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Sphaeropsocopsis myrtleae sp. n., a blind subterranean psocid from St Helena (Psocoptera: Sphaeropsocidae)

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***Sphaeropsocopsis myrtleae* sp. n., a blind subterranean psocid from St Helena (Psocoptera: Sphaeropsocidae). -** The new species is described and illustrated, based on a female captured by a modified pitfall trap ("boot trap") in a lava tube on the mid-Atlantic island of St Helena. The species is adapted to subterranean life in being depigmented and blind. This is the first case of complete reduction of compound eyes known in the insect order Psocoptera.

Key-words: Psocoptera - Sphaeropsocidae - *Sphaeropsocopsis* - eye reduction - cave species - St Helena island.

INTRODUCTION

The Psocoptera of St Helena are poorly known. 12 species have been recorded by BADONNEL (1976); one of them has also been described under a synonym by NEW (1977). All this material has been collected on vegetation or in light traps, none from subterranean habitats. Among the several psocids collected by N. P. & M. J. Ashmole in such habitats one troglobitic species of the suborder Troctomorpha is of particular interest and will be described in the following.

During the period December 1994 to May 1995 N. P. Ashmole and M. J. Ashmole carried out intensive field work on the subterranean fauna of the island of St Helena, in mid-Atlantic in 5°W, 15°S. This work was stimulated by earlier studies on dispersal of island arthropods (ASHMOLE & ASHMOLE 1988) and on the fauna of lava and cave habitats on other volcanic Atlantic islands (ASHMOLE & ASHMOLE 1987, OROMÍ *et al.* 1990, ASHMOLE *et al.* 1992).

Geologically youthful volcanic islands such as Ascension sometimes have closely related endemic species respectively in barren lava habitats on the surface and in volcanic caves and smaller underground spaces (ASHMOLE 1994, ASHMOLE & ASHMOLE 1997, CHRISTIANSEN 1998). A degree of troglomorphy [morphological

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specialization for subterranean life (CHRISTIANSEN 1962)] may be shown by cavernicolous species on such islands [e.g. pseudoscorpions (MAHNERT 1993); spiders (MERRETT & ASHMOLE 1997); psocids (LIENHARD 1996)] but is typically more extreme in caves on older islands, where true troglobites (species obligately associated with the deep cave zone) are often found (OROMÍ *et al.* 1991). However, underground caves and cracks formed at the time of volcanic eruptions are relatively ephemeral (HOWARTH 1981, ASHMOLE *et al.* 1992, HOCH & ASCHE 1993). Animals may evolve specializations to life in them, but as the caves collapse and the cracks become filled with soil, troglobites on islands may become extinct or survive in only a few localities.

The recent work on St Helena was designed to find any specialized cavernicolous arthropods that might have survived the period of about seven million years since volcanic activity on the island ceased (BAKER 1970); the species here described is the only unequivocal example encountered. Few lava tubes survive and near-surface subterranean spaces are inhabited largely by introduced soil animals (ASHMOLE & ASHMOLE, unpublished).

METHODS AND STUDY SITES

The traps used for sampling the fauna of underground spaces on St Helena were of three types: "pipe traps" (described in ASHMOLE & ASHMOLE, in press a), conventional plastic straight-sided pitfall traps (ASHMOLE *et al.* 1992) and specially designed "boot traps"; it was in one of the latter that the blind psocopteran was captured.

The boot traps are a form of pitfall trap modified for use in caves and other situations where it is impractical to bury traps with the rim flush with the substrate; they are ceramic and were commissioned from a local potter. The trap weighs a little under 400 g and is boot-shaped in profile, with base dimensions c. 125 mm long, c. 70 mm wide and c. 80 mm high. The "heel" of the boot is in the form of a straight-sided pitfall trap with internal dimensions c. 70 mm deep and c. 45 mm diameter; the "toe" forms a ramp up which arthropods can climb. The ramp is coarsely roughened to mimic the surface of lava or cinders but the interior of the trap is smooth and glazed; a broad glazed lip slopes down from the top of the ramp into the trap; on the other side of the trap opening the narrow roughened rim meets the glazed interior at a right-angle.

Each trap contains c. 25 ml of modified Turquin's liquid consisting of 10 g chloral hydrate, 5 ml formalin, 5 ml glacial acetic acid, 1 ml liquid detergent, plus beer (preferably including one third stout) to make 1 litre. In addition a bait of "Danish Blue" cheese is placed in a tiny plastic cup formed by an inverted specimen tube lid impaled on a nail with its point resting on the bottom of the trap, thus holding the bait dry above the level of the liquid.

Most of the work on St Helena involved setting traps in the network of small underground cracks and crevices characteristic of basaltic lava and termed the "MSS" or mesocavernous shallow stratum (JUBERTHIE *et al.* 1980, MEDINA & OROMÍ 1990,

ASHMOLE 1994). However, traps were also placed in the largest among the few accessible lava tubes, and it was in this cave that the blind psocid was captured.

The cave, referred to as Rupert's Battery Cave, is at UTM Grid Zone 30, TH 088 386 in northwest St Helena. The opening is at a height of roughly 50 m beside a path traversing a very steep and rocky slope above the shore between Rupert's Bay and James Bay. The opening had been blocked by a large rock which was moved in order to gain access to the cave. The cave slopes downwards very steeply to the north and may continue to sea level, but has been blocked with rubble at about four metres from the top, probably by people trying to make it less dangerous. The traps were set on the top of the rubble, mainly close to the cave walls, and were in semi-darkness; further down, the cave is presumably completely dark and also humid. Other arthropods caught in the cave included an unidentified and possibly endemic species of mogoplistine cricket, together with introduced species of blaniulid Diplopoda and lepismatid Thysanura (Zygentoma).

The following abbreviations are used in the description: B = body length; V = width of head capsule on vertex; FW = forewing length; F+tr = length of femur and trochanter (hindleg); T = length of tibia (hindleg); t1, t2, t3 = length of tarsomeres, measured from condyle to condyle (hindleg); MHNG = Muséum d'histoire naturelle de Genève.

DESCRIPTION

Sphaeropsocopsis myrtleae sp. n. (♀) Figs 1-8

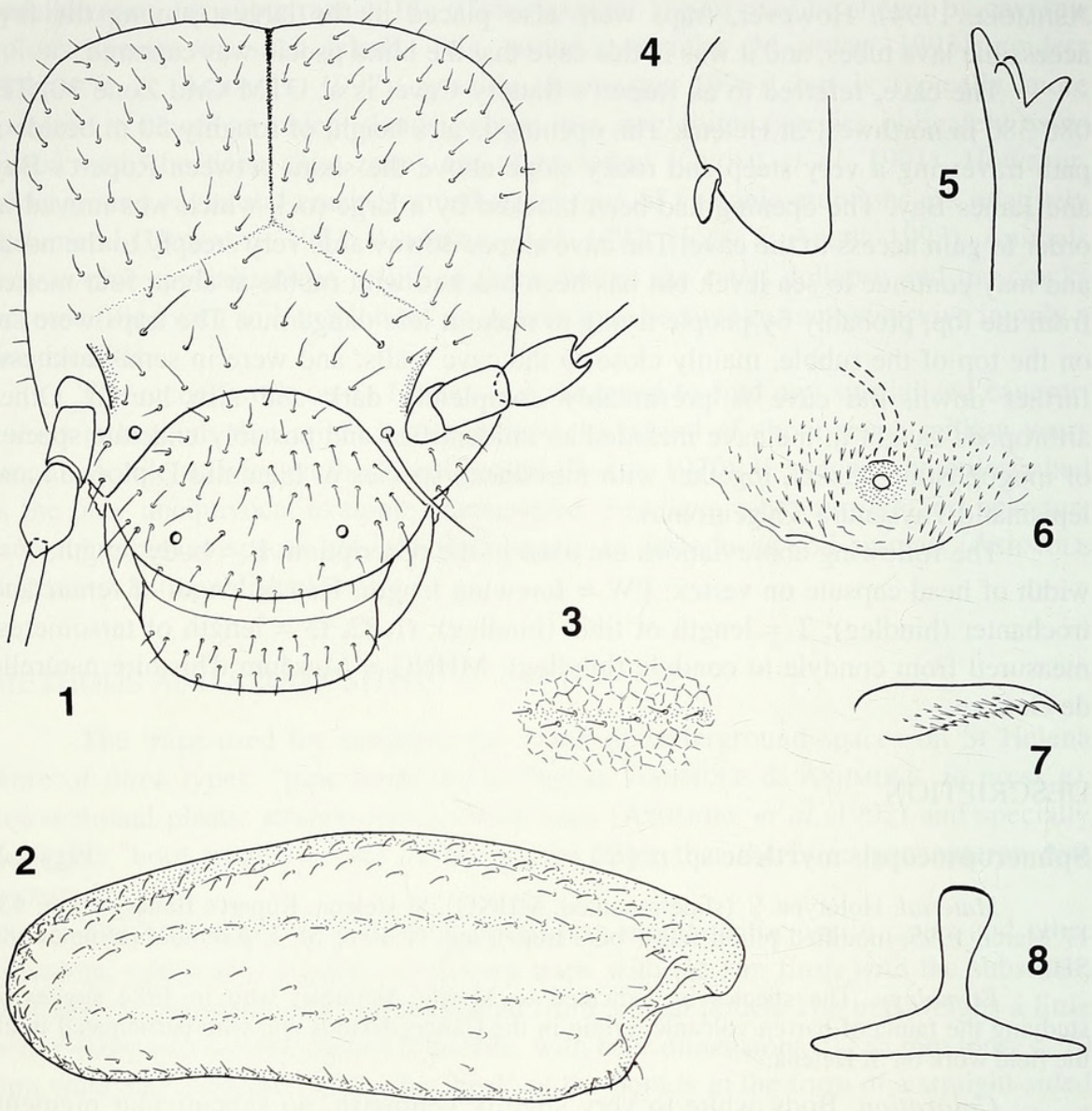
Material. Holotype ♀ (slide mounted, MHNG). St Helena: Rupert's Battery Cave, 13-17 March 1995, modified pitfall trap ("boot trap"), leg. N. P. & M. J. Ashmole (sample: 680 SH).

Etymology. The species is dedicated to Myrtle Ashmole, who in 1984 suggested studying the fauna of barren volcanic terrain in the Canary Islands and who participated in all the field work on St Helena.

Coloration. Body white to very slightly yellowish, no subcuticular pigment, cuticle transparent, the light brown mandibules visible through the head capsule. Wings, legs and antennae colorless.

Sculpture. Vertex with fine granular tubercles, their diameter distinctly smaller than the diameter of the alveoli of the small vertical hairs. Tubercles evenly distributed, no distinct spindle-shaped or polygonal areas recognizable. Sculpture of thoracic tergites similar to head.

Morphology. Compound eyes absent, no ocelli. Head capsule normally shaped but very slightly concave laterally where in the other species of the genus the compound eyes are located (fig. 1). Pilosity of head short, with a pair of distinctly longer hairs near antennal base and another pair on postclypeus, three of these hairs are broken but localizable by their large alveoli (fig. 1). Vertical suture well developed, frontal suture only visible as a slight interruption of sculpture. Both antennae broken, only a few basal segments left. Maxillary palps lacking (broken). Pilosity of labial palps badly damaged, but a particularly well developed club-like sensillum



FIGS 1-8

Sphaeropsocopsis myrtleae sp. n., female: 1, head in frontal view; 2, forewing; 3, reticulate sculpture in the middle of forewing (same magnification as fig. 2); 4, labial palpus (pilosity not represented except large lateral sensillum); 5, lacinial tip; 6, spermapore; 7, claw; 8, T-shaped sclerite of subgenital plate.

present on outer side (fig. 4). Lacinial tip largely bifurcate, outer denticle with two secondary denticles on half-length on its inner side (fig. 5).

Thoracic tergites not divided into lobes. Forewings shortened, reaching about the middle of the abdomen, hindwings absent. Venation of forewing strongly reduced, two longitudinal rows of hairs indicate the presence of two faint longitudinal main veins, wing margins also rather densely pubescent, all hairs short (fig. 2). Wing membrane with a very faint network of fine sculptural lines delimiting more or less hexagonal areas (only visible at high magnifications under phase contrast) (fig. 3).

Legs relatively long (index T/V = 1.4), tibiae with two apical spurs, claws slender, with one preapical denticle and some microtrichia on outer side (fig. 7). No coxal organ present.

Terminalia without particular diagnostic characters, T-shaped sclerite of subgenital plate well developed (fig. 8), spermapore on both sides with a field of microtrichia (fig. 6). The spermatheca is full of sperm, therefore we can affirm that the species is bisexual, even if the male is not yet known.

Measurements (µm). B = 1350; V = 315; FW = 580; F+tr = 360; T = 450; t1 = 150; t2 = 43; t3 = 60.

DISCUSSION

At present the new species has to be placed in the genus *Sphaeropsocopsis* Badonnel, 1963 because mesothoracic sternites are not subdivided into lobes and because of the eye reduction. In the very closely related genus *Badonnelia* Pearman, 1953 females always have compound eyes with 7 (exceptionally 6 or 8) ommatidia and the mesothoracic sternites show some lobation. The generic characters of the forewing (shape and venation) can not be observed in the new species because of its strong brachyptery. According to BADONNEL (1963), the form of the terminal segment of the maxillary palp is also of some value to decide about generic attribution; unfortunately both palps are broken in the unique female of the new species.

Within the genus *Sphaeropsocopsis* the number of ommatidia in females can vary from 3 to 10, but intraspecific variability is usually low. Even in *S. microps*, the only species of the genus with 3 ommatidia (sometimes 4), these remaining ommatidia are well developed and situated on a hemispherical protuberance of the head capsule, as usual in the species with higher numbers of ommatidia. The complete reduction of the compound eyes in *S. myrtleae* clearly represents an adaptation to cave life and is the first case of blindness known in Psocoptera. Several troglophilic psocids have been mentioned by BADONNEL & LIENHARD (1994), some of them show strong reduction of compound eyes but a blind species has never been observed up to now. Even in the edaphic species of the apterous genus *Liposcelis* Motschulsky, 1852 (belonging to the Liposcelididae, family closely related to the Sphaeropsocidae), where strong eye reduction occurs, at least two ommatidia always persist, forming together with some underlying pigment a reduced but probably functional compound eye (cf. LIENHARD 1998). The only known troglobitic liposcelidid, *Troglotroctes ashmoleorum* Lienhard, 1996, has usually 3 (rarely 4 or 2) ommatidia (cf. LIENHARD 1996). In *S. myrtleae* however, the head capsule shows no subcuticular pigmentation or irregularity of sculpture at the place where eyes are usually located.

Unfortunately the antennae and the maxillary palps of the single specimen known are broken. Therefore it is impossible to say if in *S. myrtleae* the optical deficiency could eventually be compensated by tactile sense organs, as long antennae and palps with particularly well developed sensilla. But it is interesting to see that the club-like outer sensillum of the labial palp is extremely well developed in this species, significantly greater than is usual in Troctomorpha. In the troglobitic *Troglotroctes*

ashmoleorum, known from subterranean habitats on Ascension Island (ASHMOLE & ASHMOLE 1997) an augmented number of sensilla on maxillary and labial palps has been observed, compared with the usual number in the family Liposcelididae (LIENHARD 1996). The relatively long legs (index T/V = 1.4) of *S. myrtleae* could probably also be interpreted as an adaptation to cave life, in the other species of the genus this index is ≤1.0 (cf. BADONNEL 1962, 1963, 1967, 1971, 1972). Another evident adaptation to subterranean life is the lack of pigmentation, which has never been observed to such an extent in the other species of the genus, which are usually litter-dwellers (cf. BADONNEL, papers cited above).

The presence of a species of *Sphaeropsocopsis* on the mid-Atlantic island of St Helena is not really surprising. The genus is known from South America, Ascension Island (mid-Atlantic), Africa, South Australia and Tasmania. A single species is known in each case from the Australian region [*S. recens* (Hickman, 1934); cf. SMITHERS 1984] and continental Africa [*S. reisi* Badonnel, 1971, only recorded from Angola (BADONNEL 1971)]. The highest diversity has been observed in South America, where one species is known from Argentina [*S. argentina* (Badonnel, 1962)] and 5 species from Chile: *S. chilensis* Badonnel, 1963; *S. microps* Badonnel, 1963; *S. spinosa* Badonnel, 1972; *S. valdiviensis* Badonnel, 1972; *S. valeriae* Badonnel, 1967. A single damaged female of *Sphaeropsocopsis* cf. *microps* has also been recorded from a subterranean habitat on Ascension Island (ASHMOLE & ASHMOLE 1997).

St Helena, which is more than 14 million years old (BAKER 1970) has been colonised during its long life by a wide variety of arthropod groups (BASILEWSKY 1985; ASHMOLE & ASHMOLE, in press b). Psocoptera, including even apterous forms such as *Liposcelis* species, are effective aerial dispersers (THORNTON 1964, THORNTON & HARRELL 1965) and the ancestors of *Sphaeropsocopsis myrtleae* seem likely to have colonised St Helena by air. There are endemic psocids on many oceanic islands, and on Ascension Island (the closest land to St Helena) there are several apparently indigenous species including a troglobitic generic endemic (*Troglotroctes* Lienhard, 1996, see above and ASHMOLE & ASHMOLE 1997).

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