ECOLOGICAL NOTES ON ORTHOPTERA *(S. STR.)* IN BRITISH COLUMBIA

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ABSTRACT

Collections and observations were made of the grasshoppers of the semi-arid Okanagan Valley of British Columbia, during August and September, 1969. The habitats, frequency and local distribution of 37 species are discussed, based on 40 collecting sites.

HABITATS

During August and September, 1969, the second author collected and observed Orthoptera in British Columbia, near Penticton and Summerland in the semi-arid Okanagan Valley near the south end of Okanagan Lake. Adjacent to the lake, on the hillsides and on the low plateau of silty loess of glacial origin, are many apple orchards grown under irrigation (Fig. 1), and beyond the irrigated areas (350-500 m) the vegetation is typical of xerophytic range land.

The different habitats (or biotopes), were sampled on 40 collection sites mostly by sweeping-net, but also by capturing single specimens. Based on these sites, some conclusions may be drawn as to the frequency of occurrence and on habitat distribution (Table 1). The numbers of collection sites in each habitat were not equal; 21 sites were in xerophytic, 17 in mesophytic and only 2 in hygrophytic areas.

This is the first account of the habitats of the grasshoppers of this area. More detailed information on each of the sites is on file at the Research Institute for Plant Protection, Budapest, Hungary and at the Lyman Entomological Museum and Research Laboratory, McGill University, Macdonald Campus, Ste. Anne de Bellevue, Quebec, Canada.

The specimens were identified by the first author. Some have been retained in the Lyman Entomological Museum, but about 70% have been deposited in the collection of the Research Institute for Plant Protection, Budapest. The species collected are listed below by sex and the habitats in which they were found.

The characteristics of the various biotopes in which the collections were made may be summarized as follows:

I. Xerophytic areas.

I-A, short-grassland; pasture with variable scattered bushy vegetation on silty loess of glacial origin; at somewhat greater altitude, a plateau with more sand and gravel (360 to 500 m). The vegetation consisted of discontinuous, short grasses, *Agropyron* and *Bromus* species, with bare spots among low bushes of Oregon grape, *Berberis aquifolium* Pursh, antelope brush, *Purshia tridentata* (Pursh) D.C. (at Okanagan Falls only), but with rabbit-brush, *Chrysothamnus nauseosus* (Pall.) Britt., and sagebrush, *Artemisia tridentata* Nutt., predominating; cactus, *Opuntia fragilis* (Nutt.) Haw., and *Centaurea* spp. (Compositae) were also significant; mostly eroded areas with disturbed surfaces and soil-slides with variable exposures; 3 collection sites.

I-B, disturbed weedy areas on sandy-gravelly soil at low elevations (360 to 500 m) in the vicinity of orchards and residential gardens, supposedly originated secondarily from the grassland biotope; vegetation sparse, mixed grasses and weeds, *Agropyron*, *Bromus*, asparagus-*Asparagus officinalis* L., *Kochia*, *Gyposophila*, sagebrush and *Rhus* species, etc.; scattered miscellaneous bushes and single pines *Pinus ponderosa* Laws., also occurred; 3 small collections.

I-C, ponderosa pine park-forest; dry slopes with short-grass pasture at middle elevations (500-800 m), in sparse pine forest; more or less sparse short grass, with significant numbers of scattered bushes of squaw currant - *Ribes cerum* Douglas, *Amelanchier* sp., rabbit-brush, sagebrush, cactus and *Centaurea* spp. also occurred; many places were disturbed, overgrazed, or in roads, etc.; 4 collection sites.

I-D, relatively undisturbed clearings in the lower montane coniferous forest (800 to 1400 m) joined with some denser ponderosa pine park-forest (650 to 800 m); clearings with dry, relatively homogeneous short grass, with some forbs (e.g., *Gaillardia* sp., Compositae) and some bushes, notably *Amelanchier* sp. and snowbrush -

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Fig. 1. General view of south end of Okanagan Lake from the Summerland area.

Ceanothus sp., probably *velutinus* Douglas; denser forest at higher elevation (more than 800 m) with Douglas firs - *Pseudotsuga menziesii* (Mirib.) Franco and occasional patches of *Juniperus* spp.; in the smaller clearings, the sparse short-grass was interspersed with low clumps of snowbrush and *Vaccinium* spp.; generally rough terrain with eroded rocks and scattered boulders. Habitat type I-D represented an extensive and important area; 4 collection sites between 650 and 800 m and 7 between 800 and 1400 m.

II. Mesophytic areas.

II-A, the residential garden area of Summerland, near Powell Beach, along roads and bare ground at low altitude (360 m); generally sandy-gravelly soil deposited by Trout Creek; vegetation consisting of patches of willow and poplar, with occasional asparagus, *Berberis*, sweet clover - *Melilotus alba* Desr., and sagebrush; 4 collection sites.

II-B, as in II-A, in the residential garden areas, mainly near Powell Beach (360 m); vegetation a mosaic of more or less cultivated legumes, ornamental, vegetable and fodder crops, such as alfalfa (lucerne) - *Medicago sativa* L., sweet clover and *Lotus* sp. together with grasses; 7 collection sites.

II-C, large disturbed clearings in the ponderosa pine park-forest zone (500-800 m) and in the lower montane coniferous forest zone (800 to 1300 m); the mainly mesophytic character of this habitat was shown by the presence of small groves of poplar, *Symphoricarpos*, and moisture-requiring bushes; besides pine and fir, there occurred grasses - *Hordeum* sp., forbs such as spp. of *Potentilla*, *Melilotus*, *Mentha*, *Verbascum*, *Centaurea*, *Erigeron*, *Achillea* and *Solidago*. *Juniperus* spp., *Rosa* spp., *Ceanothus* and *Vaccinium* were the most prominent plants in these habitats at higher elevations; 3 collection sites (500 to 800 m) and 3 more at higher elevation (800-1300 m).

III. Hygrophytic areas.

Flat ground with depressions at low altitude; homogeneous dense grass with scattered sedges, *Carex* spp., goldenrod, *Solidago* spp., popular and willow trees and

bushes on moist soil; 2 restricted collection sites.

SPECIES AND BIOTOPES

Gryllacridoidea

Rhaphidiphoridae

Ceuthophilus sp., 1♂ and 1♀ juv., probably *agassizi* (Scudder), habitat I-C, Penticton (Niggertoe Mt.), found under a decayed tree trunk.

Grylloidea

Gryllidae

Gryllus sp., 2 young nymphs, probably *G. veletis* (Alexander & Thomas) also in habitat I-C, Penticton.

Allonemobius fasciatus (DeGeer), 4♂♂ and 2♀♀, habitats II-B and III, Summerland. Usually found only where moisture is available. It was located by continuous chirping.

Oecanthidae

Oecanthus sp., probably *O. argentinus* Saussure (antennae broken off) 1♂, 1♀, habitat II-A, Summerland (lake-shore); also detected in habitat II-C by stridulation.

Tettigonioidea

Tettigoniidae

Steiroxys trilineatus (Thomas), 2♂♂, 4♀♀, habitats I-C, I-D, Summerland but more numerous at Penticton (Niggertoe Mt., eastern and western slopes). Buckell (1922) reported it as *Steiroxys* sp. on open range land.

Phaneropteridae

Scudderia furcata furcata Brunner, 4♂♂, 2♀♀, habitats II-A and III, Summerland (near Powell Beach), on humid spots only. Populations of this species tended to be small and localized here, but specimens were often seen sitting on the tops of willow bushes, feeding and chirping.

Conocephalidae

Conocephalus fasciatus (DeGeer), 3♂♂, 2♀♀, habitat III, on sedge, Summerland. Remarks on the occurrence of *S. f. furcata* largely apply to this species also.

Tetrigoidea

Tetrigidae

Tetrix subulata (Linnaeus), 7♂♂, 1♀, 3 juv., habitat II-C, Summerland (Concle Mt., dried up pond), Penticton ("Naramata" Mt., 1300 m). It was localized in mesophytic depressions in areas otherwise xerophytic.

Tetrix ornata occidua Rehn and Grant, 1♂, habitat II-C, Penticton ("Naramata" Mt., 1300 m), in company with *T. subulata*.

Acridoidea

Acrididae

Melanoplinae

Melanoplus sanguinipes sanguinipes (Fabricius), 48♂♂, 34♀♀, in all xerophytic and mesophytic habitats, Summerland, Penticton, Naramata, and Okanagan Falls; the most common and widespread species of *Melanoplus* in British Columbia and across southern Canada.

Melanoplus femurrubrum femurrubrum (DeGeer), 25♂♂, 21♀♀, in all habitats except I-C, Summerland and Penticton. Usually found in vegetation which was somewhat lush, so that it was less common than *M. s. sanguinipes*, although the general distribution was about the same.

Melanoplus packardi Scudder, 1♀, found only in habitat I-B, Summerland, near Trout Creek, on a sandy slope, with some ponderosa pine, at 400 m. This species was reported from British Columbia by Brooks (1958) but not by Buckell (1922, 1924). Not common, it was usually confined to sandy or gravelly areas with xerophytic vegetation.

Melanoplus bivittatus (Say), 17♂♂, 11♀♀, in all habitats examined in mesophytic and hygrophytic areas, Summerland and Penticton, at lower and higher altitudes and in more lush vegetation than other *Melanoplus* species of the area. Common in the residential garden area, often seen climbing and sitting on garden vegetables and particularly on high forbs, such as sweet clover, at twilight, basking, as indicated by Riegert (1967).

Melanoplus alpinus Scudder, 2♂♂, 4♀♀, habitats I-D and II-C, Summerland (Concle, Acland, Niggertoe Mts.) and Penticton ("Naramata" Mt.). Buckell (1922) stated that this species was fairly common in dry Douglas fir forests in the Chilcotin area. Brooks (1958) reported it from montane parklands and grasslands, similar to the collection sites recorded here.

Melanoplus huroni Blatchley, 1♂, 10♀♀, habitats I-C, I-D and II-C, Summerland (Concle, Niggertoe, Acland Mts., Darke Creek). Primarily a forest species, occurring in disjunct populations.

Melanoplus infantilis Scudder, 4♂♂, 2♀♀, habitats I-C and I-D, Summerland, although Buckell (1922) reported it as very common on range land in the Chilcotin area.

Phoetaliotes nebrascensis (Thomas), 2♂♂, habitat I-A, Okanagan Falls, in pasture where antelope brush predominated.

Buckellacris nuda nuda (E. M. Walker),

1♂, 1♀, habitat II-C, Summerland (Darke Creek), on the south side of Acland Mountain in bushy mixed vegetation, mainly snowbrush and juniper, grown or remaining after deforestation.

Oedipodinae

Camnula pellucida (Scudder), 12♂♂, 11♀♀, habitats I-C, I-D, II-B and II-C, Summerland. It is surprising that this species was not found in all xerophytic and mesophytic areas.

Dissosteira carolina (Linnaeus), 9♂♂, 9♀♀, habitats I-A, I-B, I-C, II-A and II-B, Summerland and Penticton. Found only on bare spots, roads, and trails in disturbed cultivated places. The sunny roadsides in the garden areas of Summerland and Penticton were basking places for adults. It was common to see specimens killed by automobiles. *C. pellucida* and *D. carolina* are found from the Atlantic to the Pacific in Canada.

Arphia pseudonietana pseudonietana (Thomas), 14♂♂, 8♀♀, nearly all habitats of the xerophytic and mesophytic areas at Summerland and Penticton. Reported as common in the British Columbia dry belt by Buckell (1922).

Spharagemon equale (Say), 6♂♂, 8♀♀, habitats I-A, I-C, I-D, and II-B, Summerland (Niggertoe Mt., Darke Creek).

Cratypedes neglectus (Thomas), 4♂♂, 5♀♀, habitats I-C, I-D and II-C, Summerland (Niggertoe Mt., Concle Mt., Darke Creek). Although the habits were similar to those of the preceding species, they were found together at only one of seven sites.

Circotettix rabula rabula Rehn and Hebard, 6♂♂, 2♀♀, habitats I-D and II-C, Summerland (Niggertoe Mt., Acland Mt.) and Penticton ("Naramata" Mt.), on bare eroded, cleared areas or outcroppings of rock or gravel, mostly at higher elevations.

Trimerotropis pallidipennis pallidipennis (Burmeister), 3♂♂, 2♀♀, habitats I-B, I-C and II-B, Summerland (Concle Mt.) and in a disturbed weedy place at Penticton. This species usually occurs in small colonies on sandy soil in protected places with sparse vegetation.

Trimerotropis sparsa (Thomas), 4♂♂, 3♀♀, habitat I-A, Summerland. Not previously recorded in the literature from British Columbia. It apparently occurs infrequently and is confined to bare areas on eroded hillsides and silty loess plateaus. At the same site were found other grasshoppers, *Melanoplus s. sanguinipes*, *M. f. femurrubrum*, *Spharagemon equale*, *Amphitornus coloradus ornatus* and an undetermined *Trimerotropis* sp. (below).

Trimerotropis verruculatus suffusa Scudder, 31♂♂, 21♀♀, habitats I-C, I-D, II-B and II-C, Summerland and Penticton, at higher places in most xerophytic and mesophytic biotopes, often in company with *Circotettix r. rabula*. It occurs all over southern British Columbia, rather evenly distributed in light, open woodlands (Buckell, 1922).

Trimerotropis fontana (Thomas), 31♂♂, 30♀♀, habitats I-A, I-B, I-C, I-D, II-B and II-C, Summerland and Penticton; common and widespread.

Trimerotropis species, 2♂♂, habitat I-A, Summerland, on silty loess plateau at 420 m. This species was recorded by Buckell (1924) as *T. gracilis* (Thomas). Brooks (1958) reported it from British Columbia as *T. gracilis sordida* E. M. Walker, but the first author of this paper found that it was not this subspecies. Further work will establish the identity of the specimens from British Columbia. It was found in company with the species listed under *Tr. sparsa*, above.

Pardalophora apiculata (Harris), 4♂♂, 8♀♀, third instar nymphs, habitats I-D and II-C, Penticton ("Naramata" Mt., 1300 m) with *Chloealtis conspersa*, *Tetrix* and *Melanoplus* species; in another habitat it was found with *Melanoplus s. sanguinipes*, *Arphia p. pseudonietana*, *Trimerotropis suffusa* and *Tr. fontana*. Based on Pickford's statements (1953), these specimens may have been overwintering nymphs. They were collected on September 5 and were kept in a warm place, about 25-30 C., exposed to sunshine; two did moult to the adult form in October, but later all died during a long journey.

Gomphocerinae

Aulocara elliotti (Thomas), 2♀♀, habitats I-A, Summerland, dry pasture at 500 m, and II-C, Naramata, lakeshore with silt, sand and rocks in sparse vegetation. Brooks (1958) reported this species as very localized on dry, grassy hillsides in some areas of Saskatchewan and Manitoba and common on grasslands in northwestern Alberta. Buckell (1922) recorded *A. elliotti* as plentiful "on the open Bunchgrass flats in the Lower Okanagan Valley."

Ageneotettix deorum deorum (Scudder), 3♂♂, 7♀♀, habitats I-A and I-B, Summerland and Penticton. Previously recorded from British Columbia as *Ageneotettix occidentalis* Bruner. This was corrected in an unpublished list by Buckell (1937).

Amphitornus coloradus ornatus McNeill,

3♂ ♂, 7♀ ♀, habitats I-A and II-C, Summerland and Penticton. In this instance, the mesophytic habitat was a small, isolated area in terrain which was otherwise xerophytic. Buckell (1922) reported it as *A. nanus* R. & H., common in dry areas of southern British Columbia.

Chloealtis conspersa Harris, 3♂ ♂, 1♀, one locality in habitat II-C, Penticton ("Naramata" Mt., at 1300 m), with *Chloealtis abdominalis*, *Tetrix subulata*, *T. ornata occidua*, three *Melanoplus* spp. and oedipodine nymphs. Buckell (1922) reported *C. conspersa* as fairly common and evenly distributed in the interior of the province.

Chloealtis abdominalis (Thomas), 9♂ ♂, 6♀ ♀, habitats I-C, I-D and II-C, Summerland and Penticton. Reported by Buckell (1922) to occur in the same habitats as the preceding species but more numerous. The present collections confirm that it is more numerous but the two species did not often occur together. *C. conspersa* was found in the Okanagan Lake area at only one of the 8 sites where *C. abdominalis* was taken. The first author has found biotopic distribution similar to that reported here, at Salmon Arm, British Columbia.

Orphulella pelidna deserta Scudder, 2♂ ♂, 6♀ ♀, habitats II-B and II-C, Summerland, near Powell Beach and Concle Mt., in local pockets of heavier vegetation in moist soil.

Chorthippus curtipennis curtipennis (Harris), 5♂ ♂, 2♀ ♀, habitats I-D and II-C, Penticton ("Naramata" Mt., at 1000 m). Normally found only in mesophytic and hygrophytic habitats, it was surprising to find it in ponderosa pine park-wood with sparse vegetation; the reason might be some spotty green grass-patches and a nearby mesophytic habitat.

Notes on Dominance, Abundance and Distribution

About 60% of the species which occur in the xerophytic biotopes of southern British Columbia are represented in the collection. If a full range of habitats had occurred in the area, the number of species would undoubtedly have been greater. Most of the species collected were found in predictable habits.

Trimerotropis sparsa (Thomas) was not previously recorded in the literature from British Columbia and *Steiroxys trilineatus* (Thomas) was reported earlier without a specific name (Buckell, 1922).

Scudder (1862) included a few species of Orthoptera from western Canada and Caudell (1904) listed species from a single area of Alberta. Walker (1906; 1910) added more species but none of these papers contained ecological notes of any significance. Buckell (1921, 1922, 1924) and Treherne and Buckell (1924a, 1924b) provided brief notes on the ecology of some of the species of Orthoptera found in British Columbia. These are the only ecological records on this group in this area to date. Handford (1961) reported in greater detail on one species, *Camnula pellucida* (Scudder). In general, the records cited were from the range areas of the Chilcotin District, near Riske Creek, and from the Nicola Valley. Few species were listed from the geographical area covered here. However, the ecological notes do not vary significantly.

Unfortunately, the different collecting sites do not have the same importance in the various habitats, but an approximate impression is given by the numbers of specimens of the most numerous species: *Melanoplus s. sanguinipes*, *Trimerotropis fontana*, *Tr. verruculatus suffusa*, *M. f. femurrubrum* and *M. bivittatus*, which were the most numerous in the late summer of 1969. *Arphia p. pseudonietana* and *Camnula pellucida* were also numerous. *Camnula* would be expected to be as common and to occur in an equally wide range of biotopes, but it was found only in certain habitats near Summerland. *Tr. fontana* might be expected to occur less frequently than *Camnula*, but this was not the case. *Melanoplus f. femurrubrum* was, as expected, confined mainly to areas where moisture was more abundant than is necessary for *M. s. sanguinipes*. *M. bivittatus* is more restricted by availability of moisture than either of these species.

Because of the relatively late season, the abundance of the grasshoppers generally was estimated to average rather less than one specimen per sq. m; in only three collecting sites was the population estimated to be greater than this. At a collecting site in the xerophythic habitat I-A (sagebrush and short-grass pasture at 400 m elevation) the abundance was estimated as 1-2 specimens per sq. m; the most abundant species here were *Trimerotropis fontana*, *Arphia p. pseudonietana* and *Melanoplus s. sanguinipes*. In a mesophytic collecting site, the abundance was estimated as 2-3 specimens per sq m, which was the highest encountered. This was in habitat II-B, an artificially cleared meadow with a weedy alfalfa-field at 800 m elevation. The species found were *Trimerotropis fontana*, *Arphia p. pseudonietana*, *Melanoplus s. sanguinipes*, *M. bivittatus* and *Camnula pellucida*. On a third collecting site, in the mesophytic habitat II-C,

Biotope	Altitude**	No. Sites	No. Species
Xerophytic - I			
A*	l	3	12
B	l	3	8
C	m	4	15
D	m	4	12
D	h	7	14
Mesophytic - II			
A	l	4	7
B	l	7	13
C	m	3	11
C	h	3	17
Hygrophytic - III	l	2	5

*Classification within biotopes as outlined in text.

**Altitudes: l = 360-500; m = 500-800; h = 800-1400m.

Total Species - 37; total specimens - 512.

Table 1. Numbers of species of Orthoptera collected at 40 sites in three habitats, Okanagan Lake area, British Columbia, August and September, 1969.

a disturbed clearing-pasture with scattered popular bushes and weeds at 950 m elevation, the abundance was estimated to be 1-2 specimens per sq m. The grasshopper population here consisted of *Melanoplus s. sanguinipes*, *M. f. femurrubrum*, *M. bivittatus*, *Arphia p. pseudonietana*, *Trimerotropis fontana* and *T. verruculatus suffusa*.

Table 1 presents summarized data on the distribution, and thus on the occurrence, of the species in the different habitats and indicates the frequency of occurrence, within the different habitats. Habitats I-D and II-C may be seen to be divided into two groups, middle (under 800 m) and higher (over 800 m) altitudes. Since the different habitats are not represented equally by collecting sites, the comparative value of species numbers in Table 1 is reduced somewhat.

There were only slight differences in species numbers between the three altitudinal biotic zones; 23, 21 and 20 species were found in the grassland (360 to 500 m), in the ponderosa pine park-forest zone (500 to 800 m) and, in the lower montane coniferous forest zone (800 to 1400 m) respectively. These differences in species numbers were less than 10% . However the vertical distance investigated was only a little more than 1000 m. In the Rocky Mountains of North Colorado (Alexander and Hilliard, 1969), the reduction in species number in similar habitats and for the same vertical distance was greater than 50% . The area in question is only about 1100 km to the south of Summerland, but it is much higher. Consequently, the degree of altitudinal difference is hardly comparable.

The middle ponderosa pine park-forest region contained a mixed group of species of Orthoptera consisting of some common elements in both the lower region: *Dissosteira*, *Spharagemon*, *Trimerotropis p. pallidpennis*, *Amphitornus* and *Orphulella*; and also in the upper regions: *Steiroxys*, *Tetrix subulata*, *Melanoplus huroni*, *M. alpinus*, *M. infantilis*, *Circotettix r. rabula* and *Chloealtis abdominalis*; but few of these species are confined to the region. Therefore, based solely on this one summer's investigation in the area, the ponderosa pine park-forest zone may be

considered as an intermediate ecotone between the short-grassland and the lower montane coniferous forest zone. Table 1 shows the general pattern of this distribution.

Several species were found to be confined to a particular biotope or to closely related habitats. Among these, habitat I-D, clearings with dry grasses, scattered bushes, mixed pine and fir forest with occasional patches of juniper, was preferred by 16 species; *Melanoplus infantilis* and *Steiroxys trilineatus* were collected almost entirely in this habitat. Habitat II-C proved the richest with 21 species; this habitat is related to type I-D, but is generally characterized by more humidity and disturbance and therefore more ecological factors than habitat I-D. *Tetrix subulata*, *T. ornata occidua*, *Buckellacris n. nuda*, *Chloealtis conspersa* and oedipodine nymphs (*Pardalophora apiculata*) were found in habitat II-C only. *Melanoplus huroni*, *M. alpinus*, *Circotettix r. rabula* were restricted to these two habitats, and *Trimerotropis verruculatus suffusa* and *Chloealtis abdominalis* were most often found here.

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