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A cavernicolous planthopper in the Galápagos Islands (Homoptera: Auchenorrhyncha: Cixiidae)

H. HOCH and I. IZQUIERDO*

Musuem für Naturkunde der Humboldt Universität zu Berlin, Institut für Systematische Zoologie, Invalidenstraße 43, D-10115 Berlin, Germany
** Universidad de La Laguna, Departamento de Biología Animal, Facultad de Biología, 38206 La Laguna, Tenerife, Canary Islands, Spain*

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A new troglobitic cixiid species, *Oliarus hernandezi* sp. n. is described from three lava tubes on the island of Floreana, Galápagos group. It is the first known obligately cavernicolous planthopper species from Galápagos. Notes on its ecology and distribution are given, and phylogenetic relationships to epigean *Oliarus* species from Galápagos are discussed.

KEYWORDS: *Oliarus hernandezi*, troglobitic, lava tubes, caves, planthoppers, Galápagos, Floreana

Introduction

In the last two decades, the results of intensive faunistic investigations of limestone caves and lava tubes in tropical regions have disproven the long-held belief that obligately cavernicolous (troglobitic) terrestrial arthropods are poorly represented in the tropics (Vandel, 1965; Barr, 1973). Among the arthropods, planthoppers (Homoptera: Auchenorrhyncha: Fulgoroidea), as rhizophagous primary consumers, have been recognized as important elements within cave communities (Howarth, 1981a). Cavernicolous planthoppers of the families Cixiidae, Meenoplidae, Kinnaridae and Delphacidae are known from Hawaii, Australia, New Zealand, New Caledonia, Western Samoa, Mexico, Jamaica, Madagascar, the Canary Is. and the Azores (see synopsis in Hoch, 1994). The recent discovery of a new troglobitic planthopper species in Galápagos (Floreana Is.) closes a gap in our knowledge of the geographic distribution of cave planthoppers in the Pacific.

Depositories of material

MCNT: Museo de Ciencias Naturales, Santa Cruz de Tenerife, Canary Islands, Spain. BPBM: Bernice P. Bishop Museum, Hawaii, USA. BMNH: The Natural History Museum, London, UK. AH: Private collection of M. Asche and H. Hoch, Berlin, Germany. ZMH: Zoologisches Institut und Zoologisches Museum, Hamburg, Germany. MFN: Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany.

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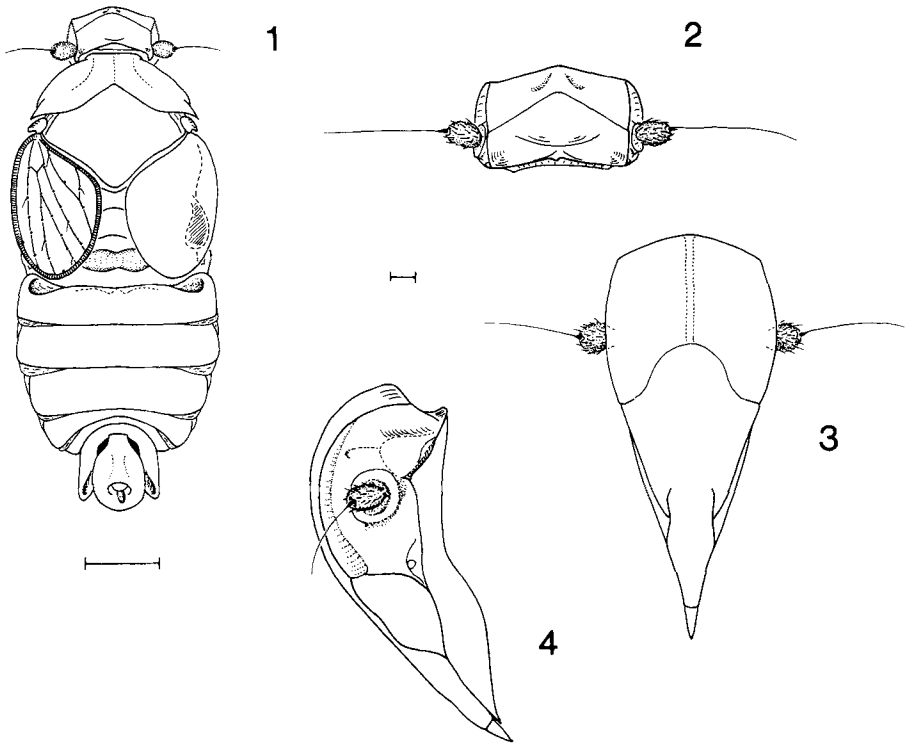


FIGS 1–4. *Oliarus hernandezi* n. sp.: paratype male (1) habitus; (2) head, dorsal aspect; (3) same, ventral aspect; (4) same, left lateral aspect. Scale bar: Fig. 1 = 0·5 mm; Figs 2–4 = 0·1 mm.

Oliarus hernandezi Hoch and Izquierdo, **sp. nov.**
(Figs 1–12)

Types

Male HOLOTYPE from Finch Cave, Floreana I., Post Office Bay, 20 April 1990, I. Izquierdo, MCNT.

Twenty-one male PARATYPES and 6 female paratypes with same data as holotype and 21 April 1990, J. J. Hernández and I. Izquierdo, MCNT, BPBM, BMNH, AH. Eighteen male paratypes and 2 female paratypes with same data as holotype except 24–28 March 1991; J. J. Hernández and I. Izquierdo, MCNT, ZMH, MFN.

Fifteen male paratypes and 1 female paratype from Barn Owl Cave, Floreana I., 21 April 1990, I. Izquierdo, MCNT.

One male paratype from Post Office Cave, Floreana I., 24–28 March 1991, J. J. Hernández, MCNT.

Additional material: 18 nymphs (2nd, 3rd, 4th, 5th instar) from Finch Cave, Barn Owl Cave, Post Office Cave, Floreana I., data as in type-material, MCNT.

Diagnosis

Cavernicolous. Medium-sized cixiid species with distinct troglomorphic characters: reduction of compound eyes, rudimentary wings and whitish-yellow integument. Differing from other *Oliarus* species from Galápagos by these characters and by the male genital structures.

Description

Habitus strongly troglomorphic, with reduced eyes, tegmina, and bodily pigmentation.

Total length. Male: 3·6–5·4 mm (4·3 + 0·33 mm; $n = 37$). Female: 4·3–5·8 mm (4·7 + 0·5 mm; $n = 8$).

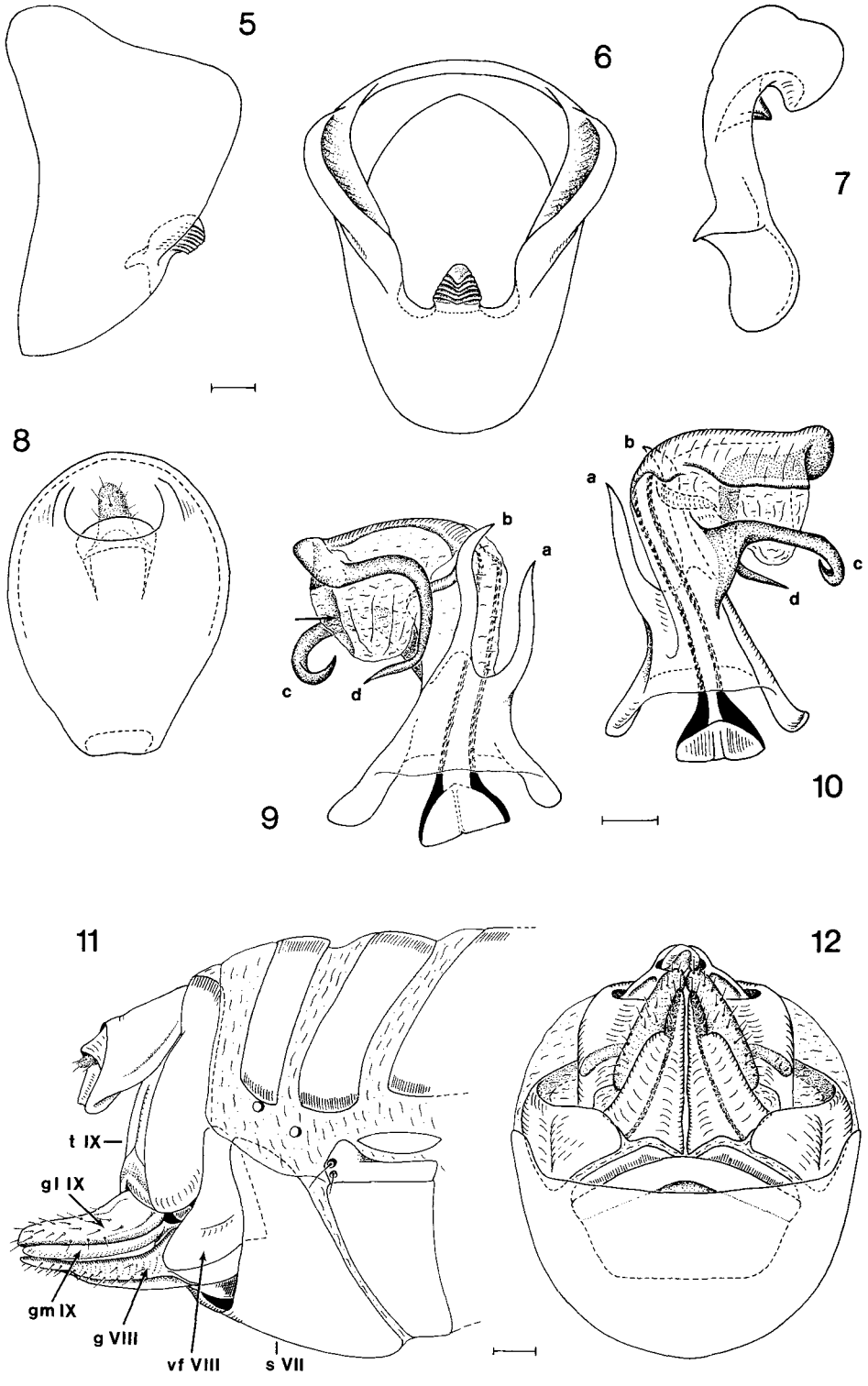
Colouration. Body uniformly yellowish, antennae and metatergites whitish-yellow, tegmina translucent, venation pale yellow.

Head (Figs 1, 2–4). Vertex short, slightly concave, about 2·1× as wide as it is long in the middle line, indistinctly separated from frons by an obsolete transverse carina. Frons convex, slightly wider than medially high (1·1 : 1), lateral carinae ridged, median carina vanishing. Clypeus smooth, without median or lateral carinae. Post- and anteclypeus together *ca.* 1·8× as long as frons in middle line. Rostrum elongate, surpassing post-trochanters. Compound eyes and ocelli absent. First antennal segment short, ring-like, second antennal segment subglobular.

Thorax (Fig. 1). Pronotum short, medially about as long as vertex, indistinctly tricarinate, lateral carinae diverging posteriorly, not attaining posterior margin; posterior margin shallowly excavated. Mesonotum shallowly vaulted, smooth, median carina absent, in some specimens lateral carinae present, but very feebly defined; in midline about 3·1× the length of pronotum. Tegulae vestigial. Tegmina strongly reduced, posteriorly not surpassing fourth abdominal tergite; venation rudimentary and variable among individuals, with sporadic bases of bristles along veins. Wings vestigial. Metatibiae laterally with one to four minute spines (individually varying), apically with six teeth. First metatarsal segment slightly longer than the second and third together. First metatarsal segment with five, second with four apical teeth. Pretarsal claws and arolia well developed.

Male genitalia. Genital segment (Figs 5, 6) symmetrical, *ca* 1·2× higher than wide, ventrally 8·7× longer than dorsally, dorsolaterally produced into a right angulate lobe; medioventral process as in epigean *Oliarus* from Galápagos 'approximately wedge-shaped, tapering distad, ornamented with five or six parallel rows of ridges' (Fennah, 1967). Parameres (Fig. 7) short, stout, apical third produced into a broad lobe which is directed caudodorsad and apically rounded; medially with a triangular process directed mediocephalad. Connective straight. Anal segment (Fig. 8) ovate in dorsal aspect, 1·4× longer than wide, anal foramen in distal third, Aedeagus (Figs 9, 10) as figured: basal part (shaft) ventrally with two strong, rigid spines (a, b), of which the right one is directed caudad, the left one runs parallel to the right one over its basal two thirds, with its apical third pointing to the right side. Shaft dorsally with a long slender spine (c) which arises from an extended yet narrow basis and is curved left laterad in its basal 0·75, then abruptly bent ventrad in its apical 0·25. Distal part of aedeagus (flagellum) comparatively short, in repose directed to left, in dorsal aspect apically with a band-shaped sclerotized plate; membraneous part inconspicuous with phallotreme exposed to the left; at the left lateral corner of the band-shaped sclerotized plate arises a long, slender spine (d) which in its basal third is curved medioventrad, then abruptly bent basad and pointing left laterad in its distal third.

Female genitalia (Figs 11, 12). Seventh sternite short, with distal margin straight, cephalic margin shallowly curved cephalad. Ventral portion of genital chamber with a distinct sclerite which surpasses distal margin of 7th sternite. Ovipositor reduced, short, in repose directed (ventro-)laterad. Gonapophyses VIII arising from a wide base but tapering into an acute apical portion, supported by a strong longitudinal sclerite. Median gonapophyses IX in repose completely covered by gonapophyses



VIII, only basally fused, narrow, apically tapering. Lateral gonapophyses IX short, stout, beset with numerous bristles. Tergite IX truncate, only slightly concave, with wax-secreting area indistinctly limited. Anal tube with ventral side slightly concave, but medially with a longitudinal ridge, lateral margins slightly compressed and extended laterad.

Distribution and ecology

Oliarus hernandezi n. sp. is known only from three lava tubes located in Post-Office Bay, to the north of Floreana Is. (Galápagos): Post-Office Cave, Barn Owl Cave and Finch Cave. All of them are near each other, running from sea level to 50 m a.s.l. (Fig. 13).

Post-Office Cave is a lava tube of 263 m length, and it is divided in two sections. In the lower one, with a length of 202 m, there is an underground pool of sea water extending nearly 60 m. The examples of *Oliarus hernandezi* n. sp. from this cave were collected from the land passage, together with 18 other invertebrate species (Hernandez *et al.*, 1992).

Barn Owl Cave is a lava tube of only 33 m length and a great part of its length is open to outside, but this is a cave of great paleontological relevance (Steadman, 1986).

Finch Cave is situated at nearly 50 m a.s.l. and, with a length of about 110 m, has an interesting troglobite community. Most examples of *Oliarus hernandezi* n. sp. studied (87%) were collected in this tube, all of them at the north end of the cave. In this area clay sediments and roots from the outside accumulate, carried through the only opening towards the inside of the cavity after the periodically heavy rains in Galápagos. The accumulation of these sediments has given rise to a clay substratum of considerable strength, very cracked and with abundant live roots inside these cracks. Therefore, in this cave, the main energy source—plant material—is not provided by roots of epigean plants which penetrate through cracks in basalt, but by rootlets which occur in the voids left by the retraction of the floor, and which are likely to be restored periodically. After the heavy rains, the hall remains flooded during a certain time. The temperature fluctuates around 26°C, and the soil humidity recorded reached 98·5%. In this environment, *Oliarus hernandezi* n. sp. cohabits with other troglobite and endemic species of Floreana such as the Isopoda *Venezillo (Sulcozillo) specus* (Rodriguez and Hernández, in press), and four undetermined species of spiders belonging to the families Pholcidae, Araneidae, Linyphiidae and Gnaphosidae (Hernandez *et al.*, 1992).

The age of these caves is unknown, but probably they can be as young as 30 000 years B.P. or less and, the vertebrate fossil fauna of these caves can safely be assumed to the late Holocean in age (Steadman, 1986).

Its strongly developed troglomorphies and its habitat in permanent darkness

FIGS 5–10. *Oliarus hernandezi* n. sp.: paratype male, genitalia, (5) genital segment (pygofer), left lateral aspect; (6) same, ventrocaudal aspect; (7) right paramere, maximal aspect; (8) anal segment, dorsal aspect; (9) aedeagus, ventral aspect (arrow = phallotreme); (10) same, dorsal aspect.

FIGS 11–12. *Oliarus hernandezi* n. sp.: paratype female, genitalia, (11) abdomen, right lateral aspect (t IX = 9th tergite, gl IX = lateral gonapohyses IX, gm IX = median gonapophyses IX, g VIII = gonapophyses VIII, vf VIII = valvifers VIII, s VII = 7th sternite); (12) female genitalia, ventral aspect. Scale bar: Figs 5–8 = 0·1 mm; Figs 9–10 = 0·1 mm; Figs 11–12 = 0·1 mm.

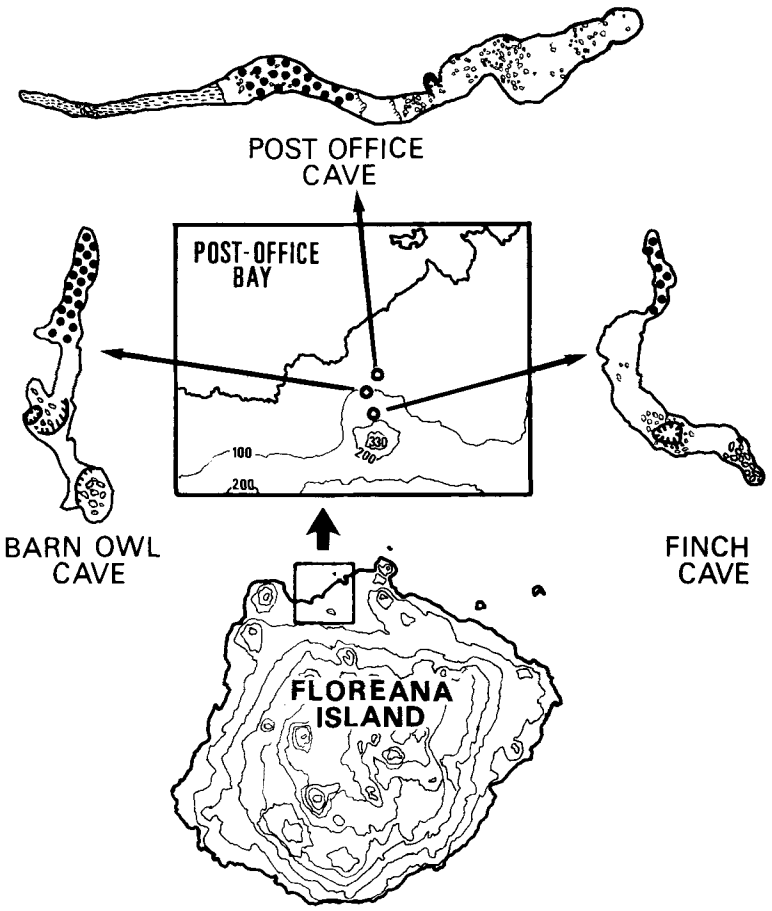


FIG 13. Cave locations of *Oliarus hernandezi* n. sp.. Black dots mark the distribution of *O. hernandezi* specimens inside each cave.

suggest that *Oliarus hernandezi* is restricted to the cave environment, and therefore ecologically classifiable as troglobitic.

Etymology

The species is named *in memoriam* of our dear friend, colleague, and caving companion, the late Juan José Hernández (formerly Museo de Ciencias Naturales de Tenerife, Santa Cruz de Tenerife).

Remarks

In the Pacific, the genus *Oliarus* is widely distributed and present in the epigean fauna of virtually all major high islands. Cavernicolous *Oliarus* species, however, are only known from the Hawaiian Islands (at least thirteen species: see Hoch and Howarth, 1993) and now from the Galápagos Is. (one species). In the epigean fauna of the Galápagos Is., *Oliarus* is represented with five species from five islands (Fennah, 1967). The only known epigean *Oliarus* species from Floreana is *O. alastor*

Fennah (Fennah, 1967). This species, however, differs considerably from the cavernicolous and highly troglomorphic *O. hernandezi* in characters of the male genitalia, especially in number and location of the aedeagal spinose processes, thus it can hardly be regarded as the closest relative in the epigean fauna. In its genital morphology, *O. hernandezi* resembles by far more *O. agrippa* Fennah which is known from Santa Cruz. Since inter-island dispersal can be excluded in terrestrial obligately cavernicolous species, it is possible that *O. agrippa* or an *O. agrippa*-like species once occurred on Floreana. Whether or not they still do, cannot be answered yet, since the epigean cixiid fauna of the Galápagos Is. must still be regarded as insufficiently known. Recent investigations by S. Peck (Ottawa, Canada) and collaborators have revealed the existence of several more *Oliarus* species in the Galápagos Is. (Hoch and Peck, in prep.). The present state of knowledge does not allow to comment on the possible relict status of *O. hernandezi*. Even if today *O. hernandezi* could be confirmed as a 'relict insulaire' (Martín *et al.*, 1989) i.e., no close epigean relative exists on the surface of the same island, it cannot be decided whether the evolution of its cave adaptation occured in parapatry as the result of an adaptive shift (*sensu* Howarth, 1981b, 1986), or in allopatry subsequent to the disappearance of the epigean ancestral species (*sensu* Barr, 1968).

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