nation of water and wastewater, 15th ed. APHA-AWAA-WPCF, Washington, DC.
BATZER, D. P. AND R. D. SJOGREN. 1986. Larval habitat characteristics of *Coquillettidia perturbans* (Diptera: Culicidae) in Minnesota. The Canadian Entomologist. 118: 1193-1198.
BECK, E. C. AND W. M. BECK, JR. 1969. The Chironomidae of Florida. II. The nuisance species. Florida Entomol. 52: 1-11.
BIDLINGMAYER, W. L. 1969. Larval development of *Mansonia* mosquitoes in central Florida. Mosq. News 28: 51-57.
CALLAHAN, J. L. AND C. D. MORRIS. 1987. Habitat characteristics of *Coquillettidia perturbans* in central Florida. J. Am. Mosq. Control Assoc. 3: 176-180.
GUILLE, G. 1976. Recherches eco-ethologiques sur *Coquillettidia (Coquillettidia) richiardii* (Ficalbi), 1889 (Diptera-Culicidae) du littoral Mediterraneen Francais. II. Milieu et compartement. Ann. Sci. Natur. Zool., Paris. 18: 5-112.
MCNEEL, T. E. 1932. Observations on the biology of *Mansonia perturbans* (Walk.) Diptera, Culicidae. Proc. N.J. Exterm. Assoc. 19: 89-96.
MORRIS, C. D., J. L. CALLAHAN, AND R. H. LEWIS. 1985. Devices for sampling and sorting immature *Coquillettidia perturbans*. J. Am. Mosq. Control Assoc. 1: 247-250.
NORUSIS, M. J. 1986. SPSS/PC+ for the IBM/PC/XT/AT. SPSS Inc., Chicago, IL.
PATTERSON, R. S. 1964. Recent investigations on the use of BHC and EPN to control chironomid midges in central Florida. Mosq. News 24: 294-299.
PATTERSON, R. S. 1965. Control of chironomid midges in Florida. Florida Anti-Mosq. Assoc. Ann. Rept. 36: 35-39.
SLAFF, M., J. D. HAEFNER, R. E. PARSONS, AND F. WILSON. 1984. A modified pyramidal emergence trap for collecting mosquitoes. Mosq. News 44: 197-199.
STEELE, R. G. D. AND J. H. TORRIE. 1980. Principles and procedures of statistics: a biometrical approach, 2nd ed. McGraw-Hill Book Company, New York, NY.

SCAPTERISCUS DIDACTYLUS (ORTHOPTERA: GRYLLOTALPIDAE) IN THE DOMINICAN REPUBLIC

J. H. FRANK
Entomology and Nematology Department, 3103 McCarty Hall,
University of Florida, Gainesville, Florida 32611, USA

R. E. WOODRUFF
Division of Plant Industry, Florida Department of Agriculture and Consumer Services,
P.O. Box 1269, Gainesville, Florida 32602, USA

AND

C. A. NUÑEZ
Departamento de Sanidad Vegetal, CESDA, San Cristóbal,
DOMINICAN REPUBLIC.

ABSTRACT

Scapteriscus didactylus (Latreille) is reported for the first time from the Dominican Republic, where it is widespread in coastal localities and one inland locality sampled. Materials identified from guts of adults and nymphs from the inland and 4 coastal

localities, all sampled in October 1986, were mainly of arthropod origin. Guts from 4 of 5 specimens from one locality contained nematodes of the genus *Chitwoodiella* which is not considered to be pathogenic. The date of introduction of *S. didactylus* into Hispaniola is unknown, but an historical account suggests its presence in Puerto Rico in 1797.

Resumen

Scaoteriscus didactylus (Latreille) es reportado por primera vez en la República Dominicana, donde se encuentra distribuido en zonas costeras y en una localidad investigada en el interior. Material identificado en el intestino de adultos y ninfas del interior y de 4 localidades del litoral, todas de muestras hechas en Octubre del 1986, fueron principalmente de origen artrópodo. Intestinos de 4 de 5 espécimenes de una de esas localidades contenián nemátodos del género *Chitwoodiella* el cual no es considerado patogénico. La fecha de introducción del *S. didactylus* en La Española es desconocida, pero una ficha histórica sugiere su presencia en Puerto Rico en el 1797.

Changa is a colloquial name used in Puerto Rico for the mole cricket *Scapteriscus didactylus* (Latreille). The same name is used in the Dominican Republic where *S. didactylus* is also a pest, though neither its presence nor the damage it causes seem to have been recorded. Collections made in 1986 at 7 localities in the Dominican Republic yielded information on distribution, habitat, food, damage, and a parasite of *S. didactylus*, with some preliminary information on seasonality.

Materials and Methods

Mole crickets were collected by digging with a trowel or pocket knife and were preserved in 70 isopropyl alcohol, at the localities listed below. Localities 3-7 yielded nymphs and adults (m = male, f = female, n = nymph), and all specimens seen there were collected, thus giving information on population structure. Pronotal lengths of nymphs were measured with a microcaliper to provide an indication of size, because the number and diagnostic characters of the nymphal instars have not been determined; nymphs are listed in descending order of pronotal length in mm. Five specimens (arbitrarily numbered N.1-N.5) from each of sites 3-7 were dissected, and dissected nymphs were classed for size as small (<5 mm), medium (5-7 mm), large (>7 mm). Digestive tracts were examined for content. Most tracts contained unidentified, brown silty materials ('soil') which were not evidently cellular and could not be attributed to plant or animal origin; identified materials are listed. The presence or absence of eggs in abdomens of adult females was noted.

Results

1. PROV. SAN CRISTÓBAL, Playa Palenque, 13-III-1986, J. Cicero [2m].
2. PROV. MONSEÑOR NOUEL, Bonao, at light in restaurant at night, 19-VI-1986, L. A. Stange and R. E. Woodruff [1f].
3. PROV. AZUA, 2 km S. of Hato Nuevo, in galleries in recently-irrigated field of green peppers, during day, 23-X-1986, J. H. Frank and C. A. Nuñez [8m, 5f, 28n (7.8, 7.1, 6.4, 6.2, 6.1, 6.1, 6.1, 5.9, 5.8, 5.5, 5.2, 4.9, 4.9, 4.3, 4.1, 4.0, 3.9, 3.9, 3.8, 3.6, 3.5, 3.5, 3.4, 3.2, 3.1, 3.1, 2.4, 2.1)]. Dissections: 3.1 [female, not gravid, with sand grains and a few insect fragments], 3.2 [male, with few plant fibers and sand grains and insect fragments including an almost intact specimen of *Thecturota* sp. (Staphylinidae: Aleocharinae)], 3.3 [medium nymph, with soil and a few plant fibers and insect frag-

ments], 3.4 [medium nymph, with insect fragments, and very few plant fibers], 3.5 [medium nymph, with many plant pieces which were neither green nor fibrous, probably roots of pepper plants, without insect fragments].
4. PROV. BARAHONA, Playa Saladilla, in galleries in sand high on sea beach, mostly under cow dung, during day, 25-X-1986, J. H. Frank [1m, 3f, 7n (8.9, 8.8, 8.3, 7.8, 7.6, 7.6, 5.9)]. Dissections: 4.1 [female, gravid, with soft, greenish-brown material, perhaps cow dung, with sand grains and fragments of a minute beetle], 4.2 [large nymph, with sand grains and insect fragments], 4.3 [large nymph, with sand grains and many fragments of a spider (possibly a lycosid)], 4.4 [large nymph, with a few, small insect fragments], 4.5 [female, not gravid, with soft, greenish-brown material, perhaps cow dung, with a few insect fragments, perhaps a fly larva, and sand grains].
5. DISTRITO NACIONAL, Boca Chica, in galleries in sand at base of small buildings for vending food, ca. 20 m from sea beach, at night, 27-X-1986, J. H. Frank [5f, 4n (7.9, 3.7, 3.6, 2.9)]. Dissections: 5.1 [female, not gravid, with sand grains, without arthropod fragments but with small, semi-soft, white particles which might be of rice grains], 5.2 [female, gravid, with sand grains and parts of an ant (*Solenopsis geminata* {Fabricius}) and with semi-soft white particles which might be of rice grains], 5.3 [female, gravid, with sand grains], 5.4 [small nymph, with sand grains and insect fragments, and with semi-soft white particles which might be of rice grains], 5.5 [small nymph, with sand grains and a few, small insect fragments, and with semi-soft white particles which might be of rice grains].
6. PROV. LA ALTAGRACIA, Nisibon, in galleries in sand around small buildings ca. 20 m from sea beach, during daylight, 30-X-1986, J. H. Frank [2m, 3f, 2n (8.0, 5.2)]. Dissections: 6.1 [large nymph, with sand grains and a few fragments of an ant (*Tetramorium simillimum* {F. Smith})], 6.2 [male, with sand grains and a few fragments of an ant (*T. simillimum*)], 6.3 [female, not gravid, with sand grains and very few fragments of an ant (*Solenopsis* {*Diolorhoptrum*} sp.)], 6.4 [female, not gravid, with sand grains and a few fragments of an ant (*Solenoosis* {*Diplorhoptrum*} sp.)], 6.5 [male, with sand grains and a few fragments of an ant (*T. simillimum*)].
7. PROV. PUERTO PLATA, Playa Cabarete, in galleries in small sand dunes overgrown with *Jacquemontia reclinata* House (beach morning glory) vines, during day, 31-X-1986, J. H. Frank [1m, 4f, 4n (7.8, 6.6, 5.4, 5.1)]. Dissections: 7.1 [female, not gravid, with sand grains and a few plant fibers and many nematodes (*Chitwoodiella* sp.)], [7.2 large nymph, with a few sand grains, insect fragments, and nematodes (*Chitwoodiella* sp.)], 7.3 [male, with insect fragments and sand grains and a few plant fibers, without nematodes], 7.4 [female, gravid, with plant fibers and sand grains and nematodes (*Chitwoodiella* sp.)], 7.5 [medium nymph, with many nematodes (*Chitwoodiella* sp.) and a few sand grains and plant fibers].

Discussion

Damage to pepper plants was observed at locality 3, where most plants were 20-30 cm tall. Some of the plants had collapsed following damage to underground parts of the stems and roots. Mole cricket galleries were numerous at the soil surface. Slight damage was seen, with fewer galleries, in a nearby, irrigated field of egg plant. The digestive tract of 1 of the 5 mole crickets dissected from this locality appeared to contain fresh plant materials, and tracts of 3 others contained smaller quantities of plant fibers which were more digested.

Size distribution is shown in Fig. 1. Locality 3 was a habitat disturbed by cultivation and irrigation, and most nymphs there were small. The other habitats were relatively undisturbed. Overall, 4 of the 10 females dissected were gravid with well-developed eggs (representing localities 4, 5, and 7), suggesting ability of populations to expand in

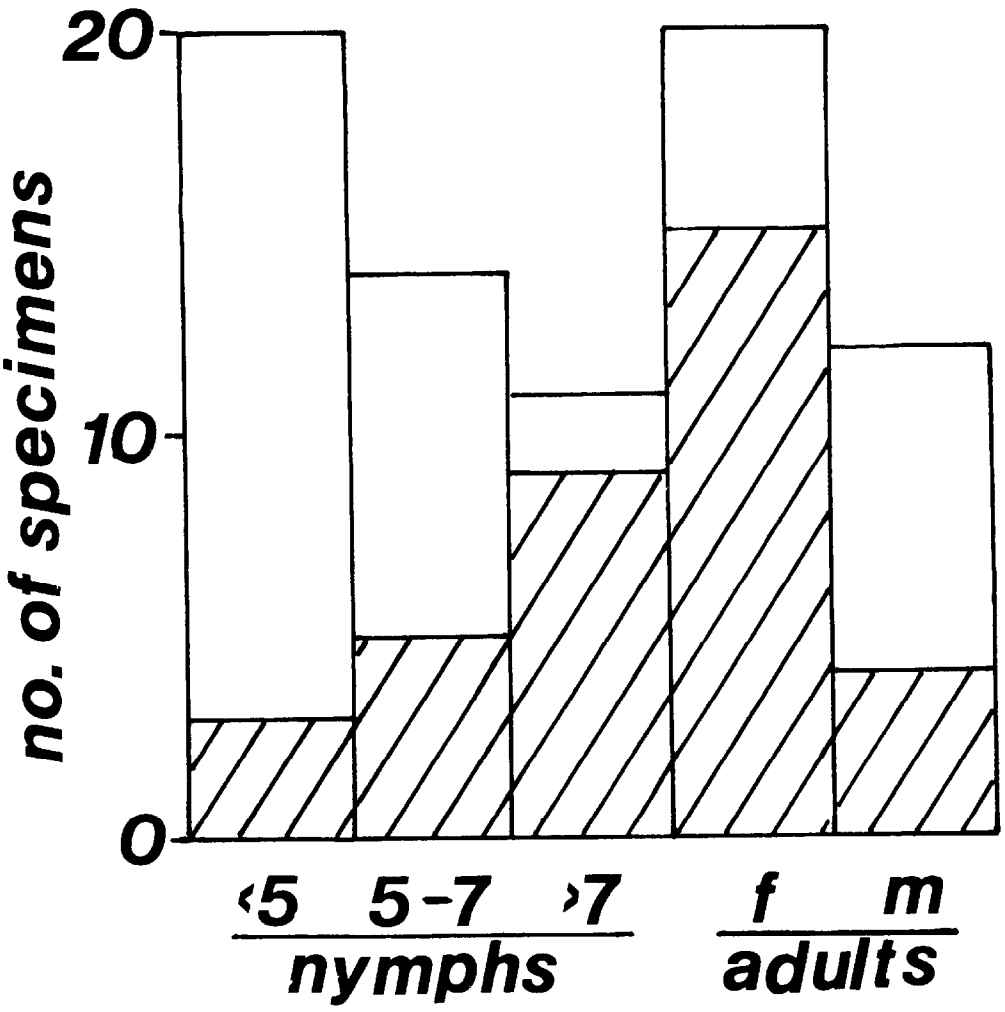

Fig. 1. Size and age distribution of *Scapteriscus didactylus* specimens collected in the Dominican Republic in 1986. Shaded parts of bars show numbers and stages of specimens from localities 4-7 (see text) and unshaded parts show the same for locality 3. Stages of nymphs are based on pronotal lengths in mm.

October under conditions favorable for survival of the immature stages. Additional data on size distribution of nymphs and content of ovarioles of females are necessary to answer demographic questions which could help in control attempts.

Castner & Fowler (1984b) found *S. didactylus* widespread throughout coastal areas of Puerto Rico, and abundant at scattered inland localities. The same appears to be true of its distribution in the Dominican Republic: it was present but not abundant at the coastal localities 1 and 4-7, and was abundant at the inland locality 3.

The nematode parasites (*Chitwoodiella* sp., Chitwoodiellidae, Oxyurida) found in the hindgut of 4 of the 5 dissected mole crickets from locality 7 are not considered to be pathogenic (K. B. Nguyen, pers. comm.).

In 23 of the 25 digestive tracts examined there were arthropod fragments or materials which might be attributed to living plants (excluding cow dung and fragments of rice grains), or both. In 15 of the tracts there were arthropod fragments, in 4 a mixture of arthropod fragments and plant materials, and in 4 plant materials only (the ratio is

15:4:4). These findings contrast with those of Castner & Fowler (1984a) who found a ratio of 1:1:30 in digestive tracts of *S. didactylus* from Puerto Rico. However, the specimens from Puerto Rico were all taken from a single locality at a golf course, where the abundance of grass was reflected in the fact that 29 of the hindguts contained grass blades. Localities 3-7 in the Dominican Republic had little or no grass, and it is not surprising that the digestive tracts of mole crickets collected there had no grass. Evidently the diet of *S. didactylus* is dependent upon habitat, and arthropods may form a substantial portion of the diet where suitable plant materials are not abundant. By dissection of digestive tracts, Matheny (1981) found that *S. vicinus* Scudder in Florida is largely herbivorous, whereas *S. acletus* Rehn & Hebard is largely carnivorous. We cannot support the contrast proposed by Castner & Fowler (1984a), that *S. didactylus* is largely herbivorous and *S. imitatus* Nickle & Castner is omnivorous, because the samples on which that proposal was based came from only 2 localities: one with abundant plant material for *S. didactylus* and a different one for *S. imitatus*. If diets of mole crickets of these 2 species are to be contrasted, then specimens dissected should preferably come from habitats where both species occur. Barrett (1902) stated that the diet of *S. didactylus* in Puerto Rico consists almost entirely of living plants, but he did not describe his method of determination; if his collections came from localities where this mole cricket was damaging plants, then his conclusion is not surprising.

Establishment of *S. didactylus* in Puerto Rico was suspected by Nickle & Castner (1984) to have occurred in the mid 1800s. A work by Ledru (1957) records results of a French expedition to Puerto Rico in 1797 and contains 2 pertinent statements: the first (p. 152) recorded: "La cigarra ó topo-grillo (*Achaeta grillotalpa* Fab.), como una cuarta parte mas pequeña que la de Europa"; the second (p. 172) noted "Los objetos con que la espedicion enriqueció el Museo de Paris, fueron los siguentes: 450 aves empajadas, 4000 mariposas é insectos. . ." Ledru's "*Achaeta grillotalpa*" *was equated with* "*Scapteriscus vicinus*" by Wolcott (1936), and Wolcott's "*Scapteriscus vicinus*" with *S. didactylus* by Nickle & Castner (1984). Thus, *S. didactylus* may have occurred in Puerto Rico by 1797, and voucher specimens may be present in collections of the Museum National d'Histoire Naturelle, Paris. The date of introduction of *S. didactylus* into Hispaniola is unknown. Nickle & Castner (1984) mentioned a record from Haiti which they were unable to confirm. The present records prove that *S. didactylus* does occur on Hispaniola and is distributed in at least 7 provinces of the Dominican Republic.

Acknowledgments

We are indebted to J. E. Trager (University of Florida) for identification of ants from mole cricket digestive tracts, to K. B. Nguyen (University of Florida) for identification of the nematode, to G. B. Edwards (Division of Plant Industry) for identification of the spider, to C. R. Artaud (Division of Plant Industry) for translation of the abstract into Spanish, and to Padre J. Cicero (Inst. Politecnico Loyola, San Cristóbal) for providing mole crickets from locality 1. We thank T. J. Walker (University of Florida) and D. A. Nickle (USDA, Washington, DC) for identification of mole crickets and manuscript reviews. The mole cricket specimens have been deposited in the US National Museum of Natural History and in the Florida State Collection of Arthropods. This is University of Florida, Institute of Food and Agricultural Sciences, journal series no. 8139.

References Cited

Barrett, O. W. 1902. La changa, ó grillotalpa (*Scapteriscus didactylus* Latr.) en Puerto Rico. Bol. Estac. Exp. Agric. Puerto Rico 2: 1-19.

Castner, J. L., and H. G. Fowler. 1984a. Gut content analyses of Puerto Rican

mole crickets (Orthoptera: Gryllotalpidae: *Scapteriscus*). Florida Ent. 67: 479-81.

———, AND ———. 1984b. Distribution of mole crickets (Orthoptera: Gryllotalpidae: *Scapteriscus*) and the mole cricket parasitoid *Larra bicolor* (Hymenoptera: Sphecidae) in Puerto Rico. Florida Ent. 67: 481-84.

LEDRU, P. A. 1957. Viaje a la isla de Puerto Rico en el año 1797, ejecutado por una comisión de sabios franceses, de orden de su gobierno bajo la dirección del capitán Nicolás Baudín, con objeto de hacer indagaciones y colecciones relativas a la historia natural; conteniendo observaciones sobre el clima, suelo, población, agricultura, comercio, carácter y costumbres de sus habitantes (2nd Spanish ed., translated from the original French ed. of 1810). Inst. Lit. Puertorriqueña, Univ. Puerto Rico. xxiii + 178 p.

MATHENY, E. L. 1981. Contrasting feeding habits of pest mole cricket species. J. Econ. Ent. 77: 444-45.

NICKLE, D. A., AND J. L. CASTNER. 1984. Introduced species of mole crickets in the United States, Puerto Rico, and the Virgin Islands (Orthoptera: Gryllotalpidae). Ann Ent. Soc. America 77: 450-65.

WOLCOTT, G. N. 1936. "Insectae Borinquenses" a revised annotated check-list of the insects of Puerto Rico. J. Agric. Univ. Puerto Rico 20: 1-631.

MATING BEHAVIOR OF THE GRASSHOPPER *MELANOPLUS TEQUESTAE* (ORTHOPTERA: ACRIDIDAE)

R. G. BLAND
Biology Department, Central Michigan Univ.,
Mt. Pleasant, MI 48859

ABSTRACT

Melanoplus tequestae Hubbell is a small, brachypterous, forb-feeding grasshopper inhabiting sand scrub and xeric oak forests of central Florida. Pair formation between silent males and females occurred when the male slowly approached the female or waited until her general activities brought her closer to him. Females raised their ventrally colored hind femora and extended their tibia to signal non-receptiveness. There was no apparent courtship before mounting, but after mounting males shook their hind femora before copulating. Mounting and copulation could last from a few hours to 1 1/2 days. Male aggressive signaling was by bursts of femur shaking.

RESUMEN

Melanoplus tequestae Hubbell es un pequeño braquíptero saltamonte habitando malezas en terrenos arenosos y bosques de cedros adaptados a ambientes secos en el centro de la Florida. El apareamiento entre machos silenciosos y hembras ocurrió cuando el macho se acercó lentamente a la hembra, o esperó a que las actividades generales de ella la trajera más cerca de él. Las hembras levantaban su colorida fémur trasero ventralmente, y extendían su tibia para señalar que no eran receptivas. Aparentemente no hubo cortejo antes de montar, pero duspués de montar, los machos sacuden su fémur posterior antes de copular. Montaje y coplación pudiera durar de unas pocas horas a 1½ dia. La señal de agresividad del macho son sacudiones del fémur.