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Discovery of *Nebria brevicollis* (Fabricius) (Coleoptera: Carabidae: Nebriini), a European Ground Beetle, Established in the Willamette Valley, Oregon

David H. Kavanaugh[1] and James R. LaBonte[2,3]

[1] *Department of Entomology, California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118, USA; Email: dkavanaugh@calacademy.org;* [2] *Oregon Department of Agriculture, 635 Capitol Street N.E., Salem, OR 97301-2532, USA; Email: jlabonte@oda.state.or.us*

The European carabid beetle species, *Nebria brevicollis* (Fabricius), is recorded for the first time for the United States and for western North America from multiple sites in the Willamette Valley of northern Oregon. These are also the first records for North America (Canada) since the 1930s. *Nebria brevicollis* is clearly well established in the region and should be expected in subsequent inventory work elsewhere in the Pacific Northwest.

KEY WORDS: Carabidae, Nebriini, *Nebria brevicollis* (Fabricius), introduced species, Pacific Northwest fauna.

Nebria brevicollis (Fabricius) (Fig. 1) is one of the best known, frequently encountered, and widely distributed ground beetle (Coleoptera: Carabidae) species in Europe. Its geographical range includes almost all of Europe within a perimeter traced from Iceland, the Faero Islands and the British Isles in the northwest, eastward across southern Scandinavia to the western edge of the Russian Plain, southeast to the Caucasus Mountains and Turkey in Asia Minor, and westward across the Mediterranean region to Spain. Löbl and Smetana (2003) also record *N. brevicollis* from Algeria in North Africa.

The habitat range of *N. brevicollis* is also broad. Although the predominant habitat is deciduous forest (Lindroth 1961), members of this species are also abundant in disturbed or synanthropic situations such as parks, gardens, and even agricultural plots. In all these habitats, they prefer the cover of leaf litter on shaded ground. The only habitats from which they appear to be excluded are those with very saline or very wet conditions. In this last trait, *N. brevicollis* members differ from those of most other *Nebria* species, which are typically more hygrophilous, occurring along the margins of streams, lakes, snowfields, or glaciers or in moist areas at the margin of subalpine meadows, particularly in montane regions. Despite the somewhat atypical habitat preferences of its members, *N. brevicollis* is the type species of the Holarctic genus *Nebria* Latreille, 1802 (by subsequent designation by Latreille 1810).

Records of the occurrence of *N. brevicollis* outside of its native range are very few. The only two such records of which we are aware are those cited by Lindroth (1955 and 1961) (Fig. 3). A single adult specimen, in poor condition and possibly found dead, was collected in St. Césaire, Quebec, in June 1930 (Lindroth 1961) and one adult male specimen was found on Miquelon Island,

[3] Research Associate, Department of Entomology, California Academy of Sciences

off the southern coast of the Island of Newfoundland, in 1937 (Lindroth 1955). Lindroth (1961) suggested, correctly in our opinion, that *N. brevicollis* had not become established at either of these locations. No additional specimens of *N. brevicollis* have been recorded from these or any other sites in North America subsequently (Larochelle 1975; Bousquet and Larochelle 1993).

Knowing well the scant historical occurrence of *N. brevicollis* in North America, we were astonished to discover and collect a series of 19 adult specimens of this species on the evening of 27 May 2008 in a mixed woodland area, just west of the city of Dallas, in Polk County, Oregon. The beetles were easily recognized, using just a hand lens, by their overall appearance (Fig. 1) and their dorsally setose tarsi (Fig. 2), a feature not found in any native *Nebria* species. One of us [JRL] collected an additional nine adults at the same site the following night. Ironically, just two days later, additional specimens of *N. brevicollis* were found in fresh samples from pitfall traps placed in several locations around the greater Portland area and at other sites in the northern Willamette Valley in early April, 2008. Furthering this set of coincidences, when JRL was visiting the Oregon State Arthropod Collection (OSAC) at Corvallis on 24 June 2008, he was asked to identify several specimens from blueberry farms in Benton and Clackamas counties, Oregon. Among them were several *N. brevicollis*! Further inquiries found that almost three thousand specimens of this species had been collected in those situations, and that a single specimen (the only one known from Oregon prior to 2008) had been collected in a strawberry field in late 2007. The purpose of this account is to report this flush of first known records of *Nebria brevicollis* for the United States and for western North America, and the first records for all of North America since the 1930's, and to encourage others to seek this species in the Pacific Northwest region.

FIGURES 1-2. Automontage® digital images of *Nebria brevicollis* (Fabricius). Fig. 1. Habitus, adult male, dorsal aspect; scale line = 1.0 mm. Fig. 2. Right front tarsus, male, dorsal aspect; scale line = 0.5 mm.

NEW RECORDS FOR *NEBRIA BREVICOLLIS* (FABRICIUS) IN NORTH AMERICA

Localities

The following new records for this species are all based upon adult specimens collected from pitfall traps except for those from Polk County, which were hand collected. Unless otherwise noted,

all specimens listed have been retained in the following repositories: CAS (California Academy of Sciences), JRL (James R. LaBonte collection), ODAC (Oregon Department of Agriculture Insect Collection), or OSAC. All specimens were collected in the Willamette Valley of northwestern Oregon as follows (see also Fig. 3):

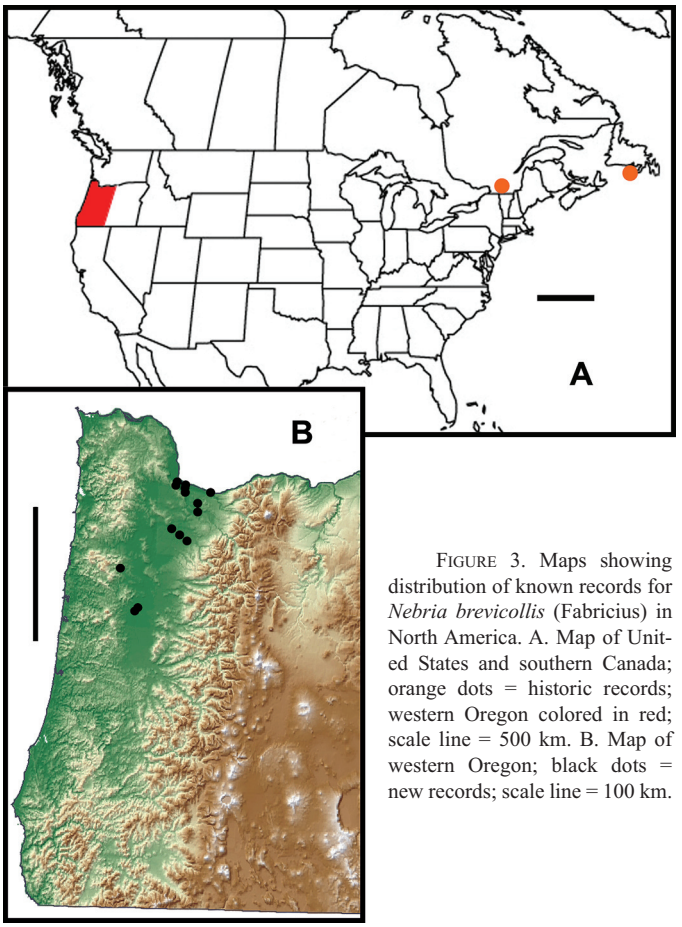

FIGURE 3. Maps showing distribution of known records for *Nebria brevicollis* (Fabricius) in North America. A. Map of United States and southern Canada; orange dots = historic records; western Oregon colored in red; scale line = 500 km. B. Map of western Oregon; black dots = new records; scale line = 100 km.

Benton County: Corvallis, strawberry field, 44.5608ºN/123.2269ºW, 2 November 2007, 1 ♀; 44.5747ºN/123.1956ºW, in samples from 5 May to 13 June 2008, many specimens. **Clackamas County**: Clackamas, container storage, 45.4044ºN/122.5525ºW, sample period 17 April to 9 May 2008, 1 ♀ and 1 ♂; Canby**,** blueberry fields, 45.1739ºN/122.6500ºW and 45.1772ºN/122.6461ºW, in samples from 5 May to 24 June 2008, many specimens. **Marion County**: Aurora, truck stop, 45.2571ºN/122.8091ºW, sample period 17 April to 25 April 2008, 10 ♀♀ and 6 ♂♂; Woodburn, commodity distribution center, 45.2128ºN/122.7206ºW, sample period 25 April to 19 May, 1 ♀ and 2 ♂♂ and sample period 19 May to 19 June 2008, 2 ♂♂. **Multnomah County:** Portland, heavy industry site, 45.4700ºN/122.5599ºW, sample period 22 April to 9 May 2008, 1 ♀ and 1 ♂, sample period 10 May to 22 May 2008, 4 ♀♀, and sample period 23 May to 10 June 2008, 2 ♀♀ and 2 ♂♂; rail depot, 45.5434ºN/122.6814ºW, sample period 9 May to 22 May 2008, 1 ♂; container yard, 45.5913ºN/122.6843ºW, sample period 8 May to 29 May 2008, 1 ♀; customs warehouse, 45.6039ºN/122.6824ºW, sample period 7 May to 29 May 2008, 1 ♀ and 1 ♂; container yard, 45.6134ºN/122.7724ºW, sample period 8 May to 28 May, 2008, 2 ♀♀; container yard, 45.6363ºN/122.7618ºW. Troutdale**,** truck stop, 45.5422ºN/122.3925ºW, sample period 9 May to 22 May 2008, 1 ♂; truck stop, 45.5423ºN/122.3881ºW, sample period 9 May to 22 May, 2008, 1 ♂. **Polk County**:2.4 km west of Dallas, forest, 165 m, 44.90743ºN/123.35465ºW, 27 and 28 May 2008, 13 ♂♂ and 15 ♀♀. Comments: Most specimens were fully pigmented and sclerotized, although some were slightly soft, suggesting eclosion from the pupal stage within the past few weeks. The beetles were found running at night in and near leaf litter on bare clay and humus soils on a rarely used dirt road through and beside the woodland; two specimens were collected at fresh banana slices used as bait for carabid beetles along this road.

The Polk County specimens were hand collected. The pitfall traps in which specimens from sites outside of Benton County, northernmost Clackamas County and Polk County were found were

part of a survey for exotic terrestrial plant pests funded by the Cooperative Agricultural Pests Surveys (CAPS) in cooperation with the U.S. Department of Agriculture, Animal Pest and Health Investigative Service (APHIS), Plant Pest and Quarantine (PPQ). The traps were placed in early and mid-April and sampled approximately every two weeks. The specimens collected in 2008 from Benton County and the northernmost Clackamas County sites were from pitfall traps surveying for pests and natural enemies in commercial blueberry fields. The following information was provided by J.C. Lee (unpublished data). The pitfalls were placed 5 May 2008 and samples were taken weekly. Up to the time of submission of this manuscript, almost three thousand specimens had been collected from these sites and *N. brevicollis* was among the most common species found. Specimens of *N. brevicollis* were collected throughout the sample periods of 5 May to 15 July at the Clackamas County sites and from 5 May to 13 June at the Corvallis site — only one was collected there during the sample period of 13 June to 14 July (J. Lee, *in litt*.). Collection of *N. brevicollis* peaked sharply during the latter half of May. The sole known specimen from 2007 was collected on 4 November from a pitfall trap placed in a strawberry field in Corvallis.

Habitats

The Benton County specimens of *N. brevicollis* and those from the northern Clackamas County sites were collected from intensively managed agricultural fields set amidst other agricultural plots. Native vegetation or non-crop vegetation was largely restricted to fence lines and borders, with a few small wood lots nearby. Both blueberries and strawberries are managed so that weeds are at a minimum within the fields.

The remaining Clackamas County and all Marion County and Multnomah County specimens were all collected from profoundly disturbed habitat in the vicinity of transport centers amid heavy industry (e.g., container storage and transport yards, steel refining and shipping, rail yards, etc.) or in rural industrial or otherwise disturbed settings. Typically, most of the surface area at these sites has been leveled and covered with gravel or pavement. Other than scattered scant weeds, what little vegetation is in the immediate vicinity is confined to the margins of the properties and consists of weeds and scrubby woody plants, if unmaintained, and dense ornamental growth of shrubs and trees, if maintained. Surprisingly, native sylvan species such as *Pterostichus algidus* LeConte and *Scaphinotus marginatus* (Fischer von Waldheim) were often abundant in these paltry refugia. However, there are often adjacent weedy fields or wetlands that may serve as more substantial, less disturbed habitat.

The Polk County specimens were collected in lightly disturbed, mature second growth mixed forest with generally closed canopy and understory shrubbery ranging from sparse to dense. The dominant tree species were Garry oak (*Quercus garryana*) and Douglas fir (*Pseudotsuga menziesii*), with some grand fir (*Abies grandis*), bigleaf maple (*Acer macrophyllum*), vine maple (*A. circinatum*), and western flowering dogwood (*Cornus nuttallii*). Understory shrubs included evergreen blackberry (*Rubus laciniatus*), Himalayan blackberry (*R. discolor*), native hazel (*Corylus cornuta*), Indian plum (*Osmaronia cerasiformis*), Oregon grape (*Mahonia aquifolium*), poison oak (*Rhus diversiloba*), and western snowberry (*Symphoricarpos occidentalis*).

Co-occurring carabid species

As all the sites other than that in Polk County were heavily disturbed and had very similar carabid faunas, the species collected with *N. brevicollis* at the blueberry fields and the industrial localities are listed together, as follows (exotic species are indicated by an asterisk*): **Agonum muelleri* (Herbst), **Amara aenea* DeGeer, *Amara littoralis* Mannerheim, *Amara longula* LeConte,

**Anisodactylus binotatus* (Fabricius), *Anisodactylus californicus* Dejean, *Anisodactylus similis* LeConte, **Bembidion lampros* (Herbst), *Blethisa oregonensis* LeConte, *Bradycellus conformis* Fall, *Bradycellus congener* (LeConte), **Bradycellus harpalinus* (Audinet-Serville), **Calathus fuscipes* (Goeze), **Carabus nemoralis* O.F. Muller, **Clivina fossor* (Linnaeus), *Elaphrus purpurans* Hausen, **Harpalus affinis* (Schrank), *Harpalus cordifer* Notman, *Harpalus opacipennis* (Haldeman), *Harpalus somnulentus* Dejean, *Loricera foveata* LeConte, *Microlestes linearis* (LeConte), *Omus auduoini* Reiche, *Omus dejeanii* Reiche, *Poecilus laetulus* (LeConte), *Pterostichus algidus* LeConte, *Pterostichus crenicollis* LeConte, **Pterostichus melanarius* (Illiger), *Scaphinotus angusticollis* (Fischer von Waldheim), *Scaphinotus marginatus* (Fischer von Waldheim), *Stenolophus conjunctus* Say, *Trachypachus gibbsii* LeConte, *Syntomus americanus* Dejean, and **Trechus obtusus* Erichson. Of these, only *Amara littoralis*, *Anisodactylus binotatus*, *C. nemoralis*, *H. affinis*, *H. cordifer*, *O. audouini*, *O. dejeani*, *P. algidus*, *P. melanarius*, *S. marginatus*, and *T. obtusus* were trapped frequently or in substantial numbers. The native species of *Harpalus*, and both *Omus* spp., and *Scaphinotus marginatus* were not trapped in the blueberry fields.

The carabid species collected with *N. brevicollis* at the Polk County site were: *Metrius contractus* Eschscholtz, *Omus audouini* Reiche, *Platynus ovipennis* (Mannerheim), *Promecognathus crassus* LeConte, *Pterostichus algidus* LeConte, *P. lama* (Ménétriés), *P. pumilus pumilus* Casey, *Scaphinotus marginatus* (Fischer von Waldheim), and *Zacotus matthewsii* LeConte.

Discussion

Nebria brevicollis is clearly well established and thriving in northwestern Oregon, as indicated by the numerous sites at which it has been collected, the multiple dates when specimens were found, and the large numbers of specimens collected from multiple sites (i.e., Aurora, Corvallis, Dallas, and the blueberry farms in Clackamas County). Whether this species is more-or-less continuously distributed from the Portland metropolitan area south to Corvallis and beyond is unknown. Given the proximity of the Washington border (formed by the northern banks of the Columbia River) to those Portland sites (along the southern banks thereof), it seems virtually certain that *N. brevicollis* is present in at least southernmost Washington.

As indicated by the map (Fig. 3), *N. brevicollis* is known in the U.S. and Oregon only from the Willamette Valley. Since this area of Oregon has the greatest concentration of human population and potential pathways for introduction, it is the most likely locality for exotic species to be introduced and established within the state. The abundance of *N. brevicollis* and its frequency of occurrence in the Willamette Valley would seem to argue against recent introduction, but several lines of evidence suggest otherwise. The limited known distribution of *N. brevicollis* in Oregon suggests that introduction occurred relatively recently, perhaps as recently as within the last decade. Since all (80%), except *Calathus fuscipes*, of the exotic carabid species documented from Oregon after Bousquet and Larochelle (1993) (Westcott et al. 2006) are small (less than 4.5 mm in total length) and inconspicuous, this suggests that *N. brevicollis* was introduced, or at least became widely established in the Willamette Valley, since Hatch (1953) and Lindroth (1961). This relatively large and active addition to Oregon's exotic carabid fauna would have been readily recognized by those authors, as well as any Oregon carabidologists, especially given that only one other Oregon nebriine, *Nippononebria virescens* (Horn), is found in similar terrestrial sylvan habitats. Further support for the recent establishment of *N. brevicollis* is provided by the absence of any North American or Oregon specimens in the extensive carabid holdings at the OSAC, as determined by JRL. The only known specimen predating the collections in 2008 is that found in Corvallis in late 2007, despite

many studies of the insect faunas of the numerous crops grown in the vicinity and throughout the state. Although records of flight for *N. brevicollis* adults have been extremely few (Lindroth 1945), all specimens of this species examined to date worldwide have had fully developed hindwings. Flight is therefore a likely, even if infrequent, means of dispersal. Active dispersal via flight and passive dispersal via various human activities combined with eurytopic habitat tolerances seem sufficient to explain rapid expansion of this species from an initial point of introduction. Multiple introductions would further aid such expansion. If anything, it is surprising that such a species, which is also so abundant in its native haunts, has not been successfully transported more frequently and widely.

Many, if not most, of the exotic carabid species found in North America were probably introduced via ballast dumping by cargo ships, especially those of European origins (e.g., Lindroth 1957). This practice has long since ceased. Imported nursery stock was suggested as the means by which *Trechus obtusus* was introduced into North America (Kavanaugh and Erwin 1985) and was discussed as a means of carabid introduction into western Canada by Spence and Spence (1988). As mentioned previously, most of the exotic carabid species documented from Oregon post-Bousquet and Larochelle (1993) are small and very apt to be introduced via this pathway. The known Oregon distributions of these species, also primarily in the Willamette Valley, make sense in light of this explanation - this area is the hub of the state's nursery industry, the number one agricultural commodity of Oregon (Oregon Dept. of Agriculture 2007). The apparent restriction of *N. brevicollis* to the Willamette Valley also fits this hypothesis. Although other scenarios are possible (e.g., "hitchhiking" in cargo containers), the introduction of *N. brevicollis* into Oregon and the U.S. via nursery stock appears very likely.

Detection of *N. brevicollis* in Oregon increases the total number of known exotic carabids in Oregon to 23 (Bousquet and Larochelle 1993; Westcott et al. 2006). Most of these species appear to be archetypal synanthropes (*sensu* Lindroth 1957) largely found in anthropogenic habitats. With the exception of the Dallas (Polk Co.) site, all Oregon localities from which *N. brevicollis* has been recovered are sites that have been intensely disturbed by human activities, either agricultural or industrial. It is not surprising that the contingent of carabid species occurring at these sites with *N. brevicollis* are almost exclusively other exotics, native species generally found in open habitats, or eurytopic natives (e.g., *Pterostichus algidus* and *Scaphinotus marginatus*). Finding a few specimens of carabid species with more restrictive habitat requirements (*e.g.*, *Blethisa oregonensis* and *Trachypachus gibbsii*), does not negate this overall pattern as they are merely indicators of adjacent less perturbed habitat.

The carabid fauna found with *N. brevicollis* at Dallas and the habitat thereof is strikingly different from that of the other Oregon sites. Other than *N. brevicollis*, none of the species found there were exotic and all were typical inhabitants of low to moderate elevation western Oregonian mixed conifer/broadleaf forests. Most exotic carabid species introduced to North America appear to be true synanthropes (*sensu* Spence and Spence 1988), both common in anthropogenic habitats and with their distributions concentrated in such settings. Since many of these species are synanthropic in Europe they have been thought to be "cultural steppe" specialists taking advantage of a more or less empty niche to which they are "preadapted" in North America (Spence and Spence 1988). Incursions by a few exotic carabids into more pristine habitats (e.g., *Carabus nemoralis* (LaBonte and Nelson 1998) and *Pterostichus melanarius* (LaBonte and Nelson 1998, Niemelä and Spence 1994) in forests and *Elaphropus parvulus* (Dejean) in riparian areas (LaBonte and Nelson 1998)) have been documented. These latter species would seem to be examples of "habitat generalists" with flexible habitat requirements in the sense of Spence (1990). In that perspective, *N. brevicollis*, which can be found in both forested and anthropogenic habitats in Europe (Lindroth 1945)

seems to be demonstrating similar habitat flexibility in Oregon through its incursion into relatively undisturbed forest in the vicinity of Dallas. An unanswered question is what the impact of this eurytopic species will be on the native sylvan carabid fauna of Oregon, especially with regard to native eurytopes such as *Pterostichus algidus* and *Scaphinotus marginatus*. At several forested sites in Idaho, *C. nemoralis* appears to be supplanting the native *C. taedatus* Fabricius (E. van den Berghe, *in litt.* and JRL, personal observation). If this is indeed the case, the perception that most exotic carabid species in North America are ecologically neutral with reference to native habitats and species (by filling and being more or less restricted to an "empty niche") may not be valid. Study of the ecology of *N. brevicollis* in Oregon, especially in sylvan habitats, certainly seems in order.

We hope that others will begin to look for *N. brevicollis* elsewhere in Oregon and adjacent states, particularly in southern Washington. Several aspects of the presumably recent establishment of this species offer excellent prospects for further study. Although its Oregon range seems to be rapidly expanding, apparently it is not yet widely distributed throughout the state or the Pacific Northwest. This offers an opportunity to explore the impacts of *N. brevicollis* not only upon native habitats and species but also upon exotic carabid associations in disturbed habitats.

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