



First observation of *Pleurodirus fairmairii* damages on *Cistus heterophyllus* subsp. *carthaginensis*, an Ibero-Balearic endangered endemism

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Abstract

Aim of study: To survey and report the behavior of the weevil *Pleurodirus fairmairii* (Kiesenwetter, 1852) as a pest species on *Cistus heterophyllus* subsp. *carthaginensis* (Pau) M.B. Crespo & Mateo (Cartagena's rockrose), in order to provide the first biological data on this species. Cartagena's rockrose is an Ibero-Balearic endemism considered as "endangered" in the Spanish Catalogue of Threatened Species. Its current distribution is limited to the Spanish provinces of Murcia, Valencia and the Balearic Islands.

Area of study: The study has been conducted in Valencia province (Spain).

Materials and methods: *Pleurodirus fairmairii* was observed in the field feeding voraciously on Cartagena's rockrose. Damages were described, and several individuals of the weevil were captured alive for preliminary observation of their feeding habits under laboratory conditions. The trials (no-choice test) consisted of offering a freshly plucked leaf from different potential host plants to the weevils introduced individually in a Petri dish. Furthermore, a male and a female were dissected for the study of genitalia, and their respective components were prepared for microscopy study and subsequently described.

Main results: This paper reports for the first time the occurrence of the weevil *Pleurodirus fairmairii* on plants of *C. heterophyllus* subsp. *carthaginensis* and describes the important damage it causes on leaves, stem, buds, flowers and fruits.

Research highlights: A short description of the adults is given, including the genitalia, that are shown and described for the first time.

Additional key words: pest; host plant; endangered species; Curculionidae; weevil.

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Introduction

Cistus heterophyllus subsp. *carthaginensis* M.B. Crespo & Mateo (Cartagena's rockrose), within the family Cistaceae, is endemic to the Iberian Peninsula (Albert et al., 2011) and Balearic Islands (Cardona & Capó, 2022). It is listed as "Endangered" at the national level in the Spanish Catalogue of Threatened Species (Moreno, 2008). It was

cited as frequent in the province of Murcia (Spain) by Jiménez Munuera (1903); however, it was later considered extinct for at least twenty years (Robledo et al., 1995), until a single specimen was discovered in 1986 in the municipality of La Pobra de Vallbona (Valencia, Spain) (Crespo & Mateo, 1988). This specimen died on February 2022 (Generalitat Valenciana, 2022). In 1993, a new population was found in Peña del Águila (Murcia, Spain) formed by nine individuals

(Robledo et al., 1995). These individuals died in a wildfire in 1998, but successively new seedlings germinated and 26 new individuals developed into reproductive specimens. Finally, in 2022, a new population of 59 individuals was discovered on the island of Cabrera Gran (Balearic Islands) (Cardona & Capó, 2022).

In 2018, the subspecies was declared as “in critical situation” in Spain by the Spanish regulation (BOE, 2018), due to the existence of an “imminent risk of extinction”. Consequently, works and projects aimed at its recovery were declared of general interest.

Since the end of the 90s of the last century, numerous actions have been carried out for the conservation of this plant, mainly included in the Recovery Plan for the species in the Autonomous Community of Valencia (Generalitat Valenciana, 2015). In response to this plan, an analysis of suitability of optimal areas for the reintroduction of specimens was established. Thus, different introductions of *Cistus heterophyllus* subsp. *carthaginiensis* (all from seeds from the Valencian wild specimen) were carried out in several locations of Valencia (Ferrer-Gallego et al., 2019). The reproductive plant material was obtained through a plant production program conducted over several years (Ferrer-Gallego et al., 2017, 2018).

The main threats for this species are its low number of individuals and its low genetic variability. In this sense, hybridisation with the rock-rose *Cistus albidus* L. affects the genetic integrity of the Iberian populations (Ferrer-Gallego & Laguna, 2012). Likewise, forest fires and habitat destruction due to infrastructure and urban expansion can also affect the survival of the taxon (Generalitat Valenciana, 2015).

A new important threat to this plant species was detected on May 2021, when several weevils were observed, in the field, feeding on leaves, flowers, buds and stems of *C. heterophyllus* subsp. *carthaginiensis* in three introduced populations of this species in Valencia (Spain) at La Manguilla (Pobla de Vallbona), Pla de Colom (Bétera) and Tancat Forestal de Porta-Coeli (Serra) (Generalitat Valenciana, 2015). However, weevils were not observed on the natural plant in La Pobla de Vallbona (Valencia, Spain), which was about 3 km from the nearest introduced population.

In this study, we provide preliminary field and laboratory observations on feeding habits and host preferences, as well as a description of the main taxonomic characteristics of this species, including male and female genitalia, which are described here for the first time.

Material and methods

Several trips were made during May 2022 to obtain the insects in the reintroduction areas of the Cartagena’s rock-rose. The insects were sampled by sweeping, and taken to the laboratory. Some of them were killed and prepared following usual procedures (Marcos & Galante, 2004). A male and a female were dissected for the study of genitalia,

and their respective components were prepared in microslides for microscopy study. Other insects were kept alive for preliminary observation of their feeding habits under laboratory conditions at the facilities of the Laboratori de Sanitat Forestal (Quart de Poblet, Valencia). The trials (no-choice test) consisted of offering a freshly plucked leaf from different potential host plants to 12 weevils individually introduced in a Petri dish for 24h. The plants offered during the trials were *Cistus heterophyllus* subsp. *carthaginiensis*, *Lavandula angustifolia* Mill., *Rhamnus lycioides* L., *Phyllirea angustifolia* L., *Mirtus communis* L., *Viburnum tinus* L., *Salvia rosmarinus* (L.) Schleid, *Anthyllis cytisoides* L. and *Pistacia lentiscus* L. All plants were obtained from the reintroduction areas of the Cartagena’s rock-rose.

Results and discussion

The weevil was identified in the laboratory as *Pleurodirus fairmairii* (Kiesenwetter, 1852). It belongs to the family Curculionidae (Coleoptera), subfamily Entiminae (short-nosed weevils), genus *Pleurodirus* Chevrolat, 1878 and subgenus *Pleurodirus*. This subgenus consists of two species, *P. carinula* (Olivier, 1807) and *P. fairmairii* (Kiesenwetter, 1852) (Alonso-Zarazaga et al., 2023). *Pleurodirus carinula* is easily distinguishable from *P. fairmairii* because its dorsum is covered by erect setae, the sides of the prothorax are not densely covered with scales, and the dorsum of the prothorax is carinate. *Pleurodirus fairmairii* is distributed throughout the eastern of peninsular Spain, from Alicante to Girona, reaching southern France. (Alonso-Zarazaga, 2018; Velázquez de Castro & Alonso-Zarazaga, 2022). It seems to have a disjunct distribution with its sister species, *P. carinula*, which is found in central and northern Spain.

A short description and biological notes of *P. fairmairii* are given below.

Habitus. Small (3.5 to 5 mm, rostrum excluded) weevil, dark brown in colour with ferruginous legs and antennae (Fig. 1). Covered with small ashen or coppery scales, more abundant on the sides of the prothorax and at the beginning of the elytral suture. Short, flat face, head with interocular fossette. Eyes round and somewhat protruding. Antennae robust and elbowed. Elytra rounded without shoulders. Prothorax elongated, moderately convex, and with strongly punctate surface. Legs with finely toothed femora, tarsi with fused nails.

Genitalia (Fig. 1). Male: the median lobe of the aedeagus ends in a sharp point. Female: the receptacle of the spermatheca is thin and has a well-developed transverse ramus. The eighth sternite is long, with an oval lamina.

Biology. It is a common species in forest areas at medium altitude (Alonso-Zarazaga, 2013). There are no data on its host plants, however, all short-nosed weevils (Entiminae) spend their larval stage inside the soil, feeding



Figure 1. Adult specimen of *Pleurodirus fairmairii* (a). Genitalia of *Pleurodirus fairmairii*: Aedeagus (b); spermatheca (c); lamina of the female sternite VIII (d); female sternite VIII (e).

on the roots of the host plant. Adults usually feed on the aerial parts of the same plant on whose roots the larvae feed, although they tend to be more polyphagous. In the case of *P. fairmairii*, it has occasionally been found on *Quercus*, *Arbutus*, *Ononis*, *Cistus* without having been observed feeding on them (Biodiversidad Virtual, 2022). Recently, the authors found two adults in Andilla (Valencia) on the rockrose *Cistus albidus*, whose flower buds were perforated. Regarding the other species of the subgenus, *P. carinula*, it has been reported feeding on *Cistus* in the Sierra de Guadarrama (Madrid) (Velázquez de Castro et al., 1990).

Field observations

The damages caused by the presence of the weevil on the Cartagena's rock-rose were defoliation of the leaves and perforation of buds, flower buds, fruits and tender parts of the stem (Fig. 2). The weevil attack did not result in the direct death of the plants, nor did they irreversibly affect their survival, although the damages definitely compromise plant reproductive capacity.

The presence of the insect in some of the introduced populations suggests that it could have been introduced into these areas via the substrate used for the nursery production



Figure 2. *Pleurodirus fairmairii* damages on leaves (a), flower buds (b) and flowers (c) of *Cistus heterophyllus* subsp. *carthagenensis*.

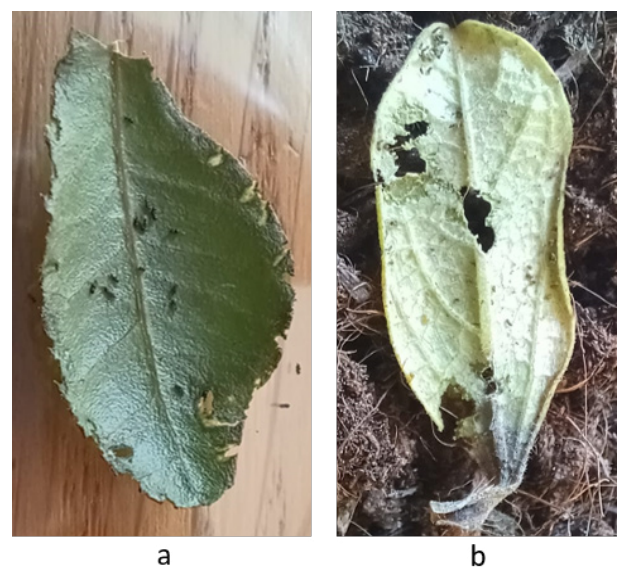


Figure 3. Bite marks on *Pistacia lentiscus* leaf (a) and *Cistus heterophyllus* subsp. *carthagenensis* leaf (b) in laboratory test.

of the seedlings. However, the insect was not found in the nursery where the seedlings were grown (Centre per a la Investigació i Experimentació Forestal, CIEF, Quart de Poblet, Valencia, Spain) neither in the substrate used, nor on the seedlings, and no damages were observed on any part of the plants. This suggests that the insect naturally occurs in the areas where it has been detected and that it has a special predilection for *C. heterophyllus* subsp. *carthaginensis*. It should be noted that the selection of suitable areas for introduction has considered the absence of certain species to avoid hybridation, especially *C. albidus*, which could be a potential alternative host of the weevil.

Laboratory observations

Preliminary observations showed that *P. fairmairii* rejected feeding on leaves of *Lavandula angustifolia*, *Rhamnus lycioides*, *Phyllirea angustifolia*, *Mirtus communis*, *Viburnum tinus*, *Salvia rosmarinus*, and *Anthyllis cytisoides*. On the other hand, the weevils provoked relevant damages on *Pistacia lentiscus* and *Cistus heterophyllus* subsp. *carthaginensis* (Fig. 3).

Conclusions

The study of the morphology and the feeding habits of *P. fairmairii* represents a little advance in the knowledge of this weevil, and useful information for the protection of *C. heterophyllus* subsp. *carthaginensis*. Indeed, further host selection trials should be carried on by offering to the insect flower buds, buds, tender shoots and leaves of those species for which the insect has shown interest.

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Authors’ contributions

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