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Invertebrates of the H.J. Andrews Experimental Forest, Western Cascades, Oregon: III. The Orthoptera (Grasshoppers and Crickets)

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Abstract

An inventory of Orthoptera (grasshoppers and crickets) at the H.J. Andrews Experimental Forest, near Blue River, Oregon, was conducted to determine the species present and ecological relationships. A key for identification and an annotated list are presented. From qualitative assessments of successional habitat relationships, generalized species associations of forest Orthoptera are proposed, and their responses to forest succession are predicted.

Keywords: Invertebrata, keys (invertebrata), checklists (invertebrata), Oregon (H.J. Andrews Exp. For.).

Introduction

Orthoptera are important primary consumers in many terrestrial ecosystems (Odum and others 1962, Rodell 1977, Uvarov 1977). In temperate regions they are especially prevalent in grassland and scrub formations (Barnum 1964, Campbell and others 1974, Otte 1976). Relatively few Orthoptera occur in temperate forests of the Pacific Northwest and little is known about species composition or about orthopteran community patterns or processes.

This study was conducted to inventory the Orthoptera of the H.J. Andrews Experimental Forest (HJA) (a long-term ecological research site of the National Science Foundation), Willamette National Forest, near Blue River, Oregon, and to provide information about and identify those species that occur there. Analysis of long-term ecological trends is of primary concern at the HJA. To determine how orthopteran communities change over time, patterns of habitat associations were qualitatively assessed for a series of sites at different stages of vegetational succession. Consistent species assemblages were found associated with generalized habitat types representing early and late seral plant communities. Predictions can be made from these findings as to how populations and species composition should respond to environmental changes resulting from natural and anthropogenic disturbances and to subsequent vegetational succession.

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The H.J. Andrews Experimental Forest is managed cooperatively by the Pacific Northwest Research Station and the College of Forestry, Oregon State University. This paper is one of a continuing series that report on scientific studies in the Forest.

Methods

The HJA is located east of Eugene, Oregon, in the Willamette National Forest on the west slope of the Cascade Range. A detailed description of the site may be found in Franklin and Dyrness (1971). Franklin and Dyrness (1973) describe several elevational forest zones in the coniferous forests of western Oregon and Washington, two of which are represented at the HJA and will be referred to in this paper. The temperate Western Hemlock Zone is found from 150 to 1 000 m elevation and covers most of the study area. Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) are the dominant canopy species. There are few natural canopy openings in the zone. The cool-temperate Pacific Silver Fir Zone is found on ridges and peaks from 1 000 to 1 500 m. The dominant canopy species are Pacific silver fir (*Abies amabilis* Dougl. ex Forbes), noble fir (*Abies procera* Rehd.), Douglas-fir, and western hemlock. Meadows and other natural openings are common.

Sampling was conducted in 1978, 1979, and 1980, primarily during late summer and autumn when most species were in the adult stage. Sample sites were chosen to represent a variety of habitat and successional vegetation types distributed throughout the HJA. Orthopteran species composition and habitat characteristics at sample sites were recorded. Voucher specimens were deposited in the H.J. Andrews Experimental Forest special insect collection in the Systematic Entomology Laboratory at Oregon State University, Corvallis.

Results

Most species of Orthoptera occurring at the HJA were probably accounted for in this study. A key to identification and an annotated list of the Orthoptera follows. The key is for adult insects, and males and females will key together except as noted. Figures 1 through 3 are provided to illustrate the locations of some morphological characters used in the key.

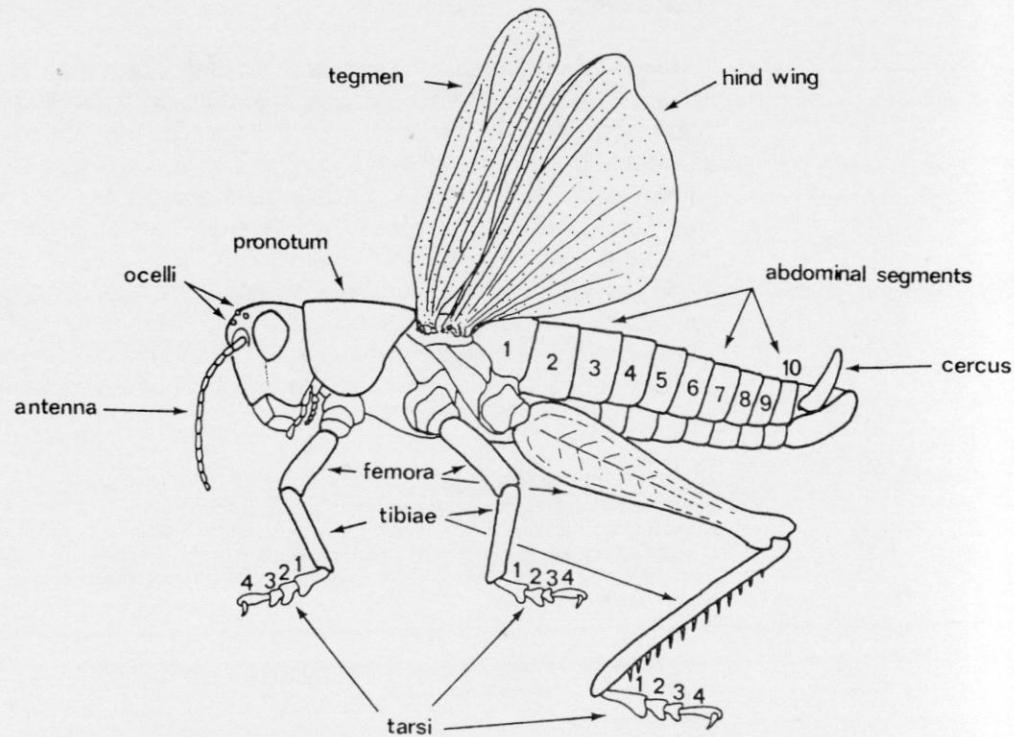


Figure 1.—Generalized orthopteran external morphology.

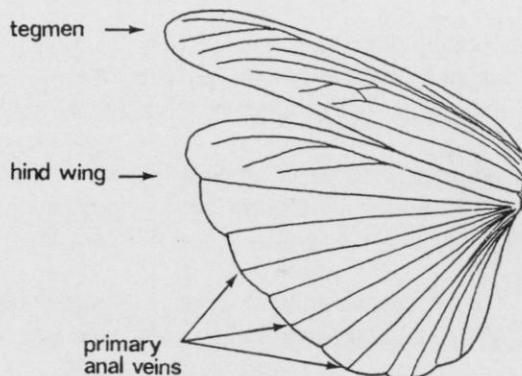


Figure 2.—Grasshopper wings.

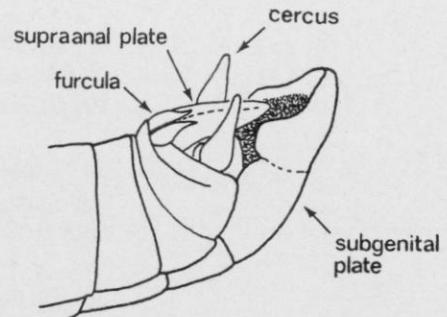


Figure 3.—Apex of a male grasshopper abdomen.

Key to the Orthoptera of the H.J. Andrews Experimental Forest

1a. Hind tarsi have three or four segments (figs. 4, 5); if three segments, auditory organ present on front tibiae (fig. 6). Antennae with more than 30 segments. (Suborder Ensifera.) ----- 13

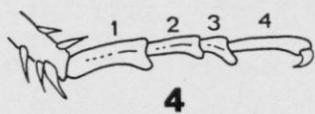


Figure 4.—Four tarsal segments.



Figure 5.—Three tarsal segments.

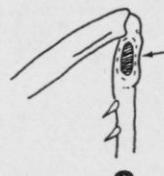


Figure 6.—Auditory organ on front tibia.

1b. Hind tarsi have three segments, no auditory organ on front tibiae; auditory organ on first abdominal segments (fig. 7). Antennae with less than 30 segments. (Suborder Caelifera.) ----- 2

2a. Pronotum greatly extended posteriorly, often to apex of abdomen (fig. 8). Tegmina much smaller than hind wings. Front and middle tarsi have two segments, hind tarsi have three segments, arolium (lobe) absent between tarsal claws (not as in fig. 10). Black to various shades of brown and gray. Very small, length 5 to 10 mm. (Pygmy locusts; family Tettigidae; subfamily Tettiginae.) ----- *Tetrix subulata* (Linnaeus)

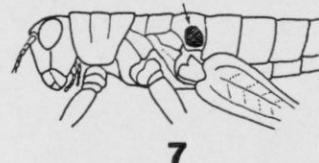


Figure 7.—Auditory organ on first abdominal segment.

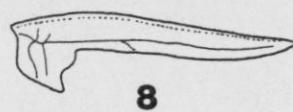


Figure 8.—Posteriorly extended pronotum of a tettigid grasshopper.

2b. Pronotum not greatly extended posteriorly (fig. 9). Tegmina equal to or longer than hind wings. All tarsi have three segments, arolium present (fig. 10). Size medium to large, length 20 to 45 mm. (Short-horned grasshoppers; family Acrididae.) ----- 3

3a. Prosternum with median spine or tubercle (fig. 11). Wings long, at least to tip of abdomen, short, or absent; when present, hind wings clear. (Spur-throated grasshoppers; subfamily Melanoplinae.) ----- 5

3b. Prosternum without median spine or tubercle. Wings present and long, hind wings colored or clear. Antennal segments round or flattened. ----- 4

4a. Face rounded, median ridge of pronotum elevated and cut by one or more transverse grooves on prozona (fig. 12). Posterior margin of metazona produced to a point at intersection of median ridge, prozona shorter in length than metazona (fig. 13). Wings long, hind wing disc yellowish or red with a black band, tegmina often mottled. Antennal segments round. (Band-winged grasshoppers; subfamily Oedipodinae.) --- 10

4b. Face slanted back ventrally, median ridge of pronotum low and cut by one transverse groove, prozona greater in length than metazona (fig. 14), posterior margin of metazona not produced to a point (fig. 15). Antennal segments flattened, especially those at base. Wings variable, often reaching apex of abdomen in males, short of apex in females. Hind femora surpassing apex of abdomen and wings. Hind wings clear, body brown to olive green, lateral ridges of pronotum lightly marked, forming a faint "X" when viewed from above. Length 14 to 25 mm. (Slant-faced grasshoppers; subfamily Gomphocerinae.) ----- *Chorthippus curtipennis* (Harris)

5a. Wings present, either fully developed or reduced to small tegminal pads (figs. 16, 17). ----- 6

5b. Wings absent. Male cerci as in figure 18. Brownish to olive green, two dark lateral bands running the length of the body, ventral surface yellow. Hind tibiae reddish brown. Length 19 to 24 mm. ----- *Boonacris alticola* Rehn and Randell

6a. Wings long or reduced to small pads. If reduced, tegminal pads nearly oval in shape, touching dorsally, or separated by a distance less than half the width of one pad. ----- 8

6b. Wings never long, reduced to small tegminal pads. Wing pads elongate and widely separated by at least a distance equal to half the width of one pad (fig. 19). ----- 7

7a. Tegminal pads very narrow (fig. 20). Posterior margin of metazona slightly notched at intersection of median ridge (fig. 21). Male cerci as in figure 22. Brownish or olive green and brown, broad yellowish dorsal band running the length of the abdomen bordered by dark lateral bands, ventral surface yellow, hind tibiae yellowish brown. Length 16 to 24 mm. ----- *Prumnacris rainierensis* Caudell

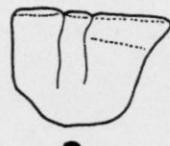
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Figure 9.—Typical grasshopper pronotum.

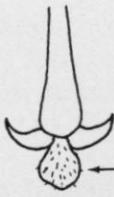
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Figure 10.—Arolium present between tarsal claws.

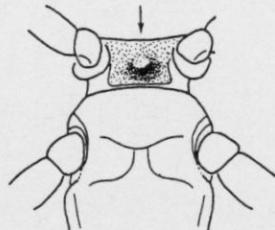
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Figure 11.—Prosternal process of a spur-throated grasshopper.

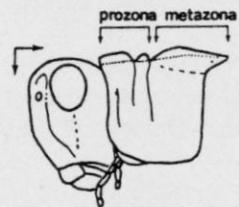
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Figure 12.—Head and pronotum of a band-winged grasshopper.

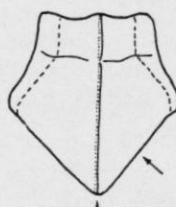
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Figure 13.—Dorsal view of a band-winged grasshopper pronotum.

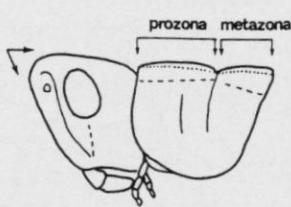
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Figure 14.—Head and pronotum of a slant-faced grasshopper.

**15**

Figure 15.—Dorsal view of a slant-faced grasshopper pronotum.

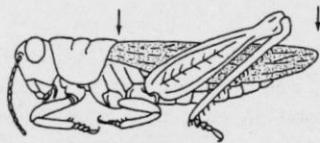
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Figure 16.—Long-winged, spur-throated grasshopper.

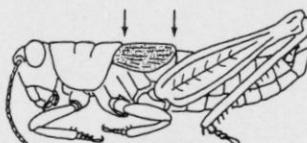
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Figure 17.—Short-winged, spur-throated grasshopper.

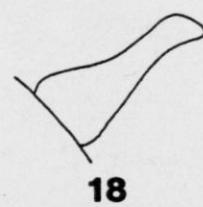
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Figure 18.—Male cercus of *Boonacris alticola*.

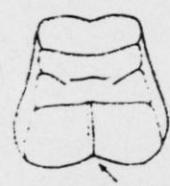
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Figure 21.—Pronotum of *Prumnacris rainierensis*.

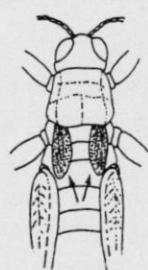
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Figure 19.—Wing pads of a short-winged, spur-throated grasshopper.

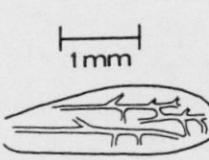
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Figure 20.—Tegminal pad of *Prumnacris rainierensis*.

**22**

Figure 22.—Male cercus of *Prumnacris rainierensis*.

7b. Tegminal pads almost oval (fig. 23). Posterior margin of metazona straight across at intersection of median ridge (fig. 24). Male cerci as in figure 25. Same general color as *P. rainierensis* except that dorsal surface of abdomen is greenish rather than yellow. Length 18 to 25 mm. ----- *Podisma hesperus* (Hebard)

8a. Wings reduced to small, oval tegminal pads (fig. 26). Male cerci as in figure 27. General color dark brown, hind tibiae red. Length 20 to 26 mm. ----- *Melanoplus validus* Scudder

8b. Wings fully developed, reaching or surpassing the apex of the abdomen. --- 9

9a. Apex of male subgenital plate slightly notched (fig. 28) (also refer to fig. 3). Male supraanal plate broad at base, becoming narrow at apex (fig. 29). Male cerci as in figure 30. Brownish to yellowish with dark spots on tegmina, hind tibiae red to bluish gray. Length 20 to 24 mm. ----- *Melanoplus sanguinipes* (Fab.)

9b. Apex of male subgenital plate broadly notched (fig. 31). Male supraanal plate constricted midway to apex (fig. 32). Male cerci as in figure 33. Brownish, yellowish, or reddish, hind tibiae red. Length 18 to 24 mm. --- *Melanoplus femur-rubrum* (DeGeer)

10a. Hind wing disc yellow or greenish yellow with black band. Median ridge of pronotum elevated more so on prozona than metazona, and cut by two grooves on prozona (fig. 34). ----- 11

10b. Hind wing disc red with black band (fig. 35). Median ridge of pronotum well elevated throughout and cut by one groove approximately midway (fig. 36). Gray to brownish gray, hind tibiae blue. Length 24 to 28 mm. --- *Arphia conspersa* Scudder

11a. Primary anal veins one, two, and three of hind wings slightly enlarged and thickened (see fig. 2 for position of wing veins), wing disc yellow, black band indistinct and broken (fig. 37). Tegmina mottled, no distinct bands. Light gray, mottled with dark and light spots, hind tibiae blue. Length 30 to 36 mm. ----- *Circotettix shastanus* Bruner

11b. Anal veins of hind wing all equal in size, wing disc yellow to greenish yellow, black band of hind wing disc entire. ----- 12

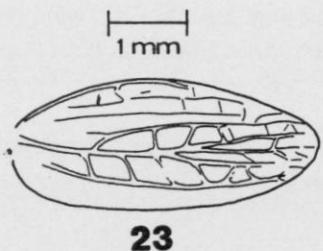


Figure 23.—Tegminal pad of *Podisma hesperus*.

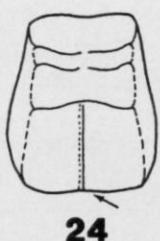


Figure 24.—Pronotum of *Podisma hesperus*.

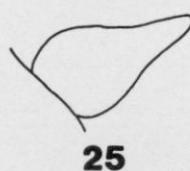


Figure 25.—Male cercus of *Podisma hesperus*.

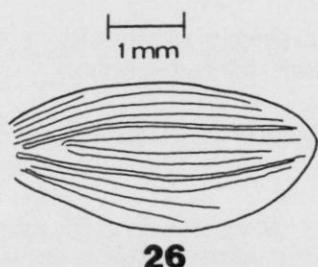


Figure 26.—Tegminal pad of *Melanoplus validus*.



Figure 27.—Male cercus of *Melanoplus validus*.



Figure 28.—Male subgenital plate of *Melanoplus sanguinipes*.

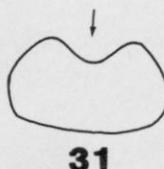


Figure 31.—Male subgenital plate of *Melanoplus femur-rubrum*.

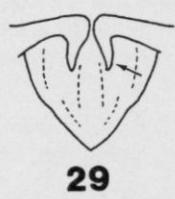


Figure 29.—Male supraanal plate of *Melanoplus sanguinipes*.



Figure 30.—Male cercus of *Melanoplus sanguinipes*.



Figure 32.—Male supraanal plate of *Melanoplus femur-rubrum*.



Figure 33.—Male cercus of *Melanoplus femur-rubrum*.

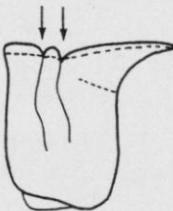


Figure 34.—Pronotal crest cut by two grooves.



Figure 35.—Left wings of *Arphia conspersa*.

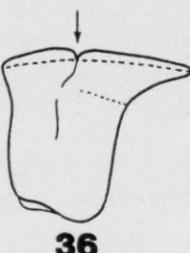


Figure 36.—Pronotal crest cut by one groove.



Figure 37.—Left wings of *Circotettix shastanus*.

12a. Tegmen banded with three dark bands. Hind wing disc greenish yellow, black band narrow and faint, spur short (fig. 38). Dark brown or gray, mottled darker, hind tibiae blue. Length 20 to 34 mm. ----- *Trimerotropis fontana* Thomas

12b. Tegmen not banded. Hind wing disc yellow, black band broad, and suffuse to apex of wing, spur long (fig. 39). Dark gray, mottled darker. Hind tibiae blue. Length 28 to 38 mm. ----- *Trimerotropis suffusa* Scudder

13a. Tarsi have four segments, ovipositor flattened, swordlike (fig. 40). Wings present or absent. ----- 14

13b. Tarsi have three segments, second segment very small, ovipositor cylindrical, not flattened. Wings present. (Crickets; family Gryllidae.) ----- 15

14a. Auditory organ located at base of front tibiae (fig. 41). Wings present, as small pads, or they are long. ----- 21

14b. No auditory organ present. Wings absent. Body rounded or humped dorsally, pronotum indistinct, not extending posteriorly over mesonotum. (Camel crickets; family Gryllacrididae; subfamily Raphidiophorinae.) ----- 18

15a. Ocelli absent. Hind tibiae armed with minute teeth between spines (fig. 42). Pronotum usually longer than wide. Head small, barely deeper than pronotum when viewed laterally (fig. 43). Wings long, usually extending past apex of abdomen. Form slender, color green or yellowish. (Tree crickets; subfamily Oecanthinae.) ----- 17

15b. Ocelli present (fig. 44). Hind tibiae without small teeth between spines. Head large, much deeper than pronotum when viewed from side (fig. 44). Wings short or long. Form robust, color black or dark brown. ----- 16

16a. Spines of hind tibiae long and movable (fig. 45). Dark brown, wing length variable (specimens from the HJA have long wings extending past the apex of the abdomen). Small, less than 15 mm long. (Ground crickets; subfamily Nemobiinae.) ----- *Eunemobius carolinus neomexicanus* Scudder

16b. Spines of hind tibiae short and immovable (fig. 46). Black, wings reduced. Size medium, over 15 mm long. (Field crickets; subfamily Gryllinae.) ----- *Gryllus veletis* (Alexander and Bigelow)

17a. First and second basal antennal segments marked with two linear black marks as in figure 47, or unmarked. Yellowish brown. Length 16 to 24 mm. ----- *Oecanthus californicus* Sauss

17b. First and second basal antennal segments marked with two black spots as in figure 48. Pale green. Length 16 to 22 mm. ----- *Oecanthus fultoni* Walker

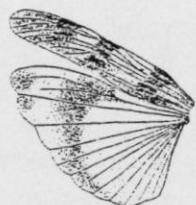
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Figure 38.—Left wings of *Trimerotropis fontana*.

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Figure 39.—Left wings of *Trimerotropis suffusa*.

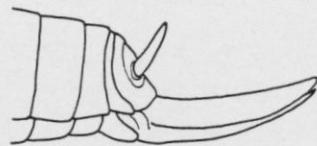
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Figure 40.—Laterally flattened ovipositor.

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Figure 41.—Auditory organ on front tibia.

**42**

Figure 42.—Hind tibia of a tree cricket.

**44**

Figure 44.—Head and pronotum of a field or ground cricket.

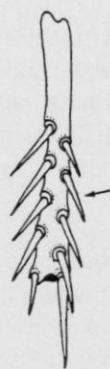
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Figure 45.—Hind tibia of a ground cricket.

**47**

Figure 47.—Basal antennal segments of *Oecanthus californicus*.

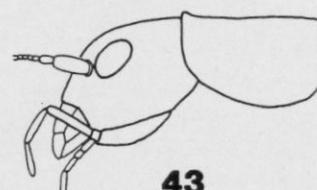
**43**

Figure 43.—Head and pronotum of a tree cricket.

**46**

Figure 46.—Hind tibia of a field cricket.

**48**

Figure 48.—Basal antennal segments of *Oecanthus fultoni*.

18a. All tibiae square in cross-section, ridges of all four angles armed with rows of small overlapping spines running the length of the tibiae. Appendages very long in proportion to body, combined length of front tibia and tarsi longer than length of body. Uniform dark reddish brown. Body length 15 to 30 mm, maximum size with appendages spread, over 200 mm. ----- *Tropidischia xanthostoma* (Scudder)

18b. Tibiae rounded below with a row of spurs dorsally on each side. Appendages not excessively long in proportion to body, combined length of front tibia and tarsi much less than length of body. Various shades of gray and brown. ----- 19

19a. Male cerci evenly incurved from base, with long, segmented, apical appendage (fig. 49). Ovipositor as in figure 50, apical portion of lower valve with more than nine crenulations on ventral surface. Dorsal surface of male abdomen armed with low, blunt tubercles. Light gray brown, lightly mottled darker with indistinct light band on dorsal surface. Length 12 to 17 mm. ----- *Pristoceuthophilus celatus* Scudder

19b. Male cerci elongate, almost straight to apex, then incurved, with short, segmented, apical appendage (fig. 51). Ovipositor as in figure 52, apical portion of lower valve with nine or fewer crenulations on ventral surface. ----- 20

20a. Dorsal abdominal segments of male armed with numerous blunt tubercles and long, conical spines, segment five bearing a large sclerotized structure (Hubbell's organ) extending over segments three through six. Dark brown, light cream-yellow central band on dorsal surface distinct. Length 12 to 15 mm. – *Pristoceuthophilus sargenta* Gurney

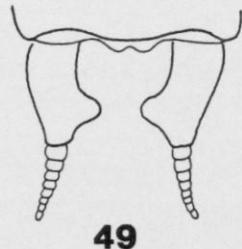
20b. Dorsal abdominal segments one through eight of male almost smooth, or with very low, blunt tubercles; Hubbell's organ absent. Coloration as above. Length 12 to 17 mm. ----- *Pristoceuthophilus cercalis* Caudell

21a. Hind legs stout, not more than 1.2 times longer than middle or fore legs. Hind tibiae armed with eight or fewer spines in each of two dorsal rows. Lateral ridges of pronotum indistinct. Tegmina of male enlarged and rugose, extending half the distance to the apex of the abdomen. Female wings and ovipositor much reduced. Gray, mottled with black, brown, and pink. Length 28 to 40 mm. (Hump-winged crickets; family Prophalangopsidae.) ----- *Cyphoderris monstrosa* Uhler

21b. Hind legs slender, hind tibia at least two times longer than middle or fore tibiae. Hind tibiae armed with more than eight spines in each of two dorsal rows. Lateral ridges of pronotum distinct. Wings reduced to tegminal pads or fully developed, reaching well past apex of abdomen. Green, brown, or gray. (Long-horned grasshoppers; family Tettigoniidae.) ----- 22

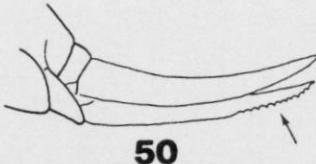
22a. Lateral groove present on first two tarsal segments (fig. 53). Ovipositor long and swordlike. ----- 23

22b. First two tarsal segments smooth, not grooved laterally (fig. 54). Ovipositor short, strongly curving upward. Fully winged and leaflike, usually green. Length 38 to 42 mm. (Bush katydids; subfamily Phaneropterinae.) ----- *Scudderia furcata* Brunner



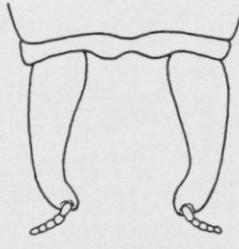
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Figure 49.—Male cerci of *Pristoceuthophilus celatus*.



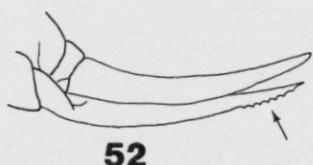
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Figure 50.—Ovipositor of *Pristoceuthophilus celatus*.



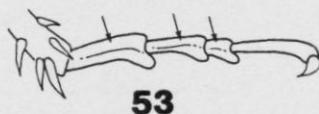
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Figure 51.—Male cerci of *Pristoceuthophilus cercalis* or *P. sargentae*.



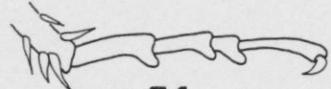
52

Figure 52.—Ovipositor of *Pristoceuthophilus cercalis* or *P. sargentae*.



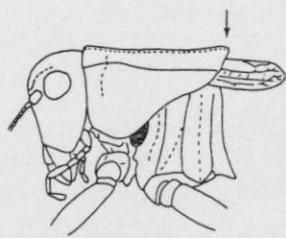
53

Figure 53.—Lateral grooves on tarsal segments.



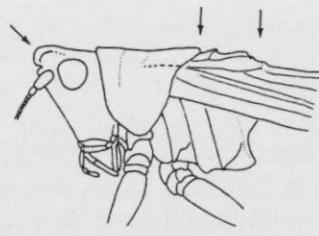
54

Figure 54.—No lateral grooves on tarsal segments.



55

Figure 55.—Lateral view of a shield-backed katydid.



56

Figure 56.—Lateral view of a meadow katydid.

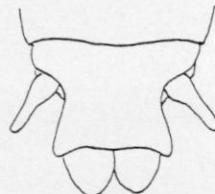
23a. One or more spines present on dorsal surface of front tibiae. Anterior vertex of head not produced forward, pronotum usually extended posteriorly over entire thorax (fig. 55). Wings reduced to small pads, partially covered by pronotum. All legs conspicuously spined. (Shield-backed katydids; subfamily Tettigoniinae.) ----- 24

23b. No spines present on dorsal surface of fore tibiae. Anterior vertex of head produced forward to rounded point, pronotum not extended posteriorly over entire thorax (fig. 56). Green with a black stripe running from the vertex of the head to the posterior margin of the pronotum. Wings long (a brownish, short-winged form is known from western Oregon, but has not been found at the HJA). Length 18 to 22 mm. (Meadow katydids; subfamily Conocephalinae.) --- *Conocephalus fasciatus vicinus* (Morse)



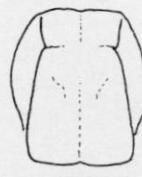
57

Figure 57.—Pronotum of *Neduba convexa*.



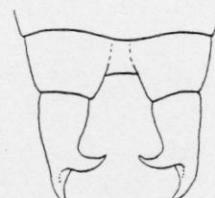
58

Figure 58.—Male cerci and pseudocerci of *Neduba convexa*.



59

Figure 59.—Pronotum of *Steiroxys strepens*.



60

Figure 60.—Male cerci of *Steiroxys strepens*.

24a. Pronotum much larger posteriorly than anteriorly when viewed from above (fig. 57). Male cerci conical with no teeth, pseudocerci present (fig. 58). Female ovipositor with teeth near apex. Brown, gray, reddish, or yellowish, never green. Length 20 to 26 mm. ————— *Neduba convexa* Caudell

24b. Pronotum uniform throughout when viewed from above (fig. 59). Male cerci curved inward at apex with a large internal tooth (fig. 60). Female ovipositor without teeth. Green, brown, or gray, often with dorsal yellow stripes. Length 22 to 24 mm.

————— *Steiroxys strepens* (Fulton)

Annotated List

ORDER Orthoptera
SUBORDER Caelifera
SUPERFAMILY Acridoidea
FAMILY Tetrigidae
SUBFAMILY Tetriginae (pygmy locusts)

***Tetrix subulata* (Linnaeus)**

1837. *Gryllus subulatus* Linneaus, Fauna Boreali-Americanus, 4:251.

Distribution: Throughout most of the Nearctic and Palearctic regions.

Habitat: Primarily riparian or occurring in low, damp areas. At the HJA: seeps and along streambanks in the Western Hemlock Zone.

References: Rehn and Grant (1961), Strohecker and others (1968).

FAMILY Acrididae
SUBFAMILY Melanoplinae (spur-throated grasshoppers)

***Boonacris alticola* Rehn and Randell**

1962. *Boonacris alticola* Rehn and Randell, Transactions of the American Entomological Society, 88: 152.

Distribution: Cascade Range and Coast Range of Oregon.

Habitat: Low, herbaceous growth in meadows, forest margins, and in open woodland areas. At the HJA: mostly in the Silver Fir Zone, often in association with western brackenfern (*Pteridium aquilinum* (L.) Kuhn).

References: Rehn and Randell (1962).

***Melanoplus femur-rubrum* (DeGeer)**

1773. *Acrydium femur-rubrum* DeGeer, Mémoires Pour Servir a la Histoire Des Insects, 3: 493.

Distribution: Throughout the United States and across southern Canada.

Habitat: Grasses in meadows, along roads, and in open woods. At the HJA: uncommon throughout the area at all elevations.

References: Helfer (1963), Strohecker and others (1968).

***Melanoplus sanguinipes* (Fabricius)**

1798. *Gryllus sanguinipes* Fabricius, Supplementum Entomologiae Systamaticae, p. 195.

Distribution: Throughout the United States and across southern Canada.

Habitat: Grasses in meadows, along roads, and in open woods. At the HJA: throughout the area, especially in the Western Hemlock Zone.

References: Helfer (1963), Strohecker and others (1968).

***Melanoplus validus* Scudder**

1879. *Melanoplus validus* Scudder, Proceedings of the Davenport Academy of Natural Sciences, 7: 197.

Distribution: Cascade Range and Sierra Nevada, from Washington to northern California.

Habitat: Grasses in subalpine meadows. At the HJA: meadows and open woods in the Silver Fir Zone.

References: Gurney and Buxton (1968).

***Podisma hesperus* (Hebard)**

1936. *Dendrotettix hesperus* Hebard, Transactions of the American Entomological Society, 62: 182.

Distribution: Known to occur only in the Cascade Range of central Oregon.

Habitat: Low, herbaceous growth in meadows, forest margins, and open woodlands. At the HJA: meadows and open woodlands in the Silver Fir Zone.

References: Rehn and Randell (1963).

Note: Rehn and Rehn (1939) transferred the species from *Dendrotettix* to *Podisma* and noted close affinities to *Podisma sapporensis* Shiraka, which has since been placed in the genus *Parapodisma*. It now appears that *Podisma hesperus* may also belong to the genus *Parapodisma* (Rehn and Randell 1963). Also see Fontana and Vickery (1976).

***Prumnacris rainierensis* Caudell**

1907. *Prumnacris rainierensis* Caudell, Proceedings of the Entomological Society of Washington, 8: 134.

Distribution: Cascade Range of Washington and northern Oregon.

Habitat: Meadows, sparsely vegetated slopes, and open forests at high elevations. At the HJA: open woodlands in the Silver Fir Zone.

References: Helfer (1963).

SUBFAMILY Gomphocerinae (slant-faced grasshoppers)

***Chorthippus curtipennis* (Harris)**

1841. *Chorthippus curtipennis* Harris, Report on the Insects of Massachusetts Injurious to Vegetation, p. 149.

Distribution: Throughout the United States and southern Canada.

Habitat: Grasses in meadows, along roads, and in open woods. At the HJA: throughout the area at all elevations.

References: Otte (1981), Strohecker and others (1968).

SUBFAMILY Oedipodinae (band-winged grasshoppers)

***Arphia conspersa* Scudder**

1874. *Arphia conspersa* Scudder, Proceedings of the Boston Society of Natural History, 17: 514.

Distribution: Western North America from Alaska to Mexico, east to the Rocky Mountains.

Habitat: Bare soil in fields and along roads. At the HJA: along dirt roads and in recent clearcuts in the Western Hemlock Zone.

References: Otte (1984), Strohecker and others (1968).

***Circotettix shastanus* Bruner**

1890. *Circotettix shastanus* Bruner, Proceedings of the U.S. National Museum, 12: 76.

Distribution: Cascade Range, Sierra Nevada, and Siskiyou Mountains of southern Oregon and northern California.

Habitat: Bare, rocky ridges at high elevations. At the HJA: rock outcroppings and talus slopes in the Silver Fir Zone.

References: Helfer (1963), Otte (1984), Strohecker and others (1968).

***Trimerotropis fontana* Thomas**

1876. *Trimerotropis fontana* Thomas, Proceedings of the Davenport Academy of Sciences, 1: 255.

Distribution: Western North America from British Columbia to northern Baja California, east to the Rocky Mountains.

Habitat: Bare soil in fields, open woodlands, and rocky hillsides. At the HJA: along dirt roads and in recent clearcuts and bare spots in meadows, at all elevations throughout the area.

References: Helfer (1963), Otte (1984), Strohecker and others (1968).

***Trimeroptropis suffusa* Scudder**

1876. *Trimeroptropis suffusa* Scudder, Bulletin of the U.S. Geological Territorial Survey, 2: 265.

Distribution: Western North America from British Columbia to northern Arizona, New Mexico, and California, east to the Rocky Mountains.

Habitat: Bare soil in open woodlands. At the HJA: along dirt roads, in recent clearcuts, and in open areas in the forest at all elevations.

References: Helfer (1963), Otte (1984), Strohecker and others (1968).

SUBORDER Ensifera

SUPERFAMILY Tettigonioidea

FAMILY Prophalangopsidae (hump-winged crickets)

***Cyphoderris monstrosa* Uhler**

1864. *Cyphoderris monstrosa* Uhler, Proceedings of the Entomological Society of Philadelphia, 2: 552.

Distribution: Western North America, Rocky Mountains from Colorado to Alberta, west to British Columbia and south through Cascade Range to southern Oregon.

Habitat: High-elevation coniferous forests.

References: Helfer (1963).

Note: *Cyphoderris* has not been found at the HJA, but is common at high elevations in the Cascade Range in Oregon. These katydids are likely to occur in the Silver Fir Zone at the HJA.

FAMILY Tettigoniidae

SUBFAMILY Phaneropterinae (bush katydids)

***Scudderia furcata* Brunner**

1878. *Scudderia furcata* Brunner, Monographien der Phaneropteriden, p. 239.

Distribution: Throughout the United States and southern Canada.

Habitat: Shrubs and small deciduous trees. At the HJA: shrubs along roads, in clearcut areas, and in open woods in the Western Hemlock Zone.

References: Helfer (1963).

SUBFAMILY Conocephalinae (meadow katydids)

***Conocephalus fasciata vicinus* (Morse)**

1901. *Xiphidium vicinum* Morse, Canadian Entomologist, 33: 203.

Distribution: Western North America from British Columbia to California, and east to the Rocky Mountains.

Habitat: Grasses in fields and meadows. At the HJA: clearcuts and other open, grassy areas in the Western Hemlock Zone.

References: Helfer (1963).

SUBFAMILY Tettigoniinae (shield-backed katydids)

***Neduba convexa* Caudell**

1907. *Neduba carniata* variety *convexa* Caudell, Proceedings of the U.S. National Museum, 32: 300.

Distribution: Western North America from western Washington south through western Oregon and into northwestern California.

Habitat: Forest floor and understory vegetation in deciduous and coniferous forests. At the HJA: understory vegetation particularly in second-growth forests in the Western Hemlock Zone.

References: Rentz and Birchim (1968).

***Steiroxys strepens* Fulton**

1930. *Steiroxys strepens* Fulton, Annals of the Entomological Society of America, 23: 611-641.

Distribution: Central Coast and Cascade Ranges of Oregon.

Habitat: Open, grassy areas in subalpine meadows. At the HJA: natural meadows in the Silver Fir Zone.

References: Fulton (1930), Rentz and Birchim (1968).

FAMILY Gryllacrididae

SUBFAMILY Rhaphidophorinae (camel crickets)

***Pristoceuthophilus celatus* (Scudder)**

1894. *Ceuthophilus celatus* Scudder, Proceedings of the American Academy of Science and Arts, 30: 97.

Distribution: Western North America from British Columbia to northern California west of the Cascade Range.

Habitat: Moist, dark areas, usually on the forest floor of woodland areas. At the HJA: under bark and objects on the ground in old-growth forests, mainly in the Western Hemlock Zone.

References: Helfer (1963).

***Pristoceuthophilus cercalis* Caudell**

1916. *Pristoceuthophilus cercalis* Caudell, Proceedings of the U.S. National Museum, 49: 673.

Distribution: Western Oregon and Washington, east to the Rocky Mountains.

Habitat: Moist, dark sites, usually on the forest floor of woodland areas. At the HJA: under bark and objects on the ground in old-growth forests in both zones.

References: Helfer (1963).

***Pristoceuthophilus sargentae* Gurney**

1947. *Pristoceuthophilus sargentae* Gurney, Journal of the Washington Academy of Sciences, 37(12): 430.

Distribution: Known only to occur in the Three Sisters-McKenzie Pass area of the Cascade Range in central Oregon.

Habitat: Usually under loose bark of trees or under objects on the ground in old-growth forests above 1 200 m elevation. At the HJA: old-growth forests in the Silver Fir Zone. Specimens have been found more than 35 m above ground level on the trunks of conifers.

References: Gurney (1947), Helfer (1963).

***Tropidischia xanthostoma* (Scudder)**

1861. *Rhaphidophora xanthostoma* Scudder, Proceedings of the Boston Society of Natural History, 8: 12.

Distribution: Coastal mountains and west side of the Cascade Range, from central California to British Columbia.

Habitat: Dark, moist sites, such as under logs and in riparian areas in old-growth forests. At the HJA: near streams in old-growth forests in the Western Hemlock Zone.

References: Helfer (1963).

FAMILY Gryllidae

SUBFAMILY Gryllinae (field crickets)

***Gryllus veletis* (Alexander and Bigelow)**

1960. *Acheta veletis* Alexander and Bigelow, Evolution, 14: 335.

Distribution: Throughout much of North America, in the West from Washington to central California.

Habitat: Holes and cracks in the ground in open fields, along roads, or other similar sites. At the HJA: on the ground in recent clearcuts and along roadsides in the Western Hemlock Zone.

References: Weissman and others (1980).

SUBFAMILY Nemobiinae (ground crickets)

***Eunemobius carolinus neomexicanus* Scudder**

1896. *Nemobius carolinus neomexicanus* Scudder, Journal of the New York Entomological Society, 4(3): 99.

Distribution: Western United States from southern Washington to Mexico.

Habitat: Grasses in fields and meadows. At the HJA: open, grassy areas, mainly in the Western Hemlock Zone.

References: Helfer (1963), Vickery and Johnstone (1973).

SUBFAMILY Oecanthinae (tree crickets)

Oecanthus californicus Saussure

1874. *Oecanthus californicus* Saussure, Imprimere Imperiale: Paris, 3: 293.

Distribution: Western United States, east to the western Great Plains.

Habitat: Brush thickets in grasslands and open forests. At the HJA: in clearcuts and along roads in the Western Hemlock Zone.

References: Walker (1962, 1963).

Oecanthus fultoni Walker

1962. *Oecanthus fultoni* Walker, Annals of the Entomological Society of America, 55(3): 309.

Distribution: Throughout much of the United States and southern Canada.

Habitat: Usually on deciduous trees, occasionally on smaller shrubs. At the HJA: on deciduous trees in the Western Hemlock Zone.

References: Walker (1962, 1963).

Discussion

The Orthoptera of the HJA were found to occupy a variety of plant communities or habitats of three generalized types based on vegetational structure and successional status. Of the 25 species of Orthoptera from the HJA, 12 were found primarily in early seral sites, 7 in natural meadows or on associated rock outcroppings, and 5 in late seral or mature forests. On the basis of these generalized relationships to habitats and to each other, the Orthoptera of the HJA may be classified into three major forest orthopteran species associations: early seral, meadow, and forest associates (table 1). Species

Table 1—Major forest orthopteran species associations at the H.J. Andrews Experimental Forest

Early seral associates	Meadow associates	Forest associates
<i>Arphia conspersa</i>	<i>Boonacris alticola</i>	<i>Cyphoderris monstrosa</i>
<i>Conocephalus fasciatus vicinus</i>	<i>Chorthippus curtipennis</i>	<i>Neduba convexa</i> ^{1/}
<i>Gryllus veletis</i>	<i>Circotettix shastanus</i> ^{2/}	<i>Pristoceuthophilus celatus</i>
<i>Melanoplus femur-rubrum</i>	<i>Melanoplus validus</i>	<i>Pristoceuthophilus cercalis</i>
<i>Eunemobius carolinus</i> <i>neomexicanus</i>	<i>Podisma hesperus</i>	<i>Pristoceuthophilus sargentae</i>
<i>Oecanthus californicus</i>	<i>Prumnacris rainierensis</i>	<i>Tropidischia xanthostoma</i>
<i>Oecanthus fultoni</i>	<i>Steiroxys strepens</i>	
<i>Scudderia furcata</i>		
<i>Tetrix subulata</i> ^{3/}		
<i>Trimerotropis fontana</i>		
<i>Trimerotropis suffusa</i>		

^{1/} Forest margins.

^{2/} Rock outcroppings.

^{3/} Temporary pools, seeps, and riparian areas.

within each of these three assemblages may be assumed to share similar ecological attributes because they consistently occur together under similar environmental conditions. These associations are generalized concepts. Individual species are not necessarily limited to a particular association or habitat type but predominate in one of the three.

Early seral associates comprise the largest assemblage of Orthoptera and occur in sites characterized by plant communities in early seral stages of forest succession. Such communities are found in clearcuts or along roadsides and are dominated by low, herbaceous vegetation. Early seral associates probably occur in such habitats because of the physical characteristics of the environment, the availability of palatable food plants, and the dispersal capabilities of the insects.

Structural attributes of vegetation may influence the distribution and abundance of grasshoppers by modifying abiotic environmental conditions (Anderson 1964, Joern 1982, Scoggan and Brusven 1973). Vegetational structure of early seral sites at the HJA may provide appropriate temperature and moisture conditions as a result of higher levels of insolation than can be found under the forest canopy. Relatively warm, dry conditions are important for the development of many temperate grasshoppers (Uvarov 1977). Plant species composition may influence the distribution of early seral associates as food resources. Several of these grasshoppers are known to be diet generalists (Banfill and Brusven 1973, Mulkern and others 1964). Diet generalist herbivores should theoretically be associated with unpredictable plants of early seral communities (Cates and Orians 1975, Rhoades and Cates 1976).

Early seral associates are mobile insects readily capable of dispersing to new locations. These species have broad distributions; all range across western North America and five range across the entire continent, thereby encompassing a wide spectrum of environmental conditions and food resources. As mobile generalists, these species are probably well adapted to dispersing rapidly and colonizing temporary habitats, such as the early seral plant communities at the HJA. Scoggan and Brusven (1973) conclude that environmental alterations, such as logging, increase the distribution and abundance of ecologically equivalent species in Idaho forests. As succession proceeds and vegetation cover increases at any given site, populations of early seral associates should decline.

Meadow associates occur at the HJA primarily in natural mesic and subalpine meadows in the Pacific Silver Fir Zone (Franklin and Dyrness 1973) but are seldom found in early seral plant communities. Like early seral associates, meadow associates occur in plant communities that are characterized by low, herbaceous vegetation and by high levels of insolation. Meadow associates, however, occur in plant communities with relatively stable plant species compositions. Meadow associates may have more specialized diets for predictable host plants that utilize different antiherbivore defenses than do unpredictable plants of early seral communities (Rhoades and Cates 1976).

Most meadow associates are flightless and limited in distribution to the coastal and Cascade-Sierra Nevada mountain ranges. At the HJA and throughout the western Oregon Cascades, meadow associates are generally restricted to widely scattered meadow communities, which results in patchy distribution patterns. Limited dispersal capabilities and possible host-plant interactions may restrict meadow associates from colonizing temporarily disturbed sites.

Only a few species of Orthoptera actually occur within the forest at the HJA. Forest associates, unlike early seral and meadow associates, are represented by nocturnal species that apparently do not require high levels of insolation. These species are probably omnivores and are not associated with any particular host plants but are associated with structural characteristics of forest communities. Forest associates are flightless, have low dispersal potential, and are limited in distribution to forests of the Pacific Northwest that are west of the Cascade Range. With the exception of those species restricted to the Pacific Silver Fir Zone, forest associates appear to be widespread throughout the forested areas of the HJA. Like meadow associates, these species occur in a relatively stable habitat where populations should remain stable until the habitat is altered.

Conclusion

The Orthoptera of the HJA exhibit close relationships to successional plant communities. Consideration of species associations or ecological groups, rather than individual species, may be more practical for making generalizations about ecological characteristics for these insects. At the HJA, the Orthoptera can be classified into the following major associations on the basis of distributional relationships to each other and to generalized successional plant communities: early seral, meadow, and mature forest associates. From a knowledge of the successional patterns of these plant communities, the following predictions for associated Orthoptera can be made: early seral associates colonize disturbed sites, but populations decline as forest succession proceeds; and meadow and forest associates form relatively stable populations over long periods of time in their respective habitats until catastrophic disturbances change those environments.

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English Equivalents

1 meter (m) = 3.3 feet
1 millimeter (mm) = 0.04 inches

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