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XYLEBORUS SERIATUS BLANDFORD (COLEOPTERA: CURCULIONIDAE: SCOLYTINAE), AN ASIAN AMBROSIA BEETLE NEW TO NORTH AMERICA

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Abstract.—*Xyleborus seriatus* Blandford, an ambrosia beetle described from Japan, is reported for the first time from North America, based on specimens examined from Massachusetts. A re-description and diagnosis of the adult female, a summary of known distribution and biology, a revision to an existing key to North American xyleborine species to include this newly detected immigrant, and photographs of the adult habitus and other diagnostic morphological features are presented.

Key Words: Coleoptera, Curculionidae, Scolytinae, Xyleborina, *Xyleborus seriatus*, new North American record, exotic species

Bark and ambrosia beetles (Curculionidae: Scolytinae) are among the most commonly intercepted beetles associated with solid wood packing materials at U.S. ports-of-entry (Haack 2001, 2003, 2006; Haack and Cavey 1997, 2000). Due to their wide host range, cryptic habits, and their polygamous, sib-mating behavior, ambrosia beetles of the subtribe Xyleborina are commonly transported in commerce and are likely to successfully establish breeding populations in new habitats (Wood 1982, Atkinson et al. 1990, Rabaglia et al. 2006). Currently 39 species of Xyleborina are recorded in America north of Mexico, with almost half (18) of these representing non-indigenous species (Rabaglia et al. 2006).

The large and complex genus *Xyleborus* Eichhoff is currently comprised of over 500 nominate species which occur worldwide wherever woody plants grow (Rabaglia et al. 2006; http://xyleborini.tamu.edu/browse.php?genus=Xyleborus). Twenty species of the genus occur in America north of Mexico, nearly half of which (9) are non-indigenous.

As part of the USDA Forest Service Early Detection and Rapid Response project, extensive trapping surveys were conducted in the northeastern United States in 2005. Lindgren funnel traps baited with host volatiles and bark beetle pheromones were placed in areas at high risk for the introduction and establishment of non-native bark and ambrosia beetles. Numerous specimens of an unrecognized species of *Xyleborus* were collected in several counties in Massachusetts. As part of the survey protocol, specimens were sent to ERH who tentatively identified them as *X. seriatus* Blandford, an Asian species, and then forwarded to RJR for comparison and confirmation. Additional recoveries of this exotic ambrosia beetle were made from other Lindgren funnel traps in Massachusetts in 2006.

This paper reviews what little information is known and published on *X. seriatus*. Herein we provide a list of distributional records and a map for this newly detected ambrosia beetle in Massachusetts; a re-description, diagnosis and revised species key for facilitating its recognition in North America; and a summary of its native distribution, host tree preferences, and biology and habits.

Xyleborus seriatus Blandford
(Figs. 1–4)

Xyleborus seriatus Blandford 1894: 111.
Xyleborus orientalis Eggers 1933: 54. Synonymized by Mandelshtam 2006: 324.

Diagnosis.—Specimens of *X. seriatus* are readily distinguished from other species of *Xyleborus* occurring in North America by the distinctly impressed area of the elytra immediately adjacent to the scutellum (Fig. 3). Also, the pronotum is nearly quadrate, only 1/4 longer than broad; the pronotal disc has the anterior half and posterolateral areas strongly asperate (Figs. 1–2); and each elytron has alternate series of longer and shorter setae.

The genus *Xyleborus* is distinguished from other genera of Xyleborina by the moderately large scutellum which is generally flat and flush with the dorsal surface of the elytra, the contiguous procoxae, the distinctly obliquely truncate antennal club, and an elongate or rounded pronotum with the posterior portion usually smooth and punctate. *Xyleborus seriatus* has been consistently placed in *Xyleborus*, although the scutellum is somewhat small and rounded and the area surrounding the scutellum is distinctly impressed. In specimens examined, this impressed area appears to be filled with a matrix that may be of fungal origin. R.A. Beaver (personal communication) suggests this impression might indicate a mycangial opening.

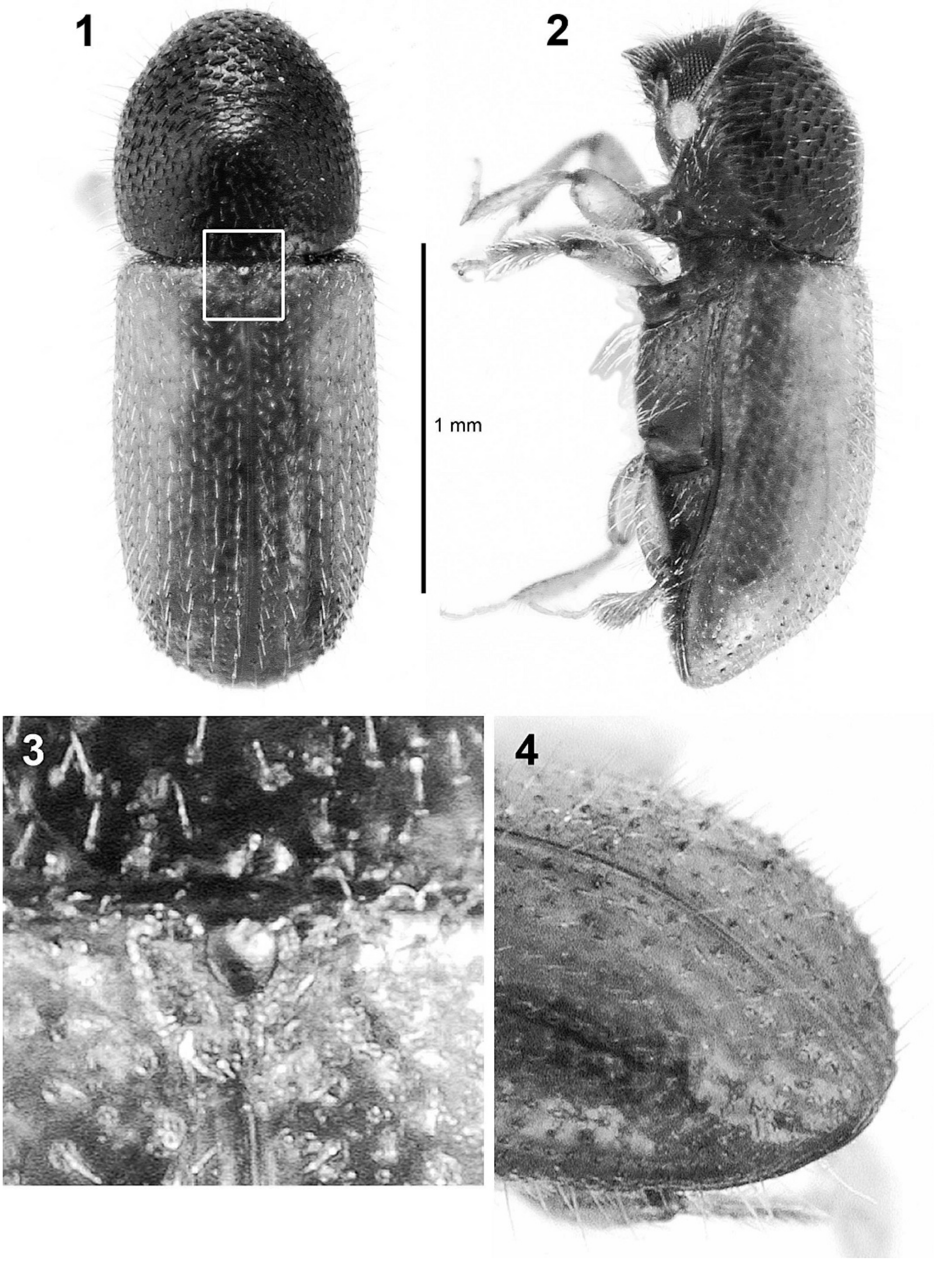
Recently, Mandelshtam (2006) synonymized *Xyleborus orientalis*, a species described from the Russian Far East, with *X. seriatus*. He noted that no morphological characters could be found that differentiate specimens of *X. orientalis* from the continental territories of the Russian Far East from specimens of *X. seriatus* from Japan.

To accommodate *X. seriatus*, couplet #2 (p. 1,037) of the key to genera of female Xyleborina in America north of Mexico by Rabaglia et al. (2006) should be modified as follows (**alterations in boldface**):

2(1). Scutellum conical, base of elytra at suture notched, with abundant setae (Fig. 3) . . . . *Xyleborinus*
– **Scutellum flat, glabrous, its surface flush with adjacent elytra, or scutellum rounded, surrounded by a moderately deeply impressed area at the base of the elytra 2a**
2a(2). Sutural area adjacent to scutellum impressed (Fig. 3 in this paper) . . . . *Xyleborus* (in part)
– **Sutural area adjacent to scutellum not impressed 3**

The following key to female *Xyleborus* in America north of Mexico (Rabaglia et al. 2006) is revised as follows (**alterations in boldface**) to include *X. seriatus*.

1. Antennal club distinctly obliquely truncate, with segment 1 corneous, its distal margin forming a complete circle extending from anterior face to apex, suture on apical area of posterior face not visible, segment 2 on anterior face not visible (Fig. 2); strial punctures in rows, elytral vestiture sparse, confined to strial and interstrial rows **1a**
– unchanged
1a(1). Area adjacent to scutellum impressed (Fig. 3); pronotum nearly as broad as long, with posterolateral areas distinctly, strongly asperate (Fig. 1–2) . . . . *X. seriatus*
– **Area adjacent to scutellum not impressed, flush with elytral base; pronotum stout or elongate, with posterolateral areas not asperate 2**



Figs. 1–4. *Xyleborus seriatus*. 1, Dorsal aspect (scutellar region outlined). 2, Lateral aspect. 3, Close-up of scutellar region showing impression surrounding scutellum. 4, Declivity.

Description (adapted from Blandford 1894 and Eggers 1933).—Female. Length 1.9–2.5 mm. Color dull reddish brown, with elytra paler; frons nearly flat, finely reticulate, sparsely, but distinctly punctured, pubescence of few, fine long setae, with an indistinct median longitudinal elevation. Eyes deeply emarginate. Antennal club type 2 (*sensu* Hulcr et al. 2007).

Pronotum 1.25 times longer than wide, truncate at base with posterior angles obtuse, lateral margins slightly rounded, in front strongly rounded to apex. Disc sparsely pubescent with an obtuse, transverse elevation at middle; anterior half distinctly asperate; posterior half finely reticulate, strongly punctured, with smooth median line; punctures of posterior half becoming asperate along lateral margins. Pronotum shape: dorsal aspect type 5; lateral aspect type 7 (*sensu* Hulcr et al. 2007).

Elytra 1.75 times longer than wide, as wide as pronotum, truncate at base with humeral angles rounded, sides straight, broadly rounded to apex; striae not impressed, distinctly punctured. Scutellum small, globose, with surrounding area (Fig. 3) distinctly impressed. Declivity (Fig. 4) broadly flattened, sloping, occupying 30–40% of elytra (Fig. 2), weakly impressed at sides of suture, with sparsely impressed strial rows of coarse, close punctures and short, fine setae. Declivital interstriae with single rows of finer and less numerous punctures, but with longer setae and very finely tuberculate on apical half. Elytral vestiture consisting of fine, long interstrial setae and shorter strial setae.

Male. Not examined.

Distribution.—The native Palearctic distribution of *X. seriatus* includes northern China (Shanxi, Sichuan), Japan, North and South Korea, Taiwan, and the Russian Far East (Kuril Islands and Primorsk Territory) (Chu 1964, Choo and Woo 1985, Wood and Bright 1992, Hua 2002, Mandelshtam 2001, 2006). In North America, *X. seriatus* is currently known only from four counties in Massachusetts (Haack 2006) (Fig. 5).

Biology, habits, and hosts.—The gallery system and boring behavior of *X. seriatus* are similar to that of bark beetles, constructing communal galleries under the bark and not penetrating the xylem (Mandelshtam 2006); the brood female, larvae, and pupae are all found together in communal chambers under the bark (Murayama 1955, Nakashima et al. 1992). In a Japanese study of several ambrosia beetles found in beech logs (*Fagus crenata* Blume), Nakashima et al. (1992) noted that the gallery tunnels of *X. seriatus*, where adult females were found, measured approximately 1 mm wide and 20 mm long and that "oval or sausage-shaped fungi" grow on the gallery walls nearest to the entrance. *Xyleborus seriatus* occurs symbiotically with fungi that are closely related to those associated with typical bark beetles. In a comparative morphological study of adult bark and ambrosia beetles, Nobuchi (1969) found the proventriculus of *X. seriatus* to be strikingly similar to that of true bark beetles. *Xyleborus cryptographus* (Ratzeburg), considered closely related to *X. seriatus* (Mandelshtam 2006), also constructs its gallery system under bark of unhealthy trees (Lekander 1963, Postner 1974).

In its native Palearctic range, its reported host taxa are extensive, including the following conifers [*Abies sachalinensis* (Friedr. Schmidt) M. T. Mast, *Chamaecyparis* spp., *Cryptomeria japonica* (L. f.) D. Don, *Larix kaempferi* (Lamb.) Carriere (cited as *L. leptolepis*), *Picea jezoensis* (Siebold & Zuccarini) Carriere, *Picea ajanensis* (Lindl. et Gord.) Fisch., *Pinus armandii* Franch., *P. parviflora* Siebold & Zucc. (cited as *P. pentaphylla*, *P. pentaphylla* var. *himekomaisu*), *P. tabuliformis* Carriere, *P. thunbergiana* Franco (cited as *P. thunbergii*), *Thuja standishii* (Gord.) Carriere, *Tsuga*

Fig. 5. Distribution of *Xyleborus seriatus* in Massachusetts.

spp., and *Taxus* sp.] and hardwoods [*Acer rufinerve* Siebold & Zucc., *Aesculus turbinate* Blume, *Alnus incana* (L.) Moench. var. *glauca*, *Betula* spp., *Carpinus tschonoskii* Maxim., *Castanopsis* sp., *Cleyera japonica* Thunb., *Fagus crenata*, *Kalopanax septemlobus* (Thunb. ex A. Murr.) Koidz., *Mallotus japonicus* (Thunb.) Müll-Arg., *Prunus* sp., *Quercus* spp., *Rhus orientalis* (Greene) C. K. Schneid. (cited as *R. ambigua*), *Schima* sp., and *Tilia japonica* (Miq.) Simonk.) (Klein 1934, Inouye 1955, Nobuchi 1966, Yin et al. 1984, Choo and Woo 1985, Wood and Bright 1992, Mandelshtam 2001, 2006). *Xyleborus seriatus* is one of a few species of ambrosia beetles that breed in both coniferous and deciduous trees.

Interceptions.—There are no USDA-APHIS port-of-entry interception records for *X. seriatus* from imported cargoes entering the United States. However, two female *X. seriatus* were intercepted from an imported yew (*Taxus* sp.) log at Kobe, Japan, in March 1981 originating from Nampo, North Korea (Browne 1981, Choo et al. 1983).

New North American records.—All distributional records of *X. seriatus* listed below and mapped in Fig. 5 are based on specimens collected from baited Lindgren funnel traps set at sites in Massachusetts from mid-April through mid-July 2005–2006. Most specimens were trapped in May. Traps were fitted with collection cups partially filled with propylene glycol (low toxicity) and water (1:1, vol./vol.). Rain often diluted this volume beyond the 1:1 ratio. Traps were generally checked every two weeks. The date each site was checked, with the number of specimens collected in parentheses, is noted below. Voucher specimens have been deposited in the Cornell University Insect Collection, Ithaca, NY; National Museum of Natural History, Washington, DC; Carnegie Museum of Natural History, Pittsburgh, PA; Massachusetts Department of Conservation & Recreation, Amherst; and the personal collection of RJR.

UNITED STATES: MASSACHUSETTS: *Essex Co.*, Andover, 25-IV-2006 (4), 9-V-2006 (27), 25-V-2006 (10), 6-VI-2006 (15); Middleton, 25-IV-2006 (3), 9-V-2006 (83), 25-V-2006 (20). *Franklin Co.*, Erving, 17-V-2005 (1). *Middlesex Co.*, Hopkinton, 23-V-2005 (19), 6-VI-2005 (9), 30-VI-2005 (1); Reading, 25-IV-2006 (2), 9-V-2006 (3), 25-V-2006 (2); Sherborn, 8-V-2006 (14), 25-V-2006 (1); Stow, 25-IV-2005 (5), 9-V-2005 (10), 23-V-2005 (133), 6-VI-2005 (29), 21-VI-2005 (1). *Worcester Co.*, Lancaster, 19-IV-2006 (12), 5-V-2006 (252), 17-V-2006 (95), 30-V-2006 (145); Leominster, 19-IV-2006 (2), 5-V-2006 (1), 17-V-2006 (1); Southboro, 11-IV-2005 (28), 25-IV-2005 (2), 9-V-2005 (15), 23-V-2005 (303), 6-VI-2005 (42), 20-VI-2005 (6), 30-VI-2005 (1), 18-VII-2005 (3); Sterling, 16-V-2005 (16), 31-V-2005 (2), 12-VI-2005 (1); West Boylston, 19-IV-2006 (1), 5-V-2006 (5), 17-V-2006 (1), 30-V-2006 (3).

In addition to the specimens trapped as part of the EDRR program (localities listed above), Nicole Campbell (USDA-APHIS-PPQ, Wallingford, Connecticut) trapped specimens of *X. seriatus* in Massachusetts in 2006 using baited Lindgren funnel traps from the following localities and dates: *Essex Co.*, Ipswich, Willowdale State Forest, 24-V-2006 (3). *Middlesex Co.*, Concord, Minuteman Nat. Historical Park, 24-V-2006 (3); and Medford, Middlesex Fells Reservation, 24-V-2006 (1).

Concluding remarks.—It is currently difficult to determine what impact *X. seriatus* will have, if any, in North America, especially since the beetle has not been found in any host trees at this time. Most species of Xyleborina attack only weakened or unhealthy trees, however, all species carry symbiotic ambrosia fungi. These fungi are usually not pathogenic, but, as was recently reported for the immigrant *Xyleborus glabratus* Eichhoff and its fungal associate in the southeastern U.S., the fungus may be very pathogenic on new, novel North American hosts (Fraedrich et al. 2008).

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