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NISIA SUBFOGO SP. N., A NEW CAVE-DWELLING PLANTHOPPER FROM THE CAPE VERDE ISLANDS (HEMIPTERA: FULGOROMORPHA: MEENOPLIDAE)[1]

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ABSTRACT

A new planthopper species, *Nisia subfogo* sp.n. is described from a lava tube on the island of Fogo, Cape Verde Islands. This is the first troglobitic planthopper known in the archipelago, where no cave-adapted fauna had ever been found before. The new species is related to other species of *Nisia* occuring on the surface habitats of Cape Verde.

Key words: *Nisia subfogo*, Meenoplidae, troglobite, lava tube, Cape Verde Islands.

RESUMEN

Se describe una nueva especie de Meenóplido procedente de un tubo volcánico de la isla de Fogo, Cabo Verde. Es el primer hemíptero troglobio conocido en el archipiélago, donde no se había encontrado hasta ahora ningún tipo de fauna cavernícola. La nueva especie está emparentada con otras especies de *Nisia* propias de hábitats de superficie de Cabo Verde.

Palabras clave: *Nisia subfogo*, Meenoplidae, troglobio, tubo de lava, Cabo Verde.

[1] This work is part of the TFMC project *"MACARONESIA 2000"*

1. INTRODUCTION

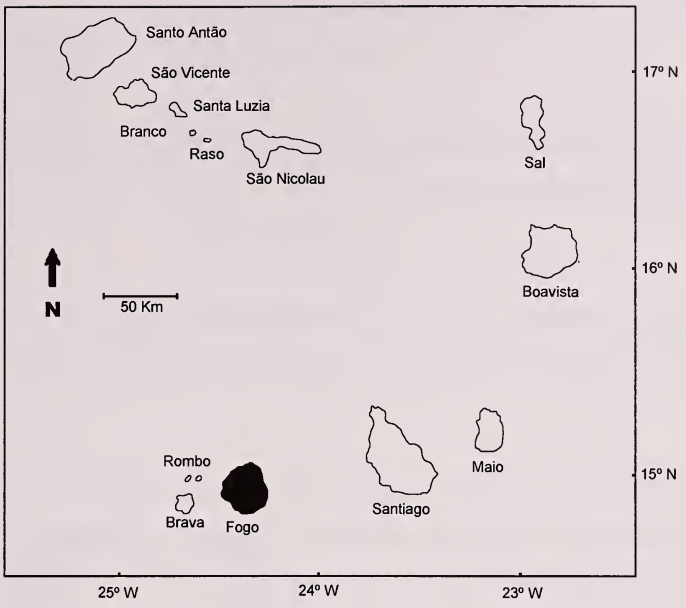
Planthoppers of the vast Cixiidae and Meenoplidae families include some hypogean species that feed on the roots and seedlings growing inside the caves. Many of these species are highly adapted to cave life, and can be found in many places around the world, especially in tropical and subtropical areas [6]. Volcanic islands provide special kinds of cave which are particularly appropriate to harbour planthopper populations. Indeed lava tubes are usually shallow caves and the roots of surface plants easily reach their passages, either hanging from the roof or growing along their lateral walls and on the ground. A variety of such species have been described in tropical oceanic archipelagos in the Pacific like Hawaii [3, 9], Samoa [7] or Galápagos [4].

The eastern Atlantic islands known as a whole as Macaronesia, range from true tropical (Cape Verdes, between 14° 48' and 17° 22'N) and subtropical (Canaries and Madeiras) to temperate islands (Azores, between 36° 55' and 39° 45'N). At least two of the Macaronesian archipelagos hold an interesting troglobitic planthopper fauna, living either in lave tubes or in the so called mesocavernous shallow stratum ("*milieu souterrain superficiel*" according to Juberthie [13]). Occurring on the Azores are *Cixius azopicavus* Hoch and *Cixius cavazoricus* Hoch on Pico and Faial islands respectively [5]. These species are related to the endemic epigean *Cixius azoricus* Lindberg. No species have ever been found in the scarce Madeiran caves, and this is either due to their deep location underground or insufficient searching.

A variety of troglobitic planthoppers occur among the rich hypogean Canarian fauna: three Cixiidae in Tenerife (*Tachycixius* spp.), two Cixiidae and two Meenoplidae in Hierro (*Cixius* spp. and *Meenoplus* spp.), four Cixiidae and one Meenoplidae in La Palma (*Cixius* spp. and *Meenoplus* spp.) each species being endemic to a single island [8]. *Tachycixius* and *Cixius* are also represented by epigean taxa on the archipelago, but for the genus *Meenoplus* no surface species have been reported so far and it is represented only by the four cave species mentioned above.

The southernmost spot on Macaronesia are the Cape Verde islands, an arc-shaped archipelago facing West Africa and made up of ten main islands with no recent volcanic activity, except Fogo (fig. 1). Fogo is mainly basaltic and still active (last eruption in 1995), with abundant fluid lavas that produced lava tubes just before solidifying.

No descriptions or surveys of these caves have ever been published and there is hardly any reference to them in scientific papers. The presence of the cave-adapted fauna has been completely ignored. A biospeleological expedition was organized in January 1999 by the Museo de Ciencias Naturales de Tenerife, with the aim of exploring lava tubes in Cape Verde and looking for a hypothetical cave-dwelling fauna that could be living there. At least three new troglobitic species were found in Fogo caves, two spiders and a planthopper, the latter described in this paper.


Santo Antão
São Vicente
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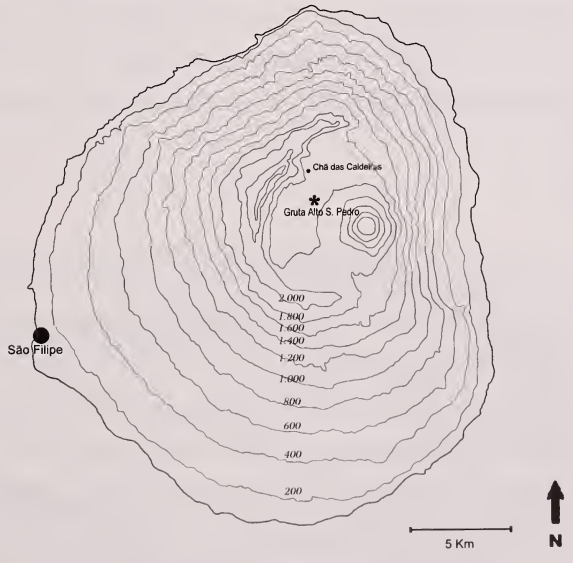

Chã das Caldeiras
Gruta Alto S. Pedro
São Filipe
2.000
1.800
1.600
1.400
1.200
1.000
800
600
400
200
5 Km
N

Figura 1.

Nisia subfogo **Hoch & Oromí sp. nov.**

(fig. 2-10)

Description.

Cavernicolous meenoplid species displaying troglomorphic characters: compound eyes and ocelli missing, tegmina and wings distally reduced.

Total length.

Male 2.5 mm (n=1). Female 2.7 mm (n=1). Measurements taken from specimens in alcohol, measured distance equaled the distance between tip of vertex and tip of abdomen.

Coloration.

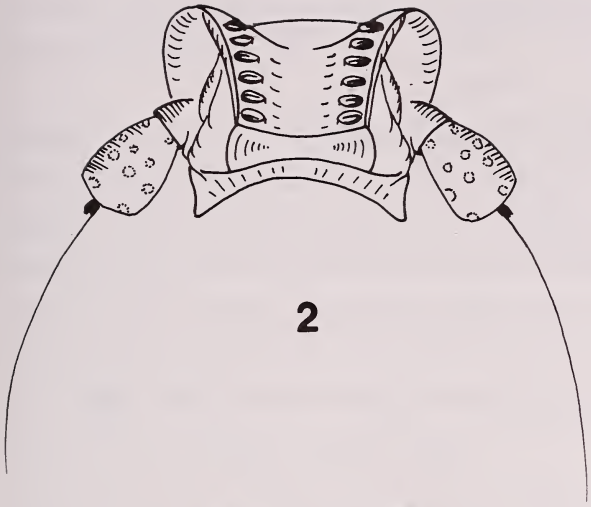
Body generally light stramineous with infuscate areas on median portions of mesonotum. Tegmina light brown with darker markings, especially in areas enclosed the basal part of the anal vein fork. Veins at distal margin accompanied by infuscate spots.

Head (fig. 2-4).

Vertex short, ca. 5 times as wide at its base as medially long, indistinctly separated from frons by a weakly defined transverse carina. Frons convex, 1.6 times as wide as medially high. Lateral carinae of frons strongly ridged and directed anterolaterad, each anteriorly bearing a regular row of sensory pits. Post- and anteclypeus together medially slightly longer than frons. Frons smooth, without median carina, postclypeus medially with an indistinct median carina, anteclypeus medially ridged. Frontoclypeal suture almost straight. Rostrum long, well surpassing hind trochanters. Compound eyes and ocelli absent, their former position recognizable by weakly sclerotized and slightly vaulted areas. First antennal segment short, ring-like, 2nd antennal segment subcylindrical, ca. 1.6 times as long as maximally wide.

Thorax (fig. 5-6)

Pronotum medially ca. 4.5 times as long as vertex, and ca. 5 times as wide as medially long. Pronotum with an indistinct median carina; posterior margin shallowly incised. Mesonotum with a feeble median carina, otherwise smooth and nearly planate, in midline about 3.3 times the length of pronotum. Tegulae, tegmina, and wings present. Tegmina and wings distally slightly reduced. Tegmina in repose distally not reaching tip of abdomen, with regular rows of sensory pits along RSc and along lateral branch of Y-shaped vein in clavus. Metatibiae laterally unarmed, with 7 apical teeth in the male, and 8 apical teeth in the female. 1st metatarsal segment slightly shorter than



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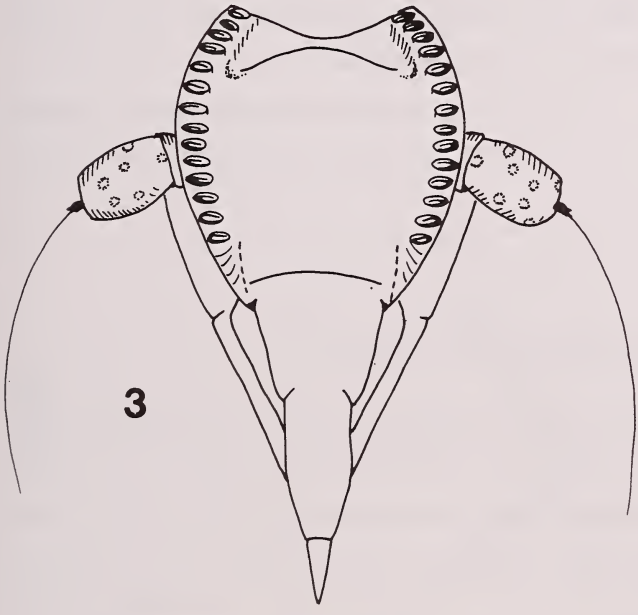

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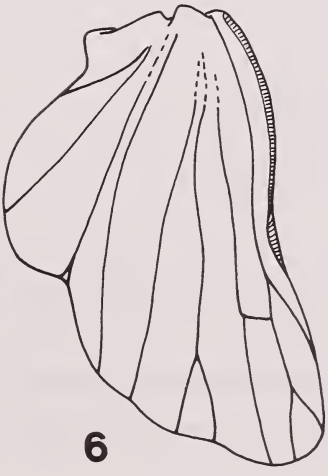

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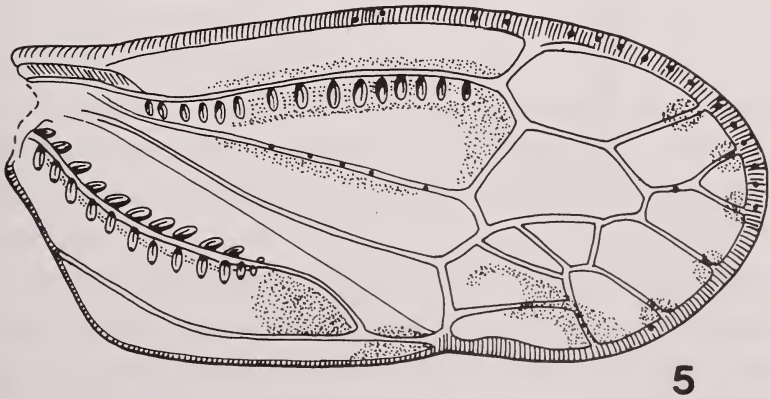

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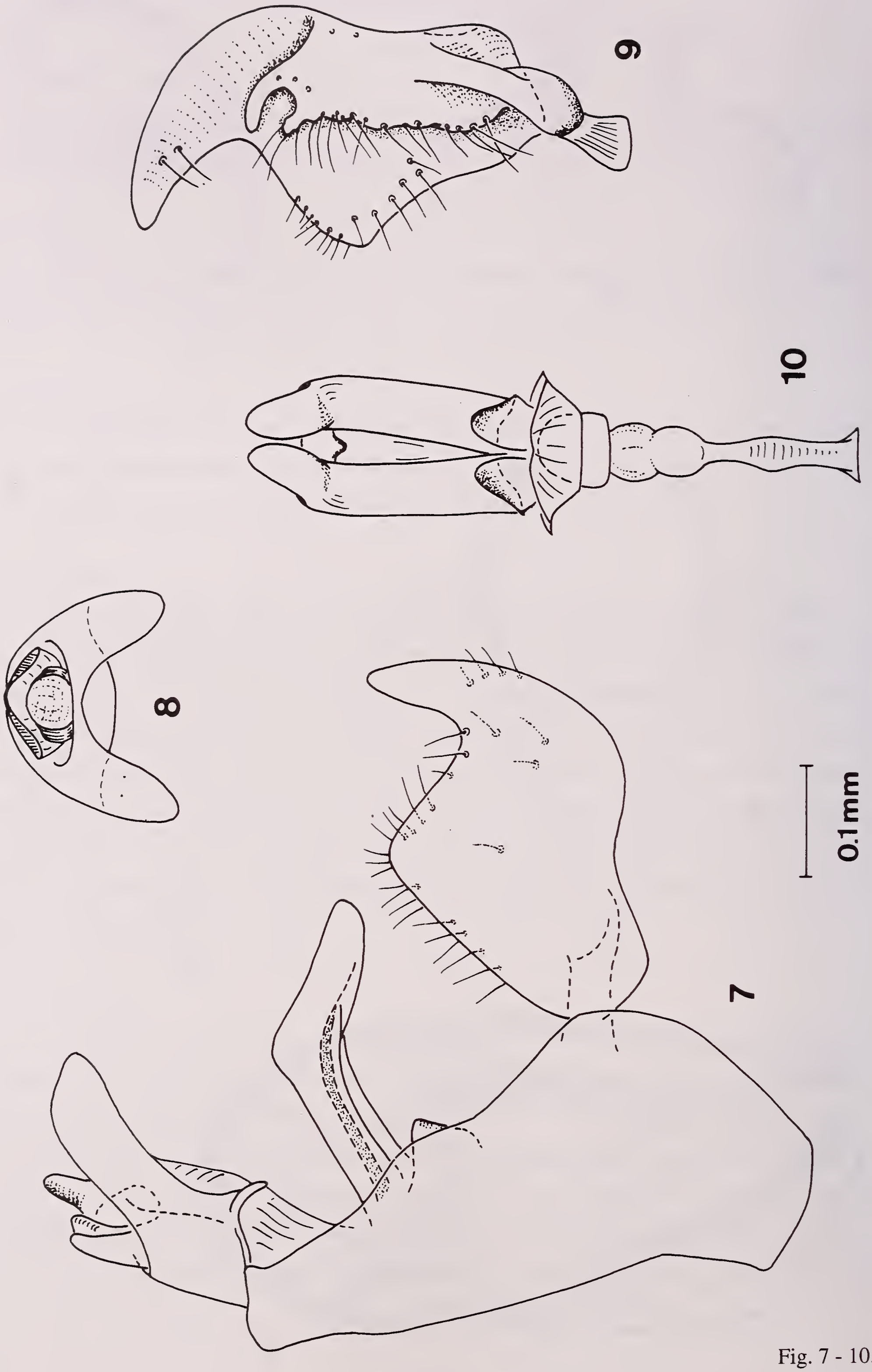

Fig. 7 - 10.

2nd and 3rd metatarsal segments together. 1st metatarsal segment with 5-6, 2nd metatarsal segment with 4-5 apical teeth.

Male genitalia (fig. 7-10)

Genital segment symmetrical, in lateral aspect ventrally 3.7 times as long as dorsally, in caudal aspect ca. twice as high as maximally wide. Anal segment distally produced into 2 ventrocaudal lobes. Parameres wide at base, medially tapering and distally produced into a finger-shaped process which in repose is directed dorsocephalad; inner surface deeply concave, ventral margin strongly reflected dorsad, apically with 2 short finger-shaped processes. Aedeagus symmetrical, apically with 2 finger-shaped processes directed ventrocaudad, and with 2 short, stout, bulbous processes arising from its ventral base.

Holotype. Male. Cape Verde Islands: Fogo Island, Gruta Alto S. Pedro, Chã das Caldeiras, 1700m, 31.i.1999, Oromí, Arechavaleta and Sevilla leg., in coll. Museo de Ciencias Naturales de Tenerife.
Paratype. 1 female. Same data as holotype.
Additional material. 4 nymphs. Same data as holotype.

ECOLOGY AND DISTRIBUTION.

Nisia subfogo sp.n. is known only from Gruta de Alto S. Pedro, a small lava tube situated in the caldera of Fogo. This cave lies at the bottom of the volcano in the northwest side, at an altitude of 1700 m (see fig. 1). This is an area of recent lava flow, althought the exact age of the pahoehoe lava enclosing the cave is not known. Posterior deposition of pyroclastic material formed a thin stratum that covers all the area.

No survey is available of this cave, which is about 100 m in total length and made up of one main gallery with a secondary narrow passage connecting to a lower, wide room with accumulations of sediments. Most of the substrate along the cave is of compact rock, with the exception of the latter sector and the area close to the entrance, where the *lapilli* has fallen down from the exterior. The cave is rather shallow and separated from the surface by a relatively thin layer of rock.

Despite its short length, the cave maintains the environmental conditions suitable to lodge a troglobitic fauna: absolute darkness, stagnant air and high humidity. Outside the cave the relative humidity is low, but the pyroclasts on the surface allow percolation of the water and isolation, supporting an atmosphere close to saturation inside the lava tube. The same phenomenon has been

described for Cuevas Negras in Tenerife (Canary Islands). This complex of small lava tubes occurs in a very similar landscape of recent lava flows with no soil yet formed but covered by abundant cinders and *lapilli* [1].

Energy resources reaching the cave either through the entrance or the network of cracks are low because of the paucity of plants living outside above the lava tube. Following from this the diversity of cavernicolous fauna is expected to be low. This was evidenced by sampling carried out with pitfall traps (10 traps with liquid bait, set for a fortnight in different sectors of the cave) for which no samples were collected. The only troglobites found (by visual searching) were the planthoppers and two species of spiders: one Theridiidae and one Hahniidae (Carles Ribera det.). They were collected together with the planthoppers, which are their probable prey considering relative sizes and disposition of the webs among the roots. No species of Hahniidae have been recorded so far in the archipelago [15], but a deeper study of the spider fauna would be necessary before arguing that this troglobite is the only extant representative of this family.

All the specimens of *Nisia subfogo* sp.n. were collected in the dark zone of the main gallery on tender rootlets hanging from the roof, and never upon the rootlets that grow horizontally on the floor of the lava tube (this is the only sector of the cave with roots). *Periploca laevigata* ssp. *chevalieri*, *Paronychia illecebroides*, *Satureja forbesii*, *Verbascum cystolithicum* and *Hyparrhenia hirta* are the most frequent plant species of the surface vegetation and may be possible hosts for the cave-dwelling planthoppers in the area.

The degree of troglomorphy, especially the complete reduction of the compound eyes and ocelli as well as the weakly pronounced bodily pigmentation suggest that *Nisia subfogo* sp.n. is restricted to subterranean habitats. It is therefore considered an obligately cavernicolous (troglobitic) species. This assumption is further supported by the occurence of nymphs in the same habitat.

SYSTEMATIC POSITION

The new species is provisionally placed here into the genus *Nisia*. The taxon is represented with 3 species in the epigean Fulgoromorpha fauna of the Cape Verdes: *Nisia* nervosa (Motschulsky)(= *N. atrovenosa* (Lethierry)), *N. minor* Lindberg, and *N. nebulosa* Lindberg [14]. Morphologically, especially in the shape of the male genitalia as well as in the color patterns of the tegmina, *Nisia subfogo* sp.n. resembles *N. nebulosa* which has so far been only reported from Santiago island but may not be restricted to it, and is apparently a high-altitude species [14]. The fact that *N. subfogo* was discovered in a cave at 1700 m a.s.l. may point to an ancestral species with a similar habitat. A completion of the inventory of the Fulgoromorpha fauna of the Cape Verdes is necessary to assess

whether or not a *Nisia* species closely related to *N. subfogo* sp.n. is (still) present in surface habitats. At present, it cannot be decided whether or not cave adaptation in *Nisia* on Fogo Island occured as an adaptive shift, i.e. in the process of an active colonization of novel habitats (*sensu* Howarth [11, 12]), or whether the underlying evolutionary scenario is rather a relict situation (*sensu* Barr [2]). The discovery of multiple cave invasions by planthoppers on geologically young oceanic islands such as the Canary Islands [8] and Hawaii [10] strongly supports the assumption that adaptive shifts have played a major role in the evolution of obligately cavernicolous planthopper species.

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Fig. 1. The Cape Verde Islands and situation of Gruta Alto S. Pedro in Chã das Caldeiras, Fogo.

Fig. 2 - 6. *Nisia subfogo* sp.n. (fig. 1-3, holotype male; fig. 4-5, paratype female)
1, head, dorsal aspect; 2, same, ventral aspect; 3, same, lateral aspect; 4, tegmen; 5, wing.

Fig. 7 - 10. *Nisia subfogo* sp.n., male genitalia (holotype male).
6, genital segment, anal tube, aedeagus, parameres, total aspect, left lateral view; 7, anal tube, caudal aspect; 8, right paramere, median aspect; 9, aedeagus, ventral aspect.