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Santo

The Natural History of

edited by
Philippe Bouchet, Hervé Le Guyader, Olivier Pascal



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Santo

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Insects of Santo

FOCUS ON ORTHOPTERA

Laure Desutter-Grandcolas, Sylvain Hugel & Tony Robillard

Orthoptera are world-wide distributed insects easily recognized by their enlarged hindlegs, adapted to jump, and by their forewings, which cover the dorsal and the lateral sides of the body. They include two infraorders, Caelifera (short-horned Orthoptera) and Ensifera (long-horned Orthoptera), subdivided into several major taxonomic groups.

Orthoptera occur in both natural and man-disturbed environments, sometimes at high density. They are diversified in forested and opened biotas, although species may have highly specialized habitats and/or ways of life. Some species are plant-specific, for food and/or oviposition, but many species depend more on vegetation structure, which defines micro-climatic conditions and the availability of micro-habitats, than on vegetation identity. Many species are either phytophagous, or omnivorous; some are carnivorous and feed on other insects.

One of the main biological characteristics of Orthoptera is their use of acoustic signals for communication purpose, especially for reproduction and defence. Sounds are produced by rubbing diverse morphological structures against one another, i.e. by stridulation. In Caelifera, sounds are produced mainly by rubbing hindlegs against the abdomen or a forewing vein. In Ensifera, stridulation modalities are very diverse, but the most distinctive one implies the forewings, which are raised above the body and rubbed together; specific parts of the forewings act as resonators, which greatly enhances the power of the emitted sounds. Some species sing during the day, but most sing at night, together with frogs. Each locality then resounds with a mix of all emitted sounds, which is determined by the species composition of the acoustic community. This assemblage of acoustic signals can be used to evaluate the diversity and density of co-occurring acoustic species. Such a biodiversity estimate is of course biased, as mute species cannot be revealed that way, and acoustic species do not sing all at the same time. It may anyhow be useful to survey already inventoried habitats or the density of particular species (Fig. 148).

In Santo, Orthoptera are represented by more than 55 species, belonging mainly to Ensifera. Some groups are well-diversified, with many species (some

still under study), but others are "missing" on the island, compared to nearby islands or territories. For Ensifera for example, and compared to New Caledonia, Santo seems to lack Anostostomatidae (wetas) and Pseudophyllinae (true katydids). In crickets, no *Oecanthus* has been found, although the Neocaledonian species, *Oecanthus rufescens*, is widely distributed in the Southwest Pacific; there is also no *Parendacustes*, while one species has been described from the Loyalty Islands and although this genus is well-diversified in the Indo-Malaysian region. Conversely, some taxa are present or diversified in Santo, while they are lacking or poorly represented in New Caledonia; this is the case of Pentacentrinae and Trigonidiinae (Trigonidiidae). The taxa diversified in both areas, i.e. Nemobiinae (Trigonidiidae), Podoscirtinae (Podoscirtidae), Eneopterinae (Eneopteridae) and Phalangopsidae, mostly belong to different genera.

Three main situations describe the orthopteran fauna of Santo in term of species distribution, as exemplified by the species of the cricket genus *Cardiodactylus*:

- some species are distributed throughout the island;
- others are restricted to the coastal margin of the island, including widely distributed species in the Southwest Pacific region, or endemic species very similar to species found in the surrounding territories; and finally,
- some species are clearly restricted to the most inner parts of Santo.

• • • Caelifera (Grasshoppers, Locusts, and Pigmy Grasshoppers)

Caelifera are poorly diversified in Santo, with less than 10 species occurring on the island. All known caelifera species in Santo are mute, i.e. they are not able to produce stridulation. Most of them are widely distributed in the Southwest Pacific; they occur in man-made biota, such as pastures, gardens and roadsides with tall grasses (*Austracris guttulosa*; *Oxya japonica*, the Rice Grasshopper), and areas with more scarce vegetation (*Aiolopus thalassinus dubius*; *Heteropternis* sp.). On the ground of wooded areas some Tetrigoidea (*Eurymorphopus* sp., Pigmy Grasshoppers) are occurring.

The most remarkable caeliferan species in Santo is *Hebridea rufotibialis*, a brachypterous grasshopper

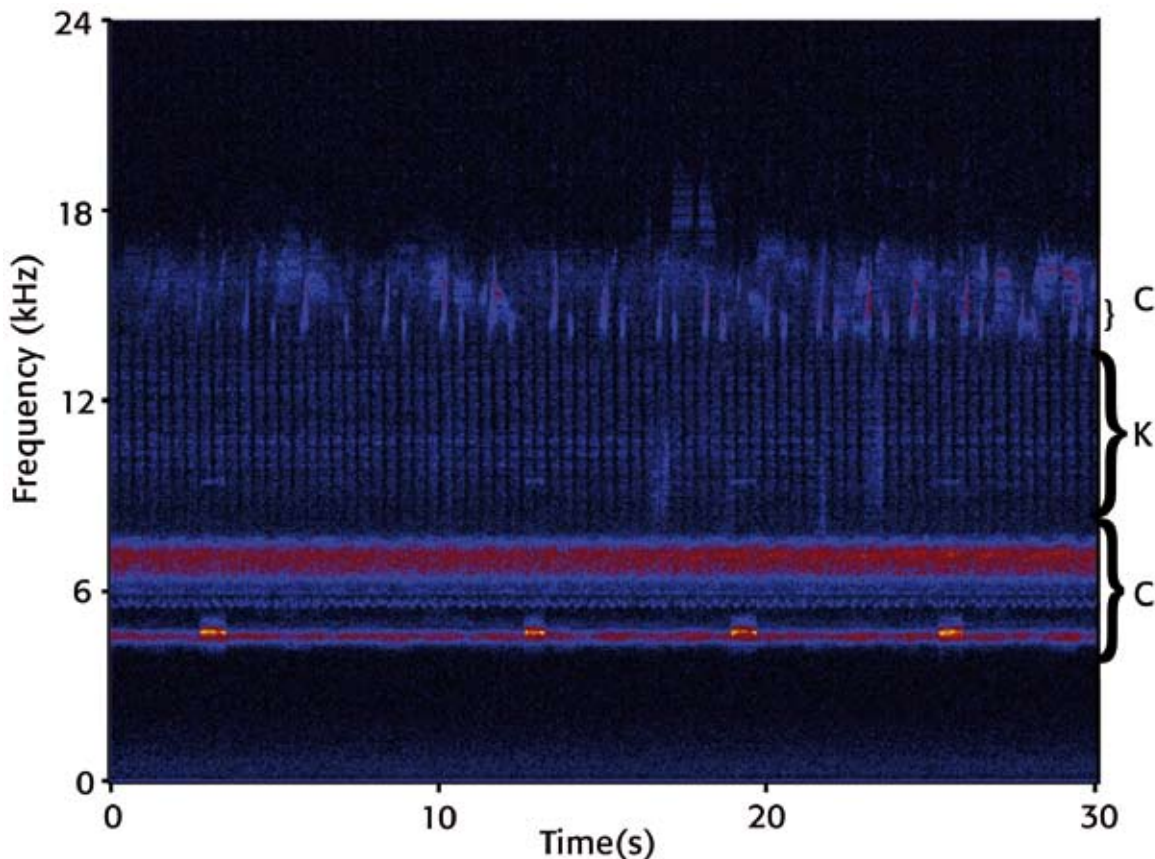


Figure 148: Sonogram of nocturnal recording at Peavot, showing the distribution of species calls in time (horizontal scale) and frequency (vertical scale). The frequencies ranging from 5 to 8 kHz are predominantly filled by crickets (C). Podoscirtinae and Phaloriinae are contributing to the low frequencies within this range (3, 13, 19 and 26 s), and Trigonidiinae to the high frequencies background noise within this range (and to a small extent Eneopterinae, Nemobiinae and Mogoplistidae). The frequencies ranging from 8 to 14 kHz are mostly filled by katydids (K). *Salomona* song corresponds to the long trill throughout the time window, whereas *Ityocephala francoisi* song corresponds to short calls at 17 and 23 s. Interestingly, the high-audio range is filled by cricket (C) species (*Cardiodactylus novaeguineae*), contrasting with the usual situation in most of the world areas where cricket songs are occupying lower frequencies range than katydid songs.

endemic to the island (Fig. 149). This grasshopper feeds mostly on screw palm (*Pandanus* sp.), but also on fern and *Dracaena* (Ruscaceae). This species is found on both preserved and moderately gardened wooded areas.

••• **Ensifera Gryllidea**

More than 30 cricket species have been found in Santo. Some are widely distributed in the Southwest Pacific, or are pantropical; they occur in man-made biota, such as pastures (Gryllidae: Gryllinae: *Teleogryllus oceanicus*) or villages (Gryllidae: Gryllinae: *Gryllodes sigillatus*), or in supralittoral vegetation near shorelines (Eneopteridae: Eneopterinae: *Cardiodactylus novaeguineae*). The large majority of species are presently known from Santo only. They live in natural environments and are found especially in forests or in extreme biotas, i.e. beaches (Mogoplistidae sp; Trigonidiidae, Nemobiinae: *Thetella* sp) or caves (Phalangopsidae; Trigonidiidae, Nemobiinae: *Cophonemobius faustini*).

The most remarkable biological feature of Santo crickets is the acoustic behavior of Eneopterinae species (three *Cardiodactylus* and two *Lebinthus* species,

three of which were discovered in 2006 and described in 2009 by T. Robillard, *C. tankara*, *L. santoensis* and *L. nattawa*). These species sing at very high frequencies, near or beyond the limit of human audible spectrum (Fig. 148).

••• **Gryllidea of opened areas**

Man-made opened areas, such as lawn or low pasture, are colonized by species largely distributed through the Southwest Pacific, especially *T. oceanicus*.



Figure 149: *Hebrideia rufotibialis* Willemse, 1926, a brachypterous grasshopper endemic to Santo.

Along roadsides, where grass is taller, *Anaxipha fuscocinctum*, a flashy green Trigonidiinae (Trigonidiidae) with red spots (Fig. 150), can be found, sometimes at high density; this species sings and reproduces during the day. Another trigonidiine, with yellowish brown legs and shiny dark head, body and forewings, has been found both in opened areas along the roads and in forest openings invaded with creeper. In slightly more covered places, such as along coastal tracks, an euscyratine species (*Euscyrtus* sp.) may also occur; devoid of a stridulum, this mute cricket species is characterized by its "*Conocephalus*-like" appearance, a resemblance due to morphological features (body thin and elongated, wings short, applicated on the body, ovipositor short, flattened and incurved), coloration (yellowish with longitudinal brown lines), and behavior: individuals of *Euscyrtus* sp. actually get stretched along grass stems when disturbed, often moving back.

Mole crickets (Gryllotalpidae) are also present in Santo and their soft calls can be heard at night, for example in the vicinity of Butmas.

••• Gryllidea of wooded areas

Crickets are diversified in all the ecological compartments of tropical forests. The ecological guilds for habitats defined by L. Desutter-Grandcolas in 1997 for Newcaledonian crickets are of a general significance for the group and exist also in Vanuatu.

In Santo, the leaf litter is occupied mostly by Nemobiinae crickets, which represent the bulk of cricket specimens in forested areas. These are small, black to brown species, which sing mostly during day time. Nemobiinae spend their whole life time in the leaf litter, while other species, such as Eneopterinae, occur in leaf litter only as early juveniles. At least four Nemobiinae species have been found in all sampled forests (genera *Dictyonemobius* and *Pteronemobius*). Several species of Gryllidae have been found but sporadically in the leaf litter, represented in our sampling by at least two species of Cephalogryllini, a group not known from the area yet, although well-diversified in Australia and New Caledonia. Finally, Trigonidiinae (*Amusurgus* spp.) and Pentacentrinae (*Pentacentrus* sp) hide during the day in the leaf litter, from which they fly rapidly when disturbed; they could be active on low plants at night.

Forest vegetation is inhabited mostly by Eneopterinae, Podoscirtinae, Phaloriinae, Trigonidiinae, the genus *Pseudotrigonidium*, and to a less extent by Mogoplistidae and Itarinae. Eneopterinae crickets (*Cardiodactylus enkraussi* distributed in the whole island (Fig. 151), *C. novae-guineae* in coastal regions; *C. tankara* in the inner lands) are the most abundant cricket species on bushes and low trees, especially near edges. They



Figure 150: *Anaxipha fuscocinctum* (Chopard, 1925), male, a diurnal trigonidiine cricket living in opened areas.

are extremely abundant and feed on many local plants, from fern leaves to the invasive creeper; they generally live from 50 cm to 2 m above the ground, on variable layers of vegetation. *C. enkraussi* lives deep inside the vegetation, hidden from the edges, from where it emits a very discrete calling song made of two distinct parts. It occurs in sympatry with either *C. tankara*, or *C. novae-guineae* which are clearly more conspicuous, as they live on top of bushes or on the edges of small trees, and emit a louder calling song. Podoscirtinae (*Aphonoides* ssp) and Phaloriinae (*Phaloria chopardi*, *P. walterlinii*, *P. japonensis* described in 2009 by L. Desutter-Grandcolas) are also found on forest bushes occasionally. They probably live higher in canopy trees and can be more easily observed



Figure 151: *Cardiodactylus enkraussi* Otte, 2007, male, one of the most abundant cricket species in Santo.

on edge trees. Some of them sing quite loudly and can be heard in many places. *Pseudotriginidium* species are elegant and shiny crickets, which are more often found at night standing on the leaves of bushes or low trees at human height, or running on lianas or twigs. They most often hide during the day below loose bark or below bush leaves. Both *Phaloria* and *Pseudotriginidium* crickets also hide in the aerial litter of tree ferns or *Pandanus* trees during the day. Other species observed on understorey plants and low trees at night include on one hand Trigonidiinae, such as a large *Anaxipha* species (pale green when alive, yellow after death), and several *Parametioche* species (trigonidiines with no hindwings, corneous forewings devoid of a stridulum and long, yellowish legs), and on the other hand scaly crickets (Mogoplistidae: genus *Arachnocephalus*).

Finally, tree trunks are the place where long-legged crickets (Phalangopsidae) are active at night. These crickets hide during the day in burrows, or in cavities under logs or dead wood; they have not been observed under loose barks or in tree cavities above the ground. These are relatively small species devoid of an acoustic stridulum; they are extremely discrete and explore their environment with their long and flexible antennae. They can be relatively abundant locally, as in the forests located on sandy soil backwards the shorelines, but seem absent in the forests located inside the island.

••• Gryllidea of specific habitats

• Shorelines

Two different cricket communities are found in specific shoreline habitats.

In the mediolittoral zone, crickets of the genus *Thetella* (Trigonidiidae: Nemobiinae) occur either in the cavities present in rocks of alveolate calcareous, or on dark pebble beach (Fig. 152). In the first case, these rapid crickets are seen running on the rocks or on the sand nearby to escape the waves. Males are heard singing from the small cavities. On dark pebble beach, *Thetella* live in sympatry with a blackish scaly crickets (Mogoplistidae), together with several predators (spiders, small lizards). High waves during stormy weather seem to depauperate these pebble beach from crickets, the areas being recolonized after several days only. *Thetella* have been found also on alveolate calcareous located on riverbanks close to the coast.

In the supralittoral zone, several crickets can be observed on small trees (*Aphonoides* ssp; *Arachnocephalus* sp.), while low plants are colonized by *C. novaeguineae*. The leaf litter is occupied by *Dictyonemobius* and *Lebinthus* species. *Lebinthus* is found sometimes in the leaf litter of the forests

located behind the coast, or near river sides, but it never occurs far from the coast.

• Caves

Only long-legged crickets and *Cophonemobius* nemobiines are found inside caves, especially those which are inhabited by bats. The presence of *Cophonemobius* in Santo caves was documented by L. Desutter-Grandcolas in 2009. *Cophonemobius* are small, fragile insects, found mostly on cave walls, but they run and hide in small cavities and cracks when disturbed. At least four species of long-legged crickets occur in Santo caves, belonging to three different genera, one of which probably new to science.

••• Ensifera Tettigoniidea (Katydids and Raspy Crickets)

Fifteen Tettigoniidea species are known to occur in Santo as documented by S. Hugel in 2009. Most of these species can be observed in secondary habitats such as gardened or logged areas, and virtually no species are strictly restricted to unmodified, native biota. This might be due to the weak dependence of Tettigoniidea on specific plant species, these insects depending usually rather on the vegetation structure and climatic parameters. Tettigoniidea are occurring in most of Santo habitats, except caves and shorelines. One third of the species are considered as endemic to Santo and/or indigenous to Vanuatu, the other two thirds are more widespread in the Indo-Australian area.

••• Tettigoniidea of opened areas

As in similar earth biota, Santo opened areas covered with grasses, such as roadsides, pasturelands, and gardens are inhabited by at least three *Conocephalus* species (meadow katydids:



Figure 152: *Thetella* sp., female, a nemobiine cricket inhabiting coastal areas such as alveolate limestones and beaches.

C. upoluensis, *C. semivittatus vittatus* and *C. oceanicus*) and also by *Pseudorhynchus lessoni* (snout-nosed katydid). These species are sometimes occurring in a relatively high density. On tall grasses of such areas, *Phaneroptera gracilis*, a nocturnal species, can also sometimes be observed. *Conocephalus* males call during both day and night whereas *Phaneroptera* are rather nocturnal; their calling song is relatively inconspicuous in the audible range. Contrasting with *Conocephalus* and *Phaneroptera* subtle song, the loud and strident buzzing call of *P. lessoni* emitted during the first hours of the night is easily audible.

••• Tettigoniidea of wooded areas

The apparent density of Tettigoniidea is relatively low in both preserved and secondary wooded areas, and in such biota these insects are hardly observed during day hours as all species are mostly nocturnal.

On trees and bushes foliage near the shore (*Terminalia*, *Barringtonia*, *Hibiscus*, etc.), the spiny predatory katydid *Phisis holdhausi* can be observed. This species is widespread across the Polynesian area, its range extending from New Guinea to Gambier. Another Phisidini species, *P. pseudopallida*, occurs in other secondary habitats. In wooded areas of low altitude, the large *Xanthogryllacris punctipennis* (Fig. 153) and another Gryllacrididae *Amphibologyllacris macrocera* can be observed rushing on branches and foliage while exploring their surroundings with their tremendously long antennae. *Xanthogryllacris punctipennis* is a widespread species with numerous subspecies living in Australia, Solomon Islands and New Guinea.

In such low altitude areas, several leaf mimicking Phaneropterinae and *Salomona redtenbacheri* are also occurring. *Salomona* are relatively large katydids with remarkably strong and harmful mandibles (Fig. 154). Males are producing the only conspicuous Tettigoniidea song audible in wooded areas; their continuous high-pitched song is usually emitted near the top of trees.

In both preserved and secondary wooded habitats above 30 m, together with *Salomona redtenbacheri*, *Furnia insularis* (Phaneropterinae) and *Amphibologyllacris macrocera*, the large endemic leaf mimicking Mecopodinae *Ityocephala francoisi* is found (Fig. 155). Two endemic Gryllacrididae species have only been found above 600 m: *Amphibologyllacris butmasi* and *Psilogryllacris tchanca*.

Beside undergrowth Gryllacrididae, all the other species are usually occurring near the canopy, and only few specimens (laying females, moulting specimens, etc.) can be observed from the ground.



Figure 153: *Xanthogryllacris punctipennis* (Walker, 1869) (Gryllacrididae) living in wooded lowlands.



Figure 154: *Salomona redtenbacheri* Brongniart, 1897, a large katydid with strong harmful mandibles.



Figure 155: *Ityocephala francoisi* Bolivar, 1903 (Mecopodinae), female, the large endemic leaf mimicking katydid.

Santo

The Natural History of

The islands of the Pacific are renowned for the high levels of endemism of, and threats to, their unique faunas and floras. Espiritu Santo, affectionately known simply as Santo, is an island of superlatives: the largest and highest in Vanuatu, Santo is an extraordinary geographical and cultural microcosm, combining reefs, caves, mountains, satellite islands, and a history of human habitation going back 3 000 years. In the spirit of famous voyages of discovery of the past, the Santo 2006 expedition brought together over 150 scientists, volunteers and students originating from 25 countries. With contributions by more than 100 authors, *The Natural History of Santo* is a lavishly illustrated homage to the biodiversity of this "planet-island". Bridging the gap between scientific knowledge and conservation and education, *The Natural History of Santo* was written with local stakeholders as well as armchair naturalists from all over the world in mind.

Les îles du Pacifique sont célèbres pour le très haut niveau d'endémisme et la grande vulnérabilité de leurs faunes et de leurs flores. L'île d'Espiritu Santo, ou Santo, cumule les superlatifs : la plus grande et la plus haute du Vanuatu, Santo est un extraordinaire microcosme géographique et culturel, avec récifs, grottes, montagnes, îles et îlots satellites, et une occupation humaine qui remonte à 3 000 ans. Renouant avec l'esprit des "Grandes Expéditions Naturalistes", l'expédition Santo 2006 avait mobilisé sur le terrain plus de 150 scientifiques, bénévoles et étudiants de 25 pays. Petit tour de force éditorial avec plus de 100 auteurs, ce *Natural History of Santo* est un éloge de la biodiversité de cette "île-planète". À la fois beau livre richement illustré et bilan des connaissances scientifiques, *The Natural History of Santo* se veut un outil de connaissance pour sa conservation durable. Il s'adresse autant aux acteurs locaux du développement et de l'éducation qu'aux naturalistes du monde entier.



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