30 June 2006
PROC. ENTOMOL. SOC. WASH.
108(3), 2006, pp. 583–610

ADVENTIVE APHIDS (HEMIPTERA: APHIDIDAE) OF AMERICA NORTH OF MEXICO

ROBERT G. FOOTTIT, SUSAN E. HALBERT, GARY L. MILLER, ERIC MAW, AND LOUISE M. RUSSELL[1]

(RGF, EM) Agriculture and Agri-Food Canada, Canadian National Collection of Insects, Ottawa, ON, K1A 0C6 Canada (e-mail: foottitrg@agr.gc.ca; mawe@agr.gc.ca); (SEH) Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL 32614, U.S.A. (e-mail: halbers@doacs.state.fl.us); (GLM, LMR) Systematic Entomology Laboratory, Plant Science Institute, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, MD 20705, U.S.A. (e-mail: gmiller@sel.barc.usda.gov)

Abstract.—We provide a compilation of 262 species of aphids that are considered as adventive to North America north of Mexico. Included for each species, where applicable, is reference to: the location and date of introduction of the first North American record; pest status in North America; principal economic hosts; and biogeographical origin. Information is also provided for species whose presence in North America is considered erroneous or questionable and for those species that are considered Holarctic or Beringian.

Key Words: Aphidoidea, plant lice, plant pathogens, invasive species, biological control, quarantine, agriculture, forestry, horticulture, ornamentals, fruit trees

In an era of a global economy and commerce, the increase of adventive species represents both domestic and international concerns. If non-indigenous species become pests, the economic consequences include loss of production, diminished quality, production cost increases, flexibility decreases in production/management decisions, increased risk of human disease, and damaging environmental and aesthetic effects (Huber et al. 2002). Various insects of agricultural concern have been identified as potentially damaging if introduced or reintroduced into the United States (Huber et al. 2002).

Many aphid species have been added to the North American fauna since colonization by Europeans, and some of these have become serious pests. In addition to direct feeding damage, aphids constitute one of the largest groups of known plant-virus vectors (Chan et al. 1991). Aphids are primarily controlled through pesticide applications, adding to crop production costs, and having environmental implications associated with increased pesticide use. The effects of some non-indigenous aphids in North America have been staggering. For example, by the early 1990's, the Russian wheat aphid, *Diur-*

[1] It is noteworthy that Louise Russell, a pioneer woman entomologist and specialist in the Sternorrhyncha, continues to publish at the age of 101.

aphis noxia (Kurdjumov), was responsible for $500–900 million cumulative losses in the western U.S. (Bernal et al. 1993, Morrison and Peairs 1998). The appearance of the brown citrus aphid, *Toxoptera citricida* (Kirkaldy), in Florida in 1995 had a major impact on the U.S. citrus industry (Halbert and Brown 1996). More recently, losses related to the soybean aphid, *Aphis glycines* Matsumura, have been estimated at about $120 million in 2003 for Minnesota alone (Anonymous 2005).

The origins of this work actually began in part in the 1970's when one of us (LMR) contributed data on invasive species in the United States (e.g., Sailer 1978). Nearly 30 years later, adventive insects are still a major concern for agriculture in North America. The objectives of this paper are to: 1) list the adventive aphid species (excluding adelgids and phylloxerans) of North America and record data on first detection date (along with validation source), principal hosts, and zoogeographic area of origin; 2) analyze these data and determine if patterns exist; and 3) compare these data to other sternorrhynchan groups.

Materials and Methods

We use the term adventive species as defined by D.R. Miller et al. (2002), i.e., for those species that are non-native to North America regardless of economic harm. Other terms such as invasive, alien, exotic, and immigrant have sometimes been used interchangeably (see Wheeler and Hoebeke (2001) and Miller et al. (2005) for discussion). Using Smith and Parron's (1978) list of North American aphids as the base, we compiled a new list for North American north of Mexico. We exclude species that have been intercepted at ports-of-entry or discovered in nurseries or greenhouses and subsequently eradicated. With the exception of *Aphis chloris* Koch, a biocontrol agent for *Hypericum perforatum* (Harris 2003), no aphid species has been purposely introduced.

Geographic origins are given in general terms only, relying heavily on Blackman and Eastop (1994, 2000), supplemented by other references, as noted in Table 1, and by opinion of the authors. The origins of a few cosmopolitan species are unknown. It is not always readily apparent whether a species is adventive or native; some species we have listed as adventive may in fact be naturally Holarctic in distribution and vice versa.

For determining the earliest record of the North American adventive aphids, we relied on published records and on specimens examined in The Canadian National Collection of Insects, Nematodes and Arachnids (CNC) and the Edith Patch Collection (CNC-Patch) housed at CNC, Ottawa, ON, Canada; the MacGillivray Collection (ACNB), Agriculture and Agri-Food Canada, Fredericton, NB, Canada; The Florida State Collection of Arthropods (FSCA), Gainesville, FL, U.S.A.; and The National Entomological Collection of the National Museum of Natural History (USNM), Beltsville, MD, U.S.A. In addition, Asa Fitch's aphid species notes that are currently housed with the USNM aphid collection at Beltsville, MD, were also examined. This collection of written records and observations from the 1840's–1870's provide some of our earliest glimpses into the North American aphid fauna. While there are some questions concerning Fitch's "species concept" versus current thinking for some of his included species, there is little confusion given the morphology and associated host plants for others. His reference to the occurrence in 1791 of the cabbage aphid, *Brevicoryne brassicae* (L.) is possibly the earliest record of an adventive aphid for North America.

Nomenclature followed herein reflects that of Remaudière and Remaudière

Table 1. Introduced aphid species in Canada and continental United States of America, giving earliest record with source of record, geographic origin, pest status, and economic host species. Aphid names follow Remaudière and Remaudière (1997). Earliest records are based on literature references and on specimens in the following collections: USNM — National Museum of Natural History; CNC — Canadian National Collection of Insects, Arachnids and Nematodes; FSCA — Florida State Collection of Arthropods; ACNB — MacGillivray collection, Agriculture and Agri-Food Canada, Fredericton, NB; CNC-Patch — Edith Patch collection, housed at CNC; EMEC — Essig Museum of Entomology Collection, University of California, Berkeley.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Acyrthosiphon caraganae (Cholodkovsky)	SK, 1940 (CNC)	Palearctic	pest	*Caragana arborescens*
Acyrthosiphon kondoi Shinji	CA, 1974 (Kono 1977)	Palearctic (e Asia)	pest Halbert et al. 2000	*Medicago sativa*
Acyrthosiphon lactucae (Passerini)	MD, 1943 (USNM)	Palearctic (Europe)		*Lactuca sativa*
Acyrthosiphon malvae (Mosley) (3)	NE, 1891 (USNM)	Palearctic (Europe)		*Geranium, Pelargonium*
Acyrthosiphon pisum (Harris)	KS, 1877 (Harper et al. 1978)	Palearctic (Europe)	pest	Leguminosae, incl. *Pisum*, *Medicago*
Aloephagus myersi Essig	CA, 1939 (Essig 1950)	Afrotropical	minor pest Essig 1950, regulatory issue	*Aloe* (greenhouse)
Amphorophora ampullata Buckton	MN, 1887 (Oestland 1887)	Palearctic (Europe)		
Anoecia corni (Fabricius)	IA, 1897 (USNM)	Palearctic (Europe)		roots of Gramineae, incl. cereals
Aphidounguis mali Takahashi (4)	NC, 1999 (CNC)	Palearctic (e Asia)		
Aphis amaranthi Holman	FL, 1990 (Halbert et al. 2000)	Neotropical (Cuba)	potential pest Halbert et al. 2000	edible *Amaranthus*
Aphis callunae Theobald	BC, 1974 (Forbes and Chan 1976)	Palearctic (Europe)		
Aphis chloris Koch	BC, 1980 (Harris 2003)	Palearctic (Europe)	Released as weed biological control agent	*Hypericum perforatum*
Aphis craccae Linnaeus	BC, NB, ME, 1965 (CNC, ACNB)	Palearctic		*Vicia cracca*
Aphis craccivora Koch (5)	NE, 1890 (USNM)	Palearctic		polyphagous, with preference for legumes
Aphis cytisorum Hartig	DC, 1906 (USNM)	Palearctic (Europe)		*Cytisus scoparius*
Aphis epilobii Kaltenbach	CO, 1915 (USNM)	Palearctic (Europe)		
Aphis euphorbiae Kaltenbach (6)	CA, 1933 (USNM)	Palearctic (Europe)		
Aphis fabae Scopoli (7)	NY, 1869 (Fitch 1870 [as *A. rumicis* L.])	Palearctic (Europe)	pest	polyphagous
Aphis genistae Scopoli	MA, 1921 (USNM)	Palearctic (Europe)		
Aphis glycines Matsumura	IA, IL, IN, KY, MI, MN, MO, OH, WI, WV, 2000 (Voegtlin 2000)	Oriental and Palearctic (East Asia)	major pest Ragsdale et al. 2004	*Glycine max*
Aphis gossypii Glover	NY, 1852 (Russell 1968)	Palearctic	major pest	polyphagous

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Aphis hederae Kaltenbach	CA, 1910 (Essig 1910)	Palearctic (Europe)	minor pest	*Hedera helix*
Aphis idaei van der Goot	BC, 1951 (Forbes et al. 1973)	Palearctic (Europe)		
Aphis nasturtii Kaltenbach	NE, 1894 (USNM)	Palearctic	pest	*Solanum tuberosum*
Aphis nepetae Kaltenbach	ID, 1957 (Gittins et al. 1976)	Palearctic		
Aphis nerii Boyer de Fonscolombe	IL, 1879 (Thomas 1879)	Palearctic (e Asia)	pest	ornamentals (flowers)
Aphis polygonata (Nevsky) (8)	IL, 1977 (FSCA)	Palearctic (Central Asia)		
Aphis pomi De Geer	PA, 1844 (Haldeman 1844)	Palearctic (Europe)	pest	*Malus pumila, Pyrus communis, Cydonia oblonga*
Aphis praeterita Walker	ME, 1918 (Patch 1918)	Palearctic (Europe)		
Aphis rumicis Linnaeus (7)	Unknown (7)	Palearctic (Europe)		
Aphis salicariae Koch	ON, 1952 (CNC)	Palearctic (Europe)		
Aphis sambuci Linnaeus	NY, 1847 (Fitch notes [as *A. sambucifoliae* Fitch])	Palearctic (Europe)		
Aphis sedi Kaltenbach	ME, 1911 (Patch 1911)	Palearctic (Europe)		
Aphis spiraecola Patch	CO, 1907 (Gillette 1910)	Palearctic or Oriental	major pest	polyphagous
Aphis taraxicola (Börner) (9)	QC, 1983 (Cloutier et al. 1986)	Palearctic		
Aphis thalictri Koch	BC, 1999 (CNC)	Palearctic (Europe)		
Aphis umbrella (Börner)	NE, SD, 1891 (USNM [as *A. maliae* Koch])	Palearctic (Europe)		
Aphis urticata Gmelin	PA, 1913 (Olsen 1921)	Palearctic (Europe)		
Aphis vaccini (Börner)	BC, 2000 (CNC)	Palearctic (Europe)		
Aploneura lentisci (Passerini)	IL, 1879 (Thomas 1879 [as *Rhizobius poae* Thomas])	Palearctic (Mediterranean)		Gramineae, including *Triticum*
Asiphonella dactylonii Theobald	AZ, 1947 (USNM)	Palearctic (e Asia)	potential pest	*Cynodon dactylon*
Aspidaphis adjuvans (Walker)	CO, 1907 (Gillette 1917b)	Palearctic (Europe)		
Atarsaphis agrifoliae (Ferris)	CA, 1921 (Ferris 1921)	Palearctic (e Asia)		
Atheroides serrulatus Haliday	QC, 1966 (CNC)	Palearctic	minor pest	Gramineae, incl. cereals
Aulacorthum circumflexum (Buckton)	CO, 1907 (Gillette 1908)	Palearctic (e Asia) or Oriental	pest	polyphagous
Aulacorthum solani (Kaltenbach)	NY, 1879 (Riley and Monell 1879)	Palearctic	major pest	polyphagous
Betulaphis brevipilosa Börner	BC, 1959 (Forbes et al. 1974)	Palearctic (Europe)		

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Betulaphis helvetica Hille Ris Lambers	BC, 1926 (Glendenning 1926)	Palearctic (Europe)		
Betulaphis quadrituberculata (Kaltenbach)	BC, 1946 (ACNB)	Palearctic (Europe)		
Brachycaudus helichrysi (Kaltenbach)	OR, 1893 (USNM)	Palearctic (Europe)	major pest	*Prunus*, Compositae
Brachycaudus cardui (Linnaeus)	NY, 1887 (USNM)	Palearctic (Europe)	pest	*Prunus*, Compositae
Brachycaudus persicae (Passerini)	MD, DE, NJ, VA, MI, 1887 (Smith 1890)	Palearctic (Europe)	pest	*Prunus*
Brachycaudus rumexicolens (Patch) (10)	CT 1913 (Patch 1917)	Palearctic (Europe)		
Brachycaudus schwartzi (Börner)	CA, 1975 (Eastop 1975)	Palearctic (Europe)	pest	*Prunus persica*
Brachycaudus spiraeae (Börner)	ON, 1956 (CNC)	Palearctic		
Brachycaudus tragopogonis (Kaltenbach)	WA, 1993 (FSCA)	Palearctic		
Brachycorynella asparagi (Mordvilko)	NY, NJ, 1969 (Leonard 1970, Race 1970)	Palearctic (Europe)	locally serious pest Stoetzel 1990	*Asparagus officinalis*
Brevicoryne brassicae (Linnaeus)	NY, 1791 (Fitch notes)	Palearctic	pest	*Brassica* crops
Calaphis betulicola (Kaltenbach)	NY, 1854 (Fitch notes)	Palearctic (Europe)		
Callipterinella calliptera (Hartig)	OR, 1909 (USNM)	Palearctic (Europe)	minor pest Hajek and Dahlsten 1986	*Betula*
Callipterinella minutissima (Stroyan)	BC, 1975 (Forbes and Chan 1980)	Palearctic (Europe)	minor pest Hajek and Dahlsten 1987	*Betula*
Capitophorus carduinus (Walker)	GA, 1948 (USNM)	Palearctic (Europe)	potential weed biocontrol agent Gassmann and Kok 2002	*Cirsum*
Capitophorus elaeagni (Del Guercio)	SD, 1892 (USNM)	Palearctic (Europe)	Potential virus vector	
Capitophorus hippophaes (Walker)	DC, 1895 (USNM)	Palearctic (Europe)		
Capitophorus pakansus Hottes and Frison	IL, 1929 (Hottes and Frison 1931)	Palearctic (Europe)		
Capitophorus horni Börner	ME, 1951 (Corpuz-Raros and Cook 1974)	Palearctic (Europe)		
Cavariella aegopodii (Scopoli)	MN, 1903 (USNM)	Palearctic (Europe)	pest	*Daucus carota*
Cavariella archangelicae (Scopoli)	WA, 1953 (USNM)	Palearctic (Europe, Iceland)		
Cavariella pastinacae (Linnaeus)	NY, 1855 (Fitch notes)	Palearctic (Europe)		
Cerataphis brasiliensis (Hempel)	OH, 1917 (USNM)	Oriental	pest	palms
Cerataphis lataniae (Boisduval)	NE, 1912 (USNM)	Oriental	pest	palms
Cerataphis orchidearum (Westwood)	DC, 1923 (USNM)	Oriental	pest	greenhouse orchids

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Ceruraphis eriophori (Walker)	UT, 1935 (Knowlton and Smith 1936)	Palearctic (Europe)		
Chaetosiphon potentillae (Walker)	NY, 1851 (Fitch notes) CO, 1916 (USNM)	Palearctic (Europe)		
Chaetosiphon tetrarhodum (Walker)	MN, 1907 (USNM)	Palearctic (Europe)		
Chaitophorus leucomelas Koch	CA, QC, 1966 (USNM, Quednau 1966)	Palearctic (Europe)		
Chaitophorus populialbae (Boyer de Fonscolombe)	ON, 1955 (CNC)	Palearctic (Europe)		
Chromaphis juglandicola (Kaltenbach)	CA, 1896 (USNM)	Palearctic (Europe)	pest Olsen 1974	*Juglans regia*
Cinara cedri Mimeur	NY 2004 (CNC, FSCA)	Palearctic (Europe)		*Cupressus, Juniperus*
Cinara confinis (Koch)	CO, 1920 (USNM)	Palearctic		*Abies*
Cinara costata (Zetterstedt)	ON, 1905 (USNM)	Palearctic		*Picea*
Cinara cupressi (Buckton)	CA, 1916 (Bartholomew 1932)	Palearctic		*Cupressus, Juniperus*
Cinara fresai Blanchard	FL, 1942 (Tissot 1944 [as *C. wacasassae*])	unknown		*Cupressus, Juniperus*
Cinara juniperi (De Geer)	NY, 1902 (USNM)	Palearctic (Europe)		*Juniperus*
Cinara laricis (Hartig)	MA, 1921 (USNM)	Palearctic (Europe)		*Larix*
Cinara pilicornis (Hartig)	ME, 1906 (Patch 1912)	Palearctic		*Picea*
Cinara pinea (Mordvilko)	DC, 1919 (Wilson 1919)	Palearctic		*Pinus*
Cinara pruinosa (Hartig)	CO, 1910 (Gillette 1917a [as *Lachnus palmerae*])	Palearctic		*Picea*
Cinara tujafilina (Del Guercio)	CA, 1914 (Davidson 1914)	unknown		
Coloradoa abrotani (Koch)	NB, 1964 (ACNB)	Palearctic (Central Asia)		
Coloradoa absinthii (Lichtenstein)	MB, BC, 1965 (CNC)	Palearctic (Central Asia)		
Coloradoa achilleae Hille Ris Lambers	ON, 1962 (CNC)	Palearctic (Central Asia)		*Achillea*
Coloradoa artemisiae (Del Guercio)	BC, 1965 (CNC)	Palearctic (Central Asia)		
Coloradoa rufomaculata (Wilson)	NE, 1890 (USNM)	Palearctic (Central Asia)	minor pest	chrysanthemums
Coloradoa tanacetina (Walker)	RI, 1974 (Smith and Parron 1978)	Palearctic (Central Asia)		
Corylobium avellanae (Schrank)	BC, 1983 (Forbes and Chan 1984)	Palearctic (Europe)	pest	*Corylus avellana*
Cryptaphis poae (Hardy)	MB, 1965 (Robinson and Bradley 1965)	Palearctic (Europe)		
Cryptomyzus galeopsidis (Kaltenbach)	ME, 1914 (Patch 1914)	Palearctic (Europe)		

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Cryptomyzus ribis (Linnaeus)	NY, 1854 (Fitch notes)	Palearctic (Europe)	pest	*Ribes*
Ctenocallis setosus (Kaltenbach)	OR, 1951 (Essig 1952)	Palearctic (Europe)		
Ctenocallis zelkowae (Shinji)	CA, 1983 (Kono 1983)	Palearctic (E Asia)	Pest Kono, 1983	*Zelkova*
Decorosiphon corynothrix Börner	NC, 1963 (Smith and Knowlton 1975)	Palearctic (Europe)		
Diuraphis frequens Walker	ON, 1951 (CNC)	Palearctic (Europe)	minor pest Halbert et al. 1992	*Triticum*
Diuraphis noxia (Kurdjumov)	TX, 1986 (Stoetzel 1987)	Palearctic (Central Asia)	major pest Quisenberry and Peairs 1998	Gramineae, incl. cereals
Drepanosiphum oregonensis Granovsky	OR, 1914 (USNM)	Palearctic		*Picea*
Drepanosiphum platanoides (Schrank)	CA, 1908 (Wilson 1909)	Palearctic (Europe)		*Acer*
Dysaphis apiifolia (Theobald)	CA, 1934 (USNM)	Palearctic	pest	Umbelliferae
Dysaphis crataegi (Kaltenbach) (11)	DC, 1915 (USNM)	Palearctic	pest	Umbelliferae
Dysaphis devecta (Walker)	QC, 1966 (Quednau 1966)	Palearctic (Europe)		*Malus pumila*
Dysaphis foeniculus (Theobald) (12)	OR, 1949 (USNM)	Palearctic (Europe)	occasional pest	Umbelliferae (including *Daucus carota*)
Dysaphis plantaginea (Passerini)	NE, 1890 (Williams 1911)	Palearctic (Europe)	pest	*Malus pumila*
Dysaphis pyri (Boyer de Fonscolombe)	CO, 1978 (Smith and Parron 1978)	Palearctic		*Pyrus communis*
Dysaphis radicola (Mordvilko)	DC, 1894 (USNM)	Palearctic (Europe)		
Dysaphis tulipae (Boyer de Fonscolombe)	NH, 1903 (USNM)	Palearctic (Europe)	pest, regulatory concern	bulbs
Elatobium abietinum (Walker)	CA, DC, 1915 (USNM)	Palearctic (Europe)	pest	*Abies*
Eriosoma grossulariae (Schüle) (13)	ON, 1913 (CNC)	Palearctic (Europe)		*Ribes, Ulmus*
Eriosoma pyricola Baker & Davidson	OH, 1897 (Baker and Davidson 1916)	Palearctic (Europe)		*Pyrus communis*
Eriosoma ulmi (Linnaeus) (13)	BC, 2003 (CNC)	Palearctic		*Ulmus; Ribes*
Eucallipterus tiliae Schouteden	DC, 1890 (USNM)	Palearctic (Europe)	pest	*Tilia*
Eucarazzia elegans (Ferrari)	CA, 1984 (Stoetzel 1985)	Palearctic (Europe)		Labiatae
Euceraphis betulae (Koch) (14)	CO, 1909 (USNM)	Palearctic (Europe)		*Betula*
Euceraphis punctipennis (Zetterstedt) (14)	NY, 1847 (Fitch notes)	Palearctic (Europe)		*Betula*
Eulachnus agilis (Kaltenbach)	NY, 1909 (Gillette 1909)	Palearctic (Europe)		*Pinus*
Eulachnus brevipilosus Börner	WA, 1954 (Hottes and Essig 1955)	Palearctic (Europe)		*Pinus*
Eulachnus rileyi (Williams)	IN, 1886 (USNM)	Palearctic (Europe)	minor pest	*Pinus*

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Referenee (2)	North American Economic Host(s)
Euthoracaphis umbellariae Essig	CA, 1929 (Essig 1932)	Palearctic (e Asia)		
Forda formicaria von Heyden	CO, 1909 (USNM)	Palearctic (Europe)		roots of Gramineae
Forda marginata Koch	DC, 1885 (USNM)	Palearctic (Europe)		roots of Gramineae
Geoica setulosa (Passerini)	ID, 1985 (FSCA)	Palearctic (Europe)	minor pest G.L. Miller et al. 2002	roots of Gramineae
Geoica utricularia (Passerini) (15)	IL, 1887 (USNM)	Palearctic (Europe)		roots of Gramineae, incl. cereals
Geopemphigus floccosus (Moreira)	FL, 1945 (USNM)	Neotropical	minor pest	roots of *Ipomoea batatas*
Glyphina betulae (Linnaeus)	PA, 1945 (USNM)	Palearctic (Europe)		
Greenidea ficicola Takahashi	FL, 2002 (Halbert 2004)	Oriental	potential pest	*Ficus*
Greenidea psidii van der Goot	CA, 1998 (Gill 1998a)	Oriental	minor pest, regulatory pest	*Myrtus*
Hayhurstia atriplicis (Linnaeus)	CA, 1887 (USNM)	Palearctic (Europe)		*Chenopodium* including *Ch. quinoa*
Hyadaphis coriandri (Das)	FL, 1997 (Halbert et al. 2000)	Palearctic (Central Asia)	major pest	Umbelliferae, including *Coriandrum, Foeniculum*
Hyadaphis foeniculi (Passerini)	NY, 1879 (USNM)	Palearctic (Central Asia)	minor pest	*Lonicera* ; Umbelliferae
Hyadaphis tartaricae (Ajzenberg)	IL, 1979 (Voegtlin 1981)	Palearctic (Central Asia)	major pest Voegtlin 1981	*Lonicera tatarica*
Hyalopteroides humilis (Walker)	DC, MA, 1909 (Hayhurst 1909)	Palearctic		
Hyalopterus amygdali (Blanchard) (16)	IL, NJ (date ?) (16) (Smith and Parron 1978)	Palearctic (e Asia)	pest	*Prunus* (s.g. *Amydalus*)
Hyalopterus pruni (Geoffroy) (16)	IL, 1879 (Thomas 1879)	Palearctic (Europe)	pest	*Prunus* (s.g. *Prunus*)
Hyperomyzus carduellinus (Theobald)	FL, 1997 (Halbert et al. 2000)	Palearctic (e Asia)		
Hyperomyzus lactucae (Linnaeus)	IL, 1878 (Thomas 1879)	Palearctic (Europe)	minor pest	*Ribes*
Hyperomyzus pallidus Hille Ris Lambers	ME, 1914 (Hille Ris Lambers 1949)	Palearctic (Europe)		*Ribes*
Hyperomyzus picridis (Börner)	PA, 1942 (USNM)	Palearctic (Europe)	potential pest	*Ribes*
Hyperomyzus rhinanthi (Schouteden) (17)	ME, 1951 (CNC)	Palearctic (Europe)		*Ribes*
Idiopterus nephrelepidis Davis	IL, 1907 (Davis 1909)	Neotropical Stoetzel 1990	pest Stoetzel 1990	greenhouse ferns
Jacksonia papillata Theobald	ID, 1959 (USNM)	Palearctic (Europe)		
Liosomaphis berberidis (Kaltenbach)	NY, 1846 (Fitch notes)	Palearctic (Europe)		
Lipamyzodes matthiolae (Doncaster)	WA, 1976 (Fox 1977)	Palearctic (Europe)		

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Lipaphis pseudobrassicae (Davis) (18)	DC, 1899 (USNM)	Palearctic (Europe)	major pest Paddock 1915	Cruciferae
Longicaudus trirhodus (Walker)	MA, 1908 (USNM)	Palearctic (Europe)		*Rosa*
Macrosiphoniella abrotani (Walker)	IL, 1929 (USNM)	Palearctic		
Macrosiphoniella absinthii (Linnaeus)	IL, 1879 (Thomas 1879)	Palearctic		
Macrosiphoniella artemisiae (Boyer de Fonscolombe)	NB, 1950 (ACNB)	Palearctic		
Macrosiphoniella grandicauda Takahashi and Moritsu	MD, 1997 (USNM)	Palearctic		
Macrosiphoniella leucanthemi (Ferrari)	PA, 1948 (USNM)	Palearctic		*Leucanthemum vulgare*
Macrosiphoniella millefolii (De Geer)	CT, 1937 (EMEC)	Palearctic		
Macrosiphoniella sanborni (Gillette)	NE, 1891 (USNM)	Palearctic (e Asia)	pest	Asteraceae (esp. chrysanthemums)
Macrosiphoniella subterranea (Koch)	PA, 1948 (USNM)	Palearctic		cultivated chrysanthemums
Macrosiphoniella tanacetaria (Kaltenbach)	CT, 1909 (CNC-Patch)	Palearctic	minor pest	cultivated chrysanthemums (occasionally)
Macrosiphum lilii (Monell) (19)	NY, 1878 (Comstock 1880)	Palearctic?	pest	Cultivated lilies
Macrosiphum rosae (Linnaeus)	MA, 1841 (Harris 1841)	Palearctic (Europe)	pest	Rosaceae (esp. *Rosa*)
Macrosiphum stellariae Theobald	BC, 1980 (Forbes and Chan 1983)	Palearctic	pest	Caryophyllaceae (esp. *Dianthus*)
Melanaphis bambusae Fullaway	GA, 1914 (USNM)	Palearctic (e Asia)		bamboos
Melanaphis sacchari (Zehntner)	FL, 1977 (FSCA)	Oriental	pest White et al. 2001	Gramineae (esp. sugarcane)
Melanaphis sorini Halbert and Remaudière	FL via CA, 1996 (Halbert and Remaudière 2000)	Oriental Halbert and Remaudière 2000	pest Halbert and Remaudière 2000	*Miscanthus*
Metopolophium dirhodum (Walker)	UT, 1910 (USNM)	Palearctic (Europe)	major pest	Gramineae, incl. cereals; *Rosa*
Metopolophium festucae (Theobald)	CA, 1970 (USNM, Eastop 1971)	Palearctic (Europe)	pest	Gramineae
Microlophium carnosum (Buckton) (20)	NE, 1889 (Williams 1911)	Palearctic (Europe)		*Urtica*
Microlophium sibiricum (Mordvilko) (20)	PA, 1963 (USNM, Pepper 1965)	Palearctic (Europe)		*Urtica*

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Mindarus abietinum Koch (21)	IL 1879 (Thomas 1879 [as *Schizoneura pinicola*])	Palearctic (Europe)		*Abies*
Monaphis antennata (Kaltenbach)	ON, 1996 (CNC)	Palearctic (Europe)		*Betula*
Muscaphis musci Börner	NC, 1962 (Smith and Knowlton 1975)	Palearctic (Europe)		
Myzaphis bucktoni Jacob	ME, 1959 (USNM)	Palearctic (Europe)		*Rosa*
Myzaphis rosarum (Kaltenbach)	NY, 1906 (USNM)	Palearctic (Europe)	pest	*Rosa*
Myzocallis carpini (Koch)	BC, 1964 (Forbes et al. 1973)	Palearctic (Europe)		*Carpinus betulus*
Myzocallis castanicola Baker	CA, 1914 (USNM)	Palearctic (Europe)	pest	*Castanea* and *Quercus*
Myzocallis coryli (Goeze)	CA, 1903 (Clarke 1903)	Palearctic (Europe)	pest	*Corylus avellana*
Myzus antirrhini (Macchiati)	MD, 1996 (USNM)	Palearctic (Europe)		polyphagous
Myzus ascalonicus Doncaster	NB, 1954 (MacGillivray 1954b)	unknown Blackman and Eastop 2000	pest	polyphagous
Myzus cerasi Passerini	NY 1855 (Thomas 1879)	Palearctic (Europe)	pest	*Prunus* (s.g. *Cerasus*)
Myzus certus (Walker)	NB, 1952 (MacGillivray 1954a)	Palearctic (Europe)	minor pest	Caryophyllaceae, incl. *Dianthus*
Myzus hemerocallis (Schrank)	FL, LA, 1958 (USNM)	Palearctic (e Asia)	pest	*Hemerocallis*
Myzus ligustri (Mosley)	NY, 1915 (USNM)	Palearctic (Europe)	occasionally severe pest Mason 1940	*Ligustrum* sp.; *Euonymus* sp.
Myzus lythri (Schrank)	DC, 1916 (USNM)	Palearctic (Europe)	potential weed biocontrol agent Voegtlin 1995b	*Lythrum salicariae*
Myzus ornatus Laing	CA, 1936 (Essig 1938)	Palearctic	pest	polyphagous
Myzus persicae (Sulzer)	MA, 1841 (Harris 1841)	Palearctic (e Asia)	major pest	polyphagous
Myzus varians Davidson	CA 1911 (Davidson 1912)	Palearctic (e Asia)	pest	*Clematis*
Nasonovia ribisnigri (Mosley)	IL, 1879 (Thomas 1879)	Palearctic (Europe)	major pest; regulatory concern	*Lactuca sativa*
Neophyllaphis araucariae Takahashi	FL, 1963 (Woodruff 1963)	Australasian (Australia)	pest Russell 1967	*Araucaria heterophylla*
Neophyllaphis podocarpi Takahashi	CA, 1954 (Russell 1967)	Australasian (Australia)	pest Russell 1967, Denmark 1969	*Podocarpus*
Neotoxoptera formosana (Takahashi)	CA, 1927 (Essig 1935)	Oriental	pest	*Allium*
Neotoxoptera oliveri (Essig)	CA, 1927 (Essig 1935)	Oriental	pest	*Allium*
Ovatus crataegarius (Walker)	OR, 1893 (USNM)	Palearctic (Europe)	pest	*Mentha* ; *Crataegus*
Paracolopha morrisoni (Baker)	MD 1916 (Baker 1919)	Palearctic (e Asia)		bamboos
Panaphis juglandis (Goeze)	OR, 1928 (USNM)	Palearctic (e Asia)	pest	*Juglans regia*

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Pemphigus bursarius (Linnaeus)	NY, 1872 (Fitch 1872)	Palearctic (Europe)	pest	*Populus nigra; Lactuca sativa*
Pemphigus spyrothecae Passerini	QC, 1972 (Alleyne and Morrison 1974)	Palearctic (Europe)		*Populus nigra*
Pentalonia nigronervosa Coquerel	DC, 1909 (USNM)	Unknown (either Neotropical or Oriental)	pest	*Musa* (banana); ornamental Musaceae, Araceae, Zingiberaceae
Periphyllus californiensis (Shinji)	WA, 1903 (Essig and Abernathy 1952)	Palearctic (e Asia) Essig and Abernathy 1952		*Acer*
Periphyllus lyropictus (Kessler)	VT, 1847 (Fitch notes [as *Aphis aceris* L.])	Palearctic (Europe)		*Acer platanoides*
Periphyllus testudinaceus (Fernie)	BC, 1924 (Essig and Abernathy 1952)	Palearctic (Europe)		*Acer*
Phloeomyzus passerini (Signoret) (22)	NB? 1950, ME 1970 (Smith 1974a [as *P. dearborni* Smith])	Palearctic		
Phorodon humuli (Schrank)	NY, 1863 (Walsh 1863)	Palearctic (Europe)	pest	*Prunus*; *Humulus*
Phyllaphis fagi (Linnaeus)	IL, 1879 (Thomas 1879)	Palearctic (Europe)	pest	*Fagus*
Pleotrichophorus chrysanthemi (Theobald)	CA, 1910 (USNM)	Palearctic (Asia?)	minor pest	chrysanthemums
Pleotrichophorus glandulosus (Kaltenbach)	CO, 1915 (USNM)	Palearctic (Europe)		*Ambrosia*, *Artemisia*
Prociphilus xylostei (De Geer) (23)	ME, 1914 (Patch 1917)	Palearctic		*Lonicera*; roots of *Picea*
Pseudacaudella rubida (Börner)	NC, TN, 1973 (Smith and Knowlton 1975)	Palearctic (Europe)		
Pseudoregma panicola (Takahashi)	FL, 1928 (FSAC)	Oriental		
Pterocallis alni (De Geer)	IL, 1910 (Davis 1910)	Palearctic (Europe)		
Pterocomma pilosum Buckton	UT, 1958 (Knowlton 1958)	Palearctic		
Pterocomma populeum (Kaltenbach)	MT, 1904 (USNM)	Palearctic (Europe)		
Pterocomma salicis (Linnaeus)	MN, 1886 (Oestlund 1886)	Palearctic		
Rhopalomyzus lonicerae (Siebold)	VA, 1912 (USNM)	Palearctic (Europe)	minor pest	*Lonicera*
Rhopalosiphoninus hydrangeae (Matsumura)	BC, 1975 (Forbes and Chan 1976)	Palearctic (e Asia)		
Rhopalosiphoninus latysiphon (Davidson)	CA, 1912 (USNM)	Palearctic	minor pest	Bulbs; *Solanum tuberosum*

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Rhopalosiphoninus staphyleae (Koch)	BC, 1953 (ACNB)	Palearctic (Europe)	minor pest	Polyphagous on roots, including stored bulbs and rootcrops
Rhopalosiphum maidis (Fitch) (24)	NY, 1851 (Fitch 1856)	Palearctic (e Asia)	serious pest	Gramineae
Rhopalosiphum nymphaeae (Linnaeus)	NE, 1890 (USNM)	Palearctic Davidson 1917	pest/ biological control	various aquatic plants
Rhopalosiphum rufiabdominale (Sasaki) (24)	NY, 1856 (Fitch 1856)	Palearctic (e Asia)	pest	Gramineae
Schizaphis graminum (Rondani)	MD, 1884 (Pergande 1902)	Palearctic	serious pest	Gramineae
Schizaphis minuta (van der Goot)	FL, 1998 (Halbert et al. 2001)	Oriental		
Schizaphis palustris (Theobald)	BC, 1974 (Forbes and Chan 1976)	Palearctic (Europe)		
Schizaphis rotundiventris (Signoret)	FL, 1988 (Halbert et al. 2000)	Palearctic (e Asia) or Oriental		
Schizolachnus pineti (Fabricius)	BC, 1961 (CNC)	Palearctic		
Shivaphis celti Das (25)	GA, SC, 1996 (Halbert et al. 2000)	Palearctic (E Asia) and Oriental	nuisance pest Halbert and Choate 1999	*Celtis*
Sipha elegans Del Guercio	NB, 1949 (ACNB)	Palearctic Blackman & Eastop 2000	minor pest	Gramineae
Sipha glyceriae (Kaltenbach)	ME, 1909 (Patch 1910)	Palearctic	pest	Gramineae (incl. rice)
Sitobion avenae (Fabricius)	NY, 1851 (Davis 1914)	Palearctic	major pest Davis 1914	Gramineae
Sitobion fragariae (Walker)	CA 1916 (USNM)	Palearctic (Europe)	pest	Gramineae, *Rubus*
Sitobion luteum (Buckton) (26)	FL, 1940 (FSCA)	unknown	minor pest	greenhouse orchids
Smynthurodes betae Westwood	DC, 1895 (USNM)	Palearctic (Mediterranean)	minor pest Stoetzel et al. 1996	polyphagous on roots incl. *Phaseolus, Solanum, Gossypium*
Subacyrthosiphon cryptobium Hille Ris Lambers	IA, 1966 (USNM)	Palearctic (Europe)		
Takecallis arundicolens (Clarke)	CA, 1903 (USNM)	Oriental		bamboos
Takecallis arundinariae (Essig)	CA, 1911 (Essig 1917)	Oriental		bamboos
Takecallis taiwanus (Takahashi)	FL, 1930 (USNM)	Oriental		bamboos
Tetraneura fusiformis Matsumura (27)	FL, 1959 (FSCA, USNM)	Palearctic (e Asia) / Oriental	possible pest	*Ulmus*?; roots of Gramineae inc. rice
Tetraneura ulmi (Linnaeus)	NE, 1890 (USNM)	Palearctic		
Thecabius lysimachiae Börner (28)	NY, 2000 (FSCA)	Palearctic (Europe)		*Populus, Lysimachia*

Table 1. Continued.

Introduced Species	Earliest N.A. record (1) (Collection or Reference)	Geographic Origin/ Reference (2)	Status in North America/ Reference (2)	North American Economic Host(s)
Therioaphis riehmi (Börner)	KS, WA, 1948 (USNM)	Palearctic (Europe)		*Trifolium*
Therioaphis trifolii (Monell) (29)	NY, 1879 (USNM)	Palearctic (Europe)	pest	Leguminosae, esp. *Trifolium* and *Medicago*
Tinocallis kahawaluokalani (Kirkaldy)	LA, 1925 (USNM)	Oriental	pest Mizell et al. 2002	*Lagerstroemia indica*
Tinocallis platani (Kaltenbach)	BC, 1927 (Glendenning 1929)	Palearctic (Europe)		*Ulmus*
Tinocallis saltans (Nevsky)	ID, 1986 (Halbert and Pike 1990)	Palearctic (e Asia)		*Ulmus*
Tinocallis takachihoensis Higuchi	MD, 1996 (USNM)	Palearctic (e Asia)		*Ulmus*
Tinocallis ulmiparvifoliae Matsumura	CA,FL, 1998 (Gill 1998b, Halbert 1998)	Palearctic (e Asia)	nuisance pest	*Ulmus*
Tinocallis zelkowae (Takahashi)	CA,1983 (Kono 1983)	Palearctic (e Asia)		
Toxoptera aurantii (Boyer de Fonscolombe)	CA, 1907 (USNM)	Palearctic (e Asia) or Oriental	major pest	polyphagous
Toxoptera citricida (Kirkaldy)	FL, 1995 (Halbert and Brown 1996)	Palearctic (e Asia) or Oriental	major pest Halbert and Brown 1996	*Citrus*
Trama rara Mordvilko	CO, 1929 (USNM)	Palearctic (Europe)		roots of Compositae
Trichosiphonaphis polygoni (van der Goot)	FL, 1974 (Smith and Denmark 1982)	Palearctic (e Asia)		*Polygonum punctatum*
Tuberculatus annulatus (Hartig) (30)	WA, 1951 (USNM)	Palearctic (Europe)		
Tuberculatus querceus (Kaltenbach)	BC, 1999 (CNC)	Palearctic (Europe)		
Tuberolachnus salignus (Gmelin)	IL, 1872 (Le Baron 1872)	Palearctic (Europe)	minor pest	*Salix*
Uroleucon achilleae (Koch)	CA, 1966 (Hille Ris Lambers 1966)	Palearctic (Europe)		*Achillea*
Uroleucon cirsii (Linnaeus)	ON, 1956 (CNC)	Palearctic (Europe)		*Cirsium*
Uroleucon sonchi (Linnaeus)	DC, 1892 (USNM)	Palearctic (Europe)		*Sonchus*
Uroleucon taraxaci (Kaltenbach)	NY, 1902 (USNM)	Palearctic (Europe)		*Taraxacum*
Vesiculaphis caricis (Fullaway)	VA, 1916 (USNM)	Palearctic (e Asia)		
Wahlgreniella vaccinii (Theobald)	IL, 1929 (USNM)	Palearctic (Europe)		

1. Names of Canadian provinces and U.S. states indicated using standard two-letter postal abbreviations (Canada Post 2005, United States Postal Service 1998).
2. Area of origin and pest status without explicit references are based on Blackman and Eastop (1994, 2000) supplemented by opinion of the authors.
3. *Acyrthosiphon malvae:* Also known as *A. pelargonii*. This name applies to a complex of entities with various host associations. We have not distinguished records for the various forms.
4. *Aphidounguis mali:* Single collection from botanical garden.
5. *Aphis craccivora*: Previously infrequent on alfalfa, the recent upsurge of this species on alfalfa may represent a separate introduction of an alfalfa-feeding population from Asia comparable to the situation in *Therioaphis trifolii* (*A. craccivora* is known as the alfalfa aphid in China).

Table 1. Continued.

6. *Aphis euphorbiae*: Listed in Williams (1911) from NE: four slides in USNM, apparently from this collection, are not *A. euphorbiae*.
7. *Aphis fabae* and *Aphis rumicis*: The latter name was used in the past for the aphid now known as *A. fabae*. The earliest occurrence of true *A. rumicis* is thus uncertain. *Aphis fabae* is currently used for a complex of taxa usually considered as subspecies. No attempt has been made here to distinguish the members of this complex. See also under '*A. evonymi*' in Table 2.
8. *Aphis polygonata*: Single record from flight intercept trap.
9. *Aphis taraxicicola*: Single record from trap.
10. *Brachycaudus rumexicolens*: Considered by Holman (1965) to be introduced into Europe from North America. However, the only recorded host, *Rumex acetosella*, is a Palearctic species naturalized in North America (Scoggan 1978).
11. *Dysaphis crataegi*: A number of similar *Dysaphis* species use *Crataegus* as primary host. Early reports of *D. crataegi* (e.g., Thomas 1879) based on association with *Crataegus* are not verifiable.
12. *Dysaphis foeniculus*: Single record.
13. *Eriosoma grossulariae* and *E. ulmi*: These names were long considered synonyms, but Danielsson (1982) showed that two species were involved. Reexamination of older North American collections named '*ulmi*' has shown that most, if not all, earlier collections are *E. grossulariae*. The 2003 collection of *E. ulmi* in CNC is currently the earliest confirmed record of this species in North America.
14. *Euceraphis betulae* and *E. punctipennis*: These species have been confused in the past and the correct identity of specific records is uncertain. Also, *E. betulae*, has been used to cover a complex of related non-European taxa. Most records of *E. betulae* and *E. punctipennis* from *Betula papyrifera* are actually specimens of the recently recognized species *E. papyrifericola* Blackman and subarctic records from dwarf birches probably *E. borealis* Blackman.
15. *Geoica utricularia*: Probably represents a complex of species (Blackman and Eastop 2000).
16. *Hyalopterus amygdali* and *H. pruni*: There is confusion of these two species in North America, and the exact status of individual records is uncertain.
17. *Hyperomyzus rhinanthi*: Distribution is alpine and northern Europe, Iceland, and northeastern North America. The North American population may represent part of a natural transatlantic distribution, rather than a human-mediated introduction.
18. *Lipaphis pseudobrassicae*: Records from past few decades as *L. erysimi* (Kaltenbach).
19. *Macrosiphum lilii*: First described from bulbs imported from Japan. However, there have been no subsequent Japanese records (Blackman and Eastop 2000)
20. *Microlophium*: This genus is in need of revision and it is difficult to say with clarity which species are present in North America.
21. *Mindarus abietinus*: Voegtlin (1995a) believes that North American populations may represent a different species from Eurasian populations. The numerous records of this species from spruce are almost all *M. obliquus*.
22. *Phloeomyzus passerini* (Signoret): Smith (1974a) refers to a collection by N.R. Brown from "Canada" in 1950. This particular collection has not been located, but other collections by Brown in ACNB from this period are all from NB.
23. *Prociphilus xylostei*: Some early North American records of *P. xylostei* were actually based on specimens of *Hyadaphis foeniculi* (=*Aphis xylostei* Schrank) misfiled in USNM.
24. *Rhopalosiphum maidis* and *R. rufiabdominale*: Both species are assumed to be of Asian origin because complete holocyclic lifecycles are documented only in Asia. Holocyclic colonies of *R. maidis* were found on *Prunus cornuta* in Pakistan (Remaudière and Naumann-Etienne 1991). Similarly, holocyclic colonies of *R. rufiabdomiale* occur on *Prunus* in Japan (Blackman and Eastop 2000). However, a holocycle for *R. rufiabdominale* also may occur in North America. (Al-Raeesi et al. 1992). There is a great deal of genetic diversity in *R. maidis* populations in North America (Blackman et al. 1990). This genetic diversity may point to a North American origin for the species, or it may be the result of mutations accumulating in continuous clonal lineages. Most other *Rhopalosiphum* species, including *Rhopalosiphum padi* (L.), are thought to be of North American origin (Halbert and Voegtlin 1998).
25. *Shivaphis celti*: Probably bonsai introductions
26. *Sitobion luteum*: Earlier North American records in USNM represent port interceptions.
27. *Tetraneura fusiformis*: Records as *T. nigriabdominalis* (Sasaki). See Eastop and Blackman (2005).
28. *Thecabius lysimachiae*: A 1956 collection by Hille Ris Lambers in Montreal, QC was questionably assigned to this species by Hille Ris Lambers (Smith 1974b). Recent collections in New England lend credibility to his determination.
29. *Therioaphis trifolii*: Eastern populations feed on clover. Alfalfa feeding populations in western USA represent a separate introduction formerly known as *Therioaphis maculata* (or *Pterocallidium maculatum*).
30. *Tuberculatus annulatus*: Record by Lintner (1889) (as *Aphis quercus*) not verified.

Table 2. Species previously reported as introduced in North America, but now considered to be erroneous or dubious records.

Species	Reason for Consideration as Erroneous or Dubious
Amphorophora rubi (Kaltenbach)	May not occur in North America. References to this species on raspberry in North America are mostly misidentifications of *Amphorophora agathonica* Hottes (Blackman and Eastop 2000). However, Hille Ris Lambers believed *A. rubi* was present in northwestern North America (Hille Ris Lambers letter to L. Russell, 13 Nov. 1972, USNM letter file). Note that the European aphid on raspberry is actually *A. idaei* (Börner) while *A. rubi* is restricted to blackberry (Blackman et al. 1977).
Anuraphis farfarae (Koch)	Listed in Bodenheimer and Swirski (1957) as occurring in North America but no supporting specimens located.
Anuraphis subterranea (Walker)	Cited in Jones (1929) from Colorado. No specimens are present in USNM.
Aphis frangulae Kaltenbach	North American records probably refer to *Aphis nasturtii*. *Aphis frangulae* is a member of a complex of taxa including *Aphis gossypii* Glover (Smith and Parron 1978, Stroyan 1984, Blackman and Eastop 2000). The overwintering host for *A. fangulae sensu stricto* is *Frangula alnus* (=*Rhamnus frangula*). *A. nasturtii* (as *A. rhamni* Boyer de Fonscolombe, see note below for *Macchiatella rhamni*) is the only *Aphis* reported on *Rhamnus* in Illinois by Hottes and Frisson (1931).
Aphis acetosae Linnaeus	Listed in Börner and Heinze (1957) as occurring in North America, but no specimens have been located
Aphis evonymi Fabricius	There is considerable confusion in the application of the name *A. evonymi* (or *euonymi*). It is probable that most, if not all, of the North American records of *A. evonymi* (or *A. euonymi*) refer to other members of the *Aphis fabae* complex. Eastop and Hille Ris Lambers (1976) state that *A. evonymi* of authors prior to 1950 is a synonym of *Aphis fabae solanella* Theobald. Eastop and Hille Ris Lambers (1976) listed *A. euonymi* Fabricius 1775 as a valid species, and Remaudière and Remaudière (1997) treat it as a subspecies of *A. fabae*.
Aphis medicaginis Koch	North American records of this species are misidentifications of *Aphis craccivora*.
Aphis grossulariae Kaltenbach	Listed in Wilson (1913) as found in Oregon. No specimens are present in USNM.
Aphis ilicis Kaltenbach	Reported from California and British Columbia in Smith & Parron (1978). No supporting specimens have been located.
Aphis hieracii Schrank	Listed in Rafinesque (1818). No North American specimens have been located.
Aphis nepetae Kaltenbach	Listed in Smith and Parron (1978) as occurring in Idaho and Minnesota. There are no North American records in the CNC, FSCA, or USNM.
Aphis plantaginis Goeze	Listed in Smith and Parron (1978) as occurring in New York. No North American specimens have been located
Aphis ulmariae Schrank	Listed in Smith and Parron (1978) from various states. Specimens from Colorado in USNM were actually *A. spiraecola*. Record by Thomas (1879) is *A. pisum*.
Aphis viburni Scopoli	Recorded in Illinois as early as 1879 (Thomas 1879). However, records are likely the result of confusion with *A. fabae* and *A. viburniphila* Patch.
Aphis vitis Scopoli	Listed in Walsh (1863) from Illinois and Missouri. A single slide of poor quality found in USNM identified as *A. vitis* is likely *Aphis illinoisensis*.
Brachycaudus prunicola (Kaltenbach)	Listed in Hunter (1901) as occurring in North America. There are no North American records for this species in the CNC, FSCA, or USNM. Blackman and Eastop (2000) state that this species is "not yet recorded outside Europe."

Table 2. Continued.

Species	Reason for Consideration as Erroneous or Dubious
Capitophorus archangelskii Nevsky	Single record from New York in 1960 (Leonard 1963). Probably *C. pakansus*. Börner and Heinze (1957) considered *C. pakansus* a synonym of *C. archangelskii*.
Cinara piceicola (Cholodkovsky)	North American records refer to *Cinara pilicornis* (Hartig)
Cinara piceae (Panzer)	No North American specimens found.
Cinara pini (Linnaeus)	North American records are doubtful. See Smith and Parron (1978).
Cinara pinicola (Kaltenbach)	No authentic North American specimens found. Records of this species appear to refer to *C. pinea* and *C. pilicornis*.
Coloradoa angelicae (Del Guercio)	A single published record from New York in 1913 (Olsen 1921) represents the only record of this species in North America. There are no North American specimens in CNC, FSCA, or USNM.
Cryptaphis poae (Hardy)	Recorded as occurring in Colorado and Manitoba (Robinson and Bradley 1965), Robinson later stated (correspondence cited in Smith and Parron 1978) that he did not believe *C. poae* occurs in North America.
Dysaphis angelicae (Koch)	Recorded by Wilson (1909) for California. US specimens in USNM are *Aphis* species and 2 alates and alatoid nymphs of a *Dysaphis* species that key to *crataegi/tulipae/angelicae/pyri/radicola* complex. The status of this species in North America is uncertain.
Dysaphis sorbi (Kaltenbach)	First listed by Clarke (1903) for California. Although recorded in some subsequent literature as present in North America, specimens identified in USNM as *D. sorbi* were actually *D. plantaginea*. Stroyan (1985) did not list *D. sorbi* as present in North America.
Diuraphis holci (Hille Ris Lambers)	Although recorded as occurring in various localities in North America (Smith and Parron 1978), *D. holci* probably does not occur in North America (Halbert et al. 1992).
Eriosoma lanigerum (Hausmann)	Generally considered to be native to North America. However, as early as 1841, Harris (1841) believed otherwise and cited various sources and observations to support his view. Eastop (1973) suggests the origin may be eastern Asiatic and introduced to Europe via America.
Eriosoma lanuginosa (Hartig)	Probably not in North America; records refer to *E. pyricola* (Blackman and Eastop 2000).
Geoica lucifuga (Zehntner)	Probably not in North America; Smith (1985) believed records dubious. No specimens located.
Glyphina jacutensis Mordvilko	Listed as *G. alni* (Schrank) in Archibald (1957). Record is doubtful; probably actually *G. longiseta* Richards, but specimens not present in Archibald collection (now in CNC).
Lachnus roboris (Linnaeus)	Smith and Parron (1978) record from California, Connecticut, and Maine. No North American specimens have been located; material seen from these states identified as *L. roboris* is *Longistigma caryae*.
Macchiatiella rhamni (Boyer de Fonscolombe)	Many North American records, but *Aphis rhamni* Boyer de Fonscolombe has been misapplied in the past by many authors to the species now called *Aphis nasturtii* Kaltenbach (Eastop and Hille Ris Lambers 1976). The presence of *M. rhamni* in North America is doubtful.
Macrosiphum funestum (Macchiati)	Recorded by Burnham (1938) for New Brunswick in 1936. No slides have been located in (CNC) or ACNB.
Macrosiphum gei (Koch)	Recorded from various localities in North America (Smith and Parron 1978). All North American specimens in FSCA and USNM were actually *Macrosiphum euphorbiae*. Blackman and Eastop (2000) state that most North American records refer to *M. euphorbiae*.
Maculolachnus submacula (Walker)	North American records probably all refer to *M. sijpkensis* Hille Ris Lambers (Blackman and Eastop 2000)
Megoura viciae Buckton	Listed in Smith and Parron (1978), citing Müller (1969). However, Müller (1969) actually states "NAs" while he uses "NAm" for North America.

Table 2. Continued.

Species	Reason for Consideration as Erroneous or Dubious
Metopolophium frisicum Hille Ris Lambers	Listed in Smith and Parron (1978), citing Börner (1952). However, no specimens of this species have been located in North American collections.
Myzus ajugae Schouteden	Smith and Parron (1978) considered the Leonard (1968) reference to "?*Myzus ajugae*" suspect, believing "the determination was made because of the host association."
Myzus myosotidis (Börner)	Smith and Parron (1978) cite Hille Ris Lambers (1966) as the basis for the occurrence of *M. myosotidis* in California. However, Hille Ris Lambers (1966) mentions this species only in a key. No specimens are present in USNM. Halbert et al. (1995) considered North American distribution doubtful.
Nasonovia nigra (Hille Ris Lambers)	Recorded by Maw et al. (2000) in British Columbia and New Brunswick, based on mididentified specimens of *N. ribisnigrae* in ACNB.
Picturaphis brasiliensis (Moreira)	Cited in Smith and Parron (1978) as occurring in Florida. Examination of specimens in USNM showed the collection to be from "Florida, P.R." (Puerto Rico), not Florida, U.S.A.
Pachypappa tremulae (Linnaeus)	North American records probably refer to the native counterpart, *P. rosettei* (Maxson).
Pemphigus borealis Tullgren	A single record from Idaho in 1952 (Gittins et al. 1976).
Periphyllus aceris (Linnaeus)	Although stated by Blackman and Eastop (1994) as introduced to North America, and recorded by various other authors, all North American collections in USNM are interceptions. Essig and Abernathy (1952) believed that reports of *P. aceris* were referable to other species and *P. aceris* had not been recorded in the Western Hemisphere.
Prociphilus bumeliae (Schrank)	According to Smith and Parron (1978), probably misidentifications of *P. americanus*.
Saltusaphis scirpus Theobald	A single record from Ohio, 1938 (Smith 1940). No North American specimens in USNM, CNC or FSCA.
Schoutedenia ralumensis Rübsaamen	A single specimen, cited in Palmer (1952) (as *Setaphis viridis* van der Goot) in Colorado. Not established.
Semiaphis dauci (Fabricius)	Records from District of Columbia and Maryland (Leonard and Bissell 1970, Smith and Parron 1978) may have been misidentification of *Dysaphis crataegi*.
Sitobion luteum (Buckton)	Cited in Smith and Parron (1978) as occurring in New Mexico and New York. All North American records in USNM are port interceptions and do not represent established populations.
Thecabius affinis (Kaltenbach)	*Thecabius affinis* is an Old World species, and *Th. populiconduplifolius* North American. They are morphologically and biologically indistinguishable, but *Th. affinis* has 2n = 38, and *Th. populiconduplifolius* has 2n = 28 chromosomes (Blackman and Eastop 1994). It is unknown whether *Th. affinis* occurs in North America.
Thelaxes dryophila (Schrank)	References to this species probably represent misidentification of *Thelaxes californica* (Davidson).
Therioaphis ononidis (Kaltenbach)	Records of *T. ononidis* from North America and Japan are misidentifications of *T. trifolii* (Monell) (Quednau 2003).
Thripsaphis caricis (Mordvilko)	North American records refer to *Thripsaphis producta* Gillette (Hille Ris Lambers 1974).
Titanosiphon artemisiae (Koch)	Questionably recorded for New York by Smith and Parron (1978), citing Hunter (1901) who lists "*Nectarphora artemisiae*? Koch." Probably a *Macrosiphoniella* species.
Uroleucon compositae (Theobald)	Listed in Hille Ris Lambers (1963) as present in "America." Although introduced into the Caribbean, this species has not yet been found in North America.

Table 2. Continued.

Species	Reason for Consideration as Erroneous or Dubious
Uroleucon muralis (Buckton)	In Nebraska, according to in Williams (1911). However, Robinson (1985) examined specimens from the USNM and determined that they were *Uroleucon sonchellum* (Monell). He believed *U. muralis* does not occur in North America.
Uroleucon solidaginis (Fabricius)	All known North American specimens identified as this species are in fact various native species of *Uroleucon*. Robinson (1985) stated that he had "not seen authentic material of *solidaginis* from North America."
Uroleucon tanaceti (Linnaeus)	Cited in Smith and Parron (1978) as occurring in several localities. However, Robinson (1985) stated that he had "not seen authentic material of this species from North America."

Table 3. Aphid species considered to have a natural Holarctic or Beringian distribution.

Aphis equiseticola Ossiannilson	The single previous North American record from Vancouver, BC suggested an introduction of this species otherwise known from Scandinavia. However, a collection (in CNC) of this species in 2004 from northern Québec indicates a possible circumboreal distribution.
Aphis farinosa Gmelin	Widespread in both Nearctic and Palearctic.
Boernerina alni Takahashi	Subspecies *alaskensis* Hille Ris Lambers and Hottes (originally described as a subspecies of *B. variabilis* Richards), widespread in Alaska and arctic Canada, is the North American segregate of this species otherwise known from east Asia.
Cavariella aquatica (Gillette and Bragg)	Widespread in both Nearctic and Palearctic, but infrequently collected.
Cavariella konoi Takahashi	According to Stroyan (1969), differences in host range among Old and New World populations indicate the possibility that this name covers a complex of taxa.
Chaitophorus horii Takahashi	Specimens from Northwest Territories match the nominate Asian subspecies, rather than the European subspecies (*beuthani* Börner), and probably represent natural migration across the Bering Strait.
Gharesia polunini Stroyan	Known from mountains of western North America and Himalayas.
Maculolachnus sijpkensis Hille Ris Lambers	Distributed across North America and in Mongolia (Blackman and Eastop 2000).
Mindarus obliquus (Cholodkovsky)	Present across boreal forest zone of North America, northern Europe, and northern Russia, but apparently not recorded in eastern Siberia.
Muscaphis escherischi (Börner)	According to Stekol'shtshikov and Shaposhnikov (1993), *Toxopterella drepanosiphoides* MacGillivrary and Bradley (known from across Canada, and in northern Europe as subspecies *irae* Shaposhnikov) is the primary host form of *M. escherischi*.
Myzodium modestum (Hottes)	Widespread in both Nearctic and Palearctic.
Thripsaphis cyperi (Walker)	Although first North American records of this species in Alaska (USNM) and Ontario (CNC) date from 1961, it is distributed across boreal and subarctic Canada and is likely naturally circumboreal.
Uroleucon simile (Hille Ris Lambers)	Widespread in Palearctic. North American records (Alaska only) likely represent a natural expansion across Bering Strait.

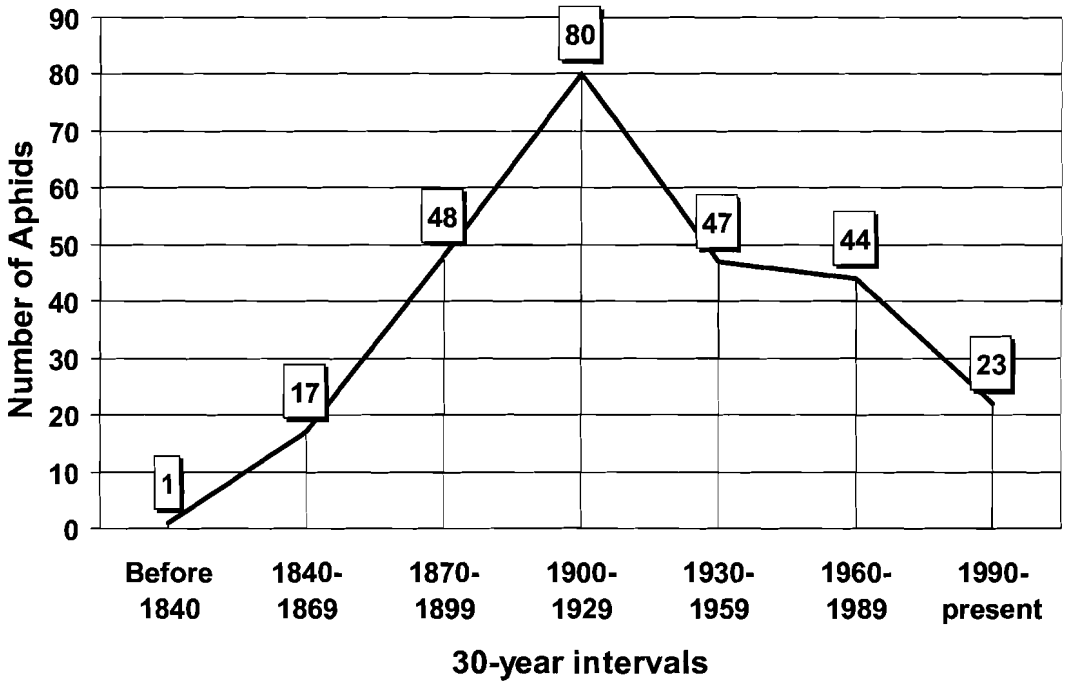

Fig. 1. Adventive aphids. Number of adventive aphids in North America north of Mexico recorded at 30-year intervals. Two species not included due to confusion with related species.

(1997), except for changes noted by Eastop and Blackman (2005). The taxonomic status and biogeographic origins of some aphid species are difficult to determine conclusively due to ongoing taxonomic problems. We have summarized relevant information in footnotes to Table 1.

Parameters for determining a pest are as defined in D. R. Miller et al. (2002), Miller and Miller (2003), and Miller et al. (2005). That is, if statements are made that a species is a pest, causes harm, requires control measures, is economically important, or reflects some comparable statement or inference, then we consider that species a pest. Pest status entries in Table 1 without reference to other authors are either from Blackman and Eastop (1994, 2000) or our personal experience. The principal hosts listed are those of the greatest economic impact in North America (including crops, ornamental plants, trees and weeds). Species causing damage to several plant families are listed as polyphagous.

A summary of species previously listed for North America, but for which we consider their occurrence doubtful or erroneous, and an explanation for their exclusion is provided in Table 2. Table 3 contains a compilation of those species, some of which were previously suspected as adventive to North America, which we consider to be most probably either Holarctic or Beringian in distribution.

Results

Based on our findings there are 1,416 aphid species in North America north of Mexico, which comprises about 30% of the world fauna of approximately 4,700 species (Remaudière and Remaudière 1997). Table 1 provides information on 262 aphid species (18% of the North American and approximately 6% of the

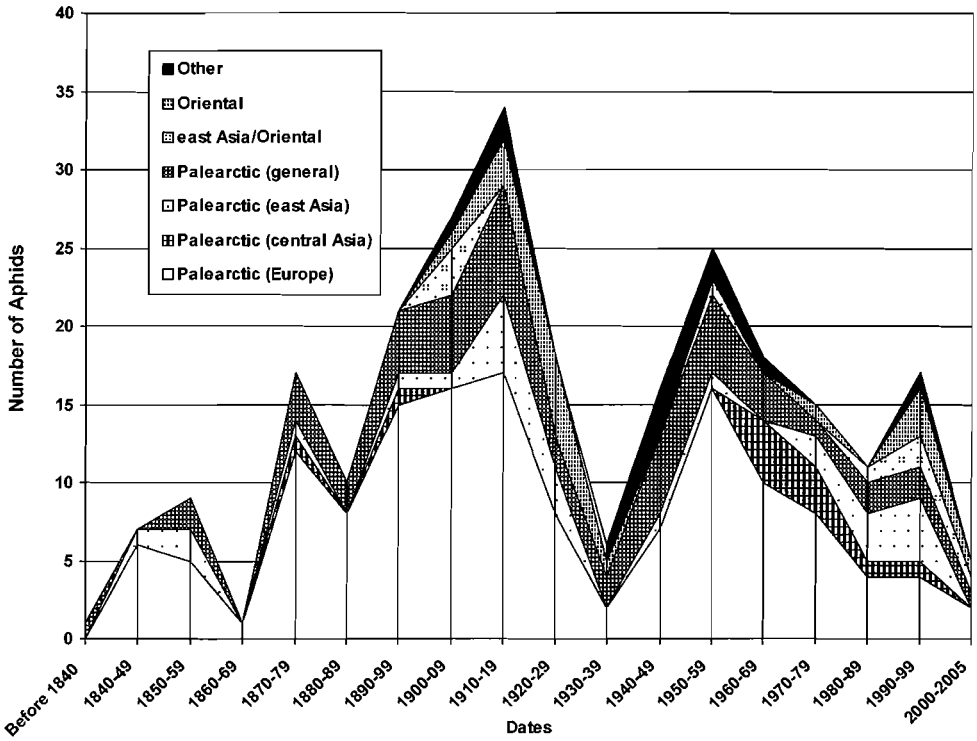

Fig. 2. Adventive aphids. Number of adventive aphids in North America north of Mexico at 10-year intervals classified by biogeographic origin. Aphids of Neotropical, Afrotropical and unknown origin combined into single category ("Other"). Two species not included due to confusion with related species.

world aphid fauna) that are considered as adventive to North America.

There has been an overall increase in number of aphid introductions per year from 1791 until 1929 (Fig. 1, number of introductions plotted at 30-year intervals in order to smooth short term anomalies), and there has been an overall decrease to the present. There are, however, a number of irregularities in this general trend that appear when first records are plotted on a finer time scale (Fig. 2, number at 10-year intervals, and Fig. 3, cumulative number at 10-year intervals). Two species, *Aphis rumicis* L. and *Hyalopterus amygdali* (Blanchard), are excluded from Figs. 1 to 3 due to uncertain introduction dates because of confusion with related species.

The geographic origin of adventive aphids is illustrated in Fig. 2 and Fig. 3. The majority originated from the Palearctic Region (227), followed by the Oriental (15), Neotropical (4), Australasian (2), and Afrotropical (1). Eight other species are generally distributed in east Asia, in both Oriental and Palearctic regions. The geographic origins of five species are unknown. As shown in other analyses (Sailer 1978, Miller et al. 2005), most insects adventive to North America originate in the Palearctic Region. We have further examined the rate of Asian introductions by subdividing the Palearctic Region into European, central Asian and east Asian components. Of the aphids originating from the Palearctic Region, 144 are found in Europe (and adjacent parts of north Africa and west Asia), 11 in central Asia, 25 in east Asia, and 48 are widespread in Eurasia. Original North American populations of the majority of the widespread Palearctic species likely originated from Europe.

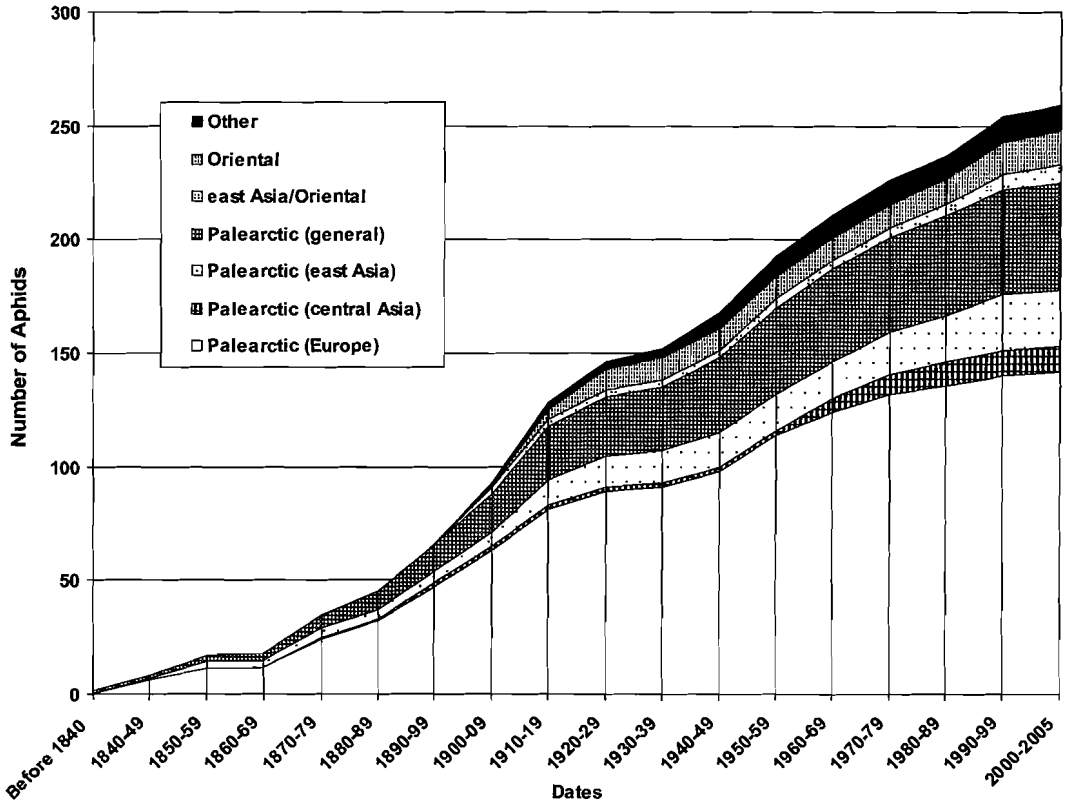

Fig. 3. Adventive aphids. Cumulative number of adventive aphids in North America north of Mexico at 10-year intervals classified by biogeographic origin. Aphids of Neotropical, Afrotropical and unknown origin combined into single category ("Other"). Two species not included due to confusion with related species.

Of the 262 adventive aphids, 114 (about 44%) are considered to be pests. Of these, 20 (>17%) are recorded as either serious or major pests (i.e., causing extensive or long term damage).

Discussion

The total number of adventive aphids in North America north of Mexico (262) is remarkably similar to the 255 adventive scales insects (Miller et al. 2005). Also, the decrease in annual number of introduced aphids since 1929 as shown in Fig. 1 is mirrored in the pattern seen in adventive Coccoidea (e.g., Miller et al. 2005). Sailer (1978) suggested that enforcement of the United States Plant Quarantine Act of 1912 has resulted in greater rate of interception and consequent decrease in successful entry and establishment of insect species. There are also finer scale changes in the number of first detections (Fig. 2), apparently due to a combination of major geopolitical and economic events, resulting in real changes in rates of introduction, and the efforts of particular individuals in recording the aphid fauna. For example, the peak in the number of first records in the 1870's is almost entirely due to the work of Thomas (1879), and there is a major trough in the 1930's apparently related to the economic depression and associated decrease in trade activity, despite active work on aphids by Essig, Gillette, and others during this period.

As for insects in general (Sailer 1978, 1983) and for scale insects in particular

(Miller et al. 2005), most adventive aphids are indigenous to the Palearctic Region (especially Europe). This is to be expected, given the immigration history of the continent and the associated transport of crops and their weeds. However, European introductions have become relatively few (Fig. 2, and seen as a leveling off of the European component of the cumulative curve in Fig. 3). Asian species now account for a major proportion of new introductions, although the total number is similar to that in the early part of the 20th century (Fig. 2). Because the Asian fauna was poorly known at the time, several of these early oriental introductions were first described from populations in the U.S.A. (*Aphis spiraecola* Patch, *Atarsaphis agrifoliae* Ferris, *Euthoracaphis umbellariae* Essig, *Neotoxoptera olivieri* (Essig), *Paracolopha morrisoni* Baker, *Periphyllus californicus* (Shinji), *Takecallis arundicolens* (Clarke), *T. arundinariae* (Essig)) as was the African aphid *Aloephagus myersi* Essig.

The proportion of pests among the adventive species is much greater than the proportion among the native species. This to be expected, given that most of these introductions were enabled by human activity, and hence associated with economically important plants. A more detailed analysis of the economic impact of adventive and native species is in preparation.

Acknowledgments

We thank D. Creel and J. Eibl (USDA, ARS, Systematic Entomology Laboratory, Beltsville, MD) for their assistance with reference verification for this paper. We also thank P. Mason (AAFC, Ottawa), E. Grissell (USDA, ARS, Systematic Entomology Laboratory, Washington, DC) and D. Nickle (USDA, ARS, Systematic Entomology Laboratory, Beltsville, MD) for their manuscript reviews.

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