

***Phloeocharis subtilissima* Mannerheim (Staphylinidae: Phloeocharinae) and *Cephennium gallicum* Ganglbauer (Scydmaenidae) new to North America: a case study in the introduction of exotic Coleoptera to the port of Halifax, with new records of other species**

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Abstract

Phloeocharis subtilissima Mannerheim (Coleoptera: Staphylinidae: Phloeocharinae), a Palearctic staphylinid, and *Cephennium gallicum* Ganglbauer (Coleoptera: Scydmaenidae: Cephenniini) are recorded for the first time for North America from Point Pleasant Park, Halifax, Nova Scotia, Canada. The bionomics of both species are discussed based on European data in addition to new observations of their ecology in Nova Scotia. The role of port cities, such as Halifax, in relation to the introduction of exotic Coleoptera is discussed with examples of other species introduced to North America from this location. The earliest known record of *Meligethes viridescens* (Fabricius) for North America and the second and third reported locations of *Dromius fenestratus* Fabricius are also presented.

Key words: Coleoptera, Staphylinidae, Phloeocharinae, Phloeocharis, Cephennium, Scydmaenidae, new records, Halifax, Nova Scotia, Canada, North America, introduction, exotic species, seaports

Introduction

The port of Halifax, Nova Scotia, has been an active gateway for shipping for over 250 years. There are many documented introductions of exotic (primarily Palearctic) species of Coleoptera through this location, many of those recorded for the first time in North America from this city. We herein report two further species, *Phloeocharis subtilissima* Mannerheim and *Cephennium gallicum* Ganglbauer, both recorded for the first time for North America.

In this context it is instructive to examine some of the processes by which such species are introduced through seaports since the mechanisms are common to all port localities. It is also worthwhile examining the subsequent fate of such species. This topic is developed in the discussion section of this paper.

***Phloeocharis subtilissima* Mannerheim**

Phloeocharis subtilissima Mannerheim, 1830 (Coleoptera: Staphylinidae: Phloeocharinae) is one of over 30 species of *Phloeocharis* from the western Palearctic Region, most with restricted distribution in the mountains of circum-Mediterranean countries of southern Europe and northwest Africa (Newton et al. 2001). One Nearctic representative, *P. californica* Smetana and Campbell, is found in the coastal mountains and Sierra Nevada of central California.

Phloeocharis subtilissima is an abundant and widely distributed rove beetle. It is recorded from throughout Europe (Austria, Belgium, Czech Republic, Denmark, England, Finland, France, Germany, Greece, Hungary, Italy, Norway, Poland, Russia, Scotland, Sicily, Slovakia, Spain, Sweden, Switzerland (Herman 2001); Latvia (Telnov et al. 1997), Northern Ireland (Anderson 1997)) and western North Africa (Scheerpeltz 1931).

The bionomics of the species have not been extensively investigated. It has been reported as “not infrequent under dry pine bark” (Reitter 1909); under bark (Freude et al. 1964); under dry bark and in litter, especially litter consisting of deep layers of decomposing leaves (Szujewski 1966); and under rotten bark, in rotten wood and in brushwood (Koch 1989). Mazur (1995) noted it to be predaceous in the galleries of the scolytines, *Tomicus piniperda* (L.) and *Xyleborus cryptographus* (Ratzeburg), in Scotch pine (*Pinus sylvestris* L.). Melke et al. (1998) classified it as a typical inhabitant of subcortical habitats, and predaceous on various developmental stages of ambio- and xylophagous organisms.

In Italy, A. Zanetti (pers. comm.) reported it in forests under bark and in detritus, primarily in mountainous areas at mid altitudes. In Belgium D. Drugmand (pers. comm.) found it in moss and under bark, primarily in deciduous forests, but occasionally also in coniferous forests. In Central Europe, A. Rose (pers. comm.), found it in dead wood and litter, sometimes associated with tunnels of the scolytine, *Ips typographus* (L.). In Poland, R. Ruta (pers. comm.) noted that it is a common species found under bark and on dead poplar (*Populus* sp.).

***Cephennium gallicum* Ganglbauer**

Cephennium gallicum Ganglbauer, 1899 (Coleoptera: Scydmaenidae: Cephenniini) is a member of a diverse and widely distributed genus that is primarily Palearctic. Freude et al. (1971) discussed 14 species of *Cephennium* from Central Europe, however, P. Jaloszynski

(pers. comm.) indicates that there are many additional undescribed species and the genus is in need of extensive revision. O'Keefe (2001) reports that there are over 100 species described worldwide. Only one of these, the blind *C. anophthalmicum* Brendel, known only from central coastal California, is Nearctic (O'Keefe 2001).

Cephennium gallicum is a widely distributed species found in central and northern Europe. Freude et al. (1971) report it from northern Spain, France, western Switzerland, Rhineland, Belgium, Holland, Denmark, and southern England. It has also been found in Skane & Uppland in Sweden (MLU), Thüringen in Germany (Köhler & Klausnitzer 1998), Ireland (Joy 1932), Scotland (Ball 2002), and Romania (Jaloszynski, pers. comm.).

Little information has been published on the bionomics of this species. Joy (1932) reports it from "old tree trunks," while Fowler (1890) says it is found "in moss, etc." Jaloszynski (pers. comm.) noted that all species of *Cephennium* are usually collected from leaf litter and rotten wood, most commonly in mountainous areas and in deciduous forests. Freude et al. (1971) state that species of *Cephennium* are found particularly in decomposing plant materials and in humus at the base of the trees; sometimes also in decomposing wood. All species of *Cephennium* are specialized predators of oribatid mites (Acari: Oribatei). Schmid (1988) discusses the specialized morphology and behaviour of these beetles for feeding on these hard-shelled mites.

Diagnosis and description

Conventions

Abbreviations of collections referred to in the text are: **ACNS**: Agriculture Canada, Kentville, Nova Scotia, Canada. **CGMC**: Christopher Majka Collection, Halifax, Nova Scotia, Canada. **CNC**: Canadian National Collection, Ottawa, Ontario, Canada. **CUIC**: Cornell University Insect Collection, Ithaca, New York, USA. **JOC**: Jeffrey Ogden Collection, Debert, Nova Scotia, Canada. **MZLU**: Museum of Lund University, Lund, Sweden. **NHM**: Natural History Museum, London, England. **NSNR**: Nova Scotia Department of Natural Resources Insectary, Shubenacadie, Nova Scotia, Canada. **NSMC**: Nova Scotia Museum, Halifax, Nova Scotia, Canada. **UCCB**: University College of Cape Breton, Sydney, Nova Scotia, Canada.

Methods

From May 2001 to May 2003 weekly visits were made to Point Pleasant Park, Halifax, Nova Scotia, Canada (44° 39' N; 63° 36' W) as part of a survey of Coleoptera. Sporadic additional sampling has continued through October 2004. Fieldwork continued throughout each year except for the month of January when no sampling took place. In February and March the site was visited approximately every 2-4 weeks. Searching of all habitats was conducted, primarily by hand and with a sweep net. The exterior surface of fallen trees and branches was regularly examined and sub-cortical environments were investigated by stripping off the bark with a penknife and collecting the beetles found beneath.

Results***Phloeocharis subtilissima* Mannerheim**

On 28 occasions between May 2001 and November 2004 the first author collected 97 specimens of *P. subtilissima* (CMC) in mixed coniferous woods in Point Pleasant Park. This species was not reported previously from North America (Figures 1 and 2). In many living specimens the elytra appears significantly more rufous in coloration in comparison with the pronotum and abdominal segments, and is paler laterally and in the epipleural region.



FIGURE 1: *Phloeocharis subtilissima* Mannerheim, Point Pleasant Park, Halifax, Nova Scotia, Canada. Dorsal habitus.



FIGURE 2: *Phloeocharis subtilissima* Mannerheim, Point Pleasant Park, Halifax, Nova Scotia, Canada. Living specimen in bark of red maple (*Acer rubrum*).

Phloeocharis subtilissima appears established and abundant within the confines of Point Pleasant Park an area 75 hectares in size and mostly covered by a largely coniferous forest consisting principally of red spruce (*Picea rubens* Sarg.); white (*Pinus strobus* L.), red (*P. resinosa* Ait.), and jack (*P. banksiana* Lamb.) pine, with smaller components of balsam fir (*Abies balsamea* (L.) Mill), hemlock (*Tsuga canadensis* (L.) Carr.), and white spruce (*Picea glauca*). Also present is a smaller deciduous component consisting of white (*Betula papyrifera* Marshall) and wire (*Betula populifolia* Marshall) birch, red maple (*Acer rubrum* L.) and red oak (*Quercus rubra* L.) and various introduced species including Norway spruce (*Picea abies* (L.)), scotch pine (*Pinus sylvestris* L.), and European beech (*Fagus sylvatica* L.) (Anonymous, 1993).

Within this forest *P. subtilissima* is commonly encountered primarily on limbs and trunks of recently fallen or damaged *Pinus strobus*, but also occasionally on *Picea rubens*, *P. glauca*, *Betula papyrifera* and (once) on *Amelanchier laevis* Wieg. The beetle is frequently observed moving on the surface of the bark, hiding beneath bark scales, or in litter on the forest floor. It is also found in galleries excavated under the bark by scolytines, with the principal species being *Crypturgus pusillus* (Gyllenhal), *Hylurgops rugipennis pinifex* (Fitch), *Ips grandicollis* (Eichhoff), *Ips pini* (Say), *Orthotomicus caelatus* (Eichhoff), and *Pityogenes hopkinsi* Swaine (CGMC).

Other Coleoptera commonly found in this sub-cortical environment together with *P. subtilissima* include *Tachyta angulata* Casey (Carabidae); *Paromalus teres* LeConte, *Platysoma coarctatus* (LeConte), *Plegaderus sayi* Marseul, (Histeridae); *Rhizophagus dimidiatus* Mannerheim (Monotomidae); *Epuraea truncatella* Mannerheim (Nitidulidae); *Silvanus bidentatus* (F.) (Silvanidae); *Charhypus picipennis* (LeConte), *Homalota plana* Gyllenhal, *Leptusa jucunda* Klimaszewski & Majka, *Nudobius cephalus* (Say), *Placusa tacomae* Casey (Staphylinidae); and *Corticeus praetermissus* (Fall) (Tenebrionidae) (CGMC). Blue-stain (*Ophiostoma*) and other (soft-rot and white-rot) fungi are also present.

Phloeocharis subtilissima has also been found to be abundant under the bark of fallen red maple (*A. rubrum*) in a rather different environment which is bereft of scolytine galleries. Other invertebrates present in this niche include the Coleoptera *Laemophloeus biguttatus* (Say) (Laemophloeidae) and *Phyllodrepa humerosa* (Fauvel) (Staphylinidae) in addition to podurid Collembola, and juvenile millipedes (Diplopoda). In this regard it seems to be somewhat generalist in its ecological requirements.

Adult *P. subtilissima* were collected each month from March to December with the exception of August. Sampling during the winter months, when there was considerable snow cover and temperatures were regularly below freezing, revealed that the adults are active on sunny days when the sub-cortical environment was observed to be warmed and defrosted. Peeling away the bark revealed individuals moving around and showing no apparent signs of torpor. In this pattern of being active during the winter it is similar to the recently described sympatric species, *Leptusa jucunda* Klimaszewski and Majka, with

which it co-occurs in Point Pleasant Park (Klimaszewski et al. 2004). The latter species, however, is found as an adult only from mid-November to the end of April.

Thus far, *P. subtilissima* appears to be confined to Point Pleasant Park. Limited field investigations in Fleming Park (1.6 km from Point Pleasant Park) and at Purcell's Cove Pond (a recently designated protected area 1.2 km from Point Pleasant Park), both wooded areas with a similar composition of tree species, have not yielded specimens. It should be emphasized that there are other possible areas of suitable habitat that have not been investigated, and that the search effort in Purcell's Cove Pond and Fleming Park has been much more limited than is the case in Point Pleasant Park.

Cephennium gallicum Ganglbauer

On five occasions (July 7, 2001, May 11, 2002, June 9, 2002, September 22, 2002, and October 9, 2004) six specimens of *Cephennium gallicum* Ganglbauer were collected in Point Pleasant Park. Five specimens were collected under the bark of branches or limbs of recently fallen or damaged white pine. The sixth specimen was collected while sweep netting through heath vegetation in a small sphagnum bog. Additionally, Peter Hammond collected four specimens in the Park in July, 1988 (NHM). These records represent the first report of this species in North America (Figures 3 and 4). *Cephennium gallicum* is also the only species of Palearctic scydmaenid known to have become established in North America.



FIGURE 3: *Cephennium gallicum* Ganglbauer, Point Pleasant Park, Halifax, Nova Scotia, Canada. Dorsal habitus.

The sub-cortical environment which *C. gallicum* inhabits is on wood which has been dead for at least a couple of years. The phloem layer has been almost completely consumed by bark- and wood-boring insects (Cerambycidae, Scolytinae, and Buprestidae)

which are now almost completely absent. The outer layer of the bark is loosely attached to the xylem leaving considerable open space beneath. Present in this habitat are considerable numbers of oribatid mites and in all occasions when *C. gallicum* were found, they were associated with these mites. On two occasions individuals of *C. gallicum* were observed with oribatid mites grasped in their mandibles. Other arthropods seen in this habitat include various entomobryid springtails (Collembola) and the weevils *Cossonus americanus* Buchanan, *Himatium errans* LeConte, and *Rhyncolus brunneus* Mannerheim (Curculionidae: Cossoninae), which appear to thrive in this rather dry environment.

As is the case with *P. subtilissima*, *C. gallicum* appears confined to the forests of Point Pleasant Park. Fieldwork in adjacent areas has not yielded specimens. Individuals have been found from May 11 to October 9.



FIGURE 4: *Cephennium gallicum* Ganglbauer, Point Pleasant Park, Halifax, Nova Scotia, Canada. Lateral habitus.

Discussion: Dispersion and Port Cities

The presence of *P. subtilissima* and *C. gallicum* in Nova Scotia provides an illuminating case study in the role that port cities such as Halifax have in relation to the introduction and dispersion of exotic Coleoptera. Atlantic Canada has long been noted for its fauna of introduced Coleoptera (Brown 1940, 1950, 1967; Lindroth 1963). Point Pleasant Park was the site of the first clearing and settlement of Halifax in 1749. Although the main settlement subsequently relocated further north along peninsular Halifax, various forms of anthropogenic activity have continued to the present (Kitz and Castle 1999). The city is a continuously active port and the port area is immediately adjacent to Point Pleasant Park.

Being a terminus for a considerable trans-Atlantic trade has provided many potential pathways for the arrival of foreign species.

The beetle fauna of Nova Scotia includes 317 introduced species, or 14.4% of its total fauna (C. Majka, unpublished data). Some of these have spread into Nova Scotia from introductions elsewhere (e.g. *Harmonia axyridis* Pallas). Others have been introduced at single or multiple locations in the province. In some cases it is clear where and when the introductions were made; in other instances specific evidence is lacking or is speculative. There are a number of introductions of exotic Coleoptera that are clearly associated with Point Pleasant Park and the adjacent environs of the port of Halifax. It is instructive to examine some of these (the list below is not exhaustive), particularly those for which Halifax introductions were amongst the first on the continent or in the country, as an example of some mechanisms of introduction, the cultural factors leading to these events, and the subsequent fate of the species. These examples are presented in chronological order of their discovery:

1) *Aphodius* spp. (Scarabaeidae): In the first published account of the Coleoptera of Nova Scotia, Jones (1869) reported the Palearctic *Aphodius fossor* (Linné), *A. fimentarius* (Linné), and *A. scybalarius* (Fabricius), all commonly found on cattle droppings in Halifax. Subsequent records of the latter species are lacking and Brown (1940) suggested that these might refer to *A. erraticus* (Linné), although it is also possible that *A. scybalarius* may have been present but did not persist. In any event, it would seem likely that they all arrived in Halifax in association with the importation of livestock and associated products. Lindroth (1963) reports *A. fimentarius* from Newfoundland as early as 1839-42 from the Peter Stuwitz collection. *A. fossor* and *A. fimentarius* are now very widely dispersed across North America and, like many other adventive, Palearctic species discussed by Lindroth (1963), their North American origins took place via introductions at eastern Canadian sea-ports.

2) *Chrysolina staphylea* (Linné) (Chrysomelidae): The first North American record of this flightless leaf beetle was from Halifax in 1897 (Evans 1899). Knab (1911) subsequently reported it from McNab's Island (from collections by J. Perrin in 1910), approximately 1.6 km across the mouth of Halifax Harbour from Point Pleasant Park, and Brown (1950) found it in Dartmouth, 2.5 km away. In Europe this species is associated with *Achillea*, *Mentha*, *Plantago*, and *Ranunculus* (Riley et al. 2002). All these plant taxa include many Eurasian species introduced to Nova Scotia. It seems probable that *C. staphylea* may have been introduced along with the accidental or deliberate introductions of these plants.

The species has now been found in a number of locations in Colchester, Cape Breton, Lunenburg, Queens, and Shelburne counties in NS (JOC, NSMC, & UCCB) and in Québec and Newfoundland (LeSage 1991). Given that the beetle is flightless and is absent

from intervening areas, the evidence would indicate multiple introductions through several seaports.

3) *Agonum muelleri* (**Herbst**) (Carabidae): Brown (1950) reported this Palearctic species based on specimens found in Halifax in 1897 while Lindroth (1963) reported specimens from Newfoundland from the 1840's. Both authors suggested that ship's dry ballast was the probably source of entry of many introduced ground-dwelling Coleoptera. Brown noted that large quantities of dry ballast were unloaded at Maritime ports during the Napoleonic Wars (1799-1815) by British vessels in search of timber at a time when Baltic ports were closed to Britain. A ground-dwelling species such as *A. muelleri*, which is known from wharves, gravel pits, lakeshores, etc. (Larochelle & Larivière 2003) would be a likely candidate for this method of entry. This species is now widely distributed in Nova Scotia (Majka 2003) and in much of North America (Bousquet and Larochelle 1993).

A similar mode of accidental introduction could apply to *Amara bifrons* (Gyllenhal), another ground-dwelling Palearctic carabid reported by Brown (1950) from Dartmouth (on the eastern shore of Halifax Harbour) in 1947. Lindroth (1963) noted specimens collected in Sydney, NS in 1929 as the first records from North America. This species is also now widespread in Nova Scotia (Majka 2003) and in northeastern North America (Bousquet and Larochelle 1993).

4) *Meligethes viridescens* (**Fabricius**) (Nitidulidae): Hoebeke and Wheeler (1996a) reported this species from 1994 and 1995 collections in Point Pleasant Park (CUIC). Brown (1967) had earlier reported it in North America from Sydney, NS in 1965. Mason et al. (2003) subsequently provided records from NS from as early as 1947 (CNC). Examination of material at the NSMC reveals specimens from September 1, 1945 (collected by Douglas Ferguson, very likely in Point Pleasant Park); these being the first known records in North America for this species. It continues to be abundant there on the coastal mustard, *Raphanus raphanistrum* L. In Europe, the Mediterranean area, and east to Kazakhstan, *M. viridescens* is widespread and common on oilseed rape (*Brassica napus* L. and *Brassica rapa* L.). It is now found in a number of other areas in Nova Scotia and Prince Edward Island (Mason et al. 2003).

5) *Dromius fenestratus* (**Fabricius**) (Carabidae): Previously unreported is the discovery of the Palearctic carabid, *Dromius fenestratus*, in Point Pleasant Park in a collection made by Douglas Ferguson, May 28, 1968 (NSMC). This species was previously reported from North America based on collections made in 1994 and 1997 in St. John's, Newfoundland (Larson 1998). Although recent fieldwork in Point Pleasant Park by the first author has not yielded specimens (suggesting that the population may not have persisted) J. Ogden has collected the species at Shubenacadie, Colchester County, August 28, 2001 in a stand of 25 year-old red pine (*Pinus resinosa*), only the third known-locality for this species in North

America (NSNR). Larochelle and Larivière (2003) report that this species in Europe is found principally in pine forests where it shelters during the day under loose bark of trees and is a frequent climber on the trees. Thunes et al. (2004) report it as arboreal in *Pinus sylvestris* forests in Norway.

6) ***Tetropium fuscum* (Fabricius)** (Cerambycidae): During a 1990 survey of bark beetles of Point Pleasant Park a number of *T. fuscum* were collected (Robertson 1990) (NSMC). Although they were originally misidentified as the native *T. cinnamopterum* Kirby, subsequent examination in 1999-2000 clarified their status as *T. fuscum* (Smith and Hurley 2000). This discovery led to a program by the Canadian Food Inspection Agency (CFIA) to eradicate the species, a legal injunction to stop it, a subsequent cutting program, a continuing quarantine of a number of areas in the Halifax Regional Municipality, and a considerable degree of public controversy (Majka 2001). Smith and Humble (2000) believe that wood-packing material in the adjacent container port was the source of the introduction. At least in Point Pleasant Park they appear to have been exterminated. The first author has seen no specimens collected from there since 2002.

7) ***Scymnus suturalis* Thunberg** (Coccinellidae): Hoebeke and Wheeler (1996b) reported the first record of the Palearctic coccinellid, *Scymnus suturalis* Thunberg, from Atlantic Canada based on a single individual collected on *Pinus sylvestris* from the campus of Dalhousie University in 1993. The species is quite abundant in Point Pleasant Park where it occurs principally on *P. sylvestris* and *P. banksiana* Lamb. (CGMC).

Gordon (1982) first reported this species from the United States, suggesting that it had been established in North America since the early part of the 20th century, and had probably been introduced with shipments of conifer nursery stock. McNamara (1992) gave the first Canadian records from Québec collected as early as 1983.

8) ***Popillia japonica* Newman** (Scarabaeidae): During the summer of 2001 it came to the attention of municipal authorities that significant numbers of the Japanese Beetle, *Popillia japonica*, were present in Cornwallis Park (1.2 km from Point Pleasant Park, and immediately adjacent to the port's railroad facilities) (LeBlanc 2002). The population was confined to a small area where adults were feeding on *Rosa rugosa* Thunb. The CFIA began a program to eradicate the population. A previous introduction of the species to Cornwallis Park in 1945 was apparently exterminated by 1951, although its re-occurrence in the same location 50 years later might cast some doubt on this. The proximate location of the railroad terminal to Cornwallis Park suggests that rail traffic from other parts of the continent where *P. japonica* is established may have been responsible for its introductions.

The species was first recorded in North America from New Jersey in 1916 on the roots of nursery stock from Japan (Ratcliffe et al. 2002). The first Canadian record was based on a specimen (ACNS) interdicted in a tourist's car in Yarmouth, NS (LeBlanc 2002). The

current program of extermination in Cornwallis Park appears to have been effective. The first author has seen no specimens since 2002.

These examples illustrate the role that commerce and cultural activity in a port city such as Halifax has and continues to play in the introduction of exotic species to the continent. The precise origin of some species remains conjectural while there are well-grounded hypotheses with respect to several others. Wood-packing material may have been the source of *T. fuscum*. Rail traffic from other parts of the continent may have been responsible for the introduction of *P. japonica*. *M. viridescens* may have arrived via shipping, probably associated with oilseed related products. *Aphodius* species probably entered in association with livestock. *Agonum muelleri* and *Amara bifrons* may have been introduced with dry ballast. *Chrysolina staphylaea* probably arrived in association with garden plants.

In the case of *S. suturalis*, *P. subtilissima*, *C. gallicum*, and *D. fenestratus*, it is likely that different cultural practices are responsible for the introductions. All are associated with conifers in general and with pines in particular. As early as 1878 Point Pleasant Park's administration reported importing various nursery plants from Scotland. In 1894, 2,500 trees (*Picea abies* (L.) Karsten, *Abies alba* Miller, and *Ulmus glabra* Hudson) were imported from Scotland and planted there. In the years 1935-37 nearly 8,000 trees (almost all of them exotic) were imported and transplanted to the park, including 2,000+ *Pinus sylvestris*, 1,000+ *P. abies*, and other exotics (Kitz & Castle 1999). It seems likely that all these beetles were imported to North America in association with these plantings of nursery stock.

Although *S. suturalis*, *P. subtilissima*, and *C. gallicum* are all found in Scotland *D. fenestratus* is not found in Great Britain, indicating that at least this species (if not others) arrived from the European continent. In this context, although Smith and Humble (2000) speculate that wood-packing material from the container port was responsible for the introduction of *T. fuscum*, evidence is lacking and it is also possible that this arboreal, continental European species could also have arrived in association with the importation of nursery stock, possibly the 1935-37 plantings.

Tetropium fuscum and *P. japonica* are in the process of being forcibly eradicated. *Meligethes viridescens* has appears to have spread to other parts of the province and (perhaps) beyond. *Scymnus suturalis*, *P. subtilissima*, and *C. gallicum* are largely or completely confined to the Park, while *D. fenestratus* has disappeared in the Park through natural circumstances. *Aphodius fossor*, *A. fimentarius*, *Agonum muelleri*, and *Amara bifrons* are now widely distributed in NS, although there have been multiple sites of introduction of these species.

Changes in shipping practices in recent years and more stringent inspections may decrease such incidents in the future although new shipping techniques provide new opportunities. The first author has observed Gypsy moths (*Lymantria dispar* (L.)) (a European species introduced to North America in 1868-69) and Armyworm moths (*Pseudale-*

tia unipuncta (Haworth)) flying from the forest adjacent to the railway tracks leading to the Halifax container terminal and taking shelter within the corrugated surfaces of containers entering and leaving the port – clearly illustrating mechanisms of potential introduction. Although the examples treated here are from the port of Halifax, the mechanisms of transmission are of equal validity and concern at all seaport locations.

The future prospects of *P. subtilissima* and *C. gallicum* in North America are uncertain. On September 28 and 29, 2003 the eye of Hurricane Juan struck Halifax. Point Pleasant Park was the most severely damaged portion of the municipality. An estimated 55,000 trees (70% of the forest) were destroyed or damaged. On the one hand, this led to an enormous increase in the volume of dead wood in the Park. Subsequent restoration and remediation programs have, on the other hand, removed and destroyed a large proportion of this fallen wood. How the species are able to adapt to this significant disruption to their environment remains to be seen. In recent fieldwork in 2004 the first author has found both species still to be present in Point Pleasant Park.

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