

Book Review: The Green Menace – Emerald Ash Borer and the Invasive Species Problem by Jordan D. Marché II

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The Green Menace – Emerald Ash Borer and the Invasive Species Problem by Jordan D. Marché II, Oxford University Press, 2017. US\$ 69.95, hbk (300 pp.) ISBN 978-0-19-066892-1

Besides plant pathogens, herbivorous insects represent the most devastating invaders in forests worldwide (Aukema et al. 2010, Rejmánek 2015, Liebhold et al. 2017). The best examples include the Asian long-horned beetle (*Anoplophora glabripennis*) responsible for mortality of trees belonging to many genera in N. America and Europe, and North American red turpentine beetle (*Dendroctonus valens*) responsible for mortality of pines in China. One of the recent additions to the most influential non-native insect pests in North America and Europe is the emerald ash borer or EAB (*Agrilus planipennis*), a beetle native to northeastern Asia. EAB larvae bore through the outer bark of ash trees (genus *Fraxinus*) and feed on the phloem, cambium and outer xylem, forming serpentine galleries that disrupt the ability of trees to transport nutrients and water. Trees typically die within 2–4 years (Herms et al. 2014). Since the first dying ash trees were noticed in the greater Detroit, Michigan, in 2001, tens of millions of ash trees have been killed by this invader in more than 20 US states and two Canadian provinces. It is still spreading, and virtually all of the 16 ash species in North America (six of them are commercially important) are seriously endangered. Over the same period, more than US\$ 300 million in federal funds have been devoted to battling this invader.

Jordan D. Marché's book "The Green Menace – Emerald Ash Borer and the Invasive Species Problem" provides the first in-depth overview of the EAB invasion and puts it into broader ecological and social contexts. By his profession, Jordan Marché is a historian of philosophy and science, but he is also a dedicated amateur entomologist. This made him uniquely qualified for this compilation. In 10 chapters, the reader is guided through the history of detection, identification, biology, spread, eradication/control attempts, and environmental impacts and economic costs of EAB in North America. Excursions into history of invasion biology (starting with Charles Elton), integrated pest management, SCOPE international projects and the role of the USDA-APHIS point to larger issues concerning invasive species in the age of globalization. Comparisons with other major forest pest invasions are elucidating.

A thoughtful assessment of the EAB impacts on the use of ash wood by Native American tribes illustrates author's synthetic approach to the topic.

The discovery and correct identification of EAB is an interesting story in itself. First, as Marché claims, the Michigan Department of Agriculture was notified of "ash decline" in 1998, but did not respond promptly enough. Had greater action and communication been implemented, EAB might have been contained within a much smaller area wherein eradication might have been possible. Second, only after dismissing initial misidentifications of the possible pest as *ash yellows* (phytoplasma) or redheaded ash borer at the beginning of 2002, it became clear that the larvae responsible for extensive damage of the inner bark and outer sapwood of ash trees in southwestern Michigan belong to the family Buprestidae (metallic wood-boring beetles) and probably to the genus *Agrilus*. However, even after obtaining adult beetles, none of the consulted American entomologists could identify the *Agrilus* species. Nevertheless, all agreed that the specimens were exotic and probably of Asian origin. Our surprise that none of the American professional entomologists was able to identify specimens to the species level is substantially moderated by the fact that there are at least 2,600 described species in this genus and new species are still being described. It was only in July 2002, when coleopterist Eduard Jendek, that time of the Institute of Zoology, Slovak Academy of Sciences, Bratislava, conclusively identified the specimens as *Agrilus planipennis*. Emerald ash borer (EAB) then emerged as the favorite common name.

EAB is indigenous to northeastern China, the Korean peninsula, and eastern Russia, where it colonizes native ash trees that are stressed, declining, or dying. However, because the American ash species haven't evolved in coevolution with EAB, even healthy trees are susceptible to and eventually killed by this pest. EAB was probably imported to one of the Detroit ports from northeastern China with a shipment of wood packing material made from infested ash. By 2003, at least five million ash trees were dead or dying in a six-county area of southeastern Michigan. It was becoming clear that EAB had the potential to devastate ash trees on a continental scale. In 2011, an analysis of the economic impacts found that EAB is the most destructive and costly forest insect to invade the United States. Eradication activities began in 2003 but were eventually abandoned largely because of the difficulty of detecting and de-

lineating infestations. Current management is focused on biological control (egg and larval parasitoids), insecticide protection of high-value trees, and integrating efforts to slow EAB spread and ash mortality (Margulies et al. 2017). Also, efforts to breed EAB-resistant ash genotypes are ongoing. Because of their inherent resistance to EAB, Asian ash species may be a source of resistance genes that could be introduced into North American species.

We are still far from completely knowing the consequences of the absence, or substantial reduction of ash trees abundance. Besides the very few positive aspects (increased density of some native insectivorous birds), ash diebacks in North America may substantially change whole ecosystems and may support invasions of non-native shrubs like Amur honeysuckle (*Lonicera maackii*) that in turn may suppress establishment and species diversity of native seedlings (Hoven et al. 2017). EAB may turn out to be the most carefully studied invader for some time to come. The number of professional papers dedicated to EAB has been steadily growing since 2003, reaching over 800 by the end of 2017. Understanding interactions between EAB and ash species that are EAB susceptible (*Fraxinus nigra*) or more resistant (*F. mandshurica*) may serve as a model for dealing with other wood-boring insects (Villaria et al. 2015). However, as in invasions in general, prevention is the most efficient and least expensive strategy. Current policies for preventing introductions of nonnative forest insects and pathogens are having positive effects but are insufficient to reduce the influx of pests in the face of burgeoning global trade (Lovett et al. 2016).

The invasion of EAB continues. In November 2017, its presence was reported from 31 US states and three Canadian provinces. Interestingly, in 2003, just two years after EAB was detected in the US, it was also reported from the Moscow area in European Russia and is now expected to reach Central Europe within 15–20 years (Valenta et al. 2017), therefore potentially reaching Bratislava where the first correct identification of the American specimens was done. Populations of European ash trees that have been experiencing diebacks due to the alien ascomycete pathogen, *Hymenoscyphus fraxineus*, will be in greater trouble.

Jordan Marché's book is timely and provides an excellent summary of the research and EAB management attempts up to 2016. The book is not only educational, but is also enjoyable reading, in parts almost like a detective story. We can learn a lot from the successes and mistakes made during the battling EAB in North America.

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