An Annotated List of the Orthoptera (*sens. lat.*) of the Canary Islands

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Abstract.—The distributions of **117** Canary Island orthopteroid species belonging to Orders Blattaria, Mantodea, Orthoptera, and Phasmida arepresentedbased on the authors' collections, rnuseum specimens, and literature since the last list in 1954. The number of species in eachorder and the percentage endernic to the archipelago are: Blattaria 24 **(50%)**; Mantodea 9 (67%); Orthoptera **83 (37%)**, and Phasrnida **1** (0%). The same for families of Orthoptera follows: Acrididae **41** (41%); Gryllidae 18 (17%); Gryllotalpidae 2 (0%); Parnphagidae 4 (100%); Pyrgornorphidae 1 (0%); Tetrigidae **1** (0%); and Tettigoniidae 16 (44%). Orthopteroid species diversity and the nurnber of endemics were greatest on Tenerife (**82** species, **24** endemics), followed by Gran Canaria (64 species, **17** endernics), and La Gomera (49 species, **14** endernics); Fuerteventura had the fewest nurnber of species (28) and the lowest nurnber of endemics (5). Tenerife supported the highest nurnber of single-island endemics (8) and La Palma had the lowest (1). The highest percentages of endernics, **27%** to 29%, occurred on Tenerife, La Gomera, La Palma, Lamarote, and Gran Canaria; Fuerteventura had 18% and El Hierro 17%.

New species, changes in nomenclature, and unconfirmed records are discussed, as are taxonornic problerns ecountered in taxa of the acridid genera *Sphingonotus* and *Acrotylus*.

Introduction

The Canary Island Orthoptera *(sens. lat.)* (Cuperorder Orthopteroidea) have been collected and described by numerous investigators beginning with an expedition in the 1830's (Brullé 1839). The Canarian literature consists typically of descriptions of new species fromsingle islands or of listsof species compiled prior to the 1930's (*e.g.*, Bolívar 1893, Krauss 1892). The most comprehensive data on the orthopteroid species of the islands include thelists and species descriptionsof Willemse (1936, 1949, 1950) and Chopard (1954) and a zoogeographical study of acridids by Holzapfel (1970). Thorough distributional data on a single island, Tenerife, were provided by Gangwere *et al.* (1972). An annotated list of the Orthoptera of Lanzarote and Gryllodea of the Canary Islands, along with new species descriptions and an extensive list of literature references, appeared recently (Kevan and Hsiung 1992).

This study combines previous and current data on the occurrence and distribution of orthopteroid species in the orders Blattaria, Mantodea, Orthoptera, and Phasmida (excluding Dermaptera) in the Canary Islands. It is based on collections by the authors, museum specimens, and literature references since the last complete list (Chopard 1954). Brief rernarks are made on taxonomic changes in many species to reconcile past and current nomenclature. Future reports are inprogress on the biogeography of Orthoptera of the Canary Islands and food preferences of selected species.

Description of the Canary Islands

The Canary Island archipelago consists of seven main islands and four islets in the Atlantic Ocean ranging from about 108 km (Fuerteventura) to 460 km (La Palma) west of the northrvest coast of Africa. The smallest island is El Hierro (277 sq km) and the largest is Tenerife (2,058 sq km). These volcanic, mountainous islands range from the eroded, relatively low land mass of the two eastern islands, Lanzarote and Fuerteventura (maximal elevations 670 and 807 m, respectively), to the five westem islands, all with elevations nearing or exceeding 1,500 m and, on Tenerife, ranging up to 3,717 m. Cteep slopes with ravines (barrancos) are prominent on the western five islands, and all have small- to moderate-sized coastal platforms (Great Britain Naval Intelligence Division 1945, Kunkel 1976a, Oromí and Izquierdo 1994, Oromí *et al.* 1991).

Therelatively uniform climate is subtropical up to about 600 m in elevation, subtemperate to temperate from 600 to 2,500 m, and subalpine above this elevation. Monthly mean temperatures range from 18°C to 24° C, depending on altitude. The northeast trade winds from the Atlantic Ocean help create an inversion zone of cloud banks at elevations of about 600 to 1,700 m, depending on the season; cloud cover is most common from March to June. These clouds bring mist and dew to north-facing, windward slopes, leaving the southern leeward slopes in a rain shadow. Annual rainfall rarely exceeds 250 mm except on the windward northeastem sides of a few islands where precipitation may reach 750 mm; most rainfall occurs from November to January. The mean annual rainfall (1949-1967) ranges from 135 mm (Lanzarote) to 586 mm (La Palma). Prolonged droughts are common, expecially on Lafizarote and Fuerteventura (Dicks 1993, Femandopullé 1976, Great Britain Naval Intelligence Division 1945).

The vegetational zones are distinct. An arid (xerophytic) sublittoral scrub zone extends to ca. 500 m (1,000 m on south slopes) followed by a transitional zone of tree heath and juniper scrub. Evergreen forests (the Laurisilva zone, followed by the Fayal-Brezal zone) extend from about 500 to 1,200 m and are replaced by Canary pine forests up to about 2,000 m. High mountain zones (subalpine scrub and alpine barrens) occur at the highest elevations (Dicks 1993, Gangwere *et al.* 1972, Schmid 1976). The natural vegetation consists of some 470 (Bramwell 1976) to 550 (Kunkel 1976b) endemic species and 450-500 Macaronesian, Mediterranean, or North African species. There are also ca. 700 species of introduced weeds or naturalized

garden plants and perhaps 1,300 species of cultivated plants (Kunkel 1976b).

Methodc and Materials

The authors have collected orthopterans on the Canary Islands over a seven-year period, primarily during the summer months. However, Lanzarote was sampled in December and from February to May, Fuerteventura in November, December, and March to May, and Gran Canaria in March, April, and October. Specimens were collected during all months on Tenerife. Collecting was by sweep nets, pitfall traps, oatmeal trails, and hand-picking insects on vegetation at night. An ultrasonic bat detector was used at night to locate tettigoniids whose stridulation was otherwise inaudible from a distance.

Museumspecimenswere recorded from the Museo Nacional de Ciencias Naturales, Madrid, the Museo Insular de Ciencias Naturales in Santa Cruz, Tenerife, and the Museum of Zoology, University of Michigan, Ann Arbor. Information on specimens in other museums was obtained through personal communication, and the extensive private collection of co-author M. Morales Martín, Santa Cruz, Tenerife, was utilized. The most comprehensive previous account of Canarian orthopteroids was compiled by Chopard (1954) and, thus, our list (Tables 4 to 9) begins with his data and adds new records. To avoid unnecessary repetition, we have not included all literature references for each species but, instead, refer the reader to Chopard (1954) **and** Willemse (1936, 1949, 1950), the latter of whom included original collecting records and other sources. Herrera (1982) and Kevan and Hsiung (1992) also include extensive lists of references.

The system of classification adopted for the following discussion generally follows that of Harz (1969, 1975) and Harz and Kaltenbach (1976). Abbreviations in Tables 4 to 9 refer to the following species collecting records: A, Ashmole and Ashmole (1988); **AO,** Ashmole *et al.* (1992); B, Bland and Gangwere collections; BA1, Báez (1984); BA2, Báez (in press); BA3, Báez (personal communication); BO, Bohn (personal communication); C, Chopard (1954); CA, Cañizo (1955); G, Gardner (1960); GA, Gangwere *et al.* (1972); GB, Garcia Becerra *et al.* (1992); GO, García-Becerra and Oromí (1992); H1, Holzapfel (1970); H2, Holzapfel (1972); HC, Holzapfel and Cantrall (1972); HM, Herrera (1993); I, Izquierdo and Martín (1990); IM, Izquierdo and Medina (1992); J1, Johnsen (1970); J2, Johnsen (1974); J3, Johnsen (1985); J4, Johnsen (1991); K, Kaltenbach (1979); KE, Kevan (1987); KH, Kevan and Hsiung (1992); KJ, Kruseman and Jeekel (1972); M, Morales collection; MA, May (1912); ME, Medina and Oromí (1990); MI, Martín and Izquierdo (1967); MM, Museo Nacional de Ciencias Naturales, Madrid; MO1, Martín and Oromí (1986); MO2, Martín and Oromí (1987); MO3, Martín and Ororní (1990); MOI, Martín *et al.* (1987); MT, Museo Insular de Ciencias Naturales, Tenerife; P1, Pinedo (1983); P2, Pinedo (1984); P3, Pinedo (1965); T, Townsend (1983); Z, Zoologisk Museum, Copenhagen.

Island abbreviations in tables are as follows: F, Fuerteventura; G, La Gomera; C, Gran Canaria; H, El Hierro; L, Lanzarote; P, La Palma; T, Tenerife. Islands are presented from east (nearest to the African mainland) to west in tables.

Results and Discussion

Table 1 is a summary of the number of species in the major taxa. There are 3.5x more species of Orthoptera (83 species) than of the next largest order, Blattaria **(24** species). However, the percentage of endemics is greater in the Blattaria (50%) than in the Orthoptera (37%). A major reason for this difference is the large number of endemic blattarian species found in caves. The number of blattarian species is 33% greater than that of the other large geophilous group, the gryllids **(16** species), and only 17% of gryllids are endemic. The greater endemisrn in cockroaches relative to crickets rnay indicate a more diverse gene pool, with genes that convey more adaptability to varied habitats (especially caves), food, competition, and other environmental requisites. Alternatively, cockroaches may have colonized the volcanic islandc earlier than crickets, which allowed cockroaches more time to exploit protected niches. Greater endemism may also reflect the largely sedentary and secretive nature of cockroaches, with little dispersa1 once they are established, allowing for more rapid speciation and proliferation of distinct, geographically restricted taxa.

Within the Orthoptera, there are slightly more gryllid species (18) than species of tettigoniids (16) but nearly as many acridids **(41)** as all other orthopteran families combined (42) (Table 1). The percentages of endemic acridids (41%) and tettigoniids (44%) are similar and much higher than that of gryllids (17%). The highest percentages of endemics occur in the pamphagids (100%) and mantids (67%). The higher levels of endemism of the above taxa could be due to narrower ecological amplitudes as compared to many gryllids, potentially leading to more extensive interpopulation divergence and the development of ecologically and morphologically distinct populations by geographic subdivision of populations.'

Table 2 shows the number and distribution of orthopteroid species by order and family on each island of the Canaries. The greatest number of species occurs on Tenerife (82), followed by 64 species on Gran Canaria, and 49 species on La Gomera; Fuerteventura has the fewest (28). Endemism follows a similar pattern: Tenerife has the greatest number of endemic species (24), Gran Canaria follows with 17, and then La Gornera with 14; Fuerteventura and El Hierro have the fewest (5 and 6, respectively). However, the islands with the greatest percentages of endemics, 27% to 29%, are Tenerife, La Gomera, La Palma, Lanzarote, and Gran Canaria; Fuerteventura has 18% and El Hierro 17%. Tenerife has the highest nur iber of single-island endemics (8); Gran Canaria has six, La G. mera fi , El Hierro and Lanzarote three, Fuerteventura two, and La I alma one (Tables 4-9). In general, pattems of species diversity and endemism reflect a number of factors including size and ecological complexity of each island (e.g., total land area covered by favorable vegetational zones, number and types of caves), climatic extremes across the seasons, relative pnsition of each island to the other islands and the mainland, and distance from an island to other islands.

The blattarians on Tenerife, represented by 17 species in seven families, are more diversified than those on the other islands (Table 2). Six of these are species of *Loboptera* that occur in caves. The second highest number (ten species in five families) occurs on Gran Canaria and the least (four species in three families) is on Fuerteventura and Lanzarote. Mantodea follow a similar distribution, except Lanzarote has the third largest

number of species and the two western-most islands, La Palma and El Hierro, have relatively few species.

Tenerife also exhibits the greatest orthopteran species diversity (56 species); Gran Canaria is second (49 species), and La Gomera is third (40 species) (Table 2). Diversity drops in the remaining islands, ranging from 22 to 28 species. Tenerife and Gran Canaria have a similar number of acridid species (27 and 26, respectively), and the remaining islands range from 14 (El Hierro and La Palma) to 19 (La Gomera and Lanzarote). Pamphagids are represented by four species, each an endemic on a specific island. Gryllid species are most abundant on Tenerife (14), with Gran Canaria a distant second (10) and Fuerteventura last (2). Tenerife and the relatively small island of La Gomera have the most tettigoniid species, 11 each, whereas Fuerteventura has only one and Lanzarote two species.

Selected characteristics of each island were compared to the island's species diversity to determine if these characteristics were significant predictors of diversity. Predictor values were derived from Femandopullé (1976), Great Britain Naval Intelligence Division (1945), Kunkel (1976a), and Oromí and Izquierdo (1994). Elevation produced the only significant correlation coefficient ($p<0.05$) when using regression analysis (Table **3).** Island size has a much reduced correlation with species diversity and age shows the least correlation. The coefficient of determination (r) predicts that 66% of the variation in the number of species is dependent upon the variation in elevation. Data for the number of species and elevation are plotted in Fig. 1.

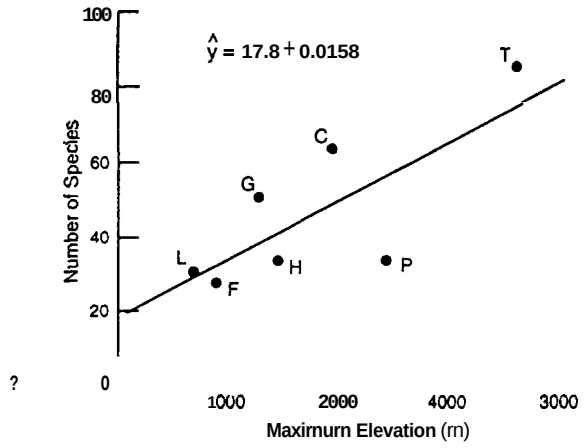

Fig. 1. The effect of maximum elevation on species diversity. Letters refer to specific islands as defined in Methods and Materials.

Although elevation and species diversity are significantly correlated, it is only an indirect relationship. Most of the islands with higher elevations provide more vegetational zones and probably more surface area for favorable orthopteroid habitats, thereby leading to greater species diversity. The correlation of size with diversity is compromised by an arid climate on some islands (e.g., Lanzarote, mean rainfall **135** mm/year) and a relatively wet climate on islands of similar size (e.g., La Palma, mean rainfall 586 mm/year) (Fernandopullé 1976). Similar variables occur when considering the distance from the mainland and age of the islands. Further analysis of combinations of predictors (e.g., mean rainfall at increasing elevations or in each vegetation zone of individual islands) is beyond the purpose **of** this study but will be addressed in a biogeographical analysis of the Canary Islands now in progress.

Table 1. Numbers of species and endemic species and percentages of endemic species of orthopteroids in the Canary Islands.

	#s of Species	Endernic Species #'s	%
Blattaria	24	12	50
Mantodea	9	6	67
Phasrnida	1	0	0
Orthoptera (total)	83	31	37
Acrididae	41	17	41
Gryllidae	18	3	17
Gryllotalpidae	2	0	0
Parnphagidae	4	4	100
Pyrgomorphidae	1	0	0
Tetrigidae	1	0	0
Tettigoniidae	16	7	44
Total nos. Species	117	49	
Average % Endernics			42

There are undoubtedly additional orthopteroid species to be found in the Canary Islands. We have surveyed habitats that varied in elevation, moisture, and types of vegetation on all islands, but certainly all localities have not been exhaustively sampled in all seasons. We have also relied heavily on museum specimens and literature data since the late 1800's. Nocturnal groups especially need more attention. No species of Gryllacrididae have ever been collected and it seems likely that this worldwide, largely nocturnal group should occur as do its gryllid and tettigoniid relatives. More nocturnal collecting using oatmeal trails and pitfall traps is needed to collect the above groups and to sample for additional blattarians. Relatively few orthopteroids have been collected from the transitional and Laurisilva zones of Gomera and El Hierro, and we suggest that more intensive nocturnal surveys are especially needed in these regions.

Remarks on Species

BLATTARIA (Table 4)

Leurolestes Rehn and Hebard. The two Canary Island species in this genus are listed in the genus *Phoetalia* by Chopard (1954).

Loboptera Brunner von Wattenwyl. This Mediterranean complex of 15 species includes seven in the Canary Islands, six of which are recently described endemic hypogean species with varied adaptations to subterranean life in modified lava tubes. The seventh, *L. cnnariensis* Chopard, is an epigean (surface) species. Descriptions of species, habitats, and evolutionary relationships are given by Bohn (1991), Martín and Izquierdo (1987), Martín and Oromí (1987), Martínetal. (1986), and Oromí et al. (1991).

Phyllodromica Fieber. This genus includes the *Arbibintta* spp. as recognized by Chopard (1954). *Arbibiatta bivittata* (Brullé) is a synonym of *P. brullei* (Princis) and *P. pallidula* Princis is a *nomen novum* for *A. pallida* Chopard (Princis 1965).

Phyllodromica (Lobolampra) lindbergi Chopard. Kevan and Hsiung (1992) treat *Lobolampra* as a genus; however, we follow Princis (1965) and Harz and Kaltenbach (1976) who relegate it to a subgenus of *Phyllodromica*.

Phyllodromica Fieber spp. 1 and 2. H. Bohn (personal com-

Table 2. Numbers and distributions of orthopteroid species by order and family on the Canary Islands. An asterisk indicates the number of endemic species on each island; abbreviations are defined in Methods and Materials.

Taxa	Islands						
	F	L	C	T	G	P	H
BLATTARIA							
Blaberidae			1	1	1	1	
Blattellidae			4(1*)	7(5*)		1*	1*
Biattidae	2	2	3	4	2	2	2
Ectobiidae	1*	1*	1'	1*	3'	1*	2'
Epilampridae				2			
Euthyrrhaphidae				1			
Nauphoetidae	1	1	1	1	1	1	1
Total no. Species	4(1*)	4(1*)	10(2*)	17(6*)	7(2*)	6(2*)	6(2*)
MANTODEA							
Empusidae	2	2	2	2	1		
Mantidae		2'	3(2*)	6(5*)	1'	2(1*)	1
Total no. Species	2	4(2*)	5(2*)	8(5*)	2(1*)	2(1*)	1
PHASMIDA							
Phasmatidae				1			
Total no. Species				1			
ORTHOPTERA							
Acrididae	16(3*)	19(5*)	26(10*)	27(7*)	19(5*)	14(3*)	14(3*)
Gryllidae	2	3(1*)	10	14(2*)	7	5	6
Gryllotalpidae	1		1	2	1		
Pamphagidae	1'		1'		1*	1'	
Pyrgomorphidae	1		1	1			
Tetrigidae			1	1	1	1	1
Tettigoniidae	1	2	9(2*)	11(4*)	11(5*)	6(3*)	7(1*)
Total no. Species	22(4*)	24(6*)	49(13')	56(13)	40(11')	27(7*)	28(4*)
Grand Total no. Species	28	32	64	82	49	35	35
Grand Total no. Endemics	5	9	17	24	14	10	6
Grand % Endemics	18	28	27	29	29	29	17

munication) has indicated that these previously unidentified specimens are new species closely related to *P. (P.) brullei*. Species 1 was collected from Mirador de Bascos, El Hierro. Species 2 was found in a laurel forest near El Cedro and in scrub vegetation near Tagamiche, Gomera.

Rhyparobia *maderae* (Fabricius). This cockroach is commonly found in earlier references as *Leucophaea maderae* (Fabricius).

Symploce microphthalma Izquierdo and Medina. Izquierdo and Medina (1992) recentiy discovered this new subterranean species on Gran Canaria.

Zetha simonyi (Krauss). *Z. vestita* (Brullé) is a synonym of this species (Princis 1965).

MANTODEA (Table 5)

A review with keys and illustrations of the Canary Island mantids was completed by Kaltenbach (1979). Two species of *Ameles* and four of *Pseudoyersinia* are endemics. Kaltenbach (1979) treats *P. Lindbergi* Chopard as a synonym of *P. subaptera* Chopard (1942,1954).

ORTHOPTERA

Acrididae (Table 6)

Acrotylus **insiibriciis** *inficitus* (Walker). It is unclear whether only **A. insiibriciis insiibriciis** (Scopoli) or **A.** i. *inficitus* occur in the Canary Islands, or whether one of these subspecies and **A.** patriielis (Herrich-Schaffer) both occur. Chopard (1954) and Holzapfel (1970) listed both species but the latter did not collect **A. insiibriciis** based on her identification criteria. Gardner (1960), Herrera (1982), Johnsen (1970, 1974), and Kevan and Hsiung (1992) recognized both species, although Herrera and Kevan and Hsiung relied on previous literature for their data. Dirsh (1965) and Harz (1975) did not list **A.** *patruelis* for the Canary Islands but Dirsh recorded **A. insiibriciis** and Harz recorded **A. i. inficitiis** as present. Maran (1958) recognized **A.** i *inficitus* as a valid subspecies, but Ingrisch and Pavicevic (1985) indicated that **A.** i. *inficitus* may be a synonym of **A.** *i.* **insiibriciis.** Baccetti and Capra (1988) included Tenerife and La Gomera for *A.* i. *inficitiis* (their **A.** *maculatus inficitus* (Walker)) but they did not list the Canary Islands for **A.** *patruelis* (their **A. insiibricirs** *stat. nov.*). La Greca (1993) indicated that **A.** *patruelis* was a vaiid species. Aquirre-Segura *et* al. (1995) reported **A.** *patruelis* and *A.*

Table 3. Regression analysis of the relationship between the number of species (species diversity) on each island and five predictors of diversity. **N=7**

Predictor	r[1]	r%[2]	b[3]	P
Maximum elevation	0.81	66.2	0.0159	0.026
Size	0.55	30.5	0.0161	0.198
Mean rainfall	0.29	8.5	0.0366	0.526
Distance from mainland	0.20	3.9	0.0270	0.670
Age	0.14	2.0	0.350	0.763

[1]correlation coefficient (Pearson); [2]coefficient of determination; [3]regression coefficient

Table 4. Blattaria (=Blattodea, Blattoptera, Dictyoptera, Dictuoptera) of the Canary Islands. Asterisks indicate endemic species; abbreviations are defined in Methods and Materials.

	Islands						
	F	L	C	T	G	P	H
Blaberidae							
Pycnoscelidinae							
Pycnoscelus surinamensis (Linnaeus)			BA3	C,J2,M	J2,MA	C	
Blattellidae							
Pseudomopinae							
Blattella germanica (Linnaeus)			B,C	C,J2,M	-		
Lobopteru anagae Martín & Orom''				M02	-		
Lobopteru canariensis Chopard			BO	BO,C,M	-		
Lobopteru cavernicola Martín & Orom''				M02	-		
Loboptera fortunata Krauss*				M	-	C,M	
Lobopteru ombriosa Martín & Izquierdo?					-		MI
Lobopteru subterranea Martín & Oromí*				M,MO2	-		
Lobopteru troglobia Izquierdo & Martín''				.I	-		
Supella longipalpa (Fabricius)			C		-		
Symploce microphthalma Izquierdo & Medina*			IM		-		
Blattidae							
Blattinae							
Blatta orientalis Linnaeus	C		C	G	-		B
Periplunetu americana (Linnaeus)	B,C	B,C	B,C -	B,C,G KJ,M	B,J2 MA	B	B
Peripluneta australasiae (Fabricius)			KJ	J2	B,J2	BA3	
Periplunetu brunnea Burmeister		B	-	C	-		
Ectobiidae							
Ectobiinae							
Phyllodromicu (Lobolampra) lindbergi Chopard*		B,C					
Phyllodromicu (Phyllodromicu) brullei (Princis)*	M		C,M GB	C,G KJ,M	B,J2 M,MA	M	B
Phyllodromicu (Phyllodromicu) pallidula Princis*					ME,B,C		
Phyllodromicu (Phyllodromicu) sp. 1*							B
Phyllodromicu (Phyllodromicu) sp. 2*					B	-	-
Epilampridae							
Epilamprinae							
Leiirolestes circumvagans Burmeister				C		-	-
Leurolestes pallidus (Brunner)				C		-	-
Euthyrrhaphidae							
Tiviinae							
Zetha simonyi (Krauss)				C,MM		-	-
Nauphoetidae							
Oxyhaloinae							
Rhyparobia maderae (Fabricius)	C	C	C	C	J,MA	BA3	BA3

Table 5. Mantodea (=Dictyoptera, Dictuoptera) and Phasmida (=Phasmatodea, Cheleutoptera) of the Canary Islands. Asterisks indicate endemic species; abbreviations are defined in Methods and Materials.

	Islands						
	F	L	C	T	G	P	H
Ernpusidae							
Empusinae							
Blepharopsis mendica (Fabricius)	K	K'	K	K,J2			
Hypsicorypha gracilis (Burmeister)	B,MM	B,KJ	MM	K,KJ	J2,K		
Mantidae							
Amelinae							
Ameles gracilis (Brullé)'			K	K			
Ameles limbata (Brullé)'				K			
Pseudoyersinia canariensis Chopard'		B		M		B,K	
Pseudoyersinia *pilipes* Chopard*					K		
Pseiidoyersinia siibapfera Chopard'		MM	K	K			
Pseiidoyersinia teydeann Chopard'				K			
Mantinae							
Mnritis religiosa Linnaeus			B,G,K	K		GB	B
Phasmida							
Phasmidae							
Bacillinae							
Clonopsis gallica (Charpentier)				BA2	-	-	-

i. insiibriciis from Gran Canaria and La Gomera.

Our collecting has resulted in specimens with appreciable size differences on the same and on different islands, and a habitat diversity ranging from soft, dry agricultura1 loam with little vegetation (where the highestpopulations occur) at low to mid-elevations, to pebbly, hard surfaces along weedy roadsides at mid- to high elevations. Presa and Llorente (1979), who studied the *Acrotylus* of the iberian Peninsula, established numerous morphological characters separating the five forms. Llorente also examined the neariy 400 Canary Island specimens in the Museo Nacional de Ciencias Naturales, Madrid, that were originally identified as ***A. patruelis***. Her opinion (personal communication) is that all are ***A. i*** *inficitus*. Because of the varied morphological characters, the great habitat diversity, and the fact that specialists such as Baccetti and Capra (1988), Johnsen (personal communication), and La Greca (1990,1993) believe that ***A.*** *pafriielis* can be separated from *A. insiibriciis*, we retain ***A.*** *patruelis* on our list of species although we favor Llorente's conclusion. Analyses of male signals, genitalia, and perhaps alloenzymes and **DNA** sequences are needed to clarify the status of this group.

Arminda Krauss. These seven Canarian endemics were described by Holzapfel (1972) and Johnsen (1974).

Calliptamus barbariis barbariis (Costa). This red-winged species was listed by Chopard (1954) as *C. siculus* Burrneister, with an indication that it may occur on Tenerife. The species is now treated as a synonym of *C. b. barbariis* (Jago 1963). Willernse (1936) listed *C. italicus* (Linnaeus) on Lanzarote and Graciosa, but it likely was *C. barbnrzis* because the latter has a more southerly distribution in the Iberian Peninsula and extends into Africa (Jago 1963, Presa 1976, Llorente 1982, Clemente ***et al.*** 1987). Willemse (1936) noted that Ramme communicated to him that *C. siculus* (described under *Caloptenus* by Burmeister) occurred in the Canary Islands but gave no specific islands. Ramme (1951) later noted that the red-winged *C. b. barbariis* is found on Lanzarote, and we have collected it there as well (Table 6). The only publication of which we are aware that reports *C. barbarus* on Tenerife is by Bormans (1883), who listed it as *Gryllus italicus* Linnaeus var. *sicula* Burmeister and var. *icterica* Serville. However, as noted, thevar. *sicula* had colorless hindwings and, thus, was most likely *C. plebeius*. Var. *ictericn*, with the reddish hindwings typical of *C. barbariis* and *C. italicus*, was actually collected on Alboran Island in the westem Mediterranean Sea. A typographical error ceparating the description from the locality (a semicolon instead of a colon) in the original publication would suggest that var. *icfericu* occurs on Tenerife. We postulate that Chopard (1954) or another person may have misread the locality.

All of the 15 male specimens from Lanzarote in our collection have pale orange hind femora and nearly all have a solid dark region on the inner side of the hind femora rather than separate dark spots. These characteristics are typical of specimens found in arid areas of southern Spain (Jago 1963, Llorente 1982, Clemente et *al.* 1987). Several males and females were of the "*marginellus*" forrn (Jago 1963).

Dericorys Serville. The species and subspecies are discussed by Holzapfel (1970). Her rneasurernents of *D. lobata* tended to confirm the presence of two subspecies, *D. l. lobata* (Brullé) on Lanzarote and Graciosa (the island near the northern tip of Lanzarote), and *D. l. luteipes* Uvarov on Fuerteventura and, occasionally, Lanzarote. Female specimens that we collected on Fuerteventura matched the characteristics of *D. l. luteipes* used by Holzapfel (1970), *i.e.*, prozonal crest higher than the metazonal crest, thoracic tubercles light colored, and the hind tibiae a dirty

Table 6. Acrididae of the Canary Islands. Asterisks indicate endemic species; abbreviations are defined in Methods and Materials.

	Islands						
	F	L	C	T	G	P	H
Acridinae							
Acrida bicolor (Thunberg)				J4,Z			-
Calliptaminae							
Calliptamus barbunis barbarus (Costa)	-	B,H1					
Calliptamus plebeius (Walker)'		B,KH KJ	B,C,H1 KJ,M	B,C,H1 J1,J2	B,H1 M,MM	B,C,H1 MM	B,C,H1 M
	-	M03	MM	KJ,M			
	-			MM			
Catantopinae							
Armindu briinneri Krauss*	-		M	C,G,H2	B,J2	H2	
	-			J1,J2			
	-			M,MM			
Armindu burri Uvarov*			C,KJ	H2			
			MM				
Arminda fuerteventurae Holzapfel*	B,H2,M						
Arnrinda hierroensis Enderlein'							C
Arminda lancerottensis Holzapfel*		B,H2					
Armindu latifrons Enderlein'					C,MT		
A. (Chopardminda) canariensis Morales'	-		H1,MM				
Cyrtacanthacridinae							
Anacridium aegyptium (Linnaeus)			G				
Schistocerca gregaria (Forskål)	C,CA, H1	B,CA	B,C,CA G,J1	C,CA MT	CA	CA	B
			MT				-
Dericorythinae							
Dericoy s lobata lobata (Brullé)		B,H1,M					-
Dericorys lobata luteipes Uvarov	B,C,H1 M	B,MM					-
							-
Dericoys lobata minutus Chopard*			C				-
Gomphocerinae							
Dociostaurus maroccanus (Thunberg)			C,H1 M,MM	C,H1 M,MM	B,H1 M,MM	B,H1 M,MM	B,MT
Leva (Stenohippus) bonneti (Bolívar)				B,C,G J1,M			B
Stenobothrus (Omocestus) simonyi Kr.*	B,H1 MM	B,C,G H1,KJ MM					
Oedipodinae							
Acrotylus insubricus inficitus (Walker)	B,M MM	C,G,M MM	C,G J2,MM	C,J1 M,MM	C,JZ MA,MM	C,MM	M
Acrotylus longipes (Charpentier)	B	B,C,H1	C,M	B,M MM	C,M		
Acrotylus patruelis (Herrich-Schaffer)	B,MM	B,C MM	C,G,H1 MM	B,C,H1 M,MM	B,MM	B,H1 MM	B
Aiolopus strepens (Latreille)		B	B,C,G KJ,M MM	B,C,G H1,J1 J2,KJ M,MM	B,C,H1 J2,MM MT	B,C,H1 MM	B,C
Aiolopus thalassinus (Fabricius)	B	B,C	B,C,G H1,J2	B,C,G H1,J1	B,C,H1 J1,MA	B,C,H1 MM	B,C
		KJ,MM	J2,KJ	MM M,MM			

continued

	F	L	C	T	G	P	H
Locusta migratoria (Linnaeus)			C,H MM -	C,G,H1 KJ,M MM	B,H1 J2,MT	B,H1	
Oedaleiis deconis (Germar)			- - -	B,C,M MM J2		B,C,H1	
Oedaleiis senegalensis (Krauss)			-				
Oedipoda caerulescens (Linnaeus)	HM		H1 -	GA,H1 M	M,MT		H1
Oedipoda canariensis Krauss*			B,C,G H1,KJ M,MM	B,C,H1 KJ,M MM	B,MM MT	C	B,MT
Oedipoda fuscocincta Lucas			-	C?	M		
Pseiidosphingonotiis canariensis (Saus.)	C,KH	C,MO3	C,G	C	C		
Pseiidosphingonotiis savignyi (Saus.)	C	MM	MM -	B,J1,J3 M,MM			
Scintharista notabilis notabilis (Walker)			B,C,G J2,M MM	C,G,H1 J1,M MM	B,C,H1 J2,MM	C,H1	B,MT
Sphingonotiu caeriilans corsiciis Chop.	H1,J2	H1,J2	H1,J2 -	H1,J1,J2	H1,J2 MA,MT	H1,J2	H1,J2 MT
Sphingonotiis r. riibescens (Walker)	B,C,MM	B,C,KJ M,MM	B,C,G J2,M MM	B,C,H1 J1,M MM	B,C,J2 M,MM	B,C,M MM	B,C MM
Sphingonotiis siiblaevis (Bolívar)'			B,C,MM	MM			
Sphingonotiu willemsei Mistshenko'			- -	B,C,H1 J3,MM			
Wernerella guancha Johnsen'			B,H1,J3				
Wernerella pachecoi (Bolívar)	B,C,H1 M,MM	B,H1 M,MM	- -			-	
Wernerella picteti (Krauss)'		KJ	B - -	B,C,H1 J3,M MM	B,H1 MM		
Wernerella sp. 1*			B				
Wernerella sp. 2'	B	B	-				
Truxalinae							
Truxalis nasuta (Linnaeus)			B,C,G H1,J1 M,MM	G			

yellow color. Malesalso matched the crest height difference but varied in coloration. Most were dark green as compared to the drab greenish-gray of females, and seven of 21 males had dark thoracic tubercles and reddish orange hind tibiae typical of *D. l. lobata*. We note these differences to indicate that sexual dimorphism for color appears to be common and can lead to taxonomic confusion between the subspecies.

Leva (Stenohippus) bonneti (Bolivar).This nomenclature was used by Jago (1971)in his revisionof the world gomphocerines and by Johnsen (1974), who noted that the name ***Stenohippus epacromioides*** Krauss (as found in Chopard (1954)) should be referred to as ***L. bonneti.*** Herrera (1982) listed the species as ***Stenohippus bonneti*** (Bolivar),and Duranton *et* al. (1984)referred to the species as ***L. epacromioides*** Krauss in their study of the Cape Verde Islands.

Oedipoda fuscocincta Lucas. Willemse (1936) cited an 1849 record listing this species for the Canary Islands, but a specific island was not indicated in the original record. Chopard (1951) and Gangwere *et al.* (1972)continued this listing, using Tenerife (with a question mark) as the likely island where it may occur, and we do the same. The only specimen we have seen is one from La Gornera in the Morales collection.

Pseiidosphingonotiis Shumakov. **This** genus was erected by Shumakov (1963)to include the former ***Sphingonotiis canariensis*** (Saussure) and ***S. savignyi*** Saussure. Since then, it has been recognized and used by Descamps (1970)and Johnsen (1985), although Herrera (1982)retains it **in *Sphingonotiis.***

Sphingonotus riibescens riibescens (Walker), ***S. caeriilans caerulans*** (Linnaeus), and ***S. caeriilans*** corsiciis Chopard. Uncertainty exists **as** to whether both species occur in the Canary Islands, and, if ***S. cueriilans*** (oftenmispelled *coerulans*) is present, is it the subspecies ***S. c. corsiciis?*** Mistshenko (1936a,b) listed only ***S. riibescens*** forthe islands, whereas Willemse (1936)listed *S. cueriilans* for each of the seven islands and ***S. riibescens*** for Tenerifeand the "Canaries." Chopard (1954), **using** the Willemse data and other collecting records, reported ***S. riibescens*** on all

Table 7. Gryllidae and Gryllotalpidae of the Canary Islands. Asterisks indicate endemic species; abbreviations are defined in Methods and Materials.

	Islands						
	F	L	C	T	G	P	H
Gryllidae							
Gryllinae							
Acheta domesticiis (Linnaeus)			C			B?	
Acheta hispanicus Rambur			C,MM	C MM	KH,MA MM		C
Acheta meridionalis (Uvarov)			M	B,C,M	J2,M		
Gryllodes sigillatus (Walker)				M,MM			
Gylliis bimaculatus DeGeer	B,MM	B	C,G M,MM	**C,G,J2** KJ,M MM	**B,C,J2** **MA** MM	C,MM	B,C M,MM MOI
Gryllus sp.			B				
Modicogylliis guanchicus (Krauss)			C,M	C,M MM	**J2,MA**		
Modicogryllus ***palmetoriim*** (Krauss)			M,MM	MM	MM		
Platygylliis brunneri (Saussure)			C,MM	C,MM	J2,MA MM		
Tartarogylliis bordigalensis (Latreille)		B?		J2,MM			
Gryllomorphinae							
Gryllomorpha canariensis Chopard'			-	**A,C,M** MM,MO1	-		
G*ryllomorpha gracilipes* Chopard	C						
G*ryllomorpha longicauda* (Rambur)			-	C,KJ,M	-	AO,KH	**AO,KH**
Gryllomorpha sp.							MOI
Hymenoptila lanzarotensis Kevan"		A,KH M03	- -	- -	- -		
Mogoplistinae (Arachnocephalinae)							
Cycloptiloides canariensis (Bolívar)*				C,MM			
Pseiidomogoplistes squamiger (Fischer)				C		AO,KH	AO,KH
Oecanthinae							
Oecanthus pellucens (Scopoli)			MM	C,M	B,MT	B,C,M	B,C
Trigonidiinae							
Trigonidiim cicindeloides Rambur			KH,MM	C,M,MM	-		
Gryllotalpidae							
Gryllotalpinae							
Gryllotalpa africana Palisot	MM		C,M MM	M -	J2,KH MA,MM	-	
G***yllotalpa robiistu*** Townsend				T?			

islands but, without explanation, omitted ***S. cueriilans.*** Whether Chopard believed that Willemse's ***S. caerulans*** was misidentified and was actually ***S. riibescens*** is unknown. Johnston (1956) and Dirsh (1965) listed both species for the islands, and Johnston (1956) cited ample literature references on the distribution of each. However, neither of Johnston's catalogs (1956, 1968) included the subspecies ***S. c. corsiciis.***

Holzapfel (1970) reported ***S. caerulans*** on all islands and ***S. riibescens*** **only** on Tenerife. **This** interpretation is consistant with Willemse (1936) but not with Chopard (1954). Gangwere ***et al.*** (1972), following the taxonomic criteria used by Holzapfel (1970), listed oniy ***S. rubescens*** for Tenerife. Holzapfel (1970) and Johnsen (1974) noted that Chopard (1954) had omitted the Willemse (1936) record **of** ***S. caerulans*** on all islands, and Johnsen added the species to his list of Canarian acridids.

Harz (1975) did not include the Canary Islands in the distribution of either species but noted that ***S. riibescens*** and ***S. c. corsiciis*** are very similar, especially in regard to the curvature of the intercalary vein on the front wing, and suggested that perhaps one was frequently mistaken for the other in southern Spain. *Sphingonotus* ***c. corsicus*** has a more southerly distribution than *S. c. caerulans* (Linnaeus) (Garcia and Presa 1981, Mistshenko 1936b). Herrera (1982) subsequently listed ***S. rubescens*** and, for the first time, ***S. c. corsiciis*** on all islands, although his rationale for replacing ***S. caerulans*** with ***S. c. corsiciis*** is unclear. Kevin and Hsiung (1992), who were concerned only with Lanzarote ortho-

Table 8. Tetrigidae, Pamphagidae, and Pyrgomorphidae of the Canary Islands. Asterisks indicate endemic species; abbreviations are defined in Methods and Materials.

	Islands						
	F	L	C	T	G	P	H
Tetrigidae							
Tetriginae							
Paratettix meridionalis (Rambur)	-	-	C,M	C,J1,M	B,C	C	B
Pamphagidae							
Pamphaginae							
Acrostira bellamyi (Uvarov)*		-	-		BA1,C	-	-
		-		-	MM,MT		
Acrostira euphorbiae García-Becerra & Oromí*	-	-		-	-	GO	-
Acrostira tamarani Báez*		-	BA1	-	-		-
Purpuraria erna Enderlein*	BA1,C	-		-	-		-
	M,MM	-		-	-		-
Pyrgomorphidae							
Pyrgomorphinae							
Pyrgomorpha conica tereticornis (Brullé)	M	-	B,G,J2	C,G		-	-
		-	H1,M			-	-
	-	-	MM			-	-

pterans, recorded *S. rubescens* as present but questioned the occurrence of *S. caerulans* in the Canaries. Johnsen (personal communication) believes that both species occur and can be differentiated from one another. Llorente (personal communication) studied over 200 specimens of *S. riibescens* from the Canary Islands and compared them to examples of *S. riibescens* and *S. c. corsiciis* from the iberian Peninsula. All canarian specimens were *S. riibescens* except one from La Gomera and one from Tenerife which may be *S. c. corsiciis.*

Our brief comparisons of 125 *Sphingonotiis* specimens from the seven islands indicates that all individuals have some characteristics of bothspecies, as described by Harz (1975)and Mistshenko (1936a,b). Nearly all have the curved intercalary vein typical of *S. rubescens* and *S. c. corsiciis.* We have not yet accumulated sufficient data to distinguish between the species and subspecies to validate their presence and distribution. In addition, *S. riibescens burri* Chopard, which occurs on the Cape Verde Islands (Chopard 1936), might also be present helping to further confuse identifications. For now, we follow Herrera's catalog (1982)that lists *S. rubescens* and *S. c. corsiciis* on all of the Canary Islands.

Sphingonotiis *sublaevis* (Bolívar).This species was formerly placed in the genus *Wernerella* as W. *sublaevis* (Bolívar)(Chopard 1954, Holzapfel 1970, Johnsen 1974) but was transferred to *Sphingonotiis* by Johnsen (1985).Johnsen (1985) also showed that *S. freyi* Uvarov of Chopard (1954)and Holzapfel (1970) is a synonym of *S. sublaevis.*

Stenobothrus (Omocestus) simonyi (Krauss). This endernic is also referred to as *Omocestus (Omocestus) simonyi* (Krauss) (Herrera 1982,Holzapfel 1970), although Jago (1971)placed the group in the genus *Stenobothrus* and reduced *Omocestus* to a subgenus.

Wernerella guancha Johnsen. Collected by Holzapfel (1970) and referred to as *Wernerelln* sp., this grasshopper was named by Uvarov some years earlier, but the description was not published. Johnsen (1985) subsequently discovered the oversight and retained Uvarov's name for the species.

Wernerella Karny, spp. 1and 2. Thesepreviously undescnbed specimens that we have collectedfrorn Lanzarote, Fuerteventura, and Gran Canaria have been placed in this genus. They will be treated in *a* future publication.

Gryllidae (Table 7)

Achetn meridionalis (Uvarov). This name replaces the synonym *A. canariensis* (Chopard)(Chopard 1967)used by Chopard (1954) and Johnsen (1974) (Kevin and Hsiung 1992).

Gryllodes sigillatus (Walker). Kevan and Hsiung (1992) replaced this name with G. *siipplicnns* (Walker), and Kevan and Kevan (1995) and Vickery (1996) considered *sigillatus* to be a junior synonym of *siipplicnns* based on female holotypes and label and rearing data. We retain the name *sigillatus* primarily because it has been so widely used and, secondarily, because of questionable type specimens and genitalia comparisons in the iiterature (D. Otte, personal communication).

Modicogryllus guanchicus (Krauss). This species is listed as *Acheta guanchica* (Krauss)by Chopard (1954) and Johnsen (1974) but was transferred to the genus *Modicogryllus* by Kevan and Hsiung (1992).

Platygryllus brunneri (Saussure). Although listed as *Acheta brunneri* (Saussure) by Chopard (1954)and Johnsen (1974), it is now placed in the genus *Platygryllus* (Kevanand Hsiung 1992).

Pseudomogoplistes squamiger (Fischer).This species has been transferred from the genus *Mogoplistes* (Chopard 1954) for reasons indicated by Kevan and Hsiung (1992).

Tartarogryllus bordigalensis (Latreille). Kevan and Hsiung (1992)indicate that the almost universal spelling *burdigalensis* is not the original spelling. We collected a specimen on Lanzarote similar in appearance to this species, but its poor condition

Table 9. Tettigoniidae of the Canary Islands. Asterisks indicate endemic species; abbreviations are defined in Methods and Materials.

	Islands						
	F	L	C	T	G	P	H
Conocephalinae							
Conocephalus (Anisoptera) maculatus (Le Guillou)			KE				
Ruspolia nitidula (Scopoli)		-	B,C,HM M,P2	-			
Decticinae							
Ariagona margaritae Krauss*			-	C,KJ,M	B		C,MT
Decticus albifrons (Fabricius)			C	C,M	B	B	B,C M,MT
Evergoderes cabrerai Bolívar'			C,G				
Platycleis albopunctata (Goeze)			C	C,M			C,MT
Platycleis falx (Fabricius)				C	MT		MT
Plutycleis intermedia (Serville)				C,M	M		
Plutycleis sabulosa Azam	B	B	B,C	C,KJ	B,MM	B,C	B
Plutycleis (Tessellana) tessellata (Charpentier)		B	B,C	B,C KJ,M	B,MM MT		B
Meconeminae							
Canariola nubigena (Krauss)'				C,M,P1	B,M	M	
Canariola willemsei Morales?			-	MM,P1	J,MM P1		
Phaneropterinae							
Phaneroptera nana sparsa Stål			B,C G,M	C,M	J,MA MM	B,C	B
Tettigoniinae							
Calliphona (Calliphona) konigi Krauss*				C,HC M,P2	M	M	
Culliphonu (Calliphonides) alluaudi Bolívar?			HC,P3	-	HC,MM MT,P3	-	
Calliphona (Calliphonides) palmensis Bolívar'						C,HC P3	

made identification uncertain and thus we placed a question mark next to the record (Table 7).

Gryllotalpidae (Table 7)

Gryllotalpa robusta Townsend. Townsend (1983) listed this species for the Canary Islands but did not specify which island. Kevan and Hsiung (1992) speculate that *G. gryllotalpa* (L.), a questionable record from Tenerife (Brullé 1839) cited by a number of other authors, may have been G. *robiista.* We list this species for the Canary Islands, with Tenerife as the likely location, but the uncertainty is indicated by a question mark next to the record (Table 7).

Pyrgomorphidae (Table 8)

Pyrgomorpha conica tereticornis (Brullé). Holzapfel (1970) and Johnsen (1974) noted the confusion as to whether *P. tereticornis* (Brullé), *P. cognata* Krauss, or both occur in the Canaries. Hsiung and Kevan (1975), in their review of the *conica-bispinosa-cognata* group, determined that the Canary Island and Cape Verde Island specimens were actually *P. conica tereticornis,* which is also known frorn Eremia and East Africa, Socotra, and southwest Asia.

Tettigoniidae (Table 9)

Calliphona Krauss. We follow the conclusions of Bolívar (1991), Holzapfel and Cantrall (1972), and Pinedo (1983), who reduced *Culliphonides* to subgeneric rank, thus relegating all three species to the genus *Culliphonu.*

Platycleis Fieber. Members of this genus aré difficult to identify although recently there has been taxonomic clarification of relationships among species. The early treatments by Ramme (1927) and Zeuner (1929) were expanded by Zeuner (1941), but his comprehensive study is oftenconsidered to have created excessive numbers of genera (Ragge 1990).Harz (1969) provided descriptions, keys, and taxonomic modifications that created additional subspecies. Recently, Ragge (1990) further clarified species relationships and eliminated questionable or synonomic nomenclature. He determined that analyzing songs of *Platycleis* is an accurate, reliable method for identifying species in the field and provided acoustical and morphological keys for the species of western Europe.

The *65* male specimens of *Plutycleis* (excluding *P. tessellata* (Charpentier))in our collection varied in length from 30-39 mm when measured from the fastigium to the apex of the tegmina,

and 19-27mm from the fastigium to the apex of the abdomen. Using the morphoiogical characters described by Ragge (1990) in his key to *Platycleis* (i.e., sizes of pronotum and hind femora, shapes of the 10th abdominal tergite and titillators), all but a few males matched the description for *P. sabulosa* Azam. A few specimens from Gran Canaria and La Gomera had pronota sufficiently large to be *P. falx* but the femora were too short for this species; however, the 10th tergite was a composite of that of *P. falx* and *P. affinis* Fieber, although the latter has not been recorded in the Canary Islands. Females generally appeared to be *P. sabulosa*. We are uncomfortable with the variance in the size of specimens but, because we iack song recordings, we are following a conservative approach listing all the specimens in our collection as *P. sabulosa*.

Platycleis albopiinctata (Goeze). Ragge (1990) treated *P. grisea* (Fabricius) as an eastern Europeansubspecies of *P. albopiinctata*, with the nominate subspecies in the western-most areas of Europe. *Platycleis denticulata* Panzer, listed by Chopard (1954) and Gangwere *et al.* (1972) for the Canary Islands, is a synonym of *P. grisea* and *P. albopiinctata* (Ander 1948, Herrera 1982, Ragge 1990, Zeuner 1941).

Platycleis (Tessellana) tessellata (Charpentier). We follow Ragge (1990) and Harz (1969) in placement of the small-bodied *Tessellaria tessellata* (Charpentier) in *Platycleis*, with *Tessellana* as a subgenus, relegating the other four species of *Platycleis* in the Canary Islands to the subgenus *Platycleis*.

Ruspolia nitidula (Scopoli). This species also appears in the literature as *Homorocoryphus nitidulus* (Scopoli) (Harz 1969) in the subfamily Copiphorinae (Herrera 1982). We follow the recent nomenclature of Pinedo (1984), who cited an earlier study that synonomized *Homorocoryphus* with *Ruspolia* and, along with Harz (1969), retained the species in the subfamily Conocephalinae.

PHASMIDA (Table 5)

Clonopsis gallica (Charpentier) was cited by Bolívar (1926) 'thout an indication of a specific island. There have been no :her reports of it in the Canaries until recently when Báez (in ess) collected it on Tenerife in a cultivated area on the north side of the island.

Undocumented Species Reported for the Canary Islands

Come species are questionably identified or.have appeared on past iists, but their presence on the islands remains undocumented by literature or a search of collections. Thus, we have not included them in the present list but believe they merit discussion.

BLATTARIA

Blattellidae

Loboptera decipiens decipiens (Germar). This epigean species has the broadest distribution of all species of *Loboptera* and has been reported on Tenerife (Gangwere *et al.* 1972, izquierdo and Martín 1990, Martín and Izquierdo 1987, Martín *et al.* 1986). However, Bohn (personal communication) notes that his review of other references and catalogs on Blattaria as well as his survey of museum collections showed no evidence of this species in the Canary Islands. Bohn communicated with Oromí at the University of La Laguna, Tenerife, in 1996. Oromí, whose research also involves *Loboptera* species in collaboration with Martín, indicated that the university collection had no *decipiens* and that he doubted its occurrence in the Canaries. We assume that the early record of this species may have been an error which was perpetuated in subsequent literature.

ORTHOPTERA

Acrididae

Calephorus compressicornis (Latreille). Collected by Brullé (1839) as *Tryxalis tereticornis* Brullé and relisted as *Oxycoryphus compressicornis* (Latreille) by Bolívar (1893), this species has not been reported in the Canary Islands since Bruilé's original work. Johnston (1956,1968) did not report this species for the islands, and, although Harz (1975) and Herrera (1982) listed it, it is likely that their data are based on the original citations. Kevan (1977) determined that the original records are a misdetermination of a specimen of *Pyrgomorpha conica tereticornis*, and we follow his interpretation.

Calliptamus italicus (Linnaeus). Although listed for the Canary Islands by Herrera (1982,1993), based on Bolívar (1886) who recorded it from Monteverde and Las Cañadas near Teide, Tenerife, this species has been coilected only occasionally in southern Spain (Presa 1976) and is not recorded from northwestern Africa (Herrera 1982). The original specimens were probably *C. plebeiiis*, which occurs in most zones (Holzapfel 1970). In the Canaries, only *C. barbariis* is known only from arid coastal regions of Lanzarote.

Calliptamus maderae Uvarov. Chopard (1954) included **this** species on Tenerife, but Jago (1963) indicated that it is known only from Madeira Island.

Eyprepocnemis cinerea (Blanchard). The type specimen from Tenerife, *Acridium cinereum* Blanchard, was incorrectly labeled as coming from Tenerife and is actually a *Stenocatantops* sp. from Asia that is too damaged for specific determination (Johnsen 1974, Johnsen personal communication). Holzapfel (1970) noted that specimens of *E. cinerea* collected in 1966 from Gran Canaria were deposited in the Natural History Museum (London), but Ragge (personal communication) reported that there were no specimens under that name.

Leptoternis candidiis (Costa). We have seen a specimen from Gran Canaria identified as this species in the Museo Insular de Ciencias Naturales, Tenerife. It is most iikely *Pseudosphingonotus canariensis*, a typical inhabitant of southern Gran Canaria. The genus *Leptoternis* is similar to *Sphingonotiis* and *Pseiidospliingonotiis*.

Sphingonotus lucasii Saussure. Holzapfel (1970) listed this species for Tenerife (with a question mark because she had not seen any specimens), and Herrera (1982) included it for the Canaries. We have omitted it based on Johnsen's explanation (1974). He pointed out that Johnston (1936) listed *S. lucassi*, a synonym of *Wernerella pachecoi* var. *dimidiata* (Morales Agacino 1947), as occurring in the Canary Islands, using Bolívar (1936) as his source. Bolívar (1936) actually wrote that the genus *Wernerella* was previously known only frorn the Canary Islands but did not refer to any species.

Sphingonotiis *teydei* Uvarov. This is a synonym of *S. willemsei* Mistshenko (Holzapfel 1970).

Wernerella aspera (Brullé). Brullé (1839) reported this species on the Canary Islands without reference toa specific isiand, and only Krauss (1692) has collected it since (on Lanzarote and Graciosa). Chopard (1954) referred to this species as *Sphingonotiis*

asper (Brullé) and listed it as questionable on Tenerife but did not mention Lanzarote or Graciosa. Kevan and Hsiung (1992) included the species for Lanzarote, but the listing is based on Brullé (1839) and Krauss (1892). Johnsen (1985) gave the taxonomic history of the species and indicated several errors that have occurred in recording its distribution. He noted that the types are lost and the original description by Brullé is inadequate, so affinities cannot be determined. The species is listed for the Canary Islands and Algeria by Johnston (1956), Dirsh (1965), and Herrera (1982), based on Bolívar (1915), but Chopard (1943) did not include it in his book on the Orthoptera of North Africa. Johnsen (1985) noted that it has not been found since in Africa, and he did not include it in his key to *Wernerella* spp. We omit it from our list based primarily on Johnsen's conclusions.

Gryllidae

Acheta hispanicus fusculus (Bolívar). Although dark-colored specimens from Tenerife in the Museo Nacional de Ciencias Naturales, Madrid, have this name (Llorente, personal communication), Harz (1969) indicated that the subspecies is too close to the nominate to be valid, and Herrera (1982) and Kevan and Hsiung (1992) did not include the subspecies on their lists.

Nemobius sylvestris (Bosc d' Antic). Harz (1969) and Herrera (1982, 1993) included the Canary Islands in the distribution of this species, but they did not cite any documentary literature. Kevan and Hsiung (1992) noted that the Azores are the nearest Atlantic island group where the species has been recorded, and the British Natural History Museum and the Museo Nacional de Ciencias Naturales in Spain do not have it from the Canary Islands (D. Ragge and V. Llorente, personal communications).

Tetrigidae

Tetrix subulata (Linnaeus). This species has not been recorded on Tenerife or on any other Canary Island since Brullé reported it in 1839. Krauss (1892) included it in his list based on Brullé's record. We believe that the recorded specimens were probably the relatively common, morphologically similar *Paratettix meridionalis* (Rambur), the only species known for the islands.

Acknowledgrnents

We greatly appreciate receiving collecting data, literature citations, and clarification of species nomenclature from the following colleagues: M. Báez, Universidad de La Laguna, Tenerife, Spain; L. Herrera, Universidad de Navarra, Pamplona, Spain; S. Ingrisch, Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt, Germany; P. Johnsen, University of Aarhus, Aarhus, Denmark; and J. Marshall and D. Ragge, The Natural History Museum, London, England. In addition to the above assistance, the identification of selected specimens was provided by H. Bohn, Universität München, München, Germany, V. Llorente, Museo Nacional de Ciencias Naturales, Madrid, Spain, and L. Desutter-Grandcolas, Muséum National d'Histoire Naturelle, Paris, France. V. Llorente was especially helpful by providing specimen measurements and label data from insects in the Madrid collection. P. Bragg, Derbyshire, England, and P. Brock, Slough, Engiand, aided us in searching for records of phasmids from the Canary Islands. H. Enghoff, Zoologick Musem, Copenhagen, Denmark, confirmed the deposit of an acridid species. We thank H. Ballard for his helpful review of the manuscript. The following people kindly provided assistance in collecting specimens: H. Ballard, University of Wisconsin, Madison, WI, USA; and M. Ernemann, L. Mertz, and D. Spiller, Wayne State University, Detroit, MI, USA. Part of our collection has come from the efforts of the late J. McKinney, who was beginning his doctoral research on Orthoptera of the Canary Islands in the late 1980's just prior to his untimely death.

This study was made possible by grants from the Research and Creative Endeavors Committee of Central Michigan University, the Department of Biological Sciences at Wayne State University, the Percy Sladen Memorial Fund administered by the Linnean Society of London, and the National Geographic Society (NGS Grant No. 5270-94).

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Addendum

Just prior to the publication of this study, J. Marshall (personal communicatrion) inforrned us that a series of oedipodine specimens frorn Gran Canaria held in the Natural History Museum, London, were recently confirmed by G. Popov as *Hyalorrhipis canescens* (Saussure) and *Leptoternis gracilis* (Eversmann). They were collected between **1960** and **1966** from Maspalomas and Las Palmas, and have not been reported in the Canaries prior to this docurnentation. Dirsh **(1965)** lists *H. canescens* as occurring iri Morocco, Algeria, and Libya, while *L. gracilis* is know frorn Libya, Egypt, and Tripolitania. Both species are strong fliers and may have been immigrants and not necessarily breeding colonies (personal comrnunication, G. Popov via J. Marshali).

OBITUARY

Ricardo **Arturo** Ronderos: 1928-1995

With the death of Ricardo Rondcros, on March 3,1993 in the City of La Plata, we havc lost a very dcar fricnd and a most compctent and reliable scicntist, thc quality of whose work in entomology was consistently high.

It is particularly difficult for me to write an obituary on Ricardo. My relationship with him was of friendship rather than a mere professional onc. It has been particularly difficult to accept the fact of his death. I knew that he was seriously ill, but somchow, as I had never seen him to fail in anything hc had attcmptcd, I was sure he could overcome his discasc.

Ricardo was born in Santa Rosa, in thc Province of La Pampa, in September 17, 1928. Hc studicd in thc University of La Plata, whcrc he obtaincd his Ph.D. in Natural Sciences in 1963. His scicntific career was for thc most part related to thc "Facultad dc Ciencias Naturales y Musco dc La Plata, but in diffcrcnt pcriods of his lifc he workcd in many parts of Argentina, always on his favoritc subjccts of entomology (including taxonomy, systematics, mcdical and othcr applied fields of cntornology) but also in subjects rclated to epidemiology, arthropod vectors of diseases, ecology and environmcnt, etc. Ricardo had a way of crcating efficient organizations, somctirncs practically out of nothing. Hc was a very determined, energetic and cfficicnt man with an innate quality of Icadcrship and a very keen cyc for chosing thc right pcoplcforcach task. He was intrinsically a kind mnn, but hcknew how to bc hard whcn nccessary, and knew also how to fight for his views and purposcs whcn hc was surc of bcing right. Hc had a fcrtileimagination that allowed him to plan and excecute all that was necessary to carry a project to its fruitful cnd.

Ricardo was instrumental in thc organization of that memorable Symposiurn of Acridology in San Martin de los Andes, in Dcecember 1976, on which thc basis of thc Pan Amcrican Acridiological Socicty (now thc Orthoptcrists' Society) was laid. For his vcry active and dccisivc work in thc organization of that historic meeting, hc dcscrves to be regarded as onc of thc real foundcrs of thc Orthoptcrists' Society. Hc later served as its first President and in othcrofficcs. Rcccntly hc had bccn clected as one of its honorary members. He was also pcrmancntly activc in thc "Sociedad Entomologica Argentina", of which he was several times its Prcsidcnt in, and cditorof its "Revista". He had also held Presidency of thc "Sociedad Zoologica de la Plata"

Ricardo workcd in Argentina in a wide array of projects and organizations. Among thcm; sanitary campaigns in different provinccs of the country; studics in thc entomological aspects of epidcmiology; locust and grasshopper control; study and control of Chagas Disease and its vectors; studics of parasitology and arthropod vectors of diseases, study of the environmental disturbances producccd by the construction and operation of hydroelectric dams and measures to bc taken to minimize thcm, etc. He occupied research positions at different times in various state organizations. His most important positions in the last 15 years were thosc of Professor of Arthropods and Head of the Department of Entomology of thc Universidad dc La Plata, and director of the Center for the study of Parasitology and Vectors. But he also served at diffcrcnt times as Vice-Dean of the same University, as Assistant Director of the Institute of Limnology and of the Center for thc study of Parasitology and Vectors, etc.

Hcpublishcd about a hundred papers, mostly on entomological subjects, both applied and basic. Among his preferred subjects wcrc thc Hemiptera (Polyctenidae, Tnatominae) Diptera (especially Culicidae), Anoplura, arthropod vectors of diseases, and othcr related subjccts. But from theearly sixties, his main research activities were on the acridomorph Orthoptera, on which he publishcd 45 papcrs between 1964and thepresent. As a researcher and scholar in his preferred fields, his restless and inquisitive nature determined that he was never satisfied with the easily available information, but wanted to obtain the best and more trustworthy in existence. This was the motive for his many trips abroad either in the Americas or in Europe, in order to work with the bcst spccialists in his current field of research, or to consult collections holding type species. He also wanted access to unpublished inforrnation which can always be found in the museums whcrc the great naturalists of the past have worked.

Ricardo was an inspiring teacher, recruiting a student following through his lcturcs and in his capacity as director of research in his specialist field. He was also aneminently public-spirited man, as shown by his permanent participation in diverse scientific socictics and in public organizations promoting the study of problcms of a national or international nature. He was always ready to share his professional knowledge and experience with anybody who needed it. His frank and open personalityled him to share information, sometimes obtained with considerable difficultyand through hard workon his part, with those who needed it. I uscd to rcccivc from Ricardo copies of the MSS and illustrations of his works, frequcntly far in advance of their publication.

Ricardo dicd whcn we still expected from him many years of fruitful activity. We have indeed been deprived of the years in which his accumulated experience and his full maturity could have made the most productive impact. Those who knew him well, fcclthat we have been robbed of a richness thatonlyhecould have produccd. He had published about a hundred papers, many of thcm of considerable scope arid breadth, and he was against sub-dividing his work to increase the number of his publications. His papcrs will continue to stand for the best in science longafter the passing of his contcmporanes. Though the scientific community will know him only through these papers, to we who knew hirn, Ricardo means much more than the whole of his published work. His human quality crowns his scientific activity with an aura which is uncommon in any profession. Thus, while it is relatively frcqucnt to find in persons of intense dedication to science, a certain disrcgard for their families, a sort of exclusive passion for thcir work which sometimes rclegates their families to second place in thcir lives, this was ccrtainly not the case with Ricardo. His family was always a most important part of his life. The lives of his parents, his wife Nelly, hischiidren and latterly his grandchildren, motivated his love and were a constant preoccupation. We havc seen hirn saddened by thcir difficultics, or happy and proud of thcir success. He also had an accessory family to which he was not united by the ties of blood, but by those bonds of friendship. To that farnily we were fortunate to belong. These ties, will unite us to hirn and to his memory forever, making his death most painful for us.

CARLOS S. CARBONELL