



## Canopy fogging in the Canarian laurel forest of Tenerife and La Gomera

by

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with 35 figures

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### Abstract

We describe the first inventory of canopy arthropods using the fogging method on the Canary Islands. Samples were taken at seven localities (41 individual foggings) on Tenerife and on La Gomera. The following groups of arthropods have been analyzed: Coleoptera, Ichneumonidae (Hymenoptera), Heteroptera, Orthoptera and Araneae. Species diversity was low or at best moderate in all these groups. Two different explanations for the low species numbers are discussed. For weevils of the subfamily Cryptorhynchinae, fogging results are contrasted with those obtained by hand-collecting with a beating sheet. It is shown that fogging is less efficient.

In Ichneumonidae, a new species, *Gelis gomerensis* Schwarz sp. n., is described from La Gomera and distinguished from other species of the genus. Further taxonomic changes in Ichneumonidae are proposed: *Megastylus canariensis* Rossem stat. nov. and *Himertosoma isabelae* (Rey del Castillo) comb. nov. (formerly *Lissonotidea*).

**Key words:** arthropod diversity, faunistics, canopies, laurisilva, subtropics, Canary Islands, Macaronesia, taxonomic changes, new species, collecting method, methodology, pyrethrum, beating sheet, Coleoptera, Cryptorhynchinae, Ichneumonidae, Pimplinae, Heteroptera, Orthopteroidea, Araneae

### Introduction

The tree canopies of the humid subtropical, evergreen 'laurisilva' (laurel forest) on the Canary Islands form an ecologically complex biotope which – due to its limited accessibility – mostly remains unexplored by entomologists. In order to reach the tree canopies with heights up to 30 m, we applied the canopy fogging method using natural pyrethrum as insecticide. Although often used in tropical forests during the last 36 years (Roberts 1973; Gagné 1979; Erwin 1982, 1983, 1989; Stork 1987; Adis et al. 1998; Floren & Linsenmair 1997), this was the first time the method was applied on the Canarian archipelago.

The incentive for the experiment resulted from a joint taxonomic project by the CURCULIO Institute (P. Stüben, Mönchengladbach) and the Zoological Research Museum Alexander Koenig (J. Astrin & W. Wägele, Bonn, Germany). Although this project focuses on a subfamily of weevils (Cryptorhynchinae), our wider, threefold goal in applying the canopy fogging method was to contribute to the

- survey of the arthropod fauna in the laurisilva canopies
- survey of arthropod communities on specific tree species
- discovery of new species.

Here we present preliminary results (further ecological investigations by A. Floren will follow), comprising a species list for Insecta (Coleoptera, Heteroptera, Hymenoptera: Ichneumonidae, Orthoptera) and for Arachnida (Araneae) (see Appendix: Table 1). In individual chapters, the specialists who made the identifications (see Appendix 2) further comment on the most notable findings and contrast the data obtained for their taxonomic group with existing information on the arthropod fauna of the Canarian laurisilva or with continental data.

## Material and methods

In the first half of October 2008, we sampled seven localities on the islands of Tenerife (two each in the Anaga and the Teno Mountains) and La Gomera (El Cedro, Los Aceviños, 'La Meseta'/Vallehermoso). All of the seven fogging sites lay within the shady and moist primary or secondary laurel forest of the thermocanarian belt, between 800 and 1000 m asl. on the northern or north-eastern slopes of the islands. Here, the trade-winds have their strongest influence and the mean annual precipitation ranges between 750 mm and more than 1000 mm (Hohenester & Welsch 1993). The western Canary Islands are characterized by a very stable climate, especially in the humid forests.

In the wood of Las Mercedes in the Anaga Mountains, one of our fogging sites on Tenerife, the lowest temperatures are reached in January and February: 12.5°C on average. In August and September, the temperatures are only 5 degrees higher. The rainfall shows higher variation. While in October through March, the monthly average amount of precipitation lies at more than 100 mm, July and August usually receive less than 20 mm (cf. Schönfelder 1997). Woodlots containing old and tall trees are rare. Most woodlots have been entirely depleted due to intensive human use during the last centuries. Some have been converted into coppice woods with a high proportion of *Erica arborea* (Sánchez-Pinto 2000). An exception is the forest of El Cedro on La Gomera in the Garajonay national park (Fernández 2009). Here, we could apply the fogging technique to lauraceous trees measuring more than 25 m in height (tree species are listed in Appendix 1).

Altogether, 41 samples were obtained at the seven localities described above (see Appendix 1: List of localities, Fig. 25), from ideally all tree strata. These samples consisted of catches collected on two or three 4x6 m plastic sheets that were spread underneath the canopies of the respective trees (Fig. 1). Table 2 lists the 10 tree or shrub species that were fogged with natural pyrethrum. The foggings were carried out by A. Floren, whenever possible during windless conditions by day or in the early hours of the night (Fig. 4). The natural pyrethrum we employed is obtained from the flowers of *Tanacetum cinerariifolium* (Trev.) Schultz-Bip. of the family Asteraceae. It decomposes photochemically within hours and leaves no persistent traces in the targeted trees. The pyrethrum was nebulized using a fogging machine of the type Swingfog SN 50 (Swingtec, Isny, Germany) (Figs. 2,7). Pure liquid paraffin served as the carrier substance, creating a characteristic 'cloud' that is well visible even at night and allows judgement of the effectiveness of the fogging (Fig. 5). Pyrethrum is a highly specific neurotoxin that acts instantly and only on the arthropod nervous system by modifying the sodium channels of the cell membrane (Schulz et al. 1993). Affected animals move in an uncoordinated way and thus fall on the collecting sheets, from which they are sampled about an hour after fogging (Fig. 8) and are preserved in 96% ethanol for subsequent sorting (Floren & Schmidl 2003). We did not sample totally isolated trees but those whose canopies stood in contact with other trees (Figs. 4,5). Further ecological studies will have to show whether the canopy arthropod fauna could thus be surveyed comprehensively and differentiated by tree species (see Appendix 1: List of localities).

We want to note that on the Canary Islands, windless conditions are very rare (even shortly after dusk). Together with obtaining the collecting permits and transporting the bulky fogging equipment, this presented a considerable challenge in terms of logistics and planning. For a future fogging project, the planning, implementation of experiments and analysis should be carried out on the Canary Islands themselves. Therefore our study, representing the first application of the method on the archipelago, should not be seen as more than a preliminary incentive.

**Table 2** Tree and shrub species fogged with natural pyrethrum

Plant family	Tree/shrub species	Spanish common name used on the Canaries
Aquifoliaceae	<i>Ilex perado</i> Aiton ssp. <i>platyphylla</i> (Webb / Berthel.)	naranjo salvaje
Aquifoliaceae	<i>Ilex canariensis</i> Poir.	aceviño
Lauraceae	<i>Laurus novocanariensis</i> Rivas-Mart., Lousa, Fern. Prieto, E. Días, J.C. Costa & C. Aguiar	loro
Lauraceae	<i>Ocotea foetens</i> (Aiton) Baill.	til
Lauraceae	<i>Persea indica</i> (L.) C.K. Spreng	viñátigo
Rosaceae	<i>Prunus lusitanica</i> L. ssp. <i>hixa</i> (Willd.) Franco	hija
Myricaceae	<i>Myrica faya</i> Aiton	faya canaria
Ericaceae	<i>Erica arborea</i> L.	brezo
Oleaceae	<i>Picconia excelsa</i> (Ait.) DC.	palo blanco
Caprifoliaceae	<i>Viburnum tinus</i> L. ssp. <i>rigidum</i> (Vent.) Silva	follado canario

## Results and discussion

Nearly all specialists report low species numbers for the analyzed samples. However, the explanations for this finding diverge widely (cf. Appendix: Table 1).

Some authors attribute the low species numbers to the season during which fogging was performed (first half of October), suggesting that autumn will always be bound to produce numbers below the optimum and that winter or early spring would be a more appropriate season for fogging, especially when considering the phenology of short-lived insects.

However, given the reduced impact of seasons on the growth of the evergreen, subtropical laurel forest of the western Canaries (in contrast to the marked seasonality of temperate forests), some authors do not share this opinion. They believe that the spectrum of species fogged would be distinct from the composition found in autumn, but that the general number of species would remain more or less at the same level (allowing for a minimal increase).

The reason for constantly low species numbers in fogging samples could be that the arthropod diversity of the central Macaronesian laurel forest is actually not very high when compared to Central and Eastern European forests (see Sprick & Floren 2008). At least in many groups of beetles, the species numbers seem to be much higher in the Canarian thermophilous shrub forest and the coastal succulent-dominated shrub zone – especially in the long 'barrancos'.

A different reason for the low species numbers as revealed by canopy fogging could also be that the method does not recover all ecological groups equally well - this phenomenon was hinted at by several of the authors in this contribution. Mobile and flying species are better represented than those typically hiding underneath the bark or in crevices (Figs. 9,11,12).

The following subchapters present and discuss the results sorted by taxonomic group.

### **Coleoptera (A. Machado)**

A total of 99 species of Coleoptera were sampled by fogging and more than half of them (57 species) were represented by less than 10 specimens (24 species by only single specimens). This group of species present in very low numbers of individuals is formed by rare species (e.g. *Canaryclerus paivae*), wood-dwelling species (e.g. *Pselactus folwacznyi*), species that are not within their phenological optimum (e.g. *Laparocerus lepidopterus*), species that visit or climb trees occasionally, or species that were just caught by the pyrethrum cloud when they were flying-by (e.g. *Ochthebius rugulosus*, a riparian beetle). Moreover, the canopy fauna list is incomplete as only two islands were surveyed, and there are many cases of Tenerife-La Gomera vicariants that should count as single elements when considering guilds. This is the case for the species of *Paradromius*, *Aulonothroscus*, *Stagetus*, *Nesotes*, *Leipaspis*, *Tarphius*, and *Philorhizus longicollis* – *P. bravoorum* and *Laparocerus excavatus* – *L. aethiops garajonayi* (Fig. 16).

All taxa recorded are native (mostly endemic), except the leaf-beetle *Scleroderma testaceum*, which invaded the island of Tenerife in the last decade.

From the total of 4,238 specimens of Coleoptera sampled by fogging, 32.88% belong to the genus *Laparocerus* (Curculionidae: Entiminae), 20.39% to the tribe Lebiini (Carabidae), 14.12% to several genera of Cryptorhynchinae (Curculionidae), and 11.09% to the genus *Longitarsus* (Chrysomelidae: Alticinae). All other groups or genera together represent 21.52%, whilst none of these individual groups represents more than 4%.

As expected, mobile tree-climbers form the bulk of the capture, either leaf-chewers such as *Laparocerus* (Fig. 3) and *Longitarsus* (Fig. 18), or predators, as are all *Lebiinae* (Cryptorhynchinae are discussed in a separate section). Indeed, there are more *Laparocerus* species present in the laurisilva, but these are mainly linked to the plants and shrubs of the understorey. Species collected are typical of the tree-layer and responsible for the characteristic feeding marks that are so abundant and ubiquitous on leaves of trees. In particular, *Laparocerus excavatus* (Tenerife), and its Gomeran vicariant *Laparocerus aethiops garajonayi* (Fig. 16) were the most frequently captured of all arthropods (709 specimens). These two species are present all year round, with abundance peaks in summer, while most *Laparocerus* are winter-spring species (Machado & Aguiar, 2005). *Laparocerus ellipticus* and *Laparocerus inflatus* are stricter summer species (Fig. 15), which seem to be less nocturnal than their allies. They were also collected in abundance.

Leaf-beetles were very common throughout all sampling localities, particularly *Longitarsus kleiniiperda* (Fig. 18), a euryoecious species that feeds in its thousands on *Senecio kleinia* (Asteraceae), a succulent plant characteristic of the lower zone scrub vegetation. It was more abundant than *L. nubigena* in Tenerife, and its vicariant *Longitarsus* sp. (new?) from La Gomera. The latter two are probably more closely linked to the forest environment. Summer-autumn activity for this group is in accordance with our field experience in beating laurisilva tree species.

Worth mentioning are *Nesotes conformis* and *Nesotes gomerensis*, strictly nocturnal species of darkling beetles that are adapted to feed on leaflets in the tree layer of the laurisilva. Their low numbers (22 and 3 specimens respectively) contrast with their abundance in other seasons.



Figures 1-12

(1) Arranging plastic collecting sheets; (2) preparing the fogger (type Swingfog SN 50); (3) cursory 'leaf-roaming' beetles can be caught through canopy fogging in good numbers: like carabids (*Dromius/Paradromius*), Chrysomelidae (*Longitarsus* spp.) or Curculionidae, e.g. *Laparocerus excavatus* Woll. (photo); (4) nebulization in the laurel forest (La Gomera, "El Cedro"); (5) cloud of natural pyrethrum bound to the carrier substance of pure liquid paraffin; (6) *Canariola willemsi* (Orthoptera: Tettigoniidae) at night; (7) canopy fogging at night - windless conditions are very rare on the Canary Islands; (8) Cryptorhynchinae (Coleoptera: Curculionidae) remain immobile for a long time in thanatosis; (9) sweeping up of the arthropod 'harvest' at night; (10) comparison of the collecting methods: for the "treeclimbers" within Cryptorhynchinae (Curculionidae) the hand-collecting through beating was more effective than canopy fogging; (11) *Dendroacalles nubilosus* (Coleoptera: Curculionidae) was not fogged on Tenerife; (12) Cryptorhynchinae often remain within dead or furled leaves and under the bark; (photos: P.E. Stüben / A. Machado).

The outstandingly high number of *Lebiini* obtained (see Appendix: Table 1) is in accordance with the general tree-climbing, predatory habits of this ground beetle group, which is mainly represented in the tropics. In the Canaries, many of the species collected during this study were known before by only a few specimens. For instance, *Paradromius amoenus* (465 specimens) ranks as the second most abundant insect species collected. The fogging method is demonstrated to be ideal for sampling at least *Paradromius*, *Philorhizus* and *Dromius* (Fig. 17). Other tree-climbing predators, like *Leipaspis* spp. (Trogossitidae), *Atheta* sp. (Staphylinidae) or *Canariclerus paivae* (Cleridae) were much less abundant.

Species that are fungivorous and move over the bark were not very abundant, but were present on many trees: *Tarphius* spp. (Colydiidae), *Micrambe hesperia* (Cryptophagidae), *Aulonothroscus* spp. (Throscidae), *Xestus* spp. (Erotylidae), etc. They should be more abundant in a more humid season.

Xylophagous beetles like Scolytinae (52 specimens), Anobiidae (12 specimens) or Cerambycidae (1 specimen) were obviously scarce due to their cryptic habits and low exposure to the fogging, unless dispersing, which they normally do during the summertime. This may also apply to some subcorticolous taxa, like *Rhopalomesites* species, that were totally absent in our samples.

Several flower-loving species were captured irregularly and in moderate numbers, probably in those trees that still kept some late flowers: *Anaspis proteus* (Scraptiidae), *Olibrus florum* (Phalacridae) or *Pharoscygnus decemplagiatus* (Coccinellidae) are good examples, but their low numbers and the absence of many other taxa, like Malachiidae, clearly indicate that we have obtained an autumn fauna, very distinct from that of spring.

The sampling of different tree species has not been sufficiently homogeneous to allow for conclusive remarks about tree-beetle species relationships. Phytophagous beetles sampled (Cryptorhynchinae not considered) seem to be polyphagous or, at least, oligophagous (i.e. Lauraceae species). The only species which may be linked to a specific tree, *Erica arborea*, is *Micrelus ferrugatus* (Curculionidae).

The general impression gained from this first and limited survey is that fogging is an interesting method to collect tree-climbing species, particularly those that climb high, like the Lebiinae and Chrysomelidae, and perhaps less so for those that do not climb much (many *Acalles* s.l.) or hide under the bark or in other refuges (rolled leaves, seeds, etc.). The month of October, which was selected for the fogging, was apparently not the best regarding beetle phenology. Species of *Cardiophorus* (Elateridae), for instance, were abundantly obtained by beating trees in Las Mercedes laurel forest (during a *Laparocerus* survey, Machado & Aguiar, 2005), from January to September, but not a single specimen has been seen in autumn. From our empirical knowledge, late winter and spring are the seasons with highest beetle diversity in the laurisilva tree-layer.

A fogging survey carried out in late spring would give a rather different faunal composition, and perhaps some novelties in flower beetles linked to the high canopy.

### ***Coleoptera: Curculionidae: Cryptorhynchinae (P. E. Stüben)*** **'Treeclimbers'**

Among the 96 currently described Macaronesian Cryptorhynchinae, there are 27 arboreal species that live in the Canarian and Madeiran laurel forest. Out of these, 11 ecologically and morphologically close species can be joined in the ecological group of the 'treeclimbers' (cf. Stüben, Fabian & Astrin 2009). The treeclimbers are composed of species in the genera *Dendroacalles* s.str. (4 species), *Silvacalles* s.str. (6 species) and *Lauriacalles* (1 species). A (formal) higher-level taxonomy and molecular phylogeny of Macaronesian Cryptorhynchinae has recently been presented by Stüben & Astrin (in press).

So far, four treeclimber species have been recorded on Tenerife, while two further species were known for La Gomera (*Dendroacalles ruteri* (Roudier, 1954) occurs on both islands, cf. Fig. 13). We had supposed that applying canopy fogging for the first time on the Canaries would reveal new species of treeclimbers, as the conventional method with beating sheets does not reach strata higher in the tree than 3 m. Treeclimber species can be beaten even from the highest branches in the laurisilva canopy with the "beating carpet" method, as demonstrated by Stüben (2002:92) on the large *Ocotea foetens* trees of Madeira (at Fanal); however, we did not want to use this method, as it is dangerous (involves climbing) and very time-consuming.

Table 1 (see Appendix) shows that 15 arboreal species known from the laurisilva of Tenerife and La Gomera could be collected through canopy fogging, thereby recovering 93,75% of the known Cryptorhynchinae species in these habitats (without counting the subterranean Torneumatini). Only *Dendroacalles nubilosus* (Wollaston, 1864) was not found (Figs. 8,11). New species were not discovered either among the treeclimbers of the highest strata nor among the deadwood dwellers of the lower storeys (*Acalles*, *Onyxacalles*, *Calacalles*) or the detritus dwellers (*Echinodera*). This finding suggests that the Canarian laurisilva hosts one of the less diverse cryptorhynchine faunas (notwithstanding its high degree of endemism), especially when compared to the thermophilous shrub forest and the arid succulent bush

that grow in the numerous barrancos between the Canarian coastal level and elevations up to 500 m (Stüben, 2009). Even many Central and Eastern European forests (be it managed or in a natural state) present comparable species numbers of Cryptorhynchinae. Nevertheless, around 30% of all western Palearctic Cryptorhynchinae species have been described from these Atlantic volcanic islands (cf. Stüben 2009).

This result should be considered in the light of the hypothesis that "*the colonisation and respectively the evolution [of the Macaronesian species of Cryptorhynchinae] started in the conspicuously more arid habitats of the coastal succulent belt and continued much later as adaptation to the shady and moist laurel forest of the thermo-Canarian belt*" (translated from Stüben & Germann 2005: 48). We could recently corroborate this hypothesis by molecular phylogenetic results (Stüben & Astrin, in press). The Bayesian relaxed-clock estimates of lineage divergence times suggested an age of 4.2 to 4.5 Ma for the treeclimbing taxa *Silvacalles* s.str. and *Dendroacalles* s.str., while the last speciation events in these groups likely took place no more than half a million years ago (Stüben & Astrin, in press). Thus, the poorness in cryptorhynchine treeclimber species of the Canarian *laurisilva* can be plausibly explained by its relatively late colonization.

### Comparison of the collecting methods

A different question from measuring the actual diversity of Cryptorhynchinae is whether canopy fogging with pyrethrum constitutes an appropriate method to assess abundance and community structure of the cryptorhynchine fauna in the Canarian laurel forest.

Figure 26 shows the collecting results at Las Mimbreras ("locality E" in Appendix 1: List of localities) in the forest of "El Cedro" (La Gomera). During a period of 1.5 hours, we conducted a parallel fogging and hand-collecting experiment: by day, in windless conditions, seven tree and shrub species were fogged: *Picconia excelsa*, *Persea indica*, *Laurus novocanariensis*, *Ilex canariensis*, *Viburnum tinus rigidum*, *Erica arborea* and *Myrica faya* (Fig. 4). Simultaneously, the same plant species in the immediate vicinity (within a radius of approx. 50m) were beaten with sticks by two colleagues and the falling insects were collected on beating sheets, each measuring less than 80 cm in diameter (Fig. 10). Thereby, we could only reach heights below approx. 3 m.

With the exception of *Acalles pilula*, all other species found in the fogging samples could be collected (at the same locality and time) in higher numbers through hand-collecting than through fogging. For the tiny species *Calacalles pumilio* (1.6 mm) only a single individual could be fogged. The species was probably also hand-collected, but overlooked on the beating sheet due its unusually small size (all treeclimbers share more or less the same, larger body size). Inversely, beating twigs at ground level delivered specimens of *Echinodera pseudohystrix*, a species that could not be found through fogging (usually it is obtained through sifting twigs and leaf litter).

The abundance of nocturnal Cryptorhynchinae remained comparatively low when fogging at night, as demonstrated in Figure 27. Only *Acalles pilula* could be found again in high abundance by canopy fogging. All other species of Cryptorhynchinae were collected in only very small numbers by canopy fogging, some only with single specimens.

Overall, canopy fogging produced inferior numbers of Cryptorhynchinae than hand-collecting. Fogging was more effective only for the species *Acalles globulipennis* on Tenerife and *Acalles pilula* on La Gomera. These representatives of the subgenus *Origoacalles* are tiny species (not larger than 2.5 mm) and can be counted among the typical dead-wood dwellers.

It has to be noted that our comparative methodological survey focused only on the time slot that was allocated to the actual fogging – to which one must add the long time spent waiting for windless conditions (often days). When adding this time to hand-collecting, conventional collecting would clearly outdo fogging even for the afore-mentioned species of *Acalles* (*Origoacalles*).

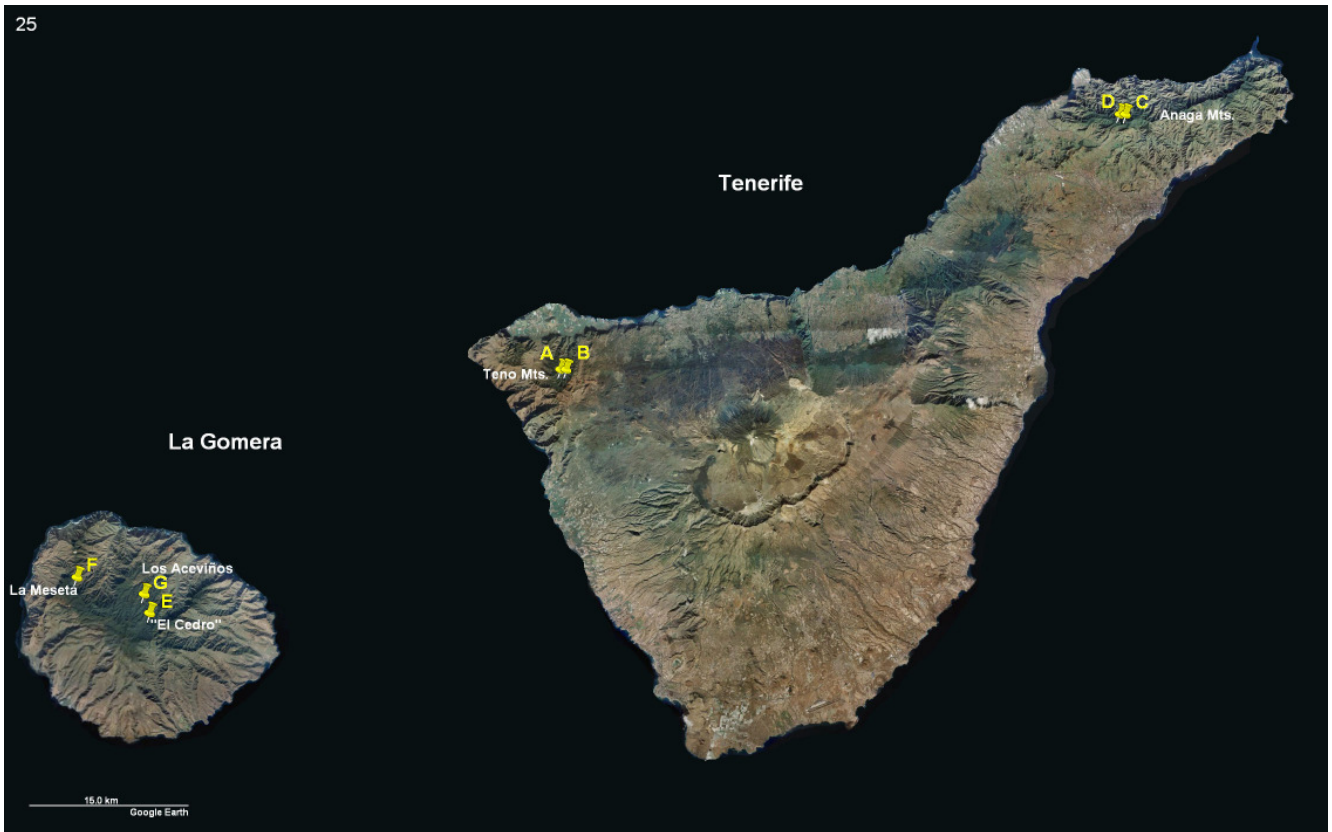
Bearing in mind the results of hundreds of nighttime excursions on the islands that were undertaken by members of the CURCULIO Institute during the last decade, we conclude that for arboreal Cryptorhynchinae, traditional, more specific hand-collecting through beating is much more effective than canopy fogging with natural pyrethrum!

How can this discrepancy between the two methods be explained? Why is fogging not the superior method? After all it covers about a hundredfold more phytomass and the approx. 300 m<sup>2</sup> of collecting sheets (Fig. 1) by far exceed the surface of the beating sheet used in hand-collecting (0.5 m<sup>2</sup> used repeatedly, but not adding up to more than 30-50 m<sup>2</sup> during the experiment). Seasonal variations in population density play no role in the long-lived Cryptorhynchinae (as opposed to the short-lived weevils of the genus *Laparocerus*, mostly active during winter, cf. Machado & Aguiar 2005). Such phenomena could never be observed in the targeted taxonomic group – neither on the Macaronesian Islands, nor in the remaining western Palaearctic region.

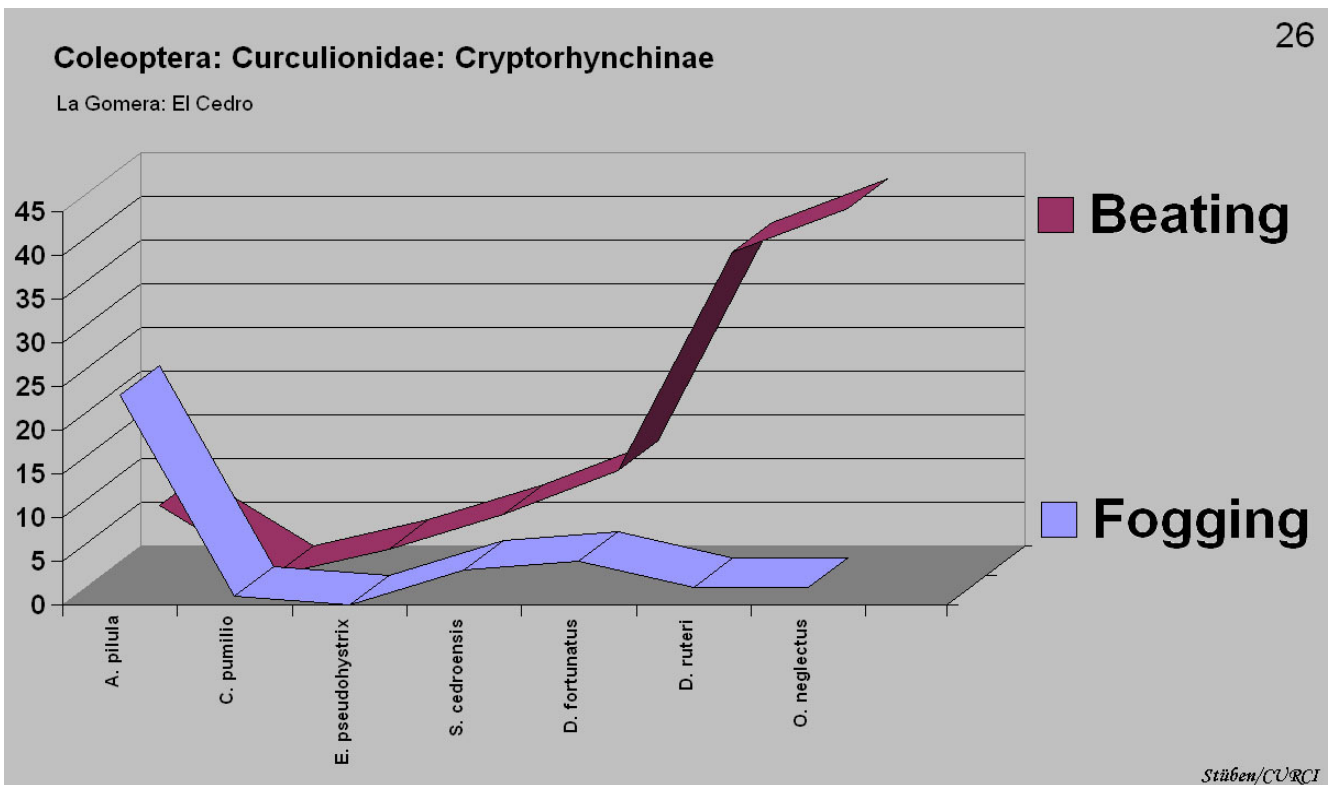


Figures 13-24

(13) *Dendroacalles ruteri* (Roudier, 1954), La Gomera, "El Cedro", (14) *Dendroacalles fortunatus* (Wollaston, 1864), La Gomera, "El Cedro"; (15) *Laparocerus inflatus* (Wollaston, 1865), La Gomera, "El Cedro"; (16) *Laparocerus aethiops garajonayi* Machado, 2007, La Gomera, "Ermita Sta Clara"; (17) *Dromius angustus plagipennis* Wollaston, 1865, Tenerife, Alto Catalane; (18) *Longitarsus kleiniiperda* Wollaston, 1860, Tenerife, Teno Mts.; (19) *Echinotheridion gibberosum* (Kulczynski, 1899), La Gomera, La Meseta, "La Piedra Encantada"; (20) *Zoropsis rufipes* (Lucas, 1838), La Gomera, La Meseta, "La Piedra Encantada"; (21) *Tromatobia quadricolor* (Kriechbaumer, 1894), La Gomera, "El Cedro"; (22) *Itopectis insularis* Hellén, 1949, La Gomera, "El Cedro"; (23) *Pimpla* cf. *turionellae* (cf. *freyi* Hellén) (Linnaeus, 1758), Tenerife, Anaga Mts. (24) *Clistopyga incitator* (Fabricius, 1793), La Gomera, "El Cedro"; (photos: P.E. Stüben).

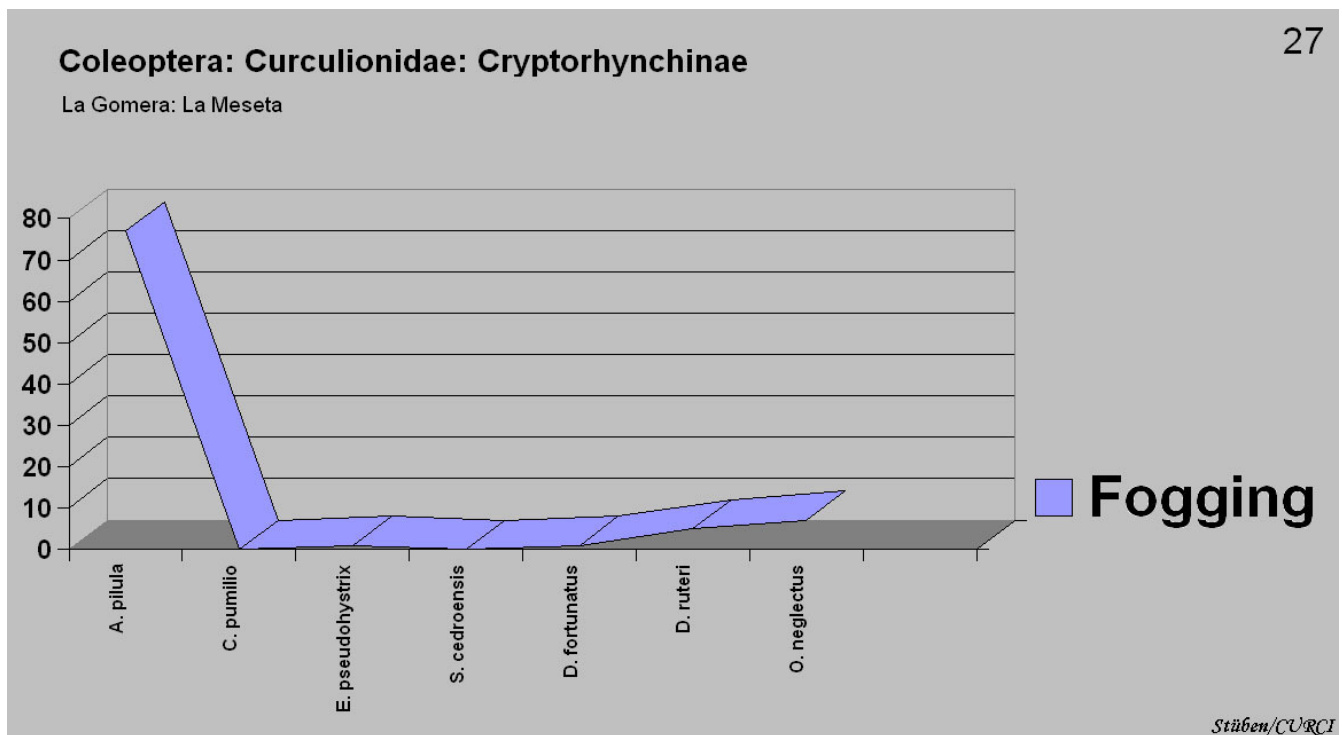


**Figure 25** Canopy fogging localities on Tenerife (Teno Mts. “A”, “B” and Anaga Mts. “D”, “C”) and on La Gomera (El Cedro “E”, La Meseta “F” and Los Aceviños “G”); see Appendix 1: List of localities.



**Figure 26** Comparison of collecting methods for Cryptorhynchinae in the laurel forest of La Gomera by day: during a period of 1.5 hours, we conducted a parallel fogging and hand-collecting experiment at Las Mimbreras (El Cedro). During the nebulizations, tree and shrub species identical to those fogged were beaten with sticks and the falling weevils collected on the beating sheets of two colleagues, each measuring less than 80 cm in diameter (see beating sheet in Fig. 10).





**Fig. 27** Canopy fogging results for Cryptorhynchinae in the laurel forest of La Gomera by night: Locality F, G32-G34 ("La Piedra Encantada", near La Meseta, *Ocotea foetens*).

An indication could be found directly at the fogging localities. Many cryptorhynchine species, especially the large tree-climbers like *Dendrocalles fortunatus* and *D. ruteri* (Figs. 13,14) withdraw by day into the dead, partially *Laparocerus*-gnawed and furled leaves of lauraceous trees as shown in Figure 11. Only vigorous beating releases them. Another situation applies to the *Onyxcalles* species. These wedge themselves into fissures of the dry trunk zone. Here they are either too low to be reached by the insecticidal cloud or they are affected deep within the fissure, which they cannot 'evacuate' (e.g. underneath bark). This seems to apply to other groups also: Colydiidae, like e.g. *Tarphius*, can usually be collected (beaten) from deadwood on Tenerife and La Gomera in high numbers. Fogging only recovered two colydiid species (21 individuals) in all 41 nebulizations.

All Canarian species of Cryptorhynchinae show nocturnal activity (like probably all western Palaearctic representatives). Nevertheless, fogging by night fails to show a significant increase in cryptorhynchine abundance (cf. Fig. 27). Collecting into a simple beating sheet (better even: into an inverted large sunshade) between midnight and 4 o'clock can produce a number of individuals many times higher (cf. Stüben 2000: 11). But in any case it is necessary to vigorously beat on twigs and leaves, as Cryptorhynchinae remain in an immobile position of thanatosis within dead and furled leaves for a long time (Figs. 9,11).

Cursory 'leaf-roaming' beetles can be caught through canopy fogging in good numbers, e.g. the mobile *Laparocerus* species or carabids (*Dromius/Paradromius*), flying Apionidae, Attelabidae or Chrysomelidae (*Longitarsus* spp.). However, the 'bark-clingers' and 'fissure-dwellers' are not affected to the same extent. A comprehensive, comparative methodological analysis – such as the one started here on a limited scale – is needed first in order to assess any ecological data obtained through canopy fogging (e.g. community structure, abundance, etc.).

### **Heteroptera (H. Günther)**

Aukema et al. (2006) list 385 species of Heteroptera from the Canary Islands. The authors give a survey on checklists of Heteroptera since 1953, when Lindberg published his first paper on Heteroptera from the archipelago.

During the fogging program, carried out in October 2008, sixteen species of Heteroptera were caught, which is 4.2 % of the total number of existing taxa. The reason for such a small number of recorded species may perhaps be due to the late period of the investigations, as many species have a rather short lifespan especially during spring and summer and cannot be found in autumn.

The list of collected taxa contains eight species of the family Lygaeidae, normally ground-living animals, which perhaps entered the trees for overwintering. Six species are taxa endemic to the Canary Islands (Kerzhner & Josifov 1999), and are known from four resp. six of the islands (Aukema et al. 2006):

*Aetorhinella parviceps* Noualhier lives on *Viburnum rugosum* in the laurisilvia (Wagner 1973). *Canariocoris viburni* (Lindberg) was the most frequent species during the fogging program. It is also a species of the laurisilvia. *Tuonia rubella* Puton lives on *Erica arborea* (Wagner 1973). *Loricula meinanderi* Péricart and *Stygnocoris barbieri* Péricart (Péricart 2001) are also known from the Canary Islands only, whereas *Kleidocerys truncatulus* Walker, *Tropistethus seminitens* Puton, *Eremocoris maderensis* (Wollaston) and *Scolopostethus pilosus maderensis* Reuter are known from Madeira also. The aradide species *Aneurus avenius tagasastei* Enderlein, endemic to the Canary Islands, is regarded as subspecies by Heiss (2001), and was upgraded to species rank by Aukema et al. (2006). The remaining species *Pinalitus conspurcatus* (Reuter), *Xylocoris obliquus* A. Costa, *Ploiaria chilensis* (Philippi) (Putshkov, P.V. & V.G. Putshkov 1996) *Lygaeosoma sardeum sardeum* Spinola and *Nysius cymoides* (Spinola) are widespread in the Palearctic, from the Canary Islands, Southern Europe, Northern Africa to Asia (Péricart 2001). *Nysius thymi latus* (Wagner) also exists on Cabo Verde and in Yemen.

### **Hymenoptera: Ichneumonidae (M. Schwarz)** **Faunistics and biogeography**

From 41 fogged trees, 1047 specimens of Ichneumonidae were obtained which have been assigned to 49 species. The number of specimens of Ichneumonidae collected from a single tree varied from 0-150 specimens. Compared to investigations in Poland where 10 oaks were fogged each in a primary and in a managed forest, yielding a total of 2880 specimens from 374 species (Horstmann & Floren 2001), the 49 species collected on Tenerife and La Gomera represent a low species number. This is relativized when taking into account that in a Central European country there are likely to be at least ten times as many species as on the Canary Islands (compare Horstmann 2001; Báez et al. 2001). The number of species occurring on the Canary Islands is unknown, because several groups of Ichneumonidae of the Canary Islands have not yet been revised and therefore the number of known species is supposed to increase when more taxonomic and faunistic studies are conducted.

It cannot be estimated if the ichneumonid fauna of the Canarian laurisilva is poorer or richer in species than other woods on these islands, as no literature on that topic exists.

The subfamily composition is not strikingly different from central European samples (Table 3). The Orthocentrinae which are parasitoids of Nematocera (particularly Mycetophilidae and Sciaridae) were abundant but not very species-rich on Tenerife and La Gomera. In Poland, this subfamily was rare in the canopies of managed forests, but abundant and diverse in early summer samples from canopies of primary forests (Horstmann & Floren 2001). Possibly the occurrence of Orthocentrinae in large numbers is an indication of primary forests, at least in temperate regions. The Pimplinae are well represented in the fogged material from the Canaries, whereas the Campopleginae are rare compared to central European samples (Table 3).

**Table 3** Subfamily composition of Ichneumonidae (% of individuals) in canopy fogging samples.

CI: Canary Islands – Tenerife and La Gomera (41 fogged trees), Le: Lesna in Poland (Le1: 4 fogged oaks, Le3/1: 6 fogged oaks, all in primary forest), De: Debowy Grad in Poland (4 fogged oaks, primary forest), Nu: Nurzec in Poland (6 fogged oaks, managed forest), St: Steigerwald in Germany (managed forest). The samples from Poland and Germany were taken in early summer, those from the Canary Islands in autumn. The data from Poland and Germany are from Horstmann & Floren (2001).

Subfamily (Ichneumonidae)	CI n = 1047	Le1 n = 912	Le3/1 n = 864	De2 n = 404	Nu3 n = 259	St/1+2 n = 573
Banchinae	4.4	2.5	7.9	9.9	7.7	5.6
Campopleginae	1.7	10.6	14.5	19.1	7.3	4.7
Cryptinae	28.6	31.7	31.4	25.2	48.6	33.5
Ichneumoninae	3.3	6.9	4.4	7.7	10.0	17.3
Orthocentrinae	30.6	31.2	21.9	13.1	0.4	1.2
Pimplinae	25.2	9.8	9.7	17.1	11.2	29.8
Tryphoninae	0.8	1.4	4.0	2.2	5.4	1.0
others	5.4	5.8	6.2	5.5	9.3	6.8

Although for most of the Canarian species of Ichneumonidae the hosts are unknown, they can be assigned to host groups based on parasitoid-host relationships of other ichneumonid species within the same genus or subfamily. Comparing the relative numbers of individuals attacking a special host group, there are no unusual differences between the Canarian material and that from Poland and Germany (Table 4). About half of the species and individuals in the samples from Tenerife and La Gomera are parasitoids of Lepidoptera. No species was found to attack Symphyta or Aculeata (Hymenoptera). All of the ichneumonids attacking Diptera are parasitoids of Nematocera, while Brachycera do not serve as hosts for the sampled species. Parasitoids of spiders (eggs and subadults) are well represented in the laurisilva.

**Table 4** Host groups of Ichneumonidae (% of individuals) in canopy fogging samples. For fogging site descriptions, see Table 3. Numbers in brackets (in Canarian samples) indicate the relative number of species.

Ichneumonid host group	CI n = 1047	Le1 n = 912	Le3/1 n = 864	De2 n = 404	Nu3 n = 259	St/1+2 n = 573
Araneae	14.7 (18.4)	6.0	2.7	4.4	3.5	1.2
Hymenoptera	2.6 (6.1)	5.3	11.7	8.4	11.6	1.5
Coleoptera	2.9 (6.1)	4.1	2.6	3.7	6.2	1.4
Planipennia	0.2 (4.1)	6.0	0.2	1.5	5.4	0.4
Lepidoptera	49.1 (53.1)	20.5	37.2	40.8	36.7	59.0
Diptera	30.6 (12.2)	32.9	22.5	13.3	0.4	1.4
other orders	0 (0)	18.6	19.5	19.8	30.5	30.2
host group unknown	0 (0)	6.6	3.7	7.9	5.0	2.6

### Taxonomic notes

*Himertosoma isabelae* (Rey del Castillo) comb. nov.

Townes (1970) synonymized *Lissonotidea* Hellén 1949 with *Himertosoma* Schmiedeknecht 1900; but Rey del Castillo (1990), when describing *Lissonotidea isabelae*, treated *Lissonotidea* as a separate genus. I have not found any characters which would justify a separation into two genera and therefore I follow Townes (1970). Consequently *Lissonotidea isabelae* is here transferred to *Himertosoma*, resulting in the new combination *Himertosoma isabelae* (Rey del Castillo).

*Megastylus canariensis* Rossem stat. nov.

This taxon was described as subspecies of *Megastylus orbitator* Schiødte. Because the material from the Canary Islands differs in some phenotypic traits (smaller size, extensive orange coloration, first segment of gaster) from the widespread continental *M. orbitator* (formerly *M. orbitator orbitator*), the taxon from the Canary Islands is here treated as a separate species rather than a subspecies.

*Gelis nivariensis* Schwarz

Hitherto only apterous females and micropterous males were known from this species. The fogged material also includes three macropterous males.

As an addition to the revision of the *Gelis* species with apterous females of the Canary Islands (Schwarz 1993) one new species is described below.

### *Gelis gomerensis* sp. n.

(Figs. 28-35)

**Holotype** (♀): "E, La Gomera, S Vallehermoso, La Meseta, "La Piedra Encantada" 6.10.2008, 819 m, 28°09'15"N 17°17'36"W", "Ocotea foetens leg. Astrin, Behne, Floren, Stüben G31 (B13)" (in Biologiezentrum, Linz, Austria).

**Paratypes** (7♀♀, 2♂♂): La Gomera: same data as holotype (2♀♀, 1♂); S Hermigua, El Cedro, Las Mimbreras, 901 m, 5.10.2008, 28°07'27"N, 17°13'26"W, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Stüben, G26 (B8) (1♀); same data except G20 (B2) (1♀); same data except *Persea indica*, G30 (B12) (1♀); same data except *Picconia excelsa*, *Persea indica*, G19 (B1) (1♀), same data except *Myrica faya*, G27 (B9) (1♂); Raso de la Bruma, 28.4.2008, leg. P. Whitehead (1♀; in Natural History Museum, London, UK). Except otherwise indicated, the paratypes are in coll. M. Schwarz.

### Differential diagnosis

*Gelis gomerensis* sp. n. belongs to the *Gelis bicolor* group (as defined by Schwarz 2002) and is most similar to *Gelis nivariensis* Schwarz, known only from Tenerife. *G. gomerensis* sp. n., *G. nivariensis* Schwarz and *G. escaleraei* Ceballos (also known only from Tenerife) can be separated from all other known Palaearctic species of the *G. bicolor* group (characterized by a deep and wide furrow on malar space, propodeum with hind transverse carina) by their first segment of the gaster lacking dorsolateral carina. *G. gomerensis* sp. n. can be rather easily separated from *G. nivariensis* Schwarz and *G. escaleraei* Ceballos by its gaster with distinct whitish coloration.

### Description

**Female:** apterous; antenna with 21-22 segments, third segment 4.6-4.9 times and seventh segment 2.4-2.8 times as long as wide; body distinctly granulated and matt; face without distinct punctures; clypeus distinctly convex and with some very fine punctures, lower margin of clypeus rounded and without a median tooth; mandible with teeth of the same length; malar space with a deep and wide furrow between eye and base of mandible (Fig. 33); malar space 0.8-1.0 times as long as width of mandibular base; frons without distinct punctures; head in dorsal view with eye 1.5-1.8 times as wide as length of head behind the eye; ratio of the shortest distance between the eye and the hind ocellus to the shortest distance between the hind ocelli 0.6-1.0; head behind the eyes weakly narrowed and rounded.



Figures 28-35

*Gelis gomerensis* Schwarz sp. n., female: (28) habitus dorsally; (29) habitus laterally; (30) ovipositor tip; (31) thorax and propodeum laterally; (32) first segment of gaster laterally; (33) head ventrally; (34) hind tibia; (35) gaster dorsally; (photos: P.E. Stüben).

Mesoscutum confluent with pronotum; mesonotum 1.1-1.5 times as long as wide, densely hairy and usually with a longitudinal median furrow; mesoscutum horizontal or weakly sloping backwards in lateral view; scutellum small and hardly or distinctly separated from mesoscutum by a transverse furrow; mesosternum somewhat longer than width of third segment of antenna; mesonotum 0.9-1.0 times as long as length of area anterior of propodeum (distance between anterior margin of propodeum and transverse carina); in lateral view propodeum higher than mesoscutum (Fig. 31); hind transverse carina of propodeum present medially and sublaterally; area petiolaris distinctly granulated and matt.

Hind femur 4.0-4.5 times as long as wide; hind tibia moderately thickened (Fig. 34).

Gaster densely hairy; first segment of gaster 1.7-1.8 times as long as wide, without dorsolateral carina (Fig. 32); second segment of gaster with laterotergite 2.9-4.9 times as long as wide; ovipositor sheath 0.6-0.7 times as long as hind tibia; ovipositor slender, its tip 3.7-3.8 times as long as high, ventrally with weak teeth (Fig. 30).

Coloration (Figs 28-29, 31-35): antenna brownish with base of flagellum lighter than other parts of antenna; head orange; frons partly or entirely, sometimes vertex, and temple dark brown or blackish; mandible yellowish basally, black apically; palps whitish and sometimes partly light brown; thorax dorsally and propodeum dorsally mainly orange; thorax laterally (anterior margin of pronotum laterally orange brown) and ventrally, propodeum with area petiolaris mainly blackish; first segment of gaster orange and whitish apically; other segments of gaster mainly blackish, whitish: broad hind margins of second and third tergites and usually second tergite mediobasally or entire median part, white hind margin of third tergite wider laterally than medially; coxae partly, trochanters and trochantelli entirely, base of tibiae and tibiae medially white (fore tibia dorsally sometimes blackish); other parts of tibiae blackish; coxae (except white parts) orange, brown or blackish; fore and middle femora brown or partly blackish with apical part orange; hind femur entirely blackish or brown; tarsi light brown.

Body length: 3.0-3.8 mm.

**Male:** like female except for sexual differences and mesothorax; micropterous; antenna with 23 segments, third segment 5.6-6.3 times and seventh segment 2.9-3.2 times as long as wide; antennal segments 10-13 with tyloids, tyloids linear; malar space 0.9 times as long as width of mandibular base; head in dorsal view with eye 1.7 times as wide as length of head behind the eye; ratio of the shortest distance between the eye and the hind ocellus to the shortest distance between the hind ocelli 0.7-1.3.

Mesoscutum separated from pronotum; mesonotum 1.7 times as long as wide; mesoscutum horizontal in lateral view; scutellum rather large and triangular, distinctly separated from mesoscutum by a prescutellar groove; mesosternum distinctly longer than width of third segment of antenna; mesonotum 1.3-1.4 times as long as length of area anterior of propodeum (distance between anterior margin of propodeum and transverse carina).

Hind femur 4.8 times as long as wide.

First segment of gaster 2.1-2.5 times as long as wide; second segment of gaster with laterotergite 4.3 times as long as wide.

Coloration similar to the female, but gaster with only hind margins of first and second tergites white.

Body length: 2.9-3.2 mm.

#### **Etymology**

The species name, a noun in the genitive case, refers to the Canarian island La Gomera, on which the species has been found.

### **Hymenoptera: Ichneumonidae: Pimplinae (S. Klopstein)**

The faunistics of parasitoid wasps on islands are especially interesting because of their high trophic level and varying degree of specialization. Parasitoids are often found at the top of the food chain and thus depend on the presence of various other organisms in order to persist on a newly colonized island. Their species richness is thus expected to be much lower on islands than on the continent. Moreover, the proportion of generalist *versus* specialist species is expected to be higher in geologically younger, more remote places.

The subfamily Pimplinae consists mostly of idiobiont ectoparasitoids of Lepidoptera, Hymenoptera and Coleoptera. Most species are broad generalists, although some specialization occurs especially in the Pimplini. A group of species in the tribe Ephialtini has even specialized on spiders as hosts, either exploiting their egg sacs or the juvenile or adult spider. The Pimplinae are represented by relatively more species than other subfamilies whose members are more specialized endoparasitoids (e.g. Ichneumoninae or Campopleginae).

Currently, there are 14 species of Pimplinae recorded from the Canary Islands, two of which are endemics (Báez & Ortega 1978; Báez et al. 2001; Hellén 1949; Horstmann 1988; Ortega 1985; Seyrig 1935; Pérez 1895). This is a very low number compared to Central Europe (Germany: 155 species, Spain: 78 species, Corsica: 33 species; Yu & Horstmann 2005). Eight of the 14 recorded species were collected here by canopy fogging.

Interestingly, the parasitoids living on spiders are very prominent among the Canarian Pimplinae in general and even more so among the species collected by canopy fogging. They account for five of the eight recorded species. The canopy of trees might be a good habitat to seek for their hosts, although very little is known about the searching behavior of these wasps.

*Pimpla freyi* Hellén (Fig. 23) was described from the Canary Islands (Hellén 1949) and later synonymized by Aubert (1967) with *Pimpla turionellae* (Linnaeus) without any further comment. Examining the substantial material collected by canopy fogging, we found distinct differences between these two taxa, and accordingly propose to remove *Pimpla freyi* from synonymy with *Pimpla turionellae*. The coxae of the Canarian species all are invariably red (black in *P. turionellae*) and the white band on the hind tibia is indistinct (distinct in *P. turionellae*). Additional characters to distinguish the two species can be found in Hellén (1949).

The identity of *Scambus nigromarginatus* (Pérez) still has to be clarified; the species is very close to *Scambus calobatus* (Gravenhorst).

### **Orthopteroidea (H. López)**

Regarding Dictyoptera (Blattaria), very few *Phylodromica* sp. (Blattidae) nymphs were sampled (14 specimens). According to our field notes and available entomological collections, adults of this tree cockroach are most common and abundant throughout winter, spring and early summer. Instead, nymphs are more frequent in the beginning of autumn. It was during this season that the study was conducted. Nevertheless the sampled animals occurred in surprisingly low numbers.

The result obtained on Orthoptera during the fogging survey is also surprising because it is known that some genera of Canarian orthopterans are abundant in the canopy of the laurel forest, such as *Calliphona* and *Acrostira* (only in La Gomera, D. Hernández pers. comm.), but they were not collected in this survey. Nonetheless, 21 specimens of *Canariola* spp. (Tettigoniidae) were sampled, this being an outstanding figure not matched before. It is clear that *Canariola* inhabits the high canopy of trees and that fogging is the adequate method to capture them. Almost half of all specimens (9 specimens) were female nymphs in the last postembryonic development instar, and the rest were adults. These latter individuals are surely recent adults mixed with those remaining from the summer population. Such overlaps of generations are known in other Canarian grasshoppers (López et al. 2007). *Canariola* species are generally not well studied due to the lack of material, and the specimens sampled here agree with the description of *Canariola willemsei* (Fig. 6), but others do not, or show some characters of both *Canariola willemsei* and *C. nubigena*. They may belong to a new taxon. Fogging offers a good opportunity of collecting abundant material of these tettigoniids for further in-depth morphological studies, and the same should apply to other 'rare' endemics, like *Evergoderes cabrerai* from Gran Canaria; it is known from only two specimens, probably because it lives in the canopy of *Pinus canariensis*.

Dermaptera of the endemic genus *Guanchia* hide under the loose bark of *Erica* or in the crevices of the bark of other laurisilva tree species. They are not uncommon, but the absence of specimens in the fogging captures may be explained either by the inappropriate season (like for Machilidae, Iulidae, etc.) or, more likely, due to their habits. These earwigs do not climb very high and during the night (when most of the fogging experiments were carried out) they normally descend from the trunks to feed on the ground.

The result obtained in Dictyoptera (Blattaria) and Orthoptera agree with the general observations that we have made over years on these groups. In the Canarian orthopterans, the most important hatch is after the first autumnal rains and the imagines appear in the following months, depending on the duration of postembryonic development, which varies according to species and sex. Probably, postembryonic development in *Canariola* takes less time than in *Phylodromica*, because all specimens of cockroaches were nymphs while in tettigoniids an important number of adults were present. *Canariola* males seem to become adults before females, because all nymphs collected were females while all males were adults. The *Canariola* male is smaller than the female. This sexual size dimorphism (SSD) is a tested effect of unequal postembryonic development (Hochkirch & Gröning 2008).

### **Araneae (J. Wunderlich)**

#### **Faunistics and biogeography**

The sampling contains approx. 33 species of spiders in 29 genera and 16 families. The most diverse families in the catches are Linyphiidae (5 genera, 7-8 species) and Theridiidae (6 genera, 6-7 species). Only a single genus - *Macaroeris* Wunderlich - of the diverse family Salticidae is reported. This is a remarkable result! The diverse family Gnaphosidae - see Wunderlich (1992) - is also reported from only a single species. This is more understandable as members of this family (the 'ground spiders') are rather rare in higher strata of the vegetation.

The most abundant species of spiders in the samples belong to the genus *Minicia* (Linyphiidae: Erigoninae).

The family Theridiosomatidae is new to the Canary Islands and even to the Macaronesian Islands!

*Lasaeola striata* Wunderlich, 1987 (so far only known from La Palma) is recorded for the first time on La Gomera and Tenerife.

Half of the spider species are widely distributed, the other half are Macaronesian or Canarian endemics:

(1) Endemics of the (usually) Western Canary Islands and partly also to the Azores (+ A) and/or Madeira (+ M):

- *Achaearanea dubitabilis*
- *Araniella maderiana* (+ M)
- *Canariellum arborens*
- *Cheiracanthium canariense*
- *Cyclosa maderiana* (+ M)
- *Echinotheridion gibberosum* (+ M) (Fig. 19)
- *Lathys dentichelis* (+ A)
- *Meta minima*
- *Clubiona minor*
- *Microlinyphia johnsoni* (+ A, M)
- *Misumeta spinifera* (+ M)
- *Scotophaeus varius*
- *Theridion musivivum* (+ A)
- *Zoropsis rufipes* (also known from Gran Canaria) (Fig. 20)
- *Zygiella minima* (also known from Gran Canaria)

(2) Island endemics are rare:

- *Minicia teneriffensis* (Tenerife)
- *Walckenaeria striata* (Tenerife)
- *Minicia gomerensis* (La Gomera)

### Taxonomic notes

The genus *Cheiracanthium* C. L. Koch is regarded here as a member of the family Clubionidae (not Miturgidae).

The genus *Zygiella* O. Pickard-Cambridge (Zygiellinae) is placed provisionally in the Araneidae although it may be considered a member of a separate family Zygiellidae.

*Scotophaeus varius* Simon will be placed in a new genus by Wunderlich (in prep.).

### Remarks on determination

With one exception (*Theridiosoma gemmosum*), only adult specimens have been entered in Table 1 (see Appendix).

The identification of *Theridiosoma gemmosum* (L. Koch) (Theridiosomatidae) is uncertain because only a single juvenile specimen has been collected.

Juvenile specimens of the genus *Philodromus* Walckenaer (Philodromidae) have frequently been collected, but not a single adult specimen. The catches probably contain more than a single species but the determination to species level is impossible.

Members of the family Pisauridae have also been collected as juveniles only (few specimens). The single known Canarian species is *Pisaura quadrilineata* (Lucas 1838).

Juvenile members of the genus *Araniella* Chamberlin & Ivie were found as juveniles, too. The only known Canarian species is *Araniella maderiana* (Kulczynski 1905).

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## Appendix

### 1. List of localities

#### \*\*\*\*\*Tenerife\*\*\*\*\*

##### Locality A (Tenerife: Teno Mts.)

**T1** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'15"W, 942 m, 2.10.2008, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Stüben

**T2** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'15"W, 942 m, 2.10.2008, *Picconia excelsa*, *Laurus novocanariensis* (6 trees, 2 species), leg. Astrin, Behne, Floren, Stüben

##### Locality B (Tenerife: Teno Mts.)

**T3** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'12"W, 940 m, 2.10.2008, at night, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Machado, Stüben

**T4** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'12"W, 940 m, 2.10.2008, at night, *Persea indica*, leg. Astrin, Behne, Floren, Machado, Stüben

**T5** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'12"W, 940 m, 2.10.2008, at night, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Machado, Stüben

**T6** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'12"W, 940 m, 2.10.2008, at night, *Myrica faya*, leg. Astrin, Behne, Floren, Machado, Stüben

**T7** = E: Tenerife: SW Los Silos, Teno Mts., Monte del Agua, Chupadero, 28°19'23"N; 16°49'12"W, 940 m, 2.10.2008, at night, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Machado, Stüben

##### Locality C (Tenerife: Anaga Mts.)

**T8** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'12"W, 905 m, 16.10.2008, *Laurus novocanariensis*, leg. Floren, Machado

**T9** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'12"W, 905 m, 16.10.2008, *Ilex platyphylla hixa*, leg. Floren, Machado

**T10** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'12"W, 905 m, 16.10.2008, *Prunus lusitanica*, leg. Floren, Machado

**T11** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'12"W, 905 m, 16.10.2008, *Prunus lusitanica*, leg. Floren, Machado

##### Locality D (Tenerife: Anaga Mts.)

**T12** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, *Myrica faya*, leg. Floren, Machado

**T13** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, *Ilex perado platyphylla*, leg. Floren, Machado

**T14** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, *Laurus novocanariensis*, leg. Floren, Machado

**T15** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, at night, *Erica arborea*, leg. Floren, Machado

**T16** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, at night, *Myrica faya*, leg. Floren, Machado

**T17** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, at night, *Ocotea foetens*, leg. Floren, Machado

**T18** = E: Tenerife: NE La Laguna, Anaga Mts., Las Mercedes, 28°31'49"N 16°17'16"W, 889m, 16.10.2008, at night, *Myrica faya*, leg. Floren, Machado

\*\*\*\*\*La Gomera\*\*\*\*\*

**Locality E (La Gomera: El Cedro)**

**G19** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Picconia excelsa*, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G20** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Stüben

**G21** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Ilex canariensis*, *Viburnum tinus rigidum*, leg. Astrin, Behne, Floren, Stüben

**G22** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Persea indica*, *Erica arborea*, leg. Astrin, Behne, Floren, Stüben

**G23** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Myrica faya*, leg. Astrin, Behne, Floren, Stüben

**G24** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G25** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G26** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, *Laurus novocanariensis*, leg. Astrin, Behne, Floren, Stüben

**G27** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, at night, *Myrica faya*, leg. Astrin, Behne, Floren, Stüben

**G28** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, at night, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G29** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, at night, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G30** = E: La Gomera: S Hermigua, El Cedro: Las Mimbreras, 28°07'27"N 17°13'26"W, 901m, 5.10.2008, at night, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**Locality F (La Gomera: La Meseta)**

**G31** = E: La Gomera: S Vallehermoso: La Meseta, "La Piedra Encantada", 28°09'15"N 17°17'36"W, 819 m, 6.10.2008, *Ocotea foetens*, leg. Astrin, Behne, Floren, Stüben

**G32** = E: La Gomera: S Vallehermoso: La Meseta, "La Piedra Encantada", 28°09'15"N 17°17'36"W, 819 m, 6.10.2008, at night, *Ocotea foetens*, leg. Astrin, Behne, Floren, Stüben

**G33** = E: La Gomera: S Vallehermoso: La Meseta, "La Piedra Encantada", 28°09'15"N 17°17'36"W, 819 m, 6.10.2008, at night, *Ocotea foetens*, leg. Astrin, Behne, Floren, Stüben

**G34** = E: La Gomera: S Vallehermoso: La Meseta, "La Piedra Encantada", 28°09'15"N 17°17'36"W, 819 m, 6.10.2008, at night, *Ocotea foetens*, leg. Astrin, Behne, Floren, Stüben

**Locality G (La Gomera: Los Aceviños)**

**G35** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G36** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G37** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G38** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G39** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G40** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

**G41** = E: La Gomera: SW Hermigua, Los Aceviños, 28°08'24"N 17°13'45"W, 992 m, 11.10.2008, at dusk, *Persea indica*, leg. Astrin, Behne, Floren, Stüben

## 2. Determinations

**Coleoptera (excl. Cryptorhynchinae):** det. A. Machado, January 2009

**Coleoptera: Curculionidae: Cryptorhynchinae:** det. P.E. Stüben, January 2009

**Heteroptera:** det. H. Günther, June 2009

**Hymenoptera: Ichneumonidae (excl. Pimplinae):** det. M. Schwarz, October 2009

**Hymenoptera: Ichneumonidae: Pimplinae:** det. S. Klopstein, May 2009

**Orthoptera:** det. H. D. López, January 2009

**Araneae:** det. J. Wunderlich, April 2009





