First North American Records of the Eastasian Metallic Wood-Boring Beetle *Agrilus smaragdifrons* Ganglbauer (Coleoptera: Buprestidae: Agrilinae), a Specialist on Tree of Heaven (*Ailanthus altissima*, Simaroubaceae)

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FIRST NORTH AMERICAN RECORDS OF THE EAST ASIAN METALLIC WOOD-BORING BEETLE *AGRILUS SMARAGDIFRONS* GANGLBAUER (COLEOPTERA: BUPRESTIDAE: AGRILINAE), A SPECIALIST ON TREE OF HEAVEN (*AILANTHUS ALTISSIMA*, SIMAROUBACEAE)

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Abstract.—The East Asian buprestid *Agrilus smaragdifrons* Ganglbauer is reported for the first time in the Western Hemisphere. Specimens of this species taken from emerald ash borer (*A. planipennis* Fairmaire) monitoring traps in New Jersey in 2015–2016 suggest establishment of this metallic wood-boring beetle in the northeastern United States. The earliest known record of *A. smaragdifrons* in the U.S. is based on a verifiable image found on BugGuide, from a specimen collected in Hudson County, New Jersey in June 2011. Diagnostic information and high-resolution images of the adult male, female, and the male aedeagus are provided to help facilitate the recognition of this adventive buprestid from other North American *Agrilus*. A summary of information about the host plant (*Ailanthus altissima*), native distribution, and biology are given, and all known North American records are listed and mapped.

Key Words: adventive, immigrant, wood-boring pest, by-catch, EAB biosurveillance, trapping survey, BugGuide

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The jewel beetle genus *Agrilus* Curtis is recognized as the largest genus of the entire Animal Kingdom and the only one with over 3,000 valid nominal species (Jendek and Grebennikov 2011). It gained considerable attention, however,

when one of its included species, *A. planipennis* Fairmaire, native to the Asia-Pacific Region and officially known as the emerald ash borer (EAB), devastated ash trees in North America and became "the most costly biological invasion by an exotic forest insect to date" (Herms and McCullough 2014). It is not surprising, therefore, that the North American *Agrilus* fauna is currently under close scrutiny for the presence of other adventive species. A list of eight such species has been previously published together with the first record of the ninth species, *A. sulcicollis* Lacordaire, feeding on oaks (Jendek and Grebennikov 2009). Recently, the tenth immigrant North American *Agrilus* has been detected, *A. ribesi* Schaefer, attacking currant and gooseberry (Jendek et al. 2015). In this paper, we newly report an eleventh non-native *Agrilus* in North America, the East Asian *A. smaragdifrons* Ganglbauer, developing on tree of heaven, *Ailanthus altissima* (Mill.) Swingle (Simaroubaceae).

Materials and Methods

The morphological terminology in the text follows that used and explained in Jendek and Grebennikov (2011).

Adults were photographed (by JEZ) with a Nikon Digital Sight DS-L3 DS-Fi2-L3 camera system mounted on a Nikon SMZ18 research stereomicroscope. A Nii-LED fiber optic light was used to provide directional lighting along with a P2-FIRL LED Ring Illumination Unit for fill light. NIS-Elements F (4.00.06 (Build 786)), 32 bit was used for image capture. Helicon Focus (version 6.4.3) was implemented for image stacking. Images were processed initially with Adobe Photoshop Lightroom (version 4.4) and Photoshop Elements 12 for final processing. The aedeagus was photographed (by RR) using a Leica Microsystems automatic LAS Multifocus Z-stack image capture module.

Voucher specimens of *A. smaragdifrons* are deposited in the University of Georgia Collection of Arthropods (Athens, GA; UGCA); the Cornell University Insect Collection (Ithaca, NY; CUIC); the collection of the New Jersey Department of Agriculture (Trenton, NJ; NJDA); the collection of the Connecticut Agricultural Experiment Station (New Haven, CT; CAES); the collection of the Pennsylvania Department of Agriculture (Harrisburg, PA; PADA); the United States National Museum of Natural History, Smithsonian Institution (Washington, DC; USNM); and the collection of Eduard Jendek (Bratislava, Slovakia; EJCB).

Results

History of the discovery of *A. smaragdifrons* in the United States.—The New Jersey Department of Agriculture, Division of Plant Industry, Bureau of Plant Pest and Disease Control began an official survey for emerald ash borer (*A. planipennis*) in 2011 following the first detections of this invasive wood-boring beetle in the neighboring states of Maryland (2003, 2006), Pennsylvania (2007), and New York (2009). The survey deployed EAB purple "prism" traps baited with the alcohol Z-3-hexanol and aromatic manuka oil at selected trapping sites. However, beginning in 2015, the New Jersey Department of Environmental Protection (NJDEP), Forest Service, changed their method of trapping for EAB, employing instead green Lindgren funnel traps baited with the same Z-3-hexanol and manuka oil EAB lure. Once a trap catch was determined to be negative for EAB, it was then screened for all Buprestidae. The by-catch was placed in plastic vials with 70% ethyl alcohol and was set aside for further identification. Most buprestid beetles collected were

members of the genus *Agrilus*. In 2015, two trap samples were found to contain a distinct but unrecognized species of *Agrilus* from two separate EAB trapping locations; the identification of these beetles, however, remained inconclusive. One specimen, a male, was collected in a green Lindgren funnel trap near Washington Rock (Somerset Co., New Jersey) on 11 June 2015. An additional 3 females and 1 male from Washington Rock and two additional localities in New Jersey (Taylor Wildlife Preserve and South Bound Brook) were collected in May and June 2015 and 2016. In mid May 2016, NJDEP Forest Service (RY) consulted with ERH regarding these unidentified *Agrilus*. On June 3, specimens were submitted to ERH, with additional specimens sent on June 21. Males were positively identified by ERH as the East Asian *A. smaragdifrons*, and RR was notified on July 5. The identification was provisionally confirmed by EJ shortly thereafter based on examination of high-resolution images of the beetles and the details of the aedeagus.

Interestingly, an ongoing EAB biosurveillance program in New England utilizing the native ground-nesting wasp *Cerceris fumipennis* Say also detected the presence of *A. smaragdifrons* in at least one location in central Connecticut in 2015. That program began assessing species richness and diversity of that state's Buprestidae as early as 2009 (Rutledge et al. 2011, 2013).

It also came to our attention later in 2016 that *A. smaragdifrons* was being collected as by-catch in other state trapping surveys. In fact, many additional specimens of *A. smaragdifrons* were made available through targeted pest surveys in Pennsylvania, particularly for EAB and the spotted lantern fly (*Lycorma delicatula* (White)), the latter a new invader in eastern Pennsylvania since 2014 (Barringer et al. 2015). The trapping protocols for these surveys call for the use of funnel traps (baited for EAB) and sticky bands (designed for *Lycorma*).

The earliest known record of *A. smaragdifrons* in the U.S. is based on an image found on BugGuide (http://bugguide.net/node/view/1139674/bgimage; accessed 1 May 2017) and labeled "unknown buprestid – *Agrilus*." The specimen that was photographed was observed at "Liberty State Park, Hudson Co., New Jersey, on 21 June 2011."

Taxonomy

Agrilus smaragdifrons Ganglbauer

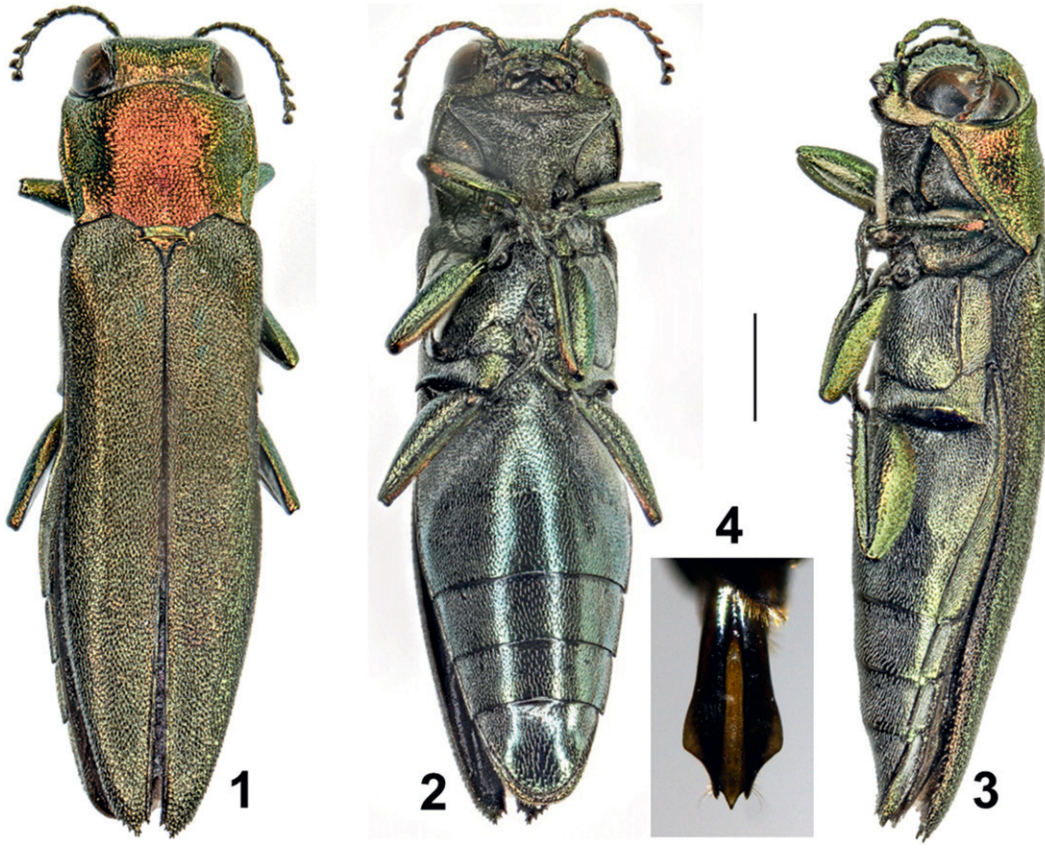
(Figs. 1-8)

Agrilus smaragdifrons Ganglbauer, 1889: 22, 29–31 (original description). Lectotype by Jendek and Grebennikov 2011: 189.

Agrilus kanssuanus Obenberger, 1930: 109 (original description). Lectotype by Jendek and Grebennikov 2011: 189. Synonymized by Jendek and Grebennikov 2011: 189.

Taxonomic assignment.—*Agrilus smaragdifrons* is assigned to the East Palaearctic and Oriental *Agrilus imitans* species-group (for included species, see Jendek and Grebennikov 2011: 26). This species-group comprises large or medium-sized, bicolored species with a cuneiform body. The pronotum is widest at the anterior margin and the marginal and submarginal interspace is narrow. The most distinctive character of the group is the long, bisinuate prehumerus (= prehumeral carina, *sensu* Fisher 1928) extending from the posterior to anterior pronotal angles.

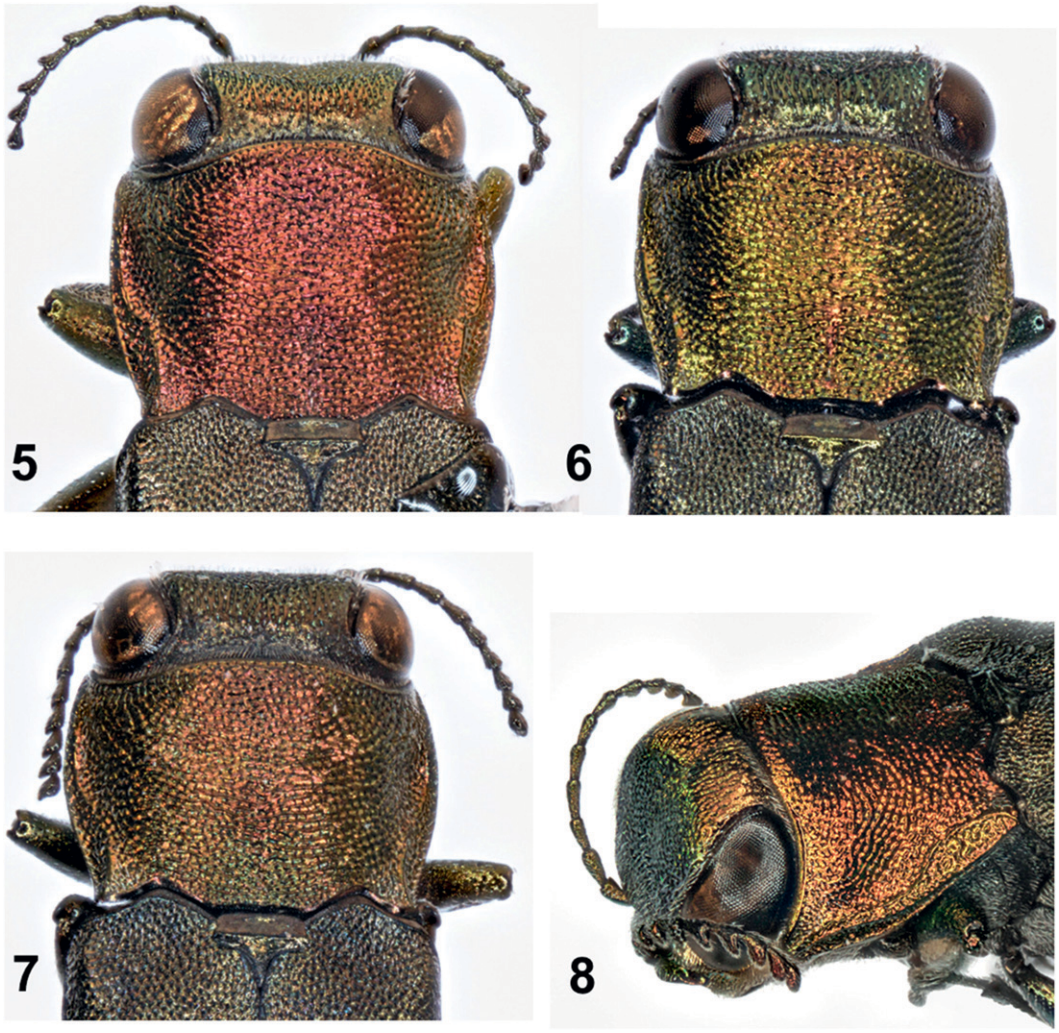
Taxonomic history, type specimens and annotated bibliography.—Since its original description by Ganglbauer (1889) until 2011, the taxonomic concept of *A. smaragdifrons* was vague, and the name of this taxon was simply cited



Figs. 1–4. *Agrilus smaragdifrons*, male habitus. 1, Dorsal aspect. 2, Ventral aspect. 3, Lateral aspect. 4, Aedeagus, dorsal aspect of apex. Scale bar = 1.0 mm.

in several Palearctic catalogs or checklists (see references below). *Agrilus smaragdifrons* was described from three syntypes from two localities — "Kan-ssu" [Gansu Province] and "Sze-tschuan" [Sichuan Province]. The male lectotype, designated by Jendek and Grebennikov (2011), is deposited in the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia. The type locality "Kan-ssu" is determined by the locality of the lectotype. Jendek and Grebennikov (2011), based on the examination of type specimens and recently collected material, proposed a new junior synonym (*A. kanssuanus* Obenberger) and provided the first comprehensive taxonomic, diagnostic and distributional revision of *A. smaragdifrons*. *Agrilus kanssuanus* was described from an unknown number of syntypes from "Kanssu" [Gansu province]. The female lectotype, designated by Jendek and Grebennikov (2011), is deposited in the National Museum (Natural History), Prague, Czech Republic.

References pertaining to *Agrilus smaragdifrons* Ganglbauer are as follows: Ganglbauer 1889 (description) — Heyden 1893: 90 (catalog; Siberia) — Kerremans 1903: 290 (world catalog) — Jakobson 1913: 797 (catalog; Russia and Europe) — Obenberger 1926: 655 (Palearctic catalog) — Obenberger 1936: 1047 (World catalog) — Peng Zhongliang 1987: 358 (checklist; China) — Hua Li Zhong 2002: 90 (checklist, China) — Jendek 2006: 401



Figs. 5–8. *Agrilus smaragdifrons*, head and pronotum; specimens from various localities selected to illustrate variability in dorsal coloration. 5, Male (Somerset Co., NJ, South Bound Brook). 6, Female (Hartford Co., CT, Berlin). 7, Female (Somerset Co., NJ, Washington Rock). 8, Male head, oblique aspect, illustrating the broad, flattened frons and sparsely, longitudinally rugose vertex.

(Palearctic catalog) — Bellamy 2008: 2297 (World catalog) — Jendek and Grebennikov 2011: 189-190 (lectotype designation; synonymy; diagnosis; faunal records; distributional summary) — Jendek 2016: 543 (Palearctic catalog).

References pertaining to the conspecific taxon *Agrilus kanssuanus* Obenberger are as follows: Obenberger 1930: 109 (description) — Obenberger 1935: 163 (characters in key) — Obenberger 1936: 1004 (World catalog) — Peng Zhongliang 1987: 356 (cited as *A. kangsuanus*; checklist; China) — Jendek 2006: 399 (Palearctic catalog) — Bellamy 2008: 2149 (World catalog) — Jendek and Grebennikov 2011: 189 (synonym of *A. smaragdifrons*; lectotype designation) — Jendek 2016: 543 (synonym of *A. smaragdifrons*; Palearctic catalog).

Diagnosis.—*Agrilus smaragdifrons* varies from 5.7–8.2 mm. The body is

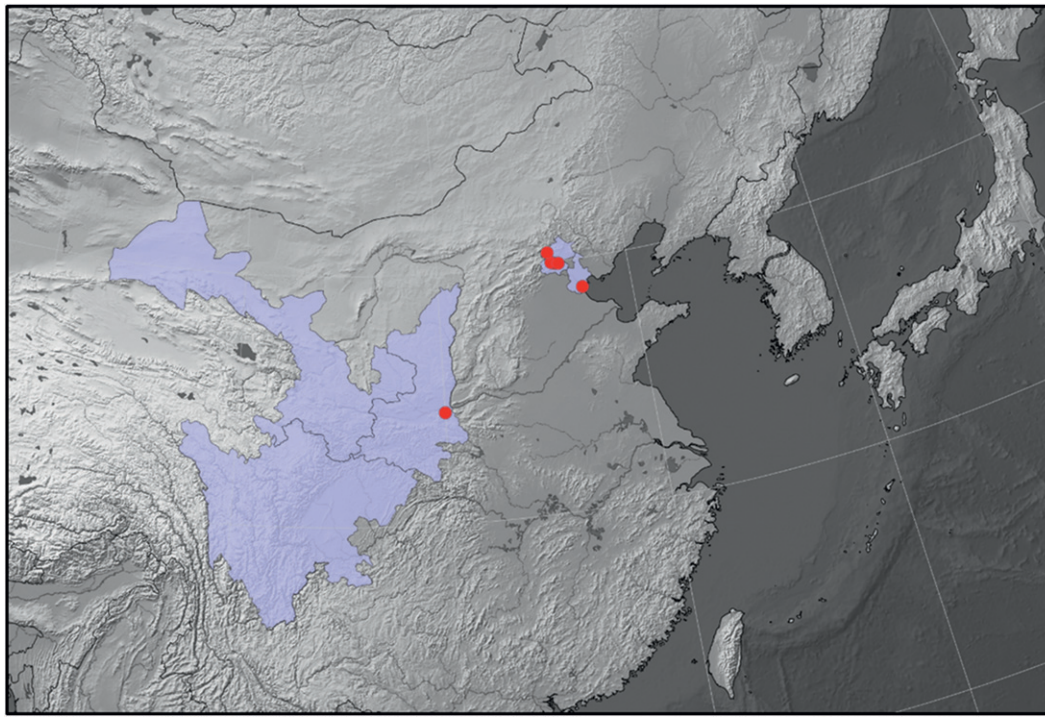


Fig. 9. Known China distribution of *A. smaragdifrons* on the provincial level (highlighted areas) and sites from which the specimens were examined (red dots).

cuneiform (apical third of elytra markedly converging) and dorsally bicolored (Figs. 1–3). The head and pronotum are golden-red or golden-green (Figs. 5–8), while the elytra are greenish, bluish or blackish (Fig. 1). The head is large with convex eyes and with a wide and obviously flat frons (Fig. 8). The vertex is sparsely, longitudinally rugose and bears a distinct medial impression (posterodorsal view). The slender and long antennae are serrate from antennomere 4 outward and reach to or beyond the middle of the pronotum. Antennomeres 7–10 each has an obvious collum (necklike portion of base of antennomere). The pronotum is widest at the anterior third, rarely at the middle. The pronotal margin is wider anteriorly and bears an obvious medial lobe that is level with the anterior pronotal angles. The pronotal disc has distinct but narrow lateral impressions and two, fine, oval medial impressions. The prehumerus (prehumeral carina) is bisinuate and extends from the posterior to anterior pronotal angles. The elytra are entirely covered with whitish pubescence, sometimes becoming sparser in the anterolateral portion. The elytral apices are narrowly arcuate or subangulate with the margin distinctly crenulate. The metatarsus is slightly longer than the mesotarsus. Metatarsomere 1 is longer than metatarsomeres 2–4 combined. The prosternal lobe is distinctly arcuately emarginate medially; the prosternal process is flat on the disc and subparallel between the coxae; and the sternal groove on the apex of the last abdominal ventrite is regularly arcuate. The aedeagus (Fig. 4) has distinctly expanded parameres and

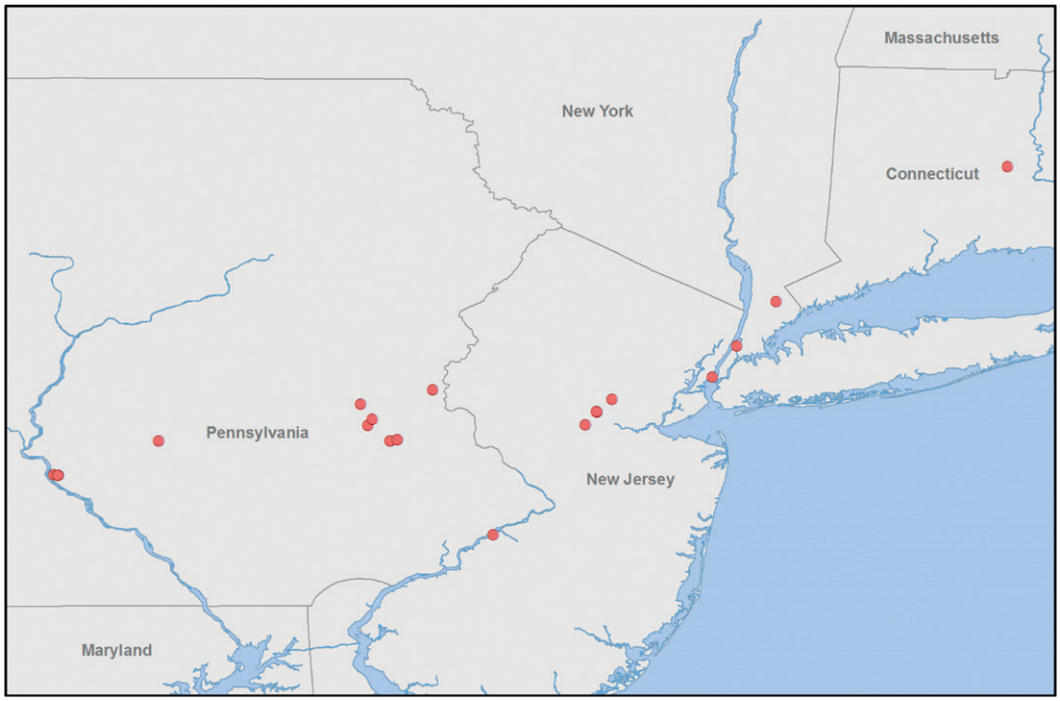


Fig. 10. Known records of *Agrilus smaragdifrons* in North America.

the apex of the median lobe is acute. The ovipositor is markedly elongate.

Sexual dimorphism.—The male differs from the female by the longer antennae reaching beyond the middle of the pronotum, by a dense brush of erect pale hairs on the prosternal process, by the expanded apical part of the mesotibiae, by the spinose posterior angle of the metacoxal plates (lateral view), and by a slight impression on the apex of the last abdominal segment.

Status of North American *Agrilus* and comparison of diagnostic features of *A. smaragdifrons* and native congeners.—There are no adequate, complete published keys to the species of *Agrilus* occurring in North America. A comprehensive revision of the entire known North American fauna is badly needed. Fisher's (1928) "Revision of the North American species" is now antiquated, published nearly 90 years ago, and his key to species contains only about 2/3 of the currently known North American species.

Identification of *A. smaragdifrons* among native North American *Agrilus* is simple and unmistakable. There is no other Nearctic *Agrilus* that possesses such an obviously flattened frons, long and bisinuate prehumerus (prehumeral carina), and the aedeagus with distinctly expanded parameres.

Using Fisher (1928), *Agrilus smaragdifrons* will key readily to *A. masculinus* Horn. However, there are a number of features that clearly differentiate these two species. In *A. masculinus*, the head and pronotum are generally bronzy green, sometimes with a brownish tinge (pronotum generally golden-red or golden-green in *A. smaragdifrons*) and the elytra are black with a prominent bronzy reflection (elytra greenish, bluish, or blackish in *A. smaragdifrons*). In

Figs. 11–16. *Agrilus smaragdifrons* on *Ailanthus altissima*. 11–12. Stressed host trees damaged or killed by *A. smaragdifrons* in Beijing, China (photo credits: E. Jendek and L. Ren). 13, Mature larva and larval galleries under bark of host (photo credit: L. Ren). 14, Adult on bark (photo credit: R. Rieder). 15–16. D-shaped adult exit holes (arrows) (photo credits: E. Jendek and R. Rieder).

A. masculinus, the frons is nearly flat to faintly convex with a weak, longitudinal, median impression; the color ranges from bronzy green (male) to coppery (female). The frons is uniformly, broadly flattened in *A. smaragdifrons* and brilliant emerald green in both males and females [hence its specific epithet: *smaragdifrons*, a combination of the Latin noun *smaragdus* (emerald or green precious stone) and the Latin noun *frons* (forehead or front)]. The prehumerus (prehumeral carina) of the pronotum is distinct but short in *A. masculinus* while

in *A. smaragdifrons* it is long and bisinuate. The elytral apices are narrowly rounded and finely crenulate or serrulate in *A. masculinus* but are more acutely pointed and strongly serrulate in *A. smaragdifrons*. The aedeagus of *A. masculinus* is narrow and parallel-sided while that of *A. smaragdifrons* is greatly expanded apically.

Agrilus ruficollis (Fabricius), one of a number of other bicolored species in the genus, superficially resembles *A. smaragdifrons* but is smaller, only 4–7 mm (5.7–8.2 mm in *A. smaragdifrons*) and is further differentiated by a broad, deep concavity of the front of the head (broadly flattened in *A. smaragdifrons*) and by a well-developed median carina on the pygidium that projects beyond the apical margin (carina lacking in *A. smaragdifrons*). The males of several species belonging to the *A. otiosus* species-group (e.g., *A. atricornis* Horn, *A. betulanigrae* MacRae, *A. crinicornis* Horn, *A. ohioensis* Knull and *A. otiosus* Say) also possess expanded parameres (MacRae 2003) but each of their modifications differ significantly from that of *A. smaragdifrons*. Also, species of the *A. otiosus* species-group are mostly black with bronze or green reflections on the head and pronotum. By contrast, the head and pronotum of *A. smaragdifrons* are golden-red or golden-green while the elytra are generally greenish, bluish or blackish.

Global distribution.—**East Asia** (native): China: Beijing, Gansu, Shaanxi, Sichuan, Tianjin. **North America** (adventive): United States: Connecticut, New Jersey, New York, Pennsylvania.

The known distribution in Gansu and Sichuan provinces is represented solely by the locality of the type specimens. We suspect that the actual geographic range of *A. smaragdifrons* is likely much greater than indicated here and probably largely overlaps with that of the host plant, *Ailanthus altissima*, in China and in North America.

Specimens examined.—EAST ASIA: CHINA (Fig. 9): Beijing: China centr., Beijing [city], 15.4.1989, O. Majzlan leg. (3, EJCB) (Jendek and Grebennikov 2011); China, Beijing city, vii-2015, reared from *Ailanthus altissima*, local collector (4, EJCB); China, Beijing Municipality, Dingjiatancun env., 39°59′10″N, 116°01′59″E, 200m, 22.vi.2016, E. Jendek & O. Šauša leg. \ swept from *Ailanthus altissima* (3, EJCB); China, Beijing Municipality, Mafangcun env., 40°23′56″N, 115°53′55″E, 500m, 29.vi.2016, E. Jendek & O. Šauša leg. \ swept from *Ailanthus altissima* (1, EJCB). Shaanxi: China, Shaanxi, 1992, 120 km E Xi an, Hua Shan, 3-4.vi, Jaroslav Turna (1, EJCB). Tianjin: China, Tianjin city, Dagang Forestry Park, 18.iv.2016, ex tree of heaven (*Ailanthus altissima*), local collector (2, EJCB).

NORTH AMERICA: UNITED STATES (Fig. 10): Connecticut: *Hartford Co.,* Berlin, 24.vii.2015, I. M. Scott, EAB biomonitoring – *Cerceris fumipennis* prey (1, CAES). New Jersey: *Burlington Co.,* Taylor Preserve, 8.vi.2016, R. Yoo, EAB (funnel) trap (3, UGCA); same data except 21.vii.2016, M. Cook, EAB trap (1, UGCA); same data except 5.vii.2016, 13.vii.2016, M. Cook, ex EAB trap and swept ex *Ailanthus altissima* (4, UGCA, NJDA). *Hudson Co.,* Liberty State Park [georeferenced as 41.992833 -74.061389], 21.vi.2011 (internet image, BugGuide #1139674). *Somerset Co.,* Bound Brook, 22.vi.2016, 7.vii.2016, 14.vii.2016, 18.vii.2016, R. Yoo, EAB trap (9, UGCA, USNM, NJDA); South Bound Brook, 14.vi.2016, 22.vi.2016, 29.vi.2016, 7.vii.2016, 14.vii.2016, 18.vii.2016, 29.vii.2016, R. Yoo, EAB traps and swept ex *Ailanthus altissima* (41, UGCA, USNM, NJDA); Millstone, 20.vii.2016, 29.vii.2016, 10.viii.2016, 16.viii.2016, R. Yoo, ex *Ailanthus altissima*

and EAB trap (4, UGCA); Washington Rock, 29.v.2015, 11.vi.2015, R. Yoo, EAB trap (2, UGCA, NJDA). New York: *New York Co.,* Highbridge Park [georeferenced as 40.8433950 -73.933243], 17.vi.2014, A. Liberta, contributor (internet images, BugGuide #940387-940390). *Westchester Co.,* White Plains, 29.vi.2016, P. Rockerman, ex black intercept panel trap with UHR EtOH (1, CUIC). Pennsylvania: *Bucks Co*., Spinnerstown (3 site locations): [trap site 1] 3. viii.2016, S. Lovenwirth, ex sweep net, *Ailanthus altissima* (1, PADA); [trap sites 2, 3] 13.ix.2016, A. Ciccarone, ex *Lycorma* sticky band (29, PADA). Milford Square (2 site locations): [trap site 1] 5. viii.2016, A. Ciccarone, ex *Lycorma* sticky band (3, PADA); [trap site 2] 6. ix.2016, V. Dutton, ex *Lycorma* sticky band (1, PADA). *Dauphin Co*.: Harrisburg (7 site locations): [trap site 1] 27. vii.2016, 29.vii.2016, 2.viii.2016, colls. L. Barringer, S. Spichiger, and P. Harchack, ex sweep net, *Ailanthus altissima* (8, PADA, UGCA); [trap site 2] 7.vii.2016, P. Harchack, ex funnel trap (1, PADA); [trap site 3] 17.viii.2016, 31.viii.2016, 14.ix.2016, 13.x.2016, P. Harchack, ex funnel traps (30, PADA); [trap site 4] 17. viii.2016, 31.viii.2016, 14.ix.2016, P. Harchack, ex funnel traps (15, PADA); [trap site 5] 31.viii.2016, P. Harchack, ex funnel trap (1, PADA); [trap site 6] 17. viii.2016, 31.viii.2016, 14.ix.2016, P. Harchack, ex funnel traps (20, PADA); [trap site 7] 23.viii.2016, 9.ix.2016, K. Roccasecca, ex funnel traps (4, PADA). *Lehigh Co.,* Allentown [40.591840 -75.559319], 26. viii.2016, K. Bernhard, ex *Ailanthus altissima* (1, UGCA); Emmaus, 29.vii.2016, S. Spichiger, ex lindgren funnel, walnut twig beetle lure (1, PADA); Upper Milford Township, 6.ix.2016, A. Ciccarone, ex *Lycorma* sticky band (3, PADA). *Northampton Co.,* Glendon Borough, 10.vi.2016, A. Heydt, ex funnel trap (1, PADA).

Biology.—Until recently, the biology and host plant of *A. smaragdifrons* were unknown (Jendek and Grebennikov 2011, Jendek and Poláková 2014). From recent field observations in China and the U.S., triggered by our discovery of this adventive species, the adult and larval host plant of *A. smaragdifrons* has been revealed to be tree of heaven, *Ailanthus altissima*. According to Jendek and Poláková (2014), this is the first *Agrilus* record for this plant species. At least two additional records of *Agrilus* associated with members of the family Simaroubaceae can be found in the literature. Adult *A. schmidli* Curletti have been found on *Simarouba amara* Aubl in Panama (Curletti 2005) and *A. abstersus* Horn has been reared from *Castela emoryi* (A. Gray) Moran & Felger in Arizona (Hespenheide et al. 2011).

As part of ongoing studies in China to obtain the weevil *Eucryptorrhynchus brandti* (Harold), a known biocontrol agent of *A. altissima*, specimens of this weevil species as well as those of *A. smaragdifrons* have been reared from sacrificed host trees. At Beijing Forestry University, selected trees were cut in early July 2015 and bolts were placed inside cages to specifically rear the weevil (LR). In Beijing, *Ailanthus altissima* has been used widely as a common roadside, garden, or landscaping tree species, many of which succumb to attack by *A. smaragdifrons* (Figs. 11–12). By the time of tree cutting, sample trees were stressed, most with almost no leaves. On the grounds of Beijing Forestry University, *A. smaragdifrons* attacked only *A. altissima*. According to observations made by LR, adults were routinely collected feeding on leaves of the host and also were reared from attacked trees.

Xu and Yang (2007) in their "Pests of Ornamental Plants in China" also give

some details about the biology of *A. smaragdifrons* (identified only as "*Agrilus* sp.", p. 316). Although the actual species discussed cannot be confirmed due to an absence of voucher specimens from the study, it is most likely that the authors were referring to *A. smaragdifrons*. Observations made by LR and a translation of the Chinese text of Xu and Yang (2007) indicate that *A. smaragdifrons* has one annual generation. Mature larvae overwinter in their galleries under bark and continue to feed and bore under bark into the following spring (Fig. 13). Pupation generally occurs by early June, and males and females begin emerging from late June to mid-late July in the Beijing region. Adults are exceptionally active on host trees (Fig. 14) on the bark surface of trunks and branches during periods of intense sunlight. Females lay eggs in cracks of the host bark. First-instar larvae tunnel under the bark, bore into the xylem, and construct an irregularly curved gallery system. Exit holes of emerging adults are D-shaped (Figs. 15–16), as typical for the genus.

Discussion

Host tree history, its geographic range in North America, and known arthropod associates.—The native range of *A. altissima*, the only known host of *A. smaragdifrons*, covers vast parts of China (from Liaoning and Hebei Provinces in the North to Guangxi and Fujian Provinces in the South, and from Zhejiang and Shandong Provinces in the East to Gansu Province in the West) and is considered a natural component of broadleaf forests there (Kowarik and Saumel 2007), occurring in a broad latitudinal range (22°–34° N latitude, *sensu* Fryer 2010). In North America, *A. altissima* thrives across a broad range of climatic conditions from Florida to the arid Southwest and the temperate Northeast, including southern parts of Ontario, Quebec and British Columbia in Canada (Miller 1990, Kowarik and Saumel 2007). The spread of tree of heaven in North America apparently followed three separate introductions from China beginning in the late 1700s (Feret 1985, Fryer 2010). It was first imported into Pennsylvania in 1784 as an ornamental (Fryer 2010). A second introduction occurred in New York in 1820, where tree of heaven was again planted as an ornamental (Davies 1942). Apparently, a third introduction occurred in California during the mid-1800s (Fryer 2010). A century after the North American introductions, tree of heaven is still most common in the Northeast and California. In the eastern United States, it is most abundant and common from New England south to the mid-Atlantic states (Feret 1985, Fryer 2010).

At least 32 species of arthropods have been recorded in association with the genus *Ailanthus* in China (Zheng et al. 2004). No species of Buprestidae have been previously documented from this tree host. The herbivorus weevil *Eucryptorrhynchus brandti* has been identified as an important pest of *A. altissima* and may have potential for biological control of this deciduous woody tree in North America based on damage to the plant (Zheng et al. 2004, McAvoy et al. 2014).

In North America, tree of heaven has been largely ignored even though it is invasive because of its ability to colonize disturbed areas quickly (Knapp and Canham 2000) and to suppress competition with allelopathic chemicals (Heisey 1996). However, much attention has been directed to tree of heaven recently because of the first confirmed presence of the spotted lanternfly (*Lycorma delicatula* (White)) (Hemiptera:

Fulgoridae) on this host in Berks County, Pennsylvania in 2014 (Barringer et al. 2015). This East Asian fulgorid poses a significant threat to grapes, stone fruit, some ornamentals, and a broad range of other plant hosts in North America (Dara et al. 2015).

Significance of by-catch in insect detection surveys. — In recent decades and in response to the accidental and unintentional introductions of various tree-killing pests in North America, such as EAB, Asian longhorned beetle (*Anoplophora glabripennis* (Motschulsky)), and Sirex wood wasp (*Sirex noctilio* Fabricius), state and federal plant protection agencies have conducted trapping surveys for undocumented alien pest species with the goal of detecting these invasive pests before they become widely established. These trapping surveys, utilizing various monitoring traps baited with generally non-selective pheromones and lures, also capture other non-target insects and some in rather large numbers. These unintentionally trapped insects, or non-targets, are generally termed by-catch, and in most surveys this abundance of insect specimens is largely ignored, discarded, or left unanalyzed (Spears and Ramirez 2015). Close examination of by-catch can sometimes lead to novel discoveries of yet other non-native and unrecognized species among the insect fauna of North America (Spears and Ramirez 2015) [e.g., *Sirex noctilio* in New York in 2004 (Hoebeke et al. 2005), *Agrilus sulcicollis* in Ontario and Michigan in 2006 and 2003–2008, respectively (Haack et al. 2009) and an Old World species of Bothrideridae in Ohio during 2013–2015 (McElrath et al. 2016)]. The first-time discovery of *A. smaragdifrons* in New Jersey was facilitated by the timely examination of specimens of an unusual *Agrilus* trapped as by-catch in EAB monitoring traps. We strongly recommend that further attention be given to non-target insects that are captured during future trapping surveys, especially those insects that show up in any abundance for the first time, or those that appear as an anachronism, looking "different, suspicious and out of place."

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