 1964 - *Biospéologie. La biologie des animaux cavernicoles.* Ed. Gautier-Villars, Paris, 619 pp.