

First record of different species of the introduced ambrosia Beetle (*Coleoptera: Curculionidae: Scolytinae*) at Jordan

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Abstract:

The first nationwide survey of Scolytinae in Jordan was conducted at 2023 to determine the presence and distribution of previously undetected alien species. Study sites included pine, and oak forests and fruit tree farms north Jordan. Insect traps baited with ethanol lures were employed to maximize the diversity of Scolytinae species collected. We collected four species of (Coleoptera: Bostrichidae) of the bark beetles which are *Xylopertha reflexicauda* (Lesne, 1937), *Scobicia chevrieri* (A. Villa & G.B. Villa, 1835), *Xyloperthella picea* (Olivier, 1790) and *Rhyzopertha dominica* (Fabricius, 1792). Four recently established alien species were detected, belong to (Coleoptera: Curculionidae: Scolytinae) which are *Xyleborinus saxesenii* (Ratzeburg 1837), *Cryphalus dilutus* Eichhoff 1878, of *Hypothenemus eruditus* Westwood, 1833, *Cryphalus* sp. Most recorded taxa are widespread species of the western Palearctic (all Bostrichidae) or species of cryptogenic origin (*X. saxesenii* and *H. eruditus*). Of particular interest is the occurrence of the invasive *Cryphalus dilutus*, a species originating from the eastern Palearctic and Indo-Malaya. This taxon is native to Myanmar and has been recently recorded or introduced in China (Guangdong, Yunnan), Malta, Italy, Tunisia, United Arab Emirates, Oman, India, Pakistan, Bangladesh and Mexico, with the current species first discovered in Jordan Still in this category.

Introduction

Bark beetles and ambrosia (Coleoptera: Curculionidae: Scolytinae) are wood-boring insects that colonize stressed or dead trees, excavate galleries in their hosts to pollinate and culture their fungal symbionts that belong primarily to the genera *Ambrosiella*, *Fusarium* and *Raffaelea*, and rely on their beetle vectors for dispersal. Bark and ambrosia beetles are difficult to intercept and detect due to their small size and ability to survive for long periods. They are easily transported in wood products, especially wooden packaging materials and tree trunks, as their reproductive strategy allows them to quickly colonize and adapt to new environments.⁽³⁾ They lack plant host specificity, so they attack living trees rather than dead and stressed trees, and some of their symbiotic fungi act as pathogens of plant diseases such as *Fusarium* dieback and wilt. Laurel, and other diseases affecting more than 58 plant families around the world (Africa, America, and occupied Palestine)⁽¹⁾. This has caused disruption to the economic production of avocados, oranges, grapes, peaches and macadamia trees, as well as profound environmental impacts on forests around the world, including the destruction of key tree species. Exotic ambrosia beetles, native to Southeast Asia, was first discovered in America in 2002. Since then, it has spread rapidly worldwide which caused severe damage and significant economic losses to natural and agricultural ecosystems, threatening the productivity of important tree crops through pollination. Tree pathogens, mass accumulation on susceptible hosts, and structural damage⁽¹⁾. Initial estimates suggest that FD – ISHB has the potential to kill roughly 27 million trees (38%) in Southern California's 4,244-square mile urban region⁽¹²⁾. In Orange County, removal of 1,524 infested trees and treatment of 2,228 trees cost the county approximately \$3 million between 2013 – 2017⁽¹³⁾. Tree losses in both urban and wildland forests result in decreased ecosystem services such as carbon storage, storm water retention, temperature moderation, and air pollution filtration. Given that urban forest trees in California remove the carbon equivalent of 120,000 cars annually (567,748 t CO₂), and their annual value of all ecosystem services is \$1.0 billion⁽¹²⁾, additionally, laurel wilt is currently a threat to the \$13.7 million dollar avocado industry in Florida and has killed over 200,000 commercial trees since its introduction into Miami-Dade County in 2010. In 2012, Ambrosia bark beetles were recorded in Palestine and were transported from Florida due to international trade, causing economic losses estimated at 57% of avocado tree production. In 2018, it was recorded in South Africa, where economic losses in Africa are estimated at around 16 billion to about 100 billion US dollars with several reports of severe damage to natural forest ecosystems and urban trees^(5, 6). As of April 2022 laurel wilt has been killed an

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estimated 300,000 redbay trees, with greater than 90 percent tree-loss reported in some forested areas of the USA. Ambrosia beetles also caused economic losses estimated at approximately \$63 million in coastal British Columbia ^(5, 6). During 2019 in Lebanon first detection of the ambrosia beetles inside oak forest tree and avocado orchid, during a field tour by foreign expert (Italian expert) ⁽¹⁵⁾. Despite the spread of ambrosia beetles, which have economic and environmental impacts in the border countries of Jordan, and the noticeable environmental deterioration in the Kingdom's lands represented by the extinction of indigenous forest trees within the Kingdom's lands, which has caused a decrease in the rate of carbon reduction, loss of shade, an increase in temperature, and an increase in environmental pollution resulting from climate change. And warming (carbon footprint), which in turn leads to an increase in the spread of wood-boring insects, especially Ambrosia beetles. In addition to the losses in the economic value of the fruits trees product resulting from structural damage and the spread of disease causes such as *Fusarium* dieback and the increase in the number of trees on display, physiological pressures through the introduction of new tree plants to the lands of the Kingdom of Jordan, such as tropical fruit trees, but this survey study It is considered the first of its kind and aims to prepare a national program to manage invasive Ambrosia beetles based on the principle that early detection and rapid assessment with rapid response is a very important line of defense that provides the greatest opportunity to manage their negative impact on the ecosystem. Two major challenges of transboundary species management are (1) to detect target species at the earliest possible stage and (2) to quickly provide specific actions to regulate or eradicate them. ⁽⁶⁾

The main objectives of the project are:

- Monitor with Identifying potential invasive alien species with high risks of introduction, identifying potential pathways for their introduction, and providing necessary awareness and guidance to deal with these invasive alien species.
- Provide the competent authorities with current distribution information on scolytids that may have recently been evacuated to the country.
- Use the expected outputs of the project to help stakeholders prioritize research, development and response activities, and adjust protocols accordingly.

Material and method:

The purpose of this project was to conduct initial and follow-up surveys in different areas of the Hashemite Kingdom of Jordan to discover and confirm the distribution of exotic food beetles in the region. These initial surveys set the baseline for future surveys and also form the cornerstone for studying the effects. Ethanol has been used as an attractant in traps. A single-season survey of Scolytinae communities was conducted to examine patterns of variation within these communities. These analyzes may reveal that the environmental disturbance observed during these years in Jordan is related to the presence of invasive insects, as high abundance and genetic diversity of scolytinae beetle communities are expected. The study was conducted in the north of the Hashemite Kingdom of Jordan in Jerash, Ajloun and Irbid governorates in pine and oak forests in one locations and in forest nurseries based on pine and oak forest trees in two locations. Another experiment was also conducted in tropical tree orchards farm in two location. These locations had an ample number of stressed and dying trees available as breeding substrates for beetles. The locations were visited by the work team at a rate of three visits per location. Traps were deployed at the first visit, traps were checked at the second visit, and traps were collected and replaced at the third visit. ⁽²⁾. Scolytinae beetles were sampled using hand-made traps (manual homemade fly trap) ⁽²⁾. At each location, 20 bottle traps containing 95% ethanol were used. The traps were attached to trees 1.5 m above the ground and separated approximately 20 m apart. The experiments were conducted serially from the beginning of September until the end of October (10-wk field trial) in the summer of 2023. If the trap[attracted the beetles on two consecutive dates this trap site will be abandoned and the surveyor will select a new trap site for sampling at least one mile from the infestation center. (To convert from 1 km to miles, multiply kilometers by 0.62; to convert from miles to kilometers, multiply the distance by 1.609) ⁽²⁾. Beetles were collected at 5-day intervals, after which the bait was renewed. Beetles specimens were collected and immersed in a sample container and preserved in 75% ethanol for sent to the Department of Science at the University of Roma Tre in Italy for identification and tally by Dr. Enrico Rozier. All bark and ambrosia beetles were assigned to the most specific taxa possible using the most recently published taxonomic keys (e.g. ZooKeys 983: 1–442 (2020) ^(4, 14), ZooKeys 995: 15–66 (2020) ^(4, 14), Die käfer mitteleuropas (book series) ^(8, 9, 10, 11).

Table (1): Locations for conducting surveys and deploying ethanol traps.

tion date	Sampling date	Site	Site Nature	Governorate	Coordinates	Host Tree
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2023	10-9-2023	Dibbin	Forest	Jerash	32° 14' 44.41'' N 35° 49' 19.83'' E	Oak and pine trees
2023	10-9-2023	Ain Gamla	Nursery	Jerash	32° 14' 57.89'' N 35° 50' 15.96'' E	Oak and pine trees
2023	10-9-2023	Faisal nursery	Nursery	Jerash	32° 12' 56.73'' N 35° 53' 25.72'' E	Oak and pine trees
2023	26-9-2023	Al-Hamma	Farm	Irbid	32° 40' 38.15'' N 35° 39' 26.03'' E	Guava fruit trees
2023	28-9-2023	Al-Rufidah	Farm	Irbid	32° 41' 36.28'' N 35° 42' 34.0'' E	Guava fruit trees

Result:

In the context of the push-pull strategy and behavioral manipulation (trapping survey) project to monitor the possibility of the entry and spread of food beetles into Jordanian territory, an initial monitoring program for food beetles was implemented in September 2023 for experimental purposes in three different locations in the north of the Hashemite Kingdom of Jordan. The number of ethanol traps used did not exceed 20 ethanol trap for each location, which led to the collection of 81 samples of beetles, was sent to the Department of Science at the University of Roma Tre in Italy, to complete their identification and cataloging by Dr. Enrico Rozier. 48 samples out of 81 were classified. 29 samples of these beetles were collected from pine and oak forests in the Jerash Governorate in the north of the Hashemite Kingdom of Jordan on 9/10/2023, and 19 samples of these beetles were collected from two guava growing sites in the Irbid Governorate in the north of Jordan on 26-28/9/2023.



Fig. 1. A. *Hypothenemus eruditus* Westwood, 1833; B. *Xyleborinus saxesenii* (Ratzeburg 1837); C. *Xylopertha reflexicauda* (Lesne, 1937); D. *Xyloperthella picea* (Olivier, 1790); E. *Scobicia chevrieri* (A. Villa & G.B. Villa, 1835); F. *Cryphalus dilutus* Eichhoff 1878; G. *Rhyzopertha dominica* (Fabricius, 1792)

Among 29 specimens of beetles captured from oak and pine forests in Jerash Governorate in the north of the Hashemite Kingdom of Jordan, five specimens were found belonging to two species of bark and ambrosia beetles recorded for the first time in the Hashemite Kingdom of Jordan: one female of *Xyleborinus saxesenii* (Ratzburg 1837). (Coleoptera: Curculionidae: Scolytinae), and 4 females of *Cryphalus dilutus* Eichhoff 1878 (Coleoptera: Curculionidae: Scolytinae) (Figure 1F). The remaining 24 specimens collected from the same location and on the same date were classified as follows: 23 females of *Scobicia chevrieri* (A. Villa & G.B. Villa, 1835) (Coleoptera: Bostrichidae) (Fig. 1E) and One female of *Xylopertha reflexicauda* (Lesne, 1937) (Coleoptera: Bostrichidae). Morphological analyzes also showed that 14 out of

19 samples of beetles taken on two different dates from two guava fruit tree cultivation sites in Irbid Governorate were females belonging to three different species of bark and ambrosia beetles from two different tribes, 10 females of *Xyleborinus saxesenii* (Ratzeburg 1837) (Coleoptera: Curculionidae: Scolytinae), which belongs to the tribe Xyleborini, 3 females of *Hypothenemus eruditus* Westwood, 1833 (Coleoptera: Curculionidae: Scolytinae) (Figure 1A) with also 1 female of *Cryphalus* sp. (Coleoptera: Curculionidae: Scolytina), both of which belong to the same tribe, *Cryphalini*. As for the remaining 5 samples, which were collected from two different sites for planting guava fruit trees on two different dates in the Irbid Governorate in the north of the Hashemite Kingdom of Jordan, they were classified as follows: two females of *Xylopertha reflexicauda* (Lesne, 1937) (Coleoptera: Bostrichidae) (Fig. 1C), two females of *Xyloperthella picea* (Olivier, 1790) (Coleoptera: Bostrichidae) (Fig. 1D), and finally one female of *Rhyzopertha dominica* (Fabricius, 1792) (Coleoptera: Bostrichidae) (Fig. 1G). Most of the taxa recorded are widely distributed species of Western Palearctic (all the Bostrichidae) or cryptogenic origin (*X. saxesenii* and *H. eruditus*). Of particular interest is the presence of the invasive *Cryphalus dilutus*, a species of Eastern Palearctic and Indomalayan origin. This taxon, originally from Myanmar was recently recorded or introduced in China (Guangdong, Yunnan), Malta, Italy, Tunisia, UAE, Oman, India, Pakistan, Bangladesh, and Mexico, and the present represents the first finding of this species in Jordan..

Table (2): Species and specimens of the beetles collected by trapped in ethanol traps.

	Host tree	Governorate	Sampling date	Sample #	Species and specimens
in Gamla nursery Faisal nursery	Oak and Pine tree	Jerash	10-9-2023	1-35	1 specimen of <i>Xylopertha reflexicauda</i> (Lesne, 1937) (Coleoptera: Bostrichidae) (Fig. 1C). 23 specimens of <i>Scobicia chevrieri</i> (A. Villa & G.B. Villa, 1835) (Coleoptera: Bostrichidae) (Fig. 1E). 1 specimen of <i>Xyleborinus saxesenii</i> (Ratzeburg 1837) (Coleoptera: Curculionidae: Scolytinae). 4 specimens of <i>Cryphalus dilutus</i> Eichhoff 1878 (Coleoptera: Curculionidae: Scolytinae) (Fig. 1F).
	Host tree	Governorate	Sampling date	Sample #	Species and specimens
a	Guava fruit tree farm	Irbid	26-9-2023	26-59	3 specimens of <i>Hypothenemus eruditus</i> Westwood, 1833 (Coleoptera: Curculionidae: Scolytinae) (Fig. 1A). 10 specimens of <i>Xyleborinus saxesenii</i> (Ratzeburg 1837) (Coleoptera: Curculionidae: Scolytinae) (Fig. 1B) 1 specimen of <i>Cryphalus</i> sp. (Coleoptera: Curculionidae: Scolytinae) (Fig. 1F). 2 specimens of <i>Xylopertha reflexicauda</i> (Lesne, 1937) (Coleoptera: Bostrichidae) (Fig. 1C). 2 specimens of <i>Xyloperthella picea</i> (Olivier, 1790) (Coleoptera: Bostrichidae) (Fig. 1D).
	Host tree	Governorate	Sampling date	Sample #	Species and specimens
h	Guava fruit tree farm	Irbid	28-9-2023	80-81	1 specimen of <i>Rhyzopertha dominica</i> (Fabricius, 1792) (Coleoptera: Bostrichidae) (Fig. 1G)

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المخلص

تم إجراء أول مسح ميداني لعائلة Scolytinae في الأردن في عام 2023 لتحديد وجود وتوزيع الأنواع الغريبة التي لم يتم اكتشافها سابقاً. وشملت مواقع الدراسة غابات الصنوبر والبلوط ومزارع أشجار الفاكهة شمال الأردن. حيث تم استخدام مصائد الحشرات المزودة بكحول الإيثانول كجاذب لأنواع مختلفة من خنافس عائلة Scolytinae. حيث قمنا بجمع أربعة أنواع من غمدية الأجنحة Bostrychidae وهي *Bostrychidae* *Xylopertha reflexicauda*, *Scobicia chevrieri*, *Rhyzopertha* *Xyloperthella picea*, *domini* , تم اكتشاف أربعة أنواع غريبة مؤخرًا تنتمي إلى Scolytinae: *Coleoptera:Curculionidae*; Scolytinae وهي *Xyleborinus saxesenii*, *Cryphalus dilutes*, *Cryphalus* *Hypothenemus eruditus*, *Cryphalus* *H. eruditus* و *X. saxesenii* . ومما يثير الاهتمام بشكل خاص وجود النوع الغازي *Cryphalus dilutes* ، وهو نوع نشأ من شرق القطب الشمالي و الهند الماليزية ، ويعتبر موطن هذا التصنيف هو ميانمار ، وقد تم تسجيله أو إدخاله مؤخرًا في الصين (قوانغدونغ ويونان) ومالطا وإيطاليا وتونس والإمارات العربية المتحدة وعمان والهند وباكستان وبنغلاديش والمكسيك. مع اكتشاف الأنواع الحالية لأول مرة في الأردن من نوع *Cryphalus dilutes* وهو من الأنواع ذات الأهمية في مجال الصحة النباتية بسبب ارتباطه بمرض وموت الأشجار من الأنواع *Ficus sp.* : *Mangifera sp.*