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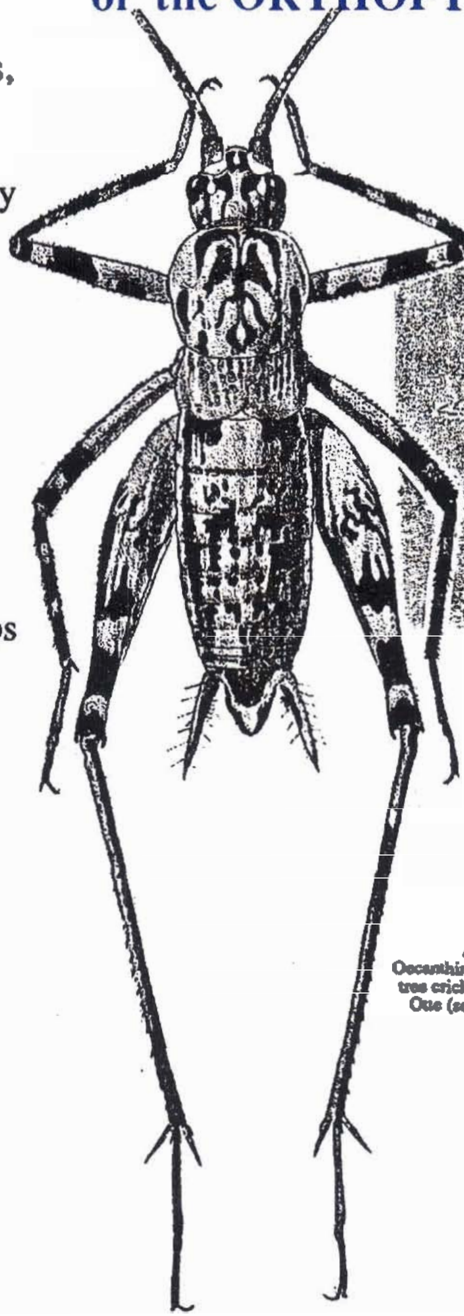
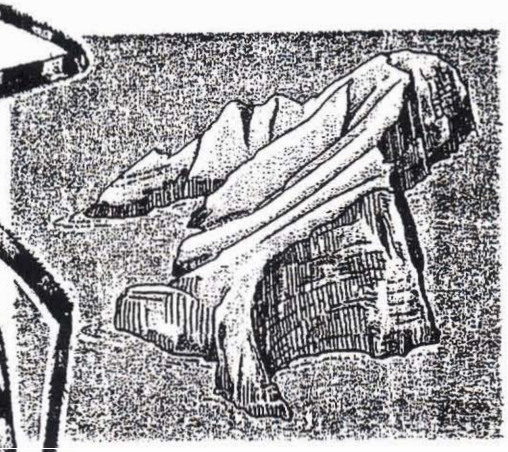
The ORTHOPTERISTS' NEWSLETTER

Vol. 14, No. 3 THE ORTHOPTERISTS' SOCIETY July 1993

In this Issue . . .

PROGRAM of the 6th INTERNATIONAL MEETING of the ORTHOPTERISTS' SOCIETY





An undescribed species of *Thaumatogryllus*, an Oecanthine cricket, from Nihoa Island [inset], the largest tree cricket in the world, currently being studied by Dan Otte (see page 18) [both figures courtesy of Dan Otte]

MEETING INFORMATION

6TH INTERNATIONAL MEETING OF THE ORTHOPTERISTS ' SOCIETY Hilo, Hawaii, USA, 1993

S. K. Gangwere, Organizer

The Organizational Committee of the Orthopterists' Society proudly presents its 6th International Meeting, convening at the College of Continuing Education and Community Service, University of Hawaii, Hilo, Hawaii (96720-4091), UHH Campus Center, August 26, 1993.

SPONSORSHIP

The 6th International Meeting of the Orthopterists' Society is co-sponsored with the University of Hawaii/Hilo Conference Center, the Depart ment of Biology of the University of Hawaii/Hilo, Hawaii Community College General Education Division, University of Hawaii at Hilo Colleg of Agriculture, the Department of Entomology of the Bishop Museum of Honolulu, Oahu, and the Department of Entomology of the University of Hawaii/Manoa.

SECTIONS

Meeting sections, each consisting of a symposium and contributed papers, are organized within the following disciplines, along with in-title presentations and poster sessions:

Section 1: Bionomics, Control, and Ecology (BCE)
Section 2: Physiology, Morphology, and Behavior (PMB)
Section 3: Systematics, Biogeography, and Evolution (SBE)

ORGANIZATIONAL COMMITTEE

Local Arrangements Chairperson:
Fred D. Stone, General Education Division, Hawaii Community College, Hilo, HI 96720, USA
Scott Miller, Bishop Museum, P. O. Box 19000-A, Honolulu, HI 96817, USA
Deborah Ward, Hawaii Institute for Tropical Agriculture and Human Resources, 875 Komohana St., Hilo, HI 96720

Committee Members:
Janet Babb, General Education Division, Hawaii Community College, Hilo, HI 96720, USA
Gordon Nishida, Department of Entomology, Bishop Museum, P. O. Box 19000-A, Honolulu, HI 96817, USA

Conference Administration:
Judith Fox-Goldstein and Karen S. Niggle, University of Hawaii/Hilo Conference Center, Hilo, HI 96720-4091, USA, (808) 933-3555; FAX (808) 933-3684

Meeting Organizer:
S. K. Gangwere, Department of Biological Sciences, Wayne State University, Detroit, MI 48202, USA

President:
Daniel Otte, Department of Entomology, Academy of Natural Sciences, 19th and the Parkway, Philadelphia, PA 19103, USA

REGISTRATION

Registration, check-in tables, packet pickup, and tickets for optional activities/meals are at the lanai of the Campus Center Building. All participants including symposium speakers are required to register formally, but accompanying dependents register only for meals and lodging. Registrations, confirmations, and refunds are the responsibility of the University of Hawaii/Hilo Conference Center, College of Continuing Education and Community Service, Hilo, HI 96720-4091, tel. (808) 933-3555, FAX (808) 933-3684. The registration fee is $125 per person, except for students, whose registration is $75 each. A $25 late fee is assessed each participant whose registration form is post-marked after July 1, 1993. All costs are in dollars (US currency). Those staying in campus housing may proceed directly to the facility that the Conference Center has designated for them.

MEETING ROOMS

Meeting rooms 301, 306, 313, and 316 Campus Center, each with overhead- and 35-mm projection equipment, are to be used for the scientific sessions; the third floor lobby of the Campus Center for poster sessions; room 313, Campus Center, for the Governing Board meeting; room 306, Campus Center, for the society business meeting; and the 3rd floor of the Campus Center for registration. The opening reception and the banquet/ closing ceremony are scheduled for room 301 of the Campus Center and the Campus Center Cafeteria, respectively. The University of Hawaii/ Hilo Center reserves the right to relocate any of the above to an alternate, appropriate facility.

ROOM AND BOARD COSTS

The Organizing Committee recommends that participants use university accommodations because they are less expensive than local hotels, and they are more convenient to the meeting site. Costs at the University of Hawaii/Hilo Conference Center for a campus suite, with three meals per day, are $270 per person. Suites have two separate bedrooms (single beds), with a connecting bath, for a total of four beds per 4 people per suite. The cost of a private bedroom with shared bath is $430 per person. Subject to availability, dormitory housing, including three meals per day, is available at a cost of $210 per person. The cost is $300 per person for a private dorm room. Dorms include two beds, with shared bathrooms down the hall.

Check in is on Sunday, August 1 or later, and departure is on Saturday, August 7 or earlier. Campus housing for shorter periods of time is offered on a space-available basis after July 1. Costs for the latter increase depending on the number of empty beds in the room or unit. Housing costs include neither the optional opening reception nor the optional closing banquet. Meals are at the Hale Kehau Cafeteria or at the Campus Center Cafeteria, both conveniently located to the meeting space. There are no restaurants within walking distance of campus, so special lunch-only and lunch/dinner passes are provided for those residing off campus. The lunch only pass, valid August 2-6, costs $40; the lunch/dinner pass, valid for lunch during August 2-6 and for dinner August 2-5, costs $68. All meals are served "buffet-style" on an "all you can eat basis", with seconds allowed. Vegetarian selections are available.

RECEPTIONS

The opening and closing receptions are listed as optional on the registration form. The opening reception/mixer, on Monday, August 2, costs $20 per person. The Friday, August 6 conference, banquet, and closing ceremony, with music and alcoholic and nonalcoholic refreshments, costs $25 per person (all costs in dollars, US currency).

PRESENTATIONS

Speakers are to use standard 35 mm slides or overhead projectors. Those who require special equipment must previously have made their needs known at the time of submission of abstracts. Poster contributions are encouraged. Posters should not exceed standard dimensions (110 x 110 cm sq) and are to be hung by thumb tacks or staples. They should include poster title, author name/s, institution/s, city, and country. The text should be succinct, understandable without accompanying oral explanation, and readable within a distance of 2 m. Presentations may also be read in title if the author/s are unable to or do not wish to deliver them personally.

PUBLICATION OF MANUSCRIPTS

All invited and contributed papers written in one of the three official languages (English, French, Spanish) will be peer reviewed and considered for publication in their entirety in the *6th Proceedings* or the *Journal of Orthoptera Research*. They will qualify for publication at the expense of the author/authors (1) if the author/s is/are members of the Orthopterists' Society, (2) if received at the Directorate within the July 1, 1993, deadline, (3) if accompanied by an abstract/resume in an official language, (4) if in compliance with the Orthopterists' Society's format, and (5) if they pass strict editorial review by specialists in the field in question. Papers read in title also qualify for publication in full upon satisfaction of these criteria. Papers which do not satisfy the criteria are to be published in abstract form only. All publications, including l-page abstracts, are subject to a $20 per-page charge due with reprint order, and 1 page abstracts will be charged the minimal $20 page charge. All charges are in dollars (US currency).

CONFERENCE AND POST-CONFERENCE FIELD TRIPS

Several conference field trips organized by Local Arrangements Chairperson Fred Stone and his committee, coordinated by the University of Hawaii/Hilo Conference Center, are arranged for the afternoon and evening of Wednesday, Aug. 4. See attachments Wl – W7. Participants are required to sign a liability waiver. The Local Arrangements Committee has also organized several post-conference field trips designed to survey the islands' orthopteroid habitats. See attachments Pl – P3 for the Saturday trips and P4 for the Sunday/Monday/Tuesday trip. As before, a liability waiver is required.

ACCOMPANYING PERSONS PROGRAM

Spouses and other family members are cordially invited to accompany participants on the above trips, subject to availability of space. There are many other interesting things to do and fascinating places to visit. Sight-seeing tours to the island and its volcanoes, as well as shopping tours, have been arranged by the University of Hawaii/Hilo Conference Center in collaboration with the Orthopterists' Society's Local Arrangements Committee. See attachments Fl – F4.

HEALTH AND ACCIDENT INSURANCE

Participants are not provided health insurance coverage but may wish to arrange for an inexpensive personal policy to meet any unexpected medical emergencies.

TRAVEL INFORMATION

Conference Site

The 6th International Meeting is being held at the University of Hawaii/Hilo (UHH) campus on the island of Hawaii, the "Big Island," with 318 miles of coastline and 4,038 square miles of varied topography and climate. The island includes desert, bog, rain forest, montane (over 13,000 feet), and coastal ecosystems. The city of Hilo is a quiet place, with a population of about 35,000 inhabitants. It is located on the island's windward side in easy reach of rain forest and volcano field trip sites. The island features a mixture of eastern, western, and native Hawaiian cultures. The UHH Conference Center will gladly provide a list of selected Big Island hotels and other facilities should you wish to extend your trip for vacation purposes.

Airline Reservations

United Airlines has been chosen by the Orthopterists' Society to serve as official carrier for the 6th International Meeting. At its Meeting Reservation Center, United has dedicated reservationists on duty 7 days a week from 7:00 am to 1:00 am EST. Your travel agent or you should call United at tel. 1 (800) 5214041 and provide the reservationist the Meeting ID Number 529QA which assures the society of receiving the most favorable possible rates and service. Your final destination should be Hilo Airport rather than Keahole (Kona) Airport, located 2 hours from Hilo by car. Both Hilo and Kona are accessible by interisland air carriers. No mainland carriers fly directly to Hilo, but United Airlines provides interisland service to Kona, plus direct flights from the mainland. Hilo Airport is served by Aloha Airlines and Hawaiian Airlines, with connections to/from all the major Hawaiian islands.

MEETING INFORMATION

BAGGAGE HANDLING

Route your luggage from the point of departure to Hilo unless you are staying overnight in Honolulu; otherwise you must retrieve your luggage at the main terminal in Honolulu, carry it on the shuttle bus to your interisland terminal, and recheck it with the interisland carrier. Airport baggage tags should list the final destination as Ito (Hilo). Travelers from outside the United States must receive their bags in Honolulu for a customs check prior to flying to Hilo.

AIRPORT TRANSFER

Allow at least 1 hour between flights to change terminals in Honolulu if you are flying through that city to Hilo. Exit the main Honolulu terminal and wait at one of the Wiki-Wiki stops for a shuttle bus, free of charge. Buses leave at 15-minute intervals for the interisland terminals. There is a taxi telephone stand at Hilo Airport.

RENTAL CARS

Public transport is limited. Taxis are available by telephone, but you may wish to rent a car while on the Big Island, giving you the additional mobility needed to see other parts of the island. A rental car is, however, a necessity only if you elect to live or eat off campus. Owing to other conferences underway at the same time as the 6th Meeting, and to numerous vacationers, rental cars are often difficult to obtain. The several companies listed below may be contacted for further information. The United Airlines Meeting Reservations Center can provide a special Hertz rate for participants making reservations through Meeting ID Number 529QA.

Rental Agency	Hilo phone #	Kona phone #	US or Worldwide phone #
Alamo	(808) 861-3343	(808) 329-8896	1-800-327-9633
Avis	(808) 935-1290	(808) 329-1745	1-800-831-8000
Budget	(808) 935-6878	(808) 329-8511	1-800-527-7000
Dollar	(808) 935-6058	(808) 329-2744	1-800-342-7398
Hertz	(808) 935-2895	(808) 329-3566	1-800-654-3131
National	(808) 935-0891	(808) 329-1674	1-800-277-7368
Sunshine	(808) 935-1108	(808) 329-2926	
Phillips	(808) 935-1936	(808) 329-1730	
Tropical	(808) 935-3385	(808) 329-2437	1-800-678-6000

PACKING

The Big Island embraces over 20 different climatic zones ranging from tropical rain forest to alpine slope and from desert to bog. The two main volcanoes reach nearly 14,000 feet. Pack clothing accordingly. The average high temperature in Hilo is in the low 80's and the average low is 70°F. Regular 10-15 mph trade winds and cool overnight temperatures make air conditioning optional. Most homes, restaurants, and the campus residence halls are not air conditioned. Hilo, with an average rainfall of 150 inches per year, enjoys the distinction of being the rainiest city in the United States. Fortunately, most of this precipitation occurs at night, but visitors should include umbrellas and raincoats.

RECREATIONAL OPPORTUNITIES

Tours are available to explore the Big Island's black, white, and green beaches, sea cliffs, volcanoes, and even snow fields. The deep sea fishing and snorkeling are fantastic. Numerous historical sites, relics, and old plantation towns can be seen. The local economy includes macadamia nut, orchid, anthurium, tropical fruit, sugar cane, and coffee production, and cattle ranching, all of which can be visited.

CAMPUS FOOD SERVICE

There are no off-campus restaurants within walking distance of campus, so plan to buy a campus meal package (see above) if you do not rent a car.

METHODS OF PAYMENT

Advance notice and payment in dollars (US currency) are required for housing/meals/optional activities. You may pay by personal check, cashier check, money order, traveler check, or purchase order, but not by credit card. Make checks payable to: Research Corporation of the University of Hawaii, in care of: 6th International Meeting of the Orthopterists' Society, UHH-CCECS, Hilo, HI 96720-4091. Registration acknowledgment is the responsibility of the UHH Conference Center.

REFUND POLICY

Refunds will be issued by the UHH-CCECS Conference Center, Hilo, HI 96720-4091, within a reasonable period following the conference. Refunds are not issued for missed meals of a meal package where registration is not formally canceled, for optional activities where registration is not canceled, or when cancellation is given with insufficient time to negate the cost. No cash refunds are generated. There is a $25 charge for cancellation 15 or more days prior to the conference, a $50 charge for cancellation 8 to 14 days prior to the conference, and no refund is made within 7 days of the conference.

FURTHER INFORMATION

Contact Karen Niggle, UHH-CCECS Conference Center, Hilo, HI 96720-4091, tel. (808) 933-3555, FAX (808) 933-3684, for additional information on (1) Hilo hotels, (2) campus housing for additional nights prior to and following the conference, and (3) spouse/family tours.

PROGRAM

Sunday, August 1.
Arrival

Monday, August 2.
8:00 - 10:30. Attendee registration (room 301, Campus Center)

9:00 - 10:30. Board meeting (room 313, Campus Center)
Presiding: OS President D. Otte

10:30 - 12:00. Opening session (room 306, Campus Center)
Moderator: OS Executive Director S. K. Gangwere

Welcoming remarks: OS President D. Otte
Welcoming remarks: UHH Chancellor E. J. Kormondy
Keynote address: F. G. Howarth

14:00 - 15:30. Bionomics/Control/Ecology Symposium
Organizers: J. A. Lockwood and A. Joern
Introduction to symposium: J. A. Lockwood
1. C. Santiago-Alvarez
2. W. D. Valovage
3. Panel discussion
BREAK

15:30 - 18:00. Bionomics/Control/Ecology Symposium, cont.
Moderator: A. Joern
4. R. Farrow
5. M. M. Cigliano *et al.*
6. J. A. Onsager
7. J. A. Lockwood
8. Panel discussion

19:00 - 21:00. Reception and mixer (room 301, Campus Center)

In-title presentations (3rd floor lobby, Campus Center)
9. J. L. Castner
10. S. K. Gangwere and D. O. Spiller
11. Barnabas Nagy
12. M. S. Wagan *et al.*
13. M. H. Launois-Luong

Posters (3rd floor lobby, Campus Center)
14. S. Sakai
15. F. D. Stone, F. Howarth, P. P. Aye, and O. Nakasato

Tuesday, August 3.
Bionomics/Control/Ecology Symposium, continued

9:00 - 11:00. Moderator: J. A. Lockwood
16. M. P. Pener
17. M. Harb
18. A. Joern
19. M. Baumgart
BREAK

11:00 - 12:30. Bionomics/Control/Ecology Symposium, cont.
Moderator: A. Joern
20. H. J. Ferenz
21. G. Cunningham
22. H. Wilps
23. Panel discussion

14:00 - 17:00. Contributed papers
Moderator: T. J. Cohn
24. A. V. Latchininsky
25. A. Fard
26. M. J. Samways
BREAK

27. A. V. Latchininsky
28. G. L. Baker and R. Pigott
29. A. V. Latchininsky
BREAK

30. L. Barrientos
31. A. Fard and M. Esmaili

19:00 - 21:00. Society business meeting (room 306, Campus Center)
Presiding: OS President D. Otte

Wednesday, August 4.

9:00 - 12:00. Physiology/Genetics/Behavior Symposium
Organizers: R. F. Chapman and R. G. Bland
Moderator: T. J. Cohn
32. W. J. Bailey
33. D. T. Gwynne
34. T. Zera
35. R. G. Bland

14:00. Afternoon field trip

Thursday, August 5.

9:00 - 12:30. Contributed papers
Moderator: W. J. Bailey
36. A. Ayali *et al.*
37. E.-B. Ma *et al.*
38. S. Masaki
BREAK

39. A. M. Murray and W. H. Cade
40. T. L. Hopkins
41. D. A. Nickle and J. L. Castner
BREAK

42. L. W. Simmons
43. J. D. Spooner
44. D. C. F. Rentz
45. T. E. Shelly
46. M. Niedzlek-Feaver

14:00 - 17:00. Systematics/Biogeography/Evolution Symposium
Organizer: D. C. F. Rentz
Moderator: D. A. Nickle
47. L. H. Field
48. D. Otte
49. L. L. Lowe
BREAK

50. S. Ingrisch
51. J. Kukalova-Peck and D. C. F. Rentz
52. G. Cassis

Friday, August 6.

9:00 - 12:00. Contributed papers
Moderator: D. C. F. Rentz
53. L. Amaral de Gambardella
54. M. G. Sergeev
55. L. DeSutter-Grandcolas
BREAK

56. X.-B. Jin
57. M. M. Cigliano *et al.*
58. P. Grandcolas
BREAK

MEETING INFORMATION

59. M. G. Sergeev
60. C. -C. Hsiung
61. S. B. Peck

9:00 - 12:00. Contributed papers
Moderator: D. C. F. Rentz
62. N. Ueshima and D. B. Weissman
63. P. M. Johns
64. M. G. Sergeev
BREAK

65. T. Wang
66. A. L. Bentos-Pereira and E. Lorier
67. K. L. Shaw

19:30 - 21:30. Conference dinner and closing ceremony (Campus Center Cafeteria).
Moderator: OS Executive Director S. K. Gangwere

Remarks: OS President D. Otte
Rentz and Recognition Awards, conferral by D. Otte
Presidential address: OS incoming President D. C. F. Rentz
Conference closure

Saturday, August 7.
Departure/Optional Field Trips

Aloha!

CONFERENCE PARTICIPANTS

The following is a list of conference participants and the sections, if any, in which they are scheduled for presentations. BCE *pertains to the Bionomics, Control, and Ecology Section;* PGB *the Physiology, Genetics, and Behavior Section;* SBE *the Systematics, Biogeography, and Evolution Section;* I *indicates intitle presentations; and* P *indicates posters.*

Agapova, O. A. See Sergeev
Amaral de Gambardella, Loreley. URUGUAY. SBE
Ayali, Amir, E. Golenser, and M. P. Pener. ISRAEL. PGB
Aye, Pyone Pyone. See Stone

Bailey, W. J. AUSTRALIA. PGB
Baker, Graeme L., and R. Pigott. AUSTRALIA. BC
Barrientos, L. L. MEXICO. BCE
Baumgart, M. GERMANY. BCE
Bentos-Pereira, Alba L., and Estrellita Lorier. URUGUAY. SBE
Bland, Roger D. USA. PGB
Bugrov, A. G. See Sergeev

Cade, William H. See Murray
Cassis, G. AUSTRALIA. SBE
Castner, James L. USA. I; also see Nickle
Cigliano, M. M., W. P. Kemp, and T. M. Kalaris. ARGENTINA and USA. BCE
Cigliano, M. M., R. A. Ronderos, and W. P. Kemp. ARGENTINA and USA. SBE
Cohn, Theodore J. USA
Cunningham, Gary L. USA. BCE

DeSutter-Grandcolas, Laure. FRANCE. SBE

Esmaili, Morteza. See Fard

Fard Parvaneh, Azmayeh. IRAN. BCE
Fard Parvaneh, Azmayeh, and Morteza Esmaili. IRAN. BCE
Farrow, Roger A. AUSTRALIA. BCE
Ferenz, Hans J. GERMANY. BCE
Field, Larry H. NEW ZEALAND. SBE

Gangwere, S. K., and D. O. Spiller. USA. I
Golenser, E. See Ayali
Grandcolas, Philippe. FRANCE. SBE
Guo, Ya-Ping. See Ma
Gusachenko, A. M. See Sergeev
Gwynne, Darryl T. CANADA. PGB

Haldar, P., and Susanta Nath. INDIA. I
Harb, M. EGYPT. BCE
Hopkins, Theodore L. USA. PGB
Howarth, Francis. USA. Keynote; also see Stone
Hsiung, Chia-Chi. CANADA. SBE

Ingrisch, Sigrid. SWITZERLAND. SBE

Jin, Xing-Bao X.-B. CHINA. SBE
Joern, A. USA. BCE
Johns, P. M. NEW ZEALAND. SBE

Kalaris, T. M. See Cigliano
Kazakova, I. G. See Sergeev
Kemp, W. P. See Cigliano
Kormondy, E. J. USA. Opening Session
Kukalova-Peck, Jarmila, and D. C. F. Rentz. CANADA and AUSTRALIA. SBE

Latchininsky, Alexandre V. RUSSIA. BCE
Launois-Luong, M. H. FRANCE. I
Liang, Ge-Qiu. CHINA
Lockwood, Jeffrey A. USA. BCE
Lorier, Estrellita. See Bentos-Pereira
Lowe, Lynette L. M. AUSTRALIA. SBE

Ma, En-Bo, Ya-Ping Guo, and Zhe-Min Zheng. CHINA. PGB
Masaki, Sinzo. JAPAN. PGB
Murray, A. M., and W. H. Cade. CANADA. PGB

Nagy, B. HUNGARY. I
Nakasota, Ona. See Stone
Nath, Susanta. See Haldar
Nickle, David A., and James L. Castner. USA. PGB
Niedzlek-Feaver, Marianne W. USA. PGB

Onsager, J. A. USA. BCE
Oshiro, Yasuhiro. JAPAN
Otte, Daniel, and Kenneth C. Shaw. SBE

Peck, Stewart B. CANADA. SBE
Pener, M. P. ISRAEL. BCE; also see Ayali
Pigott, R. See Baker

Rentz, D. C. F. AUSTRALIA. PGB; also see Kukalova-Peck
Ronderos, R. A. See Cigliano

Sakai, Seiroku. JAPAN. P
Samways, Michael J. SOUTH AFRICA. BCE
Santiago-Alvarez, Candido. SPAIN. BCE
Sergeev, Michael G. RUSSIA. SBE
Sergeev, M. G., L. V. Vysotskaya, A. G. Bugrov, O. A. Agapova, A. M. Gusachenko, and I. G. Kazakova. RUSSIA. SBE
Shaw, Kerry L. USA. SBE.
Shelly, Todd E. USA. PGB
Simmons, Leigh W. UK. PGB
Soomro, M. H. See Wagan
Soomro, N. M. See Wagan
Spooner, John D. USA. PGB
Stone, Fred D., Francis Howarth, Pyone Pyone Aye, and Ona Nakasota. USA. P

Ueshima, Norihiro, and David B. Weissman. JAPAN and USA. SBE

Valovage, W. D. USA. BCE
Vickery, Vernon R. CANADA
Vysotskaya, L. V. See Sergeev

Wagan, Muhammad Saeed, N. M. Soomro, and M. H. Soomro. PAKISTAN. I
Wang, Tianqi. CHINA. SBE

Weissman, David B. See Ueshima
Wilps, H. GERMANY. BCE

Yamasaki, Tsukane. JAPAN

Zera, Tony. USA. PGB
Zheng, Zhe-Min. See Ma

ORTHOPTERISTS' SOCIETY MEETING FIELD TRIPS

The Big Island of Hawaii, with its wide range of topography and climates, is home to diverse endemic insects, including Orthoptera. The field trips have been planned to provide maximum exposure to this diversity. Although you will be able to see and hear native species, collecting is discouraged unless it is part of a research project that does not impact the native species and ecosystems. Collecting is not permitted in Hawaii Volcanoes National Park or Natural Area Reserves without a special permit from the agency concerned.

Hats, sunglasses, and sun screen are advised for all outdoor activities in Hawaii. Rain gear is recommended for all field trips. Participants should carry drinking water. Warm clothing, such as a sweater or jacket, is advised for trips to sites at elevations of more than 600 m. Footwear should be appropriate for hiking over rough, uneven and/or muddy terrain.

WEDNESDAY, AUGUST 4, 1993 - Afternoon and Afternoon/Evening Field Trips

Cost: $20.00 (includes transportation and snack)

These field trips, which are for conference participants only, are limited to 15 persons each. Trips will be filled on a first-come, first-served basis so please indicate your first, second, and third choices of field trips on the registration billing form. Return the form and field trip fee with your conference payment.

W1. HAWAII VOLCANOES NATIONAL PARK. Focus on conservation biology of native insects in HVNP along trails in the Olaa and Puaulu (Bird Park) rainforests. Leader: David Foote, entomologist with the research division of Hawaii Volcanoes National Park. Elevation: 1200 m.

W2. KAUMANA CAVE. Focus on cave adapted species of Nemobiine crickets in Kaumana Cave and other endemic species in rainforest areas along the Saddle Road. *Recommended attire is long pants. Helmets, flashlights, and some headlights will be provided.* Leaders: Frank Howarth, entomologist with the Bishop Museum in Honolulu, and Fred Stone, Hawaii Community College. Elevation: 270-1200 m.

W3. VOLCANO RAINFOREST. Focus on native species of plants, invertebrates, and birds in rainforest areas near the village of Volcano. Leader: W. P. (Bill) Mull, noted photographer of insects and spiders, rainforest naturalist, and research associate in entomology with the Bishop Museum in Honolulu. Elevation: 1000 m.

W4. PUU MAKAALA RAINFOREST. Focus on native insects in Puu Makaala rainforest along the Stainback Highway. Leader: David Preston, entomologist with the Bishop Museum in Honolulu. Elevation: 780-1200 m.

W5. U.S. DEPARTMENT OF AGRICULTURE RESEARCH STATIONS. Includes tours of the Tropical Fruit and Vegetable Research Laboratory, which focuses on the ecology, physiology, behavior, attractants, and natural enemies of fruit fly pests; the National Germ Plasm Clonal Repository, which collects, maintains, and disseminates 14 varieties of fruit and nut crops; and the Waiakea Experimental Farm, which conducts experiments on pests of tropical plants and flowers. Leaders: Nick Liquido, Francis Zee, and Arnold Hara, with the respective research stations. Elevation: 210 m.

W6. HAMAKUA COAST. Focus on native crickets in rainforests along the Hamakua Coast, including Akaka Falls and Kalopa State Park areas. Leader: Dan Otte, Academy of Natural Sciences in Philadelphia. Elevation: 0-300 m.

W7. SADDLE ROAD. Focus on dynamic processes in biotic community development in kipukas (pockets of native rainforest that survived recent lava flows) along Saddle Road, between Mauna Loa and Mauna Kea volcanoes. Leader: Lani Stemmerman, botanist with Hawaii Community College. Elevation: 2000 m.

FAMILY/GUEST TOURS

TUESDAY, AUGUST 3, 1993 8:45a.m. - 3:00 p.m.

F1. HISTORIC HILO. A tour of the Lyman House Museum and Mission House provides insight to the ethnic diversity of Hawaii and tells the story of the lives and impact of early missionaries on the Big Island. Hilo's tsunami (popularly known as "tidal waves") history is explored through photo displays and a visit to the tsunami memorial at Wailoa Center. Enjoy magnificent views of Hilo Bay and Mauna Kea as you walk through Liliuokalani Garden, one of the largest Japanese gardens outside of Japan. Also included is time to stroll along the streets of downtown Hilo where you can shop and eat lunch and a visit to "the birthplace of all rainbows" — Rainbow Falls. Sunscreen and umbrellas are recommended. Cost: $20.00 (Includes transportation and admission fees. Does not include lunch.)

MEETING INFORMATION

WEDNESDAY, AUGUST 4, 1993 8:00 a.m. - 4:30 p.m.

F2. SUNNY WEST HAWAII. Drive through Hawaii's paniolo (cowboy) country on your way to sunshine, spectacular blue-green water and the fine white sand of Hapuna Beach State Park. Conde Nast Travel Magazine named Hapuna Beach one of the top ten beaches in the USA. On the way to sunny west Hawaii, you will stop at Akaka Falls, where a delightful 30 minute walk through lush tropical plants and flowers will take you to the longest sheer drop waterfall (420 feet) in the state. Sunscreen is essential! Bring your swimsuit and towel. Cost: $25.00 (Includes transportation and lunch.)

THURSDAY, AUGUST 5, 1993 8:00 a.m. - 4:30 p.m.

F3. HAWAII VOLCANOES NATIONAL PARK. Views of steaming craters, lava-covered landscape, and native rainforest are scenic highlights of your Crater Rim drive at the summit of Kilauea, one of the world's most active volcanoes. The tour includes stops at the park visitor center, the Thomas. A. Jaggar Museum overlooking Halemaumau Crater—Kilauea's 400 feet deep summit crater, and short walks along Devastation Trail--an area covered by cinder during the 1960 eruption of Kilauea Iki, and through Thurston Lava Tube. (The tour does not include the 3-4 hour trip to the lava-viewing area at the coast.) Wear comfortable walking shoes and bring sunscreen. The weather can be cool and rainy at the summit, so a sweater and/or rain jacket are also recommended.

Note: Pregnant women and persons with heart and/or respiratory ailments should avoid the sulfuric fumes at Halemaumau crater. Cost: $25.00 (Includes transportation, admission fee and lunch.)

FRIDAY, AUGUST 6, 1993 8:00 a.m. - 12:00 p.m.

F4. A TASTE OF ALOHA. Enjoy a narrated walking tour through Nani Mau Garden, a large cultivated tropical garden featuring plants and flowers from various climatic zones. Sample chocolates and nuts while enjoying a self-guided tour of the Mauna Loa Macadamia Nut Factory, the largest producer of macadamia nuts in the world. Conclude the morning by participating in a lesson in the art of Hawaiian hula (dance)! Wear comfortable walking shoes. Cost: $20.00 (Includes transportation and admission fees.)

BONUS! BONUS! BONUS! BONUS! BONUS!

During the conference Hilo professor Fred Stone will lead walks to the campus organic garden to view introduced orthopteran species.

POST CONFERENCE FIELD TRIPS

Post conference field trips are available to conference participants. Guests will be accommodated on a space available basis. Each trip is limited to 20 persons.

SATURDAY, AUGUST 7, 1993 - One Day Field Trips

Cost: $35.00 (includes transportation, admission fees and lunch)

P1. MAUNA KEA. Travel via four-wheel drive vehicles to the summit of Mauna Kea, one of the premier astronomical observatory sites in the world. The trip will include several stops at *kipukas* along Saddle Road to explore native rainforests for invertebrates and a stop at the Onizuka Center for International Astronomy visitor center (2800 m elevation) to acclimatize before ascending to an elevation of nearly 4200 m. At the summit you will tour the University of Hawaii astronomical facility and observe high altitude plant and insect life on the stark volcanic landscape. Leader: Fred Stone, Hawaii Community College in Hilo.

Note: Due to the extreme atmospheric conditions, children under the age of 16, pregnant women, and persons with heart, circulatory, or respiratory ailments, or who are severely overweight, are prohibited from traveling to the summit of Mauna Kea. Harsh weather conditions, such as high winds, freezing fog, and/or snow can occur at the summit even in summer, so warm clothing is essential for this trip.

P2. HAMAKUA COAST. Explore rainforests along the Hamakua Coast for crickets and other native invertebrates. Possible destinations include an *ohia* forest in Kalopa State Recreation Area and the lush Waipio Valley. Trails will be wet and muddy. Leader: Dan Otte, Academy of Natural Sciences in Philadelphia. Elevation: 0 - 350 m.

P3. HAWAII VOLCANOES NATIONAL PARK. Explore Kilauea and Mauna Loa volcanoes for native crickets at sites along the Crater Rim Road, the Chain of Craters Road, and the Mauna Loa Strip Road in HVNP. Possible stops include the Visitor Center, Jaggar Museum, Halemaumau crater, Thurston lava tube, and native rainforest areas. If conditions permit, participants may be able to witness active lava flows at the coast. Leader: Frank Howarth, Bishop Museum in Honolulu. Elevation: 0 - 1200 m.

Note: Pregnant women and persons with heart or respiratory ailments should avoid vog (sulfuric gases) and laze (steam clouds containing hydrochloric acid droplets produced by the interaction of lava and seawater) present at Halemaumau crater and along coastal areas where lava is flowing into the ocean.

SUNDAY/MONDAY/TUESDAY, AUGUST 8-10, 1993

Cost: $200.00 (Includes air fare from the Big Island of Hawaii to the Island of Maui, transportation and housing on Maui, and air fare from Maui to Oahu. Does not include meals. Does not include transportation or accommodations on Oahu.)

P4. MAUI/OAHU. Fly to Maui Sunday morning with field trip leaders Dan Otte, Academy of Natural Sciences of Philadelphia, and Frank Howarth, Bishop Museum in Honolulu. Spend Sunday afternoon and Monday exploring for native insects in a variety of habitats on Maui during field excursions to sites along the Hana Road, on Haleakala, and in Iao Valley (elevations range from 0 to 3000 m). On Tuesday, fly to Oahu where you make your own arrangements for field excursions or work in Bishop Museum.

Note: You must make your own arrangements for transportation and housing while on Oahu. Your travel agent or the UHH Conference Center can assist you.

Hilo, Hawaii Hotels/Motels

ARNOTT'S LODGE 98 Apapane Road, Hilo, Hawaii 96720
Located approx. 1 1/2 miles from the Banyan Drive hotels, about one block off Kalanianaole Street. Take Kalanianaole Street to Keokea Loop to Apapane Road. This is a "no frills" hostel-style facility in a converted apartment building. There is a common living room and kitchen shared by several units. One bathroom per unit. Bunks $15/night (4 or more bunks per room); upgraded "doubles" (two people) $36/night; private rooms (one person) $26/night; two bedroom apartment $80/night (sleeps 4 or more). Pay for 6 nights and the 7th is free. Telephone (808) 969-7097.

COUNTRY CLUB HOTEL 121 Banyan Drive, Hilo, Hawaii 96720
145 unit hotel with restaurant and cocktail lounge. Located on Hilo Bay shoreline within walking distance of Naniloa Country Club golf course, Coconut Island, Liliuokalani Park, Suisan Fish Auction, and other Banyan Drive hotels and restaurants. 1992 room rates are $39-$49 single or double (2 double beds). All have air conditioning; some have TV; some have kitchenettes. With advance application and-deposit can get monthly rate of $400. Telephone (808) 935-7171.

DOLPHIN BAY HOTEL 333 Iliahi Street, Hilo, Hawaii 96720
An 18 unit hotel located in an old residential area four blocks from downtown and three blocks from Hilo Bay. No TV, air conditioning or in-room telephones, but all have kitchenettes and are spacious and clean. Single or double occupancy rates are $36-$46 standard (twin beds), $46-$57 superior (queen and twin bed), $67 one bedroom apartment (queen size in bedroom and twins in living room), $77 two bedroom apartment (double bed in each bedroom and twin beds in living room). Telephone (808) 935-1466.

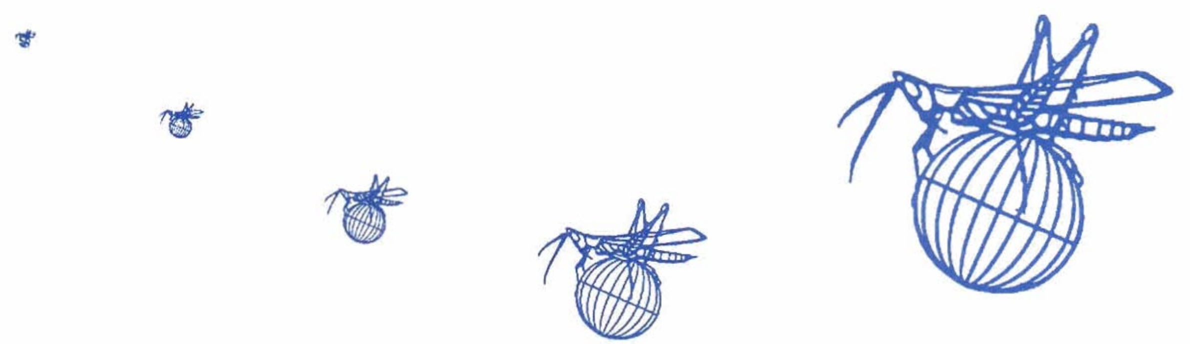
HAWAII NANILOA HOTEL 93 Banyan Drive, Hilo, Hawaii 96720
400 unit tower located on Hilo Bay shoreline within walking distance of Naniloa Country Club golf course, Coconut Island, Liliuokalani Park, Suisan Fish Auction, and other Banyan Drive hotels and restaurants. Spacious rooms, air conditioning, TV. Restaurants and lounges, tennis courts. Rates for single or double occupancy are $96 standard, $119 oceanfront, $154 deluxe. Add $15 for room and car package. Telephone (808) 969-3333; 1-800-367-5360.

HILO BAY UNCLE BILLY'S 87 Banyan Drive, Hilo, Hawaii 96720
130 unit hotel located on Hilo Bay shoreline within walking distance of Naniloa Country Club golf course, Coconut Island, Liliuokalani Park, Suisan Fish Auction, and other Banyan Drive hotels and restaurants. All rooms air conditioned with TV. Restaurant, cocktail lounge, gift shops, tropical gardens, daily hula shows. Single or double occupancy rooms are $59 standard, $64 superior, $69 deluxe, $79 ocean front. Room and car packages begin at $74. Telephone (808) 9615818; 1-800-442-5841; Alaska 1-800-367-5102; Canada 1-800-423-8733.

HILO HAWAIIAN HOTEL 71 Banyan Drive, Hilo, Hawaii 96720
290 room hotel on Hilo Bay behind Coconut Island and within walking distance of Naniloa Country Club golf course, Liliuokalani Park, Suisan Fish Auction, and other Banyan Drive hotels and restaurants. Spacious rooms, air conditioned, TV. Restaurant, cocktail lounge, shops. 1992 rates for single/double occupancy are $99 Banyan view; $120 ocean view as a special promotion including car rental. Add $15 per additional person with existing beds or rollaway. Telephone (808) 935-9361; 1-800-367-5004; 1-800-272-5275.

HILO HOTEL PO Box 726, 142 Kinoole Street, Hilo, Hawaii 96720
29 room hotel in downtown Hilo across from Kalakaua Park and in walking distance of Lyman House Museum, Hilo Bay, and downtown shops. Spacious and clean rooms with simple furnishings. Japanese restaurant. Room rates are $39 single or double occupancy without TV; $45 with TV. Room/car packages available. Also have a suite with 2 bedrooms (one with 1 double and 1 single bed; second with 2 single beds), 2 baths, living room & kitchenette at $115. All rooms have fridge, air conditioning and phone. Complimentary coffee and sweet rolls served from 7-9am. $8.00 for each add. person in room. Telephone (808) 961-3733.

HILO SEASIDE 126 Banyan Drive, Hilo, Hawaii 96720
145 unit hotel just opposite Reeds Bay. Standard but clean rooms with TV but no air conditioning. Restaurant and cocktail lounge. Of the Banyan Drive hotels listed, this one is the farthest from Coconut Island, Liliuokalani Park and Suisan Fish Auction but the sites are still in walking distance. Single or double occupancy rooms are $47-$52. Room and car packages start at $60. Telephone (808) 935-0821; 1-800-367-7000; Canada 1-800-6547020.



ABSTRACTS

ABSTRACTS OF THE MEETING IN CHRONOLOGICAL ORDER

Monday, August 2

1. THE MOROCCAN LOCUST, *DOCIOSTAURUS MOROCCANUS*, AND ITS BIOLOGICAL CONTROL BY MEANS OF ENTOMOPATHOGENS

C. Santiago-Alvarez (SPAIN)

2. THE USE OF ENTOMOPATHIC FUNGI IN RANGELAND GRASSHOPPER MANAGEMENT

W. D. Valovage (USA)

3. Panel Discussion

4. CURRENT STATUS OF LOCUSTS IN AUSTRALIA: CHANGING CLIMATES AND CONTROLS

R. Farrow (AUSTRALIA)

5. SPATIOTEMPORAL CHARACTERISTICS OF RANGELAND GRASSHOPPER (ORTHOPTERA:ACRIDIDAE) REGIONAL OUTBREAKS IN MONTANA

Marie Marta Cigliano[1], William P. Kemp[2], and Thomas Kalaris[2]

[1]CONICET, Departamento Entomologia
Museo de La Plata
1900 La Plata, ARGENTINA
[2]USDA/ARS, Rangeland Insect Laboratory,
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Bozeman, MT 59717-0366 USA

A study was conducted to examine the spatiotemporal characteristics of two rangeland grasshopper regional outbreaks in the state of Montana. Two periods were selected for study (1959-1966, 1984-1992), corresponding with the two intervals over which the highest regional densities have been recorded in the state. Geostatistical methods and geographic information system (GIS) techniques were used to generate coverages of estimated grasshopper densities and to study spatial and temporal patterns. To evaluate the temporal relationship of grasshopper abundance to vegetation types and to determine types prone to high densities, a climax vegetation coverage was also used in the analysis. Results showed that grasshopper outbreaks (≥9.6 grasshoppers per square meter) in Montana at the regional level can be characterized by the following interrelated characteristics: (1) Outbreaks are irregular and short-lived. (2) Over the long-term, the extent of the area exhibiting high densities fluctuates to the extremes. (3) Areas of high densities are present every year, although they may be geographically restricted. (4) Densities generally vary inversely with distance away from the perimeter of an area exhibiting high densities. 5. New areas of high densities do not appear to be the result of grasshopper influx from other areas, although migration may occur. (6) Although no chronically high density areas could be detected, some vegetation types appear to be more prone to high densities. (7) Densities can arise simultaneously over wide areas. (8) Areas of high densities once initiated can decline, expand, or collapse. (9) If the areas exhibiting high densities expand, the extension of the boundaries or the appearance of separate new high density areas beyond those boundaries do not follow any specific pattern (*i.e.*, prevailing winds). (10) Outbreaks at the scale and in the vegetation types studied in Montana appeared not to be self-perpetuating, but sensitive to external environmental variations.

Furthermore, in terms of the prevailing hypotheses concerning insect outbreaks (Berryman 1987), the geographical behavior of high density areas prevented their being classified as either gradient or eruptive; they appeared to exhibit behaviors of both. Our results suggest that there is a need for an extension of the existing paradigm concerning insect outbreaks.

6. PARTITIONING GRASSHOPPER LIFE TABLES TO ISOLATE MORTALITY DUE TO PARASITISM

J. Onsager (USA)

7. OUTBREAK DYNAMICS OF RANGELAND GRASSHOPPERS: ERUPTIVE, GRADIENT, BOTH, OR NEITHER?

J. Lockwood (USA)

8. Panel Discussion

PAPERS PRESNTED IN TITLE AND PAPERS PRESENTED AS POSTERS (3rd floor lobby, Campus Center):

9. OBSERVATIONS ON THE BEHAVIOR AND BIOLOGY OF LEAF-MIMICKING KATYDIDS (ORTHOPTERA: TETTIGONIIDAE: PTEROCHROZINI)

James L. Castner

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Gainesville, FL 32611 USA

Notes on the behavior and biology of the true leaf-mimicking katydids (Pseudophyllinae: Pterochrozini) are reported based on both field and laboratory observations. Field sites were located in lowland Amazon rainforests in northeast Peru near the city of Iquitos. Data are presented regarding color polymorphisms, sexual dimorphism, developmental biology, mating, defense mechanisms and specialized adaptive behaviors, and diurnal roost site selection.

10. FOOD SELECTION AND FEEDING BEHAVIOR IN SELECTED ORTHOPTERA *SENS. LAT.* OF THE BALEARIC ISLANDS, SPAIN

S. K. Gangwere and D. O. Spiller

Department of Biological Sciences
Wayne State University,
Detroit MI 48202 USA

Little is known of food selection and feeding behavior in the Orthoptera *sens. lat.* of the Balearic Islands, Spain, hence the present investigation. The study began with a field survey of Menorca and Ibiza Islands, leading to selection of stations in the Santo Tomas area, representative of Menorcan sublittoral grassland and scrub, and the Na Xamena area, representative of Ibizan coastal mountains and foothills. Following habitat analysis, 15 species of Orthoptera were investigated in detail by field observation of behavior, light microscope and SEM study of mandibular adaptation and fecal structure, and use of differential feeding tests. Six additional species were studied in less detail by analysis of mandibular adaptation and crop content. The investigation disclosed that (1) the species of the two major stations have essentially similar food habits notwithstanding the insular separation and disparities attributable to local host plant availability, and (2) the insects' feeding is generally consistent with that of their taxonomic group elsewhere in the Mediterranean region and in the adjacent Atlantic islands.

11. ARE LOCUST OUTBREAKS REAL DANGERS IN THE CARPATHIAN BASIN IN THE NEAR FUTURE?

B. Nagy (HUNGARY)

12. [Information not Available- ed.]
Wagen *et al.*.

13. LA MODELISATION DU CRIQUET PELERIN *SCHISTOCERCA GREGARIA* (FORSKÅL, 1775) SUR L'ENSEMBLE DE SON AIRE D'HABITAT: LE BIOMODELE SGR

M. H. Launois-Luona

PRIFAS - Acridologie Operationnelle - Ecoforce (R) Internationale Departement GERDAT

The Desert Locust inhabits an area of nearly 30 million km^2 and retreats to very remote arid zones during recession periods. In some years gregarization and outbreaks occur before the locusts begin to invade dozens of countries as they advance to occupy their entire range. Since the only effective strategy is to intervene once the locusts begin congregating, locust surveys must be carried out regularly. Unfortunately, locust targets are often not reached in time due to difficulties in obtaining, transmitting and verifying field data. A Desert Locust biomodel has thus been designed to permanently monitor these locusts and to forecast high risk situations.

The SGR biomodel, specific to the Desert Locust, *Schistocerca gregaria* (Forskål, 1775) for its entire distribution area, is provided with meteorological data from a world digital model operated by the European Centre for Medium Range Weather Forecasts.

The biomodel is composed of sub-models to monitor variations in the locust environment, locust development, and current locust densities per unit area, which can be correlated with phase changes. The prime objective is to permanently monitor the locust situation, determine potential outbreak zones, follow the development of locust outbreaks and to assist in selecting appropriate locust control strategies for specific situations. Within the accepted margins of error, the SGR biomodel also allows operators to reconstruct the recent past, test hypothetical scenarios by simulations, and to make short-term (two 10-day periods), medium-term (two months) and long-term (one year) forecasts, in the light of the locust situation concerned.

14. BIOECOLOGY AND REVISIONAL COMMENTS ON THE CLASSIFICATION OF DERMAPTERA

Seiroku Sakai

Institute of Biology & Life Sciences
Daito Bunka University
Nr.2-26-12, Sendagi, Bunkyo
Tokyo 113. JAPAN

Sakai (1970-1992: *Dermapterorum Catalogus*: I-XXIV, 8,651 pp.) has compiled much of the relevant taxonomic information and references on worldwide valid and invalid Dermapteran taxa since Linnaeus (1758). Global biodiversity of Dermaptera is recognized in 4 Suborders, 6 Superfamilies, 11 Families, 55 Subfamilies, 208 Genera, 1,929 Species, 34 Subspecies, 37 Varieties, and 9 forms. It is interesting to analyze why the external features of Dermaptera seem to centralize to the biodiversity to the male forceps, pygidium, manubrium, and genitalia, including the shape of virga and paramere on Dermapteran polymorphism. The citations of Steinmann's *Catalogue* (1989) and *Das Tierreich* (1986, 1989) on Dermaptera have sometimes overlooked important taxonomic references. The suprageneric names as subfamily level by Steinmann (1989) are incorrect, such as [Carcinophoridae] for Anisolabididae and [Labiidae] for Spongiphoridae. Many incorrect synonyms are cited in Steinmann's *World Catalogue* and *Das Tierreich* as Sakai (1990) has pointed out. However, Steinmann's *Catalogue* and *Das Tierreich* are useful but have several different approaches from Sakai's *Catalogus* and other references. A new genus, *Paralabella*, elected by Steinmann (1989) on the basis of paramere shape of the male genitalia, is a sample of the excellent treatment of Dermapteran classification by Steinmann (1989).

Some species complexes, including *Euborellia*, *Anisolabis*, *Labidura*, *Anechura*, and *Forficula*, are considered with respect to individual variation and biogeographical aspects.

Dermapteran insects occur principally in tropical and temperate regions, although some species are found in cooler regions. Dermaptera frequent crevices under the bark of trees and in fallen logs, and crawl beneath debris on the ground. Their food includes a wide range of living and dead plant and animal matters. They are thigmotactic, nocturnal, and are attracted to light. Dermaptera damage has been reported to bean, potato, beet, cabbage, cauliflower, pea, carrot, cucumber, dahlia, zinnia, sweet-william, berry, radish, strawberry, apple, apricot, peach, pear, plum, and grape.

The life histories of about 18 species are known as follows: *Diplatys gerstaeckeri*, *Euborellia annulipes*, *E. plebeja*, *E. philippinensis*, *Gonolabis marginalis*, *Anisolabis maritima*, *A. littorea*, *Nala lividipes*, *Labidura riparia*, *Labia minor*, *Chelisoches morio*, *Marava arachidis*, *Proreus simulans*, *Timomenus aeris*, *Anechura harmandi*, *Doru aculeatum*, *Chelidurella acanthopygia*, and *Forficula auricularia*. There are usually 4 or 5 instars but occasionally 6 or more. The females are known to provide parental care for eggs and nymphs.

Some species such as *Labidura riparia*, *Euborellia annulipes*, *E. annulata*, *E. philippinensis*, *Nala lividipes*, and *Proreus simulans* are effective predators on the Asian corn borer, *Ostrina furnacalis*. The mass releasing of *Euborellia* was of slightly greater economic cost than calender spraying with Chlorpyrifos ethyl in the Philippines.

Three forms of *Anechura harmandi* are discussed regarding biogeographical distribution.

15. ADAPTIVE SHIFT AND CHROMOSOMAL VARIATION IN HAWAIIAN *CACONEMOBIUS* (ORTHOPTERA: GRYLLIDAE)

Fred D. Stone[1], Francis Howarth[2], Pyone Pyone Aye[3], and Ona Nakasato[4]

[1]Hawaii Community College
Hilo, HI USA
[2]B.P. Bishop Museum
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[3]University of Hawaii
Honolulu, HI USA
[4]University of Hawaii
Hilo, HI USA

In Hawaii, crickets in the genus *Caconemobius* have adapted to a variety of bare-rock habitats. The presumed ancestral species, *Caconemobius* sp. C, is a scavenger in the wave splash and anchialine zones of all the main Hawaiian islands. It has an XX/XO sex determining mechanism, and a diploid number of 12 chromosomes, 3 large metacentric pairs and 2 small pairs. *Caconemobius fori* scavenges on recent lava flows and has a karyotype very similar to that of *C.* sp. C. A probable hybrid zone occurs near the coast, where the ranges of *C. fori* and *C.* sp. C overlap. *Caconemobius varius* is found in caves and mesocaverns (cracks and other medium-sized voids) on the island of Hawaii. It has XX/XO sex determining chromosomes, a diploid number of 10 acrocentric chromosomes and 1 or more supernumerary chromosomes. *Caconemobius* sp. B occurs in caves and mesocaverns parapatrically with *Caconemobius varius*. However, it has an XXY sex determining mechanism and a diploid number of 8. *C. howarthi*, an independently evolved cave species on the island of Maui, has an XX/XO sex mechanism and a diploid number of 18.

ABSTRACTS

Tuesday, August 3

16. ENDOCRINOLOGICAL TOOLS AND THEIR POTENTIAL FOR NONCONVENTIONAL ACRIDID PEST MANAGEMENT

M. P. Pener

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Interference with the endocrine system of insects has long been considered as a sound approach to development of non-conventional pest management. This consideration led to intensive research on insect growth regulators (IGRs) which act as hormone analogs or anti-hormones inducing symptoms of hormones excess or hormone deficiency, respectively. Major applied success has been achieved by disturbing metamorphosis with juvenile hormone analogs (JHA). As early as the 1970's, methoprene ("Altosid" formulation), a potent JHA, was developed by Zoecon Corporation (now Sandoz Crop Protection) as a nonconventional insecticide, especially effective against mosquitoes and some other dipterans.

Administration of effective JHAs to penultimate or very early last instar hoppers of acridids results in a supernumerary ("extra") hopper instar and the creatures so produced are named "adultoids". These represent metathetely (= inhibition of adult morphogenesis) and are unable to reproduce. In all acridids investigated to date, such adultoids die in the course of an "extra" molt, being unable to shed the exuviae. If JHA treatment is less effective (mildly active analog, low doses, etc.), imperfect adults with shortened and crumpled wings are obtained. These are unable to fly or their flight performance is much reduced.

Methoprene and some other early JHAs affect some acridids, but effective doses are much too high for applied usage against acridid pests and some species, including the notorious desert locust *Schistocerca gregaria* (Forskål), are not at all or only mildly susceptible to methoprene. More recently, however, additional JHAs, such as fenoxycarb (Ro 13-5223, "Insegar" formulation) of Dr. R. Maag Ltd., Switzerland, or pyriproxyfen (S-3 1183, "Sumilarv" formulation) of Sumitomo, Japan, have become available. Screening these compounds we revealed that *Locusta migratoria* (L.) is highly susceptible to pyriproxyfen; 0.2µ g (= 0.8µg per g fresh weight) injected in olive oil to early penultimate hoppers is about the ED50 to induce adultoids, though effective doses much depend on the mode and timing of administration. Pyriproxyfen is the first JHA capable of inducing perfect supernumerary nymphs even in *S. gregaria*. Moreover, some new yet confidential JHAs, presently tested on *Locusta*, seem to be up to a few hundreds times more effective than pyriproxyfen.

Because of the narrow gate of physiological susceptibility to disturbances of metamorphosis by JHAs (late penultimate and/or very early last instar hoppers) and asynchronous development in field populations, stability of JHAs in the field and in the insect body are crucial factors. Slow release of JHAs often leads to much improved effects. Oral application of JHAs to acridids by bait technique may enhance the effect of topical application (spraying) and/or extend the period of effectiveness. In less successful instances, wing deformations in imperfect adults should affect migratory abilities. JHAs may also affect locust phases and perhaps the fecundity of adult females. All these subjects should be adequately explored for achieving control of acridid pests by JHAs.

17. EFFECT OF ANTENNECTOMY OF THE DEVELOPMENT AND SEXUAL MATURATION OF THE GREGARIOUS PHASE OF THE DESERT LOCUST

M. Harb (EGYPT)

18. WHAT GRASSHOPPERS EAT AND WHY [tentative title- ed.]

A. Joern (USA)

19. EFFECTS OF NEEM (*AZADIRACHTA INDICA* L.) PRODUCTS ON FEEDING, METAMORPHOSIS, MORTALITY, AND BEHAVIOR ON THE VARIEGATED GRASSHOPPER, *ZONOCERUS VARIEGATUS* (L.) (ORTHOPTERA: PYRGOMORPHIDAE)

M. Baumgart (GERMANY)

20. RECENT PROGRESS IN LOCUST PHEROMONE RESEARCH: FACTS AND FICTION

H. J. Ferenz (GERMANY)

21. INTEGRATED PEST MANAGEMENT: THE PREFERRED APPROACH FOR COOPERATIVE RANGELAND GRASSHOPPER PROGRAMS IN THE UNITED STATES

Gary L. Cunningham

Grasshopper Integrated Pest
Management Project
U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Boise, ID 83706 USA

The U.S. Department of Agriculture (USDA) organized the Grasshopper Integrated Pest Management (GHIPM) Project in 1987 to develop and integrate grasshopper control strategies into a total system for use by managers of public and private rangeland. Two areas in Idaho and North Dakota serve as integrated pest management (IPM) demonstration sites. Management studies on the sites include population dynamics, economics, environmental consequences, bait applications, and biological controls. The overall goal of the project during its final phase (1992-1994) is to transfer grasshopper management research into practical application. Tangible products already developed as a direct result of the project include: HOPPER, a decision-support software system; Pfadt's "Field Guide to Common Western Grasshoppers;" and a GHIPM User Handbook summarizing IPM practices and recommendations. The GHIPM Project is a cooperative effort managed by the USDA's Animal and Plant Health Inspection Service in association with other Federal agencies, state universi zone between the plateau and the steppe among foothills or in regions of great topographical diversity at altitudes from 150 to 1200 m, mean annual precipitation between 270 and 400 mm, the mean annual temperature for the month preceding hatching and the two months following which include the nymphal and the adult life appears to be approximately 20 . Distribution, climate, vegetation, the location and development of the last outbreak in five districts are investigated.

22. ECOLOGICALLY-SOUND METHODS OF LOCUST CONTROL IN THE SOUTHERN SAHARA

H. Wilps (GERMANY)

23. Panel Discussion

24. SURVIVAL STRATEGIES OF MOROCCAN LOCUST *DOCIOSTAURUS MAROCCANUS* (THUNBERG, 1815) IN DIFFERENT PARTS OF ITS RANGE: AN ECOTONAL ASPECT

A. V. Latchininsky

(Vizr. RUSSIA)

The distribution area of the Moroccan Locust which lies in the Mediterranean zone (*sensu lato* of term) is characteristically discontinuous, many local populations being clearly isolated. The ecological requirements of the species are very narrow, particularly for oviposition. Biotopes are restricted to the ecotonal zone of transition between foothills (up to 2000 m) and plains. Vegetation is represented by dry-steppe or semi-desert associations with spring ephemerals (*Poa bulbosa, Carex pachystylis, Medicago minima*, etc.) distributed in mosaic with patches of bare ground. This type of vegetation can be either natural or of secondary origin resulting from overgrazing. Cultivation makes the land unacceptable for oviposition so the main limiting factor of the distribution of the Moroccan Locust is the human activities. Thus, land usage can create favorable conditions for the locust as well as destroy its habitats. This duality leads sometimes to quite unforeseen consequences of land development either provoking the heavy outbreaks of *D. maroccanus* (Uzbekistan, Tadjikistan) or suppressing them (Southern France), or even totally eliminating the possibility of their occurrence (Central Europe, Crimea, Northern Caucasus). The survival strategies of the species under the effect of anthropogenic influence in different geographical zones of its range are discussed.

25. AN INVESTIGATION ON THE BIOLOGY AND ECONOMIC IMPORTANCE OF *DOCIOSTAURUS CRASSIUSCULUS KRAUSSI* (INGENT.) IN IRAN

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Dociostaurus crassiusculus kraussi (Ingent.) is distributed in many Parts of Iran, and is gaining economic importance under Khorasan and Behbahan ecological conditions. This insect is usually scattered in habitats with elevations of about 300-900 meters and annual precipitation of about 200-300 mm. These insects feed on grasses such as *Poa, Rubia, Stipa, Setaria* and *Festuca*, due to excessive grazing of natural pastures and certain ecological changes particular hot and dry weather conditions. This species is being replaced by *Dociostaurus maroccanus* (Thunb.) as an important cereal pest. Their third to fifth nymphal stages migrate in dry and irrigated cereal fields and cause serious damage.

D. crassiusculus is a univoltine species. Its biological cycle is characterized by a 10 months long diapause of embryo. Duration of active life of hoppers (5 instars) and adults is from 1 1/2 to 2 1/2 months, it varies according to biotopes and from one year to another depending on climatic conditions and the development of vegetation.

26. [Inofrmation not Available- ed.]

M. J. Samways

27. GRASSHOPPER PROBLEM IN YACUTIA (EASTERN SIBERIA, RUSSIA) GRASSLANDS

A.v. Latchininsky
(Vizr. Russia)

Natural Yacutia grasslands are situated between 60-65°N and 130-135°E. Climate is extremely continental: temperature varies from -60°C in winter to +35°C in summer. Grassland vegetation of the steppe type, unique for this boreal zone, occupies the glades in the coniferous forest (taiga). Glades varying in size from 2 to 3,000 ha are utilized as pastures for horses and cows. The number of grasshopper species inhabiting these glades is over 30 but only 2-3 of them (*Chorthippus albomarginatus* (De Geer, 1773), *Aeropus sibiricus* (Linnaeus, 1767), *Omocestus haemorrhoidalis* (Charpentier, 1825)) are of real economical importance. In draught years, hopper density rises to several hundred per m^2, and if dry seasons occur in close succession, an outbreak occurs resulting in serious damages or nearly total elimination of grassland vegetation. Annual chemical treatments are executed on 50,000 ha and more. Last outbreaks took place in 1986-87 and 1992. The consequences of insecticide pressure on fragile permafrost soil are disastrous. Possible methods of solving the grasshopper problem in Yacutia are proposed: including reasonable grassland management, search for alternative control agents, and effective utilization of appropriate chemical measures on limited areas based on phenology forecast.

28. THE IMPACT OF BIOTIC FACTORS ON *CHORTOICETES TERMINIFERA* (WALKER) IN INVASION AREAS OF SOUTHEASTERN AUSTRALIA

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The population dynamics of Australian plague locust, *Chortoicetes terminifera* (Walker), in the semi-arid interior source areas, is driven by abiotic factors, principally rainfall. However, with the possible exception of southern invasion areas which receive low summer rainfall, in southeastern arable invasion areas, biotic factors, especially tachinid, sarcophagid, nemestrinid and mermithid nematode parasitoids, become increasingly more important in reducing survival in successive generations whilst the abiotic factors assume an indirect role through their influence on the biotic factors.

The parasitoids have a relatively stable population of alternative acridid hosts, principally *Oedaleus australis* Saussure and *Austroicetes vulgaris* Sjöstedt on the western plain and 0. australis and *Phaulacridium vittatum* (Sjöstedt) on the western slopes and tablelands because of the high summer rainfall in these invasion areas. Each host-parasitoid relationship differs and the form of the relationship may also exhibit temporal variation. For example, the outbreak phase of *C. terminifera* is inversely density-dependent in both the pre-influx population of alternative hosts and the first generation of *C. terminifera* immigrants, and density dependent in the subsequent generations declining as a result of emigration and control. However, the reproductive capacity of the parasitoids is only fully realized in the post-influx stage due to the unlimited availability of hosts and the substantial increase in their absolute numbers.

In the future, parasitoid induced recessions may be initiated at an earlier stage in the outbreak cycle because of the increasingly more efficient control of *C. terminifera* in the semi-arid interior source areas and reduction in the density of populations invading the southeast. However, parasitoid accommodating control strategies, including the demarcation of districts in which, under specific seasonal conditions, a "do nothing" strategy would be appropriate, need to be adopted in order to maximize the supplementary control of *C. terminifera* afforded by parasitoids in invasion areas.

29. ADVANCES IN UTILIZATION OF MICROBIOLOGICAL AGENTS FOR GRASSHOPPER CONTROL IN RUSSIA

A. V. Latchininsky

(Vizr. RUSSIA)

ABSTRACTS

Possible utilization of natural microbiological enemies is regarded as a perspective alternative in grasshopper control in ex-USSR where surfaces treated annually against these pests exceeded 3 or 4 million ha in late 1980's - early 1990's. Screening has proved high pathogenic properties in about 10 species of fungi, 1 species of bacteria, 2 species of protozoans and 4 species of nematodes. Application of the spores of *Beauveria tenella* (Siem.) Delacr. on the surface of 0.5 ha has reduced the initial population of *Dociostaurus maroccanus* (Thunberg, 1815) up to 60%. Application of a formulation based on *Beauveria bassiana* (Bals.) Vuill. on the surface of 2 ha resulted in 47.2-84.8% mortality of the tested numbers of non-swarming grasshoppers in cages placed in the field conditions. Mortality of *Calliptamus italicus* (Linnaeus, 1758) hoppers at the level of 72.5% was observed in the trials with their contamination by *Metarhizium anisopliae* (Metsch.) Sorok. The microsporidian *Nosema maroccanus* Krylova and Nurzhanov was applied against *Calliptamus italicus* (Linnaeus, 1758) bringing about the death of 100% of the insects tested. The nematodes *Steinernema* spp. killed up to 90% of hoppers of *Chorthippus albomarginatus* (De Geer, 1773) on the third day after application. The majority of these promising results were obtained in laboratory trials or in field experiments in limited areas. Present state-of-the-art and possible future directions of research are described.

30. THE PRESENT STATE OF THE LOCUST AND GRASSHOPPER PROBLEM IN BRAZIL

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For the past ten-fifteen years Brazil has undergone wide-ranging outbreaks of locusts and grasshoppers. *Rhammatocerus schistocercoides* in the State of Mato Grosso/Centre West region (1984-88/1991-92); *Schistocerca pallens* and *Stiphra robusta* in Pernambuco, Paraiba, Piaui, and Rio Grande do Norte/Northeastern region (1984-86/1991-92); *Rhammatocerus conspersus*, *R. pictus*, and *Staurorhectus longicornis* in Rio Grande do Sul/Southern region (1989-1992). This is just to mention some of the species that have become major pests.

At present there are locust/grasshopper outbreaks in at least five States of the country; amongst others Mato Grosso, Paraiba, Rio Grande do Norte and Pernambuco.

Although climatic conditions play an important role in locust outbreaks the main factors that have led to this problem in Brazil are related to changes in land man-agement, deforestation, introduction of new crops and to some extent the lack of monitoring and vigilance once the outbreaks are suppressed.

As a result of the implementation of the locust/grasshopper control campaigns in Mato Grosso (1984-1988) and Rio Grande do Sul (1991-1992) it became evident that the locust/grasshopper problem in Brazil needs a different approach.

To deal properly with the situation the Government needs to establish an integrated locust/grasshopper control programme. But little is known on alternative control methods and in some cases on the bioecology of the species concerned. Preliminary studies on biological control and bioecology of several species involved are being carried out at present in Brazil. The aim is to undertake a long term project to establish an integrated locust/grasshopper control programme.

This paper outlines the present situation of the locust and grasshopper problem in Brazil. Providing up to date information on the most recent outbreaks and analyzing those factors that may have caused an increase in locust/grasshopper populations in several States.

The limitations and implications of undertaking control campaigns are discussed and the need to establish an integrated control programme is stressed.

31. SITUATION OF THE MOROCCAN LOCUST IN IRAN

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There are ten regions in Iran under severe outbreak of *Dociostaurus maroccanus* Thunb. In each region there may be more than one outbreak area and these may vary in size and economic importance. At least 100,000 ha of cereal crops and pastures are treated with pesticides against this serious pest. Outbreak areas in the west of Iran are in a belt running up the outer edge of the Zagros mountains and extending into northern Iraq, and outbreak centers of Northern Iran which lie for the most part in the U.S.S.R.

We remarked that the outbreak areas are in the border zone between the plateau and the steppe among foothills or in regions of great topographical diversity at altitudes from 150 to 1200 m, mean annual precipitation between 270 and 400 mm. The mean annual temperature for the month preceding hatching and the two months following, which include the nymphal and the adult life, appears to be approximately 20°C. Distribution, climate, vegetation, and the location, and development of the last outbreak in five districts are investigated.

Wednesday, August 4

32. MEASURING THE COSTS OF CALLING AND MATING IN TETTIGONIIDS

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Where acoustical signals are used in mate attraction, they may be expected to be under strong evolutionary selection. Although sexual selection must play a significant role in shaping the signal, either through female choice or in the use of the signal in intrasexual competition, significant pressures will also come from natural selection: the insect must survive to reproduce. Selection for survival will come from at least two sources: obtaining sufficient nutrients, either as a larva or adult to achieve mating, and an exposure to natural enemies. Where food is limited, or where nutrients have to be partitioned as paternal investment, the ability to signal can be seen as a cost. A second cost will come from an exposure to predation, for the production of the signal not only attracts mates but also natural enemies. There is a third cost in producing a signal, that of the development of structures for both signal production and its reception.

Sound production in insects has the reputation of being extremely inefficient; there is a poor conversion of muscle to acoustic power. I enumerate costs of sound production and mate location in some species of the Tettigoniidae. I speculate on processes of selection on sound receiving systems, where there is a conflict between the recognition and detection of the conspecific's call, and the detection of predators. The metabolic costs of sound production may be such as to divert energy from one mating function to another. For example, male tettigoniids not only are the predominant acoustical sex, but they also contribute a significant protein gift to the mated female, the spermatophylax. The production of such a spermatophore constitutes, in part, mating effort and in part parental investment. Evolutionary theory would predict a tradeoff between mating effort and parental investment. A component of mating effort is the metabolic costs of sound production, and where the spermatophylax is replaced by the male following copulation, there will be an inevitable conflict between diverting nutrients to calling or to the production of a new spermatophylax. I discuss experiments where these costs have been measured and manipulated. Predictably males reared on low-nutrient diets will delay calling until the spermatophylax is of sufficient size to protect the ejaculate.

If channeling metabolic products to sound production is one cost to the male a second is predation. There is sufficient evidence from both frogs and crickets, to suggest that producing an acoustic signal incurs risks of predation. Predation of tettigoniids is from at least two sources, tachinid flies and bats. I describe current work by colleagues on predation by a tachinid *Homotrixa* of an endemic sagine in Western Australia, and I speculate on ways by which males can avoid such exposure. I also discuss experiments conducted in Perth where we examine the relationship between calling and bat predation, where not only are likely predators identified but experiments are conducted to test R.D. Alexander's predictions that calling in aggregations, either as part of a chorus or in alternation with neighboring males can afford a degree of protection to the caller.

33. SPERMATOPHORE MEALS AND MATING IN CRICKETS, KATYDIDS, AND THEIR KIN (ORTHOPTERA: ENSIFERA)

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Males of a number of different arthropods invest by feeding their mates. I will discuss the evolution of mate feeding in ensiferan orthopterans and focus on spermatophore eating. To examine the diversity of mate feeding I produced a phylogeny (cladogram) of the 9 extant families (katydids, wetas, and the humped-backed, wood, Jerusalem, mole, cave, camel, as well as tree and other true crickets). The cladogram, based on morphological and anatomical characters, divides Ensifera into two monophyletic groups. The complex spermatophore of tettigoniids and related families has evolved from a simple sperm container in the ancestral Ensiferan. Spermatophore complexity is seen in the evolution of two sperm pouches and the addition of a spermatophylax, a sperm-free mass forming the courtship meal. The spermatophylax is present in six families and has evolved at least twice. The distribution of both spermatophore characters across taxa is congruent with the phylogenetic division within the Ensifera.

Experimental evidence indicates that the original function of the spermatophylax food gift was to obtain fertilizations. As in other "courtship-feeding" insects, males in two tettigoniids and one gryllid that provide smaller-than-average meals transfer fewer sperm because insemination is terminated early by the females receiving the undersized meals. In another tettigoniid, however, the "selective maintenance" of the spermatophylax appears to be more complex. Studies of sperm transfer and paternity ('sperm competition') in *Requena verticalis* suggest that the spermatophore meal functions to enhance offspring quality in matings with virgin females but serves also to maximize fertilizations in copulations with non-virgins, a case in which the average expected paternity is low.

Finally, a consequence of the large male investment in several tettigoniid species is a reversal in the typical "courtship roles." When populations are food-stressed, the high cost of male copulation limits the numbers of males available for mating and causes females to compete aggressively for access to males.

34. [Information not Available- ed.]
T. Zera

35. EXTERNAL MORPHOLOGY AND ABUNDANCE OF ANTENNAL SENSILLA IN AUSTRALIAN GRYLLACRIDIDAE

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The external morphology of sense organs (sensilla) on the antennae of Australian Gryllacrididae is described for the first time. The species studied were *Ametris tibialis* and *Bothriogryllacris pinguipes*. Antennae were placed in a solution of pancreatic protease, followed by fixation in 2% glutaraldehyde, and then observed with a scanning electron microscope.

Ametris tibialis males had approximately 26,000 sensilla on a 65 mm-long antenna that consisted of 171 segments (154 sensilla per segment). Females had 22,300 sensilla on a 49 mm-long antenna formed from 111 segments (200 sensilla per segment). Long trichoid sensilla comprised 96 to 99% of the receptors. Males had about 700 and females 76 short trichoid sensilla, each with a flat, longitudinal ridge bordered by a deep groove on each side. Both sexes had short, multiporous basiconic sensilla (males 90, females 22). Males had 100 coeloconic sensilla scattered among most segments; females had only 16 and they were distributed in the distal 12% of the antenna. Three antennal organs, which were clusters of cuticular plates in an irregular concentric arrangement, occurred in the proximal half of the male's antenna.

Bothriogryllacris pinguipes males had approximately 25,300 sensilla on a 60 mm-long antenna that consisted of 207 segments (129 sensilla per segment). Females had 30,400 sensilla on a 93 mm-long antenna formed from 402 segments (79 sensilla per segment). Long trichoid sensilla formed 94 to 95 % of the receptors in both sexes. Males had more short trichoid sensilla (902) than females (850), but females had more multiporous basiconic sensilla (438 vs. 378 for males) and coeloconic sensilla (234 vs. 184 for males). Five antennal organs occurred on males and two on females.

Both species had an extremely large total number of sensilla. *Bothriogryllacris pinguipes* antennae contained more short trichoid, basiconic and coeloconic sensilla and more antennal organs than those of *A. tibialis*. The preponderance of long trichoid sensilla and the low diversity and number of remaining sensilla indicate that the antenna's primary role is as a mechanoreceptor. The low diversity of sensilla contrasts especially with the large diversity of sensilla on the mouthpart palpi of both species.

THURSDAY, AUGUST 5

36. PHASE-DEPENDENT DIFFERENCES IN FLIGHT FUEL MOBILIZATION IN *LOCUSTA MIGRATORIA*

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Locusts exhibit density-dependent phase polymorphism. Under crowding or under isolation they respectively develop "gregarious" or "solitary" phase characteristics. Locust phase polymorphism is continuous and intermediates exist between the extreme gregarious and extreme solitary phases. Extensive studies, carried out for over two decades in many laboratories, demonstrated that during the first 10-15 min of flight locusts utilize carbohydrates as flight fuel, but this initial flight induces release of adipokinetic hor-

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mones (AKHs) from the corpora cardiaca (CC). The AKHs then induce mobilization and release of lipids, mostly diacylglycerols, from the fat body and these serve as the major fuel for sustained migratory flight. AKHs are also responsible for rearrangement of carrier lipoproteins (lipophorins) in the hemolymph, resulting in an improved lipid transport (from the fat body to the flight muscles through the hemolymph). However, all the relevant research was carried out exclusively on crowded (gregarious) locusts. In the last three years we made an effort to reveal AKH-related phase-dependent differences in locusts.

Graded doses of CC extracts, or of synthetic AKH-I or of synthetic AKH-II of *Locusta* (Lom-AKH-II) were injected into younger (10-19 days after fledging) or older (20-30 days after fledging) isolated (solitary) or crowded (gregarious) adult males of *Locusta migratoria migratorioides* (R. & F.). Lipid levels in the hemolymph were measured just before and 90-100 min after injection. The resting lipid levels (before injection) were markedly lower in isolated than in crowded locusts. The increase of hemolymph lipids, after injection of CC extracts, or of AKH-I, or of Lom-AKH-II, was again markedly lower in isolated locusts. Both of these trends were already clearly observed in the first generation of isolated locusts and even when crowded hoppers were isolated within 24 h after fledging. No marked differences were found in hemolymph carbohydrate levels between isolated and crowded locusts and during the first 30 min of (tethered) flight the decrease of hemolymph carbohydrates was about 50% in both. Our findings indicate that long-range flight ability of solitary locusts may be inferior to that of gregarious ones.

37. CYTOTAXONOMIC STUDY OF *OXYA* IN CHINA (ORTHOPTERA:ACRIDIDAE)

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The chromosomal conventional karyotype and C-banding karyotype of eight species of the genus *Oxya* (Catantopidea) have been analyzed in the present paper. It shows that *O. chinensis*, *O. shanghaiensis*, and *O. adentata* all have similar C-banding distribution, but the model of the chromosomal group, data on chiasma localization, and the THC value are different. *Oxya agavisa* has its own C-banding feature and is distinguished from other species in this genus. *Oxya bicingula* sp.n. is similar to both *O. chinensis* group and *O. agavisa* in chromosomal marks and morphological characters. This shows that these species had some relationship during the evolutionary process. *Hyla intricata* is a "sibling species group", regarding variation of morphological features and diversity in cytotaxonomic marks. It seems that this group has higher differentational speed and more active speciational evolution in recent times. In this group, *O. apicocingula* n. sp. and *O. flavefemura* n. sp. are more specialized than the other populations which have little terminal C-banding in the genome.

In conclusion, we consider that the evolutionary rate of the species in the genus *Oxya* is unbalanced, with regard to both hereditary factors and environmental conditions between the different species.

38. RESPONSE TO DIAPAUSE SELECTION IN THE SUBTROPICAL GROUND CRICKET *DIANEMOBIUS FASCIPES* (ORTHOPTERA: GRYLLIDAE: NEMOBIINAE)

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In crickets, three different patterns of egg development can be recognized, corresponding to different climatic conditions of their habitats: stable diapause in the temperate region, opportunistic diapause in the subtropics and virtual absence of diapause in the tropics. In some univoltine temperate species, there is a clinal variation in the intensity of egg diapause in parallel with the latitudinal temperature gradient. To test the possibility that such variation in diapause can be established by selection during the expansion of species ranges over various climatic areas, selection of strains with different incidences and intensities of diapause was attempted in a subtropical population of *Dianemobius fascipes* originating from Ishigaki Island (about 24°N) near the southern end of the Ryukyu Arc.

In the founder stock at a 12-hr photoperiod and 25°C, only about 10% of the eggs usually enter diapause because of the opportunistic character of diapause. Under the same photothermal conditions, I selected four different lengths of the egg stage, <20, 51-60, 100-110, and >150 days. In the nondiapause selection (<20 days), the incidence of diapause decreased to an almost negligible level but did not completely disappear even after 30 generations of selection. In the three selection lines for diapause, the percentage diapause increased gradually, and the mean durations of diapause eggs approached the selection goals after several generations of selection, although the variances were large in all the diapause-selected lines. The maximum length of diapause at 25°C before selection was less than 100 days but exceeded this limit in the 100- and 150-day selection lines and increased to more than 200 days in the 150-day line. Thus, the diapause character has been changed from the subtropical opportunistic type into a more stable temperate type that is usually expressed at 25°C as in the closely related northern species *D. nigrofasciatus*. However, the percentage of diapause did not reach 100% even after 10-20 generations of selection in any diapause-selected line, so that the involvement of a polygenic system is inferred. This inference is supported by the results of crossing experiments between the different selection lines. These findings suggest that diapause is a physiological trait of high evolutionary potential and can be easily modified through climatic selection.

39. DIFFERENCES IN AGE DYNAMICS AMONGST POPULATIONS OF FIELD CRICKETS (ORTHOPTERA:GRYLLIDAE)

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A knowledge of the age structure of populations is important in understanding the evolution of life-history tactics. Three different species of *Gryllus*, from different habitats, were examined to explore inter-specific and inter-sexual differences in age dynamics. Field captured crickets were aged by counting daily increments of chitin in cross-sections of tibiae. Laboratory-controlled aging experiments showed a high correlation between number of chitin rings and actual age in days for all three species studied, validating the methodology.

Both field crickets from southern Ontario, *G. veletis* and *G. pennsylvanicus*, showed similar seasonal and sexual trends in age structure. In contrast, the Texas field cricket, *G. integer*, exhibited a very different pattern. These variations are discussed with respect to the selective force exerted on *G. integer* by the sex-biased predation of an acousticallyorientating parasitoid, *Ormia ochracea* (Diptera: Tachinidae).

40. GRASSHOPPER CUTICLE: BIOCHEMICAL ASPECTS OF SCLEROTIZATION AND PIGMENTATION

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Grasshopper cuticle of *Melanoplus sanguinipes* undergoes stiffening and pigmentation after ecdysis, a process that utilizes catecholamines as precursors for stabilization and polymerization reactions. The mechanism of these processes will be discussed, as well as the origins of wing pigments in the Cedopodinae.

41. STRATEGIES UTILIZED BY KATYDIDS (ORTHOPTERA: TETTIGONIIDAE) AGAINST DIURNAL PREDATORS IN RAINFORESTS OF NORTHEASTERN PERU

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More than 370 species of katydids have been identified and many of them observed over extended periods of time at three collecting sites in Loreto Province, Peru (40-160 km NW Iquitos). Defensive adaptations against diurnally active predators are reported in detail in this paper. Strategies include (1) primary defenses or adaptations to avoid contact with predators, including camouflage (*e.g.*, green and brown color generalist, and bark-, twig-, lichen-, and leaf mimicry), concealment within leaf parts or forest debris, and territoriality in the form of defending roosting sites against other competing katydids, and (2) secondary defenses or adaptations used when contact is made with predators, including colorful displays by distasteful species, various forms of aggressive counterattacks, aposematic wasp mimicry, and visual and/or acoustical alarm displays by otherwise cryptic species. These strategies are quantified for the first time for the entire tettigoniid fauna in a neotropical rainforest habitat.

Of the 378 species, 72.2% exhibited color generalism (208 green, 46 brown, and 19 with both green and brown morphs), 15.7% showed a more refined level of camouflage (2 wasp mimics, 5 bark mimics, 13 twig mimics, 29 leaf mimics, 4 lichen mimics). 4.8% were hidden from view during the day by concealing themselves within vegetation, debris, etc., and 7.3% could not be categorized because of lack of sufficient data based either on observations or relationships with similar species that had been observed. Most species with generalized color patterns were phaneropterines; most species with more specialized primary defenses of mimicry and concealment were either phaneropterines or pseudophyllines; while those with specialized secondary defenses were listroscelidines, agraeciines, and copiphorines.

All species that conceal themselves in debris, vegetation, etc. were observed returning just prior to dawn to the same site for up to twenty-two consecutive days; some of them were observed to successfully defend their roosting sites against other katydids. Twig mimics alter their substrate—a twig—by chewing a notch on the underside of the twig and nestling their body into the depression. Though exposed to view these species are well concealed. They too return daily to the same site over a period of several consecutive days.

42. COURTSHIP ROLE REVERSAL IN TETTIGONIIDS: ANOTHER ROLE FOR PARASITES?

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Members of certain tettigoniids exhibit behavioral plasticity in their courtship behaviour. When nutrient availability is high, males compete for mating opportunities while females show the typical coy and discriminative behavioral pattern. However, under conditions of nutrient limitation role reversal can occur; females compete for males and the nutrients they provide at mating, while males become the choosing sex. These patterns of behaviour are consistent with the interpretation that male nutrient investment at mating can function in the context of parental investment. Here I show how infection with a protozoan gut parasite can reduce the nutritional status and reproductive fitness of adult *Requena verticalis* and thereby be a causal agent in the reversal of courtship roles in this species.

43. A NEW PAIR-FORMING STRATEGY OF PHANEROPTERINE KATYDIDS (TETTIGONIIDAE, PHANEROPTERINAE)

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Species of Phaneropterinae form pairs as a result of males and/or females moving toward sounds produced by the opposite sex. Previous reports describe three different strategies in which only males or females move at any given time and in which differences in sound intensity elicit different responses. The present study reveals a fourth strategy in which males and females simultaneously move toward constant intensity sounds made by conspecific individuals. The four strategies are reviewed.

44. DO THE SPINES ON THE LEGS OF KATYDIDS HAVE A ROLE IN PREDATION?

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The long spines on the fore- and midlegs of katydids are usually believed to assist in catching and holding prey. Recent observations indicate that this is not the case. The meso- and metasternal processes, however, seem to be used to stabilize larger prey during feeding.

45. MATING BEHAVIOR OF THE HAWAIIAN CRICKET, *LAUPALA PACIFICA*

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In a natural population on Oahu, Hawaii, calling males of the cricket *L. pacifica* occurred at an average density of 13/m^2 and exhibited even spacing. Laboratory observations revealed that mating involves a series of 1-11 copulations over a period of 7-10 h. Dur-

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ing the final mating, the male transfers a "macrospermatophore", which is approximately 3 times larger in volume than the "microspermatophores" passed singly during each of the preceding copulations. Dissections of females indicate that sperm are transferred during every mating in the sequence. Male size (wet weight) was not correlated to the size of either the microspermatophores or the macrospermatophores produced. Based on indirect estimates, the spermatophores collectively represent only a small proportion of the male's body weight.

46. THE RELATIVE ROLES OF MALE AND FEMALE BEHAVIOR IN PAIR FORMATION IN A GRASSHOPPER. *CHORTOPHAGA VIRIDIFASCIATA* (ACRIDIDAE, OEDIPODINAE)

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Male-female interactions were observed under field and laboratory conditions. Both males and female take an active role in pair formation and maintenance. Males engage in a variety of acoustical behaviors that probably increase their conspicuousness and so their chances of contacting females. Females however appear to be choosing males primarily on the basis of relative size.

47. [Information not Available- ed.]
L. H. Field

48. HAWAIIAN CRICKETS

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The ancient Hawaiians knew about crickets but believed that the sounds emanating from forests came from land snails. The largest lu'au ever recorded in Hawaii was held at Kaniakapupu [meaning: sound of the land snails]. I collected song data and specimens in all islands from approximately 450 localities. The number of native Hawaiian species now stands at 241; many more remain to be discovered. Local Hawaiian communities are not rich in species--but they are exceptionally rich in number of closely related species. Species turnover rates are also exceptionally high. The Hawaiian cricket fauna appears to be derived from 5 original colonizing species: one oecanthine, two nemobiines, and two trigonidiines. Species of Mogoplistinae may also have colonized the islands on their own. Patterns of diversification along the archipelago vary from genus to genus; in most instances older islands are richer in species. Speciation has occurred mainly within islands. In acoustic species most song divergence is probably the result of coevolution.

49. [Information not Available- ed.]
L. L. Lowe

50. THE AGRAECINI, HIDDEN BEAUTIES OF THE TROPICAL FOREST TETTIGONIIDAE, CONOCEPHALINAE) (A PRELIMINARY ACCOUNT ON THE SYSTEMATICS AND BIOLOGY OF THE AGRAECINI OF THAILAND)

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The Agraecini are strictly nocturnal insects. During daytime they are either hiding in hollow trunks of plants or in soil crevices or are well camouflaged in patches of dense vegetation. Their general color is yellowish or brown, but the frons can have red, green, blue and/or black ornaments. 9 genera with 21 species (some polymorphic) have so far been found in Thailand, mostly during sporadic excursions between 1985 and 1993. Generic and specific revisions are proposed to arrange the taxa. 5 species in 5 genera are full-winged, 16 species in 3 genera short-winged. The latter have rather limited ranges, replacing each other in different areas. Up to 4 species have been found in the same habitat.

Agraecini are mixed feeders, consuming both plant and animal tissues. Several species show a preference for grass seeds, others are mainly predaceous. There is only one generation per year, with an adult peak either at the beginning or at the end of the rainy season. The eggs are of typical conocephaline shape, *i.e.*, thin and often pointed at one end. In the field they are possibly stuck in plant stems, leaf sheaths, or fissures; in the laboratory, females of many species accept pieces of polystyrene for oviposition. A *cf. Subria* species secretes a soft envelope around the egg, which is unique in tettigoniids. In the laboratory, egg development at 25°C often takes about 2 months, but varies with conditions. Facultative parthenogenesis occurred in a cf. *Anelytra* species. Postembryonic development, often with 7 larval instars, requires 3-7 months. The capability of regeneration of damaged legs is very high during postembryonic development; some species can even regenerate lost jumping legs.

Stridulation shows either a characteristic time pattern or is a continuous syllable train. The carrier frequency can be in the audible range, but is often close to or in the ultrasonic range. Stridulation of a species of an undescribed genus varies with the hour of the night. Another form of sound production is drumming with the hindlegs, produced as a sign of rivalry and disturbance, *e.g.*, when two individuals try to enter the same shelter in the dawn.

51. WING BASE CHARACTERS AND THE HIGHER CLASSIFICATION OF THE "ORTHOPTERA" (A PROGRESS REPORT)

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Pterygote insects originated with the development of protowings. With the advent of flapping flight insects acquired their early, major adaptations and radiated into the basic superorder lineages. There is a wealth of strong, high-level characters in wings that show the relationships of higher taxa (superorders, orders, suborders and some superfamilies).

The wing structure of Orthoneoptera (=orthopteroid lineage) can be defined by a combination of derived characters: vein sectors MA and MP fused into the stem of M, at least a part of CuA fused with MP, an enlarged anal lobe of the hindwing extending to the claval flexion line, anal fan composed of both anal sectors (AA and AP), and anal fan manipulated postero-basally by a special jugal arm composed of 3 sclerites. Two distinctive sistergroup-lines are recognized: (Grylloptera + (Phasmatodea + Embioptera)), and (Orthoptera *s.str.* + extinct Titanoptera).

In contrast to this the Blattoneoptera (Grylloblattodea + (Zoraptera + (primitive cockroach-like ancestors + (Protelytroptera + Dermaptera + (derived cockroach-like ancestors + (Isoptera + (Blattodea + Mantodea))))))) and (Hemineoptera + Endoneoptera) can be defined by sharing: MA captured basally by RP or R, hindwing with an anal lobe delimited by the anal flexion line, anal lobe supported only by one, posterior anal sector (AP), and the "jugal arm" does not exist.

The female genitalia of Orthoptera and Blattodea have non-homologous third valvulae (derived from the gonostyli, or from the gonocoxites, respectively), but the male reproductive tract has a similar cluster of accessory glands. The latter similarity is the only possible "synapomorphy" found by Hennig 1981. We maintain that the accessory glands very probably are not synapomorphic. The wing structure indicates a very early and very different mode of adaptation to flapping flight in the orthopteroids and in the (blattoids+hemipteroids+endopterygotes). Orthoneoptera and Pleconeoptera share the following wing characters: 1. In the fore- and hindwing, the presence of a medial stem (=medial sectors MA+ and MP- irreversibly fused); 2. In the hind wing, a greatly enlarged anal lobe is supported by both anal sectors (M and AP) and ends at the claval flexion line; 3. In the hind wing, a detached jugal row of sclerites serves as jugal arm (3 sclerites: jugal proxalare, axalare and fulcalare) manipulating the postero-basal end of the anal fan. These three high-level, early synapomorphies in wing structure show clearly that Orthoneoptera and Pleconeoptera are sistergroups. Blattoneoptera are very probably the sistergroup of Hemineoptera + Endoneoptera.

52. [Information not Available- ed.]
G. Cassis

Friday, August 6

53. CHROMOSOMAL CHARACTERISTICS OF *ELLIPES MINUTUS* (SCUDDER), (TRIDACTYLIDAE, TRIDACTYLINAE)

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There are very few studies on chromosomes of Tridactylinae. The species that have been studied share certain characteristics: (a) low chromosome numbers (13, 16), (b) biarmed chromosomes and (c) X/0 sex chromosomes in the male.

We have found 13 metacentric mitotic chromosomes in *Ellipes minutus*. Three large, one medium sized and two small pairs of autosomes, plus a large metacentric X chromosome were recorded at mitotic metaphase.

We have also studied the meiotic system in this species. During early meiotic prophase the large X chromosome was highly condensed and positively heteropycnotic. A slight decondensation of this sex chromosome occurring during the pachytene stage allowed us to infer that both arms of this metacentric are attached at their telomeres. This situation is maintained through all meiosis I.

At late pachytene autosomal bivalents were easily counted. It was possible to identify a centromeric region in each bivalent at this stage. At first metaphase six autosomic bivalents were observed and the large X chromosome was seen segregating to one pole.

Homologous chromosomes were seen segregating at anaphase I and the X chromosome with its attached telomeres had moved to one pole.

It would be very interesting to study many species of this group, which is considered to be primitive among the Orthoptera.

54. DISTRIBUTION PATTERNS OF ORTHOPTERAN POPULATIONS AND SOME PROBLEMS OF MODERN BIOGEOGRAPHY AND ECOLOGY

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Orthopteran populations have been analyzed in some classic papers. Such papers were usually concerned with the internal structures of some local populations, their dynamics and organization. But many problems of modern biogeography and ecology are connected with the investigations of population distributions over species ranges. This distribution is described herein as spatial organization of a metapopulation.

The analysis of species population distribution over regions and geographical landscapes allows us to distinguish their groups with similar relations to ecogeographical characters, including environmental heterogeneity.

At least four spatial portions of the ranges of widespread species may be described for plains. In mountains some specific portions should be added. But endemic and subendemic species may often be characterized by 1-3 portions of ranges only.

In the Palaearctic Region the interface of the steppe and semi-desert zones is the most important for demarcating metapopulation (range) parts. The boundaries between the semi-deserts and northern deserts and those between the latter and southern deserts are also very important. The steppe zone is optimal for Eurasian Orthoptera as a whole. Distribution patterns of species metapopulations allows us to estimate the general situation at every life-zone and large region.

The direct relationship between the different parts of species metapopulation may be observed on a regional level. It is possible to show a path of dispersion and potential contacts between parts of spatial population structures.

55. STUDIES ON THE EVOLUTIONARY BIOLOGY OF PHALANGOPSID CRICKETS (ORTHOPTERA, GRYLLOIDEA, PHALANGOPSIDAE)

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The Phalangopsidae are one of the most important cricket families in the world, both in terms of taxa number, and in terms of ecological diversity. Although they can be directly observed in the field and easily raised in laboratories, few data are yet available on their biology.

For the past several years the systematics and phylogeny of neotropical Phalangopsidae have been studied, and direct observations have been made in the field, especially on their habitats and acoustic behavior. The methodological framework recently developed in Comparative Biology has been used to analyze the evolution of phalangopsid biological attributes in reference to phylogeny.

In this paper, the present state of the systematics of Phalangopsidae is briefly reviewed. Available data on their habitats and acoustic behaviors (mainly on the basis of my own observations in the field) are presented, and several evolutionary scenarios based on my own concept of phylogenies are considered. In particular, the Amphiacustae on one hand, and the Lernecae and Strinatiae, on the other, are compared regarding the evolution of certain biological features.

56. [Information not Available- ed.]
X.-B. Jin

ABSTRACTS

57. CLADISTIC AND BIOGEOGRAPHIC ANALYSES OF THE GRASSHOPPER GENERA *LEIOTETTIX* BRUNER AND *SCOTUSSA* GIGLIO-TOS (ORTHOPTERA:ACRIDIDAE)

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The South American Melanoplinae *Scotussa* and *Leiotettix* are sister genera distributed in Paraguay, southern Brazil, Bolivia, Uruguay, northeast and central Argentina. Together with *Atrachelacris* Giglio-Tos, *Eurotettix* Bruner, *Chlorus* Giglio-Tos, and the *Dichroplus bergi* species group, they appear to constitute a natural group within the neotropical Dichroplini. *Scotussa* comprises seven species, and it is defined by the straight and slender ovipositor valves. *Leiotettix* is a natural group of seven species defined by characteristics of the male phallic complex. Cladistic analyses were performed for both genera, using the outgroup comparison method to polarize the characters. Twenty one morphological characters from the external morphology, male phallic complex and female ovipositor valves were assessed in the analysis of *Scotussa*. Using *Leiotettix* as the sister group it was possible to polarize 18 out of the 21 selected characters. The remaining characters were polarized using the group constituted by *Atrachelacris*, *Eurotettix*, *Chlorus*, and the *Dichroplus bergi* species group, as a second outgroup. The analysis yielded two equally parsimonious cladograms, each with 11 steps and a consistency index of 0.88. In the cladograms *S. liebermanni*-*S. impudica*, *S. cliens*-*S. daguerrei*, and *S. lemniscata*-*S. delicatula* are sister species, with the pair *S. liebermanni*-*S. impudica* being the sister group of the remaining species. The variation in the topology of the two minimal length trees involved the placement of *Scotussa* new species as a trichotomy or as a sister to the group constituted by *S. lemniscata*-*S. delicatula* and *S. cliens*-*S. daguerrei* species pairs. Sixteen morphological characters from the external morphology and the male phallic complex were used in the phylogenetic analysis of *Leiotettix*. Fourteen out of the sixteen selected characters were polarized using *Scotussa* as the sister group; the group constituted by *Atrachelacris*, *Eurotettix*, *Chlorus*, and the *Dichroplus bergi* species group was used as a second outgroup. One most parsimonious cladogram of 15 steps and a consistency index of 0.86 was obtained. In the cladogram the sister species *L. flavipes*-*L. hastatus* constitute a clade with *L. pulcher* to which the sister species *L. punctipes*-*L. viridis* are related. To this main clade *L. pulcher* and *L. politus* are related in a phylogenetic sequence. A biogeographic analysis of the species of *Leiotettix*, *Scotussa*, *Eurotettix*, *Chlorus*, *Atrachelacris*, and the *Dichroplus bergi* species group led to the identification of three areas of endemism, namely Pampas, Chaco and Paranense. A vicariance biogeographic analysis of these areas, based on the cladograms of *Scotussa* and *Leiotettix*, was performed. Assumption O was applied to convert the taxon cladograms to area cladograms. According to the general area cladogram the sequence of area fragmentation is (Chaco (Pampas-Paranense)).

58. THE APPEARANCE OF XYLOPHAGY IN COCKROACHES: TWO CASE STUDIES WITH REFERENCE TO PHYLOGENY

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Xylophagy in cockroaches was often considered as a rare attribute, inherited from a common ancestor with termites. This point of view is discussed in a phylogenetic perspective about two independent cockroach tropical lineages: the subfamily Polyphaginae and the group (Zetoborinae + Blaberinae + Gyninae + Diplopterinae). A phylogeny was formerly proposed for each of these two lineages. Xylophagy was respectively known from *Cryptocercus* in subfamily Polyphaginae and was recently discovered in *Parasphaeria* (subfamily Zetoborinae). This permits an investigator to test the following questions in reference to phylogenies: whether xylophagy is ancestral or derived, whether particular life histories and social behaviors are correlates or prerequisites for the appearance of xylophagy, and whether xylophagy has followed or preceded the conquest of temperate areas.

59. ORTHOPTERA OF CENTRAL ASIA: REGIONAL, ECOLOGICAL AND HISTORIC BIOGEOGRAPHY

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The orthopteran insects of Central Asia have been described by many scientists. Now we can characterize this part of Eurasia as a complex area of the Saharan-Gobian (biogeographical) Subregion. There are at least two main parts: plains and mountains. Each of them includes some well defined provinces, subprovinces, districts, and rajons (small biogeographical region). The borders between plains and montane provinces are usually well observed and correspond with the interface of mountain slopes and pediments. The grasshoppers of the subendemic taxa (Gomphomastacinae, Conophymatini) settle mainly the mountain part of Central Asia. Other groups (Diexini, Dericorythini *et al.*) are limited mostly to the desert plains. There are many endemic genera and species as well. The prevalence of terricoles is observed in the plain and low-mountain parts of this area.

The populations of local species are greatly divided. As a result, their abundance is low. Many grasshoppers, katydids, and crickets are associated with river valleys. Some species usually described as desert species really prefer the upper and middle terraces.

The Orthoptera communities of Central Asia are varied. The watershed and slope landscapes are characterized by the prevalence of endemic and subendemic Orthoptera. The importance of forms with small ranges and isolated populations increases from the north to the south.

60. THE PRESENT SYSTEMATIC STATUS OF THE GENUS *MEGACRANIA* KAUP 1871 (CHELEUTOPTERA: PHASMATIDAE)

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The genus *Megacrania* Kaup, 1871, type species *M. phelaus* (Westwood, 1859), includes six known species and two possible new species (needing further study) which are mostly distributed along the Western Pacific Ocean from the north-east of Australia to New Guinea, the Solomon Islands, Indonesia and the Philippines, extending to Micronesia and the southern coast of Taiwan.

A key to the known species of *Megacrania* is presented. Morphological studies and geographical distribution are discussed.

61. DIVERSITY AND EVOLUTION OF THE ORTHOPTERA OF THE GALAPAGOS ISLANDS, ECUADOR

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The Galapagos Islands are an equatorial, volcanic, oceanic archipelago, about 4 million years old at most, and lying in the Pacific Ocean about 1000 km west of the coast of Ecuador. They are famous as a living laboratory of evolution. The low islands are semi-arid. The high islands have the following life zones: littoral, arid, transition forest, humid forest, and sedge-fern "pampa". The last overview of Galapagos Orthoptera was by Morgan Hebard in 1920 (*Proc. Cal. Acad. Sci.* 4th ser. 2(2): 311-346) based on collections made in 1905-1906. At that time 16 species in 12 genera and 3 "families" were known. Continued field work and taxonomic change has brought the faunal total to 24 species in 14 genera and 7 families. Of these, 19 species (and 2 genera) are endemic, 1 is native (naturally occurring elsewhere in tropical America), and 4 are presumed to have been introduced by humans. Of the endemic species, 74% are flightless. It is assumed that ancestral colonizations were by flighted ancestors through the air, or by flightless ancestors (Nemobiinae and Mogoplistinae) by rafting and ocean surface transport. Considering the richness of the Orthoptera in mainland Ecuador, the fauna of the islands is impoverished. Island evolution in the Orthoptera is modest when compared to other plants and animals in the Galapagos biotas. Some specialization occurs in moist montane and cave habitats. The purpose of this presentation is to seek advice on a taxonomy for the species (especially in the Nemobiinae), and to indicate the research opportunities. The fauna is compared with that of other oceanic archipelagos (Hawaiian, Canary, Balearic, California Channel Islands, and Florida Keys).

62. CHROMOSOME EVOLUTION AND SPECIATION IN THE *PEDIODECTES* (ORTHOPTERA:TETTIGONIIDAE: TETTIGONIINAE)

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Pediodectes species are distributed in southwestern North America. The chromosome system of the *Pediodectes* is polymorphic at the inter- and intra-species level. The chromosome number of the species ranges from 2n=28 to 2n=31 in the male. Seven types of karyotypes are found in the genus. The species with the odd chromosome numbers are XO and the species with the even numbered are neo-XY. In *P. haldemani* three karyotypes are found.

Chromosome rearrangements, such as centric and tandem fusions, have played an important role in chromosome evolution at inter- and intraspecies level in *Pediodectes*. The probable pathways of chromosome evolution and speciation are discussed.

63. AN OVERVIEW OF NEW ZEALAND ORTHOPTERANS

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Some elements of the New Zealand orthopteran fauna are still relatively poorly known and many genera and species are yet to be formally recognized. New species are still being found. This overview, checklist in part, summarizes the present state and indicates interesting points of the fauna. Included are all families of Orthoptera, Grylloptera, and Blattodea and those groups which are most likely to have major changes in their constitution or understanding in the future are examined in detail.

64. THE KARYOTYPIC AND PHENOTYPIC FEATURES AS THE MARKERS OF GRASSHOPPER EVOLUTION

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The reconstruction of grasshopper evolution and phylogeny may be characterized as a complicated problem, especially in connection with the absence of sufficient paleontological data.

The karyotypic and phenotypic investigations of present grasshopper taxa allow us to understand and explain some periods and paths of their evolution. Now it is evident that the different parts of a population system of each species have their own evolutionary and ecological significance.

The comparative investigation of model taxa allows us to describe the "parallelism" pattern or main phenotypic and karyotypic characters. Often we can describe more or less identical pattern of their variability. The latter may be connected with the evolutionary specificity of each taxon. For example, two main groups of *Chorthippus s. lat.* (*Chorthippus s. str.* and *Glyptobothrus*) coincide with the variability of two types of color morphs. On the contrary, the similar pattern of this variability of *Chorthippus s str.* and the katydids of *Metrioptera*-group shows their similar evolutionary history.

Our data show that all investigated taxonomic groups of grasshoppers may be interpreted as integrated and stable evolutionary units, the formation of which is connected with specific areas of Holarctis. Gomphocerini may be characterized as the forest-steppe and steppe group in recent history and with significant variability. Podismini, Chrysochraontini, and Bryodemini are connected with stable landscapes of the Holarctic Region.

65. [Information not Available- ed.]

T. Wang

66. TAXONOMIC VALUE OF CUTICULAR STRUCTURES OF THE STOMODEUM IN ACRIDOMORPHA (ORTHOPTERA)

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ABSTRACTS

Cuticular structures of the stomodeum—such as ridges, teeth, and spines—have proved to be of taxonomic value in several groups of insects. The work leading to this paper was undertaken with the purpose of evaluating the usefulness of these characters for the identification of the families of Acridomorpha.

Samples of species belonging to Eumastacidae, Proscopidae, Tristiridae, Pyrgomorphidae, Ommexechidae, Romaleidae and Acrididae were studied. Stomodea were dissected from the insects and cut lengthwise along the dorsal midline, then treated with 10% solution of KOH to destroy the soft tissues, washed and mounted on slides in polyvinyl alcohol mounting media. These were used for observation under optical microscope. For study under the scanning electronic microscope, pieces of the stomodea treated with KOH were dehydrated in an ethanol series, washed in pure acetone, attached to squares of aluminum foil and coated with gold.

The following characters were studied: pattern of distribution of stomodeal spines (crop and proventriculus) in zones I to IV (Muralirangan's classification); arrangement of the ridges of the intima; shape and size of the spines; and shape, size and pattern of the denticles of the valvular plates.

It was found that certain characters are shared by different species within the same family. The Acrididae was the family most clearly defined by the characters studied, and certain elements were found which are useful for the identification of some of its subfamilies. All genera of Acrididae examined presented a typical structure: the so-called "oval areas", near the esophagus, in zone II of the crop.

Pyrgomorphidae, Tristiridae, and Romaleidae are similar with regard to the separation of crop and proventriculus, but the arrangement of the spines in these areas is quite different and characteristic for each one of these families.

Important similarities in the shape and arrangement of spines were found in Eumastacidae and Proscopidae. SEM observation corroborated these similarities. Relationship of these families has been recently indicated on the basis of the study of their genitalia, and also on biogeographic grounds.

The characters studied in this work contribute to the hypothesis that the Pauliniidae are an artificial group based on external convergence. This has already been published by the present authors (1992. *Int. J. Insect. Morphol. & Embryol.* 21(2): 161-174). The two genera included in the family (*Paulinia* and *Marellia*) present quite different structures. *Paulinia* has no differentiation between crop and proventriculus and no ridges of the intima. In SEM observation its spines are similar to those of the Eumastacidae and Proscopidae. *Marellia*, on the other hand, is quite similar to members of the Acrididae.

The Ommexechidae show a peculiar structure. Crop and proventriculus are well differentiated but there are no ridges in the crop, and spines are grouped in a very characteristic pattern, different from that of the other families studied.

It is concluded that the cuticular structures of the stomodeum provide valuable taxonomic characters for the separation of families, and in some cases subfamilies as well, within the Acridomorpha.

67. RAPID SONG EVOLUTION AND AN HISTORICAL TEST OF REPRODUCTIVE CHARACTER DISPLACEMENT IN A HAWAIIAN CRICKET

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Variation in the male calling song is used extensively in the taxonomy of the Hawaiian cricket genus *Laupala* Otte. Geographic variation in the acoustic structure of songs examined in this study is compared with variation in songs as reported in the literature. Patterns of variation in mitochondrial DNA sequences from the 12S rRNA, $tRNA^{val}$ and 16S rRNA were used to estimate the phylogenetic history of the genus *Laupala*. With this phylogeny I infer the evolution of the male calling song in the genus. Geographic variation in the male calling song was found to be consistent with the patterns reported in the literature. It is argued that patterns of song variation persist over ecological time. The phylogenetic pattern suggests that speciation occurred mainly within islands and that similar songs have evolved repeatedly within these islands. Given the young geological age of the Hawaiian islands, it is argued that song evolution is rapid. The macroevolutionary patterns of song in *Laupala* are exploited for an historical test of the reproductive character displacement hypothesis proposed by Otte (1989; *In Speciation and Its Consequences* Otte, D. and J.A. Endler, eds., Sinauer).

Placement of papers not determined as of this printing:

FOOD CONSUMPTION AND TISSUE GROWTH IN AN ACRIDID OF THE LATERITE ZONE OF WEST BENGAL (INDIA)

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A study was conducted regarding the food consumption, assimilation, and tissue growth of male and female *Acrida exaltata* (Walker), fed on *Sorghum helepense* Willd. leaves, under laboratory conditions. All the calculations were done on dry weight basis. The rate of food consumption in the female was 241.07 ± 10.32 to 764.26 ± 10.94 mg $g^{-1}day^{-1}$ and in the male was 234.05 ± 14.43 to 606.12 ± 17.75 mg $g^{-1}day^{-1}$. The rate of assimilation was observed (119.92 ± 14.9 to 337.14 ± 2.6 mg $g^{-1}day^{-1}$) in the female and (175.75 ± 4.25 to 434.08 ± 16.64 mg $g^{-1}day^{-1}$) in the male. Thus, the per unit weight of food consumption was higher in the female, whereas the assimilation rate was higher in the male. However, tissue growth was higher in the female (13.4±.65 to 66.46±11.94 mg g^{-1} day^{-1}) in comparison to the male insects (9.94±.89 to 27.67±1.94 mg $g^{-1}day^{-1}$). A high degree of positive correlation between consumption and assimilation was observed in female insects.

RECENT ADVANCES ON THE BIOSYSTEMATICS OF MANTODEA FROM CHINA

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(Shanghai Institute of Entomology, Academia Sinica,

Sixty years have passed since Max Beier gave the first review on the mantids of China. Following Beier's work, another review was attributed to E.R. Tinkham in his "Studies in Chinese Mantidae" in 1937, in which 14 subfamilies, 33 genera and 51 species (subspecies) were recorded. After a long term of silence, several Chinese scientists have been studying the Chinese Mantodea since 1983.

On the basis of the materials checked by the author and from early literature records, there are 115 species and 1 subspecies of mantids known in China up till the present

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time. They belong to 8 families, 19 subfamilies, and 48 genera, respectively, including 6 newly discovered genera from China: *Bolivaria, Nanomantis, Ormomantis, Xanthomantis, Hymenopus*, and *Paratoxodera*.

Some taxonomic changes have been made, *e. g., Rhombodera*, which was placed in the subfamily Mantinae as a subgenus below *Hierodula* by many previous authors, is transferred to the family Choeradodidae with the pronotum widely expanded. The genus *Palaeothespis*, formerly placed in the subfamily Thespinae, has been transferred to the subfamily Miopteriginae.

However, there are a series of taxonomic problems to be overcome. Owing to the abundance of Mantodea in China, there is much work to be done in the future, especially the investigation of species in southwestern China.

A MESSAGE FROM THE EDITOR

I want to extend my thanks to all the persons who have helped to get this volume published in record time — less than one week. They include Stan Gangwere, Karen Niggle, Mary Dimperio (my volunteer), Dan Otte, and all of the individuals who have sent their abstracts to me in time to produce this format. I look forward to seeing all of you and listening to what appears to be a very informative and interesting program of presentations.

§

In this issue I have taken the liberty to make minor changes in the wording of several of the abstracts. Due to the limited turn-around time for author's approval of such changes, I take full responsibility for any changes that have deviated from the author's intent in their writing, but as I read each abstract, I found several glaring inaccuracies in wording that I felt required editorial changes so that the information would be more meaningful to the participants in the oral presentations. If any author disagrees with the changes I have made in their abstracts, we should convene so that I can correct in the *Proceedings* any misconceptions I may have made through my editing.

§

I am hoping to work on the *Proceedings* as soon as I return from the Meeting, so that it will be published as promptly as possible. Please refer to *Metaleptea* vol. 14(2), for my instructions regarding your manuscripts. All papers will go through an additional review process, and changes are likely to be expected, especially for those papers written in English by individuals for whom English is not their primary language. I hope that recomposition of such manuscriopts will conform to standards that will improve on the communication value of the information each researcher has acquired. I will personally be in communication with each author regarding major changes in the wording of their manuscripts. As mentioned in *Metaleptea* 14(2), some of the papers may be chosen to be published in the next issue of the *Journal of Orthoptera Research.*

David A. Nickle
Editor

NOTICE

Members needing copies of past PAN AMERICAN ACRIDOLOGICAL SOCIETY or ORTHOPTERISTS' SOCIETY publications are reminded that a small number of virtually all volumes and numbers is on hand at the Directorate. Prices (in US currency) are as follows: *Metaleptea* @ $1.50 per number or $3.00 per volume of 2 (two) numbers, *Proceedings* @ $10.00 per volume, and *Occasional Papers* No. 1 @ $4.40. Please advise of the volumes and numbers desired and send remittance to: S.K. Gangwere, Executive Director, Orthopterists' Society, c/o Department of Biological Sciences, Wayne State University, Detroit, MI 48202, USA. Orders may also be filled by invoice; simply ask to be billed.

THE ORTHOPTERISTS' SOCIETY

The Orthopterists' Society (formerly *Pan American Acridological Society*) is an international scientific organization devoted to facilitating communication among those interested in Orthoptera and their allies. Research and publication are fostered in all aspects of the biology of these insects from ecology and taxonomy to physiology, endocrinology, cytogenetics, and control measures.

The Society was founded in 1978 by some 50 orthopterists meeting at San Martin de los Andes, Argentina. Its constitution and by-laws were adopted in 1979, and it was accorded tax-exempt status by the United States government shortly thereafter. The meetings held since San Martin have been at Bozeman (United States), Maracay (Venezuela), Saskatoon (Canada), and Valsain, Segovia (Spain). The next meeting will be August 2-6, 1993 at Hilo, Hawaii (USA).

Symposia, round table discussions, and research papers presented at the Society meetings are published in the *Proceedings of the Orthopterists' Society*, and a newsletter, *Metaleptea*, is issued semi-annually. Information regarding these publications can be obtained from the editor, Dr. D. A. Nickle, USDA, c/o National Museum of Natural History, NHB-168, Smithsonian Institution, Washington, D.C. 20560, USA.

The 1990-1994 Governing Board comprises President Daniel Otte (United States), President-elect R. F. Chapman (United Kingdom), Past President V. R. Vickery (Canada), Treasurer Roger Bland (United States), Regional Representatives Aiola Richards (Australia), Al B. Ewen (Canada), and B. Baccetti (Italy), Executive Director S. K. Gangwere (United States), Editor, D. A. Nickle (United States), and Editor of the new *Journal of Orthoptera Research*, N. D. Jago (United Kingdom).

Society business and finances are handled by the Executive Director, Prof. S. K. Gangwere, Department of Biological Sciences, Wayne State University, Detroit, MI 48202, USA.

All correspondance relating to *Metaleptea* or the *Proceedings of the Orthopterists' Society* should be addressed to the Editor, Dr. David A. Nickle, USDA, Systematic Entomology Laboratory, c/o U.S. National Museum of Natural History, Smithsonian Institution NHB-168, Washington, D.C. 20560 USA.

Correspondance and information regarding the new journal series, *Journal of Orthoptera Research*, should be addressed to Dr. D. Otte, Managing Editor, Academy of Natural Sciences, 19th & the Parkway, Philadelphia, PA 19103 USA.

MEETINGS: Meetings of the Orthopterists' Society are held on a triennial basis, in the United States, Latin America, Canada, or other location, worldwide, in rotation. Symposia, research papers, and business conducted at the Meetings are published in the *Proceedings of the Orthopterists' Society*.

MEMBERSHIP: Membership is open to anyone expressing an interest in Orthoptera and related orders. Annual dues for members are US $15 for Active Members, US $7 for students and US $25 for institutions. Members receive *Metaleptea*. and, upon payment of an additiontal charge, other Society publications.

PUBLICATIONS: The Society's publications include a newsletter, *Metaleptea*, which is published as news becomes available, but on at least a biannual basis, the *Proceedings of the Orthopterists' Society*, which is published triennially in conjunction with the Meetings, *Occasional Papers*, an irregularly published journal for medium- to large-sized papers dealing with research on any aspect of Orthopteroid orders, and a new journal series, the *Journal of Orthoptera Research*, a refereed journal devoted to research articles of a small to medium size. For information regarding any of these publications, contact the Editor, Dr. David A. Nickle, USDA, Systematic Entomology Laboratory, c/o U.S. National Museum of Natural History, Smithsonian Institution NHB-168, Washington, D.C. 20560 USA.