

THE GENUS "*LICINOPSIS* BEDEL (COL., CARABOIDEA) " IN THE CANARY ISLANDS AND ITS DISTRIBUTION IN THE UNDERGROUND ENVIRONMENT

by

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The Canarian endemic genus *Licinopsis* is distributed throughout the islands of Tenerife, La Gomera, La Palma and El Hierro in a somewhat complex way (Fig. 1). It was assigned by BEDEL (1899) to *Pristonychus alternans* Dejean, 1898, one of the earliest carabids of the Canarian fauna to be described. Any coleopterous species described in the islands before 1860 refers - or at least referred - to a common insect, with a clearly epigeal life. After this time (1864-65), WOLLASTON's detailed research contributed to the discovery of many less common species, some of them being extremely rare for the author such as *Licinopsis picescens* (Woll., 1864) or *L. oblitterata* (Woll., 1865). It was later proved that the apparent rareness of these insects was due to their occupation of the hypogean environment and they were found when they occasionally appeared on or near the surface. The hypogean environment was not investigated by WOLLASTON or by any other entomologists of that time.

In our century searching below the surface has been undertaken more carefully, resulting in the discovery of some additional carabids such as *Limnastis gaudini* Jeann., 1929, *Pseudomyas doramasensis* Uytt., 1929, *Pseudoplatyderus amblyops* C. Bol., 1940, etc., which were described on the basis of unique specimens found in strata not completely defined as hypogean or endogean. It was after 1980 when the research in the real hypogean environment - i. e. lava tubes and the superficial underground compartment (MSS) - led to the discovery of many new species of ground beetles (MACHADO, 1984 et 1987 ; HERNANDEZ et al., 1986 ; OROMI et al., 1986). In relation to *Licinopsis* the data is evident today : four of eight presently known forms have been discovered and defined in recent years, i.e. *L. angustula* Machado, *L. angustula schurmanni* Machado, *L. oblitterata franzi* Machado and *L. picescens gomerita* Machado. *L. picescens picescens* (Woll., 1864) - previously known from very few specimens - has been found abundantly in the MSS.

The various species and subspecies included in this genus present a complex and special insular distribution and diverse adaptations to the underground environment (Table 1). Some forms are clearly epigeal in their morphology and behaviour, while others are clearly hypogean. However, in the latter case the adaptations are not sufficiently appreciable for the insects to be considered troglomorphic in the sense of CHRISTIANSEN (1964). Also, all of the existent forms have been collected on the surface at least once. Except for the two markedly epigeal species, the rest are basically underground insects still preserving their capacity to occupy the epigeal environment under very special circumstances.

According to their habitat and morphological adaptations, both *L. alternans* and *L. gaudini* may be considered typically epigeal species : they are well pigmented insects, with completely developed eyes and a wide body. *L. alternans* is quite abundant on the surface and is distributed throughout open areas of Tenerife, even showing a certain preference for xeric environments. Its particular adaptation to different altitudes is a remarkable one, as it can be found at an altitude ranging from the sea level to around 2,300 m (CAMPOS, comm. pers. ; MACHADO, 1987) ; it has been collected in caves, though always near the entrance. *L. gaudini* is only known in epigeal environments at La

species	island	age	abundance			colour	eyes
			surf.	MSS	Cave		
<i>alternans</i>	Tenerife	7 - 16	***		*	black	normal
<i>gaudini</i>	La Palma	1.5	**			brown	normal
<i>obliterata</i>	La Gomera	8 - 18	*	?		dark-brown	normal
<i>obl. franzi</i>	El Hierro	1		**	*	dark-brown	reduced
<i>picescens</i>	El Hierro	1	*	***	**	dark-brown	reduced
<i>pic. gomerita</i>	La Gomera	8 - 18	*	?		dark-brown	reduced
<i>angustula</i>	La Palma	1.5	*	**	***	reddish	very
<i>a. schurmanni</i>	El Hierro	1	*	**		reddish	very red.

Tabl. 1 - Distribution and adaptations in the species and subspecies of *Licinopsis*. Ages in million of years.

Cumbrecita and Barranco del Riachuelo area (La Palma), where it is locally frequent. It has never been found in caves or in the MSS.

The other six forms are insects rarely found on the surface and generally adapted to underground life in a greater or lesser degree. *L. obliterata* s. str. is the only morphologically epigean form, but the few specimens seen in an area constantly visited by entomologists - El Cedro and Meriga, La Gomera island - makes us suspect that its real habitat is the MSS. It is significant too that its close relative (and probable vicariant) *L. obliterata franzi* has been found fairly frequently in the MSS of El Hierro and less commonly in some caves. At this moment, the problem cannot be solved because little subterranean investigation has been carried out in La Gomera.

L. picescens is more clearly adapted to subterranean life, especially in its size and body shape. Although known from an early date on the basis of a few specimens captured on the surface, it abounds in the MSS of the wet zone at El Golfo (El Hierro island), as well as in caves in the same area. Its close relative *L. picescens gomerita* is the most puzzling species within the genus, for the single specimen found was collected in a habitat unfavourable for all such insects (MACHADO, 1987). This suggest that ssp. *gomerita* is also occupying the MSS in La Gomera, which has been scarcely prospected, as already indicated. All the hypogean forms collected in El Hierro and La Palma islands were known thanks to the few specimens captured on the surface, before their abundance in the underground environment was discovered.

L. angustula is undoubtedly the most adapted species to the hypogean environment, featuring more reduced eyes, very narrow body and weakened pigmentation. It is represented by subspecies *angustula* s. str. and *angustula schurmanni* in La Palma and El Hierro respectively; the former is quite common in caves, less frequent in the MSS and occasional on the surface; the latter occupies the MSS of certain zones in the south of the island, but it has never been seen in caves and its sole capture on the surface can be regarded as casual.

Analysis of the situation on the four islands turned out to be somewhat different for each case. Tenerife - the biggest and one of the oldest islands - presents the greatest variety of habitats and offers good possibilities for speciation in many insects. *Licinopsis*, however, is represented only by *L. alternans*, a clearly epigean species which is now spread extensively through out the island (Fig. 1). It is absent only from humid forest such as the laurel forest and certain pine forests where it might be in competition with species from *Calathidius*, a genus closely related to *Licinopsis* to MACHADO (1987). The hypogean environment of Tenerife has been colonized by many arthropods (HERNANDEZ et al., 1986) and is the richest of the archipelago in species fully adapted to underground life. However, no *Licinopsis* has become troglobitic here and the only known species on the island has never been collected in the MSS or in the MSP (deep underground compartment). At the most, it has been found at the entrance of some caves, this not implying a hypogean adaptation since

we are dealing with a typically epigeal insect as already indicated.

Amongst the troglobitic species of Tenerife are two carabids of the same group as *Licinopsis*, the Pterostichine *Eutrichopus martini* Machado and *Wolltinertia tenerifae* (Machado). Other phylogenetically less related species are present as well. This fauna of troglobites close related to *Licinopsis*, may have been an obstacle to the evolution of new *Licinopsis* forms during the subsoil colonization in this island. This situation, contrasting with that in other islands, could be the reason why the genus has not diversified in Tenerife.

The absence of recent volcanic activity in La Gomera island has resulted in an almost total lack of volcanic cavities in this old island (MARTIN et al., 1984). Thus it is not possible to collect at the MSS, and the MSS has not been studied properly. Nevertheless, several eyeless species, i. e. *Limnastis gaudini gomerensis* Franz and *Pseudoplatyderus amblyops* C. Bol., are known to have appeared in the laurel forest. *Limnastis gaudini* is a trechine with more endogean features, appearing in fact in the edaphic environment. However, a closely related form - *L. gaudini gaudini* Jeann. - has frequently been found in volcanic caves on Tenerife (MARTIN et al., in press). *Pseudoplatyderus amblyops* is much more rare : only four specimens are known, and it has been considered an ambimorph with appendages and body size resembling those of a hypogean insect rather than an endogean one. The three latest captures made by VIGNA TAGLIANTI (comm. pers.) and ourselves were in the MSS. Further information is needed in order to determine whether the MSS has been also colonized by the two *Licinopsis* forms of La Gomera : *L. obliterated obliterated* and *L. picescens gomerita*. As previously mentioned, the records of these two forms are quite scarce and are confined to two ravines in the north of the island (Fig. 1). If the genus *Licinopsis* has actually colonized the MSS on La Gomera it may prove to be quite widely distributed, occupying the subsoil almost completely both in La Gomera and in La Palma, though only appearing on the surface in the northern more humid areas.

La Palma is characterized by its abundant lava tubes spreading throughout the island, except around the central area (Caldera de Taburiente), described as a more primitive and highly eroded landscape. The dryness of the atmosphere and soil are also significant features of this caldera, and may account for the absence of *Licinopsis* and other insects from the hypogean environment in this site. It is precisely here where *L. gaudini* colonizes the epigeal environment. In other parts of the island there is evidently a network of interconnecting cracks, since *L. angustula* s. str. has been found at many places within the hypogean environment (Fig. 1). Then other troglobitic species such as the blatellid *Loboptera fortunata* and the staphylinid *Domene benahoarensis* show a similar distribution.

In terms of troglobitic species, the subsoil of La Palma is not so rich as the subsoil of Tenerife, but richer than that of El Hierro. The analysis of the degree of adaptation of the species found in the three islands shows that this is greatest in Tenerife and lowest in El Hierro, whereas La Palma occupies an intermediate position. In fact, from the latter island several troglobitic staphylinids are known and also two troglobitic carabids (but no pterostichines) ; on Tenerife the number of troglobitic species is always higher. The relative scarcity of potential competitors in the hypogean environment of La Palma may have permitted *L. angustula* to adapt perfectly to it, in contrast to the situation on Tenerife.

The situation in El Hierro is surely the most complex of them all. It is the poorest, smallest and most remote island, but the hypogean environment there is occupied by three different, more or less transformed *Licinopsis* species. The distribution pattern is quite a peculiar one : *L. picescens picescens* is limited to the northern, humid forest zone of El Golfo and has colonized both the MSS and caves ; *L. obliterated franzi* has been collected in three widely separated points in the southern part and thus presumably occupying the subsoil of that southern slope ; *L. angustula schurmanni* has also appeared in the MSS, sharing the same habitat with *L. obliterated franzi*, since both have been sometimes collected at the same traps. It is therefore clear that, in El Hierro, a geographical exclusion affects one of the *Licinopsis* species which is separated from the other two by an ecological barrier - the main ridge of the island. This pattern coincides with that already proposed by MARTIN et al. (1986) for two subspecies of *Loboptera ombriosa*. *Licinopsis picescens* and *Loboptera ombriosa ombriosa* have been collected in El Golfo, in the same caves and MSS stations. Additionally, other insects such as *Trechus minioculatus* Machado and *Conosoma* sp. were captured. None of these species have ever been found in the southern slope, except *Loboptera ombriosa meridionalis* Martin and Izquierdo, *Licinopsis obliterated franzi* and *L. angustula schurmanni*, which are not strictly associated as the northern species mentioned above.

We believe that the presence of three different forms of *Licinopsis* in El Hierro is due to a combination of three factors. First there is an old basaltic strip forming a subterranean barrier which separates a climatically distinct northern and southern slopes. Second, *L. angustula* s. l. is only

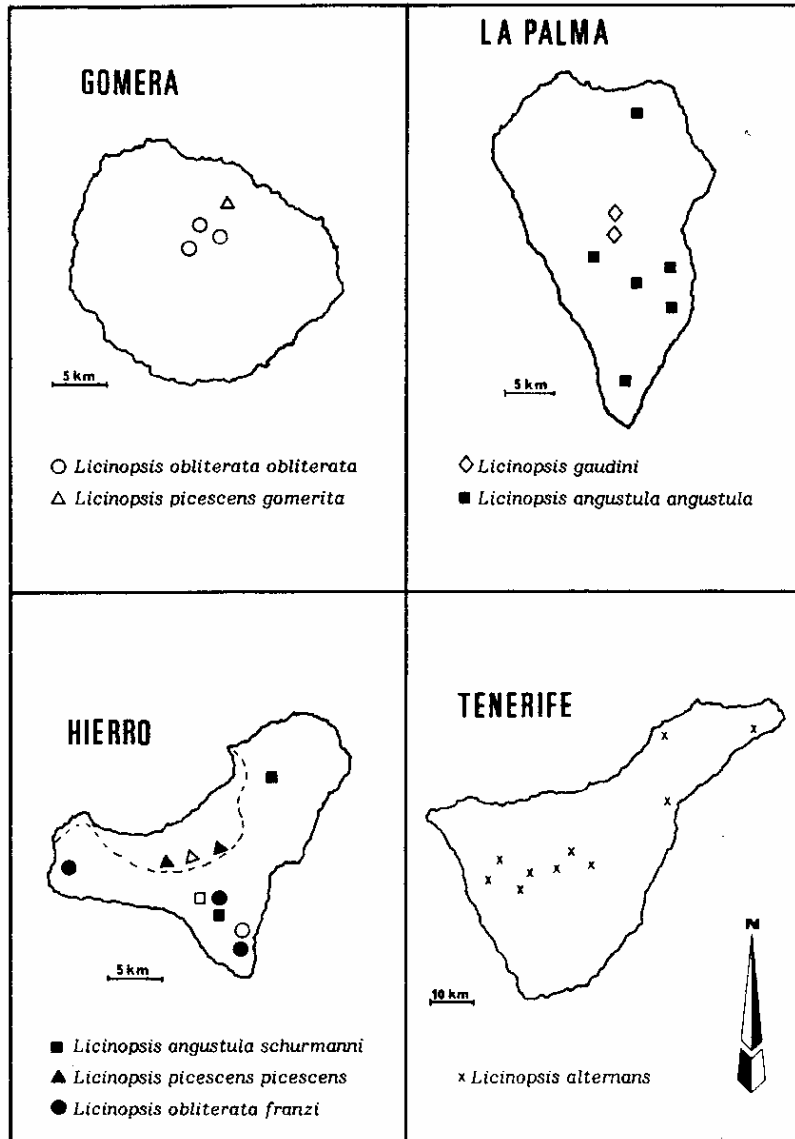


Fig. 1 - Distribution of the different species of the genus *Licinopsis* in the Canary Islands.

distantly related to the other *Licinopsis*, forming a separate subgenus (MACHADO, 1987); this would explain the peculiar co-existence of this species with *L. obliterata franzi*, which would have been difficult to understand if they had been closely related forms. Third, the relative poorness of the subsoil of El Hierro in troglobite species - probably due to its being the youngest island geologically - may have facilitated the occupation of this environment by *Licinopsis*. In fact, there is only one other underground beetle species in El Hierro - *Trechus minioculatus* - and this is unlikely to be a competitor of *Licinopsis* because of its much smaller size and lack of close relationship.

Finally, no *Licinopsis* are known from Gran Canaria island, as nobody has yet prospected the subsoil there. However, a single specimen of the pterostichine *Pseudomyas doramasensis* Uytt. has been found there and this species may occupy the underground compartment in this island.

Following the reasoning outlined above, the colonization of the hypogean environment by *Licinopsis* could partially depend on the prior occupation of the habitat by other species, which was probably more important in Tenerife than in El Hierro. The implication is that wherever *Licinopsis* could occupy the underground compartment, it did so more recently than other troglobites, such as certain *Trechus*, *Domene* and *Apteranopsis*, as well as other arthropods. This is supported by the tendency of *Licinopsis* to develop into ambimorphic rather than troglomorphic species (CHRISTIANSEN, 1964). Thus, before *Licinopsis* started to colonize the hypogean environment,

other troglobites existed already and could have stopped the settlement to some extent.

The idea of a recent colonization is also affirmed by the existence of several closely related hypogean species, in contrast of the situation in almost all the most modified troglobites of the Canaries (MARTIN et al., in press).

Amongst the hypogean *Licinopsis*, *L. angustula* s. str. of La Palma and *L. angustula schurmanni* of El Hierro are the ones presenting the most notable morphological adaptations; next are *picescens* s. str. of El Hierro and *picescens gomerita* of La Gomera; finally, *obliterata franzi* of El Hierro and *obliterata* s. str. of La Gomera are respectively the least transformed species. If a relationship is admitted between the adaptation level and the time since the beginning of subsoil colonization, the first colonist would have to be *angustula*. As this species is found in La Palma and also in El Hierro - one of the youngest islands (SCHMINCKE, 1976) - it appears that the age of the species does not depend on the age of the island, but rather on the time since colonization. This supposition along with the one referring to each species being represented in the hypogean environment of two different islands, lead us to conclude that the settlement probably took place in three different stages that affected each island in a particular way.

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SUMMARY

Licinopsis is an endemic genus from the four westernmost islands of the Canaries (Tenerife, La Gomera, La Palma and El Hierro), consisting of five different species and several subspecies. All the eight different taxa are monoisular endemics, with two or more species on each island excepting Tenerife, with only one.

Two members of the genus have nearly always been found on the surface, and thus considered as epigeal insects. However the remainder, which very rarely occur in this environment, are rather abundant in the caves or in the MSS (milieu souterrain superficiel). Although these species show some adaptations to hypogean life such as eye reduction or integument depigmentation, none of them can be considered as truly troglomorphic species.

The habitat and distribution of each species and subspecies is analyzed, and the possible reasons leading to their geographical or ecological isolation, their differentiation and their rate of adaptation to the hypogean environment is discussed. One of the most relevant features observed is that, on the contrary to other subterranean arthropods, the more adapted forms are found on the youngest islands (El Hierro and La Palma), whereas one of the less adapted species is on the oldest (Tenerife).

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