

Southwestern Distribution and Habitat Ecology of *Grylloides supplicans*

ROBERT L. SMITH AND WILLIAM B. THOMAS

ABSTRACT The "Indian house" or "decorated" cricket, *Grylloides supplicans* (Walker), probably existed in Tucson, Ariz. from the late 1940s (verified 1963). Its local populations have expanded dramatically in Tucson and other Arizona cities over the past decade, and the species has extended its range to include other southwestern United States cities. It is found in urban ecosystems in the arid Southwest from sea level to 750 m and is most numerous in high-density residential developments. It is distributed along the Pacific coast of southern California, and north along the Colorado river into Nevada below 36° N latitude. This is the first report of the natural occurrence of *G. supplicans* in the United States outside of Florida. In Tucson, *G. supplicans* populations fluctuate with temperature and rainfall. Populations attain highest levels in the hot rainy months of July and August. The origin of the southwestern United States population is not known, but its recent dramatic geographical and ecological expansion suggests that urban demes have coalesced coincident with urbanization and that the Southwest population may have evolved greater tolerance for arid environments.

THE "INDIAN HOUSE" or "decorated" cricket, *Grylloides supplicans* (Walker), is a common domiciliary species distributed throughout the tropics of the world (Hebard 1932). This cricket is medium sized (15–21 mm from the head to the abdominal apex), and it is light yellow with distinctive brown markings (Fig. 1). Females are apterous and larger than the brachypterous males. The species was described by Walker from specimens taken in Sri Lanka (Ceylon) (Walker 1859). Walker and others described several synonyms of *G. supplicans* from the tropics (Vickery & Keven 1983), and one synonym, *G. sigillatus* Walker, was the name by which this species was commonly known until Vickery & Keven (1983) published their opinions on synonymy and priority in the genus.

Grylloides supplicans and its synonyms are specifically recorded from Australia (Walker 1869), Cuba (Saussure 1874), Mexico (Hebard 1925, 1932), Florida (Rehn & Hebard 1905), Key West, Fla. (Rehn & Hebard 1915), and from "hot houses of the USDA" in Washington, D.C. (Caudell 1908). *G. supplicans* was conspicuously absent from papers on the distribution of gryllids

in the Western Hemisphere, including the surveys of North America (Lutz 1908), Colorado (Hebard 1929; Alexander 1941), Oregon (Fulton 1930), Louisiana (Folsom & Woke 1939), Arizona (Ball et al. 1942), Michigan (Cantrall 1943), and Texas (Tinkham 1948).

W. L. Nutting and E. G. Werner (personal communication) believe they observed *G. supplicans* in Tucson, Ariz., in 1948, but the earliest documented records in the Department of Entomology research collection at the University of Arizona are two specimens from Tucson collected in 1963. The species seldom appeared in University of Arizona student insect collections from the mid-1960s through the mid-1970s, and it was never recognized as a pest (sensu Norton & Conway 1977) through this period. Beginning in the late 1970s, however, these crickets became more numerous, and by the early 1980s the species was the most remarkable pest of urban dwellings in Tucson, Phoenix, and other southwestern urban communities. The spectacular expansion of its populations provoked widespread public chagrin and a plethora of newspaper and television features in Arizona cities in the early 1980s. These events inspired us to investigate the extent of the species' geographic distribution and the nature of its habitat ecology in the arid southwestern states.

Survey Methods

Cooperative extension agents in all Arizona, New Mexico, and southern California counties were sent questionnaires regarding the presence of this species. The questionnaires were accompanied by sample specimens to facilitate identification. This survey was designed to establish general boundaries for the population of *G. supplicans* in the southwestern United States. The mail survey was followed up by travel within the tentative range of distribution and beyond to delineate distributional continuities and boundaries. These visits permitted us to validate the tentative distribution by our actually seeing or collecting *G. supplicans* or by our hearing the distinctive song of the species at key localities.

Stratified sample sites were selected at random from coordinates on a map of Pima County, Ariz. First-order sample sites were within or outside of the Tucson city limits. Sites were further classified by zoning designation as low-density residential, medium-density residential, high-density residential, trailer park, business, industrial, and general rural (undisturbed Sonoran Desert). Fig. 2 depicts sample site locations plotted on a map of Tucson and Pima County, Ariz. On each sample site a reference object, such as a building or tree, was identified, and the center of the object provided a reference point for trap placement. Four delta-type sticky traps (9 by 18 by 6 cm) were nailed to the ground at equal distances from the reference point (≥ 30 cm from the reference object) at the cardinal points of the compass.

The sites were monitored from October 1983 through September 1984. Average temperatures and amount of precipitation recorded at the University of Arizona were obtained from the U.S. National Oceanic and Atmospheric Administration data banks for each month of the study years. The number of captured crickets, the developmental stage of each, and the sex of each adult were recorded weekly from May through November and biweekly from December through April. The traps were replaced at each reading.

Survey Results

Based on all of our data sources, we have determined that *G. supplicans* is currently distributed throughout southern Arizona, the Colorado River Valley to southern Nevada, and throughout southern California (Fig. 3). The species was absent from Lordsburg, N. Mex., to the east and from Flagstaff,

ROBERT L. SMITH is an associate professor of entomology and urban extension specialist in the Department of Entomology at the University of Arizona, Tucson Ariz. 85721. WILLIAM B. THOMAS is a former graduate student in the Department of Entomology at the University of Arizona, currently employed by the United States Agency for International Development (USAID) as grasshopper/locust program coordinator in Mauritania, West Africa.

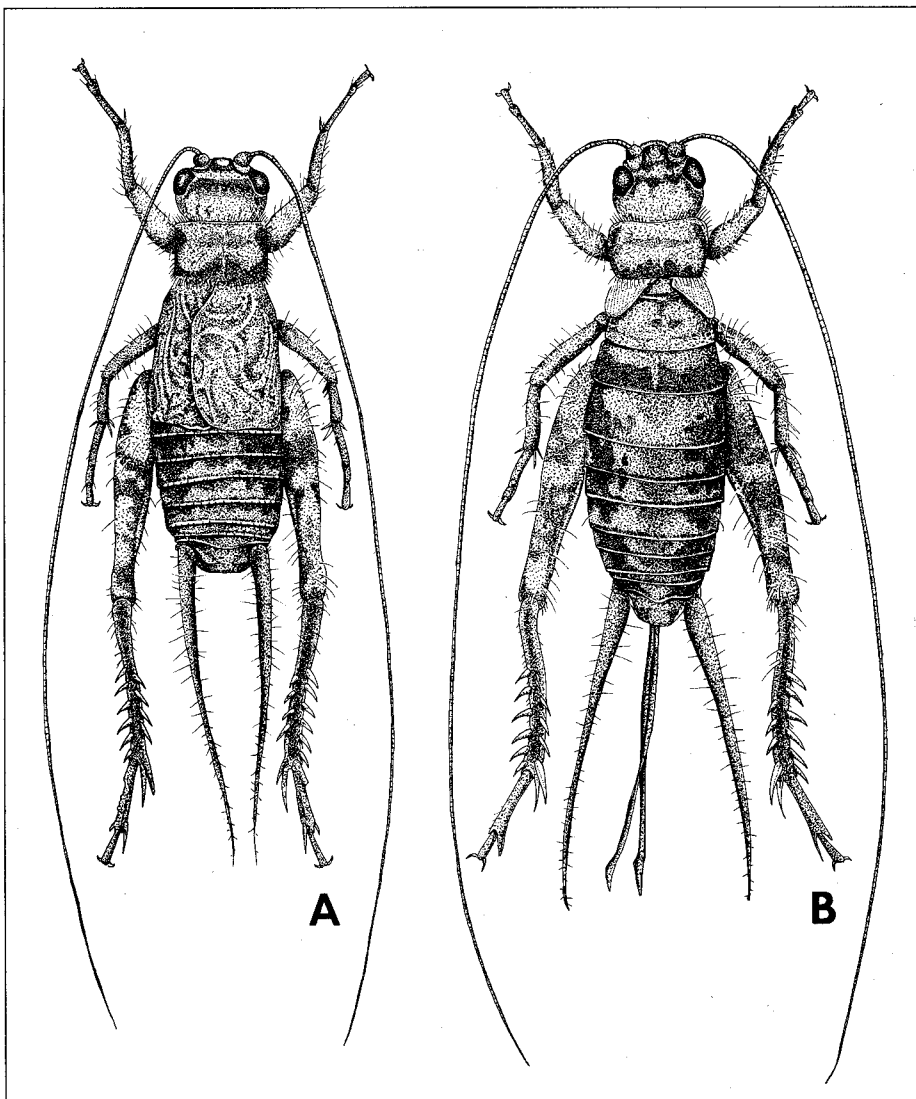


Fig. 1. Dorsal views of adult *G. supplicans* drawn from specimens taken in Tucson, Ariz. A, adult male; B, adult female.

Ariz. to the north. The absence of the species in those cities delimits the northeastern and eastern boundaries respectively. It occurs in Las Vegas, but has not been found in any other Nevada cities. Michael Rust (personal communication) reports that the species is established in Riverside Calif., and in adjacent cities, but that it has not reached Los Angeles. Recently, the crickets have been collected in Puerto Peñasco, Mexico, a popular recreation area for southern Arizonans. Yuma, Ariz., has high populations of the cricket, but the species was not found in the sister cities of Nogales, Ariz., and Nogales, Sonora, Mexico. The Southwestern distribution of *G. supplicans* seems to be circumscribed geographically to not above 36° N latitude and physiographically to not above 750 m elevation.

Our geographic collecting reconnaissance always found the species associated with urban, primarily residential, development, but also with businesses and occa-

sionally with industrial parks. Throughout its range, we never collected or heard *G. supplicans* in undisturbed desert habitats near cities. Our sticky trap survey in Pima County, caught more *G. supplicans* in the city than in the county, and none were captured at the undisturbed Sonoran Desert sites. City traps accounted for 72% of the total captured during the survey, and more adult female crickets were caught than males ($\chi^2 = 6.42, 0.025 < P < 0.05$). Although high variance among traps and sites precluded meaningful statistical comparisons, the following trends were apparent. Traps in high-density residential and business sites both in the city and in the county produced consistently high catches (range, 4.6–18.6 crickets/trap/month). Traps in industrial areas yielded negligible catches (<1 cricket/trap/month). Low- and medium-density residential and trailer park sites both in the city and in the county produced intermediate catches.

Fig. 4 is a histogram of the total monthly catches of *G. supplicans* from all traps at all sites plotted under graphs of monthly mean temperatures and total precipitation recorded at the University of Arizona (near the center of Tucson). These graphs show a dramatic expansion of *G. supplicans* populations during the period of highest mean monthly temperatures. The highest monthly cricket catch occurred in July, when the seasonal Sonoran Desert rains delivered maximum monthly precipitation.

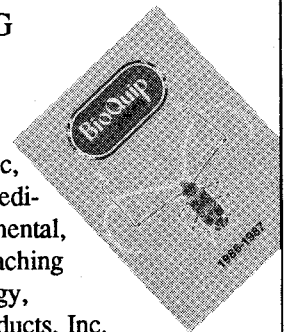
Discussion

Our survey data demonstrate that *G. supplicans* has successfully colonized and become well established in the urban areas and suburbs of the arid southwestern United States. Its previously reported occurrence in Florida and in greenhouses in Washington, D.C., are less remarkable because both locations provided high temperatures and humidity—conditions to which most populations of this pantropical species must be adapted. It seems that the Tucson *G. supplicans* population was not well adapted to the arid Southwest for at least 15 yr (probably for more than 30 yr) after its introduction. Apparently, a small number of individuals were able to colonize limited

FREE READING!

THE ENTOMOLOGIST'S CATALOG

Whether engaged in the systematic, economic, medical, environmental, aquatic or teaching of Entomology, BioQuip Products, Inc. offer the best selection, lowest prices and expert advice for the selection of your professional supplies. Inquire for the latest 1988-89 Equipment and Publication Catalog.



BioQuip
PRODUCTS

17803 South La Salle Ave.
Gardena, CA 90248 U.S.A.
Phone: 213-324-0620
Telex: 19-4561-LSA

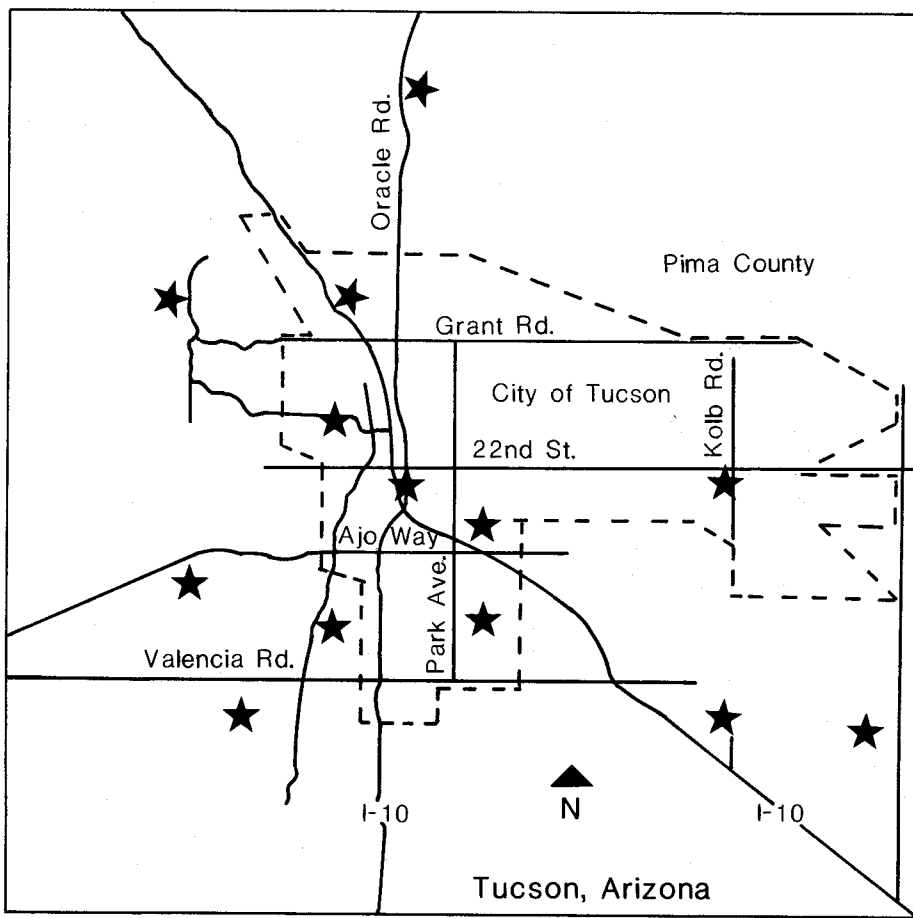


Fig. 2. Map of Tucson and Pima County, Ariz. Stars indicate *G. supplicans* habitat survey trap locations. Dashed line is city limits. Area depicted is about 625 square miles.

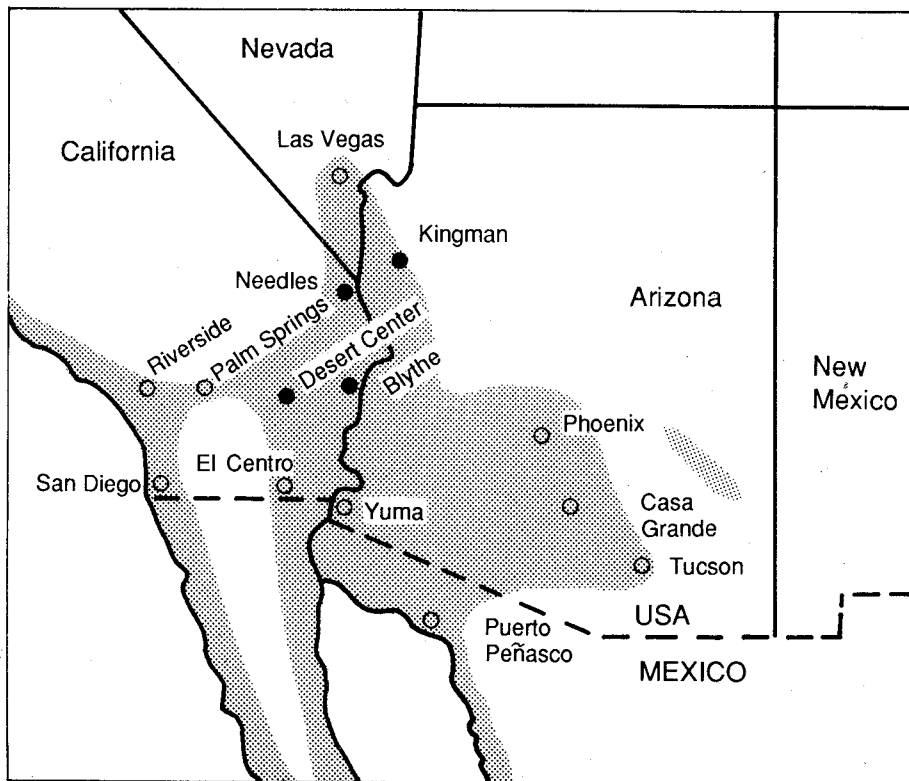


Fig. 3. Southwestern United States distribution of *G. supplicans* as of summer 1988. Open circles are cities where *G. supplicans* was collected. Closed circles are cities where *G. supplicans* was heard. Shaded area approximately delineates current and likely future range based on elevation and latitude.

habitats that have suitable microclimates, and the crickets were able to maintain their small, isolated populations for as long as three decades.

The recent geographic expansion of *G. supplicans* in the southwestern United States follows a pattern typical of species (frequently pests) introduced to regions disjunct from their normal ranges of distribution (Laycock 1966). The pattern is especially characteristic of those species that expand in environments modified by human activity (Elton 1958). However, the current example seems exceptional in the length of time between the probable initial introduction of the species and its extraordinary local and geographical expansion some 15–30 yr later.

It is conceivable that although Tucson remained a relatively small city, for a number of years after the introduction of *G. supplicans*, insular populations of the crickets occupied tiny patches of suitable habitat and experienced regular local extinction (MacArthur & Wilson 1967). As the city dramatically expanded in the late 1960s and early 1970s, islands of suitable habitat for *G. supplicans* almost certainly enlarged and coalesced. This may have created cricket demes large enough and containing sufficient genetic variation to resist local extinction, with the result that populations expanded significantly.

We speculate that in the mid-1970s, some new genetic variation occurred in, or was introduced into, existing urban populations, and that as these genes increased in frequency, the Tucson cricket population was released from certain ecological constraints to begin its explosive expansion. Although we have no evidence for what modification of the phenotype facilitated the expansion, it seems reasonable that adaptation for a greater tolerance of xeric habitats may have been responsible.

The seasonal changes of *G. supplicans* populations with temperature and moisture (Fig. 4) suggest that the species may be reproductively limited by soil moisture for oviposition. In spite of steadily increasing temperatures from February through May, we did not detect an increase in the number of *G. supplicans* caught in traps until after the onset of the summer rains in June. Populations seemed to be most severely depressed during periods of low precipitation despite advancing temperatures. Our failure to trap or in any other way to detect the species in the arid lands surrounding southwestern cities underscores this point. Elevational and latitudinal limits on the southwestern distribution of *G. supplicans* disclose this population's sensitivity to temperature.

Whatever the biological explanations for

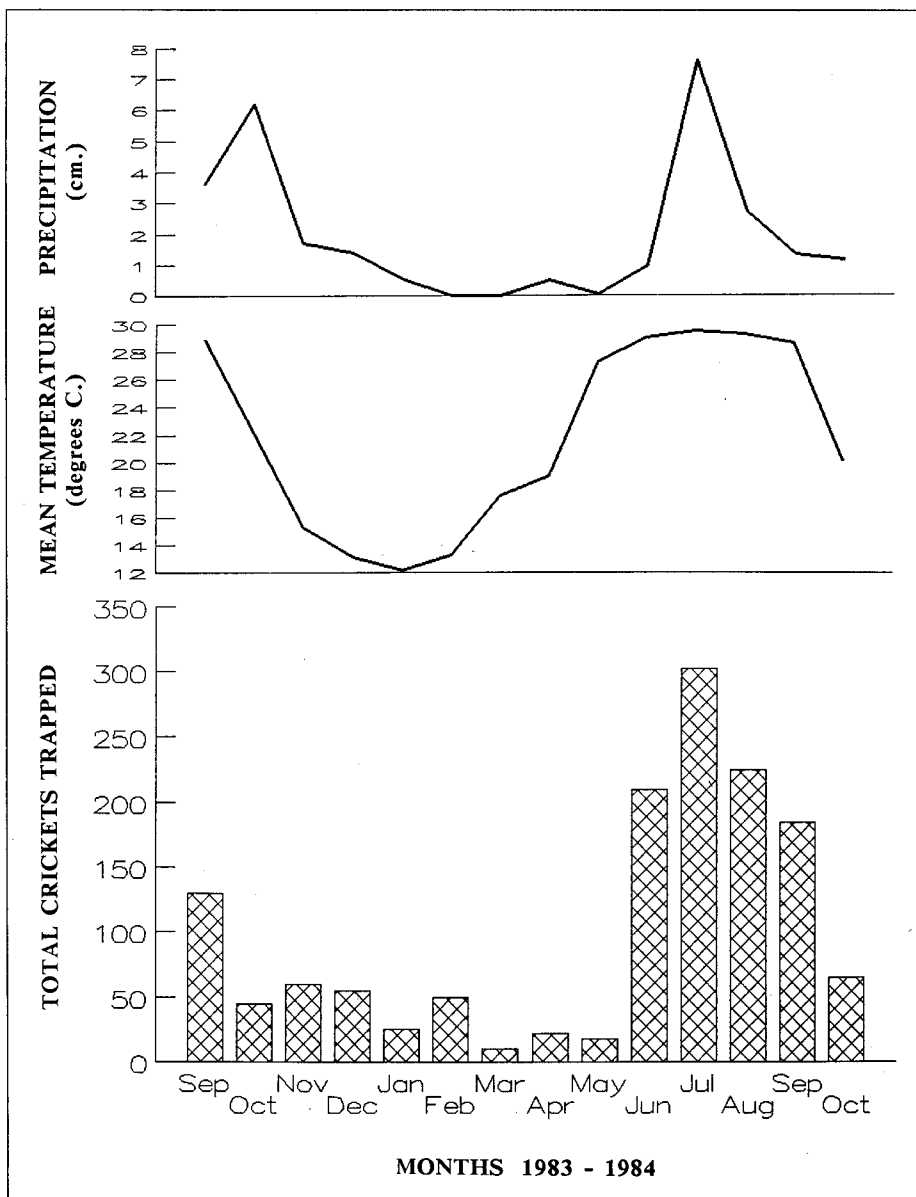


Fig. 4. Total monthly trap catches of *G. supplicans* in Tucson, Ariz. Mean monthly temperatures and monthly precipitation are plotted above cricket capture histogram.

its success, *G. supplicans*, an introduced tropical insect, has clearly become an established urban pest in the southwestern United States. The sources of the original and possible subsequent introductions of this species are not known, but the established population is apparently expanding its range through commerce. We expect that it will continue to expand northward along the California coast to include Los Angeles in its distribution and move perhaps as far north as 36° N latitude. It is not likely that members of this population could establish demes in New Mexico because of that state's high elevation. The cricket is absent from Nogales, Ariz., presumably for the same reason. It may be restrained in its northward expansion by extremes of winter temperature. ■

Acknowledgment

Floyd Werner made useful comments on the manuscript and stimulated some creative thoughts on distribution. We appreciate the Arizona, California, Nevada, and New Mexico Cooperative Extension Service county agents and entomology specialists who responded to our inquiries. Mike Rust and Robert Bechtel provided especially important distributional information and voucher specimens, and Paul Marsh, of USDA, assisted us with identifications. Gene Hall produced the original drawings of *Grylodes supplicans*. This project was supported in part from Arizona Agricultural Experiment Station Project ARZT-101740-S-31-234, Biology and Management of Urban Fauna. Truly Nolen of America, Inc., supported this and other concurrent research efforts in urban entomology with generous grants to R. L. Smith. This is Arizona Agricultural Experiment Station Manuscript 5079.

References Cited

- Alexander, G. 1941. Keys for the identification of Colorado Orthoptera. University of Colorado Studies, Series D. 1: 129-164.
- Ball, E. D., E. R. Tinkham, R. Flock, & C. T. Vorhies. 1942. The grasshoppers and other Orthoptera of Arizona. University of Arizona Agricultural Experiment Station Technical Bulletin 93.
- Cantrall, I. J. 1943. The ecology of the Orthoptera and Dermaptera of the George Reserve, Michigan. Miscellaneous Publication 54, Museum of Zoology of the University of Michigan, Ann Arbor.
- Caudell, A. N. 1908. *Grylodes sigillatus* (= *poeyi* Sauss.) in Washington D.C. Psyche 15: 96.
- Elton, C. S. 1958. The Ecology of Invasions by Animals and Plants. Methuen, London.
- Folsom, J. W. & P. A. Woke. 1939. The field cricket in relation to the cotton plant in Louisiana. USDA Technical Bulletin 642.
- Fulton, B. B. 1930. Notes on Oregon Orthoptera with descriptions of new species and races. Ann. Entomol. Soc. Am. 23: 611-641.
- Hebard, M. 1925. Dermaptera and Orthoptera from the state of Sinaloa, Mexico. Part II. Trans. Am. Entomol. Soc. (Philadelphia). 51: 265-310.
1929. Orthoptera of Colorado. Proc. Acad. Nat. Sci. Philadelphia. 81: 303-425.
1932. New species and records of Mexican Orthoptera. Trans. Am. Entomol. Soc. (Philadelphia). 58: 201-371.
- Laycock, G. 1966. The Alien Animals. Natural History Press, Garden City, N.Y.

BUY AMERICAN

Periplaneta americana

Cockroach, that is.

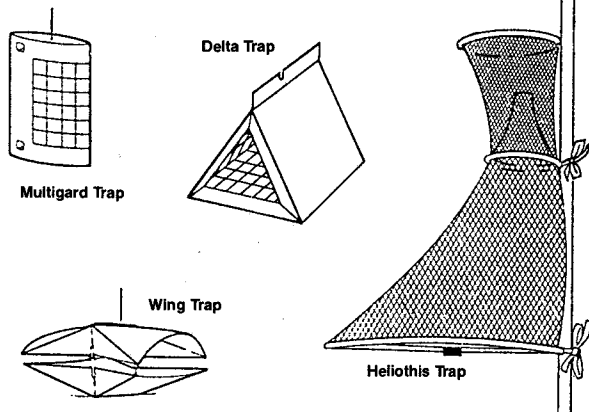
Or select your favorite insect from our catalog of colorful designs. All on American-made, heavy-weight, 100% cotton t-shirts.

Write for your free copy of **The Insectary Directory.**

SECOND SKIN STUDIOS
P.O. Box 742 Winter Haven, FL 33882

A COMPLETE LINE OF AGRICULTURAL INSECT PRODUCTS

INSECT MONITORING TRAPS AND LURES



PHEROMONE LURES FOR INSECT PESTS IN

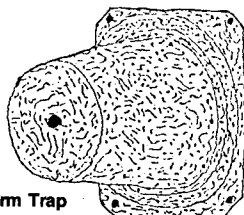
Orchard Vineyard Forest
Field Greenhouse

BIO-RATIONAL CONTROL PRODUCTS

Attract 'n Kill PBW Pink Bollworm	Attract 'n Kill TPW Tomato Pinworm
Chokegard Artichoke Plume Moth	Attract 'n Kill Heliiothis Heliiothis spp

APIARY PRODUCTS

Swarm Traps
Lures
Bee-Scent



Swarm Trap
(Approximately
31 liter capacity)

SCENTRY INC.

P.O. Box 426, Dept. ASE Buckeye, Arizona 85326
(602) 233-1772
Telex: 6711494 SI Fax: (602) 386-4887

Lutz, F. E. 1908, pp. 1-63. *In* The variation and correlation of certain taxonomic characters of *Gryllus*. Carnegie Institute of Washington Publication 101.

MacArthur, R. H. and E. O. Wilson. 1967. The Theory of Island Biogeography. Monographs in Population Biology 1. Princeton University Princeton, NJ.

Norton, G. A. & G. R. Conway. 1977. The economic and social context of crop pests, diseases and weed problems, pp. 205-226. *In* Origins of pest, parasite, disease and weed problems. J. M. Cherrett & G. R. Sagar [eds.]. Blackwell Scientific Publications, Oxford, England.

1905. A contribution to the knowledge of the Orthoptera of south and central Florida. Proc. Acad. Nat. Sci. Philadelphia. 57: 29-55.

Rehn, J. A. G. & M. Hebard. 1915. The genus *Gryllus* (Orthoptera) as found in America. Proc. Acad. Nat. Sci. Philadelphia. 67: 293-322.

Saussure, H. de. 1874. Études sur les insectes Orthoptères. Famille des Gryllides. Miss. Sci. Mex. Am. Centr. (Rech. Zool. 6, 1) p. 531.

Tinkham, E. R. 1948. Faunistic and ecological studies on the Orthoptera of the Big Bend region of Trans-Pecos Texas, with especial reference to the orthopteran zones and faunas of midwest North America. Am. Midl. Nat. 40: 521-663.

Vickery, V. R. & D. K. McE. Kevan 1983. A monograph of the orthopteroid insects of Canada and adjacent regions. Lyman Entomological Museum and Research Laboratory Memoir 13: 1-1462.

Walker, F. 1859. Characters of some apparently undescribed Ceylon insects (II). Ann. Mag. Nat. Hist. 4: 217-224.

1869. Catalogue of the specimens of Dermaptera and Saltatoria in the collection of the British Museum, Part 2. London.

Received for publication 24 May 1988; accepted 23 September 1988.

This
publication
is available in
microform
from University
Microfilms
International.



Please send information about these titles:

Name _____

Company/Institution _____

Address _____

City _____

State _____ Zip _____

Phone () _____

Call toll-free 800-521-3044. Or mail inquiry to:
University Microfilms International, 300 North
Zeeb Road, Ann Arbor, MI 48106.