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Four new palm species records for *Rhynchophorus palmarum* (Coleoptera: Curculionidae) in California

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Rhynchophorus palmarum (L.) (Coleoptera: Curculionidae) is a destructive pest of palms (Arecaceae) that is native to parts of Mexico, Central, and South America, and the Caribbean. Larval feeding damage to the meristematic region of the palm may result in palm death (Milosavljević et al. 2019). In the native range, *R. palmarum* vectors a plant pathogenic nematode, *Bursaphelenchus cocophilus* (Cobb) (Aphelenchida: Parasitaphelenchidae), the causative agent of a lethal palm disorder, red ring disease (Griffith 1987; Gerber & Giblin-Davis 1990). *Rhynchophorus palmarum* was first detected in San Diego County, California, USA, in 2011. Populations established in San Ysidro, southern San Diego County, sometime around 2015. Founding populations in San Ysidro likely originated from Tijuana, Baja California, Mexico, about 5 km south of San Ysidro, where this pest was first detected in 2010 (Hoddle & Hoddle 2017). Tijuana populations probably resulted from a gradual northwards migration of weevils that were first reported from infested Mexican fan palms, *Washingtonia robusta* Wendl. (Arecaceae), in Todos los Santos in Baja California Sur, Mexico, in Nov 2000, about 1,500 km south of Tijuana (Garcia-Hernandez et al. 2003). It is notable that *B. cocophilus* has not been detected yet in California (Hoddle & Hoddle 2017).

Known host palms for *R. palmarum* include *Cocos nucifera* L. (coconut), *Elaeis guineensis* Jacq. (African oil palm), *Euterpe edulis* Mart. (juçara, grown for hearts of palm), *Metroxylon sagu* Rottb. (true sago palm), *Phoenix canariensis* Chabaud (Canary Islands date palm), *Phoenix dactylifera* L. (edible date palm), and *W. robusta* (Mexican fan palm) (all Arecaceae). The European and Mediterranean Plant Protection Organization (EPPO) (2020) provides a comprehensive list of known palm hosts for *R. palmarum*. Adult *R. palmarum* feed on a variety of ripe fruit, including avocado (*Persea americana* Mill.; Lauraceae), banana (*Musa* spp. L.; Musaceae), *Citrus* spp. (Rutaceae), mango (*Mangifera indica* L.; Anacardiaceae), and papaya (*Carica papaya* L.; Caricaceae) (EPPO 2020). These fruits are not reproductive hosts and *R. palmarum* is not considered a significant economic pest of these crops.

The 4 palm species that dominate the urban landscape in California are *P. canariensis*, *Washingtonia filifera* (Lindl.) Wendl. (the native California fan palm), *W. robusta*, and *Syagrus romanzoffiana* (Cham.) Glassman (queen palm) (all Arecaceae). Collectively, depending on how land area calculations are made, these 4 species account for about 0.7 to 2% of the urban forest canopy in southern California (Hodel 1996). The only species of these 4 most common palm species known to have been attacked and killed by *R. palmarum* in California is *P. canariensis*, and an estimated 10,000 *P. canariensis* have been killed by this pest in San Diego County (APC 2020). Even though flight mill studies indicate this pest is a very strong flier, its rate of spread throughout the urban environment appears to be slow (Hoddle et al. 2020; 2021). One possible reason for slow spread is the high abundance and diversity of ornamental palm species, especially the highly preferred host, *P. canariensis*, growing in residential, recreational (e.g., parks), commercial (e.g., shopping malls), and riparian wilderness areas (e.g., natural area preserves that have wilding *P. canariensis*).

Balboa Park in San Diego County is a 486 ha (4.9 km^2) urban park that is renowned for its garden spaces (https://en.wikipedia.org/wiki/Balboa_Park_(San_Diego)#Gardens) in which 43 palm species in 24 genera encompassing 2,353 individuals are a defining landscape feature. The 4 most common palm species in California's urban landscape, *P. canariensis* (*n* = 213 specimens at Balboa Park), *W. filifera* (*n* = 25), *W. robusta* (*n* = 274), and *S. romanzoffiana* (*n* = 401) are curated at Balboa Park. Currently, Balboa Park is situated within the epicenter of the *R. palmarum* invasion in San Diego County and 34 *P. canariensis* (about 16%) on park grounds have been killed by this weevil. High levels of weevil activity within and around the park have resulted in a large unplanned field experiment that provides opportunities for the development of new associations between palm species that have no natural biogeographic or evolutionary association with *R. palmarum*. Exposures of this kind provide opportunities for *R. palmarum* to encounter and exploit new host species for reproduction.

In mid–2020 through early 2021, *R. palmarum*-induced mortality of 4 palm species that were previously unknown weevil hosts was observed at Balboa Park. The 4 palm species that succumbed to *R. palmarum* infestation were: (1) *Brahea edulis* Wendl. (Guadalupe palm [*n* = 3 palms killed – about 6% of planted specimens]), native to Guadalupe Island, Mexico (https://en.wikipedia.org/wiki/Brahea_edulis); (2) *Jubaea chilensis* (Molina) (Chilean wine palm [*n* = 4 palms killed – about 10%]), endemic to central Chile (https://en.wikipedia.org/wiki/Jubaea); (3) *Phoenix reclinata* Jacq. (Senegal palm [*n* = 2 palms killed – about 3%]), native to tropical Africa, the Arabian Peninsula, Madagascar, and the Comoro Islands (https://en.wikipedia.org/wiki/Phoenix_reclinata); and *Sabal bermudana* Bailey (all Arecaceae) (Bermuda palmetto [*n* = 1 palm killed – about 17%]), endemic to Bermuda (https://en.wikipedia.org/wiki/Sabal_bermudana). These observed mortality rates indicate that *P. canariensis* is the more highly preferred palm host species for attack by *R. palmarum*.

Infestation of these 4 palm species by *R. palmarum* was confirmed by collection of adult weevils, pupal cocoons, and larvae. Adult weevils were identified and confirmed as *R. palmarum* by the California Department of Food and Agriculture (Pest Detection Record Number:

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370P50000833). Additionally, identification of holes in frond basal sheaths and pupation chambers in frond bases, both of which are highly characteristic damage symptoms resulting from weevil attack, were evident readily. *Brahea edulis*, *J. chilensis*, *P. reclinata*, and *S. bermudana* killed by *R. palmarum* were within 50 to 100 m of *P. canariensis* infested with *R. palmarum*. Importantly, no attacks on *P. dactylifera* (*n* = 18), *W. robusta*, *W. filifera*, or *S. romanzoffiana* have been observed at Balboa Park. Similarly, in other areas of *R. palmarum*-infested San Diego County there have been no reports of these palm species being killed despite areas of high density plantings in some areas (e.g., landscaping for shopping malls). With respect to *P. dactylifera*, a known host for *R. palmarum*, the edible date industry in California is an iconic desert-grown specialty crop that is valued at $100 million per yr and is grown on about 4,000 ha (USDA-NASS 2018). Date gardens in the Coachella Valley are located at a linear distance of about 150 km from current *R. palmarum* infestations in San Diego County (Hoddle et al. 2020). At this time the threat posed to *P. dactylifera* by *R. palmarum* is uncertain, but this invasive weevil may pose a significant economic threat to the California date industry.

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Summary

Four palm species, previously unknown hosts for *Rhynchophorus palmarum* L. (Coleoptera: Curculionidae), were killed by this invasive palm weevil in Balboa Park, San Diego County, California, USA. The 4 new palm species recorded as reproductive hosts for *R. palmarum* for the first time are *Brahea edulis*, *Jubaea chilensis*, *Phoenix reclinata*, and *Sabal bermudana* (all Arecaceae). *Phoenix canariensis* Chabaud (Arecaceae) is the most highly attacked palm species at Balboa Park, and importantly, no attacks on the edible date palm, *Phoenix dactylifera* L. (Arecaceaae), have been observed. The edible date industry is an important specialty crop in California that may be at risk from *R. palmarum*.

Key Words: *Brahea edulis*; invasive pest; *Jubaea chilensis*; palm; *Phoenix reclinata*; *Sabal bermudana*

Sumario

Cuatro especies de palmeras, anteriormente hospederas desconocidas de *Rhynchophorus palmarum* L. (Coleoptera: Curculionidae), fueron matadas por este picudo invasor de las palmeras en el Parque Balboa, condado de San Diego, California, EE. UU. Las 4 nuevas especies de palmeras registradas como hospederas reproductoras de *R. palmarum* por primera vez son *Brahea edulis*, *Jubaea chilensis*, *Phoenix reclinata*, y *Sabal bermudana* (todas Arecaceae). *Phoenix canariensis* Chabaud (Arecaceae) es la especie de palmera más atacada en el Parque Balboa y lo que es más importante, no se han observado ataques a la palmera datilera comestible, *Phoenix dactylifera* L. (Aracaceae). La industria de los dátiles comestibles es un cultivo importante de especialidad en California que puede estar en riesgo por *R. palmarum*.

Palabras Claves: *Brahea edulis*; plaga invasora; *Jubaea chilensis*; palmera; *Phoenix reclinata*; *Sabal bermudana*

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