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Scientific Note

First report of *Pineus strobi* (Hartig, 1839) (Hemiptera: Adelgidae) in western North America

The pine bark adelgid, *Pineus strobi* (Hartig, 1839) (Hempitera: Adelgidae), is native to eastern North America and is found throughout the natural range of its main host species, eastern white pine, *Pinus strobus* L. (Pinaceae), which stretches from the Atlantic coast, west to Ontario and Minnesota (Drooz 1985). For the first time, we confirmed the presence of *P. strobi* west of this range in Washington, Colorado, and Saskatchewan by identification of contemporary samples using morphology and DNA barcodes. We also include information from existing slide-mounted specimens of *P. strobi* putatively originating from Oregon that are deposited in the United States National Museum of Natural History (NMNH) Entomology Collection. To our knowledge, this is the first published report of this species in western North America.

Pineus strobi typically reproduces parthenogenetically as sequential generations of wingless females feeding on the bark of the trunk, branches, and base of needle whorls on eastern white pine (Raske & Hodson 1964). Despite sometimes reaching very high population densities, *P. strobi* is generally not considered a pest because it does not cause serious harm to trees (Drooz 1985). The insects secrete a white, flocculent wax, which covers all life stages throughout development (Blackman & Eastop 1994, Doane 1961). Most nymphs develop to a wingless form, which continue to reproduce on white pine, thus completing an anholocylic life cycle (Raske & Hodson 1964). Some nymphs occasionally mature to a winged sexupura form, which flies to black spruce trees, *Picea mariana* (Mill.) Britton, Sterns & Poggenburg (Pinaceae), where they lay eggs on the needles. Raske & Hodson (1964) reported that the eggs laid by sexuparae hatched but failed to develop to completion. Migration from spruce back to pine, thus completing a holocycle, has not been reported.

In Washington, adults, nymphs, crawlers, and eggs of *P. strobi* were collected from western white pine, *Pinus monticola* Douglas ex. D. Don, at two locations during monthly samples from October 2015 to November 2016: Calvary Cemetery (47.1932, -122.5056) and Mt. View Cemetery (47.1797, -122.4937) in Tacoma, Pierce County. Adelgid specimens were found at the bases of needles and located by the presence of white, woolly flocculence. Herbarium voucher specimens of host trees from each location were deposited at the STAR Herbarium at Arkansas State University with accession numbers STAR033067 through STAR033070. Adelgid vouchers were deposited at the Yale Peabody Museum of Natural History (YPM) with accession numbers ENT905367 through ENT905382.

In Colorado, adults and nymphs of *P. strobi* were collected from eastern white pine growing in the Colorado State University Arboretum on 3 August 2017. Adelgids were settled on the trunk and undersides of branches of a tree with arboretum accession number 03157. Vouchers were deposited at the YPM with accession numbers ENT906562–ENT906567.

In Saskatchewan, adelgid specimens were collected on 9 June 2010 from black spruce growing on a marshy area in the village of Smeaton (53.6174, -104.7439).

Adelgids were settled under the bud scales. Vouchers were deposited in the Canadian Collection of Insects with accession number HEM070470.

In addition to using morphology of slide-mounted specimens, the adelgids were identified by comparing their DNA barcode sequences with other adelgid specimens. The DNA barcoding region of the mitochondrial COI gene was sequenced using standard methods (Foottit et al. 2009) by destructively extracting from two separate individuals per site in Washington and one individual each in Colorado and Saskatchewan. GenBank accession numbers for the COI sequences from Washington are MF572805 through MF572808, Colorado is MG652437, and Saskatchewan is JF883970. The four individuals from Washington had identical COI sequences and had 100% match (using the Kimura-2-Parameter distance model) with sequences of *P. strobi* in GenBank (searched via the Barcode of Life Database; http://www.boldsystems.org) collected in Connecticut (KR037317, EF073117), Massachusetts (FJ502638), Maine (EF073118, FJ502637), Pennsylvania (KR044444), West Virginia (KR034094, JF883951), Wisconsin (FJ502635), and Ontario (KR581164). The COI sequence from Colorado differed by one nucleotide substitution from our samples from Washington and had 100% match with a sequence of *P. strobi* collected in Quebec (KR341745). The sequence from Saskatchewan differed by one nucleotide substitution from our samples from Washington and two substitutions from our sample from Colorado. It did not match 100% any samples currently in GenBank.

In addition, there is one sample of *P. strobi* in the NMNH reported from western North America in a series of four slides with adelgids collected on "white pine" in Oregon, intercepted in Vermont on 13 April 2001 (accessions USNM ENT 00810412, 00810414 through 00810416). Unfortunately, we were not able to find more specific information about this collection beyond what is reported on the slide label.

Pineus strobi has also been reported in Europe (e.g., Marchal 1913, Hochmut 1970, Carter 1971), western Siberia (Stekolshikov & Novgorodova 2013), Mexico (Rubín-Aguirre et al. 2011), and Venezuela (Rosales & Cermeli 1993).

The records reported here are, to our knowledge, the first in the western United States and Canada outside the natural range of eastern white pine. The adelgids from Colorado were collected on an eastern white pine planted as a specimen tree in an area where this species is commonly used as an ornamental. The samples from Washington were collected from western white pine and are the first records of *P. strobi* on this host in its native range. Monitoring of *P. strobi* on western white pine in the Pacific Northwest would help assess damage that it might cause on a novel host in a novel environment. The samples that were apparently intercepted in Vermont from Oregon might also fit this scenario, but we do not know if they were collected from eastern or western white pine. The samples from Saskatchewan were collected from black spruce, the alternate host of *P. strobi*, outside of the natural ranges of both eastern and western white pines. They may have migrated there from a nearby ornamental white pine, or they could be indicative of a population of *P. strobi* that can continuously reproduce only on *Picea*, a pattern seen in some other species of adelgids (Havill & Foottit 2007) but not reported for *P. strobi*.

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