The genus *loboptera* brum. & W (blattaria: blattellidae) in the canary islands and its distribution in the underground compartment

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RESUM

Viuen espècies del gènere Loboptera a tres de les illes Canàries: Tenerife, La Palma i El Hierro. De les vuit espècies que es coneixen actualment dues són epígees (L. decipiens *i* L. canariensis); *les sis espècies restants* (anagae, cavernicola, subterranea, fortunata, ombriosa *i* meridionalis) *són endemismes monoinsulars i presenten una adaptació més o menys acusada a la vida subterrània, essent algunes d'elles troglobis vertaders.*

En aquest treball s'efectua una anàlisi de l'hàbitat i distribució de cada espècie així com de les possibles raons que han conduït a l'aïllament i posterior diferenciació de formes estretament relacionades.

RESUMEN

Viven especies del género Loboptera *en tres de las Islas Canarias: Tenerife, La Palma y El Hierro. Entre las ocho especies que se conocen en la actualidad, dos son epígeas* (L. decipiens *y* L. canariensis); *las seis especies restantes* (anagae, cavernicola, subterranea, fortunata, ombriosa *y* meridionalis) *son endemismos monoinsulares y presentan una adaptación más o menos acusada a la vida subterránea, siendo algunas de ellas troglobios verdaderos. Se efectúa un análisis del hábitat y distribución de cada especie y las posibles razones que han conducido al aislamiento y porterior diferenciación de las formas estrechamente relacionadas son también discutidas aquí.*

SUMMARY

There are species of the genus Loboptera *in three of the Canary Islands: Tenerife, La Palma and Hierro. Amog the eight species already known up today, two are epigeous* (L. decipiens *and* L. canariensis); *the six remaining species* (anagae, cavernicola, subterranea, fortunata, ombriosa *and* meridionalis) *are monoinsular endemics and present a more or less strong adaptation to the subterranean life, some of them being true troglobites. An analysis of the habitat and distribution of each species is made, and the possible reasons leading to the isolation and further differentiation of the close related forms are discussed.*

Introduction

The genus *Loboptera* includes thirteen species throughout the world, presenting a Palearctic-Mediterranean distribution as indicated in Fig. 1. All of these species are well localized except *L. decipiens*, which spreads over Southern Europe, the Canary Islands, Madeira and Northern Africa.

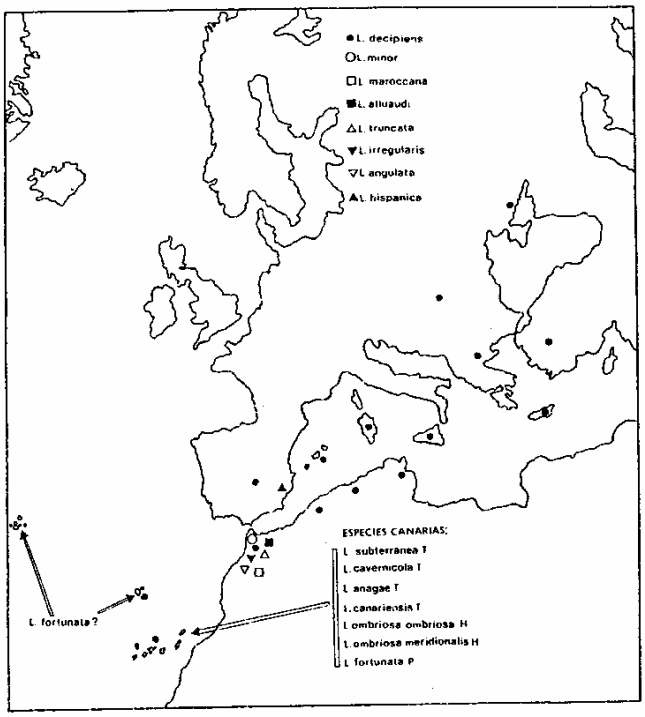

Fig. 1. Distribution of the genus Loboptera *in the world.*

Morroco seems to be the dispersal center of the genus *Loboptera* with its seven different species, though the Canary Islands are also well represented. Up to seven species have been discovered so far in the Canariesy; the following may be found in Tenerife: *L. canariensis* Chop., *L. decipiens* (Germ.), *L. subterranea* Martín & Oromí, *L. anagae* Martín & Oromí and *L. cavernicola* Martín & Oromí (MARTIN & OROMI, en press). *L. fortunata* Krauss is found in La Palma (KRAUSS, 1892) and *L. ombriosa* Martín & Izquierdo in El Hierro. This one has been divided into two subspecies, *L. ombriosa ombriosa* and *L. ombriosa meridionalis* MARTIN & IZQUIERDO, in press).

PRINCIS (1963) found *L. fortunata* both in the Azores and Madeira islands. However, this information is doubtful as any of the twenty one specimens that he analysed were not adult enough to be properly determined. At present, *L. fortunata* is located in the hypogeous habitat of La Palma island exclusively, so it is unlikey to be the same species found both in Madeira and Azores.

The seven species known in the Canary Island may be divided into two grupos. The first group includes *L. decipiens* and *L. canariensis*, two lucicolous species of small size and strong pigmentation, which are always distributed over non-forest areas. The second group is formed by the remaining species which are characterized by a bigger size, reddish colouring and by their subterranean habitat. Thus, *subterranea, cavernicola* and *ombriosa meridionalis* are troglobites of underground life exclusively, and *anagae, fortunata* and *ombriosa* s.str. live in the underground superficial compartment, ocasionally found under rocks on surface.

The other North African and European species of this genus all belong to the first group. In fact, after analizing all types of species, except *angulata* Chop. and *hispanica* Harz, we have noticed they can be fitted into the first group mentioned above. According to the original description of the two exceptions (CHOPARD, 1943; HARZ, 1975), they can also be adjusted to the morphology of the first group.

It seems then that the species included in the hypogeous group are limited to the Canaries, though Princis' specimens (op. cit.), such as *L. fortunata* of Azores and Madeira, may correspond with another species from the some hypogeous group. Then, what needs to be known is whether this group is the result of an evolution process in the archipelago or whether we are dealing with relictual species that are trapped in any of the Macaronesian Islands.

The colonization of the hypogeous environment ought to have taken place in the laurel forest as we gather from the fact that the less modified species are found among the laurel forest, whereas the more adapted ones occupy a hypogeous environment not necessarily dependent of this rain forest. Therefore, these *Loboptera* may show a relictual feature, since such vegetal system represents a relictic flora (CIFERRI, 1962; KUNKEL, 1973). There is evidence that the laurel forest had a greater extension during the Tertiary than today, covering also Northern Africa (DANSEREAU, 1968).

New species of *Loboptera* may be discovered in the near future in the Canary Islands as well as in Northern Africa, and will hopefully contribute to clarify this matter. The hypogeous fauna of some islands such as La Gomera or Gran Canaria or that of Northern Africa is not known enough as to reject the existence of new species related to the present ones.

Apart from whatever the correct alternative is, the original species lived in the forest initially, and then, they expanded their habitat in orden to colonize other environments which were relatively empty such as the underground superficial compartment and the underground deep compartment.

Concerning the lucicolous *decipiens* and *canariensis,* the first of them is a synantropous species which has spread over along with man (PRINCIS, 1963), and it probably arrived at the islands in a historical period. *L. canariensis* is an endemic species, thus, its ancestors ought to have reached the islands before *L. decipiens*. According to CHOPARD (1954), *L. canariensis* is very similar to North African *L. truncata*.

Physical underground compartment dynamics

Before introducing the particular distribution of the hypogeous species of the islands subsoil, we will analyse the formation and destruction of the lava tubes which affects the entire net of fractures and subterranean interstices. It will help us to comprehend whatever reasons may have contributed to cause the differentiation among species.

Occasionally (OROMI et al., 1984), we have pointed out how the mechanical and chemical erosion of the subsoil has filled up all the fractures throung the years. This process takes place also in limestone areas (HOWARTH, 1983; JUBERTHIE, 1983), but it is generally more intense in volcanic region. Hence, the lava tubes have a much shorter life than the calcareous caves.

The oldest areas of the Canaries (older than one million years), do not present lava tubes and the net of fractures from the deep subsoil is filled in completely. The only exception to this are the volcanic pits which due to their vertical formation are more resistent to erosion and can be found in some of the oldest and more eroded massifs. The underground superficial compartment shapes up as a disintegration band of the parent rock just when erosion becomes more apparent (JUBERTHIE, 1983). In some places, this band of materials broken into numerous interstices is developed under a coat of organic soils, which relieves the sudden temperature and humidity changes on surface. When this has taken place, the underground superficial compartment is an ideal habitat for a colonization of this subterranean species.

Another significant aspect is the existence of paleoclimates in the archipelago. The modification in the forest spreading is said to be caused by several climatic variations which happened during the Pleistocene and the Holocene. The degrees of erosion also varied during this time (CRIADO, 1984).

The existence of a special type of underground superficial

compartment originally different to that already described is another quality of the volcanic land and it can participate in the distribution of the hypogeous species. This particular type of underground superficial compartment is not formed by an erosive process but is made of scoriaceous strata from the lava flows. The final result is a compartment composed of interspersed layers of fragmented material among other layers of more compactness. This is called volcanic underground superficial compartment (MEDINA & OROMI comm. pers.).

Distribution of the hypogeous *Loboptera* in the Canary Islands

The five colonizing species of the underground compartment of the islands have shown a different degree of adaptation to the hypogeous life (table I). This is related to their respective habitats. Thus, those species living underground are more adapted than those that can be found about the surface. If the greater age of an island supposes a longer time disposal for the adaptation to the hypogeous conditions, it is then related to those levels of morphological adaptation. Those species presenting a greater adaptation to the underground life conditions belong to Tenerife Island, the oldest island of the archipelago, whereas those species existing in La Palma or El Hierro islands still preserve many of the epigeous features.

TABLA I

Species	Pigmentation range	eye development	S	Habitat MSS	MSP	Island	Age m.y.
L. subterranea	X	anophthalmous		X	X	Tenerife	16
L. cavernicola	XX	eye ustability			X	Tenerife	16
L. anagae	XXX	normal	X	X		Tenerife	16
L. ombriosa meridionalis	XX	normal			X	Hierro	1,5
L. ombriosa ombriosa	XXXX	normal	X	X	X	Hierro	1,5
L. fortunata	XXXX	normal	X	X	X?	Palma	3

Nevertheless, it is suprising to learn that some islands keep various hypogeous forms even related among themselves, such as *L. o. ombriosa* and *L.o. meridionalis* in El Hierro, or *L. anagae* and *L. cavernicola* in Tenerife. We have already discussed in another paper (MARTIN & OROMI, op, cit.) that all of the hypogeous *Loboptera* found in Tenerife come from one single ancestor probably. It all makes us inquire into the reasons of the present differentiation.

In order to analyse both the distribution and differentiation of the hypogeous species in the Canary Islands, we have to consider the following: the existence of underground barriers blocking the dispersion about the underground deep compartment, and the expansion and regresion of the laurel forest. This considerable influences upon the habitation of the underground superficial compartment (JUBERTHIE, 1983). The first of these two aspects depends upon the greater age of the soil and its degrees of erosion; the second depends on the climatic changes of the past. The forest regression also affect the species as the could remain isolated in the underground compartment (VANDEL, 1958; PECK, 1980; JUBERTHIE, 1984).

The formation of underground barriers is likely to have caused an initial distinction in the original *Loboptera* of Tenerife. An important deposit of alluvial clay found in La Laguna, Tenerife (at 500 m.h.), forms an example of such barrier (fig. 2). The underground deep compartment is filled up at lower areas because of the lack of eruptions and then the constat erosion (for a longer period of three million years). The underground superficial compartment cannot be colonized as it is too dry. So, the western population became the present *L. subterranea* and the eastern population was recently distinguished as *L. anagae* (which lives at 800-1000 m above the sea level) and as *L. cavernicola* (at 300 m above the sea level).

The distintion between *L. anagae* and *L. cavernicola* came later when the laurel forest extended around 300 meters below

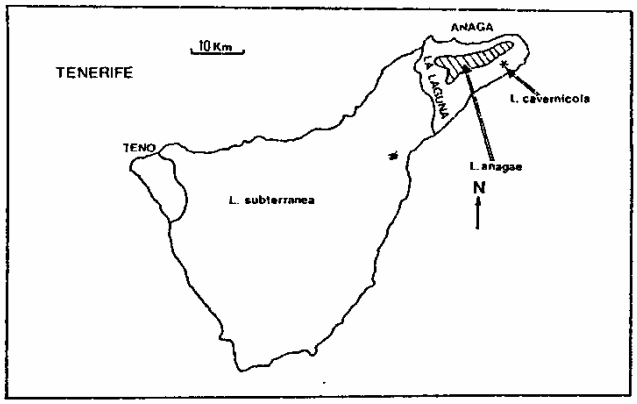

Fig. 2. Hypothetical distribution of the three species of Loboptera *existing in the subsoil of Tenerife.*

its preset level during the past wet period (WILDPRET, comm. pers.). Thus, an organic soil layer covered the lower areas, allowing the colonization of the underground superficial compartment. A single *Loboptera* would spread over by then from the hills down near the sea level. The forest receded during a drought period and the underground superficial compartment begin to dry out. At the same time, the hypogeous species of the same compartment also reduced their spreading areas to the hills only.

According to this hypothesis, some populations remained isolated in caves like Sima Robada during the recesing period, though they continued to be humid because of their significat depth. In some time, this population would differ from those of the hills and would become *L. cavernicola.*

Something similar could have happened in El Hierro islad. The differences found between the two *Loboptera* from this island do not appear clearly enough to consider them as different species. This suggests that this process of evolution has ocurred recently. The distribution area of the two subspecies, *L.o. ombriosa* and *L. o. meridionalis*, is separated by an old basalt band of more than one million years (SCHMINCKE, 1976; PELLICER, 1977), which could form an impassable barrier for both of them (fig. 3).

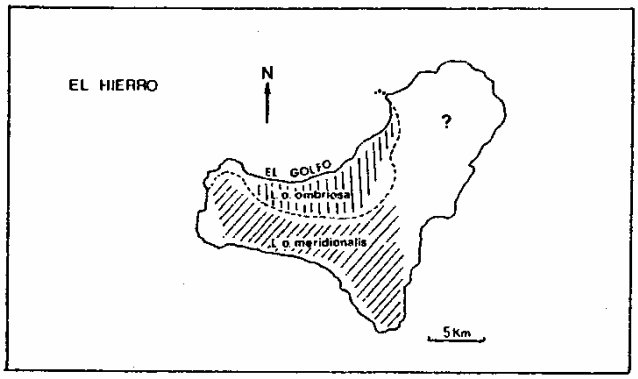

Fig. 3. Hypothetical distribution of the two subspecies of L. ombriosa *existing in the subsoil of Hierro.*

As it happened in Tenerife, other island underwent similar variation of weather conditions which affected the distribution of the original species. During wet period, the laurel forest covered a more extension than today, even descending by the southern slopes of the island (WILPRET, comm. pers.). The *Loboptera* would spread over almost throughout the entire island at this time.

Ater the forest regresion in the following drought period, these southern populations, which had been already accustomed themselves to the underground deep compartment, were the isolated from those of the north, and therefore, they were only to stay in the deep subsoil as the surface dryness increased. The northern populations of El Hierro island continued to live on the surface (in the forest confined inside the area known as El

Golfo), and in both the deep and superficial underground compartment. The old basalt band acted as an effective barrier since the subterranean dispersion was stopped by the low humidity in the underground superficial compartment and by the old age of the underground deep compartment.

We conclude that the distribution studies of the genus *Loboptera* in the Canary Islands reflects the influence of several factors on the distinction of the hypogeous species. The more significant factors are: the paleoclimate and their effect on the islands flora; the existence of a deep and a superficial underground compartment; the islandsage; and the age of specific land within the island. These five «agents» are related in their performance: the paleoclimates affect the forest expansion, which modifies itself the habitation of the undergroung superficial compartment. The geological age of a particular area may avoid the dispersion through the underground deep compartment in the oldest an eroded places. Underground barries are formed when all of these agents impede the dispersion through the deep and superficial underground compartments. Finally, the islands' age will adjust the evolution and adaptation degrees of species in relation to the time disposal for the underground environment colonization.

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