

**A REVIEW OF THE SPECIES OF ANTHOCORIDAE
(HEMIPTERA: HETEROPTERA) FOUND ON
*PINUS CONTORTA***

J. D. LATTIN AND N. L. STANTON

Systematic Entomology Laboratory, Department of Entomology,
Oregon State University, Corvallis, Oregon 97331-2907; and
Department of Zoology and Physiology, University of Wyoming,
Laramie, Wyoming 82071

Abstract.—The Anthocoridae fauna found on the widespread western North American pine, *Pinus contorta*, is reviewed. Ten genera and 18 species are reported. Three of these species (*Anthocoris* spp. and *Orius tristicolor*) are considered casual visitors to the tree. Biological, ecological, and taxonomic information is presented for each species and the pertinent literature reviewed.

Pinus contorta Dougl., ex Loud, with four subspecies, is the most widespread species of pine in North America (Critchfield, 1957, 1980, 1985; Critchfield and Little, 1966; Wheeler, Guries, and O'Malley, 1983; McCune, 1988). Commonly known as lodgepole pine throughout much of its range, the northern coastal subspecies is referred to as shore pine and the unusual dwarf subspecies is called pygmy pine. Forrest (1980a, b) recognized a number of chemical regions for *Pinus contorta*, based upon studies on the variation found in foliar monoterpenes. The subspecies occur in northern Baja California, on the north coast of California, north through Oregon, Washington and British Columbia, in the Sierra Nevada and Cascade Mountains north to the Yukon Territory, and south through the Rocky Mountains and adjacent areas to southern Colorado (Critchfield, 1957). It grows from sea level in Oregon to 12,000 feet (3,900 m) in the southern Sierra Nevada mountains (Critchfield, 1980).

We have collected Hemiptera: Heteroptera from this tree species regularly at six sites in Oregon and Wyoming. Other collections have been made at various localities in different parts of the range of *P. contorta*, and to a lesser extent, on some of the other species of conifers occurring with *P. contorta*. The family Miridae is particularly well represented on this conifer (approximately 57 species known to date; unpublished data), and so it seems are the Anthocoridae. The diverse habits of the various species of anthocorids and their particular habitat requirements, often remarkably specific, combined with the enormous ecological and geographical range of *P. contorta* result in a diverse fauna of 10 genera and 18 species (24 genera and 90 species occur in America north of Mexico [Henry, 1988]).

The objective of this paper was to coalesce information on the systematics, habitats, plant hosts, prey species, and geographic distribution for those 18 species of North American Anthocoridae found on *Pinus contorta*. The primary source of information is based upon our regular sampling of three sites in Oregon on *P. contorta contorta*, *P. c. latifolia*, and *P. c. murrayana*, and three sites on *P. c. latifolia* in Wyoming. Additional records come from specimens examined in several collections and from

the literature. We have summarized the available literature on each species treated, including taxonomic, biological, and ecological information. Appropriate literature records are presented in the condensed bibliographic style of taxonomic papers for brevity.

SYSTEMATICS

The Anthocoridae comprise a small family of Hemiptera: Heteroptera with about 80 genera and 450 species world-wide (Péricart, 1972). Henry (1988) reported 23 genera and 89 species from America north of Mexico. An additional genus and species, *Brachysteles parvicornis* (Costa), has been reported recently from the East Coast where it was taken under the bark of pine trees and beaten from *Picea* and *Pinus* branches (Asquith and Lattin, 1990; Lattin and Asquith, 1991). Approximately one-third of the species north of Mexico occur on conifers. Others are found on broad-leafed plants or in leaf litter.

Péricart (1972) provided an extensive treatment of the Anthocoridae of western Europe and permitted the comparison of elements of our fauna with those of the European continent. Herring (1976) published a key to the genera of Anthocoridae north of Mexico. Anderson (1962b) provided the most detailed summary of the Anthocoridae of the Pacific Northwest. Kelton (1978) is the only modern, comprehensive treatment of the family for North America. Earlier, he published several generic revisions of the North American species (Kelton, 1963, 1966a, 1967, 1976b) as Herring (1966) did for *Orius*. Much additional biosystematic work remains to be done on the Anthocoridae.

The higher classification of the Heteroptera is undergoing substantial change, with increased emphasis on cladistic analysis (see Schuh, 1986, for an important review). The suborder Cimicomorpha, which contains the Anthocoridae, is being reviewed by several investigators. Major changes in classification of the Anthocoridae have been suggested by Schuh (1986; pers. comm., April, 1991), based on evidence given by Ford (M.S. thesis). Schuh and Stys (1991) provided a detailed account of some of these changes. We have taken a rather conservative approach in this paper with the recognition that future phylogenetic studies are certain to modify the current definition of the family. Such information will aid in interpreting biological and ecological data.

METHODS

We collected ten genera and 18 species on *P. contorta*. The genera and species reported here are arranged alphabetically for ease of reference. Table 1 shows the same taxa arranged by systematic scheme (Carayon, 1972a; Péricart, 1972; Henry, 1988).

Collection sites: We have collected regularly at three sites in Oregon and three sites in Wyoming from April to October in 1986. Rather than repeat these localities in full, we will describe them here and refer to them together with the dates of collection. Collections made at other times and places are described in full. Branches of conifers were firmly beaten with an axe handle and the dislodged anthocorids were collected from the beating sheet held under the branch.

Oregon: Site 5: Lincoln Co., 1.6 km S Newport, South Beach State Park, R11W,

Table 1. Species of Anthocoridae collected from *Pinus contorta* subsp. arranged by current classification. * Indicates incidental occurrence.

Anthocoridae
Anthocorinae Reuter, 1884
Anthocorini Reuter, 1884
<i>Acompocoris lepidus</i> (Van Duzee)
* <i>Anthocoris antevolens</i> White
* <i>Anthocoris musculus</i> (Say)
<i>Elatophilus dimidiatus</i> (Van Duzee)
<i>Elatophilus pullus</i> Kelton and Anderson
<i>Elatophilus</i> sp. A
<i>Melanocoris longirostris</i> Kelton
<i>Melanocoris nigricornis</i> Van Duzee
<i>Tetraphleps canadensis</i> Provancher
<i>Tetraphleps latipennis</i> Van Duzee
<i>Tetraphleps pilosipes</i> Kelton and Anderson
<i>Tetraphleps uniformis</i> Parshley
Oriini Carayon, 1955
* <i>Orius tristicolor</i> (White)
Lyctocorinae Reuter, 1884
Dufouriellini Van Duzee, 1916
<i>Cardiastethus borealis</i> Kelton
Lyctocorini Reuter, 1884
<i>Lyctocoris tuberosus</i> Kelton and Anderson
Scolopini Carayon, 1954
<i>Scoloposcelis flavicornis</i> Reuter
Xylocorini Carayon, 1972
<i>Xylocoris californicus</i> (Reuter)
<i>Xylocoris cursitans</i> (Fallén)

T11S, SW¼ Sec. 20. ex *Pinus contorta contorta* Dougl. ex Loud. Site 7: Crook Co., 40 km E Prineville, 1,476 m elev., R19E, T13S, SW¼ Sec. 2. ex *Pinus contorta latifolia* Engelm. Site 8: Deschutes Co., Three Creeks Meadow, 2,069 m, 26 km S Sisters, R9E, T17S, SW¼ Sec. 13 ex *Pinus contorta murrayana* (Grev. & Balf.) Engelm.

Wyoming: Site 2: Albany Co., Medicine Bow Nat. For., Happy Jack Road, 19 km E Laramie, 2,500 m, R72W, T15N Sec. 25. ex *Pinus contorta latifolia*. Site 3: Albany Co., Snowy Range Mountains, North Fork Camp ground, Sand Lake Road, 2,800 m, 60 km W. Laramie, R78W, T16N, Sec. 17, ex *Pinus contorta latifolia*. Site 4: Carbon Co., Snowy Range Mountains, French Creek Road, 2,750 m, 90 km W. Laramie, R81W, T15N, Sec. 1 & 17. ex *Pinus contorta latifolia*.

Collections examined: All specimens are housed in the Systematic Entomology Laboratory (OSU-SEL), Department of Entomology, Oregon State University, unless otherwise indicated. Additional material was examined from the Canadian National Collection, Ottawa, Canada (CNC), Oregon Department of Agriculture (ODA), Salem, and from the U.S. Forest Service, Pacific Northwest Research Station, LaGrande, Oregon, collection (USFS-LaGrande). Supportive material was examined from the

California Academy of Sciences, San Francisco, the University of California, Riverside, and the United States National Museum, Washington, D.C.

The section that follows presents information about each species of Anthocoridae found on or reported from *Pinus contorta*. A bibliography is given for each species to provide access to the biological and systematic literature. Diagnostic characters are included to assist in recognition. Information on habitat and host plant association, prey, life history, and distribution is reviewed and summarized followed by documentation of specimens collected and examined during this study.

BIONOMICS

Acompocoris Reuter

Acompocoris Reuter, 1875:63; Harris and Shull, 1944:207; Péricart, 1972:146; Herring, 1976:146; Kelton, 1978:32; Henry, 1988:13.

Diagnosis: Normally macropterous (membrane of female may be slightly reduced); shiny, usually pubescent; rostrum almost reaching or exceeding hind coxae; hind coxae proximate; ostiolar canal broad, slightly curved in anterior direction, apex extended anteriorly as fine carina (Péricart, 1972; Kelton, 1978). North American species with head, pronotum, and scutellum, dark brown to black in contrast to pale brown hemelytra.

Acompocoris Reuter contains six species in the Holarctic Region (Péricart, 1972). Species of the genus are found only on conifers where they appear to feed on aphids, especially members of the genus *Cinara* Curtis. Two occur in North America, *A. lepidus* (Van Duzee) from California and the introduced European species, *A. pygmaeus* (Fallén). Host plant genera for North American *Acompocoris* include *Pinus* (most common), *Picea*, *Larix*, and *Abies* (Péricart, 1972; Kelton, 1978). Only *A. lepidus* occurs on *P. c. murrayana*. *Acompocoris pygmaeus* was reported from *P. sylvestris* in Nova Scotia and New Brunswick (Kelton 1977a) and *P. strobus* (Kelton, 1978).

Acompocoris lepidus (Van Duzee)

(Figure 1)

Tetraphleps lepidus Van Duzee, 1921:142.

Acompocoris lepidus: Kelton and Anderson, 1962:1307; Mitchell, 1962:53; Anderson, 1962b:1332; Kelton, 1977a:245; Kelton, 1978:32; Henry, 1988:13.

Acompocoris sp. Harris and Shull, 1944:207.

Diagnosis: Macropterous species about 3.5 mm long; shiny with long pubescence; apex of rostrum attaining or surpassing hind coxae. Color dark brown to black, pronotum entirely black, hemelytra brown, shiny; antennal segment 2 dark, pale at middle. Resembles species of *Tetraphleps* but apex of ostiolar canal not elevated above metapleuron, continued forward as fine carina (apex of canal elevated above metapleuron in *Tetraphleps*).

Habitat: Little specific information is available on the preferred habitat of this species, which was originally described from specimens collected on *Pinus contorta murrayana* in California (Van Duzee, 1921); and later reported from *P. ponderosa*

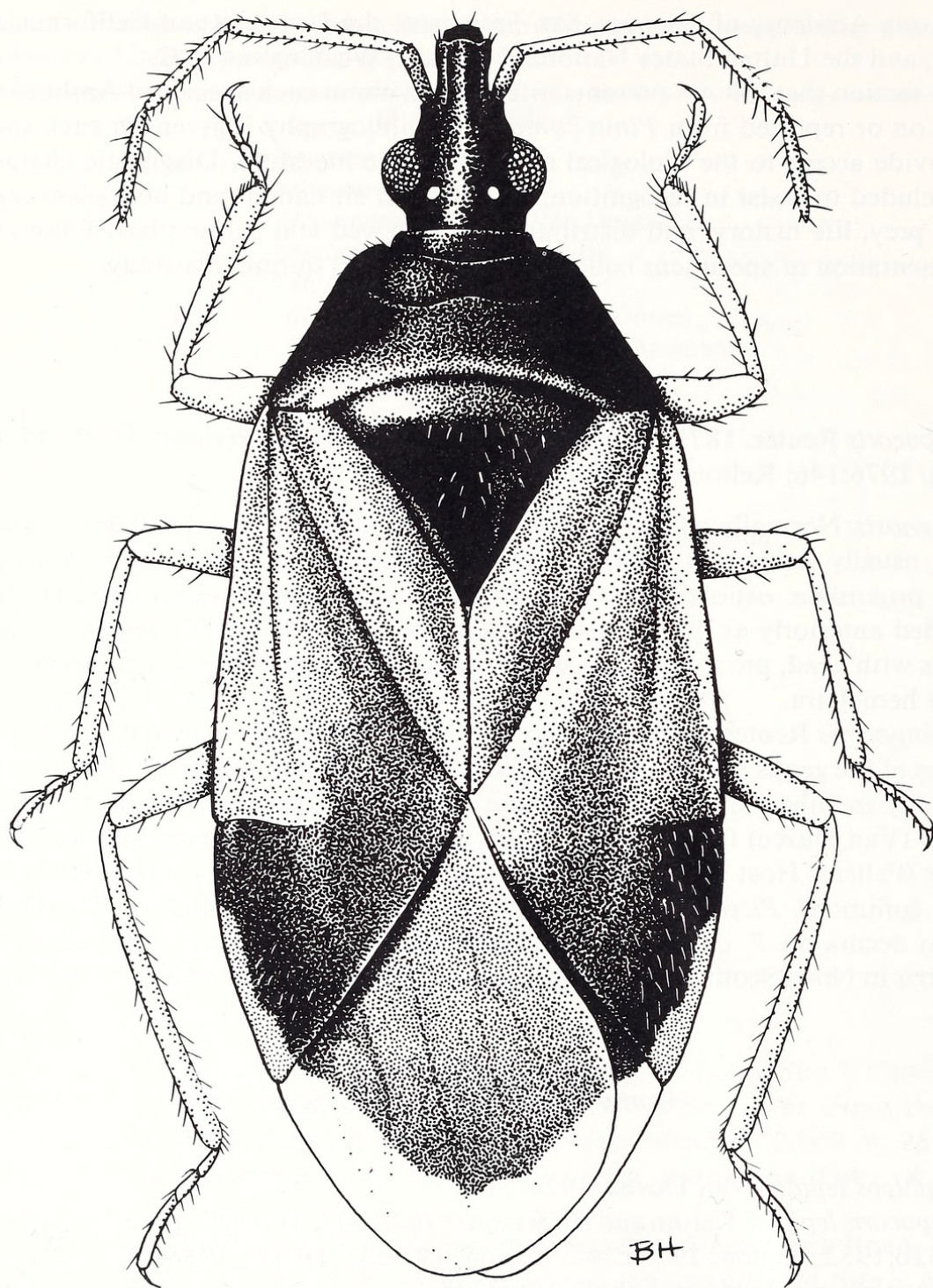


Fig. 1. *Acompocoris lepidus* (Van Duzee).

and *Picea engelmanni* in British Columbia (Kelton, 1978). We report it here from *P. c. murrayana* in the central Oregon Cascade Mountains and on *P. c. latifolia* in British Columbia, the Yukon Territory, and in Wyoming.

Prey: Mitchell (1962) considered *A. lepidus* an effective predator of the balsam woolly aphid.

Phenology and life history: Type specimens were collected in late July in southern California. Adults were collected in July in Wyoming, August in British Columbia,

Oregon, Wyoming, and Yukon Territory, and September in Colorado, Oregon, and Wyoming. No information is available on the life history of this species.

Distribution: *Acompocoris lepidus* was described from Huntington Lake, 2,277 m, Fresno Co., California (as a species of *Tetraphleps*). Harris and Shull (1944) reported an unidentified species of *Acompocoris* from McCall, Idaho (presumably *A. lepidus*). Mitchell (1962) reported *A. lepidus* from the central Cascade Mountains of Oregon. Anderson (1962b) reported the species from several localities in British Columbia (Princeton on *P. ponderosa* and Cathedral Lakes on *Picea engelmanni*). Kelton (1977a) compared *A. lepidus* with the newly collected *A. pygmaeus* (Fallén) from Europe, a species found on *Pinus sylvestris* in Nova Scotia and New Brunswick. We report *A. lepidus* here from the Yukon Territory, Colorado, Oregon, and Wyoming.

Specimens examined: CANADA: British Columbia: Summit Lake, 16 August 1982, *P. c. latifolia*, 1 male (CNC); Yukon Territory, Rancheria, 11 August 1982, *P. c. latifolia*, 5 males, 1 female (CNC). UNITED STATES: Colorado: Gilpin Co., 3 km S Guanella Pass, 3,015 m, 4 September 1991, *P. c. latifolia*, 17 females; as before but *P. aristata* Engelm., 7 females; Larimer Co., 1 km SW Milner Pass, 3,298 m, R76W T5N, Rocky Mt. N. P., 3 September 1991, *P. c. latifolia*, 3 females. Oregon: Deschutes Co., Three Crks. Mdw., 26 km S Sisters, 2,000 m, 19 September 1979, *P. c. murrayana*, 1 female; Site 8, 6 August 1986, *P. c. murrayana* (trees 3, 19), 1 female, 1 male; Site 8, 26 August 1986, *P. c. murrayana* (general collecting) 1 female; Site 8, 20 August 1986, *P. c. murrayana* (tree 3), 1 female; Site 8, 3 September 1986, *Picea engelmanni* (10 trees pooled) 1 female. Wyoming: Albany Co., Site 2.1, 9 July 1986, *Pinus flexilis* (10 trees pooled), 3 males, 1 female; Site 2.1, 11 July 1986, *P. c. latifolia* (tree 15), 1 male; Site 2.2, 25 July 1986, *P. c. latifolia* (tree 18), 1 female; Site 2.1, 25 July 1986, *P. flexilis* (10 trees pooled), 11 females; Site 2.1, 5 September 1986, *P. flexilis* (10 trees pooled), 1 female; Site 3.1, 11 July 1986, *P. c. latifolia* (tree 16), 2 males; Site 3.1, 30 July 1986, *P. c. latifolia* (trees 2, 3, 6, 15, 16, 18, 20), 31 females; Site 3.1, 27 August 1986, *P. c. latifolia* (trees 5, 13, 16), 4 females; Carbon Co., Site 4.2, 17 July 1986, *P. c. latifolia*, 1 female. Park Co., Yellowstone Nat. Pk., 16.2 km N Norris, 2,277 m, 16 September 1980, *P. c. latifolia*, 3 females; Park Co., Yellowstone Nat. Pk., 1.6 km N Indian Crk. Cmpgd., 19.5 km N Norris, 2,270 m, 16 September 1980, *P. c. latifolia*, 2 females; Yellowstone Nat. Pk., 8.1 km S Tower Falls, 2,262 m, 17 September 1980, *P. c. latifolia*, 9 females.

Anthocoris Fallén

Anthocoris Fallén, 1814:9; Reuter, 1884:66; Lethierry and Severin, 1896:243; Van Duzee, 1917a:292; Collyer, 1953:86; Hill, 1957:171; Sands, 1957:296; Southwood and Leston, 1959:173; Anderson, 1962a:67; 1962b:1327; Anderson and Kelton, 1963:439; Cobben and Arnoud, 1969:5; Carayon, 1972a:345; Péricart, 1972:110; Herring, 1976:146; Evans, 1976a:85; 1976b:157; 1976c:163; 1976d:283; Kelton, 1978:34; Kerzhner, 1988:772; Henry, 1988:14.

Diagnosis: Length 2.4 to 4.6 mm, usually macropterous (except *A. dimorphicus* Anderson and Kelton); pruinose or shiny; dorsal pubescence; usually black or brown and white. Ocelli distinct; rostrum short, apex reaching or slightly surpassing front coxae. Pronotum with distinct collar and calli; lateral margin carinate. Hemelytra

smooth, pruinose or shiny. Hind coxae proximate. Ostiolar canal curved anteriorly, apical portion attached to metapleura, continued in anterior direction as a carina.

Approximately 30 species of *Anthocoris* are known, and most occur in the Northern Hemisphere (Lethierry and Severin, 1896; Péricart, 1972). Twelve species are known from North America (Henry, 1988). No recent world monograph for the genus exists. The best current treatment is that of Péricart (1972) who treats 14 species in the western Palearctic Region. No revision is available for North America, but Hill (1957) produced a key to the 11 species known to him. The best references to North American species are those of Anderson (1962b) and Kelton (1978).

Species of *Anthocoris* occur most commonly on broad-leaved plants, particularly on trees. Only two species in North America have been reported from conifers. They are searching predators, moving over the surface of the branches and leaves (Collyer, 1953; Sands, 1957; Southwood and Leston, 1959; Anderson, 1962a, b; Cobben and Arnoud, 1969; Péricart, 1972; Evans, 1976a, b, c, d; Kelton, 1978). Kelton (1978) listed host plants and summarized some of the literature dealing with five species considered important predators. A considerable literature on this genus documents the activities of the different species in agroecosystems (see e.g., Evans, 1976a, b, c, d).

Anthocoris antevolens White

(Figure 2)

Anthocoris antevolens White, 1879:146; Reuter, 1884:77; Lethierry and Severin, 1896:243; Van Duzee, 1917a:293; b:262; Hill, 1957:172; Anderson, 1962b:1327; Anderson and Kelton, 1963:439; Kelton, 1978:37; Evans, 1983:45; Henry, 1988:14.

Diagnosis: Length 3.6–4.4 mm; macropterous, shiny; pubescence long and erect. Pronotum black, shiny, basal half usually pale brown. Hemelytra with clavus black except outer margin pale; basal third of corium and embolium pale, apical two-thirds of corium, embolium and all of cuneus black; membrane pale with middle and apical third fuscous.

Habitat: *Anthocoris antevolens* is an active, surface predator like *A. musculus* and other species of *Anthocoris*. Evans (1983) reported this species on *P. c. latifolia* in northwestern British Columbia. This species is a common predator in orchards (Anderson, 1962b; Wilde and Watson, 1963; McMullen and Jong, 1967; Kelton, 1978). According to Van Duzee (1917a) and Anderson (1962b), willow is the main host plant. Kelton (1978) added a number of host plants, mostly deciduous trees, including fruit crops where it feeds largely on Homoptera.

Prey: Anderson (1962b) reported aphids and mites as prey of *A. antevolens*. He documented this species biting humans, especially in orchards. Anderson and Kelton (1963) reported predation on several species of *Pemphigus* aphids on poplar and cottonwood and on the gall-forming aphid *Mordwilkoja vagabunda* (Walsh). Kelton (1978) reviewed some of the literature on the feeding habits of this species and noted that it feeds on psyllids (including the pear psylla) and mites. The reference to this species on *Pinus contorta latifolia* by Evans (1983) did not include prey records.

Phenology and life history: Anderson (1958, 1962b) detailed the life history of *A.*

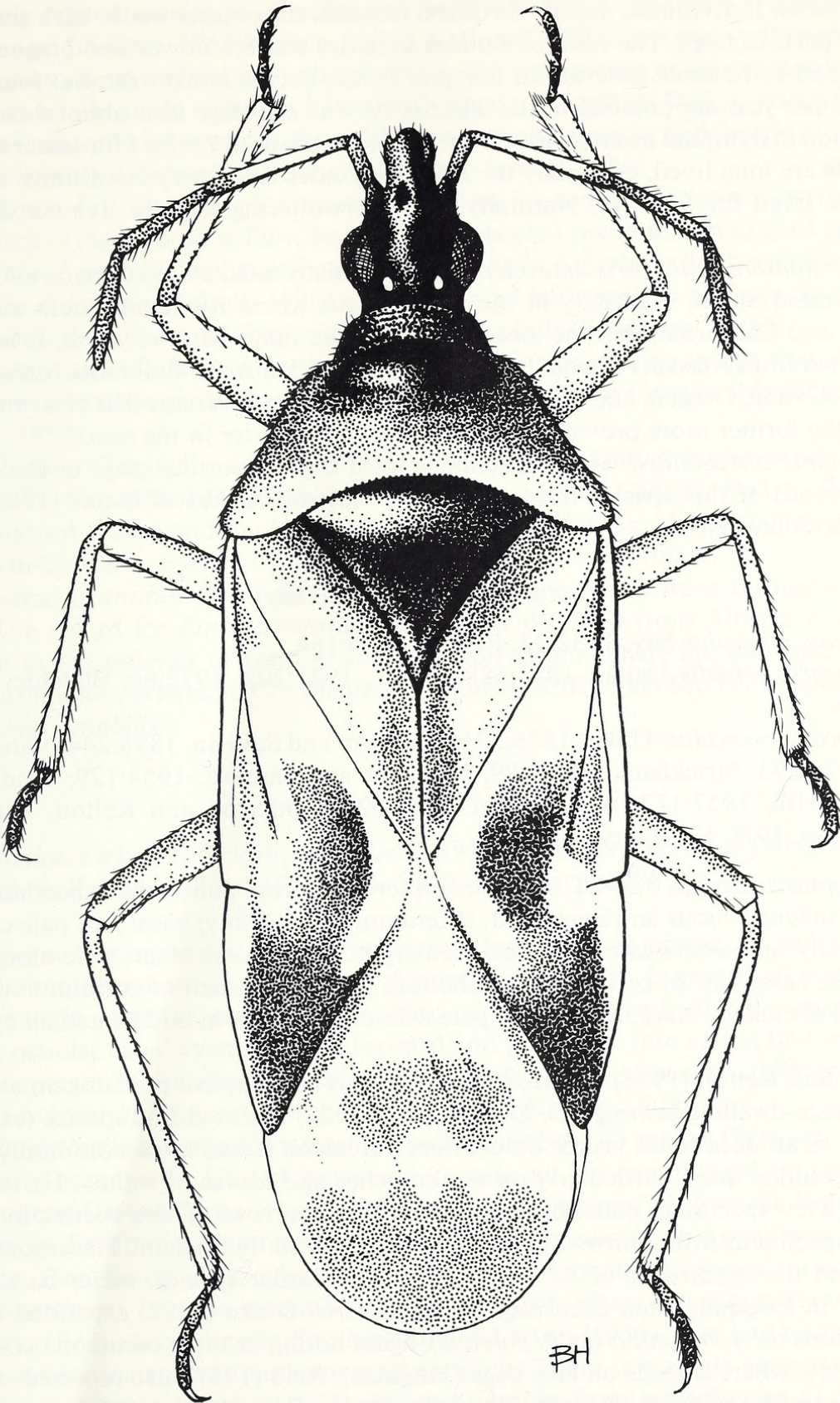


Fig. 2. *Anthocoris antevolens* White.

antevolens. Individuals, usually fertilized females, overwinter under bark scales and other parts of trees. The ratio of females to males was 8:1 in western Oregon. There appeared to be three generations per year in the Pacific Northwest, but four generations per year are possible in the laboratory. The egg stage lasts about 5 days. The duration of nymphal instars varies from 2.7 in the third- to 7.9 for fifth-instar females. Adults are long lived, especially the females. Under laboratory conditions, a mated female lived for 50 days. Naturally, the overwintering females live considerably longer.

Distribution: *Anthocoris antevolens* is widely distributed across Canada and northern United States, especially in the western part where it extends south along the coast into California, its type locality. Within the range of *P. contorta*, it has been recorded from Alaska, Alberta, British Columbia, California, Colorado, Idaho, Montana, Nevada, Oregon, and Wyoming. Much of its range overlaps that of *A. musculus*, with the former more prevalent in the west and the latter in the east.

Specimens examined: Many specimens from throughout the range of the species. The record of this species from *P. contorta latifolia* is that of Evans (1983) from British Columbia.

Anthocoris musculus (Say)

Reduvius musculus Say, 1832:32; Reuter, 1884:164.

Anthocoris borealis Dallas, 1852:588; Drake, 1921:202; 1922:66; Blatchley, 1926: 635.

Anthocoris musculus: Uhler, 1876:321; Lethierry and Severin, 1896:244; Van Duzee, 1917a:293; Strickland, 1953:199; MacPhee and Sanford, 1954:129; Reid, 1957: 111; Hill, 1957:172; Anderson, 1962b:1329; Anderson and Kelton, 1963:439; Kelton, 1978:40; Henry, 1988:14.

Diagnosis: Length 3.3–4.1 mm; macropterous, shiny; pubescence short and scattered, inconspicuous and appressed. Pronotum black, shiny; basal half pale colored, especially on postero-lateral angles. Hemelytra with clavus black, pale along outer margin; basal half of corium and embolium pale, apical half of corium, embolium and all of cuneus, black; membrane pale with dark pattern in middle and all of apical third.

Habitat: Kelton (1978) reported this species to be an active predator on a variety of surface-dwelling arthropods. Drake (1921, 1922) reported this species (as *A. borealis*) as an occasional visitor on conifers but stated it was more commonly found on deciduous trees, particularly on the branches and leaves of willow. He reported taking a few specimens under bark scales and in the burrows of bark beetles, including a few specimens from burrows of bark beetles on *Picea*. In England, Hamilton (1978) reported the occurrence of *A. nemorum* (L.), a similar species, under bark in the winter in England, often occurring with *Xylocoris*. Drake (1922) expanded his observations on *A. musculus* (as *A. borealis*), again noting its more common occurrence on willow where it feeds on lace bugs (Tingidae). Reid (1957) also reported *A. musculus* from the galleries of *Ips* in *Pinus contorta latifolia*. Kelton (1978) reported the species to be an active predator on a variety of surface-dwelling arthropods and added many additional host plants.

Anderson (1962b) reported it from alder and willow in British Columbia as do

two closely related species, *A. dimorphicus* Anderson and Kelton and *A. antevolens* (Anderson and Kelton, 1963; Kelton, 1978). Kelton (1978) added many other genera of deciduous plants as habitats and referred to its importance as a predator in orchards, especially apple orchards in eastern Canada. It appears that *A. musculus* is only an occasional visitor to conifers, although its occurrence in bark beetle galleries seems somewhat different from its usual surface-feeding habit.

Prey: Drake (1922) reported *A. musculus* feeding on several species of *Corythucha* (Hemiptera: Tingidae) on willow. Reid (1957) reported predation on eggs of *Ips* (*I. pini* Say and *I. perroti* Swain) on *P. contorta latifolia* in Alberta. It has been observed feeding on red mites (Kelton, 1978), the eyespotted bud moth in apple orchards in Nova Scotia (MacPhee and Sanford, 1954), and aphids (Strickland, 1953).

Phenology and life history: Little is known about this species except that it is a predator in orchards, particularly apple orchards, in eastern Canada (MacPhee and Sanford, 1954).

Distribution: Originally described from north-central United States, *Anthocoris musculus* is widespread from the Maritime Provinces of Canada west to British Columbia and Alaska and south to Oregon, Colorado, Kansas, Missouri, New York, and North Carolina. Part of its range overlaps that of *A. antevolens*.

Specimens examined: We have examined many specimens from throughout its range. The record for *Pinus contorta* is that of Reid (1957) from Alberta where it occurred in the galleries of *Ips pini* and *I. perroti* Swain. There are two specimens from Washington, Whatcom Co., Heather Meadows, R9E T39N Sec 19, 7 September 1979, *Abies amabilis*.

Cardiastethus Fieber

Cardiastethus Fieber, 1860:266; Van Duzee, 1917a:295; Herring, 1966:150; Péricart, 1972:249; Kelton, 1977a:246; Kelton, 1978:57; Henry, 1988:22.

Diagnosis: Macropterous, densely pubescent, long hairs on pronotum and hemelytra; antennal segments 3 and 4 hardly thinner than segment 2; pronotum punctate, lateral margin carinate; collar narrow, disc of pronotum with distinct transverse groove; ostiolar canal evenly curved forward and prolonged into carina that reaches anterior margin of metasternum. Male with single clasper, female with poorly developed ovipositor (Péricart, 1972; Herring, 1976; Kelton, 1978).

Cardiastethus is a cosmopolitan genus containing about 45 species (Péricart, 1972). Six species occur in the United States and Canada; all but one of these are found in the southern United States (Henry, 1988). A single species, *C. borealis* Kelton, is northern in distribution and may be the only species occurring on a conifer in North America. One European species, *C. fasciventris* (Garbiglietti), occurs on conifers (*Abies* and *Picea*), but also is found on broad-leaf trees where it feeds on Psocoptera (Péricart, 1972). According to Southwood and Leston (1959), this latter species is mainly subcortical and overwinters as an adult. There is a single generation per year. Perris (cited in Péricart, 1972) reported nymphs from male flowers of pine in France. It will eat aphids in captivity. Another European species feeds upon scale insects.

Cardiastethus borealis Kelton

(Figure 3)

Cardiastethus borealis Kelton, 1977a:246; Kelton, 1978:57; Henry, 1988:22.

Diagnosis: Small (2.25–2.70 mm), reddish-brown species, i.e., pronotum and hemelytra densely pubescent. Pronotum, scutellum and cuneus dark, most of wing pale. Habitus similar to species of *Orius*, but larger, brown rather than black, and more pubescent. Ostiolar canal distinctive, long and slender, evenly curved forward, terminal carina reaching anterior margin of metasternum. Single, sickle-shaped male clasper.

Habitat: Little information is available on the microhabitat of *C. borealis*. It has been collected on *Pinus ponderosa* in British Columbia, *P. banksiana* in Manitoba, and *P. sylvestris* in Nova Scotia (Kelton, 1977a, 1978). We record it here from *P. contorta latifolia* in central Oregon (Ochoco Mountains). *Pinus ponderosa* occurs at this locality in some abundance. The 1965 Oregon specimen, from northwest of Lakeview, lacked host information but probably occurred on *P. ponderosa* (J.D.L.).

Prey: No prey information is available for *C. borealis*. The single European species of *Cardiastethus* [*C. fasciventris* (Garbiglietti)] occurring on conifers (*Abies* and *Picea*), is reported to feed on Psocoptera (Péricart, 1972). A nonconifer inhabiting species in Europe is reported to feed on scale insects (Péricart, 1972).

Phenology and life history: Southwood and Leston (1959) reported that the British species of *Cardiastethus* overwinters as an adult. Perris (cited in Péricart, 1972) stated that the nymphs of *C. fasciventris* occurred on the male strobili of pine in France. The early appearance of the adults on the strobili suggests they overwinter as adults or as eggs (e.g., most Miridae). The original type series (Kelton, 1977a) contained only a single male collected in early June in British Columbia. The other six specimens, all females, were collected in June (British Columbia and Manitoba) and July (Nova Scotia). The two specimens recorded here from central Oregon, a male and a female, were collected in July and August, respectively. Much remains to be learned about the habits of this species. Limited evidence suggests most species of *Cardiastethus* occur on deciduous trees: only two are found on conifers, one in Europe and the other in North America. *C. borealis* appears to occur on different hosts in different parts of its range.

Distribution: The type locality of *C. borealis* is Aspen Grove, British Columbia (Kelton, 1977a). Included in the type series were specimens from Seddon's Corner and Telford, Manitoba, and Mt. Uniacke, Nova Scotia. To these records we add two localities from central Oregon. A comprehensive systematic review of this genus is needed.

Specimens examined: Oregon: Crook Co., Ochoco Mts., Site 7, 9 July 1986, *Pinus c. latifolia* (tree 13), 1 male; Klamath Co: L. Elder Ck., 48.7 km W Lakeview, 18 August 1965, 1 female.

Elatophilus Reuter 1884

Elatophilus Reuter, 1884:616; Blatchley, 1928:86; Sands, 1957:303; Southwood and Leston, 1959:173; Péricart, 1967:52; Biliotti and Riom, 1967:1103; Cobben and Arnoud, 1969:8; Carayon, 1972a:345; Péricart, 1972:97; Herring, 1976:146; Kel-

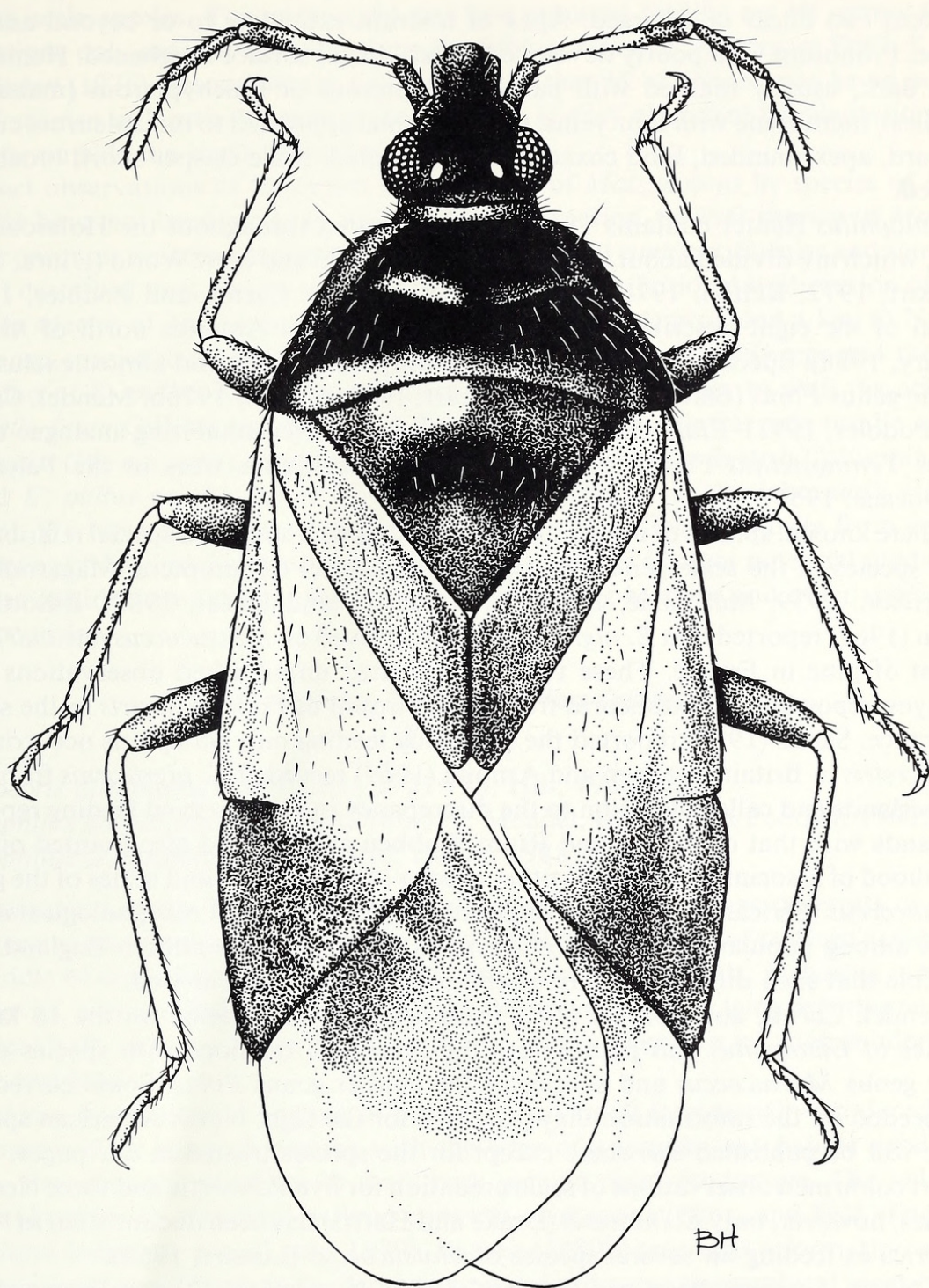


Fig. 3. *Cardistethus borealis* Kelton.

ton, 1976b:631; Kelton, 1977b:1017; Kelton, 1978:19; Henry, 1988:15; Mendel, Carmi, and Podoler, 1991:502.

Xenotracheliella Drake and Harris, 1926:38 (Synonymized by Kelton and Anderson, 1962: 1306).

Diagnosis: Length 2.5–4 mm, flattened, usually dark with some pale markings, pubescence short. Head elongate, eyes prominent (especially in male). Antenna with

segment two linear or enlarged. Apex of rostrum extending to or beyond anterior coxae. Pronotum with poorly developed collar, dorsal surface roughened. Hemelytra dull, dark, usually marked with pale, macropterous or brachypterous (males and females), membrane with four veins. Ostiolar canal appressed to metapleuron, curved forward, apex rounded, hind coxae widely separated. Male clasper short, broad and curved.

Elatophilus Reuter contains 18 species distributed throughout the Holarctic Region, which are divided about equally between the Old and New World (Hiura, 1966; Péricart, 1972; Kelton, 1976b, 1977b, 1978; Mendel, Carmi, and Podoler, 1991). Seven of the eight described Nearctic species occur in America north of Mexico (Henry, 1988). Species of *Elatophilus* occur only on conifers and almost exclusively on the genus *Pinus* (Blatchley, 1928; Péricart, 1972; Kelton, 1976b; Mendel, Carmi, and Podoler, 1991). *Elatophilus* appears to be the conifer inhabiting analogue of the genus *Temnostethus* Fieber, a genus found on deciduous trees in the Palearctic (LeQuesne, 1955).

Where known, species of the genus *Elatophilus* appear to have a special relationship with species of the scale genus *Matsucoccus* Cockerell (Homoptera: Magarodidae) (Morrison, 1939; McKenzie, 1942a, b; Kosztarab and Kozar, 1988). Biliotti and Riom (1967) reported that *E. nigricornis* (Zett.) preyed on *Matsucoccus feytaudi* Duc., a pest of pine in France. These two authors cited unpublished observations of J. Carayon reporting the anthocorid from male strobili of *Pinus sylvestris* in the spring in France. Sands (1957) reported the same bug feeding only on aphids occurring on *P. sylvestris* in Britain. Cobben and Arnoud (1969) recorded *E. nigricornis* from The Netherlands and called attention to the discrepancy in the observed feeding reported by Sands with that of Biliotti and Riom. Cobben and Arnoud also pointed out the likelihood of associations between other species of *Elatophilus* and scales of the genus *Matsucoccus*. Péricart (1967) and Woodroffe (1969) described morphological differences among populations of *E. nigricornis* in Scotland and southern England. It is possible that such differences may extend to prey preference as well.

Mendel, Carmi, and Podoler (1991) summarized information on the 18 known species of *Elatophilus* and pointed out the presumed relations with species of the scale genus *Matsucoccus* and species of the conifer genus *Pinus*. Some corrections are needed on the information they provided for the eight North American species; these will be published elsewhere except for the species treated in our paper. They report confirmed observations of scale predation for five Palearctic and three Nearctic species, however, only *E. inimicus* (Drake and Harris) has been documented in North America as feeding on several species of *Matsucoccus* (Lussier, 1965).

In North America, Bean and Godwin (1955), Hartzell (1957) and Doane (1965) associated *E. inimica* with the red pine scale, *M. resinosae* Bean & Godwin, in New England. Lussier (1965) wrote a thesis on *E. inimica* and its role as a predator of the scale. He discussed the life history of this anthocorid in detail, and found a close correlation between the presence of the prey scale and the occurrence of the bug on the tree. Although Lussier found the anthocorid associated chiefly with *M. resinosae* on *P. resinosa*, he did cite one occurrence of the bug on *P. rigida* in association with *M. gallicolus* and on *P. sylvestris* in association with aphids and mites without the apparent presence of specimens of *Matsucoccus*. Drooz (1985) recorded the association of *E. inimica* with both species of *Matsucoccus* and summarized the life history

of both scale species. The anthocorid was first reported feeding on *M. resinosae* in plantations only outside the natural range of *Pinus resinosa*. Anderson, Ford, Kegg, and Risley (1976), among others, have suggested that *M. resinosae* may be an introduced species in North America since the scale is very abundant on plantations of the pine outside the tree's natural range.

Direct observations of predation upon species of *Matsucoccus* by species of *Elatophilus* have not been made in western North America. Several species of *Matsucoccus* occur on western species of pine, including *Pinus contorta*. Furniss and Carolin (1977) described host plants, seasonal history, and distributional information of the western species of *Matsucoccus*. Ray and Williams (1984) provided a key to North American species and gave additional host data. Anderson (1958) reported the association of *E. pullus* Kelton and Anderson (as *Elatophilus* sp. b) with the aphids *Essigella fusca* Gillette and Palmer and *Cinara* sp., and with the pine needle scale, *Chionapis* (*Phenacaspis*) *pinifoliae* (Fitch), on *P. ponderosa* in British Columbia. He reared *E. pullus* on the aphid *Myzocallis coryli* (Goeze) in the laboratory (1958, 1962b). We have encountered species of *Essigella* and *Cinara* on trees from which specimens of *Elatophilus* have been collected. A number of other potential predators of these aphids were taken at the same time, including Miridae and other species of Anthocoridae.

Elatophilus dimidiatus (Van Duzee)
(Figure 4)

Anthocoris dimidiatus Van Duzee, 1921:139; Hill, 1957:173.

Elatophilus dimidiatus: Kelton, 1976b:632; Mendel, Carmi, and Podoler, 1991:503.

Elatophilus (*Elatophilus*) *dimidiatus*: Henry, 1988:15.

Diagnosis: Length 3.0 mm. Males macropterous, females macropterous or brachypterous; ocelli present in all forms and sexes. Head with apex of rostrum extending to middle of mesosternum. Basal half of hemelytra white or pale, including most of the clavus, corium, and embolium, apical half brown to black, wing membrane pale on basal half, dark brown to black on apical half; pubescence of wing moderately dense and long.

Habitat: Conventional beating of branches and small trees usually produced few specimens. Very rigorous beating with the edge of a straight axe handle produced more. Branches and trunks with scaly bark seemed most productive. The only recorded host for *E. dimidiata* is *Pinus contorta murrayana* (Grev. and Balf.) Engelm, the Sierra lodgepole pine (Little, 1979). Forrest (1980b) provided information about the monoterpenes of *P. contorta* oleoresin and defined some geographical areas based upon these chemical characteristics, including one he calls the Sierra Nevada Division that encompasses many of the collection sites of *E. dimidiatus*. All specimens that we have collected were beaten from the branches of *P. c. murrayana*.

Prey: Although Mendel, Carmi, and Podoler (1991) cite *Matsucoccus* spp. as the prey of *E. dimidiatus* no specific host prey have been observed or identified thus far. *Pinus contorta* hosts at least one species of *Matsucoccus*, its presumed prey, as well as the aphids belonging to *Cinara* and *Essigella*.

Phenology and life history: This species appears to overwinter as a nymph or an adult. The males seem to disappear much earlier than the females (see Péricart,

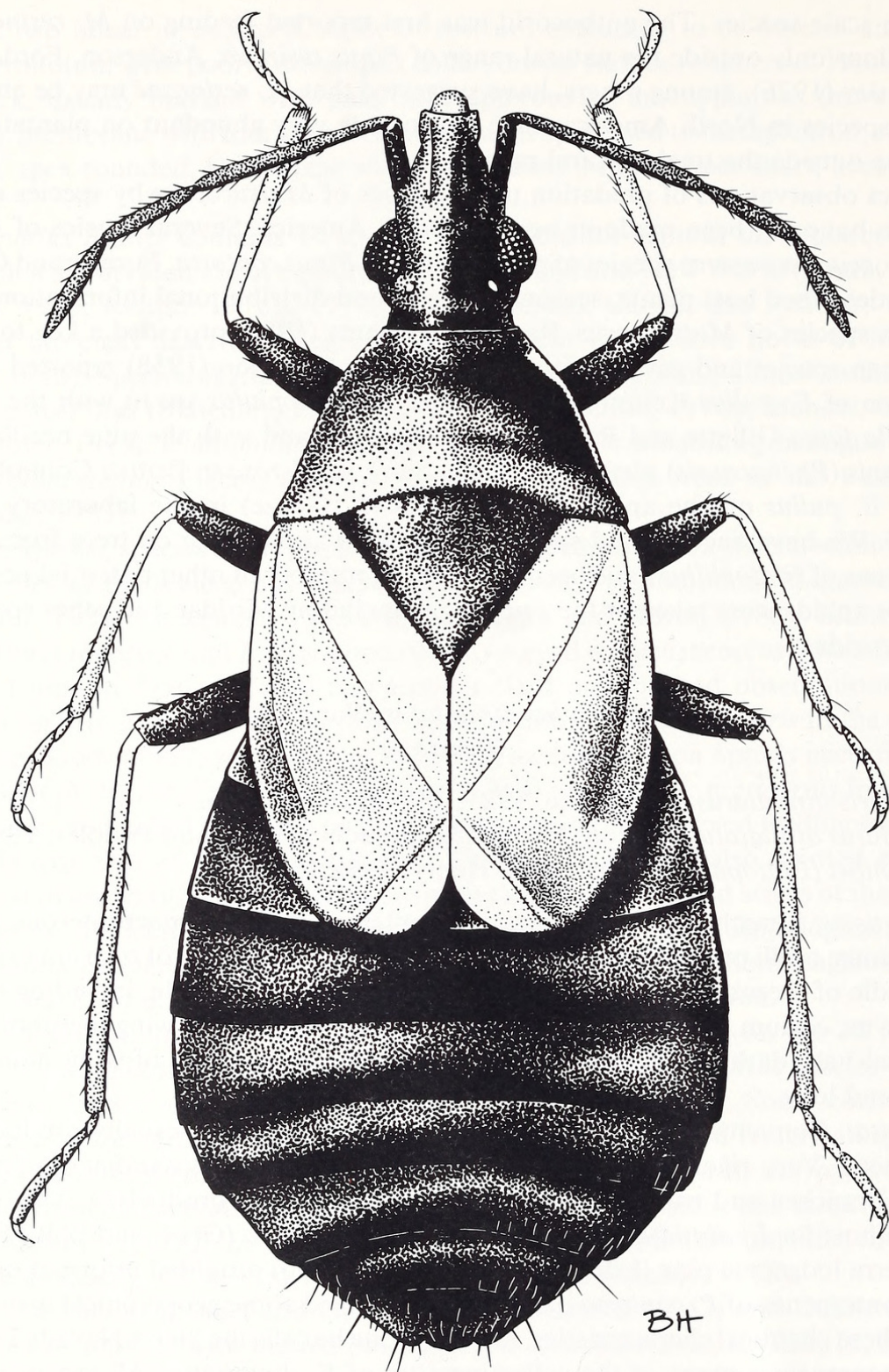


Fig. 4. *Elatophilus dimidiatus* (Van Duzee).

1967). Males and females were collected above Big Bear Lake, California, at an elevation of 2,215 m on June 8, 1989; a male was collected at an elevation of 2,954 m, west of Big Pine, California on June 6, 1989; brachypterous females were collected on June 23, 1981 at Childs Meadow, California (1,538 m) (Fig. 4); and the type series

(only females) from Cayton, California was collected on July 15, 1918. Near Sisters, Oregon; only females were collected on July 6, 1989.

Distribution: *Elatophilus dimidiatus* was described by Van Duzee (1921) (as a species of *Anthocoris*) from the Felch Ranch, near Cayton, Shasta Co., California based on three females. The type is mature and macropterous, the second specimen is teneral and macropterous, and the third, described by Van Duzee as a nymph, is actually a brachypterous female. As indicated in the section on wing polymorphism, species of this genus have always been regarded as macropterous in contrast to its deciduous tree analogue, *Temnostethus*. This brachypterous specimen of *E. dimidiatus* was subsequently included as a paratype of *Temnostethus fastigiatus* Drake and Harris (1926). In their paper (Drake and Harris, 1926), they erroneously cited the collection date of the specimen as 1913 rather than 1918. The taxonomic problems resulting from a mixed-type series will be dealt with in a subsequent publication.

As currently recognized, *E. dimidiatus* is known to occur above Big Bear Lake (San Bernardino Co., California); west of Big Pine (Mono Co., California); near Child's Meadow (Tehama Co., California); the type locality, Cayton (Shasta Co., California); and northward along the east side of the Cascade Mountains of Oregon at least as far as Sisters (Deschutes Co.). Brachypterous specimens, all females, are thus far known only from the San Bernardino, Tehama, and Shasta Co., California, localities.

Specimens examined: California: Mono Co., Cienega Mirth, 19.5 km W Big Pine, 6 June 1989, *Pinus c. murrayana*, 1 macropterous male; San Bernadino Co., above Big Bear Lake, end FS2N11, Champion tree site, R1W T2N NW ¼ Sec 34; 2,215 m, 8 June 1989, *P. c. murrayana*, 4 macropterous males, 12 brachypterous females; Tehama Co., Brokenshire Picnic area, 3.2 km W Child's Meadow, 1,754 m, 23 June 1981, *P. c. murrayana*, 3 brachypterous females. Oregon: Deschutes Co., Jct Hwy 20 and Metolius road, 1,077 m, 6 July 1989, *P. c. murrayana*, 6 macropterous females; 9.1 km NW Sisters, Hwy 20, 1,015 m, 26 August 1989, *P. ponderosa*, 2 macropterous females; as above, 14 September 1989, *P. ponderosa*, 1 macropterous female; as above, 26 September 1989, *P. ponderosa*, 2 macropterous females; 4.9 km S Sisters, 1,066 m, 14 September 1989, *P. ponderosa*, 1 macropterous female; as above, 24 September 1989, *P. ponderosa*, 1 brachypterous female; 14.6 km NW Sisters, Jct Hwy 20 and FS 2,060, 1,031 m, 6 July 1989, *P. c. murrayana*, 6 macropterous females; as above, 16 August 1989, *P. ponderosa*, 1 macropterous female; as above, 29 August 1989, *P. ponderosa*, 1 macropterous male, 1 macropterous female; as above, 14 September 1989, *P. ponderosa*, 2 macropterous, 1 brachypterous female; as above, 26 September 1989, *P. ponderosa*, 1 macropterous female.

Elatophilus pullus Kelton & Anderson
(Figure 5)

Elatophilus pullus Kelton & Anderson, 1962:1306; Anderson, 1962b:1332; Kelton, 1978:22; Mendel, Carmi, and Podoler, 1991:503.

Elatophilus (Elatophilus) pullus: Henry, 1988:16.

Diagnosis: Length 2.6 to 3.0 mm. Males and females macropterous. Head with tip of rostrum reaching middle of mesosternum. Hemelytra dark, dull; bases of corium and embolium and middle of clavus often pale; membrane fumate, transparent; pubescence silvery, sparse, short and semi-erect.

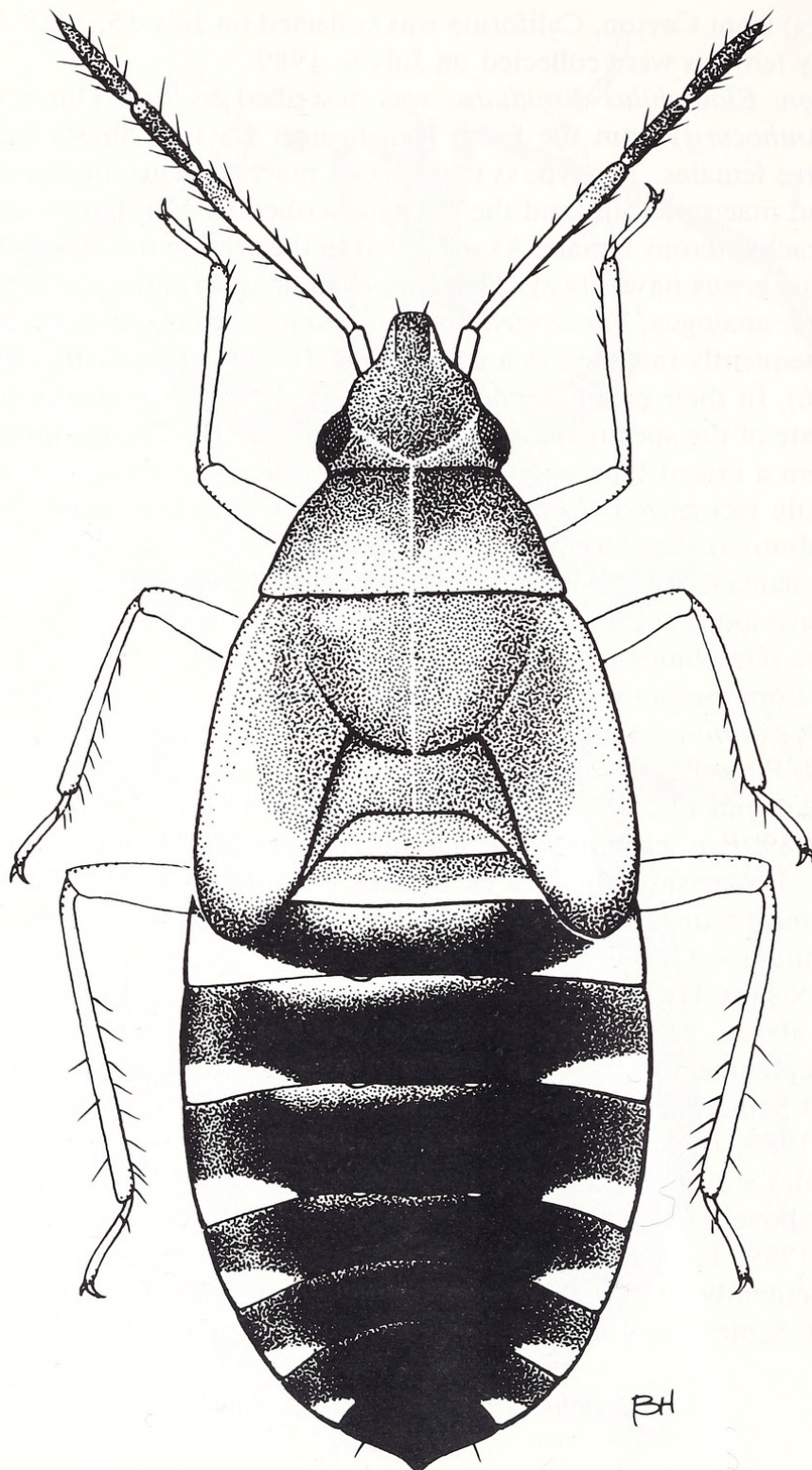


Fig. 5. *Elatophilus pullus* Kelton and Anderson.

Habitat: *Elatophilus pullus* occurs on *Pinus ponderosa* from British Columbia south to Oregon (Evans, 1983). The type series was collected from *P. ponderosa*. The exception is the John's Prairie, Washington site where we collected it from *P. contorta*. This locale, northwest of Olympia, is on the west side of the Cascade Mountains at the southern end of the Puget Sound. *Pinus ponderosa* occurs very rarely on the west

side of the mountains in Washington (Critchfield and Little, 1966). According to Forrest (1980b), the populations of *P. contorta contorta* in the Puget Sound area are discrete chemically and not particularly similar to the populations to the north or to the south. The trees looked more like the subspecies *P. c. murrayana* or *P. c. latifolia* than the coastal subspecies. No *Elatophilus* have yet been taken farther south from the coastal subspecies, *P. c. contorta*. Kelton (1978) lists *Pinus flexilis* James and *Picea glauca* (Moench) Voss as additional hosts.

Prey: Although the aphids *Essigella* and *Cinara* are taken regularly with *E. pullus* and other predatory Heteroptera, the relatively small numbers of the anthocorids collected suggest that the prey may be scale insects of the genus *Matsucoccus*. Furniss and Carolin (1977) provided host tree information on western species of *Matsucoccus* that differed from the scale species cited by Mendel, Carmi, and Podoler (1991) as possible prey for *E. pullus*.

Phenology and life history: According to Anderson (1962b), *E. pullus* overwinters as a fifth-instar nymph in the region around Summerland, British Columbia. Second and third instar nymphs were taken in mid-November and only fifth-instar nymphs were taken the following March. Males appeared first at the beginning of April, followed by the females about two weeks later. The males died within a month. Eggs were deposited during late April and hatched in early May. The occurrence of early instars in September suggested the possibility of a second generation. The series we collected from John's Prairie near Olympia, Washington, in early July from *P. contorta*, were all females. This bug has not yet been collected from the coastal form of *P. contorta* further south where we have collected extensively. In the vicinity of Sisters, Oregon, at an elevation of 1,046 m, we collected females of *E. pullus* on *P. ponderosa* on May 3, June 7, July 6, and August 2, 1989; fifth-instar nymphs from June 7 to August 16 (Fig. 5), and third-instar nymphs from July 6 to August 2, 1989. The early occurrence of females at this locale, and the absence of males suggests that fertilized females overwinter. A rather protracted generation may occur through the summer, with the males and females appearing in late August.

Distribution: *Elatophilus pullus* was described by Kelton and Anderson (1962) from specimens collected in British Columbia and Oregon. The type came from Westbank, British Columbia. Anderson (1962b) reported the species from Westbank and Summerland, British Columbia, and Adel, Chandler State Park, and Klamath Falls, Oregon, all from *P. ponderosa*. We have seen additional specimens from John's Prairie, near Shelton, Washington, and in the vicinity of Sisters, Oregon. With the exception of the John's Prairie record, all localities are on the east side of the Cascade Mountains from southern British Columbia, south to at least Klamath Falls, Oregon, near the Oregon-California border. At Sisters, Oregon, it occurs at the same locality as *E. dimidiata*, although on different host trees.

Specimens examined: CANADA: British Columbia: Summerland, 1 April 1958, *P. ponderosa*, 1 male; Summerland, 5 November 1957, lab reared ex *P. ponderosa*, 1 male; 16 km W Westbank, 26 June 1957, *P. ponderosa*, 1 female; Wilson's Landing, 14.6 km N Westbank, 6 May 1958, *P. ponderosa*, 2 females; as above, but 12 June 1956, 1 female. UNITED STATES: Oregon: Deschutes Co., 14.6 km NW Sisters, Jct Hwy 20 and FS 2060, 1,031 m, 7 June 1989, *P. ponderosa*, 1 female; as above, 20 July 1989, *P. ponderosa*, 1-IV instar nymph; as above, 16 August 1989, *P. ponderosa*, 1-V instar nymph; 4.9 km S Sisters, 1,066 m, 3 May 1989, *P. ponderosa*, 2 females; as above, 11 May 1989, *P. ponderosa*, 1 female; as above, 24 May 1989,

P. ponderosa, 1 female; as above, 7 June 1989, *P. ponderosa*, 1-IV instar nymph; as above, 2 August 1989, *P. ponderosa*, 1-II, 1-III instar nymphs; as above, 14 September 1989, *P. ponderosa*, 1 female; 9.1 km NW Sisters, Hwy 20, 1,015 m, 7 June 1989, *P. ponderosa*, 2-IV, 2-V instar nymphs; as above, 21 June 1989, 5-V instar nymphs; as above, 6 July 1989, 3 females; as above, 20 July 1989, 1-III, 1-IV instar nymphs; as above 2 August 1989, 1 female; as above, 16 August 1989, 3-V instar nymphs; as above, 26 September 1989, 2 females. Washington: Mason Co., John's Prairie, nr Shelton, 2 July 1988, *P. contorta*, 4 females. Wyoming: Park Co., Yellowstone Nat. Pk., 1.6 km N Indian Crk. Cmpgd., 19.5 km N Norris, 2,269 m, 16 September 1980, *P. contorta latifolia*, 2 females.

Elatophilus sp. A.

An undescribed species of *Elatophilus* from *Pinus contorta* is referred to here as species A; it will be formally described when the generic revision of *Elatophilus*, now in progress, is completed. Species A may be separated from the other species of *Elatophilus* occurring on *P. contorta* by the enlarged second antennal segment. All specimens thus far collected have been macropterous.

Habitat: One specimen was taken on *Picea engelmanni* on Washington Pass, Washington; the other specimens have come from *Pinus contorta murrayana* in Oregon and northern California. No specific prey information is available other than the usual aphids beaten from the same hosts. Scale insects have not yet been collected from *P. contorta*, although at least one species of *Matsucoccus* is known to occur on it.

The specimens we collected were all females. The collection dates (from north to south) were Washington Pass, Washington, late September; southern Oregon Cascades, late June and mid-July; northern California, mid-July and mid-August. No nymphs have been collected that can be referred to this species with certainty.

Distribution: The species occurs in the Cascade Mountains from northern Washington (Washington Pass) south into northern California (near McCloud) and in the Sierra Nevada of California (near Calpine, Sierra Co.). Thus, it occurs in several different regions of *P. contorta murrayana*, as defined chemically by Forrest (1980b).

Specimens examined: California: Sierra Co., Plumas Nat. For., Hwy. 89, 5 km W Calpine, 1,631 m, 15 July 1987, *P. c. murrayana*, 1 female; Siskiyou Co., 24.4 km NNE McCloud, Swamp Creek Road and Hwy. 19, 14 August 1988, *P. c. murrayana*, 3 females. Oregon: Deschutes Co., 14.6 km NW Sisters, Jct 20 and FS 2060, 1,031 m, 6 July 1989, *P. c. murrayana*, 1 female; as above but 29 August 1989, 1 male; 14 September 1989, 1 female; 4.9 km S Sisters, 1,066 m, 14 September 1989, *P. ponderosa*, 1 male, 2 females; Harney Co., 16 km W Denio, 23 September 1959, 1 female; Klamath Co., 1.6 km W Crescent, 1,385 m, 17 July 1979, *P. c. murrayana*, 1 female; Klamath Co., nr Klamath Falls (above Geary Ranch), 26 June 1959, 1 female. Washington: Okanogan Co., Washington Pass, 1,615 m, 20 September 1979, *Picea engelmanni*, 1 female.

Lyctocoris Hahn

Lyctocoris Hahn, 1836:19; Reuter, 1884:6; Van Duzee, 1917a:228; Sands, 1957:307; Kelton and Anderson, 1962:1302; Anderson, 1962b:1325; Kline and Rudinsky,

1964:8; Kelton, 1966b:320; Kelton, 1967:807; Chu, 1969:1; Carayon, 1972a:337; Péricart, 1972:200; Herring, 1976:149; Kelton, 1978:57; Dixon and Payne, 1979: 12, 13; Berisford, 1980:250; Goyer, Lenhard, Nebeker, and Schmitt, 1985:4; Kerzhner, 1988:770; Henry, 1988:23.

Diagnosis: Macropterous; length 3.30–4.90 mm; slightly flattened, shiny, pale to dark brown, pronotum and hemelytra punctate. Antennal segments three and four slender, setose; tip of rostrum reaching or exceeding middle coxae. Anterolateral margins of pronotum expanded, collar present and narrow, calli distinct. Hemelytra punctate and pubescent, four veins in membrane. Ostiolar canal slender, angulate, apex pointing forward. Left and right claspers present; ovipositor well-developed.

About 25 species of *Lyctocoris* have been described (Chu, 1969; Péricart, 1972); eight occur in the United States and Canada. The genus is distributed over much of the world. At least one species, *L. campestris* (Fabricius), is almost cosmopolitan, occurring very commonly in stored grain facilities. The extensive movement of grain throughout the world may be responsible for its wide distribution. This species also occurs in bird and mammal nests, hay stacks and thatch (Sands, 1957; Hicks, 1959). While largely predaceous on other arthropods in these habitats, it has been reported biting a person in New Zealand (Woodward, 1951; Anderson, 1962b). Anderson (1962b) reported it from a hen house, on apple trees, and in grain storage facilities. He recorded its occurrence under bark scales of maple and oak trees (fifth-instar nymphs and adults) during the winter in southern England. Moore (1972) reported *L. campestris* as a predator of the southern pine beetle. Kinzer (1976) reported this species from *Abies concolor* in New Mexico. This identification needs to be confirmed.

Dixon and Payne (1979) and Goyer, Lenhard, Nebeker, and Schmitt (1985) reported *L. elongatus* Reuter under pine bark in association with southern pine beetles, chiefly *Dendroctonus frontalis* Zimmerman but including three species of *Ips* as well. The species of *Ips* arrived slightly later to the trees than did *Dendroctonus frontalis*, and *Lyctocoris elongatus* (Reuter) showed a closer correlation with the *Ips* spp. than with *D. frontalis*. Kline and Rudinsky (1964) reported a *Lyctocoris* sp. as a possible predator of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins.

Kelton (1967) published a synopsis of the genus *Lyctocoris* for North America, providing information on the nine known species. He discussed the habits of some of the species treated. Most species are found under the bark of a wide variety of trees. Thus far, only a single species of *Lyctocoris* has been collected from *P. contorta*.

Lyctocoris tuberosus Kelton and Anderson
(Figure 6)

Lyctocoris elongatus: Downes, 1927:11.

Lyctocoris tuberosus Kelton and Anderson, 1962:1303; Anderson, 1962b:1326; Kelton, 1967:812; Kelton, 1978:62; Evans, 1983:45.

Lyctocoris (Lyctocoris) tuberosus: Henry, 1988:24.

Diagnosis: Length 3.6 to 3.9 mm. Head and pronotum reddish brown, scutellum dark brown, hemelytra yellow brown tinged with reddish brown; membrane clear, outer vein well developed, other three faint; legs pale yellow brown. Tip of rostrum reaching hind coxae. Male with front and middle tibiae with a row of short, brown

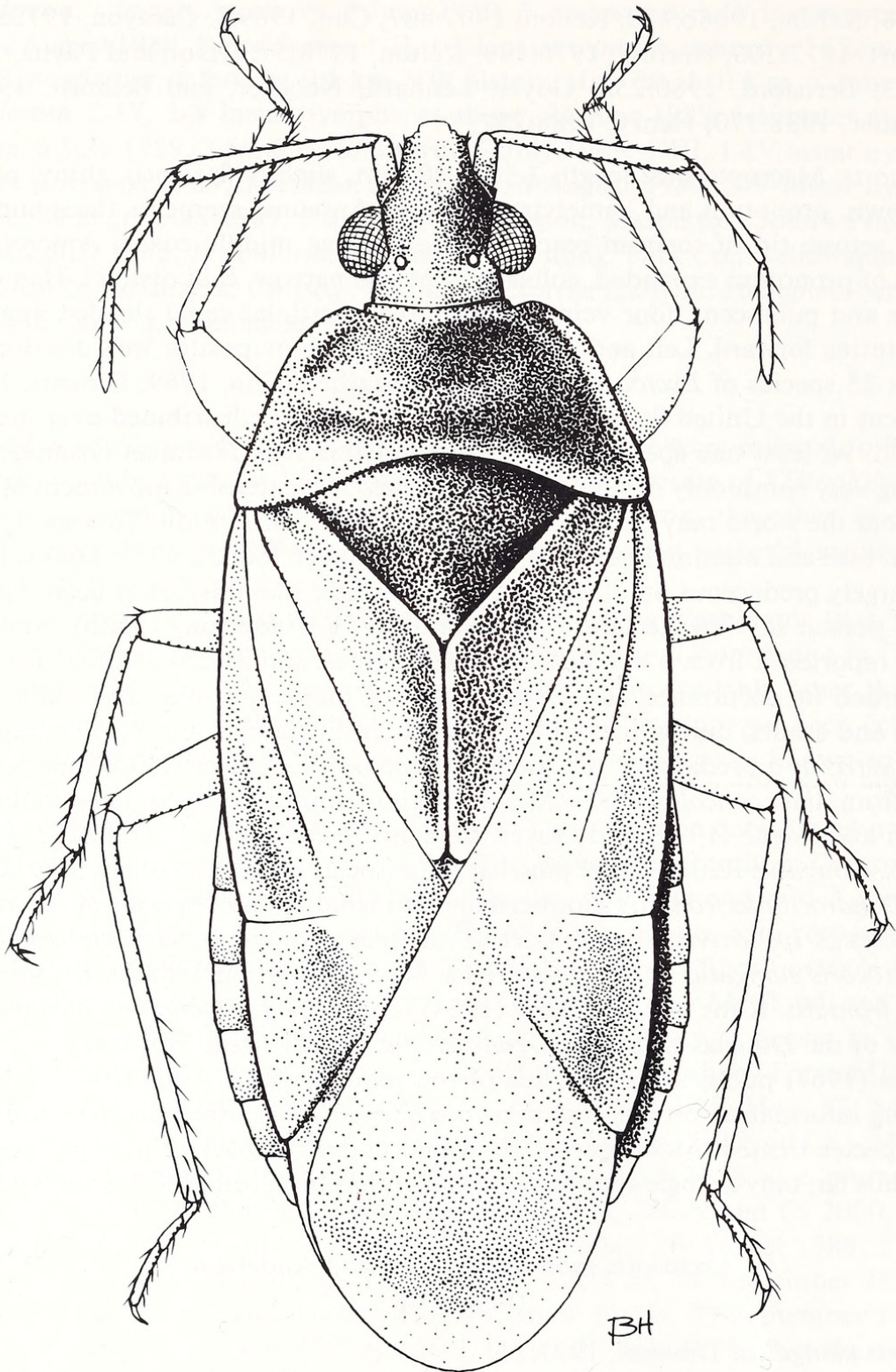


Fig. 6. *Lyctocoris tuberosus* Kelton and Anderson.

pegs on inner surface, hind tibiae with several long spines; abdominal segment seven with small tubercle on each side; left clasper flattened, apex obliquely truncate, right clasper smaller. Female with median portion of abdominal sternum six extended in posterior direction, inner margin of abdominal sternum seven gently curved, posterior margin almost straight, postero-medial angle rounded. Ovipositor well developed.

Habitat: Most records provide only host plants, but Kelton (1967) stated that the species occurs under the bark of *P. ponderosa*, *P. contorta*, and *Picea engelmanni* in association with bark beetles. Kline and Rudinsky (1964) reported *Lyctocoris* sp. from under the bark of *Pseudostuga menziesii*, also in association with bark beetles.

The holotype was collected from *P. ponderosa* at Aspen Grove, British Columbia. Other host plants listed in the type series included *P. contorta* in British Columbia, *Picea engelmanni* in British Columbia, *P. ponderosa* in British Columbia and Colorado, and *Pinus monticola* in British Columbia. Anderson (1962b) added *P. ponderosa* in northeast Washington, *Pseudotsuga menziesii* (Mirbel) Franco in Oregon and *Pinus contorta* var. *latifolia* Engelm. in Oregon (note: this should be *P. c. murrayana*). Evans (1983) cited *P. ponderosa* as a host in southeastern British Columbia.

Prey: Kelton (1967) listed a species of the bark beetle genus *Ips* occurring on several species of *Pinus* and on *Picea engelmanni* as potential prey. Kline and Rudinsky (1964) cited a species of *Lyctocoris* as a possible predator of the Douglas-fir bark beetle, *Dendroctonus pseudotsugae*, in the Pacific Northwest. Evans (1983) cited *L. tuberosus* as a "small active predator." Mosier, Thatcher and Pickard (1971) reported *L. elongatus* (Reuter) as an associate of *D. frontalis* and *Ips* spp. Goyer, Lenhard, Nebeker and Schmitt (1985) reported *L. elongatus* (Reuter) as a predator of southern pine bark beetles.

Phenology and life history: Very little is known about this species of *Lyctocoris*. Adults have been collected from April 28 through August 31 in southeastern British Columbia with both sexes being taken in late August. Specimens from southwestern Colorado were collected on April 23 (Kelton and Anderson, 1962). How many species overwinters is not yet known. No information is yet available on the immature stages.

Distribution: The type series contained specimens from Aspen Grove, Fernie, Lorna, Midday Valley, Merritt, Kane Valley and Trinity Valley, British Columbia, and from Pine River, La Plata Co., Colorado (Kelton and Anderson, 1962). Anderson (1962b) added Northport, Stevens Co., Washington, and Keno, Elsie and Pringle Falls, Oregon. He also stated the 1927 record of Downes of *L. elongatus* (Reuter) from Midday Valley, British Columbia, actually referred to a specimen of *L. tuberosus*. Kelton (1967) added South Dakota, with no specific locality. This is a widespread species, but with few known localities within that range.

Specimens examined: CANADA: British Columbia: Aspen Grove, 15 June 1933, *P. ponderosa*, #17480, lot 23, 1 female; Stanley, 26 June 1932, *Abies lasiocarpa*, #17424, lot 6, 1 female. UNITED STATES: Oregon: Jefferson Co., 3 km S Camp Sherman, 20 October 1962, under *P. ponderosa* bark, 1 female.

Melanocoris Champion

Melanocoris Champion, 1900:329; Van Duzee, 1917a:819; Kelton and Anderson, 1962:1307; Herring, 1976:144; Kelton, 1977a:246; Kelton, 1978:23; Henry, 1988:16.

Diagnosis: Macropterous; shiny; pubescence on hemelytra pale, flattened, scale-like or elongate and simple, may be serially arranged. Head short, tip of rostrum extending beyond anterior coxae; pronotum with collar indistinct, lateral margins broadly expanded; ostiolar canal short, straight, apex elevated; hind coxae widely separated, metasternum with apex straight or evenly rounded.

The genus *Melanocoris* contains four described species, all found in North America. The type of the genus is *M. obovatus* Champion, described from a female collected at Totonicapam, Guatemala (Los Altos region), between 8,500 and 10,500 feet, likely from a pine tree (Champion, 1900). The other three species occur in western Canada and United States (Drake and Harris, 1926; Kelton and Anderson, 1962; Kelton, 1978; Henry, 1988). Species of *Melanocoris* occur only on conifers, chiefly species of *Pinus* but occasionally on *Picea* and *Abies* (Champion, 1900; Van Duzee, 1921; Drake and Harris, 1926; Kelton and Anderson, 1962; Anderson, 1962b; Kelton, 1977a, 1978).

Melanocoris longirostris Kelton

Melanocoris longirostris Kelton, 1977a:246; Kelton, 1978:25; Henry, 1988:16.

Diagnosis: Length 2.60–3.00 mm, head and pronotum black, shiny; hemelytra brown, punctate, shiny, pubescence short and simple. Tip of rostrum extending beyond hind coxae.

Habitat: Kelton (1977a) reported *M. longirostris* from *Pinus monticola* in British Columbia; *P. ponderosa* and *P. strombiformis* in Arizona; and *Pinus flexilis*, *Picea glauca*, and *Abies lasiocarpa* in Colorado. We have collected it on *P. c. latifolia* and *P. flexilis* in Colorado; *P. c. murrayana* and *P. monticola* in Oregon; and *P. c. latifolia* and *P. flexilis* in Wyoming.

Prey: No specific prey information is available for this species. It was collected with woolly aphids on *P. monticola* in Corvallis, Oregon.

Phenology and life history: Adults have been collected in June, July, and August throughout the known range of the species. No specific life history information is available although both nymphs and adults were collected on July 25, and adults only on July 27 at site 2 in Wyoming.

Distribution: The species was described from a series of specimens collected at New Denver, British Columbia, and other localities in British Columbia, Colorado, New Mexico, Arizona and Utah. We add localities from eastern and western Oregon, Nevada, and southeastern Wyoming. The various host plants are listed under habitat.

Specimens examined: California: San Bernardino Co., above W end Big Bear Lake, R1W T2W NW¼ Sec 34, 2,215 m, 8 June 1989, champion *P. c. murrayana*, 3 females. Colorado: Larimer Co., Rocky Mt. Nat. Pk., 8.1 km W Estes Park, R13W T5N Sec 19, 2,677 m, 29 September 1990, *P. c. latifolia*, 1 female; Las Animas Co., 4 km S Cucharas Pass, 2,892 m, 5 September 1991, *P. aristata*, 1 female; Pitkin Co., 10 km S Aspen, 2,646 m, 11 September 1991, *P. c. latifolia*, 10 females, 1 male. Nevada: Washoe Co., Galena Cr., Mt. Rose, 14 June 1964, 1 female. Oregon: Benton Co., Corvallis, OSU campus, 1 July 1988 (teneral), *P. monticola*, 1 male, 1 female; Klamath Co., base of Gearhart Mt., 7 June 1959, *P. c. murrayana*, 1 female; Lane Co., H. J. Andrews Exp. For., 18 km NE Blue River, 18 August 1988, *P. monticola*, 2 males, 5 females, 2 V-instar nymphs. Wyoming: Albany Co., Sites 2.1 and 2.2, 25 July 86, *P. c. latifolia* adults and nymphs, 1 female; Site 2.2, 27 July 86, *P. c. latifolia* adults; Site 2.1, 9 July 86, *P. flexilis* (10 trees pooled), 1 female; Site 2.2, 25 July 86, *P. c. latifolia* (T-20), 1 female.

Melanocoris nigricornis Van Duzee
(Figure 7)

Melanocoris obovatus: Van Duzee, 1917a:819, b:262.

Melanocoris nigricornis Van Duzee, 1921:143; Kelton and Anderson, 1962:1307; Anderson, 1962b:1332; Kinzer, Ridgill and Watts, 1972:10; Kelton, 1977a:246; Kelton, 1978:23; Henry, 1988:16.

Tetraphleps novitus Drake and Harris, 1926:41 (Colo.); Kelton and Anderson, 1962:1307.

Diagnosis: Moderate length (2.66–3.50 mm), head, and pronotum black, base and margins of pronotum often brown; hemelytra dark brown, finely sculptured, shiny; pubescence on hemelytra scalelike and serially arranged. Tip of rostrum reaching anterior coxae.

Habitat: The original series was collected from pines in the southern part of the Sierra Nevada of California. One specimen was taken from Jeffrey pine (Van Duzee, 1921). Anderson (1962b) reported *M. nigricornis* from *Pinus ponderosa* and *P. c. latifolia* in British Columbia and *P. ponderosa* in Oregon. Kinzer (1976) reported *M. nigricornis* from *P. ponderosa* in New Mexico. Kelton (1978) reported the species from *Pinus sylvestris*, *P. contorta*, *P. ponderosa*, and *Picea engelmanni* in British Columbia. We add *P. c. murrayana* in Oregon, California, and Mexico, *P. c. latifolia* in Wyoming, and *P. radiata* in California.

Prey: *Melanocoris nigricornis* was collected in association with the aphids *Cinara* sp. and *Essigella fusca* G. & P., as well as the pine needle scale, *Phenacaspis pinifoliae* (Anderson, 1962b). Kelton (1978) speculated that the species probably feeds upon aphids, scales and other small arthropods. We collected aphids belonging to both *Cinara* and *Essigella* from the Oregon and Wyoming sites during 1986.

Phenology and life history: Adults have been collected from April (California and Mexico) to September (Oregon and Wyoming) in various parts of the range (Van Duzee, 1921; Drake and Harris, 1926; Anderson, 1962b; Kelton, 1978). According to Anderson (1962b), *M. nigricornis* overwinters as an adult in southern British Columbia and adults and nymphs were common from July to October. Reproduction continued into the fall with last instar nymphs collected in the latter part of October. Males and females were collected in early winter but only the females survived until spring. Under laboratory conditions, development from egg to adult took 24 days, and two consecutive generations were reared in the laboratory in only 67 days. Thus two generations are possible under field conditions.

Distribution: *Melanocoris nigricornis* was originally described by Van Duzee (1921) from three female specimens from California. One specimen was taken at Summit, Placer Co., at 2,154 m; another on pine trees on Mt. Tahquitz above Keen Camp, Riverside Co., at 2,154 m; the last was taken on Jeffrey pine at Monmouth, Mono Co. Previously, Van Duzee (1917a) reported this species (under the name *Melanocoris obovatus* Champion) from Summit, in Placer Co., California locality. *Tetraphleps novitus* was described by Drake and Harris (1926) from specimens collected in Colorado on pine at Stonewall and Trinidad, Las Animas Co., 2,770 m and Estes Park, Larimer County [note: *Pinus ponderosa scopulorum* is the common pine at these locales]. This species was synonymized with *Melanocoris nigricornis* by Kelton and

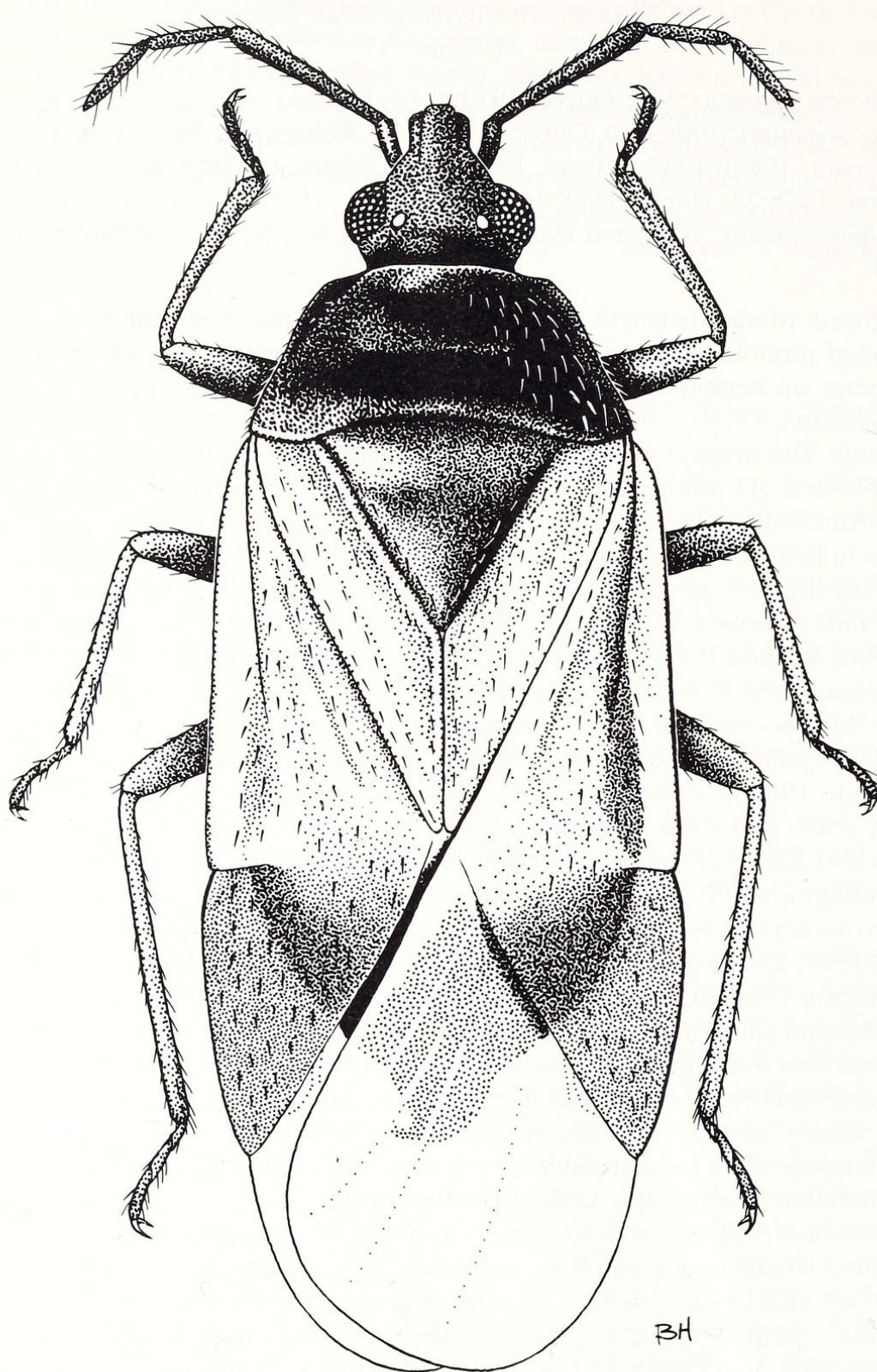


Fig. 7. *Melanocoris nigricornis* Van Duzee.

Anderson (1962). Anderson (1962b) reported *M. nigricornis* from several localities in the Okanagan Valley of British Columbia: Oliver to Westbank, Princeton, and from Adel, Oregon. Kelton (1978) reported it from several localities in southeastern British Columbia. We report here additional localities in Oregon and California and add Washington, Wyoming, and Mexico.

Specimens examined: CANADA: British Columbia: 19.5 km W Princeton, 1,169 m, 31 July 1957, *P. contorta*, 1 male. MEXICO: Baja California Norte, 90 km E San Telmo, 18 April 1979, *P. contorta*, 2 males, 4 females. UNITED STATES: California: Fresno Co., Pioneer Basin, 27 October 1959, 1 female (UCR). Mono Co., June Lake, Hwy. 158, 16 June 1989, *P. c. murrayana*, 3 females; Monterey Co., Pt. Lobos St. Res., E Hwy 1, Huckleberry Ridge Oak area, 8 April 1979, *P. radiata*, 1 female; Sierra Co., Tahoe Nat. For., off FS Rd. 07, 27.7 km W Hwy. 89, 2,092 m, 16 July 1987, *P. c. murrayana*, 1 female. Colorado: Larimer Co., Estes Park YMCA Camp, 6 km SW Estes Park, 2,465 m, R13W T4N Sec 4, 26 September 1990, *P. ponderosa scopularum*, 1 male, 3 females; Las Animas Co., 4 km S Cucharas Pass, 2,892 m, 5 September 1991, *P. ponderosa scopulorum*, 1 female. Oregon: Deschutes Co., Three Creeks Mdw., 26 km S Sisters, 2,065 m, 1 September 1977, *P. c. murrayana*, 3 males; Three Creeks Lake, 28 km S Sisters, 2,100 m, 14 June 1990, *P. c. murrayana*, 8 females; Black Butte Ranch, 13 km NW Sisters, 1,015 m, 24 March 1990, *P. sylvestris*, 3 males, 3 females; Linn Co., Big Lake, 1,431 m, 1 October 1979, *P. c. murrayana*, 4 females. Washington: Kittitas Co., 8 km W, 5 km S of Cle Elum, 6 June 1970, 1 female. Wyoming: Park Co., Yellowstone Nat. Pk., 8 km S Tower Falls, 2,262 m, 17 September 1980, *P. c. latifolia*, 3 females; Teton Co., Grand Teton Nat. Pk., 2,123 m, 18 September 1980, *P. c. latifolia*, 3 males.

Orius Wolff

Orius Wolff, 1811:5; Carayon, 1953b:1206; Wagner, 1952:22; Carayon and Steffan, 1959:53; Kelton, 1963:631; Herring, 1966:1093; Carayon, 1972a:346; Péricart, 1972:160; Herring, 1976:147; Kelton, 1978:46; Henry, 1988:18.

Triphleps Fieber, 1860:266; Van Duzee, 1917a:293.

Diagnosis: Small, shiny, ovate, macropterous. Head short, ocelli distinct; tip of rostrum reaching anterior coxae; antennal segments II, III, and IV of equal thickness. Pronotum with punctures; short collar, not well differentiated; calli distinct, smooth. Hemelytra shiny, finely punctate, three veins in membrane. Anterior tibiae with fine, stout spinules on inner surface. Ostiolar canal curving forward, evaporative area broad and shiny.

More than 70 species of *Orius* are recognized and almost half of these occur in the Northern Hemisphere (Péricart, 1972). This is a large, complex genus with much additional work needed to achieve an understanding of the taxon. Wagner (1952) monographed the European species and recognized four subgenera. Kelton (1963) published a synopsis of the North American species, and Herring (1966) monographed the species of the Western Hemisphere. Carayon and Steffan (1959) reviewed the feeding habits of the genus. The North American fauna still requires additional work, for many of the described taxa are known from very few individuals. Two native species, *Orius insidiosus* (Say) and *O. tristicolor* (White), are abundant throughout their respective ranges in North America, the former chiefly eastern and southern, and the latter northern and western (Kelton, 1963; Herring, 1966). Both have been deliberately introduced into Hawaii as biological control agents for two different Lepidoptera (Weber, 1953; Davis and Krauss, 1963). A selected bibliography of these two species was published by Ryerson and Stone (1979). A third species, *Orius minutus* (L.), represents an introduction into North America (Lattin, Asquith, and Booth, 1989).

Orius tristicolor (White)
(Figure 8)

Triphleps tristicolor White, 1879:145; Van Duzee, 1914:15; Van Duzee, 1917a:293; b:262.

Orius insidiosus var. *tristicolor*: Blatchley, 1926:637.

Orius tristicolor: Harris and Shull, 1944:207; Anderson, 1962b:1330; Kelton, 1963:634; Herring, 1966:1103; Kelton, 1978:50; Henry, 1988:19.

Diagnosis: Length 1.80–2.3 mm. Head black, shiny; tip of rostrum extending to anterior coxae. Pronotum black, shiny, punctate and rugose; calli smooth, raised. Scutellum black, shiny. Hemelytron with anterior half of corium, parts of clavus pale and shiny; balance of wing black; pubescence short, scattered; membrane fuscous, with two visible veins.

Habitat: Species of *Orius* occur on the surface of forbs, shrubs and trees including conifers. They are mobile predators that patrol the plant surfaces, feeding on small arthropods and their eggs (Collyer, 1953). Most species seem to be generalist predators, taking prey scaled to their size. *Orius tristicolor* has been found on a wide variety of plants and associated with many prey species (Anderson, 1962b; Ryerson and Stone, 1979). This species is often encountered in flower heads as well as on other parts of the plant.

Along with *O. insidiosus*, this is a ubiquitous species of Anthocoridae. Not primarily a conifer-inhabiting species, we have seen specimens from *Pinus ponderosa* (Oregon) and from *P. c. murrayana* (Baja California, Norte, Mexico). The Oregon locality (near Sisters) had a scattered shrub understory of *Chrysothamnus* and *Purshia*.

Prey: *Orius tristicolor* feeds especially on Homoptera (Anderson, 1962b; Wilde and Watson, 1963; McMullen and Jong, 1967). However, Barber (1936) found that the early nymphal instars of *O. insidiosus*, a closely related species, were largely phytophagous and in fact could complete development on plant food alone. Dicke and Jarvis (1962) indicated that pollen is an important food source for *O. insidiosus*. Carayon and Steffen (1959) reported similar feeding habits for other species of *Orius*.

Phenology and life history: According to Anderson (1962b), this species overwinters as an adult (mostly females) and has been collected during winter from ground litter and has been beaten from deciduous and coniferous trees. He stated that three generations per year were likely in the Pacific Northwest but a fourth was possible. Developmental time from egg to adult was approximately 3 weeks. Eggs are inserted into leaves (including the veins) and hatch in about 7 days. Five instars occur with the duration of each stage about 4 days.

Distribution: The species ranges widely over Canada, northern and western United States, south through Mexico into Central and South America and the Bahamas (Kelton, 1963; Herring, 1966). In the eastern part of Canada and United States, it is largely replaced by *O. insidiosus*, which ranges through the southern and central states into Mexico and Central and South America and several of the West Indies (Kelton, 1963; Herring, 1966).

Specimens examined: Many specimens from throughout the range of the species. MEXICO: Baja California Norte, 90 km E San Telmo, 18 April 1979, *P. contorta*. UNITED STATES: Oregon: Deschutes Co., 4.9 km S Sisters, 26 September 1989, *Pinus ponderosa*, 2 females; Linn Co., Big Lake, 1,431 m, 1 October 1979, *P. c. murrayana*, 1 female.

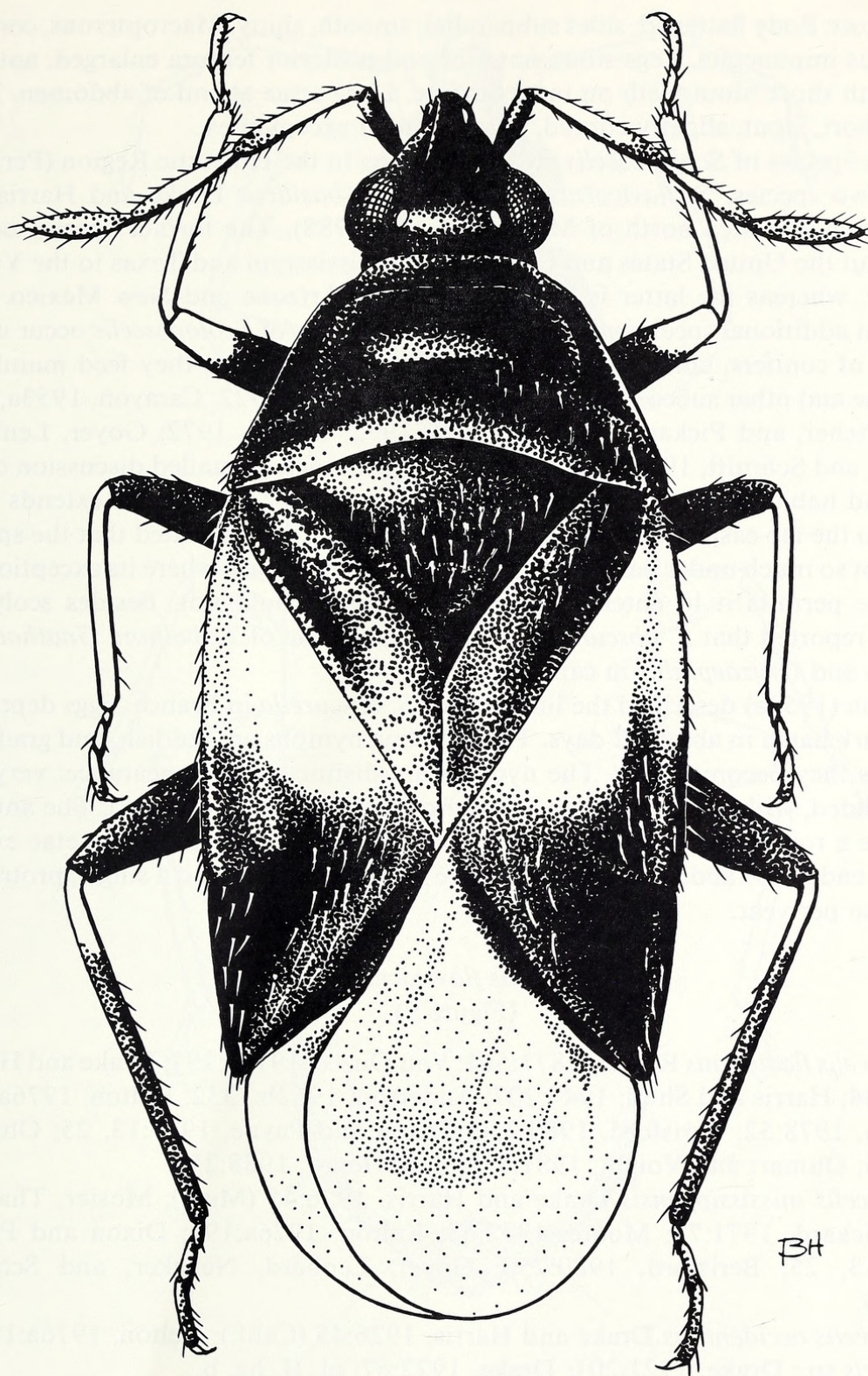


Fig. 8. *Orius tristicolor* (White).

Scoloposcelis Fieber

Scoloposcelis Fieber, 1864:62; Van Duzee, 1917a:296; Carayon, 1953a:65; Carayon, 1972a:341; Péricart, 1972:279; Kelton, 1976a:196; Herring, 1976:149; Kerzhner, 1988:771; Henry, 1988:25.

Diagnosis: Body flattened, sides subparallel, smooth, shiny. Macropterous, corium, and clavus impunctate. Legs stout, anterior and posterior femora enlarged, anterior femur with short, stout teeth on inner surface. Long setae at end of abdomen. Male clasper short, stout, slightly curved, parallel-sided except apex.

Twelve species of *Scoloposcelis* are known, nine in the Holarctic Region (Péricart, 1972). Two species, *S. flavicornis* Reuter and *S. basilicus* Drake and Harris, are known from America north of Mexico (Henry, 1988). The former species occurs throughout the United States and Canada from Mississippi and Texas to the Yukon Territory, whereas the latter is known only from Arizona and New Mexico. It is likely that additional species will be recognized. Species of *Scoloposcelis* occur under the bark of conifers, chiefly species of the genus *Pinus* where they feed mainly on Scolytidae and other subcortical insects (Drake, 1921, 1922; Carayon, 1953a; Mosier, Thatcher, and Pickard, 1971; Péricart, 1972; Moore, 1972; Goyer, Lenhard, Nebeker, and Schmitt, 1985). Carayon (1953a) provided a detailed discussion of the habits and habitats of *S. obscurella* (Zett.). The range of this species extends from Europe to the far-eastern U.S.S.R. (Kerzhner, 1988). Carayon stated that the species occurs not so much under bark, but between the layers of bark where its exceptionally flat shape permits it to enter crevices most insects could not. Besides scolytids, Carayon reported that *S. obscurella* fed upon the larvae of *Tribolium*, *Gnathocerus*, *Anobium* and *Oryzaephilus* in captivity.

Carayon (1953a) described the life cycle of *S. obscurella* in France. Eggs deposited in tree bark hatch in about 12 days. The resulting nymphs are reddish, and gradually darken as they become older. The nymphs are distinctive in appearance: very flat, parallel-sided, with the anterior and posterior femora greatly enlarged. The anterior pair have a row of short teeth on the inner surface. Several very long setae extend from the end of the abdomen. There are five nymphal instars and a single, protracted generation per year.

Scoloposcelis flavicornis Reuter
(Figure 9)

Scoloposcelis flavicornis Reuter, 1871:561; Van Duzee, 1917a:297; Drake and Harris, 1926:44; Harris and Shull, 1944:207; Anderson, 1962b:1332; Kelton, 1976a:196; Kelton, 1978:52; Berisford, 1980:250; Dixon and Payne, 1979:13, 25; Ohmart, 1981:5; Ohmart and Voight, 1981:677, 680; Henry, 1988:25.

Scoloposcelis mississippiensis Drake and Harris, 1926:45 (Miss.); Mosier, Thatcher and Pickard, 1971:73; Moore, 1972:63; Kelton, 1976a:196; Dixon and Payne, 1979:13, 25; Berisford, 1980:250; Goyer, Lenhard, Nebeker, and Schmitt, 1985:4.

Scoloposcelis occidentalis Drake and Harris, 1926:45 (Calif.); Kelton, 1976a:196.

Anthocoris sp.: Drake, 1921:201; Drake, 1922:67; pl. II, fig. b.

Diagnosis: Body elongate, parallel-sided and very flat; dorsum shiny, glabrous; anterior and posterior femora enlarged, anterior femur with short teeth on inner surface. Several long setae at end of the abdomen. Head and pronotum dark, shiny; macropterous, hemelytra shiny, glabrous; clavus and corium largely pale, dark along claval suture, embolium and most of cuneus, with membrane clear.

Some morphological differences in some of the specimens examined suggest the likelihood of at least one other species, perhaps a northern and southern species.

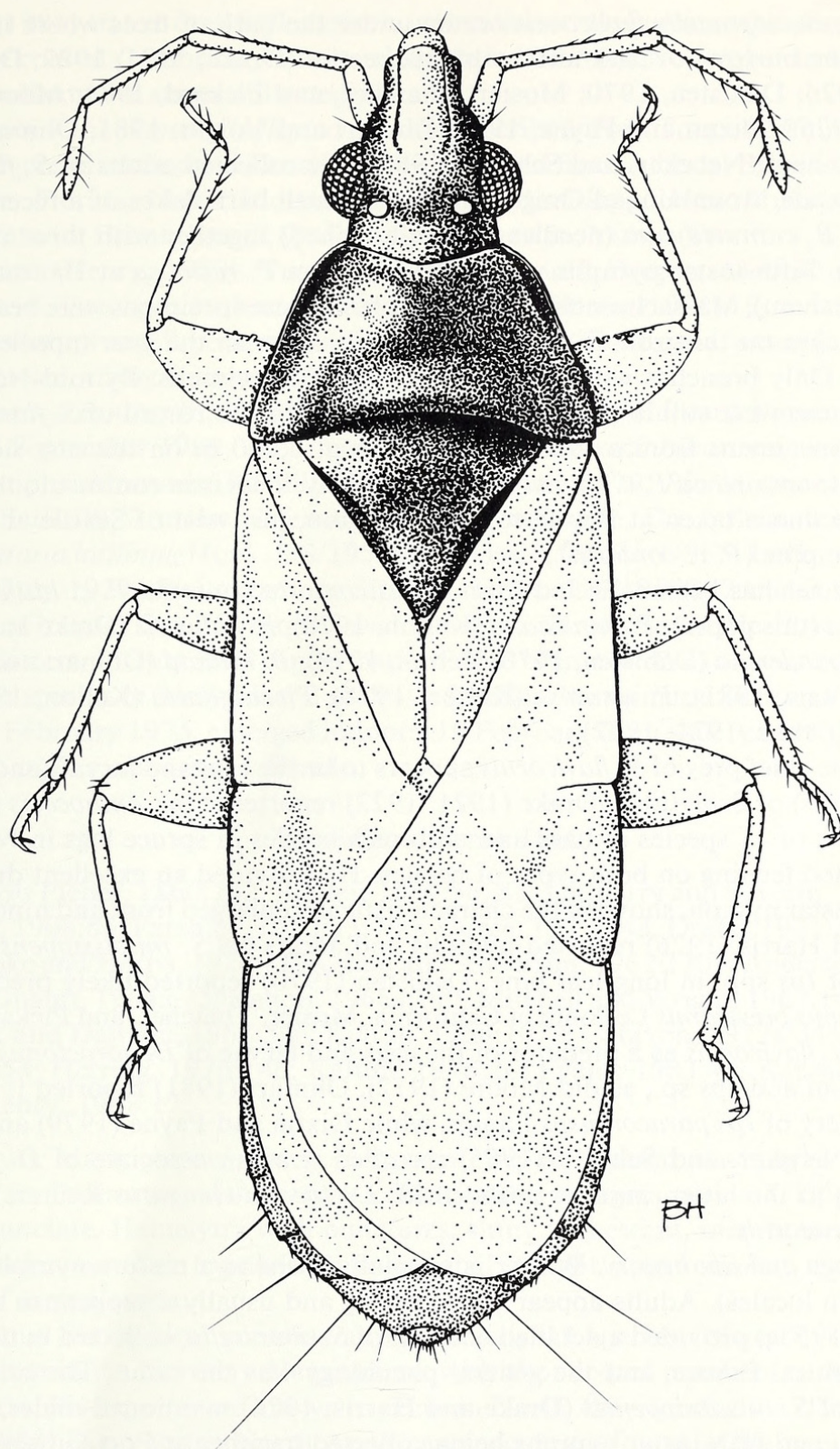


Fig. 9. *Scoloposcelis flavicornis* Reuter.

Only a thorough examination of available specimens will clarify this situation. Because both *S. obscurella* Zett. and *S. pulchella* Zett. have been reported from the far-eastern Palearctic Region by Kerzhner (1988), specimens from the far northwestern portion of North America should be examined with special care.

Habitat: *Scoloposcelis flavicornis* occurs under the bark of trees where it is often found in the burrows of bark and ambrosia beetles (Drake, 1921, 1922; Drake and Harris, 1926; Dahlsten, 1970; Mosier, Thatcher, and Pickard, 1971; Moore, 1972; Kelton, 1976a; Dixon and Payne, 1979; Ohmart and Voight, 1981; Ohmart, 1981; Goyer, Lenhard, Nebeker, and Schmitt, 1985). We collected adults of *S. flavicornis* in the Cascade Mountains of Oregon in July beneath bark flakes of a recently dead branch of *P. c. murrayana* (needles brown, attached) together with three species of Scolytidae. Fifth-instar nymphs were collected from *P. resinosa* at Harvard Forest (near Petersham), Massachusetts, in mid-October. These specimens were beaten from dead branches on the ground that had been cut earlier in the year (needles brown, attached). Only branches with scaly bark produced specimens. By mid-November, the specimens were still in the nymphal state. The Oregon record of *S. flavicornis* is based on specimens from a subalpine meadow at 2,000 m on the east side of the Cascade Mountains on *P. c. murrayana* in mid-July. This is in contrast to the Washington specimens taken at Bremerton, Washington, just west of Seattle at sea level from shore pine (*P. c. contorta*).

This species has been collected from *Pinus contorta contorta*, *P. c. latifolia*, *P. c. murrayana* (this paper), *P. banksiana* (Kelton, 1978), *P. palustris* (Drake and Harris, 1926), *P. ponderosa* (Dahlsten, 1970; Kelton, 1978), *P. radiata* (Ohmart and Voight, 1981; Ohmart, 1981), *P. resinosa* (Kelton, 1978), *Picea glauca* (Kelton, 1978), and *Picea* sp. (Drake, 1921, 1922).

Prey: The chief prey of *S. flavicornis* appears to be the eggs and larvae (and perhaps callow adults) of Scolytidae. Drake (1921, 1922) reported it (as *Anthocoris* sp.) from the burrows of 11 species of bark and ambrosia beetles in spruce logs in New York and reported feeding on both types of beetles. He provided an excellent drawing of the fifth-instar nymph, showing the characteristically enlarged front and hind femora. Drake and Harris (1926) reported nymphs and adults (as *S. mississippiensis*) in the burrows of *Ips* spp. in long-leaf pine. Dahlsten (1970) reported likely predation on *Dendroctonus brevicomis* LeConte in California. Mosier, Thatcher, and Pickard (1971) reported *S. flavicornis* as a predator of the eggs and larvae of *Dendroctonus frontalis* Zimmerman and *Ips* sp., as did Moore (1972). Ohmart (1981) reported it from the brood gallery of *Ips paraconfusus* Lanier, while Dixon and Payne (1979) and Goyer, Lenhart, Nebeker, and Schmitt (1985) recorded it as an associate of *D. frontalis*. According to the latter, another anthocorid, *Lyctocoris elongatus* Reuter, occurred with *S. flavicornis*.

Phenology and life history: Winter is normally spent as a mature nymph (at least in northern locales). Adults appear in the spring and usually disappear in early fall. Carayon (1953a) provided a detailed account of *S. obscurella*, collected in the mountains of central France, and the general phenology was the same. The original description of *S. mississippiensis* (Drake and Harris, 1926) mentioned males, females, and fourth and fifth-instar nymphs being collected together at Port Gibson, Mississippi, on *Pinus palustris* in late July. Mosier, Thatcher and Pickard (1971) reported the occurrence of *S. flavicornis* (as *S. mississippiensis*) in January and March through November. Dixon and Payne (1979) showed a close correlation between the arrival of *Scoloposcelis* and the bark beetles, especially *Dendroctonus frontalis*, attacking pines in southern United States. The beetles are multivoltine and it appears that the anthocorid is too, thus explaining the occurrence of the bug throughout the year.

Ohmart (1981) stated that *S. flavicornis* was collected throughout the year on *Pinus radiata* in coastal California, but was most abundant from November to March. He did not indicate life stages collected.

Distribution: *Scoloposcelis flavicornis* was described from Texas by Reuter (1871). This widespread anthocorid has since been recorded from Alberta, British Columbia, California, Florida, Idaho, Indiana, Manitoba, Mississippi, New Brunswick, Nova Scotia, Ontario, Pennsylvania, Quebec, Saskatchewan, Yukon Territory, Guatemala, and Mexico (Henry, 1988). To these records we add Oregon, Massachusetts and Washington. Two species described by Drake and Harris (1926), *S. mississippiensis* from Mississippi and *S. occidentalis* from Ventura Co., California, were synonymized with *S. flavicornis* by Kelton (1976a).

Specimens examined: Massachusetts: Worcester Co., Harvard Forest, nr Petersham, 28 September 1989, under bark of dead branches of *Pinus resinosa*, five fifth instar nymphs. Montana: Ravalli Co., Sula, 26 June 1929, *Pinus contorta latifolia*, Hopk. US/19509, 7 males, 2 females (USFS, LaGrande, Ore.); Sula, 8 July 1929, *Pinus contorta latifolia*, Hopk. US/19509, 6 males, 1 female (USFS, LaGrande, Ore.); Sula, 27 July 1929, *Pinus contorta latifolia*, Hopk. US/19509, 7 males, 2 females (USFS, LaGrande, Ore.) Oregon: Deschutes Co., Three Creeks Meadow, 2,069 m, 26 km S Sisters, 11 July 1988, under bark of dead branch of *P. c. murrayana* together with three species of Scolytidae, 2 males, 6 females. Washington: Kitsap Co., Bremerton, 17 February 1975, emerged indoors, 19 February from gallery of *Pityophthorus confertus*, in *P. c. contorta*, 1 female.

Tetrableps Fieber 1860

Tetrableps Fieber, 1860:262; Reuter, 1884:56, 85; Lethierry and Severin, 1896:245; Reuter, 1908:86; Parshley, 1920:83; Van Duzee, 1921:143; Drake, 1921:203; 1922:67; Drake and Harris, 1926:41; Kelton and Anderson, 1962:1307; Anderson, 1962b:1331; Ghauri, 1964:675; Kelton, 1966a:199; Mitchell and Wright, 1967:143; Harris, Holms, and Dawson, 1968:5–6; Kelton, 1968:1072; Carayon, 1972a:345; Péricart, 1972:154; Herring, 1976:146; Kelton, 1978:26; Evans, 1983:45; Kerzhner, 1988:771; Henry, 1988:17.

Diagnosis: Macropterous, shiny, pubescent. Tip of rostrum reaching or exceeding front coxae. Pronotum with distinct collar, lateral margins carinate, calli smooth, surface punctate. Hemelytra with punctures, shiny, pubescent, membrane with four veins. Hind coxae close together. Ostiolar canal straight, apex rounded, raised above surface of metapleuron.

The genus *Tetrableps* contains approximately 12 species (Péricart, 1972). The species occur in the Northern Hemisphere, with about equal numbers in the Old and New World. Five species are known to occur in North America (Kelton, 1966a, 1978; Henry, 1988). Keys to the North American species are found in the two papers by Kelton (1966a, 1978), together with information on distribution and host associations. Species of *Tetrableps* are found only on conifers, especially of the genus *Pinus*, and to a lesser extent on *Larix*, *Picea*, *Abies*, and *Pseudotsuga* (Reuter, 1908; Péricart, 1972; Kelton, 1978). Kinzer, Ridgill, and Watts (1972) and Kinzer (1976) recorded *Tetrableps* sp. from *Pinus ponderosa* cones in New Mexico. Evans (1983) reported *Tetrableps* sp. from lodgepole pine in the northern interior of British Columbia.

Species of *Tetrphleps* are active, surface feeding predators, often abundant on their host plants. Their main food seems to be aphids. Péricart (1972) mentioned several aphids of the genus *Cinara* as primary prey of *T. biscuspis* (H.-S.) in Europe. *Cinara* spp. were commonly collected from *P. c. murrayana* and *P. c. latifolia* at a number of localities in the present study. Specimens of the aphid genus *Essigella* also were taken.

Mitchell and Wright (1967) reported the introduction of *Tetrphleps* spp. from Pakistan and India in 1964. Specimens from Pakistan were released at Randle, Washington, and Portland, Oregon (Hoyt Arboretum), and those from India at Wind River, Washington (Wind River Arboretum), and into a laboratory culture. It is not known if they have become established (Dr. R. G. Mitchell, pers. comm., 12 March 1990). These anthocorids were released as potential predators of the balsam woolly adelgid, *Adelges piceae* (Ratzeburg). These same species, ultimately identified as *Tetrphleps Abdulghani* Ghauri from Pakistan, and *T. raoi* Ghauri from India (Ghauri, 1964; Henry, 1988), were introduced onto Vancouver Island (Thetis Park), British Columbia in 1965 (Harris, Holms, and Dawson, 1968). According to Dr. L. M. Humble, Forest Insect and Disease Survey, Forestry Canada, Victoria, British Columbia, these species apparently have not become established (pers. comm., 2 March 1990). According to Kelton (1978), they were also introduced into New Brunswick and Nova Scotia, and as of 1971, had not been recovered. Two native species, *T. latipennis* Van Duzee and *T. sp.*, were collected at the Thetis Park release site in 1964 and 1965.

A shortage of specimens from a number of localities makes it difficult to assess the degree of species variation. Females predominate in most collections, mainly because of the timing of collections; and thus the variation in male genitalia, especially the claspers, is largely unknown. A thorough revision of *Tetrphleps*, with examination of all type material, almost certainly will result in the recognition of additional species.

Tetrphleps canadensis Provancher

Tetrphleps canadensis Provancher, 1886:90; Parshley, 1920:85; Van Duzee, 1921:142; Drake and Harris, 1928:50; Anderson, 1958:50; Kelton and Anderson, 1962:1307; Anderson, 1962b:1331; Kelton, 1966a:199; Kelton, 1968:1072; Kelton, 1978:27; Henry, 1988:17.

Lyctocoris canadensis: Van Duzee, 1912:320.

Tetrphleps americana Parshley, 1920:84; Drake and Harris, 1928:50.

Tetrphleps osborni Drake, 1922:67; Kelton and Anderson, 1962:1307.

Acompocoris (*Tetrphleps*) *osborni*: Drake and Harris, 1926:43.

Tetrphleps edacis Drake and Harris, 1926:43; Kelton and Anderson, 1962:1307.

Diagnosis: Length 3.1 to 3.9 mm. Head, pronotum and scutellum black, shiny, pubescence dense and rather long. Hemelytra pale brown, shiny, finely punctate, with rather long, dense pubescence. Apex of rostrum reaching middle of mesosternum. Hind tibiae with short setae. Ostiolar canal with posterior margin concave, apex broadly rounded.

Habitat: Drake (1921) reared a specimen (as *Tetrphleps* n. sp.) from the burrows of a weevil from Bebb's willow (*Salix bebbiana* Sarg.) in New York, but he thought

that pine was its usual host. Drake (1922) mentioned it (as *Tetrphleps osborni*) was a predator of leaf-feeding insects on *Pinus strobus* in New York. Drake and Harris (1926) reported *Larix laricina* as a host (as *Tetrphleps edacis*) in New York. Kelton (1966a, 1978) listed *Abies balsamea* L., *Pinus banksiana*, *Picea glauca*, *P. mariana*, and *Larix laricina* as host plants.

Prey: Drake (1921, 1922) cited the beetle, *Cryptorhynchus lapathi* Linnaeus, as prey of *Tetrphleps osborni* Drake (= *T. canadensis* Provancher), but thought that herbivorous insects on conifers, in particular *Pinus strobus*, provided most of its food. Kelton (1966, 1978) mentioned its association with the balsam woolly adelgid in eastern Canada.

Phenology and life history: The type of *Tetrphleps americana* Parshley (= *T. canadensis* Prov.), a female, was collected in Maine in early August and the paratype, also a female, was collected at Ottawa, Canada, in early September. Adult *Tetrphleps osborni* Drake (= *T. canadensis* Prov.) were taken in New York during July, August, and September (Drake, 1922). Drake (1922) stated that nymphs and adults were found during the summer, but the larger nymphs and adults (males and females) were found only during the latter part of the summer. He reported only a single generation per year. How this species overwinters is not known. According to Péricart (1972), adults of *T. bicuspis* (H.-S.) overwinter under the bark of their coniferous hosts. Parshley (1920) recorded no host data when he described *T. americana*.

Distribution: Originally described from Cape Rouge, Quebec, *Tetrphleps canadensis* Provancher is now known to occur across southern Canada from Newfoundland west to British Columbia (Kelton, 1978). Kelton (1966a) also cited Alaska, Maine, Michigan, and Wisconsin. *Tetrphleps americana* Parshley (= *T. canadensis* Provancher) was described from Maine; *T. osborni* Drake (= *T. canadensis*) from New York (Barber Point, Wanakena, and The Plains); and *T. edacis* Drake and Harris (= *T. canadensis*), from The Plains, Wanakena, New York. We report it here from coastal Oregon.

Specimens examined: We have examined several specimens of what appears to be this species along the Oregon coast. Oregon: Lincoln Co., Driftwood Beach Wayside, 8.5 km N Waldport, 8 August 1985, *P. c. contorta*, sample #91, 1 female.

Tetrphleps latipennis Van Duzee
(Figure 10)

Tetrphleps latipennis Van Duzee, 1921:140; Downes, 1927:11; Harris and Shull, 1944:206; Anderson, 1958:50 (in part); Kelton and Anderson, 1962:1307; Anderson, 1962b:1331; Kelton, 1966a:201; Harris, Holms, and Dawson, 1968:15; Furniss and Carolin, 1977:81; Kelton, 1978:29; Henry, 1988:17.

Tetrphleps profugus Drake and Harris, 1926:42; Kelton and Anderson, 1962:1307; Kelton, 1966a:201; Henry, 1988:17.

Diagnosis: Length 3.50 to 4.35 mm, dorsum shiny; pubescence distinct, short and appressed. Tip of rostrum reaching anterior coxae. Pronotum with calli black, balance red brown; scutellum black; hemelytra red brown, shiny, membrane brown, narrowly pale around veins.

Habitat: This is a surface-feeding species, primarily a predator of small arthropods. It forages for aphids on the branches and needles of various conifers, most commonly

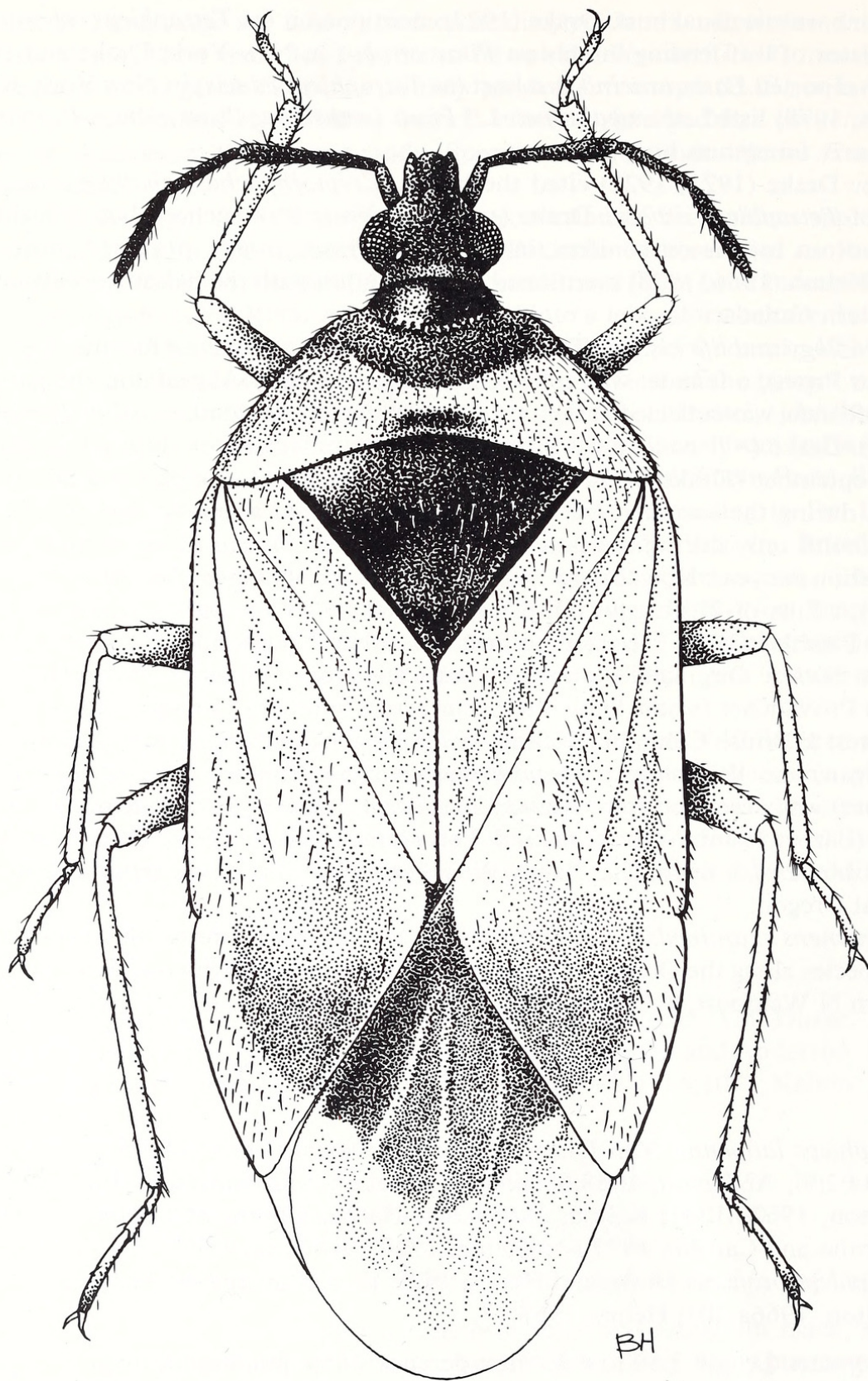


Fig. 10. *Tetraphleps latipennis* Van Duzee.

on pines. The type series was collected on white-bark pine (*P. albicaulis*) (Van Duzee, 1921); *Abies*, *Pseudotsuga*, *Picea*, *Pinus*, and *Larix* (Anderson, 1962b); *Pseudotsuga menziesii* (Mirb.); *Pinus ponderosa* Laws., *P. c. latifolia* Engelm., *Abies grandis* (Dougl.), *Picea* sp., *Larix* sp., and on *Alnus* sp. (Kelton, 1966a); *Abies grandis* (Harris, Holms, and Dawson, 1968); *Abies*, *Pseudotsuga*, *Picea*, *Pinus*, and *Larix* (Furniss and Carolin, 1977); and *Abies balsamea*, *A. amabilis*, *A. lasiocarpa*, *Larix occidentalis*, *Picea engelmanni*, *P. glauca*, *Pinus monticola*, *P. albicaulis* (Kelton, 1978). We add *P. c. murrayana* from Oregon.

Prey: Kelton (1966a) reported *T. latipennis* feeding on the balsam woolly adelgid in eastern Canada. Furniss and Carolin (1977) stated that this species is the most common anthocorid on conifers and reported it feeding on *Adelges cooleyi*. Kelton (1978) added "... other aphids in British Columbia."

Phenology and life history: Anderson (1962b) thought there were two generations per year and that the adults overwintered beginning in late August or September; the spring generation adults matured in late June or July. The only immature stages collected were fifth-instar nymphs in southeastern British Columbia in June and July together with males and females. The earliest adults in British Columbia were collected in late May and the latest, September 12. The type series, all females, were collected in California on July 28 (Van Duzee, 1921).

Distribution: The type series was taken on the top of Mt. Eddy (2,800 m), Siskiyou Co., California (Van Duzee, 1921). Also included in the type series were specimens from Huntington Lake (2,308 m), Fresno Co., and near Walker, Siskiyou Co., California as well as a specimen from Nanaimo, Vancouver Island, Canada. Downes (1927) reported it from Victoria, British Columbia; Harris and Shull (1944) from Moscow Mountain, Idaho; Anderson (1958) listed localities in British Columbia, Idaho, Washington; Anderson (1962b) recorded it from several other British Columbia localities, McCall, Idaho and Corvallis, Oregon. Kelton (1966a) added many localities from Alberta, British Columbia, California, New Brunswick, Newfoundland, Oregon and Wyoming; and (1978) provided a distribution map of the species in Canada. A considerable gap existed between the western and eastern localities and the map showed several localities in Saskatchewan and one in Manitoba besides the provinces already recorded.

Specimens examined: CANADA: British Columbia; Westbank, 12 June 1956, Douglas-fir, 1 female. UNITED STATES: California; Shasta Co., 14 km E Shasta City, 8 August 1956, *Abies shastensis*, 1 male, 2 females; Siskiyou Co., Medicine Lk. Rd., 1,846 m, 26 June 1979, *Abies concolor*, 4 females. Idaho: Benewah Co., Emida, Charlie Crk. Rd., 8 July 1979, *Abies* sp., *Abies concolor*, 4 females; Latah Co., Moscow, 25 July 1920, 1 female. Oregon: Benton Co., Mary's Peak, Saddle, 17 August 1978, Douglas-fir, 1 male, 1 female; Mary's Peak, summit, 4 October 1977, *Abies procera*, 2 females; Clackamas Co., Molalla, 1,108 m, 26 September 1977, *Abies procera*, 3 females; Deschutes Co., Three Creeks Lake, 26 km S Sisters, 2,154 m, 14 June 1990, *Pinus contorta murrayana*, 4 females; Black Butte Ranch, 13 km NW Sisters, 1,015 m, 23 March 1990, under bark of *Pinus sylvestris*, 1 female; Hood River Co., Mt. Hood, nr Silcox Hut, 2,154 m, 24 August 1980, on snow bank, 1 female; 5 km N Barlow Pass Summit, R9E T3S Sec 15 NW~, 1,372 m, 5 September 1979, *Abies amabilis*, 2 females; Jackson Co., Tubb Springs, 10 km W Pinehurst, 1,323 m, 19 May 1960, 15 females; Klamath Co., 8 km E Kirk, 1,385 m, 21 May

1958, *P. c. murrayana*, 1 female; Lake of the Woods, Rainbow Camp, 1,508 m, 23 May 1958, *Pinus c. murrayana*, 3 females; same but *Abies concolor*, 25 females; same, but *Pinus monticola*, 18 females; Lane Co., 3 km W Willamette Summit, 1,431 m, 17 July 1979, *Tsuga mertensiana*, 1 male, 1 female; Lane-Linn Co., H. J. Andrews Exp. For. R6E T15S Sec 7, SW~ 1,323 m, 31 July 1979, *Abies amabilis*, 1 male, 1 female; same but McRae Crk. crossing, FS rd 1506-359, 1,237 m, 309 August 1978, *Abies procera*, 1 female; same, 25 August 1980/860825-11 Psme-1 (*Pseudotsuga menziesii*), 1 female; Marion Co., 5 km W Breitenbush Lk., 5 June 1966, *Abies lasiocarpa*, 2 females; Multnomah Co., Portland, Black light trap, 13 August 1963, 1 male, (OSDA): Union Co., 6 km ESE Tollgate, 1,538 m, 26 June 1960, 1 female. Washington: Chelan Co., Pump Chance Crk., 4 km E Swauk Pass, 1,415 m, 10 August 1978, 1 male, 4 females; King Co., Summit, Stevens Pass, R13E T26N Sec 14, 22 August 1979, *Abies amabilis*, 5 males, 3 females; Okanogan Co., Washington Pass Mdw., 1,662 m, 11 August 1978, *Pinus albicaulis*, 1 male; Whatcom Co., Mt. Baker Nat. For., R9E T39N Sec 17, 7 September 1979, *Tsuga mertensiana*, 1 male, 1 female; Yakima Co., 5 km E White Pass Summit, 1,292 m, R12E T14N Sec 33 SW~, 22 August 1979, *Abies procera*, 5 females.

Tetraphleps pilosipes Kelton and Anderson

Tetraphleps pilosipes Kelton and Anderson, 1962:1307; Anderson, 1962b:1331; Kelton, 1966a:200; Kelton, 1978:28; Henry, 1988:17.

Diagnosis: Length 3.8 to 4.2 mm; head, pronotum, and scutellum black and shiny; hemelytra brown, shiny, and punctate; pubescence long and dense on pronotum, scutellum, and hemelytra. Hind tibia with long, distinct bristles. Ostiolar canal straight, slender, with narrowly rounded apex.

Habitat: *Tetraphleps pilosipes* is commonly beaten from the branches of its host trees. This species was originally described from specimens collected on *Abies lasiocarpa* in British Columbia and on *A. procera* in Oregon, and specimens without host data from Manitoba and the Yukon Territory (Kelton and Anderson, 1962; Anderson 1962b). Kelton (1966a) added *Larix laricina*, *Picea glauca* and *P. mariana*; he reported *Pinus albicaulis* and *P. contorta* in his 1978 paper.

Prey: The only positive prey information was provided by Kelton (1966a, 1978), who reported its association with the balsam woolly adelgid. Aphids of the genus *Cinara* are commonly found on *Abies procera* at the Oregon locality of Mary's Peak.

Phenology and life history: This species has been collected from early May to mid-October on Mary's Peak (1,231 m) near Corvallis, Oregon, and early May (British Columbia) to early September at Churchhill, Manitoba. Both males and females were collected in late August at Blackwall, Manning Park, British Columbia.

Distribution: Described from Blackwall, Manning Park, British Columbia, the type series also contained specimens from other localities in British Columbia, Manitoba, the Yukon Territory, and Oregon (Kelton and Anderson, 1962). Records for Alaska and Newfoundland were added by Kelton (1966a) and repeated in his 1978 publication. We add records of a disjunct population in southeastern Wyoming. The occurrence of *T. pilosipes* in Newfoundland, well removed from the main area of occurrence, is perhaps paralleled by *T. latipennis* Van Duzee.

Specimens examined: Specimens were examined from Oregon (mainly from *Abies*

spp.), Washington, and British Columbia. We include a selection of these specimens. The record of collection from *P. contorta* given by Kelton (1978) did not give a specific locality but the distribution map shows several localities in British Columbia and the Yukon Territory that fall within the range of *P. contorta*. Specimens from Site 3.1 in Wyoming from *Pinus contorta latifolia* are reported. Colorado: Grand Co., 9 km S Fraser on Hwy 40, 17 August 1980, *Abies lasiocarpa*, 1 female. Oregon: Benton Co., Mary's Peak, nr Summit prkg. lot, 1,123 m, R7W T12S Sec 21 SW~, 2 October 1979, *Abies procera*, 2 males, 2 females; same, summit mdw., 4 October 1977, *Abies procera*, 4 males, 2 females; same, summit, 23 August 1988, *Abies procera*, 1 male, 2 females, 3 nymphs; Grass Mountain, 8 km NW Alsea, R8W T13S Sec 21 SW~, 1,092 m, 17 September 1979, *Abies procera*, 6 females; same, 985 m, 14 August 1980, *Abies procera*, 1 nymph; Clackamas Co., Molalla, 1,108 m, 26 September 1977, *Abies procera*, 4 males, 31 females; Mt. Hood, 1.5 km below Timberline Lodge, 9 September 1976, 1 male. Washington: Okanogan Co., Washington Pass Mdw., 1,662 m, 11 August 1978, 2 males, 1 female; Yakima Co., 5 km E White Pass Summit, R12E T14N Sec 33 SW~, 1,292 m, 22 August 1979, *Abies procera*, 2 females. Wyoming: Albany Co., Site 3.1, 30 July 1986, *P. c. latifolia* (trees 3, 15), 1 male, 1 female.

Tetraphleps uniformis Parshley

Tetraphleps n. sp.: Slosson, 1906:326.

Tetraphleps uniformis Parshley, 1920:85, Van Duzee, 1921:143; Kelton and Anderson, 1962:1307; Kelton, 1966a:202; Kelton, 1978:31; Henry, 1988:17.

Tetraphleps furvus Van Duzee, 1921:141; Anderson, 1958:52; Kelton and Anderson, 1962:1307; Anderson, 1962b:1331; Kelton, 1966a:202; Kelton, 1978:31; Henry, 1988:17.

Tetraphleps concolor Drake, 1922:68. *Nomen nudum*.

Diagnosis: Length 3.5 to 4.2 mm; shiny, uniformly light brown with head slightly darker and hemelytra slightly paler; pubescence dense, long. Rostrum just reaching beyond anterior coxae. Lateral margins of pronotum narrowly carinate. Membrane long, pale brown, with pale area at base end along middle of each vein. Ostiolar canal with posterior margin shallowly concave, apex broadly rounded.

Habitat: Little is known about the habits of this species. The original description by Parshley (1920) did not include host information, but he speculated that it would occur on conifers. Kelton (1966a) reported it from white and black spruce (*Picea glauca* and *P. mariana*), balsam fir (*Abies balsamea*) and on *Pinus contorta latifolia* and *P. sylvestris*. We add *P. c. murrayana* and *Picea engelmanni* from Oregon.

Prey: Kelton (1966a) stated that *T. uniformis* is associated with the balsam woolly adelgid. He repeated this prey record for eastern Canada and added that it likely feeds on other aphids on other hosts (1978). This anthocorid was very abundant on several *P. c. murrayana* heavily infested with a species of *Cinara* near Sisters, Oregon. *Melancoris nigricornis*, another anthocorid, was taken in lesser numbers from the same trees.

Phenology and life history: Although locality records of this species have been published (Parshley, 1920; Kelton, 1966a), no collecting dates were included. The specimens we have examined bore dates ranging from May to September.

Distribution: Parshley (1920) described this species from a female collected on Mt. Washington, New Hampshire. Kelton (1966a) added many localities from Newfoundland west to British Columbia and the Yukon Territory in Canada and added Maine, New York, and Colorado in the United States. He also gave a map showing transcontinental distribution in Canada.

We saw some distinct differences in specimens from the Rocky Mountains of Wyoming and Colorado, especially in the shape and length of the pronotum, and length of the membrane. The color pattern of the typical specimen, rather uniformly brown, differs considerably from those of Kelton (1966) (head, pronotum and scutellum black). We have examined specimens from Colorado and Wyoming that fit the description of *T. furvus* very well. Careful study of specimens from throughout the range is likely to disclose more than a single species.

Specimens examined: Colorado: Grand Co., 8.6 km S Fraser on Hwy 40, 17 August 1980, *P. contorta latifolia*, 1 female; Gilpin Co., 3 km S Guanella Pass 3,015 m, 4 September 1991, *P. c. latifolia*, 1 female, 1 male. Oregon: Deschutes Co., Site 8, 20 August 1986, *Picea engelmanni* (10 pooled trees), 1 female; Site 10, 10 June 1986, *Abies lasiocarpa*, 1 female; Three Creeks Lake, 26 km S Sisters, 2,069 m, 14 June 1990, *P. c. murrayana*, 8 females; 7 October 1989, *P. c. murrayana*, 2 females. Wyoming: Albany Co., Site 3.1, 11 July 1986, *P. c. latifolia* (tree 19), 1 female; Site 3.1, 30 July 1986, *P. c. latifolia* (trees 3, 13, 15, 16), 5 males, 2 females; Carbon Co., Site 4.1, 17 July 1986, *P. c. latifolia* (tree 2), 1 male; Site 4.2, 11 July 1986, *P. c. latifolia* (tree 19), 2 females; Site 4.2, 12 July 1986, *P. c. latifolia* (tree 10), I-V instar nymph, Site 4.2, 17 July 1986, *P. c. latifolia* (trees 6, 11), 2 females.

Xylocoris Dufour

Xylocoris Dufour, 1831:423; Van Duzee, 1917a:290; Chu, 1969:47; Carayon, 1972a:337; 1972b:579; Péricart, 1972:210; Herring, 1976:70; Kelton, 1976a:193; Kerzhner and Elov, 1976:364; Kelton, 1977b:1017; Kelton, 1978:63; Kerzhner, 1988:771; Henry, 1988:26.

Diagnosis: Small, smooth, shiny species; both sexes may be macropterous or brachypterous. Antennal segments one and two of normal thickness, segments three and four slender, with long setae. Pronotum shiny, collar narrow, lateral margins carinate. Hemelytra punctate or smooth, with or without pubescence; membrane, when present, with four veins. Metacoxae proximate; ostiolar canal well developed, curved or angled. Males with anterior and middle tibiae with pads. Left clasper only; ovipositor well developed.

The genus *Xylocoris* contains approximately 30 described species. Although widely distributed in the world, most of the species are found in the northern temperate regions (Chu, 1969; Carayon, 1972a, b; Péricart, 1972). The type of the genus is *Xylocoris rufipennis* Dufour, a junior synonym of *Lygaeus cursitans* Fallén. Chu (1969) presented a list of world species. The genus contains four subgenera (Carayon, 1972b; Péricart, 1972). Representatives of three of the four subgenera occur in North America and twelve species are known in America north of Mexico (Henry, 1988). Three of these, including *X. cursitans*, are considered introductions into the Nearctic (Kelton, 1978; Henry, 1988).

Species of *Xylocoris* occur in quite different habitats, ranging from leaf litter, stored-

grain facilities, to subcortical environments, sometimes entering the galleries of bark beetles (Trägårdh, 1914; Sands, 1957; Southwood and Leston, 1959; Anderson, 1962b; Péricart, 1972; Kelton, 1978). Aside from the several species known to occur in stored grain, little is known about the habits of the North American *Xylocoris*. Chu (1969) provided a detailed study of *X. galactinus* (Fieber) in Japan. Papers by Arbogast (1979) and Arbogast, Flaherty, and Press (1983) provided similar information on *X. flavipes* (Reuter) and *X. sordidus* (Reuter), respectively, in North America.

The North American fauna needs careful study to clarify the status of almost all of the species, including those considered to be introductions. Because of the low vagility of brachypterous forms, for example, it is difficult to imagine their rapid dispersal in natural forests. At present, no key exists for the North American species. Kelton (1976a, 1978) provided descriptions of several species and a key to the four species found in Canada and Alaska. Chu (1969), Carayon (1972b), Péricart (1972), Kerzhner and Elov (1976), and Kerzhner (1988) provide valuable information on the Palearctic fauna.

Xylocoris californicus (Reuter)

Piezostethus californicus Reuter, 1884:600; Lethierry and Severin, 1896:239; Van Duzee, 1917a:291.

Xylocoris californicus: Van Duzee, 1916:34; 1917a:291; 1921:138; Harris and Shull, 1944:207; Anderson, 1962b:1326; Chu, 1969:18.

Xylocoris (Xylocoris) californicus: Henry, 1988:27.

Diagnosis: Macropterous. Length 3 mm. Dark brown to black, smooth, shiny. Apex of rostrum attaining middle coxae. Pronotum polished, calli indistinct, transverse impression absent. Hemelytron largely pale with inner margin of clavus and commissural margin piceus, also apex of embolium and all of cuneus except inner angle, piceus. Ostiolar canal curved, apex obtuse, ending some distance from anterior margin of metapleuron; area anterior to canal, broad and striate.

Xylocoris californicus is similar to *X. umbrinus* Van Duzee. It may be separated from the latter by the paler portions of the hemelytra (*X. umbrinus* tends to be largely brown to dark brown), and the shorter ostiolar canal with more of the evaporative area anterior to the canal than in *X. umbrinus*, where the canal is longer and approaches the anterior edge of the metapleuron. Van Duzee (1921) compared the two species.

Habitat: Little is known about the habitat of this species. The female reported here was collected from the branches of *P. c. murrayana* near Bartle, California. Since this species appears close to *X. umbrinus* Van Duzee, it is possible that some of the records for *X. californicus* actually refer to *X. umbrinus*. Van Duzee (1921) reported taking *X. californicus* at Cayton and Bryson, California, the same localities as the type series of *X. umbrinus*. He mentioned a female of *X. umbrinus* taken at Cayton under the bark of an old fir log. The only host plant information available is that of *Pinus contorta murrayana* from the specimen taken near Bartle, Siskiyou Co., California.

Prey: No information is available regarding the specific prey of this species.

Phenology and life history: Harris and Shull (1944) reported collections from July

14 to September 19 in Idaho. The female we report here was collected in late June in northern California. No information is available about its life history.

Distribution: *Xylocoris californicus* was originally described from Mariposa, Mariposa Co., California (as *Piezostethus californicus*) (Reuter, 1884). Van Duzee reported it from Utah, New Mexico and California (1917a) and from Cayton, Shasta Co., and Bryson, Monterey Co., California (1921). Harris and Shull (1944) reported the species from Hagerman and Twin Falls, Idaho. Anderson (1962b) added Merrill and Klamath Falls, Oregon.

Specimens examined: California: Siskiyou Co., 2 km E Bartle, Hwy. 89, 1,246 m, 21 June 1981, *P. c. murrayana*, 1 macropterous female.

Xylocoris cursitans (Fallén)
(Figure 11)

Lygaeus cursitans Fallén, 1807:74.

Piezostethus cursitans: Reuter, 1871:411; 1884:43; Van Duzee, 1914:14.

Xylocoris cursitans: Van Duzee, 1916:34; 1917a:291; 1921:137; Harris and Shull, 1944:207; Sands, 1957:305; Southwood and Leston, 1959:185; Anderson, 1962b: 1326; Carayon, 1972b:582, 593; Péricart, 1972:228; Kelton, 1978:68; Henry, 1988:27.

Xylocoris vicarius: Anderson, 1962b:1326.

Diagnosis: Length 1.8–2.5 mm, width 0.70–1 mm, dark red brown to black, shiny, smooth. Tip of rostrum reaching middle of mesosternum. Pronotum black, shiny, calli smooth, basal portion transversely rugose. Scutellum with basal portion smooth, apical portion rugose, a slightly elevated median carina. Hemelytra (macropterous form) smooth, shiny, with moderately long, semi-erect and dense golden pubescence; corium and clavus adjacent to corium pale, balance of wing dark brown to black; membrane pruinose, only outer vein distinct. Hemelytra of brachypterous form reduced, extending to posterior margin of abdominal segment three; membrane greatly reduced. Ostiolar canal strongly elbowed. Male clasper slender and sinuate.

Habitat: The principal habitat is beneath the bark of dead trees, both deciduous and coniferous (Trägårdh, 1914; Sands, 1957; Southwood and Leston, 1959; Anderson 1962b; Péricart, 1972; and Kelton, 1978). Rarely it has been found in granaries, leaf litter, and on plants (only macropterous forms in the latter) (Sands, 1957; Péricart, 1972). It seems most abundant under bark of trees in the early stages of decay (Southwood and Leston, 1959). Such genera as *Quercus*, *Fagus*, *Fraxinus* and *Populus* have been cited as examples of deciduous trees, while *Pinus* has been reported as the coniferous example (Sands, 1957; Anderson, 1962b; Péricart, 1972). We report its occurrence here under the bark of *P. c. contorta*.

Prey: Anderson (1962b) cited its association with dipterous larvae (likely Mycetophilidae) under bark. He was able to rear it on aphids in the laboratory. Morkrzecki (1923) reported this species feeding on *Ips typographus* Linnaeus. Péricart (1972) suggested a variety of prey, such as the larvae of many insects and other subcortical arthropods including larval Scolytidae, other beetles, thrips, and Collembola.

Phenology and life history: Anderson (1962b) reported that the number of generations per year had not been established although most life stages were present throughout most of the year. Both nymphs and adults overwinter under the bark of

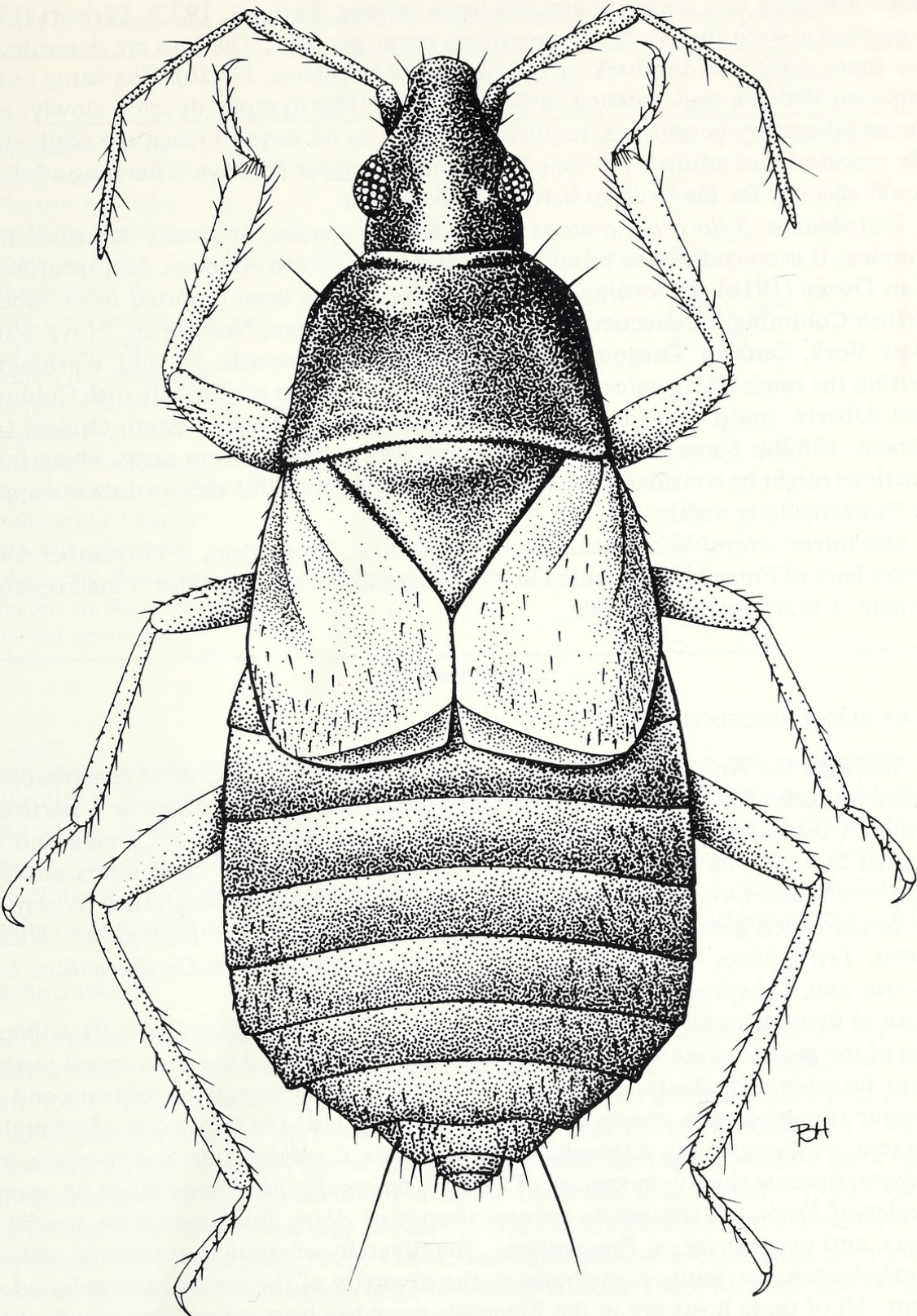


Fig. 11. *Xylocoris cursitans* (Fallén).

trees, although true diapause appears to be lacking (Péricart, 1972). Péricart (1972) suggested at least two or three generations occur per year. The eggs are deposited on the inner surface of the bark or rotten wood (Anderson, 1962b). The same author reported that the eggs hatched in 8 to 10 days. The nymphs develop slowly, even under laboratory conditions, requiring from 58 to 62 days to reach the adult stage. He reported that adults were long lived, one living for 80 days. This long adult life could account for the overlap between generations.

Distribution: *Xylocoris cursitans* is a Palearctic species, originally described from Sweden. It is considered to be an introduction into North America, first recorded by Van Duzee (1916). According to Henry (1988), it has been reported from Alberta, British Columbia, Connecticut, Idaho, Indiana, Michigan, New Jersey, Nova Scotia, New York, Ontario, Oregon, and Quebec. To these records, we add Washington. Within the range of *P. contorta*, the species is known from southern British Columbia and Alberta, south into Idaho, western Washington, through western Oregon (Anderson, 1962b). Some of these localities are well removed from areas where introductions might be considered reasonable, especially since this species does not appear to be particularly vagile.

Specimens examined: Washington: Kitsap Co., Bremerton, 2 November 1974, under bark of *Pinus contorta* killed in 1972; abandoned by Scolytidae, 1 macropterous female, 1 brachypterous female.

DISCUSSION

HOST PLANT ASSOCIATION

Although the Anthocoridae are primarily predaceous, some show remarkable fidelity to particular plants at various taxonomic levels (i.e., conifers or a particular genus of plants). Of the 28 genera of Anthocoridae known from Canada and the United States, 8 have some or all of their species occurring on conifers and two (*Anthocoris* and *Orius*) are occasionally found on conifers, although they live chiefly on broad-leaved plants. Five of the eight genera (*Acompocoris*, *Elatophilus*, *Melanocoris*, *Tetraphleps*, and *Scoloposcelis*) occur only on conifers. *Cardiastethus*, *Lycotocoris*, and *Xylocoris* occur on non-coniferous trees as well.

All of the species reported in this paper were taken on conifers (Table 2), although two of the genera (*Anthocoris* and *Orius*) should be regarded more as casual visitors from broad-leaved plants. They are, however, broadly foraging predators and do become involved with insects on *Pinus contorta* (Reid, 1957). Species of several of the genera (*Acompocoris*, *Elatophilus*, *Melanocoris*, *Cardiastethus*, *Scoloposcelis*, and *Xylocoris*) occur chiefly on species of *Pinus*. Ten species have been taken on several species of *Picea*, six species on several species of *Abies*, four species on species of *Larix*, and two species on *Pseudotsuga*. The diversity of coniferous hosts in western North America certainly contributes to the diversity of the Anthocoridae found on them. All of these hosts are in the Pinaceae; none has been taken from plants of the family Cupressaceae. Specimens of *Dufouriella ater* (Dufour) were taken from *Juniperus occidentalis* near Sisters, Oregon, but this species was not taken from *Pinus contorta murrayana* or *P. ponderosa* occurring in the immediate vicinity. Several of the taxa, notably *Melanocoris longirostris*, all five species of *Tetraphleps*, and *Scoloposcelis flavicornis*, show wide host plant associations. How many of these represent

Table 2. Occurrence of Anthocoridae on different subspecies of *Pinus contorta*.

	<i>Pinus contorta contorta</i>	<i>Pinus contorta murrayana</i>	<i>Pinus contorta latifolia</i>
<i>Acompocoris lepidus</i>		OR	BC, YT, COLO, WY
<i>Anthocoris antevolens</i>	BC		
<i>Anthocoris musculus</i>			ALB
<i>Elatophilus dimidiatus</i>		CA, OR	
<i>Elatophilus pullus</i>	WA		WY
<i>Elatophilus</i> sp. A		CA, OR	
<i>Melanocoris longirostris</i>		CA, OR	COLO, WY
<i>Melanocoris nigricornis</i>		CA, OR, MEX	BC, WY
<i>Tetrableps canadensis</i>	OR		
<i>Tetrableps latipennis</i>		OR	BC
<i>Tetrableps pilosipes</i>			BC, WY
<i>Tetrableps uniformis</i>		OR	COLO, WY
<i>Orius tristicolor</i>		OR, MEX	
<i>Cardiastethus borealis</i>			OR
<i>Lyctocoris tuberosus</i>		OR	BC
<i>Scoloposcelis flavicornis</i>	WA	OR	MT
<i>Xylocoris californicus</i>		CA	
<i>Xylocoris cursitans</i>	WA		

hosts upon which the insects breed rather than “sitting” records remains to be determined. The capability to identify immature individuals to species would be of great value. It does appear that greater host plant breadth occurs in the northern regions (i.e., Canada and northern United States) but that may be an artifact of collecting or the dominance of conifers over broad-leaved trees in the same area. Again, close attention to the occurrence of immature stages should clarify this matter.

FEEDING HABITS

The Anthocoridae are generally regarded as predaceous, although there is ample evidence that some plant feeding occurs in some species (e.g., Dicke and Jarvis, 1962; Chu, 1969; Bachelor and Baranowski, 1975). Members of this family are part of the guild of predators found on a variety of plants (Carayon, 1961; Anderson, 1962b; Péricart, 1972; Evans, 1976a, b, c, d), but detailed biological studies have been confined largely to species occurring in agroecosystems (e.g., Collyer, 1953; Sands, 1957; Carayon, 1961; Anderson, 1962a, b; Chu, 1969; Evans, 1976a, b, c, d; Ryerson and Stone, 1979; Arbogast, 1979, 1984). Some predaceous species have been introduced as biological control agents (e.g., Davis and Krauss, 1963; Mitchell and Wright, 1967; Harris, Holms, and Dawson, 1968).

Less information is available on the genera and species found on conifers, and much of it is contained in taxonomic papers or those dealing with collections of insects from different localities or from different hosts. Some have well-defined feeding habits that suggest prey specificity, a phenomenon also noticed in some other insect predators (Thompson, 1951).

Generalist Feeders

The genus *Anthocoris* contains many species that feed on a variety of prey, usually scaled to their size (Carayon, 1961; Evans, 1976a). They forage over the surface of trees, and, to a lesser extent, shrubs for aphids, scales, young lepidopterous larvae, thrips, mites, and other small arthropods. *Orius* contains several very small species that occur on many different plants, including a variety of forbs and grasses. Both genera are normally found on deciduous plants but *Anthocoris antevolans* and *A. musculus*, and *Orius tristicolor* were taken on *Pinus contorta* (Evans, 1983; Reid, 1957; this study). The genus *Tetraphleps* is a coniferous analogue of *Anthocoris*, but it seems more specific in its feeding habits—chiefly Homoptera, and especially aphids (Péricart, 1972).

Lyctocoris beneficus (Hiura), a species similar to *L. campestris*, occurs in Japan and Korea (Chu, 1969). Chu (1969) provided a detailed study of this species and *Xylocoris galactinus* (Fieber). While both species were primarily predaceous, they were able to survive for short periods feeding on moldy grain. Reproduction did not occur when restricted to such food.

Specialist Feeders

Aphids: Anthocorids that feed on aphids are surface dwellers. This group contains the generalist feeders (*Anthocoris* and *Orius*); but it also contains three genera (*Acompocoris*, *Melanocoris*, and *Tetraphleps*) that appear to feed chiefly upon aphids. According to Péricart (1972), *Acompocoris pygmaeus* feeds on *Cinara pinicola* Kaltendbach and *Schizolachnus pineti* Fabricius in Europe. *Acompocoris lepidus* occurs on *Pinus contorta murrayana* in North America, together with the aphids *Cinara* spp. and *Essigella* spp. Footitt and Mackauer (1990) provide information on populations of *Cinara nigra* (Wilson), a widely distributed species found on *Pinus contorta*.

Melanocoris nigricornis has been taken in association with the aphids *Cinara* sp., *Essigella fusca* and the pine needle scale, *Phenacaspis pinifoliae* (Anderson, 1962b). Both genera of aphids were taken in our collections.

The balsam woolly adelgid, *Adelges piceae*, is a major pest of the true firs (*Abies* spp.) in boreal North America. A native of Europe, it was first recorded from North America in 1908 from Maine (Drooz, 1985). Today, it occurs in the eastern and far western parts of Canada and the United States (Furniss and Carolin, 1977; Footitt and Mackauer, 1983). *Acompocoris lepidus* is reported to feed on this insect in the central Cascade Mountains of Oregon (Mitchell, 1962). Several native species of *Tetraphleps* have been reported occurring with the aphid, including *T. canadensis* (Kelton, 1966a, 1978), *T. latipennis* (Kelton, 1966a, 1978; Harris, Holms, and Dawson, 1968; Furniss and Carolin, 1977), and *T. uniformis* (Kelton, 1966a, 1978).

Bark beetles: A number of genera and species of Anthocoridae are found associated with bark beetles (Coleoptera: Scolytidae). These bugs are generally found in the galleries where they feed upon the eggs and larvae of the beetles.

Although not usually regarded as a conifer inhabitant, *Anthocoris musculus* (Say) has been recorded as an egg predator of *Ips* bark beetles on lodgepole pine by Reid (1957). Kline and Rudinsky (1964), Furniss and Carolin (1977), and Dahlsten (1982) reported *Lyctocoris* sp. or spp. from bark beetle galleries. Fronk (1947) reported *L. elongatus* (Reuter) as a predator of the southern pine beetle, *Dendroctonus frontalis*

Zimmerman, as did Dixon and Payne (1979), Mosier, Thatcher, and Pickard (1971), Berisford (1980), and Goyer, Lenhart, Nebeker, and Schmitt (1985). Moore (1972) and Berisford (1980) also recorded *L. campestris* (F.) feeding on the same beetle. Kelton (1967) reported *L. tuberosus* Kelton and Anderson as an associate of *Ips* spp. found on several hosts, including *P. contorta*. He (Kelton, 1967) also reported *L. mexicanus* Kelton in association with the bark beetles *Ips* and *Dendroctonus* spp., the weevils *Cossonus* spp., and the buprestids *Chrysobothris* spp.

Carayon (1953a) provided a detailed study of *Scoloposcelis obscurella* (Zett.) in France, where the bug feeds upon the larvae of several species of Scolytidae. In North America, Drake (1922) reported *Scoloposcelis flavicornis* Reuter (as *Anthocoris* sp.) from the galleries of a number of bark and ambrosia beetles in New York. Drake and Harris (1926) described several species of *Scoloposcelis*, including *S. mississippiensis*, taken from the burrows of bark beetles on long-leaf pine. Mosier, Thatcher, and Pickard (1971) reported this species as an associate of the southern pine beetle, *Dendroctonus frontalis* Zimmermann, as did Moore (1972), Dixon and Payne (1979), Berisford (1980) and Goyer, Lenhart, Nebeker, and Schmitt (1985). Dahlsten (1970) recorded a species of *Scoloposcelis* (likely *S. flavicornis*) from *Pinus ponderosa* bark disks infested with *Dendroctonus brevicornis* LeConte. Ohmart (1981) reported *S. flavicornis* from the foliage of *Pinus radiata* D. Don, and from the brood galleries of *Ips paraconfusus* Lanier. Dahlsten (1982) found *Scoloposcelis* spp. common in adult and egg galleries of bark beetles. He pointed out the problems predators face in coping with the clumped distribution of their prey and that they may locate them by chance encounters; however, Borden (1982), citing Dixon and Payne (1979), reported a species of *Scoloposcelis* that was attracted to the aggregation pheromones of Scolytidae.

Xylocoris cursitans (Fallén) is common under bark. According to Chu (1969), Trägårdh (1914) was the first to report it as a predator of bark beetle larvae. He also cited Morkrzecki's (1923) record of *X. cursitans* feeding on *Ips typographus* Linnaeus in Europe.

Bark-lice: *Cardiastethus fasciiventris* (Garbiglietti), a European species, is reported to feed on Psocoptera (Péricart, 1972), but no specific prey data have been given for *C. borealis* Kelton, our only North American species found on conifers. *Cardiastethus borealis* has been found on *Pinus ponderosa*, *P. banksiana*, and *P. sylvestris* (Kelton, 1978) and report it here on *P. contorta latifolia* in central Oregon. Psocoptera are usually abundant on most of these species of pines, and thus, potentially available as prey.

Mites: In Europe, *Brachysteles parvicornis* (Costa), reported recently from North America by Asquith and Lattin (1990), feeds on members of the mite suborder Oribatida in Europe (Carayon, cited in Péricart, 1972). Specimens were collected in Maine and Massachusetts, on *Picea glauca* (Moench) Voss and *Pinus rigida* Miller, in association with the cosmopolitan oribatid *Humerobates rostromellatus* Grandjean (Family Ceratozetidae) (Lattin and Asquith, 1991).

Needle miners: Struble (1967) reported occasional predation on the lodgepole needle miner, *Coleotechnites milleri* (Busck) (Lepidoptera: Gelechiidae) on *Pinus contorta murrayana* by an unidentified species of Anthocoridae in Yosemite National Park, California.

Scale insects: Anderson (1958) associated *Elatophilus pullus* (as *Elatophilus* sp. b.)

and *Melanocoris nigricornis* (Anderson, 1962b) with the pine needle scale, *Chionapis* (*Phenacaspis*) *pinifoliae*. Species of the genus *Elatophilus* feed primarily on various Coccidoidea, chiefly species of the scale genus *Matsucoccus* (Homoptera: Magarodidae) (Biliotti and Riom, 1967; Cobben and Arnaud, 1969; Drooz, 1985; Mendel, Carmi, and Podoler, 1991). Lussier (1965) provided a detailed study of *Elatophilus inimica* preying on red pine scale, *Matsucoccus resinosae*. Although there is at least one species of *Matsucoccus* and several species of *Elatophilus* on lodgepole pine, no direct feeding observations have yet been made.

Subcortical insects: The flattened shape of Anthocoridae makes them well adapted for preying on insects under bark (Hamilton, 1978). Some species of *Elatophilus* are known to feed on scales in the genus *Matsucoccus* (Lussier, 1965; Mendel, Carmi and Podoler, 1991). *Lyctocoris campestris* (F.) has been taken under bark (Anderson, 1962b), as have other species of *Lyctocoris* (e.g., Kelton, 1967; Goyer, Lenhart, Nebeker, and Schmitt, 1985). *Scoloposcelis flavicornis* Reuter is a subcortical species that also enters bark beetle burrows (e.g., Drake, 1922; Mosier, Thatcher, and Pickart, 1971; Goyer, Lenhart, Nebeker, and Schmitt, 1985). *Xylocoris cursitans* is commonly collected under the bark of dead trees (e.g., Trägårdh, 1914; Anderson, 1962b; Péricart, 1972; Kelton, 1978). One from the type series of *Xylocoris umbrinus* was collected under the bark of an old fir log (Van Duzee, 1921). Many other species of *Xylocoris* are found in leaf litter (e.g., Anderson, 1962b; Carayon, 1972b; Péricart, 1972; Kerzhner and Elov, 1976; Kelton, 1976a).

INTRODUCTIONS

At least twelve species of Anthocoridae have been introduced into North America either accidentally [(e.g., *Acompocoris pygmaeus* (Fallén), *Brachysteles parvicornis* (Costa), and *Orius minutus* (Linneaus)] or deliberately [e.g., *Anthocoris nemoralis* (Fabricius)]; none has yet been taken on *Pinus contorta* (Anderson, 1962b; McMullen and Jong, 1967; Kelton, 1978; Henry, 1988; Lattin, Asquith, and Booth, 1989; Asquith and Lattin, 1990; Lattin and Asquith, 1991). At least four species are conifer associates (e.g., *Acompocoris pygmaeus*, two species of *Tetrphleps* and *Brachysteles parvicornis*), while the others are found on broad-leaved hosts, in litter, or in stored-grain facilities. *Tetrphleps abdulghanii* Ghauri and *T. raoi* Ghauri have been introduced into North America from Pakistan and India, respectively, as predators of the balsam woolly adelgid, a pest of true firs (Ghauri, 1964; Mitchell and Wright, 1967; Harris, Holms and Dawson, 1968), but apparently they have not become established (L. M. Humble and R. G. Mitchell, pers. comm., March, 1990). *Xylocoris cursitans* (Fallén), found on *P. contorta*, may be naturally Holarctic, rather than an introduction; it occupies essentially the same habitat in both hemispheres—the galleries of beetles, usually Scolytidae, beneath the bark of both coniferous and deciduous trees. *Xylocoris galactinus* (Fieber), found chiefly in organic litter and stored grain, sometimes under bark, may be an introduction rather than a naturally Holarctic species.

Two species, *A. confusus* Reuter and *A. nemoralis* (Fabricius), have been introduced accidentally from Europe. The latter species subsequently was introduced into southern British Columbia from Switzerland in 1963 as a potential biological control agent for the pear psylla (McMullen and Jong, 1967; McMullen, 1971; Fields and Beirne, 1973). This species seems to have adapted to orchards in the Pacific Northwest.

Much less is known about *A. confusus*, but its range has been expanding (Kelton, 1978; Scudder, 1986).

WING POLYMORPHISM

In the Anthocoridae wing reduction is usually correlated with cryptic habits; under and within cracks and crevices of bark; and, to a lesser extent, within the litter layer. Wing reduction, either by brachyptery or microptery, occurs in a number of genera of Anthocoridae (Péricart, 1972; Kelton, 1978), including several collected during this study (*Anthocoris*, *Elatophilus*, and *Xylocoris*). Brachyptery is more common than microptery (Péricart, 1972). While wing modification may occur in both sexes, it is most common in females. Psocoptera show a similar trend (Thornton, 1985).

Hamilton (1978) considered the subcortical habitat to have been of considerable evolutionary importance in the insects. He included examples of several genera of Anthocoridae (*Xylocoris* and *Anthocoris*) in his discussions; representatives of both of these genera have been collected from *P. contorta*.

The reduction of wing size and development, accompanied by the loss of flight, is often associated with some degree of habitat stability (Usinger, 1950; Southwood, 1961, 1962; Hamilton and May, 1977; Slater, 1977; Hamilton, 1978; Denno and Grissell, 1979; Greenwood, 1988; Roff, 1990). Insects with reduced wings, or lacking wings entirely, are found frequently on large bodies of water, including the oceans (e.g., *Halobates*), in the ground or in the litter layer, as ectoparasites, and under bark. In contrast, insects with high flight activity are normally associated with temporary habitats (Southwood, 1960).

Wing reduction in the Heteroptera sometimes results in fewer nymphal instars during development. Stys and Davidova-Vilímová (1989) reviewed unusual numbers of instars in the Heteroptera and, citing Péricart (1972) for *Temnostethus gracilis* Horváth, suggested that Anthocoridae displaying wing reduction may have a reduced number of developmental stages.

We collected three brachypterous females of *Elatophilus dimidiatus* (Van Duzee) from the branches of *P. contorta murrayana* outside of Lassen National Park in Tehama Co., California. Another series of specimens was collected above Big Bear Lake, San Bernardino Co., California, on the same host; the four males were macropterous and the 12 females were brachypterous. We also collected a brachypterous male and brachypterous females of an undescribed species of *Elatophilus* from *Pinus ponderosa* near Sisters, Oregon. The genus *Elatophilus* had been regarded as always macropterous (Péricart, 1972; Kelton, 1976b, 1978), but see our discussion under *E. dimidiatus*. A brachypterous female of *Xylocoris cursitans* (Fallén) was taken under the bark of *P. c. contorta* killed by Scolytidae at Bremerton, Washington; a macropterous female was collected at the same time. Kelton (1978) found *X. cursitans* in Canada under the bark of dead trees, both coniferous and deciduous. Both sexes occur in the macropterous and brachypterous state in Europe and North America. Two additional species, *X. galactinus* (Fieber) and *X. umbrinus* (Van Duzee), are known to occur under the bark of trees in North America, but neither has yet been collected from *P. contorta*. *Xylocoris galactinus* is only known in the macropterous state, while both sexes of *X. umbrinus* occur in the macropterous and brachypterous state.

It is interesting that brachypterous males and females have ocelli. Many taxa in the Heteroptera lose their ocelli when the wings are reduced (e.g., Lygaeidae). According to Péricart (1972), brachypterous females in the family Microphysidae lack ocelli, or else they are vestigial, and the strongly brachypterous Cimicidae lack ocelli in both sexes. However, Péricart (1972) reported that the brachypterous *Xylocoris thomsoni* (Reuter) was the only brachypterous anthocorid lacking ocelli known from the western Palearctic Region.

RESEARCH NEEDS

This is an interesting family of insects about which we know relatively little. Most species are predators of small insects and other arthropods, including such pests as the balsam woolly adelgid, some scale insects and bark beetles. The various genera and species often show specific host plant and habitat preference, the details of which are largely unknown. Biological and ecological studies of most species would be useful. Our knowledge of the distribution of nearly all species is fragmentary at best with much additional collecting needed. Generic revisions are needed to allow accurate identification of the various taxa, including consideration of species variation throughout their range. Sands (1957), Anderson (1958), and Péricart (1972) have shown that eggs and nymphs can be recognized, often to species, thus encouraging further work with these stages. Finally, a well-illustrated and updated key to the genera of the Anthocoridae of North America would be of value.

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