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Field survey guidance for *Rhynchophorus ferrugineus*

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This document presents guidance to national plant protection organizations (NPPOs) to support active surveillance, detection, identification, control and prevention of *Rhynchophorus ferrugineus*. It was created with technical and financial support from developed countries partnering with the IPPC in 2023, in the framework of the Africa Phytosanitary Programme (APP), and reviewed by technical officers at the IPPC Secretariat. The IPPC implements APP in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the African Union Commission on Agriculture, through its technical unit, the African Union Inter-African Phytosanitary Council (AU-IAPSC). The IPPC Secretariat and the IPPC community are grateful to all the institutions that contributed to the production of this document.

Abbreviations

APHIS	Animal and Plant Health Inspection Service
APP	Africa Phytosanitary Programme
AU-IAPSC	African Union Inter-African Phytosanitary Council
GIS	Geographic Information System
IPPC	International Plant Protection Convention
NPPO	National Plant Protection Organization
PPQ	Plant Protection and Quarantine
USDA	United States Department of Agriculture

Introduction

Continuous and systematic monitoring and surveillance are essential for countries to determine the presence or absence of plant pests, particularly those that significantly impact food security, the environment, trade, and agricultural productivity. This early warning information is vital for timely response, making sound phytosanitary decisions, effective risk management, and protecting borders against pest invasions.

This field survey guidance therefore provides easy-to-follow guidelines for technical personnel of national plant protection organizations (NPPOs), to survey *Rhynchophorus ferrugineus*, a key pest commonly known as red palm weevil.

This field survey guidance provides a protocol to aid in the monitoring, detection, sample collection and identification of *Rhynchophorus ferrugineus*, ensuring effective phytosanitary decision-making to manage the pest risk and protect trade in plants and plant products. It also provides visuals and guidance on recommended pest traps.

This guidance complements the digital tools available to NPPO plant health inspectors, through the Africa Phytosanitary Programme (APP) mobile applications and Geographic Information System (GIS) platforms.

APP is an initiative of the International Plant Protection Convention (IPPC), designed to transform pest management across Africa by enhancing the capabilities of phytosanitary personnel within NPPOs, to leverage advanced science and modern digital technology for effective and timely pest surveillance, detection, identification, control, and prevention. APP aims to strengthen the resilience of Africa's phytosanitary systems against plant pests of regulatory, economic, and environmental significance. Some of the countries involved in APP listed *Rhynchophorus ferrugineus* as a priority pest in their countries, requiring effective surveillance.

The IPPC implements APP in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the African Union Department of Agriculture, Rural Development, Blue Economy and Sustainable Development, through the African Union Inter-African Phytosanitary Council (AU-IAPSC).

Field survey guidance for *Rhynchophorus ferrugineus*

Scientific name
Rhynchophorus ferrugineus (Olivier)

Common name
Red palm weevil, Asiatic palm weevil, coconut weevil, red stripe weevil

Type of pest
Weevil

Taxonomic position
Class: Insecta
Order: Coleoptera
Family: Curculionidae (often listed as Dryophthoridae)

Notes on taxonomy and nomenclature: Colour variation of adult red palm weevil caused multiple taxonomic changes in the past. Recent molecular research suggests that red palm weevil may be a species complex composed of two or more cryptic species.

Figure 1. Red palm weevil adult
© USDA-APHIS/Amy Roda

Figure 2. Red palm weevil adult colour variation
© Center for Invasive Species Research

Known Hosts
Preferred hosts
Many species of palm can be infested. These are the preferred hosts and should be the focus of survey efforts if there is a wide range of palms in the country: coconut palm (*Cocos nucifera*), Canary Island date palm (*Phoenix canariensis*) and date palm (*Phoenix dactylifera*).

Other palm hosts
Betel nut palm (*Areca catechu*), sugar palm (*Arenga pinnata*, synonym: *A. saccharifera*), palmyra palm (*Borassus flabellifer*), Mexican blue palm (*Brahea armata*), palasan (*Calamus merrillii*), Philippine fishtail palm (*Caryota cumingii*), pugahan (*Caryota maxima*), dwarf fan palm (*Chamaerops humilis*), gebang palm (*Corypha utan*, syn. *C. elata*, *C. gepanga*), talipot palm (*Corypha umbraculifera*), oil palm (*Elaeis guineensis*), Australian fan palm (*Livistona australis*), Chinese fan palm (*Livistona chinensis*), ribbon fan palm (*Livistona decisions*), fountain palm (*Livistona rotundifolia*), taraw palm (*Livistona saribus*), sago palm (*Metroxylon sagu*), thorny palm (*Oncosperma horridum*), nibung palm (*Oncosperma tigillarium*), date palm (*Phoenix sylvestris*), Cretan date palm (*Phoenix theophrasti*), royal palm (*Roystonea regia*), cabbage palm (*Sabal palmetto*, syn. *S. blackburniana*), windmill palm (*Trachycarpus fortunei*), Mexican fan palm (*Washingtonia robusta*) and other *Washingtonia* spp.

Survey protocol

Target life stage

Trapping will target adults; however, visual surveys to detect larvae and pupae may be used to detect populations before adults emerge.

Time of year to survey

Trapping and visual surveys can be conducted year-round.

Adult flight activity is lower during hot summer and cold winter conditions in the Near East, and during monsoon season in tropical areas. In Mediterranean climates, flight activity likely begins in spring, with most flight activity taking place during the summer, extending into winter in locations such as Israel.

Visual survey

- Target palms with highly suspect damage or clear signs of infestation.
- For mature palms, inspect the crown and the base of the fronds.
- For young palms, inspect the crown, the fronds and the trunk.
- Note: Accessing the crown/canopy of large palms may be difficult or dangerous.

To inspect the crown or the trunk:

- Search for holes caused by weevils (see Figure 6 and Figure 7), which may be accompanied by oozing brown liquid, chewed-up fibres or a foul fermented odour.
- For highly suspect or heavily damaged trees, cut a “window” in the crown of the tree:
  - Remove all the fronds from one side of the crown.
  - Inspect the denuded crown for tunnels or other damage.
  - **Note:** This method will negatively affect the appearance of the palm.

To inspect the fronds:

- Pull the fronds to the ground by hand or cut them at the base with a machete or pole cutter.
- Search for frass and cocoons at the base of damaged fronds after they are removed from the tree (see Figure 8, Figure 9 and Figure 10).

Signs and symptoms

Early detection of weevil-infested palms is challenging because larvae are concealed within the plant. Larval feeding destroys meristematic tissue, which may not be visible from the exterior. Damage caused by larval feeding can also resemble symptoms caused by other palm pests, namely Fusarium fungi (e.g. wilting, drooping fronds) or rodents (e.g. holes at the base of the fronds). It can be difficult to definitively diagnose the damage until red palm weevil specimens are found inside the palm.

Visible symptoms include:

- distorted or deformed growing points at the top of the palm, often with an umbrella-like appearance (see Figure 3).
- distorted or “clipped” fronds (see Figure 4 and Figure 5); and
- holes caused by weevils (see Figure 6 and Figure 7).

Evidence of red palm weevil infestations is shown below in Figure 3 to Figure 10.

Figure 3. Umbrella-like canopy. Deformed, offset growth of the upper canopy creating an umbrella-like appearance resulting from the drooping of damaged leaf petioles
© USDA-APHIS/Amy Roda

Figure 4. Clipped fronds. Extreme red palm weevil adult damage to palm fronds
© USDA-APHIS/Amy Roda

Figure 5. Distorted fronds. Red palm weevil larval damage to palm fronds
© USDA-APHIS/Amy Roda

Figure 6. Larval feeding holes. Red palm weevil larval feeding holes at the base of frond (see arrows)
© USDA-APHIS/Amy Roda

Figure 7. Adult emergence holes. Adult red palm weevil emergence holes (see arrows)
© USDA-APHIS/Amy Roda

Figure 8. Tunnels and cocoons. Red palm weevil larval tunnels visible in the frond and fibrous pupal cocoons
© USDA-APHIS/Amy Roda

Figure 9. Pupal cocoons. Frond with fibrous pupal cocoons (see arrow)
© USDA-APHIS/Amy Roda

Figure 10. Unemerged adults and pupae. Palm frond with unemerged adult weevils inside partially opened pupal cocoons
© USDA-APHIS/Amy Roda

Trapping

Survey site selection

Surveys should target date farms or palm production areas such as nurseries, natural environments where native palms occur and urban environments where palms have been planted as ornamental trees. Locations that receive international shipments of host material from countries with known populations of red palm weevil should be considered high-risk for introduction.

Recommended traps

- Palm weevil cone traps (Picusan traps);
- Palm weevil bucket traps; and
- Homemade bucket traps.

Figure 11. Palm weevil bucket trap
© USDA-APHIS-IPHIS

Figure 12. Palm weevil cone trap (Picusan trap)
© SOSPALM.com

Bucket traps are suspended above the ground, while palm weevil cone traps are placed on the ground. Both types of traps use the same propylene glycol-water solution, lures and food baits. For homemade traps, the bucket may range in size from 4 litres to 20 litres.

Recommended lures

- *Rhynchophorus ferrugineus* aggregation lure (ferrugineol);
- synergist (ethyl acetate); and
- food bait (fermenting sugar cane, cut apples, palm pieces, pineapple chunks, dates mixed with water and baker's yeast, or 10 percent molasses containing 5 ml of baker's yeast).

The addition of baker's yeast to the food bait greatly increases its attractiveness to palm weevils. The simultaneous use of all three attractants – commercially available aggregation pheromone, synergist and food bait – in traps is highly recommended to detect red palm weevil.

A polysleeve palm weevil lure dispenser (*Rhynchophorus ferrugineus* aggregation lure) is effective for 42 days. Other types of lure dispensers may need to be replaced from time to time; follow the manufacturer's recommended replacement interval for the type of lure being used.

The release rates and longevity of the lures are based on temperature (i.e. the pheromone evaporates faster at higher temperatures). Lures may need to be changed more frequently in hot, dry regions. Placing traps in the shade may make the lure last longer.

Food baits should be placed in the bottom of the bucket or cone trap and covered with liquid. Water is necessary for the bait to ferment. Food baits can be placed in separate aerated containers that are fitted inside traps. These containers allow fermentation to occur by protecting bait, water and yeast from the propylene glycol that is often added to traps to drown and preserve weevils.

Trap placement and spacing

Bucket traps should be suspended from **non-host** trees or poles. Traps should be hung approximately 2 m above the ground to reduce the possibility of disturbance by people, pets and wild animals. Hang the traps at least 30 m from host palms that may be attractive to red palm weevil.

Palm weevil cone traps are placed on the ground and use the same liquid and baits as a bucket trap. These traps should also be placed at least 30 m from host trees.

Note: It is important to place all traps at least 30 m from any palms. If traps are near host trees, weevils not captured by the trap may attack the palm instead.

Trap servicing

Collect insect specimens from the trap and replace food baits every seven to nine days. Replace pheromone and ethyl acetate lures every six weeks (42 days). Lures may need to be changed more frequently in hot, dry regions. To ensure the fermentation of baits, it is crucial to keep food bait covered with water.

Sample collection

Weevils captured by hand from infested trees or found in traps should be placed in labelled vials of ethanol or isopropyl alcohol (minimum 70 percent) and submitted for confirmatory identification. Vials should be labelled with the following information: trap number (if from trap), location, host plant species, date collected and surveyor's initials.

Pest identification and diagnostics

Pest description

Red palm weevil (*Rhynchophorus ferrugineus*) is a large weevil that attacks palms. Adults can be seen crawling or flying near palms or captured in traps. Adults primarily fly during the day but will also fly at night.

The larval stage, weevils feed on meristematic tissue and, in some cases, can kill host plants. Adult males and females are similar in appearance, varying in size from 15 mm to 40 mm in length

Figure 13. Red palm weevil larva, pupa and adult
© Center for Invasive Species Research

and 7 mm to 15 mm in width. Male weevils have hair on the dorsal side of the snout. The body is elongate (oval in shape) and can be variable in colour, but it is often a dull orange with dark spots. The antennae arise from the base of the snout. The elytra (wing covers) can be dark red to black, shiny or dull, and slightly pubescent (hairy). The black spots on the pronotum are extremely variable in appearance (see the dorsal region behind the head of the adult weevils in Figure 1, Figure 2 and Figure 13).

Adults and larvae can infest palms year-round with multiple generations (see Figure 14). Weevils at different life stages can be found residing in the same palm plant simultaneously

Sorting and screening

Rhynchophorus pheromone traps should be sorted initially for the presence of weevils of the appropriate size, colour and shape. Traps that contain weevils meeting all of the following requirements should be screened:

1. Weevils are longer than 25 mm (see Figure 15).
2. Weevils have an overall shape that is like the outline depicted in Figure 15.
3. Weevils have an elongated rostrum (see Figure 16).
4. Weevils are dark red to black with variable red colouration (see Figure 17, Figure 18, and Figure 19).

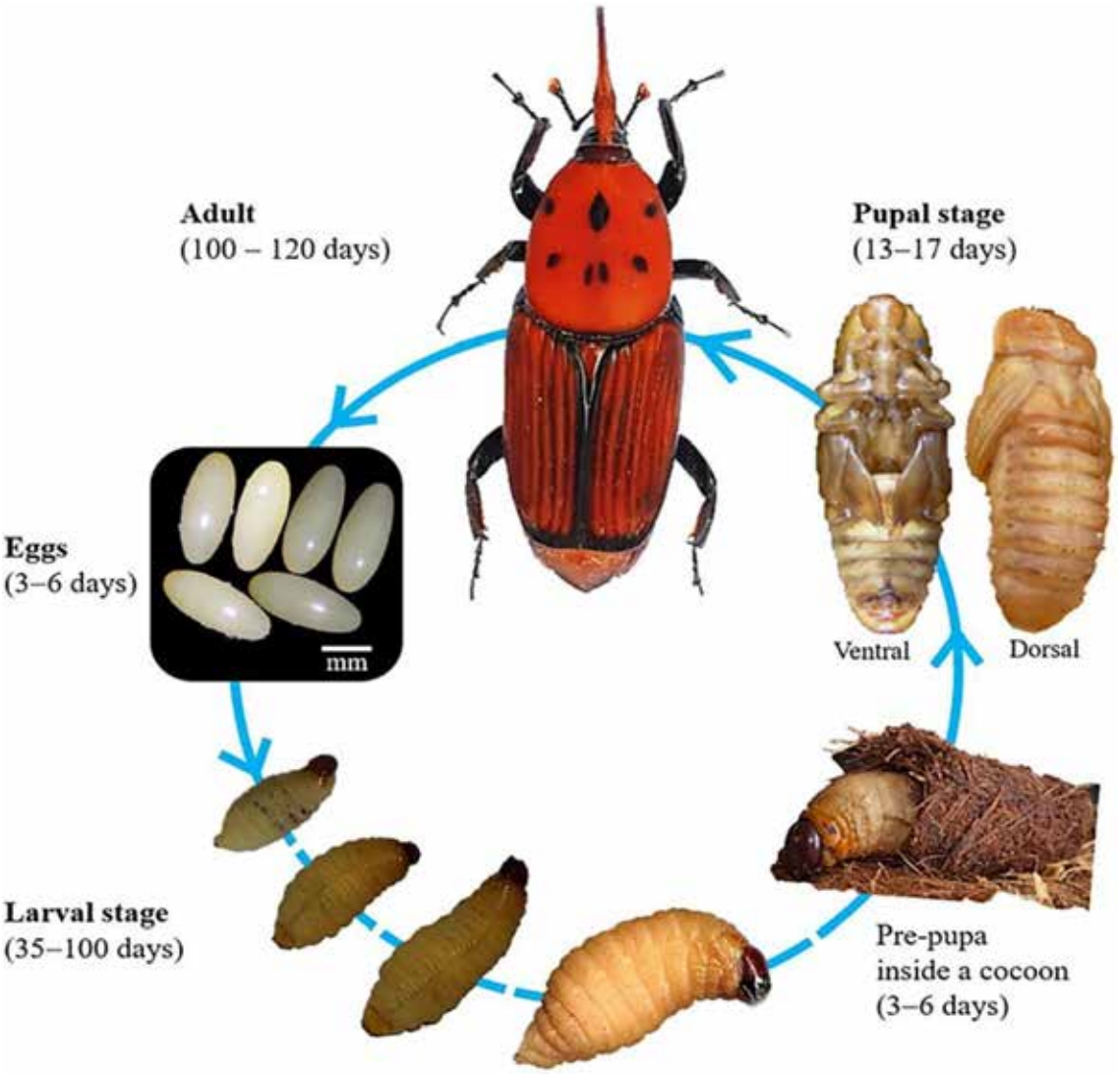

Figure 14. Red palm weevil life cycle
© CABI

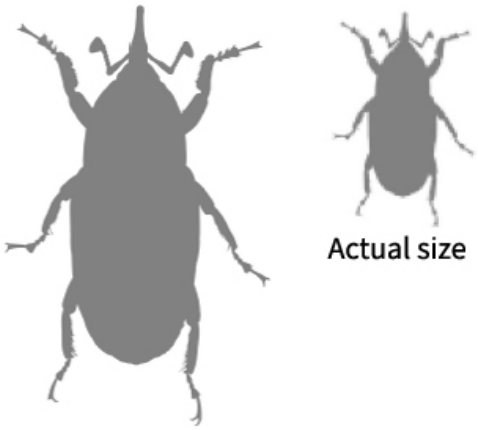

Figure 15. Outline of an adult *Rhychophorus ferrugineus*
© USDA-APHIS-PPQ/Hanna Royals

Figure 16. Elongated rostrum. Males of *Rhynchophorus palmarum* have stout setae on the rostrum
© USDA-APHIS-PPQ/Hanna Royals

Figure 17. Variable red and black colouration of red palm weevil (female)
© USDA-APHIS-PPQ/Hanna Royals

Figure 18. Variable red and black colouration of red palm weevil (male)
© USDA-APHIS-PPQ/Hanna Royals

Figure 19. Black colouration of *Rhynchophorus palmarum*
© USDA-APHIS-PPQ/Hanna Royals

Family-level screening

Separation to family level can be accomplished based on tarsal and antennal characteristics.

Tarsus: *Dryophthoridae* have flaps between tarsal claws (see Figure 20(a)) and *Curculionidae* do not (see Figure 20(b)).

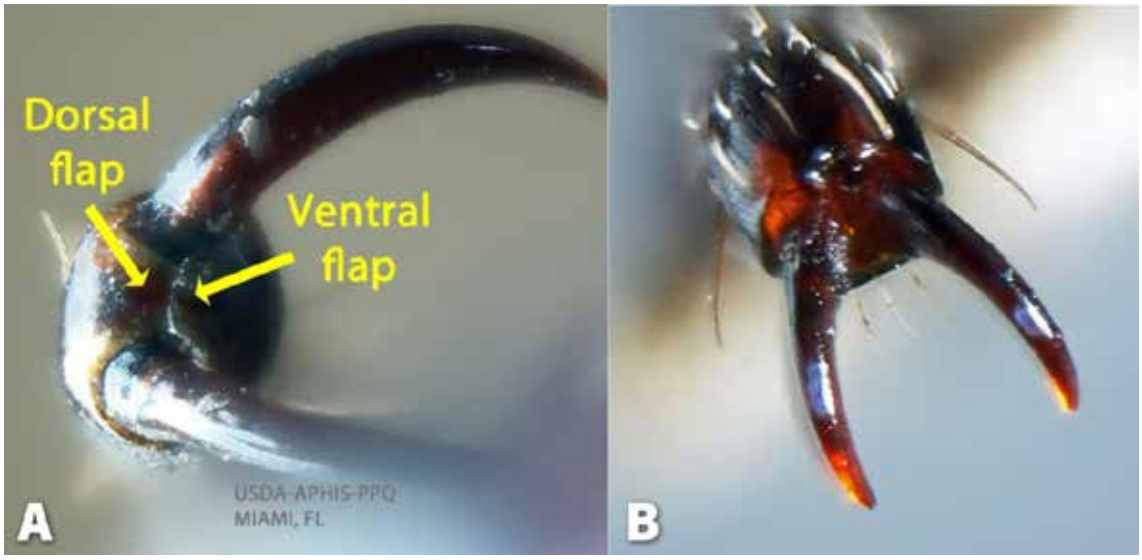

Figure 20. Tarsal claw characteristics: flaps between tarsal claws are present in (a) *Dryophthoridae* and absent in (b) *Curculionidae*
© USDA/APHIS/PPG/Charles Brodel

Antennae: *Dryophthoridae* have a glabrous (lacking setae) first antennal club segment (see Figure 21(a)) and a scape that surpasses the posterior margin of the eye (see Figure 21(b)). *Curculionidae* have a first antennal club segment that is not glabrous (see Figure 21(c)) and a scape that does not surpass the posterior margin of the eye (see Figure 21(d)).

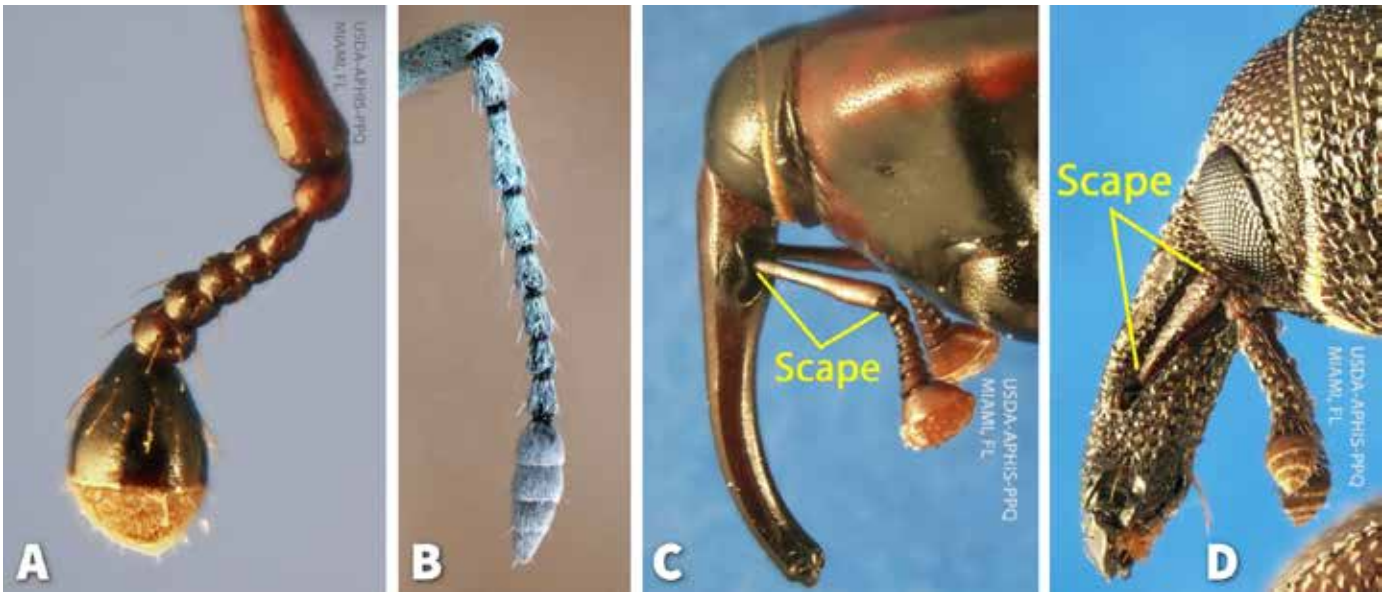

Figure 21. Antennae characteristics: (a) *Dryophthoridae* antennae have a glabrous first antennal club and (b) a scape that surpasses the posterior margin of the eye. (c) *Curculionidae* have a first antennal club that is not glabrous and (d) a scape that does not surpass the posterior margin of the eye
© USDA/APHIS/PPG/Charles Brodel

Genus-level screening

There are many genera in the *Rhynchophorini* subfamily that might be similar in appearance to the *Rhynchophorus* palm weevils, though none are comparable in terms of size. In addition to their large size, *Rhynchophorus* can be differentiated by their relatively broad metepisternum (see Figure 22) and distinct antennae with a transverse sub-triangular club that is wider than it is long (see Figure 23).

Figure 22. Metepisternum shape (highlighted in magenta): (a) *Rhynchophorus* species have a broad metepisternum; (b) Scyphophorus species have an elongate metepisternum
© USDA-APHIS-PPQ-ITP/Hanna Royals

Figure 23. Antennae shape: (a) *Rhynchophorus* antennae have a wide antennal club; (b) Scyphophorus have a longer antennal club
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Key to genus-level screening of *Rhynchophorus* spp. suspects

There are many genera in the *Rhynchophorini* subfamily that might be similar in appearance to the *Rhynchophorus* palm weevils, though none are comparable in terms of size. In addition to their large size, *Rhynchophorus* can be differentiated by their relatively broad metepisternum (see Figure 22) and distinct antennae with a transverse sub-triangular club that is wider than it is long (see Figure 23).

1. Metepisternum broad, length more or less two times width (see Figure 22); antennae with transverse club, wider than long, shape subtriangular (see Figure 23); total body length greater than 25 mm ***Rhynchophorus* suspect**.
2. Metepisternum narrow, length three or more times width; antennae with elongate club, longer than wide, shape subquadrate or sub oval; total body length less than 25 mm
   Not *Rhynchophorus*.

Species-level identification resources

Rhynchophorus is difficult to identify to species level without expert knowledge. Therefore, all specimens passing family- and genus-level screening should be submitted for identification by a specialist.

Diagnostic resources

EPPO (European and Mediterranean Plant Protection Organization). 2007. EPPO Standard on Diagnostics. PM 7/83 (1) *Rhynchophorus ferrugineus and Rhynchophorus palmarum. EPPO Bulletin,* 37: 571–579. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2338.2007.01165.x

Easily mistaken species

There are multiple large palm weevils that can be mistaken for red palm weevil, including *R. bilineatus, R. phoenicis* and *R. quadrangulus.*

IPPC

The International Plant Protection Convention (IPPC) is an international plant-health agreement that aims to protect global plant resources and facilitate safe trade. The IPPC vision is that all countries have the capacity to implement harmonized measures to prevent pest introductions and spread, and minimize the impacts of pests on food security, trade, economic growth, and the environment.

Organization

- There are over 180 IPPC contracting parties.
- Each contracting party has a national plant protection organization (NPPO) and an official IPPC contact point.
- Ten regional plant protection organizations have been established to coordinate NPPOs in various regions of the world.
- The IPPC Secretariat liaises with relevant international organizations to help build regional and national capacities.
- The secretariat is provided by the Food and Agriculture Organization of the United Nations (FAO).

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