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CACOPSYLLA PEREGRINA (FOERSTER) (STERNORRHYNCHA: PSYLLOIDEA: PSYLLIDAE): FIRST U.S. RECORDS OF AN OLD WORLD SPECIALIST ON HAWTHORNS (*CRATAEGUS* SPP.)

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Abstract.—Known previously from British Columbia, Canada, the Palearctic *Cacopsylla peregrina* (Foerster) is reported from California, Oregon, and Washington as the first U.S. records for this psyllid. Detected in 1999 in Washington on English hawthorn (*Crataegus monogyna* Jacq.), which has been introduced and planted as an ornamental in North America, *C. peregrina* is thought to have been accidentally introduced with hawthorn nursery stock from Europe. A brief taxonomic description of the adult and this psyllid's Old World distribution and bionomics are provided.

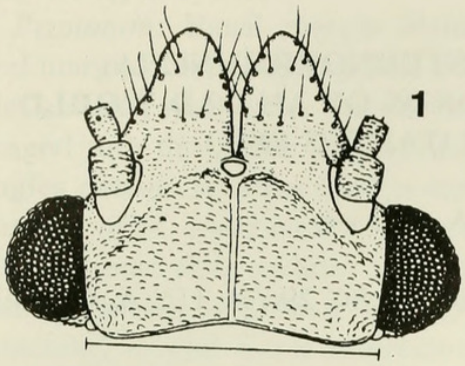
Key Words: insect detection, distribution, adventive species, psyllids

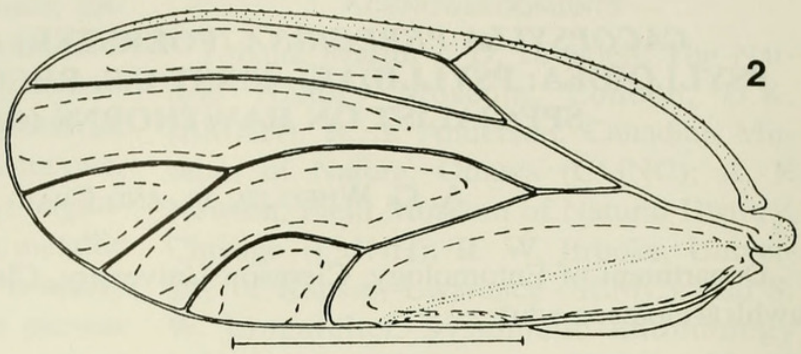
Psyllids of the genus *Cacopsylla* Ossiannilsson are among the more abundant herbivores on European hawthorns (*Crataegus* spp.; Rosaceae) (Novak and Achtziger 1995). The North American psyllid fauna contains more than 20 adventive species (Hodkinson 1980, 1988; Wheeler and Hoebeke 1997), including one of the common European hawthorn feeders. *Cacopsylla peregrina* (Foerster) was listed from British Columbia in the recently published checklist of Canadian Hemiptera (Maw et al. 2000).

Herein, we provide the first U.S. records of *C. peregrina,* which was collected on hawthorn (*Crataegus* spp.) in the Pacific Northwest (Washington State) in 1999 and 2000, and make available the collection data for the previous British Columbian records. This psyllid also was detected in a nursery in California in 2000 and is established in Oregon (see Distribution). Also included are a brief description of the adult, including illustrations of the male and female terminalia, to facilitate recognition of *C. peregrina* in the New World, and a summary of this psyllid's Palearctic distribution and bionomics.

Cacopsylla peregrina (Foerster)

Hawthorn-feeding psyllids historically were placed in *Psylla sensu lato,* a heterogeneous assemblage of species that did not form a monophyletic group. Many species formerly placed in *Psylla s.l.,* including those found on hawthorn, are not congeneric with the type species *P. alni* (L.). Ossiannilsson (1970), on the basis of nymphal characters, recognized *Cacopsylla* as one of five subgenera of *Psylla;* Klimaszewski (1972) elevated *Cacopsylla* (and other subgenera of *Psylla s.l.*) to generic status. The Holarctic genus *Cacopsylla* (*sensu* Hodkinson 1980, Burckhardt 1987; cf. Loginova 1978, White and Hodkinson 1985) comprises more than 100, mainly north temperate, species. Several species of *Cacopsylla* are naturally Holarctic, and several *Salix* feeders are considered Palearctic-Nearctic species pairs (Hodkinson 1980).





Figs. 1–2. *Cacopsylla peregrina.* 1, Head of female, frontal aspect. 2, Left forewing of male. Scale line for Fig. 1 = 0.5 mm; for Fig. 2 = 1.0 mm (from Ossiannilsson 1992: 130).

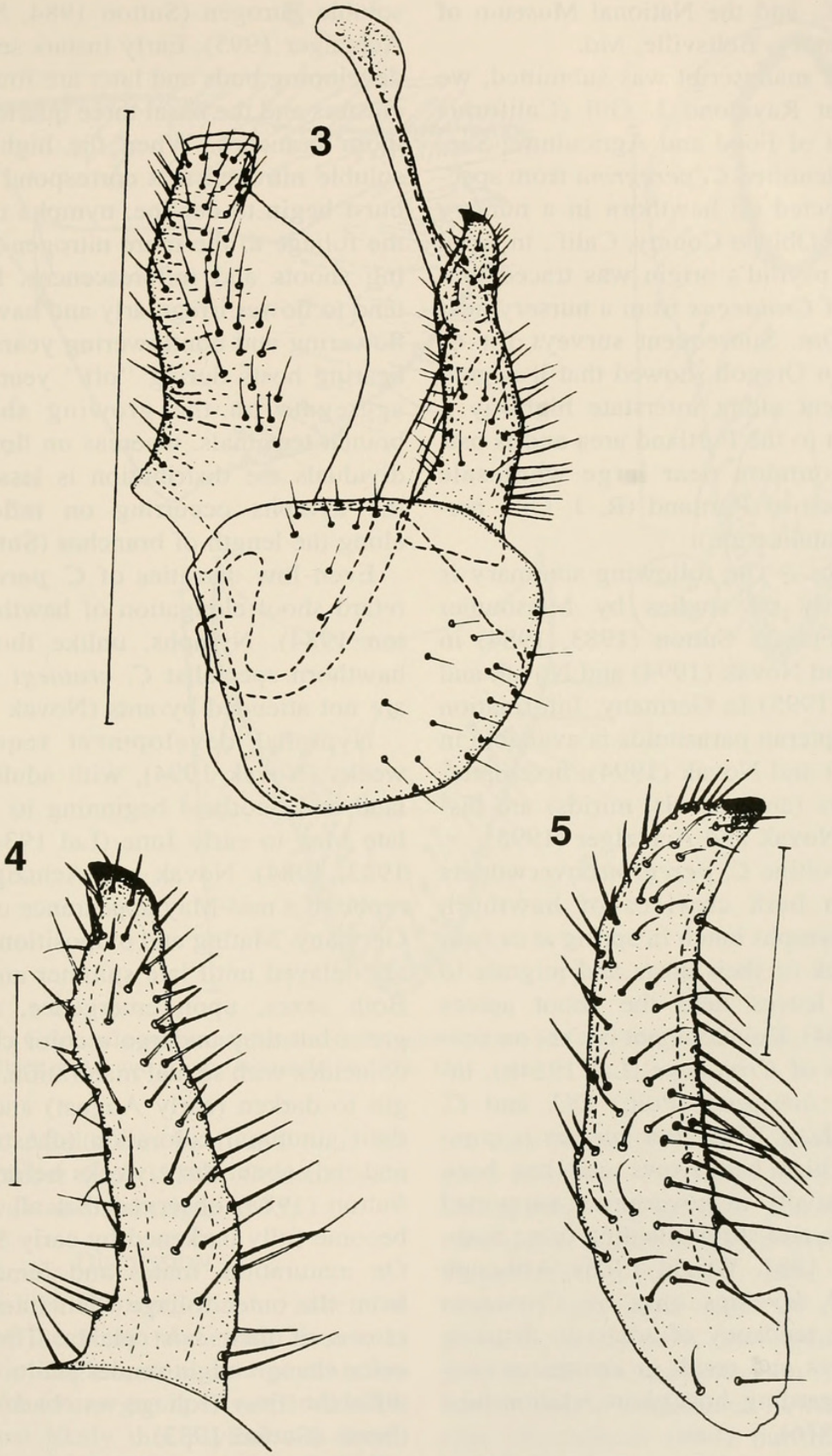
Recognition.—Adults of *C. peregrina* resemble those of the apple sucker, *C. mali* (Schmidberger). *Cacopsylla peregrina* was once considered a race of *C. mali* (Lal 1934b) and has been misidentified as *C. mali* (e.g., Ing 1971); for a list of misidentifications of *C. peregrina,* the reader is referred to Lauterer (1976) and Hodkinson and White (1979).

The following brief description of the adult is based on Loginova (1964), Hodkinson and White (1979), and Ossiannilsson (1992). All measurements are in millimeters.

General coloration bright green (spring, summer), becoming chestnut brown and red with sexual maturity (autumn; see also Bionomics). Overall length of male 2.76–3.52; female 3.10–3.57. Shape and surface structure of head as in Fig. 1; genal cones conical, not longer than vertex, not slender and tapering at apex (Fig. 1); vertex more than half as long as broad, convex anteriorly, in profile forming shallow curve with genal cones. Wing length 2.38–2.76 in male, 2.45–2.94 in female; length of hind wing 0.68–0.82 in male, 0.72–0.84 in female. Forewing (Fig. 2) clear, apex narrowly rounded; veins yellow; pterostigma long; basal width: height ratio of cell cu_1 of forewing = 1.39–1.71. Male terminalia as in Fig. 3; paramere in lateral view long and slender with a small, slender, curved tooth apically (Figs. 3–5). Female terminalia as in Figs. 6–8.

The egg is illustrated by Ossiannilsson (1992). White and Hodkinson (1982) and Ossiannilsson (1992) described the fifth-instar nymph (see also Lal 1934b, 1937; Ossiannilsson 1970).

Distribution.—*Palearctic:* Common throughout Britain and most of continental Europe, ranging east to Japan (Klimaszewski 1973, Hodkinson and White 1979, Ossiannilsson 1992). *Nearctic:* CANADA: British Columbia: Victoria, 22 May 1992, 4 June 1993, Canadian Forest Service, Pacific Forestry Centre [Forest Insect & Disease Survey 92-0021-02, 93-0127-02], ex *Crataegus monogyna.* UNITED STATES: Washington: King Co., University of Washington, Seattle (47°39.5′N, 122°17.9W), 10 June 2000, A. G. Wheeler, Jr. and C. A. Stoops, ex *Crataegus x media* (11 ♀, 12 ♂); Kitsap Co., Poulsbo (47°45′N, 122°39′W), 11 Sept. 1999, A. G. Wheeler, Jr. and C. A. Stoops, ex *Crataegus monogyna* (20 ♀, 8 ♂); Skagit Co., Hawthorne Memorial Park, College Way, Mount Vernon (48°26.2′N, 122°19.1′W), 8 June 2000, A. G. Wheeler, Jr. and C. A. Stoops, ex *Crataegus x media* (9 ♀, 10 ♂); Thurston Co., nr. Capitol, Olympia (47°02.1′N, 122°54.2′W), 9 June 2000, A. G. Wheeler, Jr. and C. A. Stoops, ex *Crataegus x media* (5 ♀, 3 ♂); Whatcom Co., Western Washington University, Bellingham (48°44.2′N, 122°29.3′W), 8 June 2000, A. G. Wheeler, Jr. and C. A. Stoops, ex *Crataegus* sp. (3 ♀, 2 ♂). Voucher specimens are deposited in the Cornell University Insect Collection,



Figs. 3–5. *Cacopsylla peregrina,* male. 3, Terminalia, from left. 4, Left paramere, from left. 5, Left paramere, from behind. Scale line for Fig. 3 = 0.5 mm; for Figs. 4–5 = 0.1 mm (from Ossiannilsson 1992: 130).

Ithaca, N.Y., and the National Museum of Natural History, Beltsville, Md.

After our manuscript was submitted, we learned that Raymond J. Gill (California Department of Food and Agriculture, Sacramento) identified *C. peregrina* from specimens collected on hawthorn in a nursery in San Luis Obispo County, Calif., in April 2000. The psyllid's origin was traced to a shipment of *Crataegus* from a nursery near Portland, Ore. Subsequent surveys for *C. peregrina* in Oregon showed that it is generally present along interstate highway 5 from Salem to the Portland area and is particularly common near large wholesale nurseries east of Portland (R. J. Gill, personal communication).

Bionomics.—The following summary is based mostly on studies by Missonnier (1956) in France, Sutton (1983, 1984) in England, and Novak (1994) and Novak and Achtziger (1995) in Germany. Information on hymenopteran parasitoids is available in Lal (1934a) and Novak (1994); heteropteran predators (anthocorids, mirids) are discussed by Novak and Achtziger (1995).

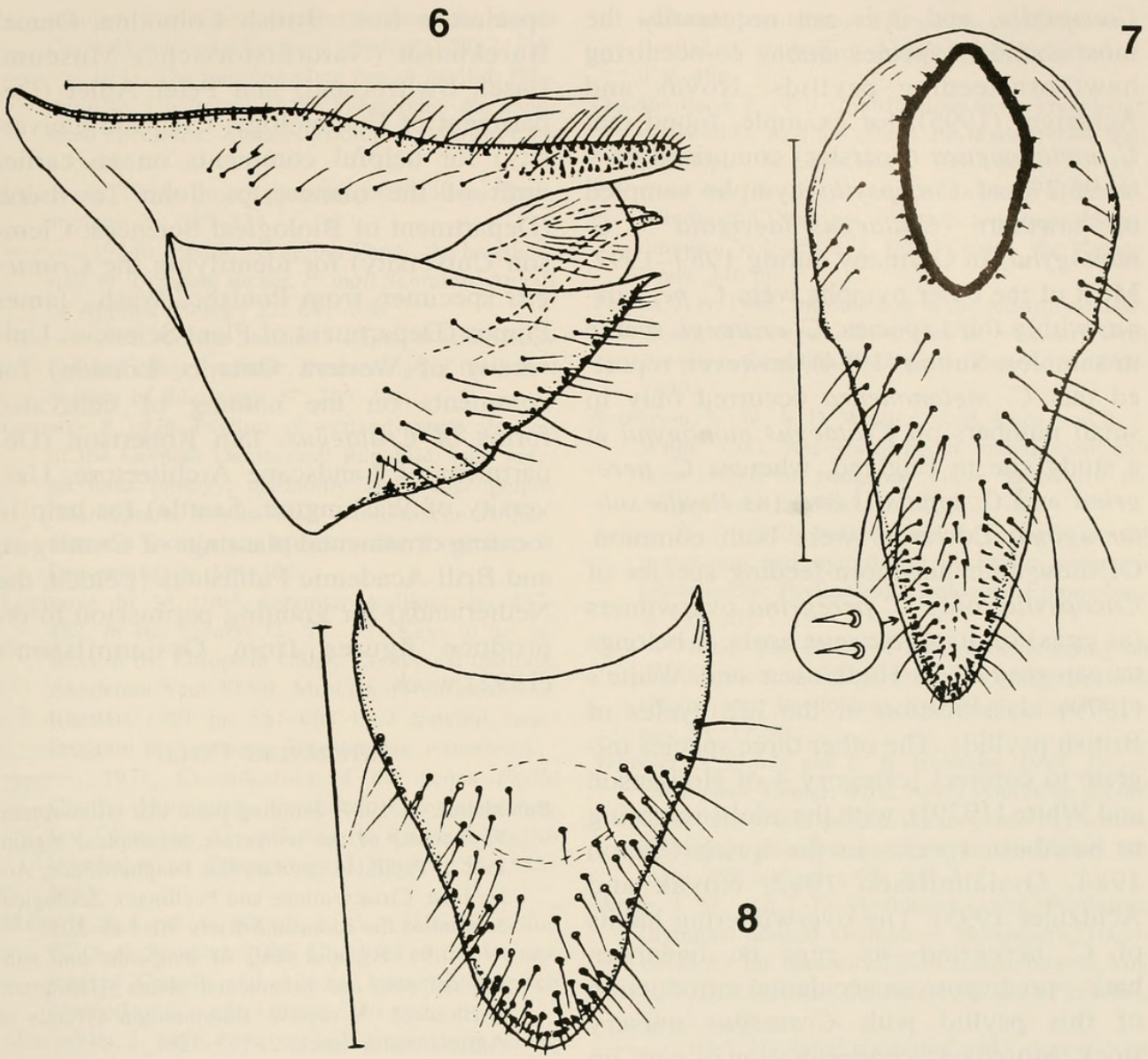
The univoltine *C. peregrina* overwinters as eggs in bark crevices of hawthorn branches; nymphs hatch in spring at or near the budbreak of their hosts and migrate to expanding leaves near the shoot apices (Sutton 1984). Development occurs on several species of *Crataegus* (Lal 1934b), including *C. laevigata* (Poir.) DC. and *C. monogyna* Jacq. The latter species is common in British hedgerows and has been used extensively in government-supported amenity tree and shrub planting (e.g., Sotherton et al. 1981, Wright 1983). Although this psyllid develops only on *Crataegus* species, the tendency of adults to disperse to other trees can result in erroneous conclusions regarding host-plant relationships (Lauterer 1976).

As phloem specialists, nymphs of *C. peregrina* feed on a low-nitrogen resource. Consequently, the feeding sites and synchronization with host phenology reflect this psyllid's need to maximize the levels of soluble nitrogen (Sutton 1984, Novak and Achtziger 1995). Early instars settle on the developing buds and later are found on leaf clusters and the basal three quarters of hawthorn branches. When the high levels of soluble nitrogen that correspond with budburst begin to decline, nymphs move from the foliage to the more nitrogen-rich growing shoots and inflorescences. Hawthorns tend to flower irregularly and have alternate flowering and nonflowering years. On nonbearing hosts during "off" years, nymphs aggregate on the growing shoots near branch terminals, whereas on flowering individuals the distribution is less clumped, the nymphs occurring on inflorescences along the length of branches (Sutton 1984).

Even low densities of *C. peregrina* can retard shoot elongation of hawthorns (Sutton 1984). Nymphs, unlike those of the hawthorn specialist *C. crataegi* (Schrank), are not attended by ants (Novak 1994).

Nymphal development requires 4–5 weeks (Novak 1994), with adults in England and Scotland beginning to emerge in late May to early June (Lal 1934b; Sutton 1983, 1984). Novak and Achtziger (1995) reported a mid-May appearance of adults in Germany. Mating and oviposition, however, are delayed until late summer and autumn. Both sexes, upon emergence, are bright green but they undergo a color change that coincides with sexual maturation. Males begin to darken (early August) and to attain their autumnal coloration (chestnut brown and red) about three weeks before females. Sutton (1983) observed that all males had become fully darkened by early September. On maturation, males and females move from the outer foliage shell into the inner crown of their host plants. The seasonal color change might render adults cryptic on different sites (foliage vs. bark) on hawthorns (Sutton 1983).

In England, oviposition begins about early September, although most eggs are not laid until mid-September. Eggs are deposited singly on the bark of hawthorns, especially toward the base of branches (Sut-



Figs. 6–8. *Cacopsylla peregrina,* female. 6, Terminalia, from left. 7, Proctiger, from above. 8, Subgenital plate. Scale lines = 0.5 mm (from Ossiannilsson 1992: 131).

ton 1983). Adults can be found until the end of October (Lal 1934b, Ossiannilsson 1992, Novak and Achtziger 1995).

Discussion

We consider *C. peregrina* an adventive member of the North American fauna; in the Nearctic Region, no native psyllids are known from *Crataegus* species (Hodkinson 1988). Most likely this psyllid was introduced as eggs on *C. monogyna,* the principal host plant in Washington, or on some other common European hawthorn, such as *C. laevigata.* Both hawthorn species are common in Great Britain—in North America they sometimes are referred to as English hawthorn—and they have been introduced from Europe and planted as ornamentals in North America (Everett 1981). Phipps (1998), however, noted that the records of cultivated forms of *C. laevigata* generally pertain to *C. monogyna* cv. Paul's Scarlet. *Cacopsylla peregrina* is not recorded as a pest of ornamental hawthorns in Europe (Burckhardt 1994), but this adventive psyllid is potentially injurious to *Crataegus* species in North American nurseries and landscape plantings.

In Europe, *C. peregrina* is only one of several hawthorn specialists in the genus

Cacopsylla, and it is not necessarily the most abundant species among co-occurring hawthorn-feeding psyllids. Novak and Achtziger (1995), for example, found that *C. melanoneura* (Foerster) comprised 65.9 to 95.7% of *Cacopsylla* nymphs sampled on hawthorn (*Crataegus laevigata* + *C. monogyna*) in Germany during 1989–1992. Most of the other nymphs were *C. peregrina,* with a third species, *C. crataegi,* scarce in samples. Sutton (1984), however, reported that *C. melanoneura* occurred only in small numbers on *Crataegus monogyna* at a study site in England, whereas *C. peregrina* and *C. affinis* (Löw) (as *Psylla subferruginea* Edwards) were both common. Of these four hawthorn-feeding species of *Cacopsylla,* only *C. peregrina* overwinters (as eggs) on its *Crataegus* hosts; it belongs to category 1 in Hodkinson and White's (1979) classification of the life cycles of British psyllids. The other three species migrate to conifers (category 4 of Hodkinson and White [1979]), with the adults returning to hawthorn species in the spring (Sutton 1984, Ossiannilsson 1992, Novak and Achtziger 1995). The overwintering habits of *C. peregrina*—as eggs on hawthorn bark—predispose an accidental introduction of this psyllid with *Crataegus* nursery stock. Moreover, a concentration of eggs on hawthorn branches (often >1,000–2,000/ branch [Sutton 1983]) would facilitate the psyllid's establishment in North America.

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