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SYSTEMATICS AND BIONOMICS

KEY TO THE ORTHOPTEROID INSECTS OF THE CHANNEL ISLANDS AND ADJACENT MAINLAND CALIFORNIA

The following key includes all species known from the Channel Islands and adjacent mainland and several species which may be present there. The key should enable even the novice to identify all species and should be used in association with the "Recognition characters" synopses.

1 [Triplet]Hind femur not enlarged; tarsi with 3 segments; abdomen elongate; a broad stick insect. (Santa Monica Mountains) . . . . . *Timema chumash* p. 124

1' Hind femur enlarged for jumping; tarsi with 4 or fewer segments 2

1" Hind femur not enlarged for jumping; tarsi with 5 segments (roaches, mantids, stick insects except *Timema*, see 1) 87

2(1') Hind tarsus with a single elongate segment, without apparent claws; small aquatic insects less than 10 mm in length (Santa Catalina Island) . . . . . Tridactylidae, *Ellipes minutus* p. 122

2 Hind tarsus 2–4 segmented with apical claws 3

3(2) Antenna short, less than half as long as body; auditory organs, if present, located on sides of first abdominal tergite; ovipositor very short, only slightly protruding from tip of abdomen (grasshoppers) 4

3 Antenna long, as long or longer than body; auditory organs, if present, located on front tibia; ovipositor about as long as body to very much shorter than abdomen 41

4(3) Pronotum extending to tip of abdomen, tapering to acute apex; tegmina short, scale-like; wings long . . . . . Tetrigidae, *Paratettix* 5

4 Pronotum short, extending at most over only a few abdominal segments; tegmina and wings usually as long or longer than body, or both reduced or absent 6

5(3) Middle femur of both sexes with ventral margin straight (Fig. 4l), not lobate (Santa Monica Mountains, Santa Cruz Island) . . . . . *Paratettix aztecus* p. 58

5 Middle femur of both sexes with ventral margin distinctly lobate (Fig. 40) (Santa Monica Mountains, Santa Rosa, Santa Cruz, Santa Catalina Islands) . . . . . *Paratettix mexicanus* p. 58

6(4) Tegmina and wings absent; antenna shorter than fore femur; small species under 25 mm in length . . . . . Eumastacidae 7

6 Tegmina and wings present; antenna longer than fore femur; over 25 mm in length 9

7(6) Found on mainland California . . . . . *Morsea californica californica* p. 59

7 Found on Channel Islands 8

8(7) Restricted to Santa Cruz and Santa Rosa Islands . . . . . *Morsea californica islandica* p. 59

8 Restricted to Santa Catalina Island . . . *Morsea californica catalinae* p. 60

9(6) Prosternum armed with a peg-like projection 10

9 Prosternum unarmed 16

10(9) Median carina of pronotum raised crest-like, surface of pronotum rugose; tegmina short, not used in flight; greyish with whitish flecks; body robust (Santa Monica Mountains) . . . . . *Dracotettix monstrosus* p. 61

10 Without above combination of characters 11

11(10) Subgenital plate of male deeply notched at apex; pronotum with broad, longitudinal, yellow-tan stripe; body length greater than 35 mm (Santa Monica Mountains, San Nicolas, Santa Catalina, San Clemente Islands) . . . . . Cyrtacanthacridinae, *Schistocerca nitens nitens* p. 65 [Formerly *S. vaga vaga* Scudder]

11 Subgenital plate of male entire or feebly notched; pronotum without yellow stripe, although whitish stripe often present; always much less than 35 mm in length . . . . . Melanoplinae 12

12(11) Tegmina fully developed, extending beyond tip of abdomen 13

12 Tegmina short, reaching middle of abdomen 14

13(12) Cercus of male deflexed, abruptly depressed mesad, apex truncate; small, greyish; bush-dwelling (Santa Monica Mountains, Santa Cruz, Santa Rosa, Anacapa, Santa Catalina Islands) . . . . . *Melanoplus cinereus cyanipes* p. 62

13 Cercus of male straight, dorsal surface of apex slightly depressed; larger, brownish, grassland (Santa Monica Mountains, San Miguel, Santa Rosa, Santa Cruz, Santa Catalina Islands) . . . . *Melanoplus devastator* p. 63

14(12) Head and pronotum with white stripes (Santa Monica Mountains) . . . . . *Hesperotettix pacificus pacificus* p. 62

14 Head and pronotum without white stripes 15

15(14) [Triplet] Pronotum with median carina indistinct or low on prozona; cercus of male sharply pointed, tegmina widely separated (Santa Monica Mountains, Santa Rosa, Santa Cruz Islands) . . . . . *Oedaleonotus tenuipennis* p. 65

15' Pronotum with median carina indistinct on prozona; cercus of male weakly but decidedly spatulate, distally compressed; tegmina almost touching, apices narrowly rounded (Santa Monica Mountains) . . . . . *Aeoloplides fuscipes* p. 62

15" Pronotum with median carina sharp on prozona; cercus of male with apex swollen, slightly enlarged; tegmina barely touching, apices acute (Santa Monica Mountains) . . . . . *Melanoplus obespsolus* p. 63

16(9). Antenna flattened, usually broader basally than distally; hind wings not brightly colored; stridulation by means of pegs on inner surface of hind femur, no flight crepitation . . . . . Gomphocerinae 17

16 Antenna filiform, of nearly uniform width throughout; hind wings often brightly colored; flight crepitation in some species . . . Oedipodinae 20

17(16) Brachypterous species (Santa Monica Mountains, Santa Cruz Island) . . . . . *Chloealtis gracilis* p. 66

17 Long winged species 18

18(17) Head and pronotum striped; hind tibia blue (Santa Monica Mountains) . . . . . *Amphitornus coloradus ornatus* p. 66

18 Head and pronotum together not striped; hind tibia not blue 19

19(18) Robust species; hind tibia brown; lateral foveolae of vertex not showing when viewed from above; salt marshes (Santa Monica Mountains) . . . . . *Orphulella pelidna* p. 67

19 Slender species; hind tibia pale yellow; lateral foveolae of vertex plainly visible when viewed from above; in sparsely vegetated areas adjacent to chaparral (Santa Monica Mountains, Santa Rosa, Santa Cruz Islands) . . . . . *Psoloessa thamnogaea* p. 67

20(16) Brown or tan species; wing disk orange, opaque; fastigium of vertex rugose (Santa Monica Mountains) . . . . . *Arphia conspersa ramona* p. 67

20 Without above combination of characters 21

21(20) Hind wings colorless or with a yellowish tinge, translucent; pronotum with 3 sharp, low carinae; hind tibia pale yellow (Mainland and most Channel Islands) . . . . . *Camnula pellucida* p. 68

21 Without above combination of characters 22

22(21) Median carina of pronotum high, cut by a single, deep notch; wing disk colorless to light green (Santa Monica Mountains) . . . . . *Chimarocephala pacifica incisa* p. 68

22 Without above combination of characters 23

23(21) Pronotal carinae completely absent; wing disk greenish, translucent (Santa Monica Mountains) . . . . . *Cibolacris parviceps* p. 69

23 Pronotal carinae present; wing disk variously colored 24

24(23) Median carina of pronotum indicated only as two prominent tubercles on prozona and mesozona, the mesozona tubercle bounded by a smaller tubercle on each side; wing disk either yellow, blue-green, or yellow-blue, black band heavy (Santa Monica Mountains) . . . . . *Derotmema saussureanum* p. 70

24 Median carina of pronotum not as indicated above 25

25(24) Wing disk rose or pink (Santa Monica Mountains, Santa Rosa, Santa Cruz, Santa Catalina Islands) . . . . . *Dissosteira pictipennis* p. 70

25 Wing disk not rose or pink 26

26(25) Hind tibia red 27

26 Hind tibia variously colored, not reddish 28

27(26) Bands of tegmen present only on anterior half (Santa Monica Mountains, Point Mugu) . . . . . *Conozoa sulcifrons sulcifrons* p. 69

27 Bands of tegmen complete or represented as conglomerate of speckles and not restricted to anterior portion (Santa Monica Mountains) . . . . . *Trimerotropis californica* p. 76

28(26) Median carina of pronotum entire or cut by a single principal notch . . 29

28 Median carina of pronotum usually with two notches; if cut by only one notch, then fastigium broad and with a median carina 31

29(28) Wing disk bright yellow, translucent with subapical hyaline region (Santa Monica Mountains) . . . . . *Lactista gibbosus* p. 71

29 Wing disk not yellow 30

30(29) Wing disk light green; hind tibia straw brown; median carina of pronotum raised, rather deeply cut by a single sulcus (San Clemente Island) . . . . . *Scirtetica clementina* p. 74

30 Wing disk translucent, clear, or with a greenish tinge; hind tibia blue; median carina of pronotum not raised (Santa Montica Mountains, Santa Rosa, Santa Cruz Islands) . . . . . *Encoptolophus robustus* p. 70

31(28) Median carina of pronotum low in profile 32

31 Median carina of pronotum high in profile 34

32(31) Large robust species; wing disk green or blue-green; pronotum with shining tubercles (Santa Monica Mountains, Santa Rosa, Santa Cruz, San Clemente, Santa Catalina Islands) . . . . . *Leprus intermedius* p. 71

32 Smaller species without above combination of characters 33

33(32) Antenna annulate; wing disk bluish green, usually without any yellow (Santa Monica Mountains) . . . . . *Trimerotropis santamonica* p. 83

33 Antenna color uniform; wing disk yellow-green, (Santa Monica Mountains) . . . . . *Trimerotropis thalassica* p. 85

34(31) Hind tibia brown or yellow 35

34 Hind tibia blue 38

35(34) Wing disk yellow 36

35 Wing disk greenish-yellow or faintly greyish-green 37

36(35) Wing disk bright yellow, wing band present, hind tibia yellow (Mainland and most Channel Islands) . . . . . *Trimerotropis pallidipennis pallidipennis* p. 80

36 Wing band absent, hind tibia brown (Point Conception, San Miguel, Santa Rosa Islands) . . . . . *Microtes occidentalis* p. 77

37(35) Wing disk light greenish-yellow; hind tibia with base and apex darker brown, median portion lighter brown or yellowish, fresh specimens with a faint bluish or purple overcast on tibia; tegmina with distinct bands (Santa Barbara Island) . . . . . *Trimerotropis santabarbara* p. 81

37 Wing disk light greyish-green; hind tibia light yellow brown speckled with darker brown spots, without apical and basal bands; tegmina without distinct bands (San Nicolas Island) . . . . . *Microtes nicola* p. 72

38(34) Wing disk distinctly blue (Santa Rosa, Santa Cruz, San Nicolas, San Clemente, Santa Catalina Islands) . *Trimerotropis pseudofasciata* p. 80

38 Wing disk yellowish or greenish 39

39(38) Tegminal bands dark and sharp; lateral lobe of pronotum with posterior margin rounded, apex of wing disk entirely smoky (Santa Monica Mountains, Santa Rosa, Santa Cruz, Santa Catalina Islands) . . . . . *Trimerotropis fontana* p. 76

39 Tegminal bands often weak or obscure; lateral lobe of pronotum often with a ventro-posterior tooth, apex of wing disk not smoky 40

40(39) Lateral lobe of pronotum with an irregular horizontal ridge near middle of anterior portion (Fig. 156) (Santa Monica Mountains) . . . . . *Trimerotropis occidentaloides* p. 78

40 Lateral lobe of pronotum smooth (Fig. 236) (Santa Monica Mountains) . . . . . *Trimerotropis topanga* p. 86

41(3) Tarsi, at least the tarsi of the middle leg, 4–segmented; ovipositor usually laterally compressed, sword-shaped, not enlarged at apex, but often with conspicuous teeth, when greatly reduced somewhat triangular 42

41 All tarsi 3–segmented; ovipositor straight, tubular, needle-shaped, apex often slightly expanded, not with large teeth . . . . . Gryllidae 62

42(41) Fore tibia with an auditory opening (oval or slit-shaped) near base, adult males always with well developed, broad tegmina (sometimes short and concealed from above by pronotum), bearing a file of teeth for stridulation; tegmina sometimes reduced to pads in female . . . . . Tettigoniidae 43

42 Fore tibia without an auditory opening, both sexes apterous 74

43(42) Auditory structure of fore tibia circular, tambourine-shaped, ... Phaneropterinae 44

43 Auditory structure of fore tibia consisting of two slits separated by a bridge-like structure . . . . . Decticini 49

44(43) Small robust species; tegmina abbreviate less than 30 mm in length, not extending much beyond tip of abdomen 45

44 Larger species, tegminal length greater than 30 mm, extending considerably beyond tip of abdomen 46

45(44) Green species; second and third tergites of male with a median process; cercus with a sharp sclerotic pigmented terminus (Santa Monica Mountains, Santa Cruz, Santa Catalina Islands) . . . . . *Platylyra californica* p. 89

45 Small grey species; male tergites not developed as above (Santa Monica Mountains) . . . . . *Brachyinsara hemiptera* p. 88

46(44) Tegmina distinctly wider at middle than at apex; body form leaf-like . 47

46 Tegmina long, narrow, not appreciably broader in middle; body form not leaf-like 48

47(46) Male cercus with minute apical tooth; apex of ovipositor with 3 or fewer teeth on ventral valve (Santa Monica Mountains (?)) . . . . . *Microcentrum californicum*

47 Male cercus with large apical tooth; apex of ovipositor with more than 5 teeth on ventral valve (Santa Monica Mountains) . . . . . *Microcentrum rhombifolium* p. 88

48(46) Tenth tergite of male with median process with lateral lobes obliquely compressed, twice as long as broad; larger more attenuate species (Santa Monica Mountains, Santa Cruz, Anacapa, Santa Catalina Islands) . . . . . *Scudderia mexicana* p. 90

48 Tenth tergite of male with median process with lateral lobes rounded, not compressed, less than twice as long as broad; more robust species (Santa Monica Mountains, Santa Cruz Island) . . . . . *Scudderia furcata* p. 89

49(43) Tegmina fully developed, longer than abdomen, capable of flight (Santa Monica Mountains) . . . . . *Capnobotes bruneri* p. 90

49 Tegmina short, not much longer than the length of pronotum and often completely concealed by it 50

50(49) Pronotum not produced hood-like over thorax and anterior abdominal tergites 51

50 Pronotum produced hood-like over abdomen (Figs. 250, 254, 256) especially in males 52

51(50) Pronotum with strongly developed lateral carinae; female ovipositor short, sickle-shaped (Santa Monica Mountains) . . . . . *Decticita balli* p. 90

51 Pronotum without pronounced lateral carinae or indicated only in posterior portion of disk; ovipositor elongate, straight (Santa Monica Mountains) . . . . . *Idiostatus aequalis* p. 91

52(50) Male with supra-anal plate quadrate, apices of plate acute angled (Fig. 303); (female unknown) (Santa Catalina Island) . *Neduba (N.) propsti* p. 105

52 Male with supra-anal plate rounded, tongue-like (Figs. 253, 258); subgenital plate of female produced (Fig. 301) laterally as subparallel, digitiform appendages 53

53(52) Male pseudocercus with tooth subapical in position (Figs. 262, 265, 270); female subgenital plate with lateral processes short (Fig. 275) 54

53 Male pseudocercus with tooth apical in position (Fig. 253); female subgenital plate with lateral processes elongate, digitiform (Fig. 251) 60

54(53) Tegmina of male protruding beyond apex of pronotum (Fig. 263); apex of pronotum subacute (Santa Monica Mountains) . . . . . *Neduba (A.) longipennis* p. 96

54 Tegmina of male concealed by pronotum 55

55(54) Confined to Channel Islands 56

55 Occurring along coastal southern California and in Santa Monica Mountains 57

56(55) Known only from Santa Cruz Island . . . . . *Neduba (A). morsei santacruzae* p. 103

56 Known from Santa Rosa and Anacapa Islands . . . . . *Neduba (A.) morsei islandica* p. 101

57(55) Known from the mountains of southern California 58

57 Known from coastal southern California 59

58(57) Fore and middle femora armed; male pseudocercus slender (Fig. 265) (known only from Mt. Wilson, Los Angeles County) . . . . . *Neduba (A.) morsei morsei* p. 97

58 Fore and middle femora unarmed; male pseudocercus stout (Fig. 277) (Santa Monica Mountains) . . . . . *Neduba (A.) morsei curtatus* p. 100

59(57) Pronotum large (Fig. 297), hood-like, pseudocercus of male with minute internal tooth (known only from Point Dume, Santa Monica Mountains) . . . . . *Neduba (A.) morsei tectinota* p. 104

59 Pronotum more typical of species (Fig. 271); pseudocercus of male with well developed internal tooth (known only from Point Mugu State Park, Santa Monica Mountains) . . . . . *Neduba (A.) morsei costalis* p. 99

60(53) Coastal subspecies; male titillator with base constricted (Fig. 255) (Point Conception) . . . . . *Neduba (A.) diminutiva constrictans* p. 92

60 Inland, montane, or coastal form; male titillator not constricted at base (Fig. 257) 61

61(60) [Triplet] Male pseudocercus slender; titillator twisted (Fig. 257); female subgenital plate with extremely elongate digitiform processes (Santa Monica Mountains, Point Mugu State Beach) . . . . . *Neduba (A.) diminutiva dactyla* p. 94

61' Male pseudocercus slender; titillator not twisted but broadly concave; female subgenital plate with digitiform processes not as long (Coastal Santa Monica Mountains) . . . . . *Neduba (A.) diminutiva malibu* p. 95

61" Male pseudocercus not as slender; titillator with arms concave; female subgenital plate with arms not as elongate (Fig. 251) (Mount Diablo, Marin County, to San Benito County) . . . . . *Neduba (A.) diminutiva diminutiva* p. 92

62(41) Minute (3–5 *mm*), wingless inquilines in ant nests (Santa Monica Mountains and most Channel Islands) . . . . . *Myrmecophilus oregonensis* p. 112

62 Not as above 63

63(62) Small (5–13 *mm*), scale-covered crickets with very short tegmina, ground dwelling 64

63 Larger, body not covered with scales, often long-winged crickets, ground dwelling, or in herbs and low vegetation 65

64(63) Pronotum produced hood-like over abdomen (Fig. 314) and bearing paired dark markings cephalad (Point Dume, Santa Monica Mountains) . . . . . *Cycloptilum distinctum* p. 111

64 Pronotum short, not produced hood-like over abdomen and lacking paired dorsal markings cephalad (Santa Monica Mountains, Santa Cruz, Anacapa, Santa Catalina, San Clemente Islands) . . . . . *Hoplosphyrum boreale* p. 111

65(63) Ocelli absent; head elongate, horizontal; hind tibia with minute teeth between spines; pale green or brownish crickets, males with deltoid tegmina . . . . . Oecanthinae 66

65 Ocelli present; head short, vertical; hind tibia without teeth between spines; black, reddish, or brownish ground-dwelling crickets . . . Gryllinae 69

66(65) Inner margin of scape of antenna without a pale swelling 67

66 Inner margin of scape of antenna with a pale swelling 68

67(66) Brownish species; basal antennal segments dark, scape and pedicel often with a single narrow black stripe (Santa Monica Mountains, Santa Cruz, Santa Rosa, Anacapa, Santa Catalina Islands) . . . . . *Oecanthus californicus* p. 110

67 Greenish species; basal antennal segments not dark; pedicel with two black markings confluent or contiguous or separated by no more than a third of the width of inside mark (Santa Monica Mountains and most Channel Islands) . . . . . *Oecanthus argentinus* p. 109

68(66) Dark mark on pedicel less than half the length of segment or completely absent, mark round, oval, not straight (Santa Monica Mountains, Santa Cruz, Santa Catalina Islands) . . . . . *Oecanthus rileyi* p. 110

68 Dark mark on pedicel occupying at least half the length of segment, center of mark near midpoint of segment, mark straight (Santa Monica Mountains, Santa Cruz Island) . . . . . *Oecanthus fultoni* p. 110

69(65) Restricted to San Nicolas Island (and without combination of characters of *Gryllus* III or VI), body and wings dark, micropterous, male (one specimen) file with 111 teeth, 31.7 teeth/mm, song unknown . . . . . *Gryllus* V p. 108

69 Not restricted to San Nicolas Island, body and wings dark or light, micropterous or macropterous 70

70(69) More than 600 chirps/minute, 3 pulses/chirp; macropterous (Santa Monica Mountains, Santa Cruz, San Nicolas, San Miguel, Santa Barbara Islands) . . . . . *Gryllus* VI p. 109

70 Less than 500 chirps/minute, micropterous or macropterous 71

71(70) 11–17 pulses/chirp (less than 100 chirps/minute, macropterous) (Santa Monica Mountains, Santa Cruz, Santa Catalina Islands) . . . . . *Gryllus* I p. 106

71 Song with less than 11 pulses/chirp, micropterous or macropterous . . . 72

72(71) 6–10 pulses/chirp (80–300 chirps/minute, ecologically widespread, usually in cracks in grass fields) (Santa Monica Mountains and most Channel Islands) . . . . . *Gryllus* III p. 108

72 Less than 6 pulses/chirp 73

73(72) File with more than 150 teeth, 3–5 pulses/chirp, 70–165 chirps/minute (Santa Monica Mountains, Anacapa, Santa Cruz, Santa Catalina Islands) . . . . . *Gryllus* II p. 108

73 File usually with fewer than 150 teeth, 2–3 pulses/chirp, 195–400 chirps/minute (Santa Monica Mountains) . . . . . *Gryllus* IV p. 108

74(42) Antennal bases nearly touching, separated by about the width of the basal antennal segment 82

74 Antennal bases widely separated by several times the width of the basal antennal segment 75

75(74) Base of abdomen and often head much wider than thorax, tibia short and thick (Figs. 327, 328) . . . . . Stenopelmatinae 76

75 Base of abdomen and head almost the same width as thorax, tibia thin . . . . . Henicinae 78

76(75) Ventral surface of hind tibia with a single central apical spur; ventral surface of fore tibia with 1 or 2 small spurs one behind the other; all spines and calcars short and spatulate (Point Conception) . . . . . *Ammopelmatus muwu* p. 116

76 Ventral surface of hind tibia with a pair of apical spurs; ventral surface of fore tibia with 3 larger spurs placed in linear sequence; only some spines and spurs spatulate . . . . . *Stenopelmatus* 77

77(76) Adult size very large (35–50 *mm*); northern island individuals melanistic (Santa Monica Mountains, San Miguel, Santa Rosa, Santa Cruz, Anacapa Islands) . . . . . *Stenopelmatus fuscus* p. 117

77 Adult size well under 35 mm; not melanistic (Santa Rosa, Santa Cruz Islands) . . . . . *Stenopelmatus intermedius* p. 118

78(75) Eye stripe with a single major fork (Figs. 319A, 321A) 79

78 Eye stripe with 2 forks, one on occiput, the other running on to genae (Figs. 313A, 322A, 326A) 80

79(78) Ovipositor scarcely surpassing apex of abdomen (Santa Cruz, Santa Rosa, San Miguel Islands) . . . . . *Cnemotettix caudulus* p. 115

79 Ovipositor very elongate, extending well beyond abdominal apex (San Clemente Island) . . . . . *Cnemotettix pulvillifer* p. 115

80(78) Occiput without a testaceous cap (Santa Rosa, Santa Cruz, Anacapa, San Nicolas Islands) . . . . . *Cnemotettix spinulus* p. 116

80 Occiput with a distinct testaceous cap 81

81(80) Male tenth tergite truncate; spine of paraproct small; setation reduced (Los Angeles to Monterey County) . . . . . *Cnemotettix bifasciatus* p. 113

81 Male tenth tergite feebly bilobed; spine of paraproct moderately large; setation pronounced (San Diego region, Santa Catalina Island) . . . . . *Cnemotettix miniatus* p. 115

82(74) Fastigium bituberculate (Santa Monica Mountains, Santa Cruz Island) . . . . . *Gammarotettix genitalis* p. 120

82 Fastigium not bituberculate 83

83(82) Male styles absent; ovipositor armed ventrally with 4–5 aciculate teeth 84

83 Male styles present, ovipositor armed ventrally with low crenulations . . . . . *Pristoceuthophilus* 86

84(83) Four disto-dorsal spurs of hind tibia crowded apically (Fig. 333) (Point Conception) . . . . . *Rhachocnemis validus* p. 121

84 Dorsal spurs of hind tibia widely and uniformly separated . . . . . *Ceuthophilus* 85

85(84) Male pseudosternite dorsally broad, auriculae separated by 4–5 times their width (Santa Monica Mountains, San Miguel, Santa Rosa Islands) . . . . . *Ceuthophilus californianus* p. 119

85 Male pseudosternite narrow, auriculae separated by only 2.0–2.5 times their width (Santa Monica Mountains) . . *Ceuthophilus hesperus eino* p. 119

86(83) Overall ground color grey or grey brown; body form slender; male with hind tibia weakly curved at base, abdominal tergites densely tuberculate (Santa Monica Mountains, San Nicolas, San Clemente, Santa Catalina Islands) . . . . . *Pristoceuthophilus marmoratus* p. 121

86 Overall ground color dark brown, usually with a yellow dorsal stripe; body form robust; most males with hind tibia strongly bisinuate; abdominal tergites sparsely tuberculate (Santa Monica Mountains (?), Anacapa, Santa Rosa, Santa Cruz Islands) . *Pristoceuthophilus pacificus* p. 121

87(1") Fore legs raptorial, modified for grasping prey (Santa Monica Mountains, Santa Rosa, Santa Cruz, Santa Barbara, Santa Catalina Islands) . . . . . *Litaneutria minor* p. 125

87 Fore legs not modified for grasping 88

88(87) Cerci 1–segmented; body form very slender; resembling twigs or grass stems . . . . . Phasmatidae 89

88 Cerci with more than 5 segments; body form not slender but ovate or elongate . . . . . Blattaria 91

89(88) Antenna shorter than the length of fore femur (Santa Monica Mountains, Santa Cruz, Santa Catalina Islands) . . . *Parabacillus hesperus* p. 123

89 Antenna longer than fore femur 90

90(89) Female cercus short, 1.5 times longer than broad, just barely surpassing apex of supra-anal plate (Santa Catalina Island) . . . . . *Pseudosermyle catalinae* p. 123

90 Female cercus 2.5 times longer than broad, extending for at least a third its length beyond apex of supra-anal plate (Santa Monica Mountains) . . . . . *Pseudosermyle straminea* p. 123

91(88) Middle and hind femora without numerous spines on ventro-posterior margin or with a few hairs or bristles (Santa Monica Mountains) . . . . . *Arenivaga* species p. 126

91 Middle and hind femora with numerous spines on ventro-posterior margin . . . . . Blattellidae 92

92(91) Body color dark brown or orange-brown; pronotum concolorous dark brown (Santa Monica Mountains) . . . . . *Parcoblatta americana* p. 126

92 Body color straw brown, somewhat darker medially; pronotum with 2 dark brown stripes (Santa Monica Mountains (?), San Nicolas, San Clemente Islands) . . . . . *Blattella germanica* p. 125

Tetrigidae, Eumastacidae, and Acrididae

See Strohecker et al. (1968) for nomenclatorial citations for the above.

TETRIGIDAE: Pygmy Grasshoppers

Rehn and Grant (1957, 1961) have extensively reviewed the taxonomy and biology of the North American species.

TETTIGONIIDAE: Katydids

PHANEROPTERINAE: Bush Katydids

Brachyinsara hemiptera Hebard

Brachyinsara hemiptera Hebard, 1939, Trans. Am. ent. Soc. 65: 162.
Holotype male, "Tia Juana, San Diego County, California". Holotype in ANSP.

Recognition characters: Differs from *B. magdalenae* Rehn and Hebard by tegmina extending to about tip of abdomen; from *Insara*, by fastigium of vertex on three levels or steps, and more dilated abdomen.

Geographic distribution: Southern California, from three areas: Inyo County (Walker Pass), Los Angeles County (Santa Monica Mountains), and San Diego County; in the study area: Santa Monica Mountains.

Habitat: Coastal bluff community (Santa Monica Mountains, a single female on *Haplopappus*) and chaparral.

Seasonal occurrence: Probably adult in mid to late summer.

Discussion: B. hemiptera is very secretive and slow in its movements. Its stridulation is a very soft trill. It is never particularly abundant.

Microcentrum rhombifolium Saussure

Phylloptera rhombifolia Saussure, 1859, Rev. et. Mag. de Zool., 11: 204. Holotype in Geneva Museum.
Microcentrum laurifolia Howard, 1901, The Insect Book, color plate 35, Fig. 2. Type locality unknown. Holotype female in USNM.

Recognition characters: Differs from *M. californicum* Hebard by: cercus with a large apical tooth (minute in *M. californicum*); ventral of ovipositor with five teeth on apex (three or fewer in *M. californicum*); male calling song a series of 8–21 ticks followed by a lengthy pause.

Geographic distribution: Central and southern United States and central and southern California; in the study area: Santa Monica Mountains. Its western distribution may be influenced by the activities of man.

Habitat and food preferences: An arboreal species found in a wide variety of large trees but prefers soft wood deciduous trees other than oaks. It may have been introduced in parts of the West. This species is frequently attracted to lights and moderate concentrations of adults may be encountered in shrubbery around street lights. It feeds on a wide variety of plants.

Discussion: M. rhombifolium is the only species of this genus known from the Santa Monica Mountains. In the western United States it seems to be associated with man, and is seldom encountered far from suburban areas. It probably has been partially distributed by man through the movement of ornamental trees and shrubs with which it is commonly associated. The presence of this katydid in the Santa Monica Mountains is surprising but is probably the result of the encroachment of housing developments and general increased human activity. The species seems rare and our specimens came to light near an irrigated garden. Females oviposit in a characteristic manner (Blatchley, 1920). A ridge is chewed along the longitudinal axis of a woody stem. A double row of linearly overlapping eggs is laid, one on each side of the ridge and completely exposed. Spooner (1968) discusses the acoustic system in this katydid.

Although its relative *M. californicum* has not been found in our study area, the distribution of that species from southern Baja California through San Diego County to Humboldt County, California (ANSP, unpublished records) indicate that it probably occurs at least in the Santa Monica Mountains. The two species are often sympatric and can be heard together in loud choruses on warm nights with *californicum* less raucous than *rhombifolium*. However, because *californicum* is more secretive, it is usually difficult to collect. *M. californicum* prefers tall trees, especially *Quercus agrifolia*.

Platylyra californica Scudder

Platylyra californica Scudder, 1898. Proc. Acad. Arts and Sci., 33: 288. Lectotype male, Mt. Wilson, Altadena, 723 m, Los Angeles County, California. Lectotype designated by Grant and Rentz (1966), in ANSP.

Recognition characters: Fore femur more than one-third as long as hind femur; male with second and third abdominal tergites each with a median process, cerci elongate, sinuate, with a sharp pigmented terminus, subgenital plate elongate, apically emarginate, without styles; female with ovipositor broad, short, apically acute, dentate, and with a fleshy, ventrally directed process on each side of its base.

Geographic distribution: California west of the crest of the Sierra Nevada, from Mendocino County southward, probably into northern Baja California (Grant and Rentz, 1966); in the study area: Santa Monica Mountains, Santa Cruz and Santa Catalina Islands.

Habitat and food preferences: Chaparral and oak woodland, not on conifers. Eggs are laid in leaves of various deciduous trees, preferably oaks, in the late summer and fall. Nymphs have been found on low herbaceous vegetation, especially species of the Labiatae where they feed and mature. Adults are found in shrubs and trees.

Seasonal occurrence: Adult from early summer until the early fall.

Discussion: Grant and Rentz (1966) reviewed this monotypic California endemic genus. The species is nocturnal in the adult stage and is frequently attracted to lights. Its stridulation is distinctive, and our song records indicate that it is usually common.

Scudderia furcata Brunner

See Rehn and Hebard (1914) for nomenclatorial citations.

Recognition characters: Males with lobes of tenth tergite similar to those of *S. mexicana* (see under that species) but never laterally compressed and not much longer than broad; females more robust and with shorter legs than *S. mexicana*.

Geographic distribution: Throughout United States, south into Central America; in the study area: Santa Monica Mountains, Santa Cruz Island.

Habitat and food preferences: S. furcata has much the same habits as *S. mexicana* but has been found among more woody plants and trees. *Scudderia* species lay their eggs in the edges of living leaves.

Seasonal occurrence: Adult in late summer and fall, often well beyond the first fall frosts.

Discussion: See under *S. mexicana*.

Scudderia mexicana (Saussure)

See Rehn and Hebard (1914) for nomenclatorial citations.

Recognition characters: Males with lobes of the projecting portion of the tenth abdominal tergite obliquely compressed, twice as long as broad, and deeply emarginate mesad; females more slender and with longer legs than *S. furcata*.

Geographic distribution: Southwestern Texas, southern Arizona, California south of San Francisco, and throughout Mexico; in the study area: Santa Monica Mountains, Santa Cruz, Anacapa, and Santa Catalina Islands.

Habitat: Herbaceous perennials, non-woody plants, and moderate-sized shrubs, common on introduced sweet anise *Foeniculum vulgare*; not as common on woody plants as *S. furcata*, with which it is sympatric over much of its range.

On Santa Cruz and Santa Catalina Islands, *S. mexicana* is common on *Salix* and *Baccharis viminea* in riverbeds. It is also occasionally found on *B. pilularis*. The Anacapa Island adults were found in *Eucalyptus* trees.

Seasonal occurrence: Adult in May in Mexico and Texas, late June or July to late fall in the study area.

Discussion: In southern California *S. mexicana* is usually more common than *S. furcata* and is not as wary. *S. mexicana* males call more frequently at night, the calls are spaced more closely together, and each call consists of one, two, or three plain "zit" or "zeet-zeet-zeet" sounds. In contrast, *S. furcata* males often call in the afternoon, have long pauses between calls, and each call is a rich sounding "tsick" or "swick", usually given in spaced groupings of one to three. In both species females answer with a scarcely audible "tick".

DECTICINI: Shield-backed Katydids

Rentz and Birchim (1968) have revised or reviewed most of the western genera of this subfamily. See that paper for nomenclatorial details, distribution, and biology.

Capnobotes bruneri Scudder

Recognition characters: Male cercus stout, with a pair of internal teeth; tegmen abruptly narrowed distad of middle.

Geographic distribution: Scattered localities in Kern County (Tehachapi Mountains) and Santa Barbara County, California; in the study area: Santa Monica Mountains.

Habitat and food preferences: Chaparral, above 200 m in the Santa Monica Mountains in dense vegetation. In our study area we have not heard it singing from trees, but elsewhere it has been taken in pines. It is probably largely predaceous like other members of the genus, and is nocturnal.

Seasonal occurrence: Adult in mid summer.

Discussion: Judging by the spacing of singing males, populations are not dense. Singing males may fly from one bush to another during the course of a single evening. We have found no individuals on road surfaces at night, although elsewhere other members of the genus have been found there.

Decticita balli Hebard

Recognition characters: Differs from the other two species of *Decticita* by prominent lateral carinae on pronotum.

Geographic distribution: Coastal Ranges from San Benito to Tulare Counties, California; in the study area: Santa Monica Mountains, Palos Verdes Peninsula.

Habitat and food preferences: Grasslands, in open meadows, or on hillsides adjacent to chaparral or oak woodland. Its food is predominantly grass. Nymphs are more omnivorous than adults, and feed on aphids and leafhoppers in captivity.

Seasonal occurrence: Eggs hatch in late winter or early spring and adults live until early summer.

Discussion: See Rentz (1963) for biological observations. This genus and *Acrodectes* are the only North American decticine genera not known to produce an externally visible spermatophore. Copulation lasts for a considerably longer period of time than in other decticines, and the sperm are placed directly into the spermatheca. Eggs are deposited singly in hollow, dry grass stems, usually one of the introduced wild oats (*Avena* spp.). Eggs hatch in early spring and the nymphs commence feeding on the young grasses. Male stridulation is a continuous low buzz made during the day.

Idiostatus aequalis (Scudder)

See the revision of the genus by Rentz (1973) for a full discussion.

Recognition characters: Long-legged; males with elongate, incurved cercus with a small internal knob; all males and some females with a dark spot on the tip of the tegmen.

Geographic distribution: Westernmost Utah, Nevada, California south of Monterey, mostly in the Coastal Ranges; in the study area: Santa Monica Mountains, Point Conception.

Habitat and food preferences: Chaparral and coastal dunes in herbs and perennials as well as bushes. Aggregations of nymphs are often found in moist areas near creeks with lush vegetation. *I. aequalis* is ominivorous and feeds on fruits, grasses, and insects. It is not uncommon to observe specimens feeding on animals killed on roads at night.

Seasonal occurrence: Adult from late June to mid September.

Discussion: I. aequalis is primarily a nocturnal species, singing and mating at night, but males occasionally sing in the late afternoon deep within bushes. The song consists of a low continuous buzz. In late summer, this species is abundant along the margins of chaparral. Females oviposit directly in the ground.

Genus *Neduba* Walker

Rentz and Birchim (1968) revised this genus while Ueshima and Rentz (1979) commented upon the cytological relationships of the various taxa.

Intensive collecting of two of the common *Neduba* species in the study area coupled with detailed study of their morphology and stridulation, indicate that both species are comprised of morphologically, behaviorally, and ecologically different populations. Most differences are minor and we have chosen to recognize them as subspecies, although Walker (1964) has documented that such differences may reflect cryptic species. Because genitalic structure among *Neduba (sensu lato)* species is not as diversified as in many decticine genera, we suspect that other species of the genus previously reported as widespread represent, in reality, complexes of sibling species or subspecies similar to those we have delineated here.

Neduba (Aglaothorax) Caudell

The three species of this subgenus in the mainland study area form a distinctive group of small, uniformly colored *Neduba* species. Although there is some overlap in the measurements of the larger of the subspecies here described (*diminutiva dactyla, d. malibu*, and *morsei santacruzae*) and several other *Neduba* species (*gurneyi* Rentz and Birchim, and *ovata* subspecies), members of this group, including the above subspecies, rarely exceed 20 mm in length in either sex, whereas the other *Neduba* species are rarely smaller than 21 mm.

The three species are sympatric and synchronic in various combinations at some points in their range.

Neduba (Aglaothorax) diminutiva Rentz and Birchim

Recognition characters: In males: pseudocercal tooth apical (Figs. 253, 258, compare for example Fig. 265); in females: digitiform processes of subgenital plate elongate (Fig. 251, compare Fig. 268). The song is also distinctive in this group and consists of a long series (greater than 5 seconds) of short, staccato pulses (zit, zit, Fig. 248).

Geographic distribution: Middle (Contra Costa County) and southern (Channel Islands and Santa Monica Mountains) California in the Coast Ranges at low elevations. Males with the *diminutiva* song have been heard between these two areas but have not been studied.

Neduba (Aglaothorax) diminutiva diminutiva Rentz and Birchim (Figs. 249–252, Table 8)

Although this subspecies is not found in the study area, it is included for comparison with the new subspecies described herein.

Recognition characters: See Table 8.

Geographic distribution: Coast Ranges of Central California; Contra Costa (Mount Diablo) and San Benito Counties (Pinnacles National Monument).

Habitat and food preferences: Chaparral. This species was sypmatric with the more abundant *N. (N.) diabolica* (Scudder) which occurs under large trees and in the adjacent shrubby vegetation. *N. (A). d. diminutiva* was found on chamise bushes at night feeding on flowers. It appears to be rare.

Seasonal occurrence: Nymphs were found at the type locality in early spring, and adults in early July. It has a relatively short period of adult activity of about four to six weeks.

Neduba (Aglaothorax) diminutiva constrictans Rentz and Weissman, new subspecies (Figs. 37, 248, 253–255, Table 8)

Recognition characters: See Table 8.

Geographical distribution: Southern California, at Point Conception, Santa Barbara County.

Holotype male: California, Santa Barbara Co., Point Conception, Bixby Ranch, dunes near lighthouse, 8–viii–1971, D.C. Rentz, D.B. Weissman. Holotype in California Academy of Sciences, No. 12455. HEAD: fastigium produced, broadly rounded, with median longitudinal sulcus, width of fastigium equal to that of first antennal segment. PRONOTUM: disk narrowly ovate (Fig. 254), median carina weak, obsolete in anterior portion; lateral lobe produced, ventral margin subtruncate, surface of disk with a number of large tubercles. APPENDAGES: fore and middle femur with two rows of stout

TABLE 8
Distinguishing Characteristics among the Subspecies of *Neduba (A.) diminutiva.*

Character	*diminutiva* (Figs. 249–252)	*constrictans* (Figs. 253–255)	*dactyla* (Figs. 256–261)	*malibu*
Coloration				
Ground color	Light brown	Variable, light brown, grey	Dark brown, dark grey	Light brown
Pronotum	Speckled	Mottled, concolorous, not distinctly streaked	Dark brown or mottled	Light brown, speckled
Males				
Pseudocercus	Short	Elongate	Very elongate	Elongate
Apical tooth	?	Stout	Minute	Minute
Titillator				
Distal arm	Long, aciculate twisted, strongly concave	Short, feebly concave	Long, aciculate, twisted, strongly concave	Long, aciculate, not twisted, strongly concave
Base	Not constricted	Constricted	Not constricted	Not constricted
Females				
Supra-anal plate	Broader than long	?	Longer than broad	Longer than broad
Subgenital plate				
Median tooth	Absent	?	Present or absent	Absent
Lateral process	Shorter than other species	?	Extremely long	Extremely long
Notch	Broad	?	Narrow	Broad
Cercus	Relatively stout, apex strongly directed laterally	?	Relatively elongate, apex feebly directed laterally	Elongate, apex straight
Pronotum, distal margin	Truncate	?	Obtuse	Obtuse

spines dorsally. ABDOMEN: dorsal surface without median carina; supra-anal plate (Fig. 253) broader than long, apex truncate; cercus stout, elongate, *in situ* reaching end of supra-anal plate, apical tooth stout, titillator (Fig. 255) short, weakly concave on outer margin, constricted at base; phallic lobes elongate; subgenital plate with apex broad, styles less than half as broad as apical width of plate.

Variation: The type is speckled dark grey with darker longitudinal markings on the abdominal tergites; others are uniform straw brown or darker brown except for a dark stripe on the outer pagina of the hind femur and the purple tegmina.

Measurements (mm):

		Length body	Length pronotum	Width pronotum	Length hind femur
Males:					
Holotype		18.5	7.7	5.5	12.8
Paratopotypes (12)	Mean	16.3±1.4	8.1±0.4	5.8±0.3	14.0±1.2
	Range	14.5–19.1	7.5–8.8	5.3–6.5	13.0–17.5

Song: See Fig. 248.

Habitat: Coastal bluffs (known from a single locality, Fig. 37A) on *Eriogonum parvifolium, Lupinus arboreus, Haplopappus ericoides spp. palmeri* complex, and *H. venetus* var. *sedoides.*

Specimens studied: CALIFORNIA: SANTA BARBARA CO.: Point Conception, lighthouse area, 8–viii–1971 D.C. Rentz, D.B. Weissman, 3♂ including holotype; 8–viii–1974 D.B. Weissman, 10♂.

Discussion: Although males were common as judged by their singing, females were not seen. On large bushes, such as *L. arboreus* males occurred in the interior, whereas on smaller bushes, such as *E. parvifolium*, they were often perched on an outside branch. Males near each other synchronized their songs – one male began singing and neighboring males joined in sequential order. Several minutes elapsed between such singing periods usually initiated by the same male. The subspecies is named for the distinctive constriction at the base of the arm of the titillator.

Neduba (Aglaothorax) diminutiva dactyla Rentz and Weissman, new subspecies (Figs. 248, 256–261, Table 8)

Recognition characters: See Table 8.

Geographic distribution: Southern California, Santa Monica Mountains, Los Angles County, and Point Mugu, Ventura County.

Holotype female: California, Los Angeles Co., Santa Monica Mountains, Highway 23S and Mulholland Highway (9 km S. Thousand Oaks), 11–vii–1971, D.C. Rentz, D.B. Weissman. Holotype and allotype in California Academy of Sciences, No. 12434. HEAD: fastigium broadly triangulate, well produced, bearing median depression and minute median longitudinal sulcus, width of fastigium as great as that of first antennal segment. PRONOTUM: disk narrow, produced caudal, more so than in other subspecies; median carina weak but distinct, obsolete in anterior one-fifth where a minute transverse sulcus occurs; lateral lobe with ventral margin obtuse. APPENDAGES: fore and middle femur armed dorsally with a moderate number of widely scattered spines. ABDOMEN: dorsally with a weak but distinct median carina; supra-anal plate (Fig. 259) elongate, apex obtuse; cercus stout, conical, tapered subgenital plate (Fig. 260) elongate, lateral processes elongate, median notch narrow and with small tooth. Ovipositor (Fig. 261) armed on dorsal surface of dorsal valve with sixteen teeth, ventral surface with seven teeth, ventral lobe bearing five teeth. COLORATION: overall color dark grey brown, without streaks, lateral lobes of pronotum black, except along ventral margin; fore and median femora grey with apical black band extending onto opposing portion of tibia; outer pagina of hind femur black or dark brown in ventral half, bounded by a light longitudinal stripe.

Allotype male: Same data as for holotype, but collected 29–vi–1971. Differs from holotype in: pronotum (Fig. 256) attaining apex of first abdominal segment, distal margin subacute; tegmina with distal margins extending beyond pronotum; supra-anal plate (Fig. 258) wider than long, lateral margins concave; cercus *in situ* extending to apical two-thirds of supra-anal plate; pseudocercus slender, elongate, apical tooth minute; titillator (Fig. 257) with distal portion of arm elongate, concave on outer margin; phallic lobes elongate. Tegmina uniform dark purple.

Variation: Two of the four females have a distinct tooth mesad on the notch of the subgenital plate.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Allotype	15.8	8.1	5.3	13.0	
Paratopotypes (2)	18.1–21.0	7.8–8.7	5.6	14.0	
Females:					
Holotype	20.6	8.3	5.5	18.2	12.0
Paratopotypes (3)	18.3–20.6	7.4–8.5	5.2–6.0	16.6–18.1	12.0–13.0

Song: See Fig. 248.

Habitat: Coastal sage and chaparral.

Specimens studied: CALIFORNIA: LOS ANGELES CO.: Santa Monica Mountains, Highway 23S and Mulholland Highway. 30–vi–1971, 7–vii–1971, and 23–vii–1971, D.C. Rentz, D.B.Weissman, 3 ♂, 4 ♀, 1 ♀ nymph. VENTURA CO.: Point Mugu State Beach dune area below and into coastal sage, 13–vii–1971, D.B. Weissman, 1 ♂.

Discussion: At the Mulholland Highway site it is sympatric and synchronic with *N. m. curtatus* which it outnumbers. The name refers to the distinctive finger-like projections of the subgenital plate of the female.

Neduba (Aglaothorax) diminutiva malibu Rentz and Weissman, new subspecies (Fig. 35, Table 8)

Recognition characters: See Table 8.

Geographic distribution: Southern California, Santa Monica Mountains, Los Angeles County.

Holotype male: California, Los Angeles Co., Malibu, Big Rock Canyon Road, 0.4 km above Pacific Coast Highway (Fig. 35), 19–vi–1975, D.B. Weissman. Holotype (in alcohol) in California Academy of Sciences, No. 12433. HEAD: fastigium broadly triangulate, without median sulcus; width of fastigium slightly greater than that of first antennal segment. PRONOTUM: disk relatively well developed; tegmina slightly protruding; median carina present but faint; ventral margin of lateral lobe truncate. APPENDAGES: Fore and middle femora armed dorsally with a number of minute spines, hind femur armed with many stout spines dorsally. ABDOMEN: Supra-anal plate slightly longer than basal width, lateral margins weakly obtuse, apex emarginate; cercus stout, slightly narrowed in distal quarter, feebly directed laterad, *in situ* two-thirds length of supra-anal plate; pseudocercus slender, elongate, apical tooth minute; titillator arm elongate, broadly concave, not twisted. COLORATION: ground color light grey, pronotum with small black spots on posterior margin; fore and median femora with a subapical dark band; opposing portion of tibia similarly colored but not as intensely; fore and median tibia each with a subapical light brown band; hind femur with a faint longitudinal stripe on outer pagina, dorsal stripe somewhat lighter. Tegmina dark purple.

Allotype female: California, Los Angeles Co., Malibu, corner of Big Rock and Inland Roads 28–vi–1976. D.B. Weissman. Differs from holotype in: fore femur armed dorsally with only a single dorsal, subapical spine; supra-anal plate one and one half times longer than broad, apex truncate; cercus half again longer than basal width, conical, straight; subgenital plate notch broad without median

tooth, digitiform processes very long; ovipositor with 13 teeth on dorsal margin, ventral margin with 5, 6 teeth. Coloration darker.

Variation: One specimen has an abnormally short pronotum (see Measurements) which leaves the apical third of the tegmina uncovered. One specimen has a pattern of dark spots on the dorsal surface of the abdomen creating two indistinct longitudinal stripes.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	21.0	8.4	5.8	14.2	
Paratopotypes (4)	19.5–23.0	6.3–9.2	5.3–6.6	14.1–15.0	
Female:					
Allotype	17.7	8.2	5.6	17.9	13.3

Habitat: Most specimens were collected on introduced ice plant (*Mesembryanthemum*), but others were heard less commonly in nearby chaparral, the apparent natural habitat.

Specimens studied: Type, allotype, and four additional males at allotype locality.

Discussion: The type series was collected in a large expanse of ice plant in association with *Neduba (A.) longipennis*. The two species were completely sympatric but easily distinguished by song. The name of the species refers to the type locality.

Neduba (Aglaothorax) longipennis Rentz and Weissman, new species (Figs. 35, 248, 262–264)

Recognition characters: In males: tegmina protrude beyond pronotum, posterior margin of pronotal disk acute, calling song of only two to five lisps followed by a pause of a minute or more. In females: subgenital plate with a broad, shallow excavation, lateral appendages very short.

Geographic distribution: Southern California, Santa Monica Mountains, Los Angeles County.

Holotype male: California, Los Angeles Co., Malibu, entrance to Big Rock Canyon, Big Rock Canyon Road, first curve, 75 m above Pacific Coast Highway, 20–viii–1974, D.B. Weissman. Holotype and allotype deposited in California Academy of Sciences, No. 12438. HEAD: fastigium of vertex broadly triangulate without median depression, first antennal segment half again as broad as fastigium; eye ovate. PRONOTUM (Fig. 263): anterior margin of disk weakly concave, posterior margin broadly acute; lateral lobes shallow, ventral margin truncate; surface of disk faintly tuberculate, with very weak median carina; tegmina protruding beyond pronotal apex for nearly one-quarter their length. APPENDAGES: fore femur unarmed dorsally, middle femur dorsally with two spines, hind femur with a moderate number of spines over entire dorsal surface. ABDOMEN: with strong median dorsal carina; supra-anal plate (Fig. 262) about as long as broad, apex truncate; cercus elongate, straight, reaching midpoint of pseudocercus; pseudocercus (Fig. 262) flanged basally, distal portion slender, apex rounded; tooth of pseudocercus subapical, minute; titillator (Fig. 264) arms short, stout, weakly directed laterad; phallic lobes apically broadly rounded; subgenital plate narrowed distad, styles elongate, half as long as intra-stylar distance. COLORATION: uniformly straw brown except outer pagina of hind femur dark brown, darker in ventral half, all spines dark tipped, tegmina uniformly lavender with distal margin somewhat darker.

Allotype female: Los Angeles Co., Malibu, Big Rock Canyon Road junction with Rockport Road, 19–vi–1975 (matured 20–vii–1975), D.B. Weissman. Differs from holotype in: fore femur armed dorsally with five minute spines; supra-anal plate one and one quarter times as long as broad, apex subacute; cercus slender, conical, apex weakly but distinctly directed outward; subgenital plate elongate, with broad, shallow excavation, lateral appendages very short, acute; ovipositor with eight and nine teeth on dorsal margin, ventral margin with six and eight very minute, blunt teeth.

Variation: Two males have the tegmina reduced and barely extending beyond the apex of the pronotum, whereas the other males have tegmina which protrude considerably beyond the apex of the pronotum as in the holotype. A single female shows traces of black markings on the sides of the abdomen. The rest have the abdomen concolorous. Half of the type series is colored like the holotype and allotype. The others are dark grey or brown.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length tegmen	Length file	Length ovipositor
Males:							
Holotype	15.4	7.4	5.2	13.2	5.2	3.5	
Paratopotypes (8)	14.6–17.6	7.3–8.4	5.9–6.3	13.2–14.4			
Females:							
Allotype	15.2	7.5	5.2	15.5			11.2
Paratopotypes (5)	15.5–18.0	6.1–7.3	5.1–5.6	14.3–16.0			11.0–12.0

Song: See Fig. 248.

Habitat: Nocturnally in chaparral and canyon stream bottom vegetation (Fig. 35, type locality). Most specimens were found on the introduced ice plant (*Mesembryanthemum*), others were heard less commonly in adjacent chaparral.

Specimens studied: Type, allotype, and 13 ♂, 6 ♀ at allotype locality.

Discussion: N. longipennis is sympatric with *N. d. malibu* at the type locality. *N. longipennis* is more common, as indicated by numbers of singing males, and occurs closer to the canyon floor. The calling song of this species is highly distinctive (Fig. 248) comprising a brief series of two to five pulses. Males sing from deep within perennial vegetation and, although common, are extremely difficult to capture. The name refers to the protruding tegmina of the males.

Neduba (Aglaothorax) morsei Caudell

Recognition characters: From *N. (A.) diminutiva* males: pseudocercal tooth always subapical (Figs. 265, 270, 279, 289, 298); females: digitiform processes of subgenital plate short (Fig. 268, compare Fig. 251). From *N. (A.) longipennis* males: by the tegmina which are concealed or almost so by the pronotum. The song is distinctive in this group and is best compared to a shuffling sort of motion (Fig. 286), in contrast to the staccato pulses of *N. (A.) diminutiva* species.

Geographic distribution: Southern California on the Channel Islands and nearby Cross Ranges to Mount Wilson. Arizona material and that from farther south have not been studied.

Neduba (Aglaothorax) morsei morsei Caudell
(Figs. 265–269, Table 9)

Although this subspecies is not found in the study area it is included for comparison with the new subspecies described herein.

Recognition characters: See Table 9.

Geographic distribution: Southern California, Los Angeles County, Mount Wilson. Material recorded by Rentz and Birchim (1968) from elsewhere has not been restudied.

Holotype male: California Mount Wilson, Altadena, 2400 ft., July 27, 1897. Type #15406, *Tropizaspis morsei* Caudell, Type. A.P. Morse coll. Holotype in ANSP. HEAD: missing. PRONOTUM: most of disk missing, ventral margin of lateral lobe broadly rounded; tegmina missing. APPENDAGES: all legs missing except fore and middle legs of right side, hind legs detached; fore tibia armed dorsally with two spines, one at distal margin of auditory foramen, the other at apex of posterior margin; middle

TABLE 9
Distinguishing Characteristics among the Subspecies of *Neduba (A.) morsei.*

Character	*morsei* (Figs. 265–269)	*curtatus* (Figs. 276–278)	*santacruzae* (Figs. 289–294)	*islandica* (Figs. 279–285)	*costalis* (Figs. 270–275)	*tectinota* (Figs. 297–302)
Spination						
Fore femur, dorsal surface	3 spines	Unarmed	Variable	Unarmed	Unarmed	Variable
Fore tibia spine over auditory foramen	Variable	Unarmed	Unarmed	Variable	Variable	Variable
Middle tibia dorso-anterior margin	4	2	2	3	1–2	1–2
Vestiture						
Fore and middle tibia	Dense	Sparse	Almost naked	Sparse	Moderate	Dense
Coloration						
Ground color	Dark brown	Dark brown	Light brown or grey	Light brown or grey	Light brown	Mottled dark grey
Pronotum	Uniform	Uniform	Uniform	Sometimes streaked	Uniform	Sometimes streaked
Males						
Pseudocercus	Slender	Stout	Elongate	Stout	Stout	Robust
Tooth	?	Minute	Large	Minute	Minute	Large
Cercus	Short, stout	Slender	Short, stout	Slender	Slender	Extremely elongate
Titillator arm	Stout	Short, highly concave	Aciculate concave	Short, stout	Stout, concave	Aciculate, highly concave
Females						
Supra-anal plate	Very elongate	As long as broad	As long as broad	Longer than broad	Longer than broad	Longer than broad
Subgenital plate						
Notch	Narrow	Narrow	Broad	Narrow	Broad	Broad
Median tooth	Present	Present	Absent	Absent	Absent	Present
Lateral process	Elongate	Stout	Stout	Stout	Stout	Stout
Cercus	Elongate, straight	Very elongate, apex feebly outcurved	Elongate, apex outcurved	Robust, straight	Elongate, apex outcurved	Elongate, apex outcurved

tibia armed dorsally on anterior margin with four evenly spaced spines; dorsal surface of fore femur bearing three stout anterior-projecting spines near apex of posterior margin; hind femur with a large number of spines dorsally. ABDOMEN: with prominent carina on dorsal surface; supra-anal plate slightly broader than long, apex truncate; cercus short, conical, apex not produced; pseudocercus (Fig. 265) slender, apex sub-acute, subapical tooth small; titillator (Fig. 266) with distal portion of arm stout, apex directed laterad; subgenital plate with apex missing.

Female pleisiotopotype: Same data as holotype, except collected 14–ix–1908. In ANSP. Supra-anal plate (Fig. 267) elongate, rounded; cercus conical, elongate, evenly tapered to apex which is feebly directed laterad *in situ* surpassing apex of supra-anal plate; subgenital plate (Fig. 268) notch narrow and with median tooth, appendages elongate; ovipositor (Fig. 269) with twelve teeth on dorsal margin and seven teeth on ventral margin of dorsal valve; ventral valve with seven teeth; coloration pale brown, ventral half of outer pagina of hind femur darker, this area bounded by a whitish stripe.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	14.4	*	*	15.8	
Females:					
Topotypes (2)	18.7–19.7	8.4–8.5	5.8–6.3	17.6–18.8	12.0–13.6

*damaged specimen

Habitat: Probably chaparral.
Seasonal occurrence: Adults from 27 July to 18 October.

Neduba (Aglaothorax) morsei costalis Rentz and Weissman, new subspecies (Figs. 270–275, 286, Table 9)

Recognition characters: See Table 9.

Geographic distribution: Southern California, Santa Monica Mountains, Los Angeles and Ventura Counties.

Holotype male: California, Ventura Co., Point Mugu State Park, 13–viii–1973, D.B. Weissman. Holotype and allotype in the California Academy of Sciences, No. 12439. HEAD: fastigium of vertex broad with weak median depression; first antennal segment as wide as fastigium; eye ovate, not bulging. PRONOTUM (Fig. 271): small, not greatly expanded, with anterior margin of disk straight, posterior margin obtuse; lateral lobe shallow, ventral margin weakly concave; surface of disk moderately tuberculate, median carina weak; tegmina concealed by pronotum. APPENDAGES: fore tibia dorsally, with a single apical spine; middle tibia dorsally with two spines on anterior margin; fore and middle tibia hirsute. ABDOMEN: with strong median carina on all but last two segments; supra-anal plate (Fig. 270) slightly longer than broad, apex truncate; cercus attenuate conical, feebly directed laterad, attaining distal two thirds of supra-anal plate; pseudocercus broad, stout, apex broad, subapical tooth heavy; titillator (Fig. 274) with distal portion of arm short, stout, much shorter than base, outer margin slightly concave, phallic lobes stout, apices broadly rounded; subgenital plate relatively narrow, apex very narrow, styles robust, approximately half as long as inter stylar distance. COLORATION: uniform grey brown with dark brown markings on dorsal portions of lateral pronotal lobes and on ventral half of the posterior femur, this area bounded by a whitish stripe; dorsum of abdomen with faint darker blotches laterally.

Allotype female: Same data as for holotype. Supra-anal plate (Fig. 272) longer than broad, *in situ* reaching apex of supra-anal plate; subgenital plate (Fig. 275) notch broad and smooth, lateral projections short, in length half width of the notch; ovipositor (Fig. 273) short, dorsal valve with eleven teeth on dorsal margin, seven teeth on ventral margin, ventral valve with seven teeth.

Variation: The holotype is the only specimen which bears no spine on the dorsal surface of the fore tibia distad of the auditory foramen. Several males have the spine on one side and not the other. The series also shows variation in the number of teeth on the ovipositor valves. A pair of topotypic specimens taken in 1974 are light straw brown in coloration with a series of black spots along the distal edge of the pronotum.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	15.5	8.1	6.0	13.6	
Paratypes (4)	14.2–16.0	7.4–7.9	5.3–5.7	12.0–13.1	
Females:					
Allotype	14.0	6.3	5.1	15.2	11.0
Paratypes (3)	14.4–16.6	6.8–7.2	5.1–5.4	15.0–16.7	11.1–12.0

Song: See Fig. 286.

Habitat: Coastal sage and riparian, in low branches of trees and in leaf litter.

Specimens studied: CALIFORNIA: VENTURA CO.: Point Mugu State Park, 13–viii–1973, 21–viii–1974, D.B. Weissman, 5 ♂, 4 ♀, including holotype and allotype; LOS ANGELES CO.: Malibu, corner of Malibu Canyon Road and Pacific Coast Highway, 1–vii–1976, D.B. Weissman, 2 ♂.

Discussion: The species occurs sympatrically and synchronically with *N. d. dactyla* but the songs are very different. The song of *N. m. costalis* consists of a series of closely spaced pulses which resemble a shuffling motion (Fig. 286). This species is also more common than *N. d. dactyla. N. m. costalis* was found within $\frac{1}{2}$km of *N. d. dactyla* in a similar coastal sage habitat, but that of the latter was more open and just above the dunes. The name refers to its coastal distribution.

Neduba (Aglaothorax) morsei curtatus Rentz and Weissman, new species (Figs. 276–278, 286, Table 9)

Recognition characters: See Table 9.

Geographic distribution: Southern California, Santa Monica Mountains, Los Angeles County.

Holotype male: California: Los Angeles Co.: Santa Monica Mountains, Highway 23S and Mulholland Highway (9 km S. Thousand Oaks), 548 m., 24–vi–1971, D.C. Rentz, D.B. Weissman, D.C. Rentz, recording 113. Holotype and allotype in California Academy of Sciences,, No. 12436. HEAD: fastigium of vertex produced, peg-like, with broad median longitudinal impression; eye distinctly cordate. PRONOTUM (Fig. 276): moderately produced almost completely concealing tegmina; posterior margin broadly rounded, disk with well defined median carina; lateral lobes deep, ventral margin truncate; surface of disk with a few widely scattered tubercles. APPENDAGES: fore tibia dorsally with only a single apical spine; middle tibia dorsally with two spines on anterior margin; internal genicular lobes of median tibia very sparsely hirsute. ABDOMEN: with well defined median carina; supra-anal plate (Fig. 277) as long as broad, apex broadly rounded; pseudocercus short, stout, with minute subapical tooth; titillator (Fig. 278) with distal portion of arm short, highly concave; phallic lobes rather stout. COLORATION: dark brown, abdomen without any dark markings; fore and middle femora with distal black band, opposing base of tibia similarly colored; outer pagina of hind femur with a narrow longitudinal black stripe, ventral half of femur somewhat darkened; tegmina dark purple, apically suffused with brown.

Allotype female: Same data as holotype except collected 30–vi–1971. ABDOMEN: Supra-anal plate elongate, apex broadly rounded; cercus elongate, apex feebly directed laterad, *in situ* reaching distal two-thirds of plate; subgenital plate notch narrow and with small median tooth, lateral projections short; ovipositor elongate, dorsal valve with eleven teeth on dorsal margin, seven teeth on ventral margin, ventral valve with seven teeth. COLORATION: somewhat lighter than in holotype and with a trace of a pattern on the dorsal surface of abdomen.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	17.0	7.5	5.7	12.8	
Paratopotype	14.0	7.1	5.2		
Females:					
Allotype	17.5	7.0	5.6	14.7	12.5

Song: See Fig. 286.

Habitat: Chaparral and garden.

Seasonal occurrence: Adult in mid-summer.

Specimens studied: At the type locality in addition to the types: 13–vii–1972, D.B. Weissman, 1 ♂; 23–vi–1971, 30–vi–1971, D.C. Rentz, D.B. Weissman, 1 last instar ♂ and ♀, 1 antepenultimate ♀ and ♂.

Discussion: This subspecies occurs sympatrically and synchronically with *N. d. dactyla* though it may mature later. The song of this species is distinctive in its brevity (Fig. 286) in comparison with other subspecies of *N. morsei*, and is intermediate between the songs of *N. morsei* and *N. diminutiva*. The name refers to the short song.

Neduba (Aglaothorax) morsei islandica Rentz and Weissman, new subspecies (Figs. 16, 279–288, Table 9)

Recognition characters: See Table 9.

Geographic distribution: Southern California, Anacapa, and Santa Rosa Islands only.

Holotype male: California, Ventura Co., West Anacapa Island, Frenchy's Cove, 23–vi–1971, D.C. Rentz, D.B. Weissman, D.C. Rentz recording 117. Holotype and allotype in California Academy of Sciences, No. 12440. HEAD: fastigium of vertex broad, not as produced as in other subspecies, with short but distinct median sulcus; eye cordate. PRONOTUM (Fig. 280): large, expanded distally, apex broadly rounded, median carina weak but distinct; lateral lobes relatively deep, ventral margin truncate; surface of disk feebly rugose, not tuberculate; tegmina slightly protruding from beneath pronotum. APPENDAGES: fore tibia dorsally with a single apical spine; middle tibia dorsally with three spines on anterior margin; fore and middle tibia sparsely hirsute. ABDOMEN: with weak median carina; supra-anal plate (Fig. 279) elongate, apex truncate; cercus conical, elongate, two-thirds the length of supra-anal plate; pseudocercus broad, stout, subapical tooth relatively minute; titillator (Figs. 284, 285) with distal arms very short; phallic lobes elongate. COLORATION: greyish, pronotum light grey brown with darker brown blotches, not striped; fore and middle femora with a distal black band, opposing base of tibia similarly colored; outer pagina of hind femur with ventral half contrastingly darker than dorsal half, area separating the two intensified by a light cream-colored stripe; dorsum of abdomen whitish, region bounding this area outlined in black, sides of abdomen grey brown; tegmina purple or lavender, distal mantle dark brown.

Allotype female: Same data as holotype. Supra-anal plate (Fig. 283) slightly longer than broad, apex obtuse; cercus robust, almost straight, but feebly directed laterad, *in situ* slightly surpassing apex of supra-anal plate; subgenital plate (Fig. 281) notch narrow, shallow, without a median tooth, lateral

projections short, stout, in length about half width of notch; ovipositor (Fig. 282) elongate, dorsal valve with nine teeth on dorsal margin, six teeth on ventral margin, ventral valve with eight teeth.

Variation: A number of males bear a spine on the fore tibia distad of the auditory foramen. Several have the spine present on one leg but absent on the other. The type series is predominantly grey in coloration. Only four brown specimens are present (Fig. 288). A number of individuals have dark longitudinal stripes on the pronotum (Fig. 287). The two males from Santa Rosa Island are light brown in color, the females are dark grey brown. The evidence indicates that the coloration, at least in this subspecies, may be edaphically controlled.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	17.0	6.5	5.9	15.0	
Paratypes (14)	15.5–19.9	8.1–9.5	5.7–6.6	13.8–16.7	
Females:					
Allotype	18.6	7.9	5.9	17.3	12.5
Paratypes (5)	16.2–19.8	7.5–8.7	5.4–6.3	17.0–18.6	11.5–13.0

Song: See Fig. 286.

Habitat: Coastal bluff community, chaparral, dry riverbed.

Specimens studied: CALIFORNIA: VENTURA CO.: West Anacapa Island, Frenchy's Cove, 27–vi–1971, D.C. Rentz, D.B. Weissman, 5♂, 6♀, including holotype and allotype; Middle Anacapa Island, 16–vi–1970, D.B. Weissman, 7♂, 2♀. SANTA BARBARA CO.: Santa Rosa Island, Black Mountain, 1.2 km N. summit in *Quercus dumosa*, D.B. Weissman, 2♂, 2♀.

Discussion: At Frenchy's Cove specimens were found under rocks during the day. At night the katydids emerged from these shelters and from their plant cover and moved on to the widely scattered woody perennials such as *Coreopsis giganteum* and *Eriogonum* spp. where they sang and could be seen feeding. During overcast days scattered males were heard at irregular intervals. Males usually commence singing just prior to sunset. On 20 July, 1972, a stiff wind at dusk apparently caused the katydids to cease singing. Later around 2:00 a.m. the wind ceased and stridulation commenced and continued until dawn. This subspecies may also occur on East Anacapa Island, but we have not detected it.

This subspecies is rare on Santa Rosa Island. Even though much of the island was traversed at night both in 1971 and in 1974, specimens were heard only near the crest of Black Mountain (396 m elevation) and at the entrance to Windmill Canyon.

Biogeographically, *N. m. islandica* is of particular interest. It is the only orthopteran species on the northern Channel Islands to show a disjunct distribution: it occurs on Anacapa and Santa Rosa Islands but not on the intervening Santa Cruz Island where *N. m. santacruzae* is found. This situation probably reflects the following events. When sea level was sufficiently lowered sometime between 100,000 and 18,000 years ago the four northern islands were connected with each other but not with the mainland. *N. m. islandica* was probably found on all the northern islands at that time. Sea level then rose isolating each island. The San Miguel Island population became extinct with the destruction of its habitat. The Santa Cruz Island population changed sufficiently so that we now recognize it as a separate subspecies, but the

populations on Santa Rosa and Anacapa Islands have not diverged and we consider them consubspecific.

Neduba (Aglaothorax) morsei santacruzae Rentz and Weissman, new subspecies
(Figs. 286, 289–295, Table 9)

Recognition characters: See Table 9.

Geographic distribution: Southern California, Santa Cruz Island only.

Holotype male: California, Santa Barbara Co., Santa Cruz Island, University of California Research Station, 1–viii–1969, D.C. Rentz, D.B. Weissman. Holotype and allotype in California Academy of Sciences, No. 12441. HEAD: fastigium of vertex low, broad, with median Y-shaped sulcus; eye low, cordate. PRONOTUM (Fig. 290): disk greatly expanded caudad; median carina present, but weak; lateral lobes shallow, ventral margin broadly obtuse; surface of disk smooth; tegmina wholly concealed. APPENDAGES: fore tibia dorsally with a single apical spine; middle tibia dorsally with one spine on anterior margin; fore and median tibia sparsely hirsute; fore femur dorsally with a few scattered short spines at base. ABDOMEN: with strong dorsal carina; supra-anal plate (Fig. 289) short, broad, apex truncate; cercus short, stout; pseudocercus short, slender, internal tooth robust; titillator (Fig. 293) arm shorter than base, aciculate, greatly concave on outer margin, base not constricted; phallic lobes acute; subgenital plate with styles elongate. COLORATION: uniformly light straw brown in color except: eye dark brown, outer pagina of hind femur with a narrow darker brown longitudinal stripe.

Allotype female: Same data as for holotype. Supra-anal plate (Fig. 294) as long as broad, apex obtuse; cercus elongate, apex distinctly directed outward, *in situ* surpassing apex of supra-anal plate; subgenital plate (Fig. 291) with notch broad, truncate, without median tooth; lateral projections stout, length two-thirds width of notch; ovipositor (Fig. 292) relatively short.

Variation: A number of males lack completely the subapical spine of the fore and middle femora. A number have a minute spine on one side, none on the other. Similarly, the scattered minute spines of the dorsal surface of the basal portion of the femora may be present or absent, frequently on one side and not the other. All but the holotype bear two spines on the anterior dorsal margin of the median tibia. The subspecies is the only geographic race studied which completely lacks a spine over the auditory foramen of the fore tibia. Most males have the apex of the supra-anal plate rounded, but two specimens have it distinctly truncate. Although a full range of color patterns is present the predominant ground color is brown (Fig. 295).

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	19.4	9.7	6.8	14.4	
Paratopotypes (4)	17.0–20.0	8.2–8.6	6.0–6.6	13.0–14.5	
Females:					
Allotype	21.5	8.5	6.0	17.5	13.0
Paratopotypes (3)	20.0–20.2	8.2–8.3	6.3–6.5	16.1–17.2	11.0–12.0

Song: See Fig. 286.

Habitat: Probably throughout island in chaparral and in adjacent oak savannah, often in lush vegetation around oaks.

Specimens studied: CALIFORNIA: SANTA BARBARA CO.: Santa Cruz Island, U.C. Research Station, 1–viii–1969, 14–viii–1974, D.C. Rentz, D.B. Weissman, 6♂, 4♀, including holotype and allotype; Prisoner's Harbor, 22–vii–1968, C.L. Remington, 1♀.

Discussion: The type population at the University of California Research Station is large, but not as dense as those on Middle and West Anacapa Islands. Males can be heard singing at night from the Research Station north to Prisoner's Harbor and from the Research Station south into the Christi Pines.

Neduba (Aglaothorax) morsei tectinota Rentz and Weissman, new subspecies (Figs. 33, 286, 297–302, Table 9)

Recognition characters: See Table 9.

Geographic distribution: Southern California, coastal area of Santa Monica Mountains, Los Angeles County.

Holotype male (Fig. 298): California, Los Angeles Co, Point Dume, corner Birdview and Cliffside Drive, 13–viii–1973, D.B. Weissman. Holotype and allotype in California Academy of Sciences, No. 12442. PRONOTUM: disk greatly expanded posteriorly (Fig. 297), apex broadly rounded, wholly concealing the tegmina. APPENDAGES: fore tibia dorsally with a single apical spine; middle tibia dorsally with one and two spines on anterior margin; fore and middle tibia and femora relatively densely hirsute. ABDOMEN: cercus more proportionally elongate than in any other subspecies (Fig. 298), robust, basal portion broad, subapical tooth large; supra-anal plate as long as basal width, apex broadly rounded; titillator (Fig. 299) with basal portion elongate, apex short, strongly curved outward; phallic lobes broad, dorsal surface feebly tuberculate; subgenital plate narrowed apically, styles elongate, at least five times as long as basal width. COLORATION: uniform brown, lateral lobes of the pronotum darker,; outer pagina of the hind femur is somewhat darker but not forming a distinct stripe.

Allotype female: Same data as for holotype. Differs from male in: fore and middle femora armed dorsally each with a subapical spine, basal portion of each femur bearing minute spines; fore and median tibia and femora sparsely hirsute; supra-anal plate longer than broad, apex broadly rounded; cercus elongate (Fig. 300) apex surpassing supra-anal plate, distal third narrowed, directed outward; subgenital plate (Fig. 301) with notch slightly broader than length of lateral processes, with median projection. Ovipositor long (Fig. 302), dorsal valve with 14 teeth on dorsal margin, 11 teeth on ventral margin.

Variation: There is considerable variation in the number of spines present on the dorsal surface of the middle tibia even on a single individual specimen. The dorsal surface of the fore and median femur and the genicular lobes are spined on some specimens but unspined on others. The production of the pronotum is greatest in the holotype although its distinctive nature is exhibited by all the other males. The color pattern of this subspecies is highly variable and each specimen is distinctive. Two males have dark longitudinal stripes on the pronotum. Another has the distal portion of the disk of the pronotum whitish. A single male is uniformly dark grey. In many individuals the outer pagina of the hind femur is contrastingly marked, the dorsal half light, the ventral half dark brown, the two zones separated by a thin white stripe. The most notable variation in females is that of the subgenital plate. The tooth is present only in the allotype and is absent in the remaining two paratypes.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length hind femur	Length ovipositor
Males:					
Holotype	16.0	9.4	6.8	15.3	
Paratopotypes (7)	13.0–15.5	8.0–9.3	5.8–6.4	13.2–15.4	
Females:					
Allotype	16.9	8.6	6.6	18.7	14.1
Paratopotypes (2)	15.7–18.0	7.2–7.8	5.4–5.5	16.1–16.2	11.5–12.6

Song: See Fig. 286.

Habitat: Coastal bluff and sand dunes (Fig. 33).

Specimens studied: CALIFORNIA: LOS ANGELES CO.: Point Dume, corner Birdview and Cliffside Drive, 13–viii–1973, D.B. Weissman, 2♂, 2♀, includes holotype and allotype: 18–vii–1974, D.B. Weissman, 5♂, 1♀.

Discussion: N. (A.) m. tectinota is similar in many respects to the nominate form of the species but differs considerably in the proportions of the pseudocerci (*cf.* Figs. 265 and 298) and the cerci. The type population is large. Males and females prefer coastal bluffs rather than dunes. The name refers to the large, shield-like pronotum.

Neduba (Neduba) propsti Rentz and Weissman, new species (Figs. 248, 296, 303, 304)

Recognition characters: In males: pronotum short, truncated; cerci, subgenital plate, and styles elongate. Female unknown.

Geographic distribution: Southern California, Santa Catalina Island only.

Holotype male: California, Los Angeles Co., Santa Catalina Island, 1 km NE. Middle Ranch, Middle Ranch Canyon, 17–vi–1971, D.C. Rentz, D.B. Weissman, D.C. Rentz recording 94. Holotype (in alcohol) (Fig. 296), in California Academy of Sciences, No. 12443. HEAD: fastigium of vertex prominent, quadrate, with weak median sulcus; eye round; second segment of antenna with a distinct but small swelling on internal margin. PRONOTUM: weakly rugose; median carina indicated solely in median portion of disk; anterior portion of disk with prominent transverse sulcus; anterior margin of disk weakly concave, posterior margin truncate extending to median portion of first abdominal segment. APPENDAGES: fore tibia dorsally with two very small spines, one at distal margin of auditory foramen, the other at apex of tibia; dorsal surface of all femora with distally directed spines, those of the hind femur more numerous and more prominent. Tegmina with apical protruding portion flanged. ABDOMEN: with weak, but distinct median carina; supra-anal plate with corners produced, broadly rounded; cercus (Fig. 303) very elongate, with apex feebly directed outward, reaching apex of supra-anal plate; subgenital plate (Fig. 304) elongate, median portion weakly concave, styles elongate, about half as long as interstylar distance; pseudocercus unmodified, elongate, internal margin straight; titillators (Fig. 303) with apices acute, abruptly directed dorsad, ventral sclerites small. COLORATION: uniform grey; eye bi-colored; lateral lobe of pronotum with dark brown humeral angle typical of subgenus; distal quarter of fore femur and adjacent portion of tibia with dark brown to black band, that of tibia less heavily pigmented; middle femur and tibia similarly marked but less heavily pigmented; hind femur and tibia without any trace of apical banding; outer pagina of hind femur with longitudinal black stripe running for nearly entire length of appendage; tegmina with exposed portions blackish; antenna faintly but distinctly banded.

Variation: One specimen bears faint dark grey markings laterally on first three abdominal segments, a highly variable character in *Neduba*.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length fore femur	Length middle femur	Length hind femur
Males:						
Holotype	26.4*	9.1	6.3	5.3	6.9	22.3
Paratopotypes (2)	23.0–23.5	9.0–9.3	6.6–6.8	5.3–5.5	6.5–6.7	20.6–22.2

*Somewhat distended because of poor preservation; measured from fastigium to apex of pseudorcerci.

Song: See Fig. 248.

Habitat: Riparian, chaparral, oak woodland; usually in denser vegetation, probably throughout island.

Specimens studied: In addition to the holotype: CALIFORNIA: LOS ANGELES CO.: Santa Catalina Island, Middle Ranch Canyon, 2.6 km above Ben Weston beach, 17–vi–1971, D.C. Rentz, D.B.Weissman, 1 ♂; Isthmus area, west of Isthmus, along dirt road through chaparral leading to northwest end of island, 30–vi–1973, D.B. Weissman, 1 ♂.

Discussion: The calling song is of the zwee-zwee type of the subgenus (Fig. 248). It is very high pitched, continuous, extremely loud, and can be heard for a considerable distance. Singing males are dispersed and in some 4.0 km along a road we heard only twelve males.

This species is not closely related to any described species in the subgenus.

This species is named in honor of Mr. Douglas R. Propst, congenial manager of the Santa Catalina Rock and Ranch Co., who extended every courtesy to the authors during our visits to the island.

GRYLLIDAE: Crickets

GRYLLINAE: Field Crickets

Genus *Gryllus* Linnaeus

There has been no modern study of the western members of this genus, but, using the methods pioneered by Fulton (1952) and Alexander (1957), we have identified six species in the study area. We are hesitant to describe any of these until the old specific names of the western forms are properly assigned and the species are studied from a wider area in the western United States. Revisionary studies are under way by Weissman et al. (1980).

In general no one character should be used to identify any of the western species of *Gryllus* as we have sorted them out (Table 10). Song is unquestionably the most important one, but it must be recorded and analyzed by sonograms for the greatest utility. Structural details of the file of the male are also of primary significance. Habitat is another important character. The remaining morphological characters have been frequently used in the past but in general they must be used in conjunction with song, file, or habitat for adequate identification.

Gryllus I
(Fig. 305)

Recognition characters: See Table 10.

Geographic distribution: Southern California, along coastal plain from Santa Barbara to San Diego Counties; in the study area: Santa Monica Mountains, Santa Catalina and Santa Cruz Islands.

Song: See Table 10 and Fig. 305.

Habitat: Usually near water, salt and fresh water marshes, coastal beaches, reservoirs, cultivated and irrigated fields; under vegetation, seldom in cracks.

Seasonal occurrence: Most numerous in summer, isolated individuals heard throughout year.

Discussion: The song of this species is distinctive. Only one micropterous individual has ever been seen (Middle Ranch Reservoir, Santa Catalina Island). *Gryllus* I is often found sympatrically with *Gryllus* IV.

TABLE 10
Summary of Acoustical, Morphological, and Ecological Characteristics among *Gryllus* Species.

Gryllus	Habitat	Ave. chirp rate (range)**	Pulses per chirp (range)	Teeth (T) range and Aver. T/mm	Wing length	Body color	Geographic range
I	moist areas	61 (25–100)	12–14* (11–16)	108–143/35	long	dark body and lighter wings	SMM, SCr, SCa
II	chaparral	110 (70–165)	4 (3–5)	146–190*/40	short (usually)	dark body and wings	SMM, An, SCr, SCa
III	grassfields, chaparral (in cracks)	175 (80–300)	7–8 (6–10)*	112–152/40	short and long	variable, red to black	SMM, all Channel Islands except SM
IV	moist areas	260 (195–415)	2–3	126–150/41	usually short	dark body and wings	SMM only
V	grassland	?	?	111/31.7	short	dark body and wings	SN only* (compare with *G.* III and VI)
VI	widespread	1000* (720–1260)	3 (2–3)	115–152/41	long	dark body and lighter wings	SCr, SN, SM, SB, SMM

*Character unique to this species; a combination of characters needed for *Gryllus* IV.
**Includes data of Maskel (1975).

Key:

SB = Santa Barbara Island
SCa = Santa Catalina Island
An = Anacapa Island
SCr = Santa Cruz Island
SM = San Miguel Island
SMM = Santa Monica Mountains
SN = San Nicolas Island

Gryllus II
(Figs. 306, 310)

Recognition characters (Fig. 310): See Table 10.

Geographic distribution: Southern California, widespread from Santa Barbara to San Diego Counties; in the study area: Santa Catalina, Santa Cruz, and Anacapa Islands, Santa Monica Mountains.

Song: See Table 10 and Fig. 306.

Habitat: Chaparral, in cracks in ground or under rocks in dry stream-beds.

Seasonal occurrence: Adult from late spring probably into fall.

Discussion: This species is sympatric with *Gryllus* III. Individuals in rock piles are not easily deterred from singing by the disturbance created by collectors searching for them.

Gryllus III
(Figs. 307, 311–313)

Recognition characters: See Table 10.

Geographic distribution: Southern California, widespread from Santa Barbara to San Diego Counties; in the study area: all Channel Islands except San Miguel, Santa Monica Mountains.

Song: See Table 10 and Fig. 307.

Habitat: Widespread in grassland, chaparral, coastal sage, coastal beach, and oak woodland; almost always in cracks.

Seasonal occurrence: Most common in summer, although isolated individuals heard almost any time of year.

Discussion: This is the most common, ecologically widespread, and morphologically variable *Gryllus* species in the study area. Individuals vary from almost uniform black (Fig. 311) to light red-brown (Figs 312 and 313). It is sympatric with *Gryllus* II, *Gryllus* V, and *Gryllus* VI.

Gryllus IV
(Fig. 308)

Recognition characters: See Table 10.

Geographic distribution: Southern California from Santa Barbara to San Diego Counties; in the study area: Santa Monica Mountains.

Song: See Table 10 and Fig. 308.

Habitat: Under vegetation in moist areas, salt and freshwater marshes, irrigated gardens, cultivated ivy, along desert streams.

Seasonal occurrence: Adult in late winter to mid-summer, and into late summer at higher elevations; peak abundance in May and June.

Discussion: This species overwinters as juveniles. It is often sympatric with *Gryllus* I.

Gryllus V

Recognition characters: See Table 10.

Geographic distribution: Southern California, apparently restricted to San Nicolas Island (known from 1 male and 1 female).

Song: Unknown.

Habitat: Female under rocks in a moist seepage area, male in grassland.

Seasonal occurrence: Mid-June (one male), mid-August (one female).

Discussion: The tooth count on the file of the single male is 111 and is thus lower than in any other *Gryllus* in the study area except extreme individuals of *Gryllus* I. This species is sympatric with *Gryllus* III, and may represent aberrant specimens of that taxon.

Gryllus VI
(Fig. 309)

Recognition characters: See Table 10.

Geographic distribution: Southern California from Santa Barbara to San Diego Counties; in the study area: San Miguel, Santa Cruz, Santa Barbara, and San Nicolas Islands, Santa Monica Mountains.

Song: See Table 10 and Fig. 309.

Habitat: In cracks, under vegetation or litter; often near or in human habitations such as gas stations, supermarkets, lawns, fields near street lamps, siding of a building in barracks area (San Nicolas Island), cracks near winery (Santa Cruz Island); sometimes in natural habitat but then always near towns.

Seasonal occurrence: Adults most numerous in summer.

Discussion: Individuals of this species fly well. It is often sympatric with *Gryllus* III.

OECANTHINAE: Tree Crickets

Genus *Oecanthus* Serville

Reference should be made to the revision of the United States species of this genus by Walker (1962, 1963, 1969) for nomenclatorial, taxonomic, and biological details.

Oecanthus argentinus Saussure

Recognition characters: First antennal segment with inner margin straight; first and second antennal segments each with two elongate black spots, these sometimes confluent; body and head green or brown.

Geographic distribution: Most of North America except east coastal states and most Gulf Coast states; in the study area: Santa Monica Mountains, all Channel Islands except San Miguel.

Habitat: Most habitats except forest and marshes; in grass, forbs, and low-growing shrubs; on Santa Cruz Island on *Centaurea, Baccharis viminae*, and *Lepidospartum*.

Seasonal occurrence: In the study area, first adults in early summer, peak adult abundance in mid-summer; one generation per year.

Discussion: In the study area, *O. argentinus* is by far the most common *Oecanthus* species. Its song, a continuous trill, is similar to *O. californicus* but not as loud, and can be heard during the day but more commonly at night. The base color is variable even at a single locality and habitat.

On San Clemente Island, we found this species only in 1969 when 11 individuals (males and females) were swept from *Ambrosia chamissonis*.

Oecanthus californicus Saussure

Recognition characters: First antennal segment with inner margin straight; first and second antennal segments each with a single black line, sometimes absent; body brown, head and antennae usually tinged with red.

Geographic distribution: United States west of Rocky Mountains; in the study area: Santa Monica Mountains, Santa Cruz, Santa Rosa, Anacapa, and Santa Catalina Islands.

Habitat: Chaparral, oak savannah, grassland, usually near ground, never in trees; on Santa Cruz Island on *Cirsium vulgare*.

Seasonal occurrence: In the study area, first adults in late spring, peak adult abundance late summer.

Discussion: In the study area, *O. californicus* occurs sympatrically on low shrubs and annuals with another trilling species, *O. argentinus*; the song of *O. californicus* is louder, more piercing, and carries farther.

Oecanthus fultoni T. Walker

Recognition characters: First antennal segment with inner margin convex; first and second antennal segments each with a single, large, central black spot about half the length of the segment; body green; chirp rate at 21°C about 150 per minute.

Geographic distribution: Throughout United States except southeast; in the study area (song records only): Santa Monica Mountains, Santa Cruz Island.

Habitat: Oak woodland and riparian situations, most commonly in trees.

Seasonal occurrence: Adult from mid-July to mid-November.

Discussion: O. fultoni had been wrongly identified as *O. niveus* (De Geer) until Walker (1962) clarified the situation.

In the far west *O. fultoni* can only be confused with *O. rileyi*, where the two are frequently sympatric. They are the only species of United States *Oecanthus* that produce a regular chirp. *O. fultoni* has a chirp rate approximately twice that of *O. rileyi* at the same temperature at any one locality. In the Santa Monica Mountains, on Santa Cruz Island, and in Palo Alto, Santa Clara County (where both species are common and easily accessible), *O. rileyi* was recorded at 60–100 chirps per minute, whereas *O. fultoni* had a chirp rate of 120–200 per minute. *O. rileyi* is also louder than *O. fultoni*.

In the study area *O. rileyi* is always much more common than *O. fultoni*, but the situation is reversed in the Palo Alto area. *O. fultoni* is sometimes so rare, and so inaccessibly high in oaks, that its song becomes the only identification character. The eggs of this species are laid in the bark of trees (Walker, 1962).

Oecanthus rileyi Baker

Recognition characters: First antennal segment with inner margin convex; first and second antennal segments each with a small black spot less than one quarter the length of the segment, these sometimes absent, the spot on second segment near distal margin; body green; chirp rate at 21°C about 90 per minute.

Geographic distribition: Pacific Coast states; in the study area: Santa Monica Mountains, Santa Cruz and Santa Catalina Islands.

Habitat: Oak woodlands and gardens, exclusively on perennials, often high in trees; on Santa Cruz Island on *Baccharis viminae*.

Seasonal occurrence: Adult from late June to late November (Walker, 1962).

Discussion: Comparison of the abundance and song of this species and *O. fultoni*, with which it is often sympatric, is made under the latter species. Males of both synchronize their songs with nearby conspecifics. The eggs of *O. rileyi* are laid in compact rows slanting across the pith in small diameter stems.

MOGOPLISTINAE: Scaly Crickets

Hoplosphyrum boreale (Scudder)

Ectatoderus borealis Scudder, 1902, Proc. Davenport Acad Sci., 9: 58. Type locality: La Cueva, Organ Mountains, New Mexico. Lectotype male designated by Rehn and Hebard (1912b). Lectotype in ANSP.

Recognition characters: Differs from *H. occidentale* (Scudder) by: shorter pronotum only slightly longer than broad, less arcuate lateral pronotal lobes, the more robust ovipositor distinctly shorter than the hind femur; male subgenital plate narrow and with a distinct but shallow median depression (that of *H. occidentale* deeper, apex convex, and without a medial depression).

Geographic distribition: Southern New Mexico to central and southern California and Baja California, but probably with a much wider distribution (R.E. Love, pers. comm.); in the study area: Santa Monica Mountains, Santa Cruz, Anacapa, Santa Catalina, and San Clemente Islands.

Habitat: Coastal bluff community, chaparral, and oak savannah on mainland, only in coastal bluff and chaparral communities on islands; usually associated with rocks.

Seasonal occurrence: Adult in late fall until winter freeze. Eggs apparently hatch in early summer.

Discussion: H. boreale is locally common at many of the study sites and usually concentrated in groups.

Cycloptilum distinctum Hebard
(Figs. 314, 315)

Cycloptilum distinctum Hebard, 1931, Trans. Am. ent. Soc., 62: 150. Type locality: "Tia Juana, San Diego County, California." Holotype male in ANSP.
Ornebius distinctus: Chopard, 1967, Fauna of India, Grylloidea, p. 186. Transferred back to *Cycloptium* by Love and Walker (1979).

Recognition characters: Pronotum of male covering most of abdomen, broad, rounded caudad (unique in study area); pronotum with paired anterior dark markings in both sexes.

Geographic distribution: Baja California north to Los Angeles County; in the study area: at Point Dume.

Habitat: Our single colony in coastal bluff community on sand. Common plants here include: ice plant (*Mesembryanthemum* spp.), *Coreopsis giganteum, Escholtzia californica, Croton californicus* var. *tenuis, Abronia umbellata* spp. *variabilis, Ambrosia chamissonis.*

Seasonal occurrence: Adults in mid-summer into fall. Our series was taken in mid-August, at which time at least 75% of the population consisted of late instar nymphs although a few sporadic males were heard singing. In the laboratory growth was surprisingly slow for such a small insect.

Discussion: Because of its small size this species is very difficult to capture if one attempts to locate it by song. The population is large and dense at Point Dume, and large numbers can be obtained there by searching through the vegetation in the vicinity of singing males. The song of the male (Fig. 248) is surprisingly loud for such a small cricket.

There is some discrepancy between the figures accompanying the original description and the shriveled, damaged, and distorted types. The fastigial projection of the holotype and of both sexes of our series (Fig. 314) is much more pronounced than in the original figure, and the subgenital plate of the female (Fig. 315) is truncate or feebly notched rather than rounded apically as in the original figure.

MYRMECOPHILINAE: Ant Crickets

Myrmecophilus oregonensis Bruner

Myrmecophila oregonensis Bruner, 1894, Can. Ent. 16: 43. Lectotype female: Portland, Oregon, designated by Rehn and Hebard (1912a). Lectotype in USNM.
Myrmecophila formicarium Scudder, 1899, Psyche, 8: 426. Lectotype male: Sisson, California, designated by Hebard (1920). Lectotype in ANSP.

Recognition characters: Tiny (less than 5 mm long), wingless, always associated with ants; caudal metatarsal spurs usually slightly longer than last tarsal segment.

Geographic distribution: Pacific Coast of North America; in the study area: San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Clemente, and Santa Catalina Islands, Santa Monica Mountains; apparently absent from Santa Barbara and San Nicolas Islands.

Habitat: In nests of ants.

Seasonal occurrence: The few adults collected were found in late summer. Nymphs are occasionally encountered in moderate numbers in spring and early summer.

Discussion: We have found this ant cricket with the following hosts: *Aphaenogaster patruelis* Forel (San Clemente Island): *Crematogaster mormonum* Emery (Santa Cruz, East Anacapa Islands); *Formica occidua* Wheeler (Santa Cruz Island); *F. pilicornis* Emery (Santa Monica Mountains); *Camponotus semitestaceus* Emery (Santa Rosa Island); *Iridomyrmex humilis* (Mayr) (Santa Catalina Island); *Lasius niger* (Linnaeus) (San Miguel Island); *Monomorium minimum* (Buchl.) (San Clemente Island); *Pheidole hyatti* Emery (Santa Cruz Island). Regarding the rather broad tolerance of hosts of this species, R.R. Snelling, Los Angeles County Museum (pers. comm.), reports, "In my experience *Myrmecophilus* species do not show any evidence of being host specific, but there are certain genera with which they most frequently occur: *Vermessor, Aphaenogaster, Camponotus*, and *Formica*. They may not associate with Dorylinae, Pseudomyrmecinae, Ponerinae, and rarely with Dolichoderinae... hosts are normally soil-nesting ants, which tie the association together. Most of the hosts have populous nests with fairly large galleries and chambers and few are aggressive predators. But there are exceptions enough to make these factors of dubious significance."

STENOPELMATIDAE

HENICINAE: Silk-spinning Crickets

Genus *Cnemotettix* Caudell

This genus was revised by Rentz and Weissman (1973) where complete details on nomenclature, taxonomy, biology, and biogeography may be found.

Two additional summers of collecting have resulted in new information affecting several major conclusions in the revision. *C. caudulus* was found on Santa Cruz Island, extending its range beyond Santa Rosa and San Miguel Islands. An adult male collected on San Miguel Island confirms the diagnostic characters given for males but previously based on nymphs of that species (Table 11). The aberrant female from San Nicolas Island, recorded as *C. miniatus* (1973, pp. 96 and 105), and as an endemic species (1973, p. 92), we now believe is an abnormally small specimen of *C. spinulus*, individuals of which we have since collected at the same locality. We have found *C. spinulus* on Santa Rosa Island with characters similar to those of the San Nicolas Island population, and we now conclude that no subspecific differentiation has occurred between the northern and southern island groups.

The revised species distribution patterns are summarized in Fig. 316. Only one species is endemic to a single island, *C. pulvillifer* on San Clemente Island; only one species is found on both an island and the mainland, *C. miniatus* on Santa Catalina Island and northern Baja California; two species are found on more than one island but not on the mainland, *C. caudulus* and *C. spinulus*; only one species is found on both northern and southern islands, *C. spinulus*; one species is found widespread on the mainland but not on any island, *C. bifasciatus*.

Certain of our 1973 conclusions on the ecology of the species require revision or further discussion. We have recently found *C. bifasciatus* on sand dunes at Point Dume and Point Conception indicating that the occurrence of the Island faunas on the sand dunes does not represent a new adaptation. Individuals of the mainland population, like those on the islands, are most numerous on dunes and sandy coastal habitats and less numerous in the other habitats ranging from coastal sage, riparian, chaparral, to oak woodland. Several specimens of *C. bifasciatus* have been found on flower heads suggesting that this is not atypical of the species. The recent large mainland collections partially confirm the rarity of males in most if not all species of *Cnemotettix*. This phenomenon may result from post-coital cannibalism, the reason Tinkham and Rentz (1969) suggested for similar rarity of males of the related *Stenopelmatus*. Caged *Cnemotettix* will eat dead grasshoppers and females may therefore be cannabalistic toward males.

Cnemotettix bifasciatus Rentz and Weissman
(Figs. 316, 318)

Recognition characters: See Table 11 and Figs. 318A, B.

Geographic distribution (Fig. 316): Southern California in the Coast Ranges from Monterey to Los Angeles, and inland to San Bernardino and San Jacinto Mountains; in the study area: Santa Monica Mountains, Point Dume, and Point Conception.

Habitat: Coastal sand dunes, coastal bluffs, oak woodland, and redwood forest, to 1600 m (San Jacinto Mountains).

Seasonal occurrence: Adult in early August and fall.

TABLE 11
Distinguishing Characteristics among the Species of *Cnemotettix*.

Character	Species				
	bifasciatus (Figs. 318A,B)	*spinulus* (Figs. 322A,B)	*caudulus* (Figs. 319A,B,C)	*pulvillifer* (Figs. 321A,B)	*miniatus* (Figs. 320A,B)
Females					
Abdominal tubercle	Well indicated	Elongate	Well indicated	Concealed	Well indicated
Subgenital plate	Broader than long	Broader than long	Broader than long	Elongate	Broader than long
Ovipositor					
length*	7.34	8.82	1.75	7.50	6.60
ovip-fem ratio**	0.58	0.79	0.18	0.70	0.68
apex	Blunt	Acute	Acute	Acute	Acute
Males					
Tenth tergite, apex	Truncate	Bilobed	Feebly bilobed	Bilobed	Feebly bilobed
Phallic lobes, lateral extensions	acutely pointed	acutely pointed	acutely pointed	elongate	rounded
Paraprocts					
setation	Dense	Sparse	Sparse	Sparse	Dense
spine	Small	Minute	Large	Very large	Moderate, erect
Subgenital plate					
length	Short	Broad	Long	Short	Long
median incision	Shallow	Shallow	Deep	Shallow	Moderate
Shared Characters					
coloration, base color, stripes distinct (D), less distinct (L)	Light grey D	Grey brown D	Grey D	Dark Brown L	Grey D
Eye stripe	Testaceous "cap", feebly bifurcate	Two forks	One fork	One fork	Testaceous "cap", feebly bifurcate
Setation	Reduced	Reduced	Moderate	Moderate	Pronounced
Habitat	Chaparral	Coastal sand dunes, chaparral, *Eucalyptus* grassland	Fossilized sands, chaparral	Coastal sand dunes	Chaparral

*Average length in mm.

**Values in error in Rentz and Weissman (1973).

Discussion: Since our 1973 revision we have collected two relatively large series of this species on sand dunes (10 ♂, 13 ♀ at Point Dume; and 1 ♂, 8 ♀, several large nymphs at Point Conception). These series are all larger than any other, despite the occurrence of the species in a wide variety of habitats. Island populations of other species are also more dense on sand dunes. We now have four records of this species on flower heads: *Eriogonum cinereum, E. parvifolium, Lupinus arboreus,* and *Salvia melifera* (misidentified in our 1973 paper as *Marrubium*).

Cnemotettix caudulus Rentz and Weissman
(Figs. 316, 319)

Recognition characters: See Table 11 and Figs. 319A, B, C.

Geographic distribution (Fig. 316): Southern California, Santa Rosa, San Miguel, and Santa Cruz Islands.

Habitat: Most common in sandy habitats, also in chaparral, and among pines.

Seasonal occurrence: Adult as early as early July, most abundant in late summer and early fall.

Discussion: Despite extensive collecting and the use of oatmeal trails, we have found only one female on Santa Cruz Island (1974).

Cnemotettix miniatus Rentz and Weissman
(Figs. 316, 320)

Recognition characters: See Table 11 and Figs. 320A, B.

Geographic distribution (Fig. 316): Southern California, Santa Catalina Island, northern Baja California.

Habitat: Scrub-oak and chaparral.

Seasonal occurrence: Adult in mid-summer but possibly matures earlier than other congeners.

Discussion: The San Nicolas Island female recorded by us (1973) is almost certainly a small individual of *C. spinulus*; additional collecting at the same locality has yielded more *C. spinulus* and no *C. miniatus*.

Cnemotettix pulvillifer Caudell
(Figs. 316, 321)

Recognition characters: See Table 11 and Figs 321A, B.

Geographic distribution (Fig. 316): Southern California, San Clemente Island only.

Habitat: Coastal sand dunes and coastal bluff. Most specimens have been taken around the roots of *Ambrosia chamissonis*, the main plant on the dunes.

Seasonal occurrence: Adult probably in late summer and fall (only nymphs have been collected).

Discussion: The Caudell (1928) record from Santa Rosa Island was based on an unidentifiable nymphal male and almost certainly represents either *C. caudulus* or *C. spinulus*.

Cnemotettix spinulus Rentz and Weissman
(Figs. 316, 322)

Recognition characters: See Table 11 and Figs. 322A, B.

Geographic distribution (Fig. 316): Southern California, Santa Cruz, Santa Rosa, Anacapa, and San Nicolas Islands.

Habitat: Coastal sand dunes, chaparral, needle mat of Torrey Pines.

Seasonal occurrence: Adult in late summer.

Discussion: Rentz and Weissmans' suggestion (1973) that the San Nicolas Island specimen might represent a different subspecies must now be discarded. The first adult male (reared in captivity by the authors) from a northern island, Santa Rosa, possesses the same characteristics as the San Nicolas Island males.

C. spinulus was most common on East Anacapa Island, where it was dug from the hardened sands in the lighthouse region. On Middle Island in 1972, an oatmeal trail laid in the *Eucalyptus* grove area attracted six individuals. Although some oatmeal was taken by *Peromyscus*, enough remained at 4 a.m. to still attract crickets. During similar collecting in 1974 *Rattus* was so common that the oatmeal and probably any *Cnemotettix* at the trail were consumed by 9:30 p.m.

The only *Cnemotettix* found on West Island in 1971 after much searching was a last instar female being dragged by a sphecid wasp *Palmodes insularis* Bohart and Menke. The rat population on West Island in 1971 was as high as that on Middle Island in 1974, which probably accounted for the poor collecting.

STENOPELMATINAE: Jerusalem Crickets

Ammopelmatus muwu Rentz and Weissman, new species
(Figs. 39, 323, 325–329)

Recognition characters: From *Stenopelmatus*: all apical tibial spurs and calcars short and spatulate, fore tibia with only two small ventral spurs, hind tibia with only one ventral spur and with reduced or no dorsal teeth. From *A. kelsoensis* Tinkham: fore tibia (Fig. 327) has the apical spur on the internal margin curved, hind tibia (Fig. 328) with first tooth on internal margin and first major tooth on external margin short, blunt.

Geographic distribution: Southern California, Point Conception only.

Holotype male: California, Santa Barbara Co., Point Conception, Bixby Ranch, dunes near lighthouse, 18–vii–1972. D.B. Weissman. Holotype and allotype (in alcohol) in California Academy of Sciences, No. 12428. HEAD (Fig. 323): frons more flattened and eyes more pyriform than in other stenopelmatines. PRONOTUM: quadrate, ventral margin of lateral lobes undulant, anterior and posterior margins emarginate; surface of disk with shallow median longitudinal sulcus, medio-distal portion of disk depressed. APPENDAGES: fore tibia armed dorsally as in Fig. 327; ventral surface of all tibia armed with a single apical spine except left median tibia which bears two spines, hind tibia with ventral spine, minute, blunt, excavate; median tibia armed with six spines; hind tibia armed dorsally as in Fig. 328; tarsal segments normal, unmodified. ABDOMEN: when extended attaining apex of hind tibia; cercus (Fig. 325) stout, apically blunt; supra-anal plate (Fig. 325) with apex narrowed, hooks directed dorsad. COLORATION: whitish except for head which is orange, abdomen with annular black rings narrow (Fig. 323) in center of segments; spatulate portion of tibial spines and spurs dark brown.

Allotype female: Same data as holotype except collected 30–vi–1971, D.C. Rentz, D.B. Weissman. Differs from holotype in: larger, more robust, median tibia each armed ventrally with a pair of apical spines. Ovipositor short, extending only to base of paraprocts (Fig. 329); subgenital plate short, broad, median portion produced.

Measurements (mm):

	Length body	Length pronotum	Width pronotum	Length fore femur	Length median femur	Length hind femur	Length fore tibia	Length median tibia	Length hind tibia
Holotype	37.0	6.0	9.4	6.1	5.4	8.7	7.1	6.2	8.9
Allotype	32.0*	7.0	10.0	7.5	6.1	9.5	8.0	6.1	11.4

*abdomen retracted

Habitat (Fig. 39): Coastal sand dunes.

Seasonal occurrence: Adult in mid-summer (one male, one female).

Specimens studied: 1 ♂, 1 ♀, 1 antepenultimate instar female, (30–vi–1971) all at type locality (includes holotype and allotype).

Discussion: This species, like its congener, *A. kelsoensis*, is strikingly adapted for arenicolous existence: the legs are short and robust, spines and spurs are reduced, but the distal ones are short and spatulate, and the general color is light. This is the second known species in the genus, widely separated from *A. kelsoensis* (Tinkham, 1965) which is found in the Mohave Desert sand dunes near Kelso, San Bernardino County, California. One other stenopelmatine is similarly adapted to sand dunes, *Viscainopelmatus* (Tinkham, 1970; Tinkham et al., 1974) found far to the south in the Viscaino Desert near Guerrero Negro, Baja California.

A. muwu is apparently rare as is the case with *A. kelsoensis* and *Viscainopelmatus*. We have collected extensively at the type locality and other coastal dune areas in southern California without finding any other colonies. All three specimens were found in a highly restricted colony of *Rhachocnemis*, with one in a burrow feeding on a small nymph of *Rhachocnemis*.

The name is derived from that given to sand dunes by the Chumash Indians who lived along coastal southern California.

Genus *Stenopelmatus* Burmeister

Reference should be made to Tinkham and Rentz (1969) for taxonomic and biological details regarding the Californian species, and Hebard (1916) for nomenclature. The latter author lists many synonyms for *S. fuscus*, but that species has not been adequately analyzed over its wide range with modern methodology.

Stenopelmatus fuscus Haldeman
(Fig. 324)

Recognition characters: Adult size large (35–50 mm), hind tibia with innermost pair of spurs spatulate; specimens from San Miguel Island melanistic (Fig. 324).

Geographic distribution: Western United States; in the study area: San Miguel, Santa Rosa, Anacapa, and Santa Catalina(?) Islands, Santa Monica Mountains.

Habitat: Widespread except salt marsh and sand dunes; under boards, logs, other debris.

Seasonal occurrence: Adult throughout year; individuals most common in winter and spring when ground is moist.

Discussion: This species, found widespread on the mainland and on all four northern Channel Islands, has only recently been found on the southern islands and there only on Santa Catalina but identified as to species with uncertainty. Laughrin (1973) first noted the occurrence of *Stenopelmatus* in fox scats on Santa Catalina

Island. This was subsequently confirmed by our single and only record (from the Middle Ranch bunkhouse area). Absence of earlier records from any southern island (e.g., Cockerell, 1939, p. 291) despite previous collecting in the spring when these crickets are most readily encountered because of moist conditions, raises the possibility that this species was recently introduced on Santa Catalina Island. In personal correspondence (September 1974), Douglas Propst, Superintendent of Ranches of the Catalina Rock and Ranch Company, notes that "over the years we have imported a lot of alfalfa hay for the horse ranch; also sand used for building has been imported," thus providing a possible vehicle for introduction. Laughrin (pers. comm.) also reports finding *Stenopelmatus* parts in feral cat scats from Santa Catalina Island. Despite much collecting we have found only one specimen. Other samples of fox scats collected by Barbara Propst in 1974 and 1975 from 12 diverse habitats contained no *Stenopelmatus*, but a few did contain *Gryllus* parts. We have seen Laughrin's material and confirmed his identification. Because only 16% of those scats contain *Stenopelmatus*, it is possible that Jerusalem crickets have been only recently introduced on Santa Catalina Island, and are still rare.

This species is darker on San Miguel Island (Fig. 324) than at any other place in its range. On mainland specimens body segments are usually brown or orange brown; specimens from San Miguel Island are dark brownish purple or black. This is probably an environmentally induced melanism. Early instar nymphs when brought to the laboratory gradually lighten up as they mature when maintained at 25°C with a 12 hour light and 12 hour dark period.

Stenopelmatus intermedius Davis and Smith

Recognition characters: Adult size small (usually less than 35 mm); color of head dark, with tan sutural areas (mainland) or orange (Channel Islands); apical tibial spurs longer than in *S. fuscus*. On the mainland *S. intermedius* is darker in coloration than *S. fuscus*.

Geographic distribution: San Francisco Bay region; in the study area: Santa Cruz and Santa Rosa Islands.

Habitat: Chaparral, oak woodland, and oak savannah.

Seasonal occurrence: Adult from late October to mid-March (Tinkham and Rentz, 1969).

Discussion: The wide separation of the island populations from the nearest mainland colony in the San Francisco Bay region raises the question of identity of the two groups, despite their morphological similarity. The distributional gap may be a result of poor collecting or collecting at the wrong season.

Adults of this species are generally smaller than the smallest adult *S. fuscus* but may be easily confused with nymphs of that species. Maturity in males of *Stenopelmatus* is indicated by well developed hooks on the paraprocts. Maturity in females is more difficult to determine, but study of the degree of development of the ovipositor and subgenital plate usually provides sufficient evidence.

S. intermedius is not melanistic on Santa Rosa Island whereas *S. fuscus* is much darker there.

RHAPHIDOPHORIDAE

Genus *Ceuthophilus* Scudder

Nomenclature, taxonomy, and biology of this genus may be found in Hubbell (1936).

Ceuthophilus californianus Scudder
(Figs. 20, 333)

Recognition characters: Males with subgenital plate produced as a pair of elongate, flattened lobes, touching mesad; pseudosternite with prominent dorsolateral auriculae widely separated; proximal portion of ventral lobe of penis uniformly sclerotized, with a pair of erect membranous flaps sheathing auriculae of the pseudosternite; supra-anal plate large, as long as broad, distally convex to subtruncate. Females cannot be distinguished from *C. hesperus*, the only other species in coastal California.

Geographic distribition: Southern California, coast ranges and San Joaquin Valley from Sonoma County to Los Angeles; in the study area: Santa Monica Mountains, San Miguel and Santa Rosa Islands.

Habitat and food preferences: Sand dunes (Fig. 20), coastal sage, coastal bluff, chaparral, and dry riverbeds. Like most camel crickets, this species is probably omnivorous.

Seasonal occurrence: Adults in April and June in the study area; Hubbell (1936) reports adults in the fall also.

Discussion: On the sand dunes on San Miguel Island, adults and immatures of all stages may be found in a single extensive tunnel system housing up to 12 individuals. Often a pair of adults may be found in a single burrow.

About 25% of the San Miguel Island population (especially the nymphs) are melanistic (*cf.* Figs. 333A and B) a color phase found nowhere else in the wide distribution of this normally uniformly brown species. Both light and dark color phases may be found in the same burrow. The three adult males and two juveniles collected on Prince Island, an islet just off the coast of San Miguel Island, are all dark, suggesting that a much higher percentage of the dark phase occurs there.

Ceuthophilus hesperus eino Rentz and Weissman, new subspecies
(Fig. 332)

Recognition characters: From *C. californianus*: male subgenital plate (Fig. 332A) with widely separated cornuate processes, pseudosternite (Fig. 332B) with auriculae much closer together, proximal portion of ventral lobe of penis with sclerotization broken in middle, without lateral flaps; females indistinguishable. From other subspecies of *C. hesperus*: male subgenital plate (Fig. 332A) with distal processes straight, more widely separated; pseudosternite (Fig. 332B) with auriculae more prominent, dorsal bar concave and with angulate margins; females indistinguishable.

Geographic distribution: Southern California, Santa Monica Mountains only.

Holotype male: California, Los Angeles Co., Santa Monica Mountains, near corner of Mulholland Highway and California Highway 23S (9 km S. Thousand Oaks), 13-vi-1971, D.C. Rentz, D.B. Weissman." Holotype and allotype (in alcohol) in California Academy of Sciences, No. 12429. Differs from *C. h. hesperus* Hubbell (and *C. californianus*, see Hubbell descriptions, 1936) in: SIZE: large for species. BODY: length 17 mm, moderately robust. LEGS: short and not as stout as in other subspecies; genicular spur of middle femur short, middle tibia with two spines on anterior margin and three spines on posterior margin, middle and fore tarsi of almost equal length, hind femur less robust, hind tibia with spines straight and more slender. SUBGENITAL PLATE (Fig. 332A): with lateral margins straight. PSEUDOSTERNITE (Fig. 332B): with auriculae more prominent than in other subspecies, dorsal bar weakly

concave with angulate margins, cephalic lobe broad. COLORATION: lighter, straw brown, distal portions of abdominal tergites and genicular lobe of hind femur darker brown.

Allotype female: Same data as for holotype. Differs from *C. h. hesperus* and other species of Californianus Group in: dorsal valves of ovipositor blunt, coloration slightly darker than male.

Variation: There is considerable variation in the armature of the ovipositor probably because of age: one specimen lacks the distal tooth and the others are worn almost smooth. Several paratypes possess a white herring-bone color pattern on the outer pagina of the hind femur which is accentuated by stout setae. This pattern is widespread among species of *Ceuthophilus*.

Measurements (mm):

	Length body	Length pronotum	Length hind femur	Width hind femur	Length ovipositor
Male:					
Holotype	17.0	4.2.	12.0	3.4	
Females:					
Allotype	21.0	5.1	12.7	4.0	4.5
Paratopotypes (3)	19.0–24.5	4.9–6.0	11.5–14.2	4.0–4.2	4.9–5.4

Habitat: Chaparral at 548 m. The few specimens collected were found in gardens.

Seasonal occurrence: Early summer.

Specimens studied: CALIFORNIA: LOS ANGELES CO.: Santa Monica Mountains, near corner Mulholland Highway and California Highway 23S, 13–vi–1971, D.C. Rentz, D.B. Weissman, 1 ♂, 4 ♀, including holotype and allotype, 1 penultimate ♂ nymph; Malibu, Big Rock Canyon, Big Rock Canyon Road at Rockport Road, 18–vi–1976, D.B. Weissman, 1 ♂.

Discussion: This subspecies may represent the northern extreme of a chain of three subspecies, *C. h. hesperus* (San Diego County), *C. h. clunicornis* Hubbell (Los Angeles area) and *C. h. eino* (Santa Monica Mountains) in which the projections of the male subgenital plate become longer and the distance between them becomes wider to the north (Figs. 330–332).

In the Santa Monica Mountains, D.B. Weissman found a single *C. h. eino* male and a single male *C. californianus* within 30m of one another on an oatmeal trail in Big Rock Canyon, confirming Hubbell's (1936) suspicion that the two forms were sympatric and therefore represented distinct species.

The subspecies is named in honor of the authors' friend, Mr. Eino Rompannon, who permitted us to stay and work on his property in the Santa Monica Mountains on many occasions, and who collected Orthoptera for us.

Gammarotettix genitalis Caudell

Gammarotettix genitalis Caudell, 1916, Proc. U.S. Nat. Mus. 49:663. Type locality: Los Angeles County, California. Holotype male in USNM.

Recognition characters: Head with fastigium of vertex bituberculate, hind legs very short; male cerci strongly and uniformly incurved; female subgenital plate with three short apical teeth.

Geographic distribution: Coast Range from northern Los Angeles County to San Diego; in the study area: Santa Monica Mountains, Santa Cruz Island.

Habitat and food preferences: Oak woodland and chaparral with preference for deciduous and evergreen oaks, also on chamise. Our large series was taken on *Quercus agrifolia* (Santa Cruz Island) and *Rhus laurina* (Santa Monica Mountains).

Seasonal occurrence: Peak adult abundance in late May; stragglers until early July.

Discussion: In some years, particularly 1970 and 1971, *G. genitalis* was locally abundant. Individuals are apparently somewhat gregarious and attracted to molasses bait.

Pristoceuthophilus marmoratus Rehn

Pristoceuthophilus marmoratus Rehn, 1904, Ent. News, 15:280. Type locality: Mountains near Claremont, Los Angeles County, California. Holotype male in ANSP.

Recognition characters: From *P. pacificus*: color strongly mottled, male abdomen densely tuberculate but tubercles low, male hind tibia bent at most in a weak open V and with a low ventro-proximal flange.

Geographic distribution: California from Mendocino County to northern Baja California and in central and southern Sierra Nevada; in the study area: Santa Catalina, San Clemente, and San Nicolas Islands, Santa Monica Mountains.

Habitat: In the study area: chaparral, coastal bluff, coastal sage, sand dune.

Seasonal occurrence: Adult in late summer and fall.

Discussion: The genus *Pristoceuthophilus* is being revised by T.H. Hubbell and T.J. Cohn.

Pristoceuthophilus pacificus (Thomas)

Marsa pacifica Thomas, 1872. Preliminary report of the U.S. Geol. Surv. of Montana and adjacent territories. Fifth Report, p. 436. Type locality: California. Holotype in USNM.

Recognition characters: From *P. marmoratus*: color uniform (densely and finely speckled when seen under microscope); male abdomen at most weakly tuberculate; male hind tibia strongly bent (less so in smallest males) the distal portion often slightly recurved, and with a large ventro-proximal flange.

Geographic distribution: British Columbia to southern California, east to Nevada; in the study area: Santa Cruz, Santa Rosa, and Anacapa Islands.

Habitat: Riparian, chaparral, grassland, coastal bluff, dry riverbed sand, and on Sants Cruz Island in *Eucalyptus* groves.

Seasonal occurrence: Adult probably in fall and winter.

Discussion: Hubbell and Cohn report (pers. comm.) that our material is not typical of the species in several respects. They also report no material of *P. pacificus* from any mainland site near the northern Channel Islands.

Rhachocnemis validus (Scudder)
(Figs. 39, 333C)

Phrixocnemis validus Scudder, 1894, Proc. Am. Acad. Arts and Sci. 30(22): 105–106. Type locality: California. H. Edwards collector. Holotype in ANSP.

Rhachocnemis validus, Caudell, 1916, Proc. U.S. Nat. Mus. 49: 683–684.

Recognition characters: Spurs of hind tibia (Fig. 333C) crowded distally and flattened for digging; tarsi four segmented; color whitish to yellowish, caudal margins of tergites brownish.

Geographic distribution: Central and southern coastal California from Point Reyes (Marin County) to Point Conception (Santa Barbara County).

Habitat: Sand dunes (Fig. 39), one individual found in coastal bluff community 50 m from dunes. This species is abundant where it occurs and is omnivorous and may be predaceous at times.

Seasonal occurrence: Adults throughout year, greatest abundance in winter, especially February (D.C.F. Rentz, unpublished observations on San Francisco populations).

Discussion: R. validus is limited to a very small part of the dunes at Point Conception where its population is very much more dense than any other camel cricket in the region. Other areas have similar sand grain size, slope, and exposure, but few or no *R. validus*.

The burrow network of *R. validus* is very extensive and during the summer a single hole probably remains usable for many months because the sand is fairly hard and moist (at least at Point Conception). In two daytime instances we found an adult male and female in the same burrow which suggests that mating may take place there. Several times males and females were found in connected burrows. A single adult male was dug from a hole a full meter below the surface. All holes were apparently occupied by at least one cricket. It appears that as the cricket digs into a hole each morning, it plugs up the passageway behind it.

Individuals emerge from their burrows shortly before dark when they are still visible to the unaided eye. Most individuals at an oatmeal trail in the first hour were small, but they were joined by large numbers of large individuals within an hour. These crickets may feed on the oatmeal for long periods of time, with one marked individual present for almost two hours.

TRIDACTYLIDAE: Pygmy Mole Grasshoppers (formerly Crickets)

Ellipes minutus (Scudder)

Tridactylus minutus Scudder, 1862, Boston J. Nat. Hist. 7: 425–426. Type locality: So. Illinois. Types in ANSP. Transferred to *Ellipes* by Günther (1977).

Recognition characters: From other orthopterans: minute (3–5 mm) but fully winged when adult; front tibia short, broad, with large apical spurs; hind tarsus minute, replaced by two elongate, narrow, flattened hairy tibial spurs.

Geographic distribution: Widespread in North and Central America into South America; in western North America, from Mendocino County, California to Mexico and along west slopes of the Sierra Nevada; in the study area: Santa Catalina Island.

Habitat: Sand bars and banks of streams, rivers, lakes, and temporary ponds.

Seasonal occurrence: Adult in the Coast Range from mid June to end of summer; in the Sonoran Desert, adult in February.

Discussion: Members of this family burrow just under the surface of mud using the highly modified front legs, and often swim using the even more peculiarly modified hind tibial spurs. Günther revised this genus (1977) and identified our single specimen.

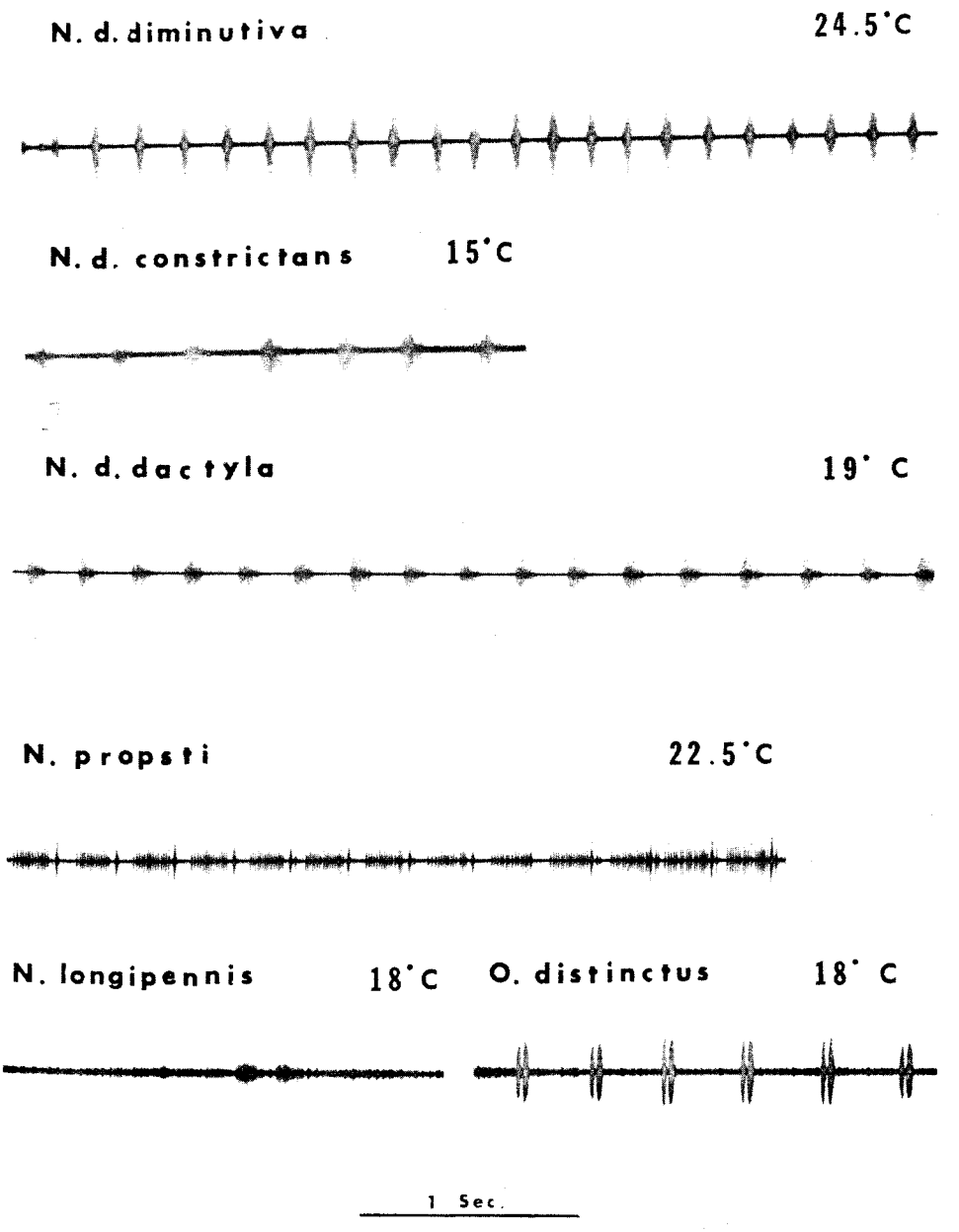
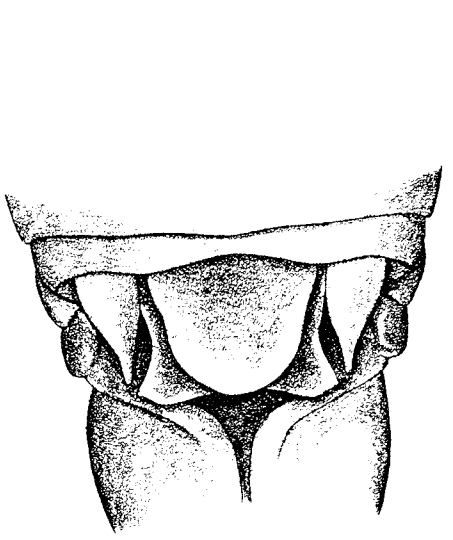


Figure 248: Oscillograms of calling songs in *Neduba* species and *Cycloptilum distinctum*.



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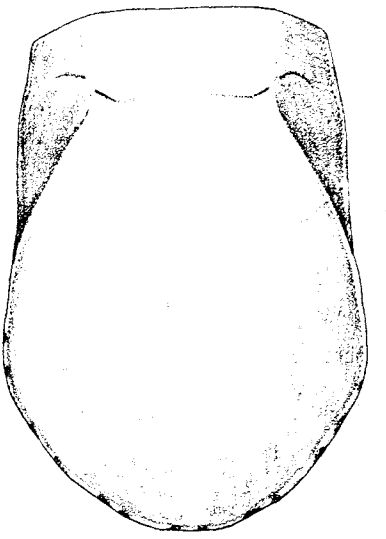

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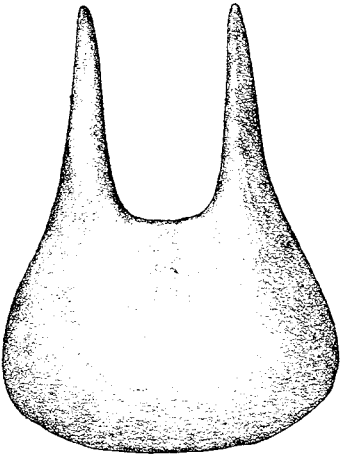

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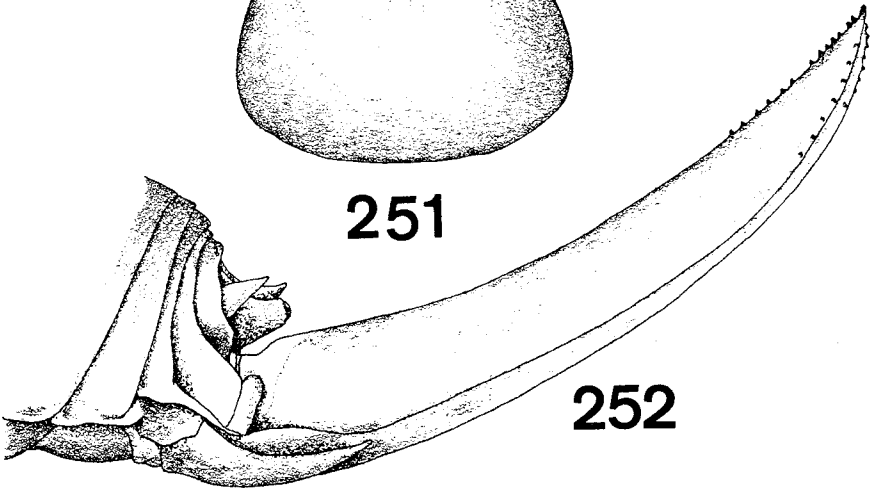
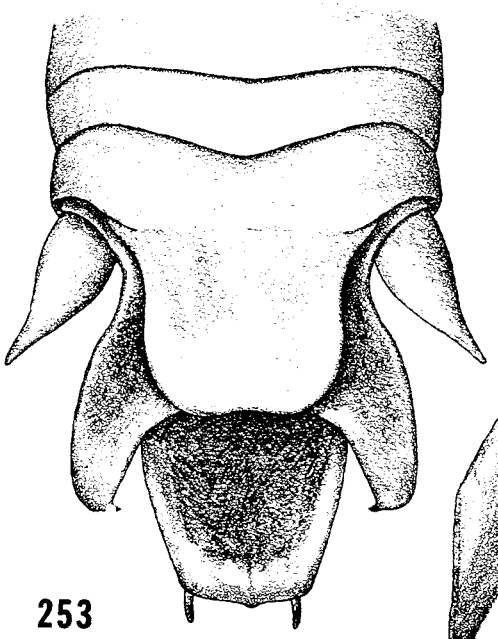
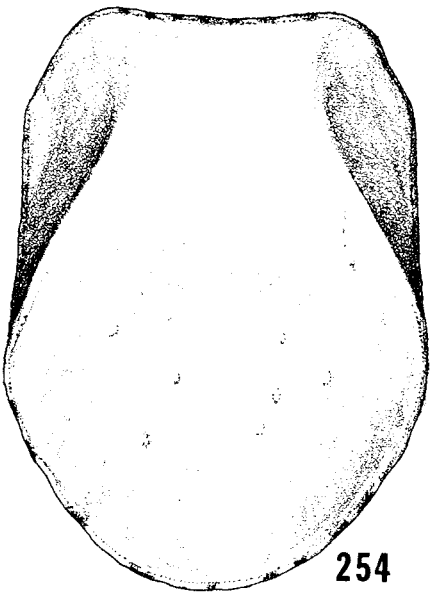
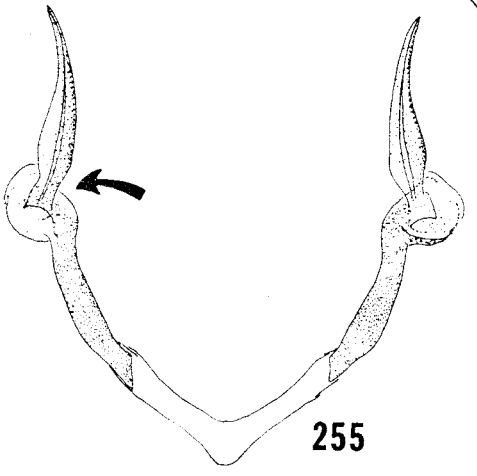


252

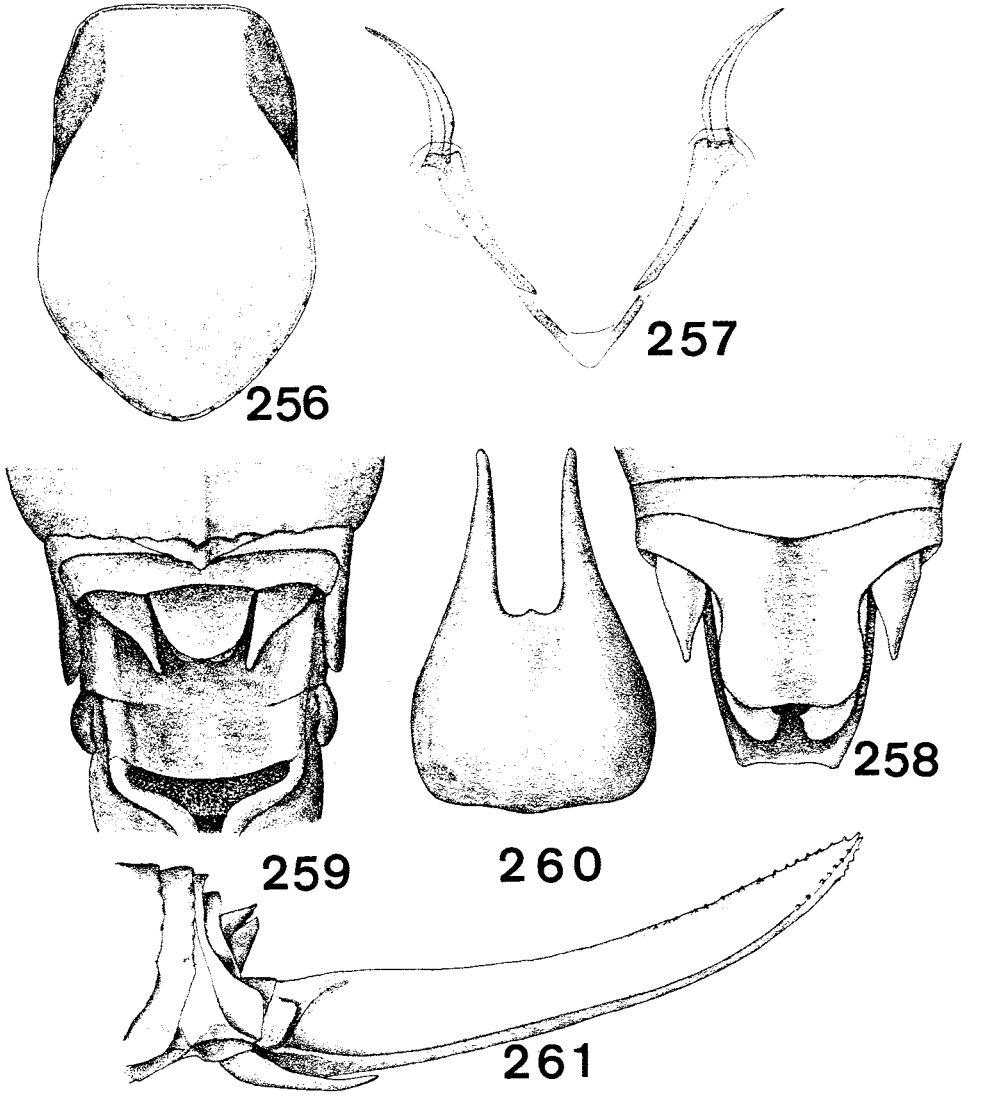
Figures 249–252: Diagnostic structures in *Neduba d. diminutiva*. Fig. 249: Dorsal view apex abdomen. Fig. 251: Subgenital plate. Fig. 252: Lateral view ovipositor, paratopotype female. Fig. 250: Dorsum of pronotum, male. All figures 25X except Fig. 251, 50X.



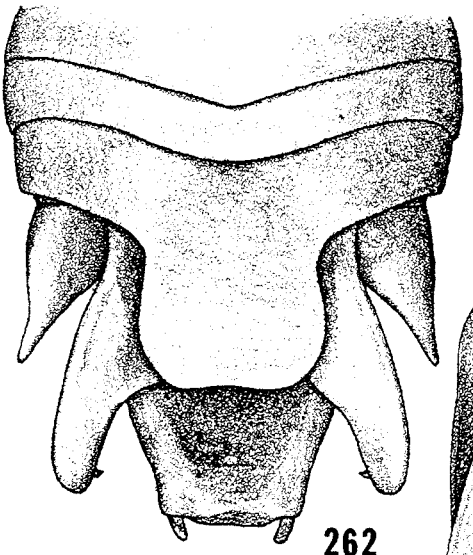




Figures 253–255: Diagnostic structures in *Neduba d. constrictans*. Fig. 253: Dorsal view apex abdomen, holotype male. Fig. 254: Dorsal view pronotum, holotype male. Figs. 253 and 254, 25X. Fig. 255: Titillator, paratype male, 100X; note basal constriction.



Figures 256–261: Diagnostic structures in *Neduba d. dactyla*. Figs. 256–258: Allotype male, 25X. Figs. 259–261: Holotype female, 25X. Fig. 257: Titillator, 100X.



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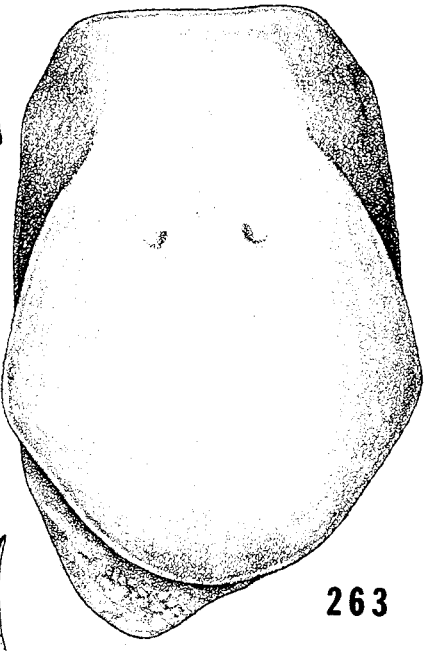

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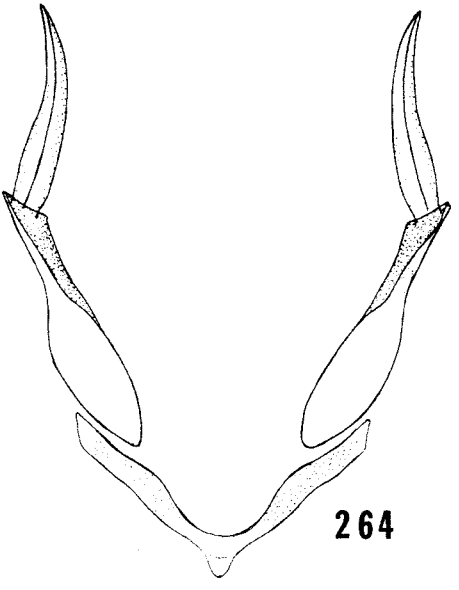
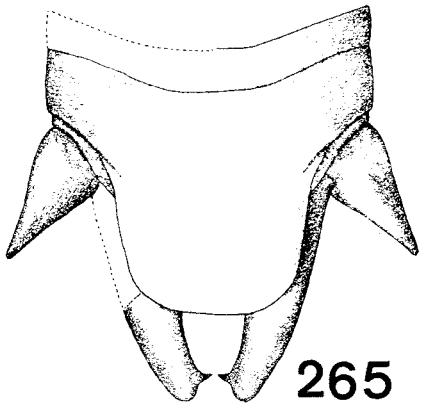
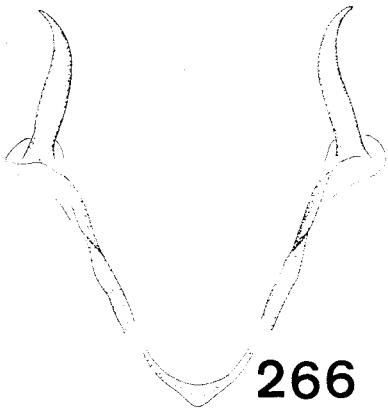
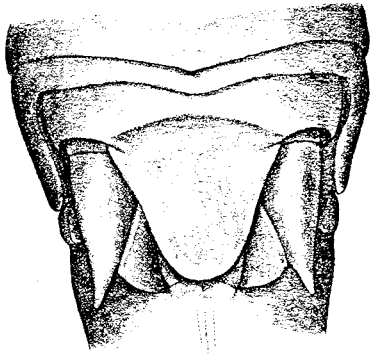


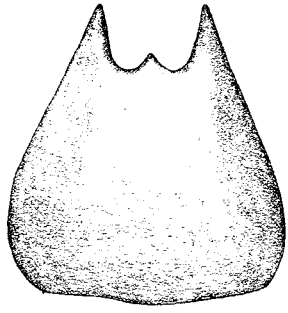
264

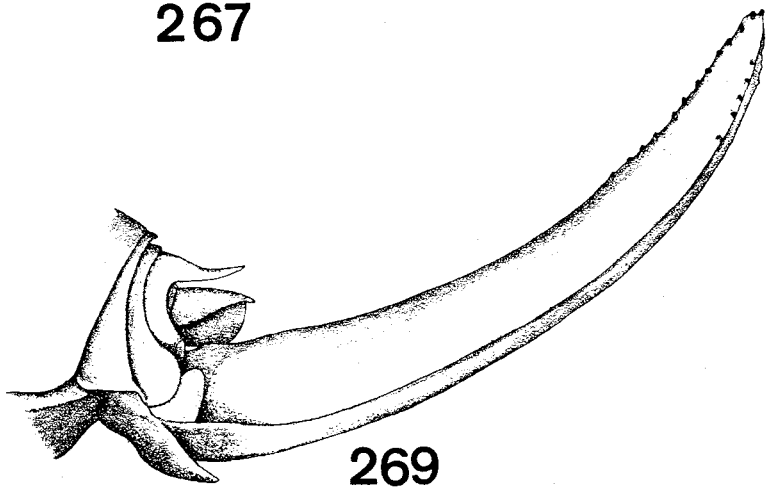
Figures 262–264: Diagnostic structures in *Neduba longipennis*. Fig. 262: Apex abdomen, holotype male. Fig. 263: Dorsum of pronotum (right tegmen removed). Fig. 264: Titillator. Figs. 262, 263, 50X. Fig. 264, 100X.



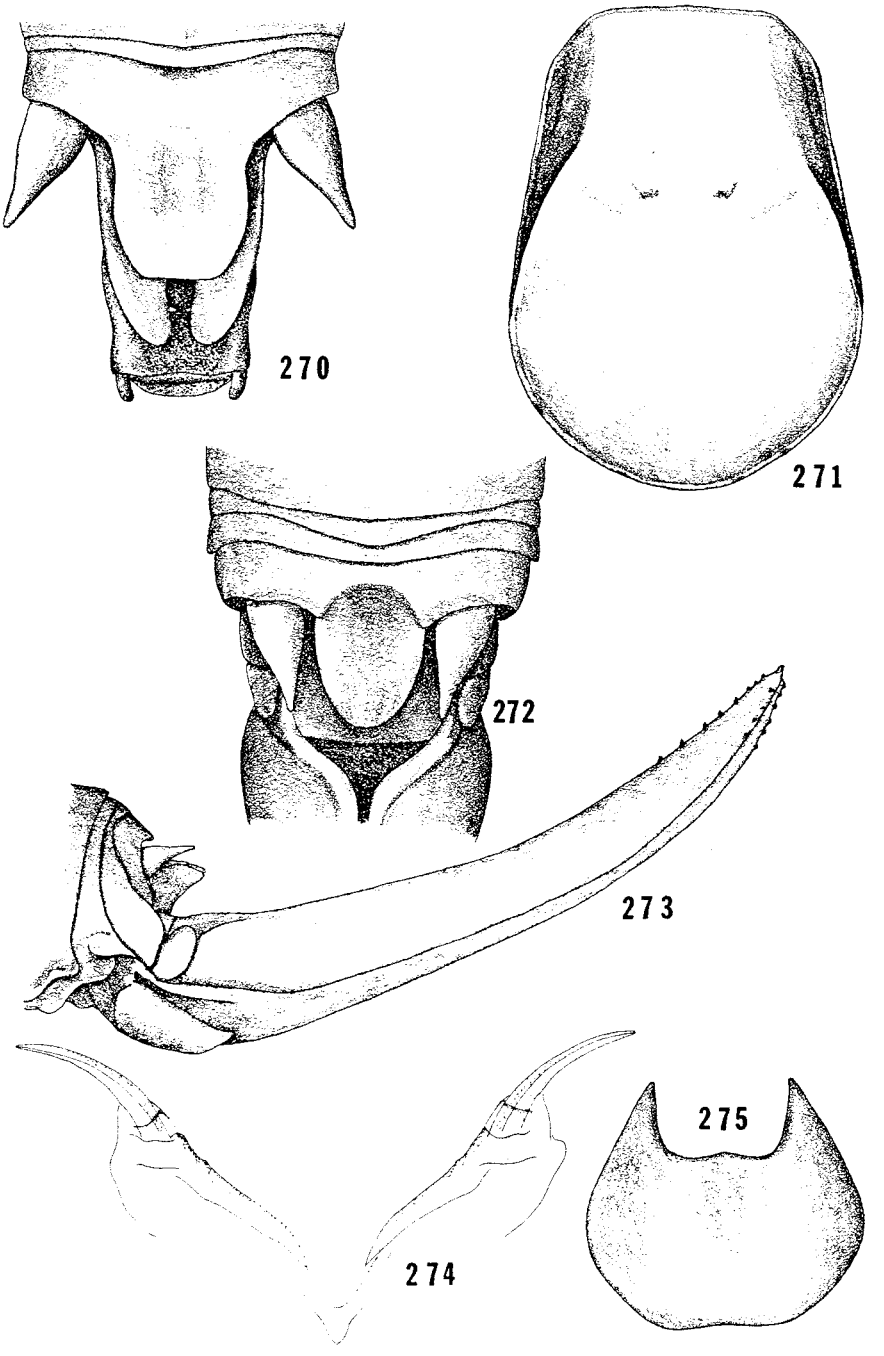




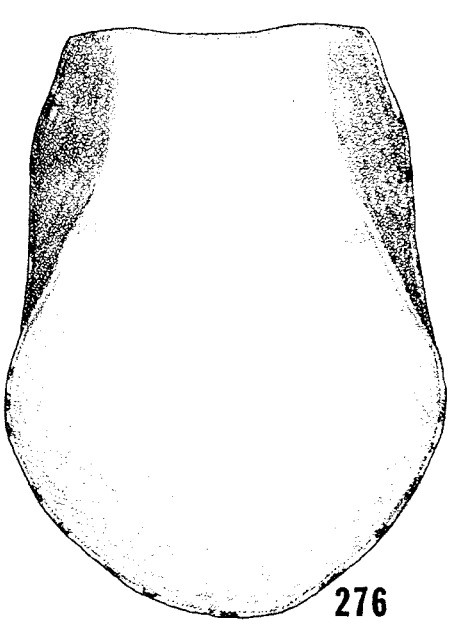


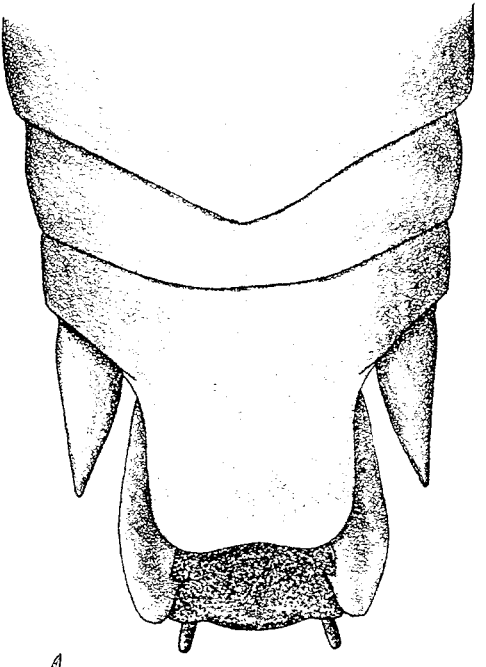


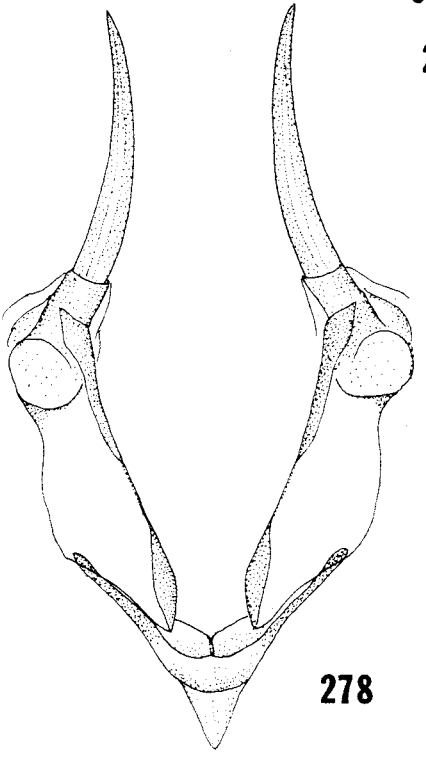
Figures 265–269: Diagnostic structures in *Neduba m. morsei*. Figs. 265 and 266: Holotype male; dotted line indicates extent of pest damage to type. Figs. 267–269: Topotype female. Fig. 268, 50X. Fig. 266, 100X. Others, 25X.



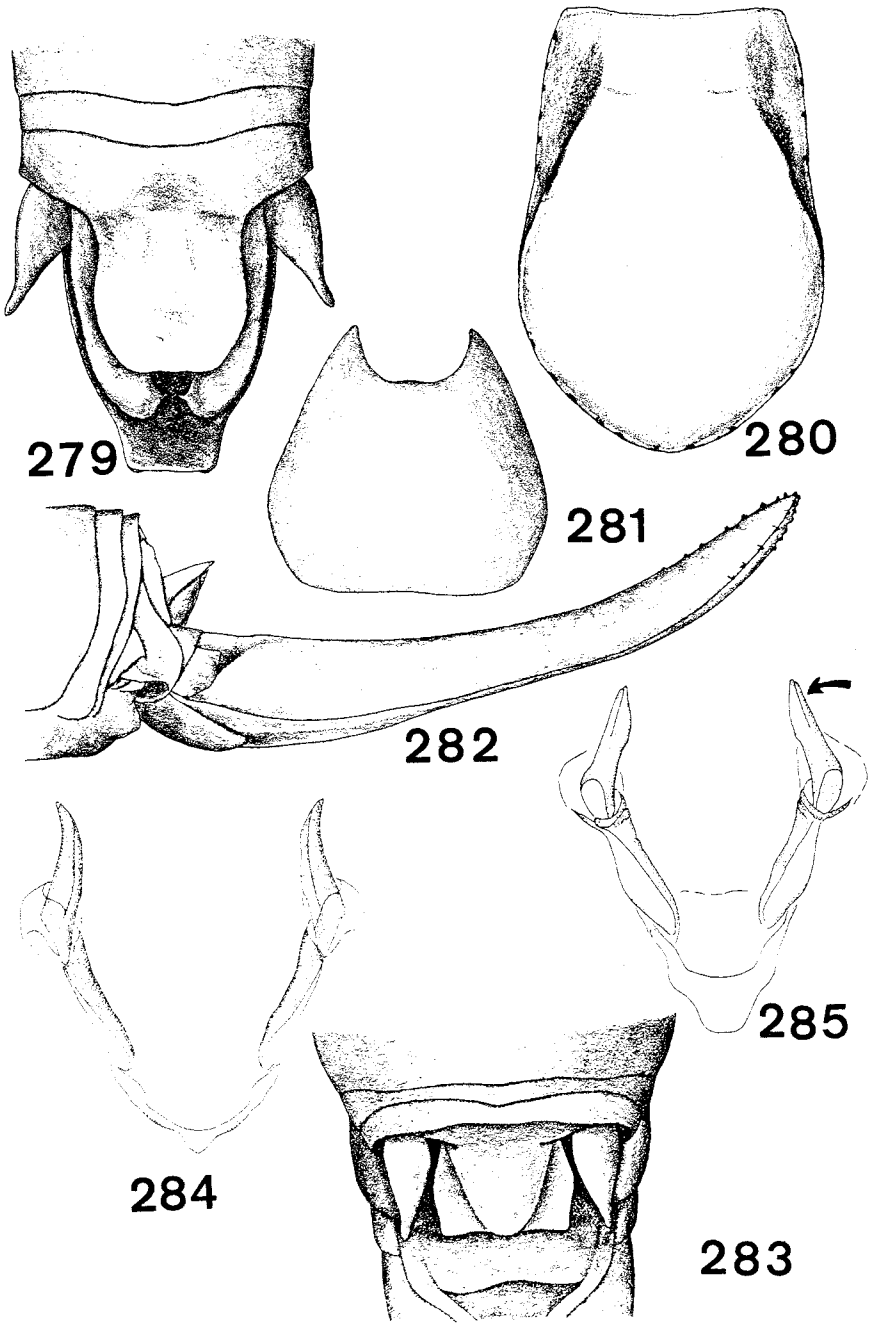
Figures 270–275: Diagnostic structures in *Neduba m. costalis*. Figs. 270 and 271: Holotype male. Figs. 272, 273, 275: Allotype female. Fig. 274: Titillators, paratype, 100X. Fig. 275: Subgenital plate, 50X. Others, 25X.







Figures 276–278: Diagnostic structures in *Neduba m. curtatus*. Figs. 276 and 277: Holotye male. Fig. 278: Paratype male, 100X.



Figures 279–285: Diagnostic structures in *Neduba m. islandica*. Figs. 279 and 280: Holotype male. Figs. 281–283: Allotype female. Figs. 284 and 285: Titillators of paratype males; note apical groove. All figures, 25X, except Figs. 284 and 285, 100X; Fig. 281, 50X.

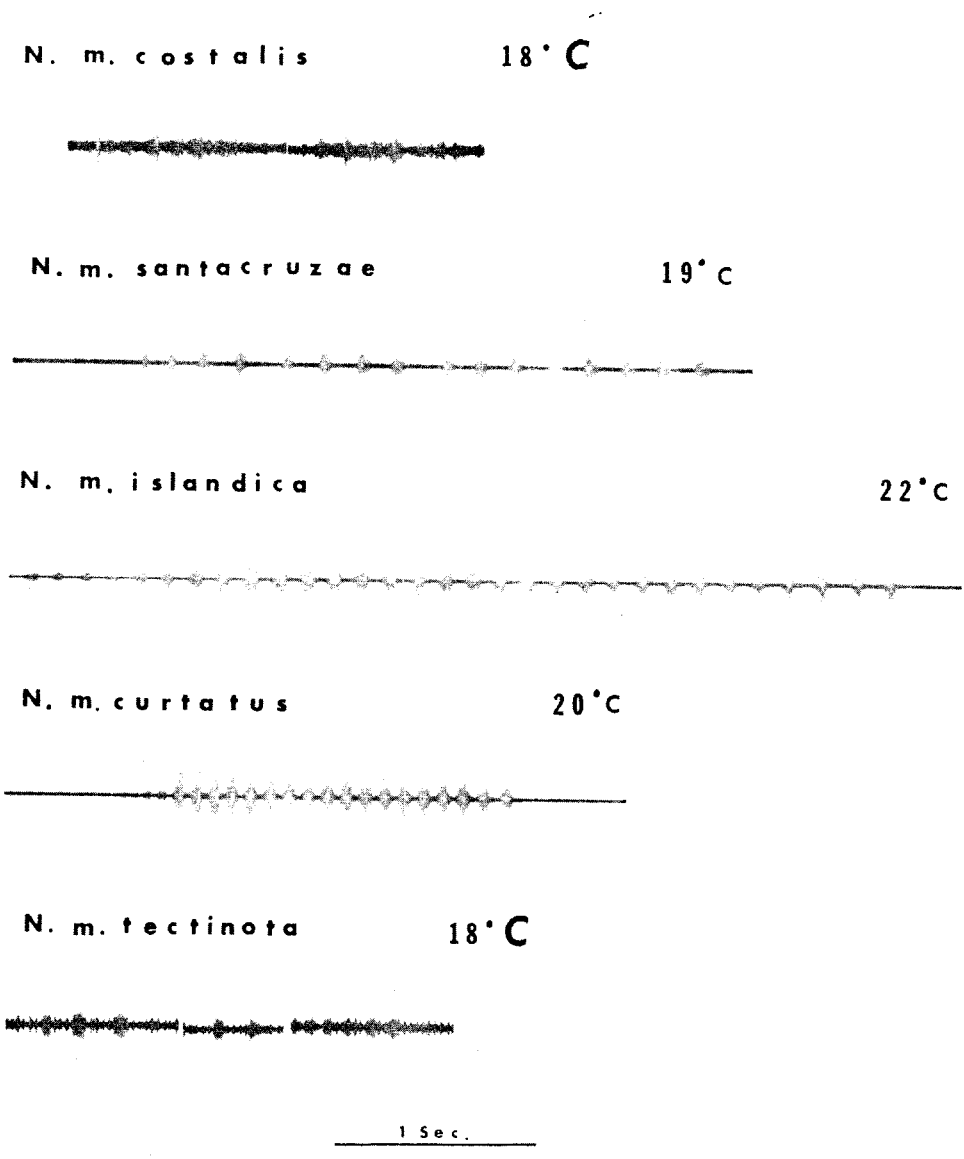
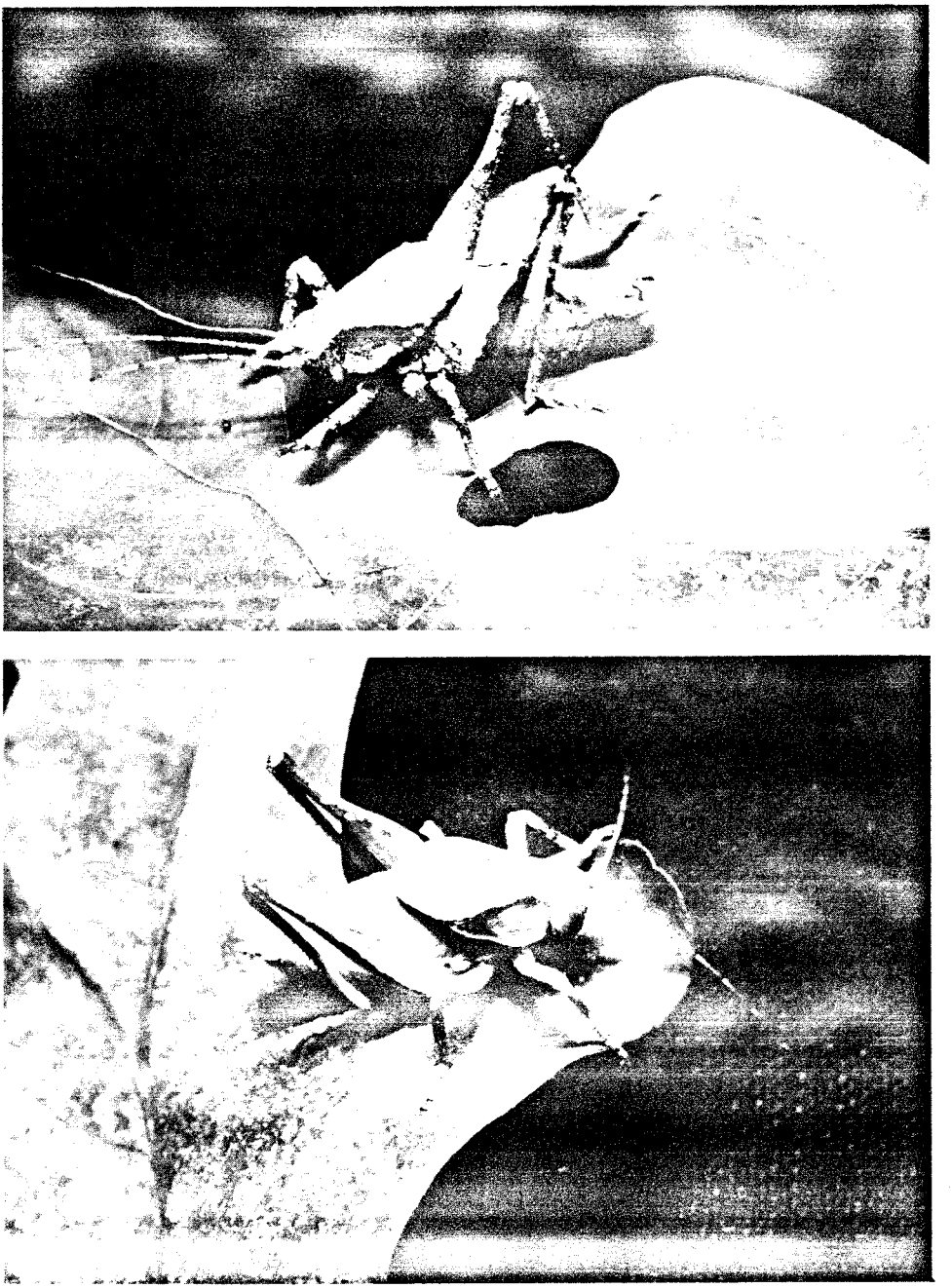
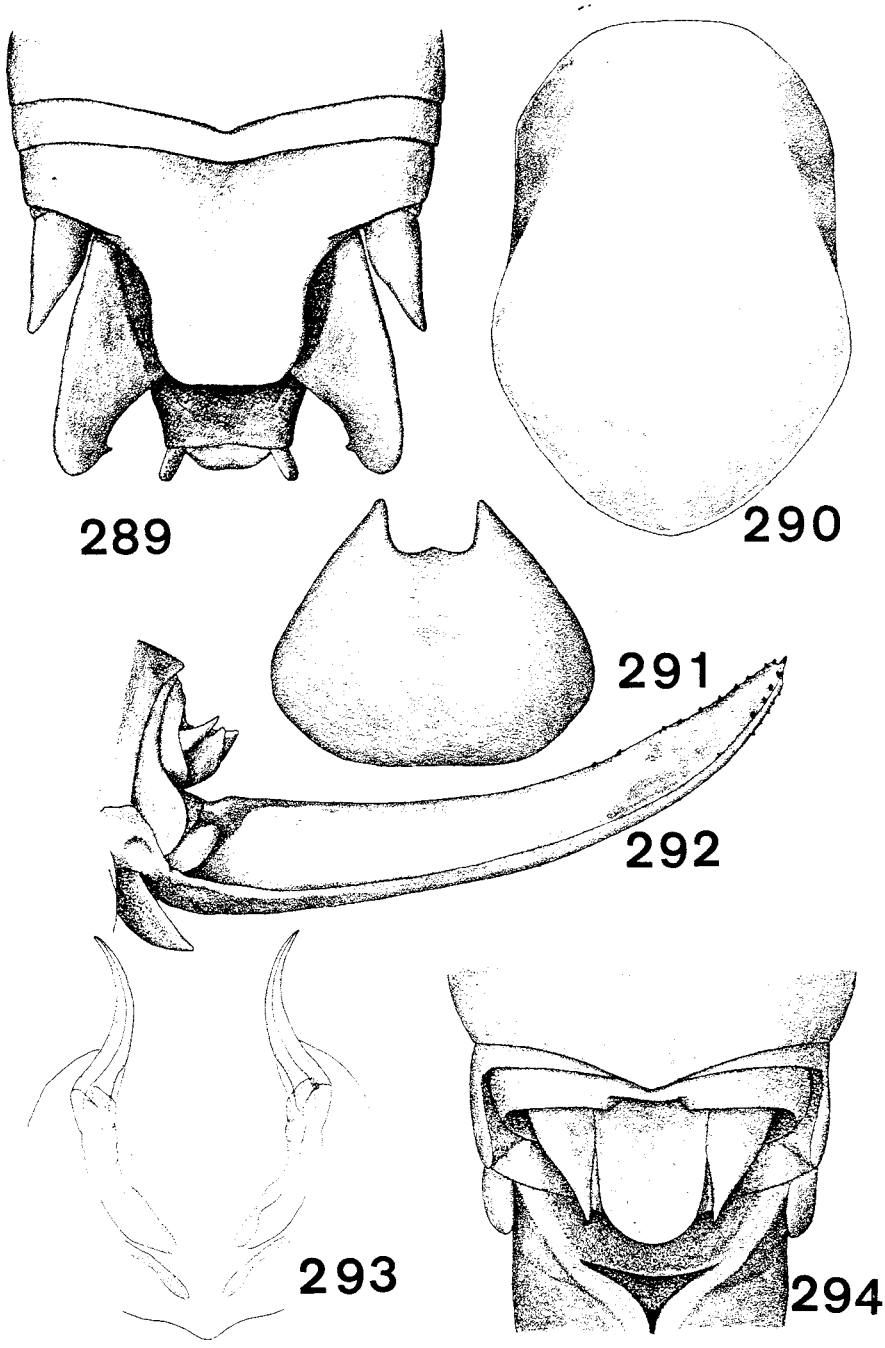


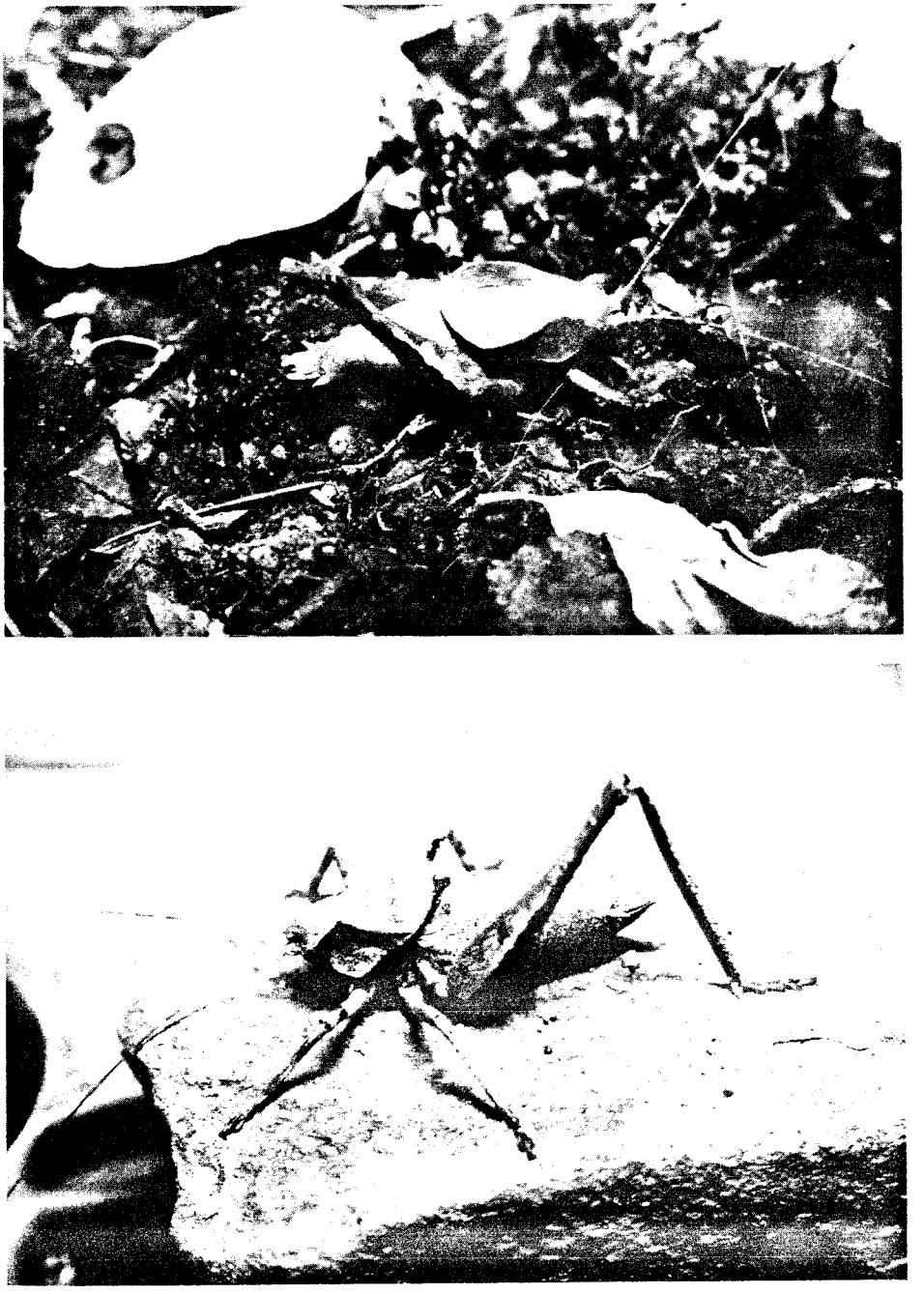
Figure 286: Oscillograms of song patterns of *Neduba morsei* subspecies.



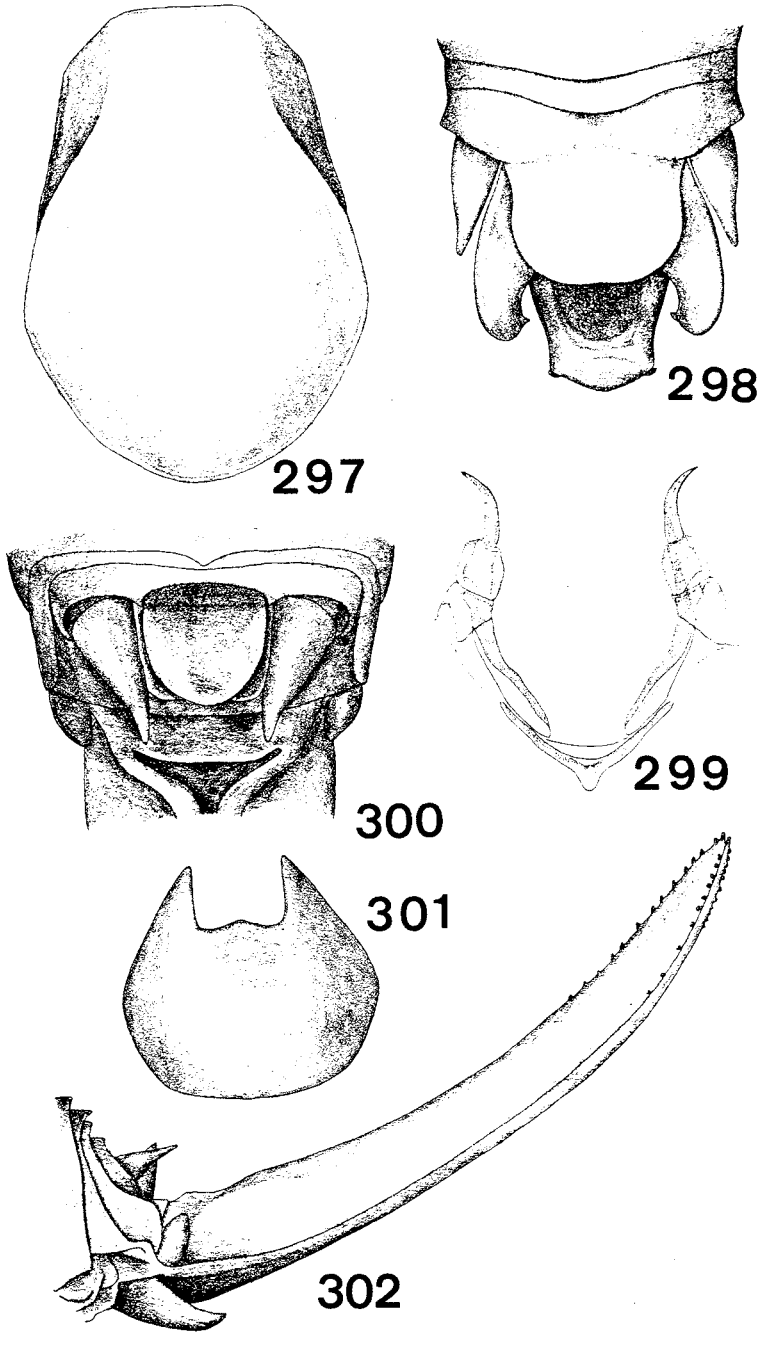
Figures 287 and 288: Males of *Neduba m. islandica* from Middle Anacapa Island. Fig. 287: Top, grey striped phase. Fig. 288: Bottom, light brown phase.



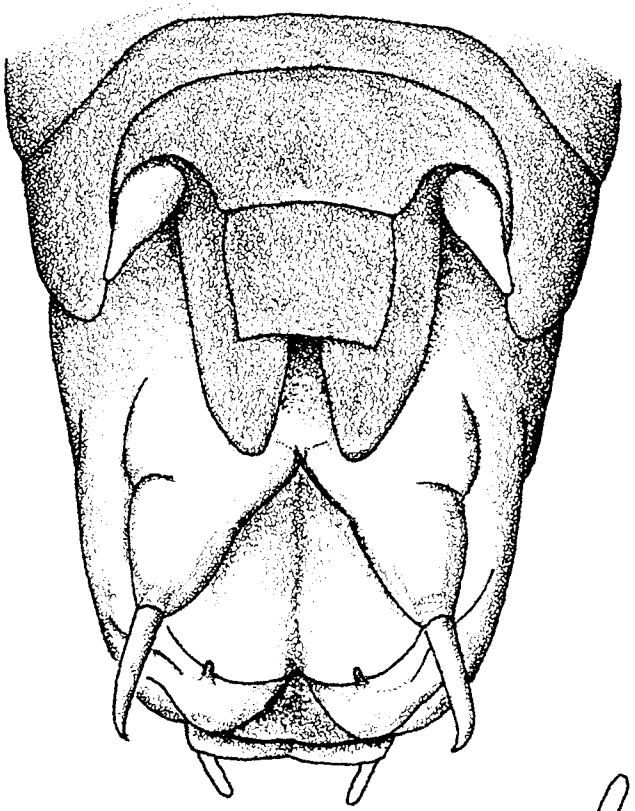
Figures 289–294: Diagnostic structures in *Neduba m. santacruzae*. Figs. 289, 290, 293: Holotype male. Figs. 291, 292, 294: Allotype female. All figures, 25X except Fig. 291, 50X; Fig. 294, 100X.



Figures 295 and 296: Fig. 295: Top, *Neduba m. santacruzae*, Santa Cruz Island. Fig. 296: Bottom, holotype male, *N. propsti*, Santa Catalina Island.



Figures 297–302: Diagnostic structures in *Neduba m. tectinota*. Figs. 297–299: Holotype male. Figs. 300–302: Allotype female. All figures, 25X except Fig. 301, 50X; Fig. 299, 100X.



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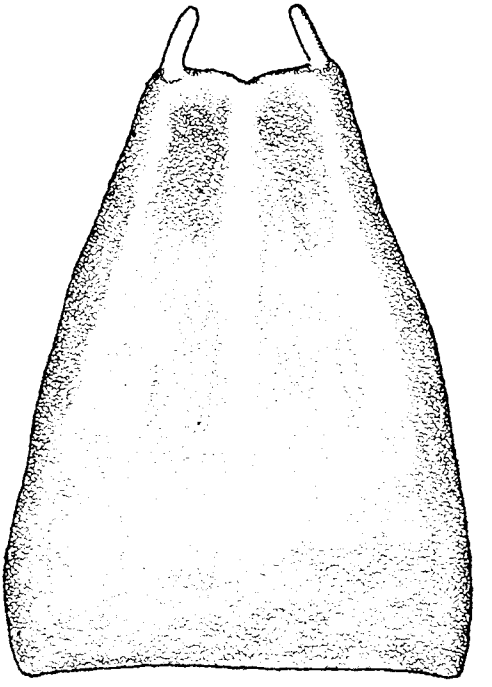

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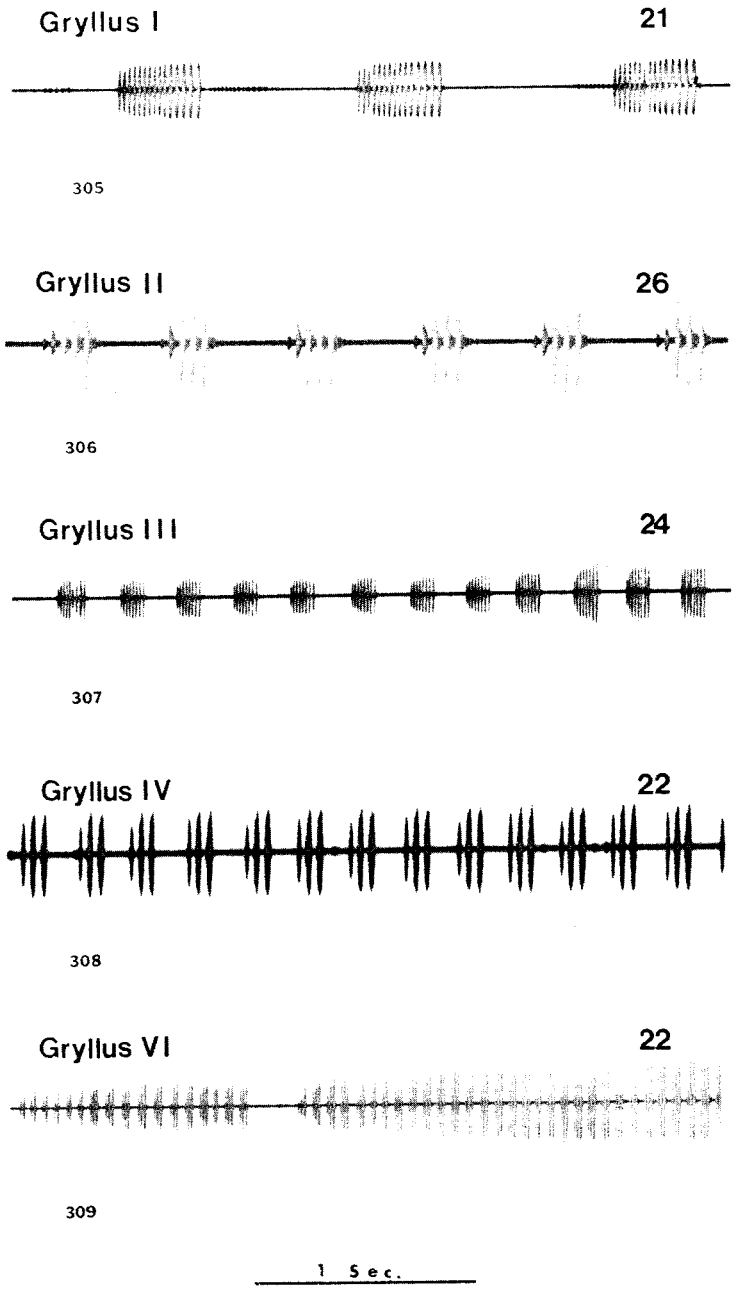
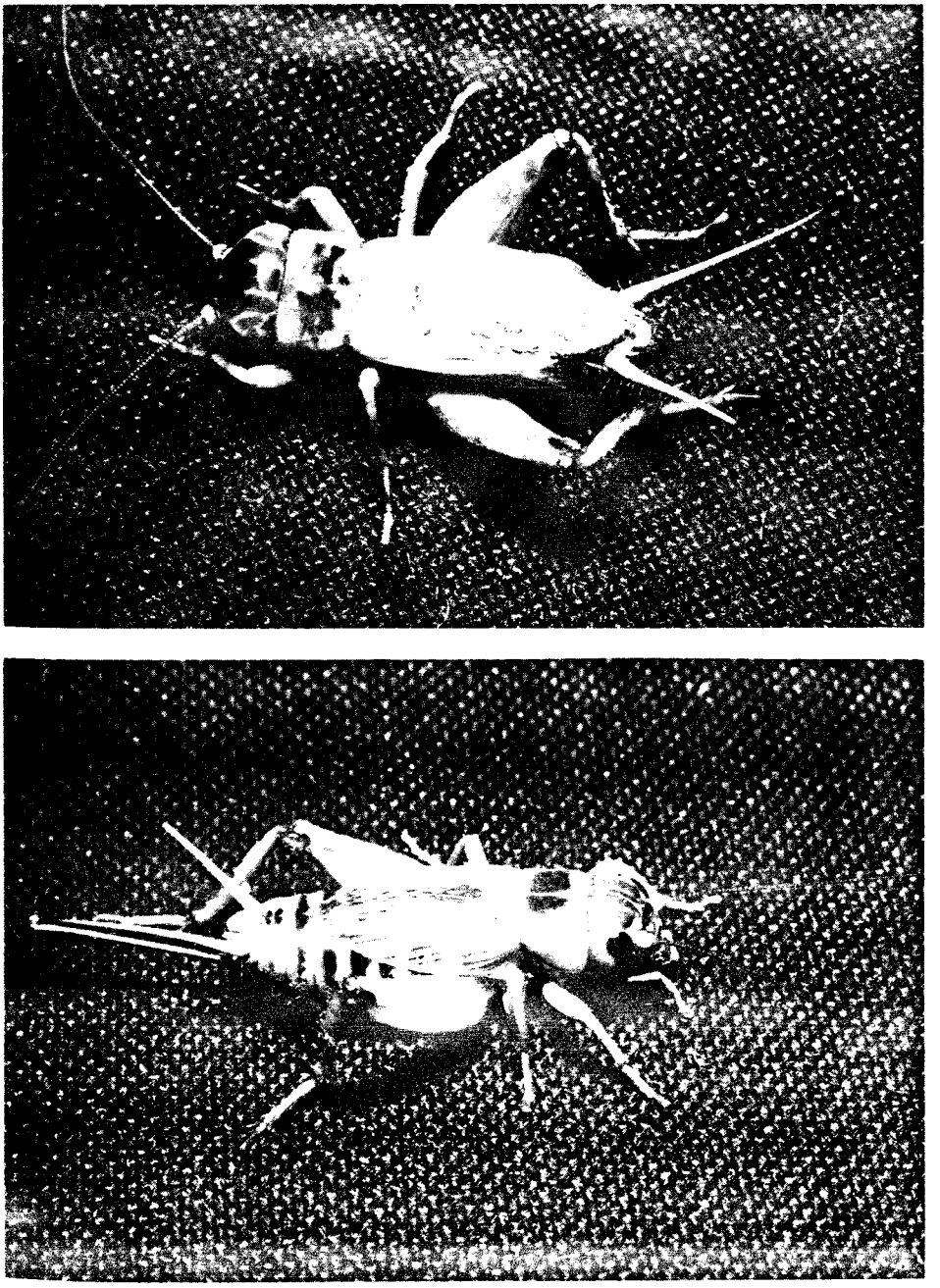
Figures 303 and 304: Diagnostie structures in *Neduba propsti*. Fig. 303: Apex of abdomen, holotype male. Fig. 304: Holotype male, subgenital plate, ventral view.



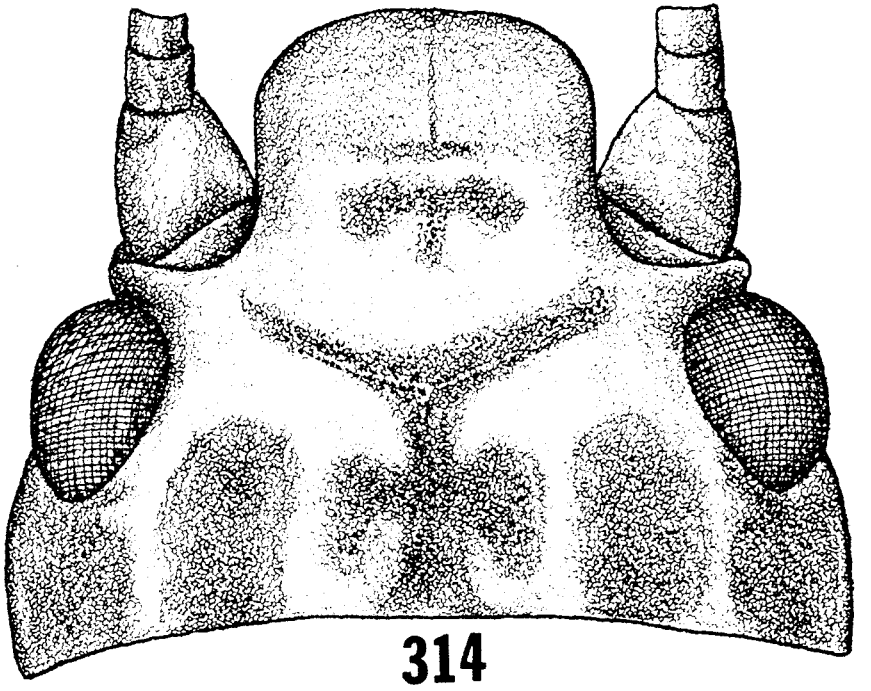
Figures 305–309: *Gryllus* oscillograms with recording temperatures on right side of figure. Fig. 305: Specimen from Santa Catalina Island. Fig. 306: Specimen from Santa Cruz Island. Fig. 307: Specimen from Santa Monica Mountains. Fig. 308: Specimen from Orange, Orange County, California. Fig. 309: Specimen from Palo Alto, Santa Clara County, California.

Figure 310: *Gryllus* II in dry stream on Santa Catalina Island.

Figure 311: *Gryllus* III. Dark phase. Male from San Clemente Island.



Figures 312 and 313: *Gryllus* III. Light phase. Fig. 312: Top, male. Fig. 313: Bottom, female. Both from San Nicolas Island.



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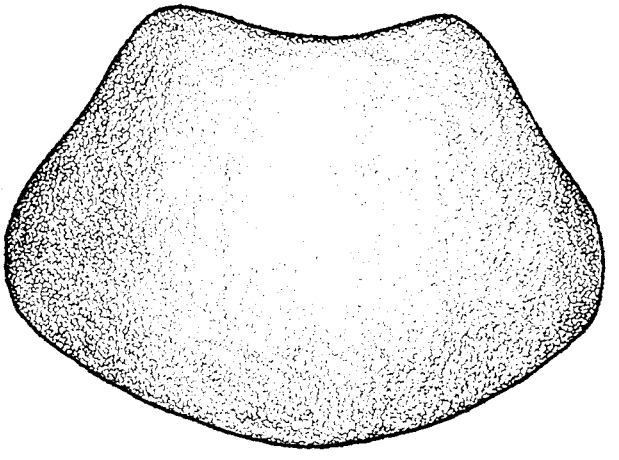

315

Figures 314 and 315: *Cycloptilum distinctum*, Santa Monica Mountains. Fig. 314: Head, female. 25X. Fig. 315: Female subgenital plate. 50X.