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Report of a Pest Risk Analysis for *Diocalandra frumenti*

This summary presents the main features of a pest risk analysis which has been conducted on the pest, according to EPPO Decision support scheme for quarantine pests.

Pest: ***Diocalandra frumenti* (Fabricius)**

PRA area: The PRA area is the EPPO region (see map www.eppo.org).

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STAGE 1: INITIATION

Reason for doing PRA: In March 1998, *Diocalandra frumenti* (Fabricius) (Coleoptera: Rhyncophoridae) a tropical pest of palms was detected in the region of Maspalomas, Gran Canaria, Canary Islands (Salomone Suárez *et al.*, 2000a) where it was associated with damage to *Phoenix canariensis*, *P. dactylifera* and their hybrids, and to damage to individual trees of *Cocos nucifera* and *Washingtonia* spp. How the pest entered Gran Canaria is unknown. Within the EPPO region, this pest is regulated in the Canary Islands and Morocco. This PRA was initiated to assess the risk presented by *D. frumenti* to palms in other EPPO countries.

Taxonomic position of pest: Coleoptera : Curculionidae

STAGE 2: PEST RISK ASSESSMENT

Probability of introduction

Entry

Geographical distribution: *D. frumenti* has a wide distribution in countries within and bordering the Indian and Pacific Oceans, across tropical Asia, northern Australia, and in several African

countries. It has also established in Ecuador. According to Lepesme (1947), the species appears to be native in the Indian Ocean Basin. It has recently been detected in the EPPO region in Canary Islands (Salomone Suárez *et al.*, 2000a).

Europe: Canary Islands (Gran Canaria, Lanzarote, Tenerife, Fuerteventura, it is still absent from other islands of the Canary Islands). First detected in 1998.
Asia: Bangladesh, China, India, Indonesia, Japan (first detected in 1977), Malaysia, Myanmar, Philippines, Singapore, Sri Lanka, Taiwan, Thailand
Africa: Madagascar, Mauritius, Seychelles, Somalia, Tanzania (including Zanzibar).
South America: Ecuador.
Oceania: Australia (Northern Territory, Queensland, Western Australia), Federated States of Micronesia, Guam, Palau, Papua New Guinea, Samoa, Solomon Islands, Vanuatu.
(souce: CABI, 2008)

Major host plants or habitats:

Diocalandra frumenti is restricted to Arecaceae, and 17 genera of this family have been reported as hosts. These include economically important species cultivated for food, oil, housing or landscape plants. A large number of other landscape palm species are mentioned in the literature (eg. AVA 2006; NGIA 1998).

Major host: *Cocos nucifera* (coconut), and landscape palms such as *Phoenix canariensis* and its hybrids, *P. dactylifera, Washingtonia* spp. (Kahlshoven, 1981, Salomone Suárez *et al.*, 2000b).

Minor hosts: *Archontophoenix alexandrea, Bismarkia* sp., *Caryota* sp., *Chrysalidocarpus lutescens, Dypsis lutescens, D. lucebensis, Elaeis guineensis, Howea belmoreana, Mascarena verchaffeltii, Metroxylon sagu, Nypa fruticans, P. canariensis P. loureirii, P. roebelenii, Ptychosperma macarthurii, Ravenea rivularis, Roystonea regia, Sabal palmeto,* and *Wodyetia bifurcata,* (Lepesme, 1947, NGIA, 1998, Salomone & Caballero Ruano, 2008).

This distinction between major and minor hosts is based on worldwide literature, however, minor hosts may change into a major host depending on host availability. For instance, in the Canary Islands where there are few coconuts, *P. canariensis, P. dactylifera* and their hybrids and *Washingtonia* spp. are heavily infested (Gobierno de Canarias, pers. comm., 2008).

Considering the uncertainty on its host range, all palm species are considered as potential host plants in the present PRA.

Cocos nucifera (coconut), *P. canariensis, P. dactylifera* and *Washingtonia* spp. occur in the EPPO region (Tutin *et al.*, 1964)..

Which pathway(s) is the pest likely to be introduced on:

The EWG considered the following pathways:

I. Commercial import of plants for planting of palm species (Arecaceae) other than seedlings of* Howea forsteriana *from where the pest occurs (except Canary Islands)

Diocalandra frumenti is a pest of Arecaceae, and has at least 23 species from 17 genera as hosts. In this PRA, we consider all palm species as potential host plants.
Seedlings of *Howea forsteriana* are excluded as they are imported as very small

seedlings (pers. comm. F Salomone Suárez, Jefe de la Sección de Medioambiente y Servicios Municipales Ayuntamiento de San Cristóbal de La Laguna, November 2008)
Infested plants for planting are considered as pathway of introduction of the pest in Japan (Morimoto, 1985), and possibly in the Canary Islands (Salomone Suárez *et al.*, 2000a). It is also considered as a way of spread within Australia (NGIA, 1998).
There is no record of interception of this pest in the EPPO region (Peter Oostelbos, Plant Protection Service of the Netherlands 2008; EPPO Secretariat, 2008).
More than 40 genera of palms are imported into the EPPO region
In 2005-2007, at least 1.8 million of palms trees are imported per year from countries where *D. frumenti* is present, with Sri Lanka and China being the main exporting countries, and *Livingstona* spp. and *Rhapis* spp. the main species imported.
Plant material from palms is imported on a daily basis throughout the whole year in sea containers. The commodity is very widely distributed throughout the EPPO region.
As eggs and larvae develop in the fronds and stem of the plants and are protected from adverse conditions, it is very likely that the pest will survive transport and storage conditions within living palm trees.
D. frumenti may easily transfer from an infested plants for planting to an unintended habitatas palms are likely to be placed near other host plants which can be infested by adults emerging from the imported plants, at least in southern countries.
Salomone Suárez *et al.* (2000b) estimated that hundreds of individuals could be found in a single palm tree and in case one or more infested trees are imported, it is very likely that at least one male and female beetle (or larvae) are present.
The probability of entry along this pathway is considered as moderately likely.
Uncertainty/lack of information: High. Few references are available, including for the native area of the species. The host range is unknown/uncertain.

II. Commercial import of plants for planting of palm species (Arecaceae) from where the pest occurs in the Canary Islands

All palms including *Howaea* are considered since these are exported from Canary Island as juvenile plants of up to 2 m in height in pots with diameter of 17-25 cm.
Due to the specific legislation in the Canary Islands to prevent infestations of both *R. ferrugineus* and *D. frumenti* in nurseries, it is expected that nurseries are free of the pest (Commission Decision on *R. ferrugineus* of 2007 May 25th and BOC Orden de 29 de octubre de 2007). Specific controls are carried out in nurseries since January 2007 and no signs of the pest have been detected (Gobierno de Canarias, pers. comm., 2008).
The pest is therefore less likely to be found on this pathway.
Palm species are exported from Canary Islands during the whole year in sea containers without climate control and occasionally there are some airfreight consignments (Gobierno de Canarias, pers. comm., 2008).
Probability of survival during transport/storage and probability of transfert are similar to that of other infested countries (see previous pathway).
The probability of entry along this pathway is considered as very unlikely to unlikely.
Uncertainty: Low

III. Movement of palm trees with passengers from where the pest occurs

Passengers can import (parts of) host plants including palm trees from areas where the pest is present, although such even is very rare. The volume of palms transported is minimal. Nevertheless, it is difficult to detect the pest since it is

cryptic. There are no limitations for passengers to carry plants in most of the countries of the EU and probably also into the EPPO region.
The probability of entry along this pathway is considered as very unlikely to unlikely.
Uncertainty: Low

IV. Commercial import of palm fronds from where the pest occurs

Eggs or larvae of *D. frumenti* can be present in palm fronds.
Little information is available on the abundance of the pest and management practice in palm nurseries in which plants are grown. Palm fronds can be produced in palm nurseries, or be taken from wild palm trees, as it is the case for *Chamaedorea* palms in Central America (Current, 2006). As fronds as exported for ornamental purposes, it is expected that level in infestation by the pest would be minimal.

Eggs and larvae develop in the fronds and will be protected from adverse conditions. As the palm fronds will be transported by airplane, the duration of transportation will only last a few hours and the pest is very unlikely to multiply/increase in prevalence during transport.
Palm fronds are considered to be imported throughout the year. Consignments therefore arrive at a suitable time of year for pest establishment. As palm fronds are intended to be used indoors, the pest is unlikely to transfer from the palm frond to unintended habitats
In conclusion, **the probability of entry of the species as a contaminant of palm fronds is considered as unlikely.**
Uncertainties: **High** (lack of trade data, management practice)

<u>Pathways considered very unlikely or impossible</u>

I. Commercial import of seedlings of* Howea forsteriana *from where the pest occurs (except Canary Islands)
This pathway is very unlikely since *Howea* are imported as very small seedlings.

II. Natural spread
Since *D. frumenti* is not recorded to fly long distances, natural spread of the species from Canary island is not considered possible.

III. Commercial import of seeds of host plants
D. frumenti adults may be present as a hitchhiker on imported seeds of host plants, but the **probability is very low** as the seeds will be cleaned before shipment. The presence of larvae in commercial imports of seeds is **very unlikely.**

IV. Import of consignments of fruits of palms (coconuts, dates)
There are no records of *D. frumenti* being a hitchhiker on palm fruits, or a contaminant in fruits. The species does not lay eggs in fruits, it is therefore very unlikely that fruits could be infected.

V. Import of consignments other than fruits/seeds of palms
D. frumenti may enter as a hitchhiker on consignments imported from areas where the pest is present, but the probability would be **very low** as there is no obvious reason for the pest to enter consignments other than host plants.

Establishment

Plants or habitats at risk in the PRA area:

Ornamental palm trees in the southern areas of the EPPO region (Mediterranean countries, Macaronesia, Portugal) are at risk. Palms are found into the wild in the Mediterranean Basin and Macaronesia. Endemic species exist: *Phoenix canariensis* in the Canary Islands, *P. theophrastii* in Greece and Turkey, and *Chamaerops humilis* in Spain, Italy, France, Morocco (*C. humilis* subsp. *cerasifera*).

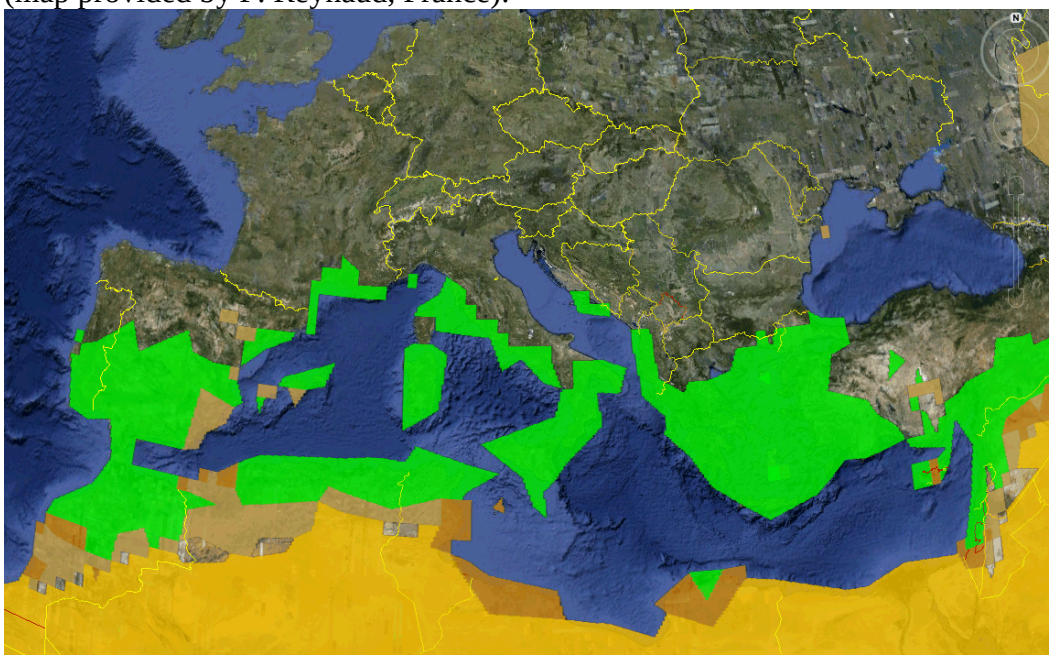
Palms as crop for oil and food

Palms as crop for oil and food are found into the EPPO region (see table 7).

Climatic similarity of present distribution with PRA area (or parts thereof):

Moderately similar, low uncertainty

Although no specific study has been conducted on the temperature requirements of this pest, some indications are given from the places where it is present.
Since the species spends most of its development phase in the trees protected from adverse climatic conditions, these do not appear to be very limiting at least at the immature stages. A detailed climate study is therefore not considered useful. The Köppen distribution map for the climatic zones where *D. frumenti* is as follows (map provided by P. Reynaud, France):



Legend: Köppen-Geiger classification maps in the EPPO region with the categories considered to be suitable for palms.

The following countries within the EPPO region and the neighbouring countries have these climate categories at least on part of their territories:
Albania, Algeria, Bosnia Herzegovina, Bulgaria, Croatia, France, Greece (including Crete), Cyprus, Egypt, Israel, Italy, Jordan, Lebanon, Libya, Malta, Montenegro, Morocco, Palestine, Portugal, Republic of Macedonia, Serbia, Spain, Syria, Tunisia, Turkey.

Climatic conditions in the southern EPPO region are moderately similar to those in the current area of distribution of the pest.

The climatic conditions in the northern EPPO-region are not similar to those in the current area of distribution of the pest; conditions in protected conditions in the northern region are considered similar.

Characteristics (other than climatic) of the PRA area that would favour establishment:

Highly favourable
Medium uncertainty

Considering that the species spends most of its development phase into the trees, abiotic factors are probably of minor importance for establishment.
No competitors are recorded where the pest occurs, and no competitors are known in the PRA area. In general, the EWG considered that it is very unlikely that predators, entomopathogens or other biological control agents will prevent establishment.

The managed environment in highly favourable in the southern part of EPPO region. Palm plants are present in nurseries, in urban and private landscape (e.g. forests and in neighbourhoods public and private gardens). Palm trees are usually pruned which will create wounds that may attract the pest for oviposition (NGIA, 1998; Zimmerman, 1993). Incorrect irrigation procedures (e.g. over-irrigation) may create a stressed situation for the palm, which makes it more sensitive to infestation by the pest. High densities of planting may also favour the establishment of the pest. The over planting of palms in areas which are not favourable for these plants is also a factor that may stress palms and increase the probability of establishment of the pest.
The EWG considered that where *Rhynchophorus ferrugineus* is present, imidacloprid as well as other insecticides that are applied regularly would limit the potential for establishment of *D. frumenti*.
In forests (natural areas) and residential areas, plant protection products are usually not applied.

Which part of the PRA area is the endangered area:

The endangered area is primarily the southern part of the EPPO region (Mediterranean countries, Macaronesia, Portugal) where palm trees are grown outdoors as crops or present in the urban landscape and in forests.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

The pest only attacks palms and the host range is quite broad (at least 17 genera). However, the precise status of this weevil as a pest is open to dispute.

Effects on crop yields

According to Hill (1983), some entomologists believe that the damage is primary and results in appreciable crop losses while others maintain that damage is purely secondary. Hill (1983) reported that *D. frumenti* is a major pest of coconut (*Cocos nucifera*) and oil palm (*Elaeis guineensis*). *D. frumenti* has also been found attacking *Phoenix canariensis* as well as the date palm *Phoenix dactylifera* and its hydrids, though impacts on this crop are not detailed (Salomone Suárez *et al*., 2000b). Hill (1983) considered *D. frumenti* to be a minor pest of date palms, but this is an important crop in the southern EPPO region.

In Taiwan, Liao & Chen (1997) reported attacks of *D. frumenti* on ornamental palm seedlings of *Mascarena verchaffeltii, Roystonea regia* with a damage comprised between 5 and 20%, while the damage on *Phoenix loureiri* was estimated to be lower than 5%.

In China, Yani *et al*. (2007) list *D. frumenti* among the primary disease in South China. Lu *et al*. (2003) present *D. frumenti* as “an important pest on coconut and other palms in mainland Africa, Madagascar, India, Japan, South-East Asia, Pacific region and Taiwan, China”, although impacts for all the countries quoted cannot be traced back. Such publications are in Chinese and cannot be accessed.

Feeding damage by larvae may cause premature yellowing and collapse of palm fronds in the crowns (NGIA, 1998; Salomone & Caballero Ruano, 2008). Damage can occur on roots (Liver, 1969), fronds and fruit stalks which will reduce the vigour of the plant and the value of ornamental plants.

Synergistic effects with other pests

Although *D. frumenti* is known to have caused the death of mature ornamental palms of *Phoenix canariensis* in Queensland (Australia) (Giblin-Davis, 2001), later observations suggest that *D. frumenti* only in combination with other pests could kill plants of *Phoenix canariensis* in Canary Islands (Gobierno de Canarias, pers. comm. 2008). In the Northern Territory, where *R. obscurus* is absent, the impact is low and there is no effort to manage *D. frumenti* (S Smith, Department of Primary Industry, Fisheries and Mines, Northern Territory, Australia, pers. comm., 2008).In Australia, damage by this pest is usually minor, although where it is associated with another weevil pest, *Rhabdoscelus obscurus*, the combined attack can cause significantly greater damage and even death of susceptible host palms (NGIA, 1998).

The activity of *D. frumenti* may favour the entry of pathogens.

Quality to cultivated plants and control costs

Even when the pest does not kill the palm host plants, the aesthetic damage may make the plants unmarketable and makes them more vulnerable to attack by other pests.

Around 2000 heavily infested palm trees were removed in Gran Canaria. The removal of one tree cost around 500 euros, depending on plant characteristics (planting site, size, species, etc.).

Environmental damage

No reports are known of environmental damage caused by *D. frumenti*, except in Canary Islands. *D. frumenti* (only in combination with other pests) killed plants of *P. canariensis*, an endemic species in Canary Islands (Gobierno de Canarias, pers. comm. 2008).

Social damage

Phoenix canariensis is by law the Canary Island vegetal symbol (Ley 7/1991 de Símbolos de la Naturaleza para las Islas Canarias) so impact on this tree has an important social impact.

Destuction of palms trees by the pest could affect the local populations as palm trees are used traditionally: palm fronds were used for artcrafts, to feed the livestock and traditionally to sweep the streets; the traditional production of honey palm (guarapo) obtained from *P. canariensis* involves production practices to yield the honey which are assumed to make the plant vulnerable to attacks by *D. frumenti*, leading to higher palm damages.

There are no other social impacts reported in other areas where the pest is present.

Describe damage to potential hosts in PRA area:

Palms (Arecaceae) for ornament

Southern region (outdoors)

The pest is expected to have varied effects similar to those experienced in other areas of the world. In combination with other weevils or pathogens, it may cause very significant damage (and death) to palm trees.

Northern region (protected cultivation)

The effect is expected to be limited since it seems unlikely that large populations will build up in glasshouses and the pest could easily be managed.

Palms as crop for oil and food

The pest may negatively affect yield of date palms *(Phoenix dactylifera)* which is an important crop in Northern Africa (Anonymous, 2003) (see table 1), but impacts on this crop are not detailed (Hill, 1983; Salomone Suárez *et al.*, 2000a). However, the pest usually does not kill trees and mainly infests damaged or weakened trees and, therefore, large losses of palm trees/forests are not expected.

Table 1 Area (ha) covered by harvested dates in 2005, 2006 and 2007.

Countries	2005	2006	2007
Algeria	147,906	154,372	140,000
Morocco	34,700	35,500	36,000
Tunisia	46,000	40,740	39,830
Turkey	3,850	3,850	3,900
Israel	2,600	2,600	2,600
Spain	893	900	950

(source FAO STAT)

Synergistic effects with pests already present in the PRA area

In Australia, the combined attack with *Rhabdoscelus obscurus* can cause significantly greater damage and even death of susceptible host palms (NGIA, 1998). The Expert Working Group considered that the same may happen with *Rhynchophorus ferrugineus* which is present in some EPPO countries, as well as with other palms pests (e.g. *Oryctes nasicornis, Paysandisia archon*, etc.).

Environmental damage

The pest can attack palms that are present as landscape trees in the whole Mediterranean area, Macaronesia and Portugal and also threaten palm forests (e.g. the Elche palm forest in Spain which is a UNESCO site) and palms in historical parks and collections.

D. frumenti is a threat for the endemic *Phoenix canariensis* in the Canary Island, particularly in combination with other pests. *D. frumenti* could be a threat to the endemics *Phoenix theophrasti* in Greece and Turkey (registered on the IUCN red list) and *Chamaerops humilis* in Spain, Italy, France and Morocco (*C. humilis* subsp. *cerasifera*).

In natural forests, no treatments are implemented to control the pest butplants in natural forests are likely to be more resistant to pests since they are not pruned or subject to inefficient irrigation practices and would be less at risk from wounds.

Social damage

Southern EPPO-region

The pest can attack palm trees in the environment and may, thereby, decrease the recreational value of landscapes, private gardens, historical palm sites and botanical gardens.

In North African countries, date palm production is an important crop. Damages on this crop could affect lifestyle.

How much economic impact would the pest have in the PRA area:

<u>Southern EPPO region</u>: Moderate

<u>Northern EPPO region:</u> Minimal

Uncertainty: medium

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

The pest is currently listed as a quarantine pest in Canary Islands and Morocco. There are damage symptoms to palms and palm deaths on Gran Canaria, whether directly or indirectly (via invasion of microorganisms) attributable to *D. frumenti*.
Although the reported direct impacts on palms are not considered as major, the pest in synergy with other pests may weaken and kill culturally and socially significant palm species in the Southern EPPO region.

Estimate the probability of entry:

The overall probability of entry is considered as moderately likely to likely.
The uncertainty is high.

Estimate the probability of establishment:

<u>Southern EPPO region</u>:
Host plants are present outdoors in commercial nurseries, in urban areas, in gardens, in forests and in the wild. The climate is moderately similar to the climate in areas where the pest is present (e.g. tropical and subtropical areas such as Taiwan and Japan), but *D. frumenti* spends most of its development protected from adverse conditions. Management measures of palms (i.e. pruning, irrigation, high densities of planting, etc.) are highly favourable for the establishment of *D. frumenti*.
Probability of establishment: very likely
Uncertainty: low

<u>Northern EPPO region</u>:
The pest may be able to establish in commercial palm glasshouses in the northern areas of the EPPO region as climatic conditions are suitable and host plants are present throughout the year. However, the generally short growing period of imported palms together with the relatively long life cycle of the pest could make it difficult for the pest to become established after entry in a glasshouse.
When palms are maintained for longer period in glasshouses such as botanical palm collections, or any place with permanent palm plantations (e.g. recreation centers) establishment is very likely, however the species would be easy to eradicate.
Probability of establishment:
Moderately in commercial palm glasshouses (with rapid turnover of plants) and very likely under protected conditions with "permanent" palms;
Very unlikely outdoors
uncertainty: low to medium

Estimate the potential economic impact:

<u>Southern EPPO region</u>:
Areas where palms are grown outdoors (Mediterranean area, Macaronesia, Portugal) are most at risk. The biggest dangers are to culturally and socially significant palm species, such as *Phoenix canariensis* and date palms.

It is estimated that there is **moderate** risk of economic damage occurring in the Canary Islands.

There is a **moderate** risk to areas within the southern EPPO region.
Uncertainty: Medium

Northern EPPO region:
The only impacts expected are on the quality of imported palms and potential control costs in glasshouses.
minor (protected cultivation):
uncertainty: low

Degree of uncertainty

It is to be noted that most data and experience come from the Canary Island as there are very few bibliographical references on this species, some of which are only available in other languages (e.g. Chinese).
The following uncertainties have been identified:

- Potential host range
- damage levels to various palms, including the endemic palms in the Mediterranean basin;
- Prevalence in nurseries in areas where the pest occurs from which plants are being imported (except Canary Islands);
- Probability of disease transmission.

OVERALL CONCLUSIONS

There are damage symptoms and palm deaths to palms on Gran Canaria, but they are rather indirectly (via invasion of microorganisms) attributable to *D. frumenti*. There is in addition contradictory and scare information on the impacts of *D. frumenti* in countries where it has been introduced, as for example in Australia.

For these reasons, the EPPO Panel on Phytosanitary Measures considered that *D. frumenti* does not qualify as a quarantine pest as there are too many uncertainties on its impacts. Management options are therefore not considered, but this conclusion could be revised in the case of additional data found on impacts.

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