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## RESEARCH ARTICLE

### An annotated synopsis of the powder post beetles of Iran (Coleoptera: Bostrichoidea: Bostrichidae)

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**Abstract:** An annotated synopsis of Iranian Bostrichidae (Coleoptera: Bostrichoidea) is provided as a basis for future studies, with notes on distribution, host plants, biology and economic importance. In total, 31 species from 18 genera and 4 subfamilies (Bostrichinae, Dinoderinae, Lyctinae and Psoinae) are listed from Iran. *Sinoxylon anale* Lesne, 1897, *Sinoxylon perforans* (Schrank, 1789), *Stephanopachys linearis* (Kugelann, 1792) and *Xylopertha retusa* (Olivier, 1790) are new records for Iran.

**Key words:** Coleoptera, Bostrichoidea, Bostrichidae, powder post beetles, checklist, new record, Iran.

## Introduction

This paper provides an annotated synopsis of all the Iranian Bostrichidae. It forms a continuation of the series of checklists and synopses of Coleoptera of Iran (Legalov *et al.* 2010: Curculionoidea; Lason & Ghahari 2013: Kateretidae and Nitidulidae; Bunalski *et al.* 2014: Scarabaeoidea; Bartolozzi *et al.* 2014: Lucanidae; Ghahari *et al.* 2015: Buprestidae; Novák & Ghahari 2015: Alleculinae; Ghahari & Háva 2015: Silphidae; Beaver *et al.* 2016: Curculionidae: Platypodinae and Scolytinae). The paper is intended to provide a baseline for future studies of the fauna, particularly in relation to the growing importance of bostrichids as economically important pests in the region. It provides for each species a summary of what is currently known about its distribution, host plants, biology, and economic importance. Four species are added to the previously known fauna.

The bostrichid beetles have a world-wide distribution but are mainly found in tropical and arid areas (Liu 2010). The biology of bostrichids has been reviewed by Lesne (1924), Beeson and Bhatia (1937), Gerberg (1957), and Liu *et al.* (2008). The family comprises eight subfamilies (Ivie 2002; Liu & Schönitzer 2011): Lyctinae, Dysidinae, Psoinae, Polycaoninae, Euderinae, Endecatomininae, Dinoderinae and Bostrichinae. The first four subfamilies have a prognathous head, visible from above, and rather flat body, and comprise the lyctiform group. The rest have a cylindrical body form, and a hooded pronotum covering a hypognathous head, and comprise the bostrichiform group (Liu & Schönitzer 2011). The morphological differences are associated with different life styles.

The male and female of the lyctiform group court and mate on the surface of the host plant. The females have an extensible membranous ovipositor which allows oviposition either in cracks in the bark, in the axils of small branches, or in the big pores of the xylem vessels in the sapwood of hardwoods and bamboo. The adults of this group do not bore into wood, but their larvae are well-adapted to a xylophagous life (Liu & Schönitzer 2011). The bostrichiform group is wholly adapted to xylophagous life. The adults of this group bore tunnels into wood or bamboo, court, mate and lay their eggs in the tunnels. There is a nuptial chamber in the gallery system to allow the occupants to turn round, reverse direction, mate, and avoid predators (Liu *et al.* 2008).

In both cases the larvae tunnel through the host tissues making extensive frass-filled galleries. Most species are polyphagous and attack a wide variety of host plants in many different families (Beeson & Bhatia 1937; Beaver *et al.* 2011). Because of the ability of the larvae and some adults to reduce sapwood, particularly of hardwoods, into a powdery frass, the beetles are of considerable economic importance to forestry and the wood-using industries, especially in tropical countries (Beeson 1961; Liu *et al.* 2008; Beaver *et al.* 2011). Some species have also become pests of stored grain and root crops (Liu *et al.*, 2008; Beaver *et al.* 2011). In addition, maturation feeding by some species in young stems and shoots of living trees can result in dieback, and increases the risk of breakage by wind and infection by pathogens (Liu *et al.* 2008). Some species have been dispersed around the world by trade in timber and timber products (e.g. Haack 2006; Beaver *et al.* 2011). Various coleopteran predators (e.g. Cleridae, Histeridae, Melyridae, Trogossitidae) (e.g. Lesne 1906, 1924; Bahillo de la Puebla *et al.* 2007; Kolibáč 2013, Lawrence & Slipinski 2013), and an ectoparasitoid (Passandridae) (Deepthi & Ramavedi 2012), and hymenopteran parasitoids (especially Pteromalidae and Braconidae) (e.g. Gerstmaier *et al.* 1999; Bahillo de la Puebla *et al.* 2007; Yu *et al.* 2012; Ghahari *et al.* 2015; May 2015; Noyes 2015) are known to attack bostrichids. Predation by birds also occurs (Bahillo de la Puebla *et al.* 2007). The predators and parasitoids are not known to have a significant effect on bostrichid populations in natural conditions (Katiyar & Sharma 1987; Edde 2012; May 2015).

Taxonomically, the family is one of the best known amongst the beetles, thanks to the revisions of Pierre Lesne in a series of publications between 1895 and 1941 (Berland 1951). Borowski and Węgrzynowicz (2007) have catalogued the family (but see Ivie (2010) for corrections to the catalogue). Liu and Schönitzer (2011) published the first phylogenetic analysis at the suprageneric level. New geographical records continue to be added from all over the world (e.g. Liu 2010; Beaver *et al.* 2011; Nardi & Mifsud 2015; Park *et al.* 2015).

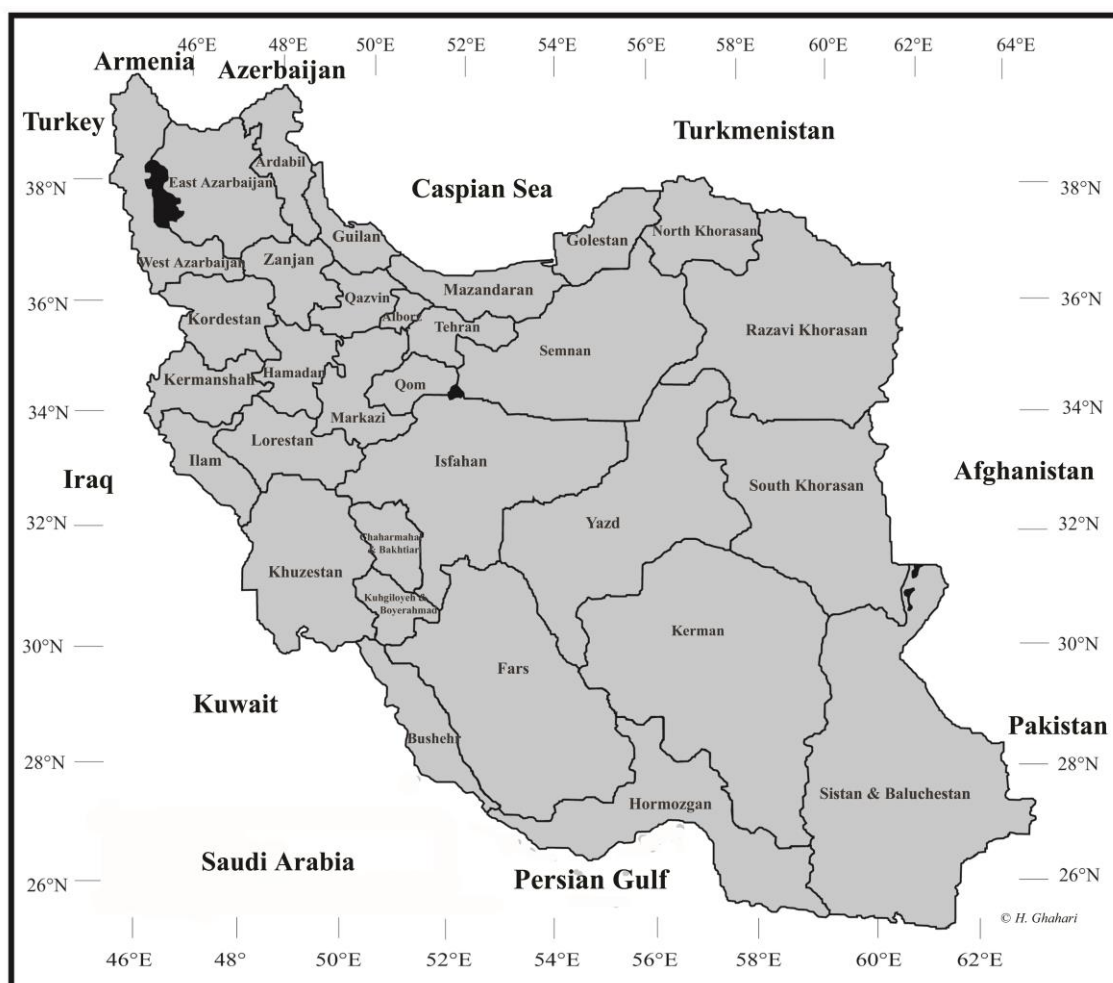
## Material and methods

The published data on the distribution of the family Bostrichidae (Coleoptera) in Iran are summarized by province. Subfamilies, tribes, genera and species are listed alphabetically.

The following data are included in the catalog for each species: (1) valid name; (2) junior synonym(s) used in literature about Iran; (3) published Iranian records by province (in alphabetical order of Iranian province names) and the relevant references (in chronological order); (4) new country records, with number of specimens and the collection in which the specimens are deposited in parentheses; (5) information on general distribution on a world scale besides Iran; (6) information on host plants, biology and economic importance. However, because the great majority of bostrichids are polyphagous, and attack a wide range of host trees, only host families are given for the great majority of extra-Iranian records. There is a large literature pertaining to some of the species, especially those of economic importance, and only a selection of references is given.

The classification and nomenclature are based on Borowski & Węgrzynowicz (2007) as corrected by Ivie (2010), and Liu & Schönitzer (2011). The general distribution is based on Borowski (2007), and Borowski & Węgrzynowicz (2007), with additions from the later literature (e.g. Nardi 2004a,b; EPPO 2005; Liu 2010; Borowski & Węgrzynowicz 2012; Simon 2014) and other sources. The countries in the "General distribution" are listed from West to East. When accurate data about local distribution in Iran are lacking in a quoted reference, "Iran (no locality cited)" is used. The provinces of Iran are shown in Figure 1.

The classification and nomenclature of host plants are based on the International Plant Name Index (IPNI) (available at: <http://www.ipni.org>).



**Figure 1.** Map of Iran with boundaries of Provinces.

## Results

**Family Bostrichidae Latreille, 1802**

**Subfamily Bostrichinae Latreille, 1802**

**Tribe Apatini Jacquelin du Val, 1861**

**Genus *Apate* Fabricius, 1775**

***Apate monachus* Fabricius, 1775**

**Distribution in Iran:** Northern and southern provinces (Modarres Awal 1997).

**General distribution:** Throughout Africa apart from the Sahara, southern Europe, Arabian peninsula. Introduced into Central and South America, including the West Indies.

**Biology:** *Eucalyptus* sp. (Myrtaceae), *Olea europaea* (Oleaceae), *Albizia julibrissin* (Fabaceae), *Tamarix* sp. (Tamaricaceae) and “many fruit and other trees” have been recorded as host trees in Iran (Modarres Awal 1997). More than thirty-five families of plants are recorded as hosts by Lesne (1924), Roberts (1968, 1969), Halperin & Damoiseau (1980), Bonsignore (2012), Nardi & Mifsud (2015) and others, and the species will clearly attack almost any host in suitable condition. The young adults tunnel into the stems of healthy trees to feed (Roberts 1969). Their tunnels may kill or weaken young stems so that they are easily broken, or allow the introduction of wood-rotting fungi (Browne 1968; Roberts 1968, 1969). After two or three weeks, the beetles leave, and fly to attack dying or dead trees in which breeding occurs (Roberts 1969). The maturation and breeding hosts may or may not be of the same species. Oviposition occurs in a short tunnel, and the larvae bore into the sapwood eventually reducing it to a fine powder (Roberts 1968).

**Genus *Phonapate* Lesne, 1895**

***Phonapate nitidipennis* (Waterhouse, 1881)**

**Distribution in Iran:** Hormozgan (Damoiseau 1969, as *P. uncinata uncinata* Karsch, 1881), generally distributed (Modarres Awal 1997, as *P. frontalis* sensu Lesne, 1909), Iran (no locality cited) (Borowski 2007, as *P. uncinata uncinata*; Borowski & Węgrzynowicz 2007).

**General distribution:** Throughout Africa, South Europe (Cyprus), Afghanistan, Arabian Peninsula, Iraq, Israel, Pakistan.

**Taxonomy:** We follow Borowski & Węgrzynowicz (2007) in considering the correct name for this species to be *P. nitidipennis* (Waterhouse, 1881) rather than *P. uncinata* Karsch, 1881 nec Germar, 1824, or *P. frontalis* sensu Lesne, 1909 nec Fähræus, 1871. The latter names have frequently been used in the literature.

**Biology:** Recorded from *Phoenix dactylifera* and *Nannorrhops ritchieana* (Arecaceae) in Iran (Modarres Awal 1997). Also recorded from Arecaceae by Lesne (1924), Beeson and Bhatia (1937), and from the base of date palm leaves by Helal & El-sebay (1994, as *Phonapate frontalis*), and from Tamaricaceae by Lesne (1924, as *P. frontalis*), and Halperin and Damoiseau (1980). Lesne (1924) notes that the species is nocturnal, starts to fly at dusk, and is attracted to lights.

**Tribe Bostrichini Latreille, 1802****Genus *Amphicerus* LeConte, 1861*****Amphicerus bimaculatus* (Olivier, 1790)**

**Distribution in Iran:** Golestan (Samin *et al.* 2015, as *A. (Caenophrada) bimaculata* [sic!] A.G. Olivier, 1790 [sic!]).

**General distribution:** Throughout the Mediterranean Region including the Arabian peninsula, Middle East, Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Ukraine. Introduced into USA but not yet established.

**Biology:** The species has been recorded from plants in the families Annonaceae, Fabaceae, Rosaceae, Moraceae, Oleaceae, Punicaceae, Solanaceae, Tamaricaceae and Vitaceae (Fisher 1950; Bahillo de la Puebla *et al.* 2007; Nardi & Mifsud 2015). In the Mediterranean region, the species breeds primarily in the dying or dead wood of grape vines (*Vitis* spp.) and tamarisk (*Tamarix* spp.) (Moleas 1988; Nardi & Mifsud 2015), but also attacks pomegranate (*Punica granatum*) (Andreadis *et al.* 2016). In Italy, the species bred in old pruned branches and neglected vines, and then attacked nearby newly planted vines (Moleas 1988). In Greece, the adults may attack living, healthy pomegranate by boring in near the buds, causing wilting, dieback, and greater liability to mechanical damage (Andreadis *et al.* 2016). Bento (2015) provides further details of the biology. Possible control and damage mitigation measures are suggested by Moleas (1988), Bento (2015) and Andreadis *et al.* (2016).

**Genus *Bostrichus* Geoffroy, 1762*****Bostrichus capucinus* (Linnaeus, 1758)**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Europe, North Africa, Sudan, Middle East, Iraq, Kazakhstan, Turkmenistan, through Russia to eastern Siberia and China. Introduced into USA but not yet established (Simon 2014).

**Biology:** In the temperate parts of Europe and the Mediterranean region, this species prefers to breed in the stumps and large roots of dead or dying oaks (*Quercus* spp.) (Fagaceae) (Lesne 1901, as *Bostrychus capucinus*; Bahillo de la Puebla *et al.* 2007; Nardi & Mifsud 2015), but it can also breed in a number of other plants, including trees in the families, Ericaceae, Fabaceae, Fagaceae, Moraceae, Myrtaceae, Rhamnaceae, and Vitaceae, and in timber (e.g. Fisher 1950; Halperin & Damoiseau 1980, as *Bostrychus capucinus* (L.); Nardi & Mifsud 2015). In the Iberian peninsula, the adults are active between April and September, and can be found on the stems from which they emerged, and where they are predated by various birds (Bahillo de la Puebla *et al.* 2007).

**Comments:** Yu *et al.* (2012) record a braconid wasp, *Chorebus (Phaenolexis) posticus* (Haliday, 1839), as a parasitoid of the larvae of *B. capucinus*; this wasp is recorded also from Iran (Gadallah *et al.* 2015).

**Genus *Lichenophanes* Lesne, 1899*****Lichenophanes varius* (Illiger, 1801)**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Southern and central Europe, North Africa, Middle East, Western and southern Russia, Turkmenistan, Ukraine.

**Biology:** In Europe, the species attacks primarily trees of the family Fagaceae (Lesne 1899), but is also recorded from Aceraceae, Betulaceae, Fabaceae, Salicaceae, Tiliaceae and Ulmaceae (Cymorek 1961; Muscarella *et al.* 2013). Both these authors describe the gallery system in the trunk and branches of large dead trees. Larval development can extend over five years (Recalde Irurzun & San Martin Moreno 2012). Cymorek (1961) records the beetles are active after dusk in June, and hide in cracks of the wood in day.

The species appears to be associated with wood infected by *Biscogniauxia nummularia*, a pathogenic canker fungus (Xylariaceae), which may be responsible for the decline of beech in Europe (Muscarella *et al.* 2013). Like many bostrichids, the adult remains hidden during the day, but flies around dusk, and is attracted to light (Lesne 1899). The species is rare and included in the Red Lists of several European countries (Muscarella *et al.* 2013).

### Tribe Sinoxylonini Lesne, 1899

#### Genus *Calopertha* Lesne, 1906

##### *Calopertha truncatula* (Ancey, 1881)

**Distribution in Iran:** Hormozgan (Damoiseau 1969), Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Saharian Africa from Senegal and Mauritania to Ethiopia and Somalia, Arabian Peninsula, Israel, Iraq, India (Punjab), Pakistan.

**Biology:** It is recorded from three species of *Acacia* (Fabaceae) (Lesne 1924; Halperin & Damoiseau 1980). The species normally occurs in very dry areas (Roberts 1969).

#### Genus *Sinoxylon* Duftschmid, 1825

##### *Sinoxylon anale* Lesne, 1897

**Material examined:** Sistan and Baluchestan province, Bampur, 27°19'N 60°45'E, 07.v. 2009, (1 ex, Muséum national d'histoire naturelle, Paris). New record for Iran.

**General distribution:** Species probably native in China, India, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand. Introduced to Europe and to the African, American and Australian continents and New Zealand and Middle East. The species has probably been recently introduced to Iran.

**Biology:** This species is considered to be one of the most destructive wood borers in India, and the adults attack a great variety of plants (Fisher 1950, Teixeira *et al.* 2002). Beeson and Bhatia (1937) record 67 different species in 20 families as hosts of the species in India, and the list could be greatly extended with records from the countries where the species has been introduced. The young adults tunnel into shoots and young stems of living trees to feed, and can damage or kill the plants (Browne 1968). The adults sometimes bore into living shoots to feed or hibernate, and may cause damage to young saplings (Sittichaya *et al.* 2009); breeding occurs in the sapwood of dead or dying trees (Beeson & Bhatia 1937). The life cycle is very variable in length and can take from a minimum of three months to a maximum of over four

years (Liu *et al.* 2008). The adults emerge throughout the year, and generations strongly overlap (Beeson & Bhatia 1937; Liu *et al.* 2008).

### ***Sinoxylon crassum* Lesne, 1897**

**Distribution in Iran:** Iran (no locality cited) (Borowski 2007, as *S. crassum crassum*). This country is not included in the distribution provided by Borowski and Węgrzynowicz (2007); this record was probably simply overlooked since the species occurs also in the South of Pakistan (Dr. Z. Ahmed, pers. comm., March 2016), and is likely to be native to Iran.

**General distribution:** India, Nepal, Pakistan, Sri Lanka, Southeast Asia, Philippines. Introduced to Europe (Germany, Poland), Oman and Tanzania.

**Taxonomy:** Lesne (1906) distinguished two subspecies, *S. crassum dekkanense* Lesne, 1906 occurring in South and Central India, and *S. crassum crassum* Lesne 1897 occurring through the rest of the range. However, Beeson and Bhatia (1937) note that both forms may be bred from the same piece of wood, and that the ranges of the two subspecies overlap. We follow Borowski and Węgrzynowicz (2007) and consider *S. crassum dekkanense* to be a synonym rather than a valid subspecies.

**Biology:** Beeson & Bhatia (1937) recorded the species from the following families: Anacardiaceae, Apocynaceae, Bombacaceae, Casuarinaceae, Combretaceae, Dipterocarpaceae, Euphorbiaceae, Fabaceae, Fagaceae, Moraceae, Lamiaceae, Lythraceae, Pinaceae, Poaceae (Bamboo), Rhamnaceae, Rubiaceae, Rutaceae, and Verbenaceae. The young adults tunnel into young shoots to feed causing die-back or breakage, before dispersing to breed in dead or dying trees (Browne 1968). Beeson & Bhatia (1937) note that the species is primarily a sapwood borer, especially of leguminous trees, and the adult and larval tunnels usually do not penetrate the heartwood. The larvae tunnel irregularly, eventually reducing the sapwood to a fine powder. There are usually two or three generations per year depending on temperature (Rai & Chatterjee 1963, as *S. crassum crassum*), but the generations overlap, and beetles emerge from caged logs throughout the year (Beeson & Bhatia 1937).

### ***Sinoxylon perforans* (Schrank, 1789)**

**Material examined:** Northern Khorasan province, Esfarayen, 37°00'N 57°33'E, 11.vii.2013, (2 exx, Islamic Azad University, Tehran, Iran). New record for Iran.

**General distribution:** Central and southern Europe, Cyprus, Israel, Morocco, South-West Russia, Syria, Turkey, Turkmenistan.

**Biology:** Recorded in Europe from *Castanea*, *Quercus* (Fagaceae), *Prunus*, *Pyrus* (Rosaceae), and *Vitex* (Vitaceae) (Cymorek 1961; Frediani 1961; Tiberi & Ragazzi 2008). Cymorek (1961) records that the female bores into the wood, while the male removes the frass. Galleries are longer in vines than in oak. The next generation of beetles emerges over a prolonged period. Frediani (1961) and Liu *et al.* (2008) give further details of the life cycle. The species is univoltine, passing the winter as adults. It can be a pest of grape vines when piles of pruned branches are not removed, or vineyards are neglected (Filip 1986; Ragazzini 1977), and is a quarantine species in some wine-producing countries, e.g. Australia (Department of Agriculture, Fisheries and Forestry 2013). It may also transmit a canker fungus (*Botryosphaeria stevensii*) which causes 'black dead arm' in vines, and may be involved in oak decline (Tiberi & Ragazzi 1998 as *Diplodia mutilus*).

***Sinoxylon pugnax* Lesne, 1904**

**Distribution in Iran:** Hormozgan (Damoiseau 1969), Iran (no locality cited) (Borowski 2007; Borowski & Węgrzynowicz 2007).

**General distribution:** Afghanistan, India, Pakistan, Oman.

**Biology:** Recorded only from *Acacia* and *Albizia* (Fabaceae) (Beeson & Bhatia 1937). Mortazavi *et al.* (2015) have described an associated mite, *Dolichomotes sinuspersicus* Mortazavi & Hajiqanbar (Heterostigmata: Dolichocybidae), from Iran.

***Sinoxylon sexdentatum* (Olivier, 1790)**

**Distribution in Iran:** Kaspische Walder (Adeli 1972); East Azarbaijan, Hamadan, Zanjan and other northern provinces (Modarres Awal 1997).

**General distribution:** Eastern and Southern Europe, North Africa, Cyprus, Israel, Syria, Turkey. Introduced into North America.

**Biology:** This species is recorded in Iran from *Malus pumila*, *Prunus persica*, *Pyrus communis* (Rosaceae), *Ulmus pumila* (Ulmaceae) (Modarres Awal 1997) and *Zelkova carpinifolia* (Ulmaceae) (Adeli 1972). It has been recorded elsewhere from the families Anacardiaceae, Araliaceae, Fabaceae, Fagaceae, Juglandaceae, Moraceae, Oleaceae, Poaceae, Ranunculaceae, Rhamnaceae, Rosaceae, Ulmaceae, Vitaceae (Fisher 1950; Halperin & Damoiseau 1980; Moleas 1988; Mourikis *et al.* 1998; Akşit *et al.* 2005; Buse *et al.* 2013; Sarikaya 2013). The biology is similar to *Sinoxylon perforans*, and like that species, it may transmit a canker fungus (*Botryosphaeria stevensii*) which causes 'black dead arm' in vines, and may be involved in oak decline (Tiberi & Ragazzi 1998 as *Diplodia mutilus*). Moleas (1988), Mourikis *et al.* (1998), and Akşit *et al.* (2005) record the species damaging stems and branches of various fruit trees and vines.

**Comments:** This species was listed by Borowski (2007), and Borowski and Węgrzynowicz (2007) under the name *Sinoxylon muricatum* (Linnaeus, 1767), with *S. sexdentatum* as a synonym, but Ivie (2010) points out that their action was unjustified, and that *S. muricatum* should be considered as a *nomen oblitum*, while *S. sexdentatum* (Olivier, 1790) was declared as a *nomen protectum* (Ivie, 2010).

Yu *et al.* (2012) record a braconid wasp, *Triapsis floricola* (Wesmael, 1835), as a parasitoid of the larvae; this species is recorded also from Iran (Gadallah & Ghahari 2013).

**Tribe Xyloperthini Lesne, 1921****Genus *Enneadesmus* Mulsant, 1851*****Enneadesmus auricomus* (Reitter, 1898)**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Syria, Turkmenistan, Uzbekistan.

**Biology:** Unknown.

***Enneadesmus forficula* (Fairmaire, 1883)**

**Distribution in Iran:** Hormozgan (Damoiseau 1969), Iran (no locality cited) (Borowski & Węgrzynowicz 2007).



**General distribution:** Widespread in the drier parts of Africa, including South Africa (Lesne 1924), Greece (Crete), Egypt (Sinai), Saudi Arabia and Yemen, India, Israel, Jordan, Oman, Pakistan.

**Biology:** Recorded from several species of *Acacia* (Fabaceae) (Lesne 1924; Beeson & Bhatia 1937; Halperin & Damoiseau 1980), and from *Citrus* (Rutaceae) (Halperin & Damoiseau 1980).

#### ***Enneadesmus obtusidentatus* (Lesne, 1899)**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Egypt, Eritrea, Ethiopia, Iraq, Saudi Arabia, Syria, Yemen. Introduced into Germany.

**Biology:** The species is recorded from *Ficus* (Moraceae) (Kinawy *et al.* 1991) and date palm, *Phoenix dactylifera* (Arecaceae) (Helal & El-sebay 1994) in Egypt. Kinawy *et al.* (1991) studied the seasonal history and changes in abundance in fig trees, and recorded about three broods per year.

#### ***Enneadesmus trispinosus* (Olivier, 1795)**

**Distribution in Iran:** Iran (no locality cited) (Borowski 2007).

**General distribution:** South-west Europe, North Africa, Canary Islands, Iraq?.

**Biology:** Recorded from *Citrus* (Rutaceae) and *Tamarix* (Tamaricaceae) (Lesne 1901; Halperin & Damoiseau 1980). The species also frequently breeds in the midrib of dry date palm leaves (*Phoenix dactylifera*) (Arecaceae) (Lesne 1901; Borowski & Mazur 2001; El-Shafie 2012). Lesne (1901) notes that the adults are crepuscular, but do not come to light.

#### **Genus *Paraxylogenes* Damoiseau, 1968**

##### ***Paraxylogenes pistaciae* Damoiseau, 1968**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Iraq, Israel, Pakistan. Intercepted in Australia.

**Biology:** Recorded from *Pistacia* (Anacardiaceae) by Damoiseau (1968) and Halperin (1986). It is a secondary pest of pistachio stems and branches in Israel (Halperin 1986).

**Comments:** Gerstmaier *et al.* (1999) record *Denops albofasciatus* (Charpentier, 1825) (Coleoptera, Cleridae) as predator in Israel.

#### **Genus *Scobicia* Lesne, 1901**

##### ***Scobicia chevrieri* (A. Villa & J.B. Villa, 1835)**

**Distribution in Iran:** Kerman (Farahbakhsh 1961; Adeli 1972, as *S. chevrieri* Villa), generally distributed (Modarres Awal 1997).

**General distribution:** North Africa and Middle East, widely distributed throughout the Mediterranean region, both in southern Europe, as far North as Slovakia (Kollár 2014),

Hungary and Central Russia, and Azerbaijan, Georgia, southern Russia. Introduced into North America.

**Biology:** This species is recorded from: *Pistacia vera* (Anacardiaceae), *Juglans regia* (Juglandaceae), *Ficus carica* and *Morus alba* (Moraceae), *Eucalyptus* sp. (Myrtaceae), and *Tamarix* sp. (Tamaricaceae) in Iran (Farahbakhsh 1961; Adeli 1972; Modarres Awal 1997). It has also been recorded damaging metal tubes carrying gas in Iran (Farahbakhsh 1961). Elsewhere it is recorded from the following families: Anacardiaceae, Betulaceae, Fabaceae, Fagaceae, Hamamelidaceae, Lauraceae, Lythraceae, Malvaceae, Moraceae, Myrtaceae, Oleaceae, Pinaceae, Poaceae, Punicaceae, Rhamnaceae, Rosaceae, Rutaceae, Salicaceae, Ulmaceae and Vitaceae (Fisher 1950; Halperin & Damoiseau 1980; Borowski & Mazur 2001; Akşit *et al.* 2005; Mifsud *et al.* 2012; Buse *et al.* 2013; Sarikaya 2013; Nardi & Mifsud 2015). The species usually breeds in dead and dying stems, but Akşit *et al.* (2005) record the species damaging stems and branches of figs (*Ficus carica*) in Turkey. It is often collected at light and in window flight traps (Nardi & Mifsud 2015).

### ***Scobicia pustulata* (Fabricius, 1801)**

**Distribution in Iran:** Northern provinces (Modarres Awal 1997).

**General distribution:** North Africa, Southern Europe, Cyprus, Syria, Turkey, Georgia, Azerbaijan, and southern Russia. Nardi and Mifsud (2015) note that previous records from Malta actually refer to *S. chevrieri*.

**Biology:** The species seems to have a smaller host range than *S. chevrieri*, but this may simply reflect its greater rarity. It has been recorded from *Ceratonia* (Fabaceae), *Quercus* (Fagaceae), *Laurus* (Lauraceae), *Ficus* (Moraceae) and *Vitis* (Vitaceae) (Baena & Zuzarte 2013; Valladares *et al.* 2013).

### **Genus *Xylogenes* Lesne, 1901**

#### ***Xylogenes dilatatus* (Reitter, 1889)**

**Distribution in Iran:** Southern and central provinces (Farahbakhsh 1961; Modarres Awal 1997), Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Azerbaijan, Iraq, Jordan, Kazakhstan, Kyrgyzstan, Syria, Tadjikistan, Turkmenistan, Uzbekistan (EPPO 2005).

**Hosts:** *Tamarix* spp. (Tamaricaceae), and other deciduous trees (Farahbakhsh 1961; Modarres Awal 1997; EPPO 2005).

**Biology:** The larvae tunnel through woody parts and inner bark of dying trees (Farahbakhsh 1961). The species can also cause damage to wood used in buildings (EPPO 2005).

#### ***Xylogenes mesopotamicus* Lesne, 1937**

**Distribution in Iran:** West Azarbaijan (Samin *et al.* 2015).

**General distribution:** Armenia, Iraq, Syria.

**Biology:** Unknown.

**Genus *Xylopertha* Guérin-Méneville, 1845*****Xylopertha reflexicauda* (Lesne, 1937)**

**Distribution in Iran:** Kerman (Lesne 1937: 200), Fars, Guilan, Isfahan, Tehran, other northern provinces (Modarres Awal 1997), Azarbaijan-e-Sharghi (Lotfalizadeh & Khalgani 2008).

**General distribution:** India, Pakistan.

**Biology:** Recorded from *Pistacia vera* (Anacardiaceae) (Lesne 1937; Modarres Awal 1997), *Quercus* sp. (Fagaceae), *Ficus carica*, *Morus alba* (Moraceae) in Iran (Modarres Awal 1997), and *Prosopis cineraria* (= *spicigera*) (Leguminosae) in Pakistan (Lesne 1937).

**Comments:** Lotfalizadeh and Khalgani (2008) record *Eurytoma blastophagi* Hedqvist, 1963 (Hymenoptera, Eurytomidae) and *Heydenia pretiosa* Förster, 1856 (Hymenoptera, Pteromalidae) as parasitoids in Iran (East Azerbaijan).

***Xylopertha retusa* (Olivier, 1790)**

**Distribution in Iran:** Mazandaran, vic. Kolijak, mountain slope, 36°28'18"N, 51°40'14"E, 1840 m, 05.v.2010, A.Weigel leg., (2 exx, Erfurt Museum, Germany). New record for Iran.

**General Distribution:** North Africa (Egypt excepted), Central and southern Europe, part of Caucasia, Cyprus, part of Siberia, Turkey, and Israel (Borowski 2007).

**Biology:** Recorded from fresh wood of trees in the families Fabaceae, Fagaceae, Moraceae, Ulmaceae, and Vitaceae (Bahillo de la Puebla *et al.* 2007; Markovič & Stojanovič 2012; Buse *et al.* 2013). The species was active from May to July in Southern Europe (Cymorek 1961 as *Xylonites retusus*; Bahillo de la Puebla *et al.* 2007), but in October to December in Israel (Buse *et al.* 2013). In central Europe, the beetles prefer boring into dry oak branches; the larvae tunnel particularly in the sapwood; they overwinter in diapause and pupate in spring (Cymorek 1961 as *Xylonites retusus*).

**Comments:** Several clerid and a melyrid predators (Coleoptera: Cleridae, Melyridae) are listed by Bahillo de la Puebla *et al.* (2007). Yu *et al.* (2012) list as parasitoids: *Triaspis floricola* (Wesmael, 1835), *Diospilus capito* (Nees, 1834) and *Aspicolpus carinator* (Nees, 1812) (Hymenoptera: Braconidae). These Hymenoptera occur also in Iran (Gadallah & Ghahari 2013; Gadallah *et al.* 2016).

**Subfamily Dinoderinae C.G. Thomson, 1863****Genus *Rhyzopertha* Stephens, 1830*****Rhyzopertha dominica* (Fabricius, 1792)**

**Distribution in Iran:** Golestan (Khormali *et al.* 2002; Eyidozehi *et al.* 2013), Tehran (Mehrabadi *et al.* 2011; Aref & Laizadegan 2015), West Azerbaijan (Mahdneshin *et al.* 2009), generally distributed (Ashouri & Shayesteh 2009; Modarres Awal 1997; Ziaee *et al.* 2006).

**General distribution:** Cosmopolitan. Nardi and Mifsud (2015) provide a list of additional countries omitted from Borowski (2007). The species probably originated on the Indian subcontinent (Nardi & Mifsud 2015), but has been spread worldwide by commerce.

**Biology:** The species has been recorded from all kinds of husked and unhusked grains, dried fruits and starchy dried foods in Iran (Farahbakhsh 1961; Modarres Awal 1997). Although now known primarily as an economically important pest of stored grain (e.g. Kenis & Branco 2010; Edde 2012), the species originally bred in dead wood. Beeson and Bhatia (1937) recorded the species from caged logs of twelve plant families in India, and Buse *et al.* (2013) record it from “multiple woody hosts” in Israel.

This species is one of the most difficult stored product insect pests to control using insecticide grain protectants. Prevention is by far the best control option, but may be impractical given the ability of *R. dominica* to migrate into grain storage. The biology and control of the species have recently been reviewed by Edde (2012).

**Comments:** Eyidozehi *et al.* (2013) record *Anisopteromalus calandrae* (Howard, 1881) and *Theocolax elegans* (Westwood, 1874) (Hymenoptera: Pteromalidae) from Golestan as parasitoids of the pupae. These species have been investigated as possible biocontrol agents against *R. dominica* (Ahmed 1996; Flinn & Hagstrum 2002).

### **Genus *Stephanopachys* Waterhouse, 1888**

#### ***Stephanopachys linearis* (Kugelann, 1792)**

**Material examined:** Ardabil province, Germe, 39°00'N 47°57'E, 02.viii.2010, (1 ex, Islamic Azad University, Tehran, Iran). New record for Iran.

**General distribution:** Central and northern Europe, through Russia to Siberia and northern China (Zhang *et al.* 1995; Borowski 2007).

**Biology:** This species is unusual in breeding only in trees (usually damaged by fire, but still alive) in the family Pinaceae. It has been recorded from *Pinus sylvestris* in China, Norway and Sweden, from *Picea abies* in Norway, and from *Larix gmelinii* in China (Heilongjiang) (Ranius *et al.* 2014; Zhang *et al.* 1995). Ranius *et al.* (2014) describe the dynamics of a metapopulation on burned pine trees in Sweden.

### **Subfamily Lyctinae Billberg, 1820**

#### **Tribe Lyctini Billberg, 1820**

#### **Genus *Acantholyctus* Lesne, 1924**

#### ***Acantholyctus cornifrons* (Lesne, 1898)**

**Distribution in Iran:** SE Iran (no locality cited) (Halperin & Geis 1999), Hormozgan, Kerman (Liu 2010, as *A. semiermis* (Lesne, 1914)).

**General distribution:** Whole Africa, Sinai, Jordan, Arabian Peninsula.

**Biology:** It is recorded from *Acacia tortilis* (Fabaceae) by Halperin & Geis (1999) in Sinai. Its biology is probably similar to other lyctines (see introduction). The adults gnaw the surface of wood only occasionally, probably to test the suitability of breeding substrates before oviposition. They shelter during the day in dark places, in cracks and holes on trees, or underneath planks, boards, etc. (Halperin & Geis 1999). The adults start to fly at dusk, and are attracted to light (LYL pers. obs.).

**Comments:** Borowski & Węgrzynowicz (2010) synonymized *Acantholyctus semiermis* (Lesne, 1914) described from South Africa, with this species.

**Genus *Lyctus* Fabricius, 1792*****Lyctus brunneus* (Stephens, 1830)**

**Distribution in Iran:** Caspian forests (Niloufari 1985), Tehran and other northern and central provinces (Adeli 1972; Modarres Awal 1997).

**General distribution:** Cosmopolitan. It may have a neotropical origin, but has now invaded most faunal regions (Gerberg 1957). In Europe it is largely confined to synanthropic habitats (Halperin & Geis 1999).

**Biology:** Recorded in Iran from dry wood of *Acer* (Aceraceae), *Alnus*, *Carpinus* (Betulaceae), *Fagus* (Fagaceae), *Populus* (Salicaceae), *Ulmus* (Ulmaceae) and other broad leaf trees and also furniture and construction timbers (Modarres Awal 1997; Niloufari 1985). Beeson & Bhatia (1937) reported Anacardiaceae, Bombacaceae, Burseraceae, Combretaceae, Dipterocarpaceae, Fabaceae, Fagaceae, Magnoliaceae, Malvaceae, Moraceae, Pinaceae, Poaceae (bamboo), and Proteaceae as host families.

This is one of the most widespread and damaging species of Lyctinae to hardwood timber, and has been dispersed all over the world through trade in timber and wood products. Like all lyctines, the species oviposits in pores in the wood, and softwoods without pores are not normally attacked, nor are hardwoods with pores smaller than the diameter of the female's ovipositor (Peters *et al.* 2002). Larvae can develop only in sapwood with a sufficiently high starch and moisture content, and the heartwood is never infested (Peters *et al.* 2002).

**Comments:** The larvae are attacked by various parasitoid (Hymenoptera: Braconidae) and predaceous insects (Coleoptera: Cleridae), but not in high enough numbers to ensure efficient biological control (May 2015).

***Lyctus cavicollis* LeConte, 1866**

**Distribution in Iran:** Iran (no locality cited) (Modarres Awal 1997). This species has been introduced from North America.

**General distribution:** This species is widespread throughout the USA (Gerberg 1957), and imported into Australia, Tasmania and Europe.

**Biology:** Gerberg (1957) has recorded this species from *Quercus* (Fagaceae), *Carya* (=Hicoria) (Juglandaceae), and *Fraxinus* (Oleaceae) in USA.

***Lyctus linearis* (Goeze, 1777)**

**Distribution in Iran:** Caspian Sea area and other northern and central provinces (Adeli 1972; Modarres Awal 1997).

**General distribution:** Gerberg (1957) listed the species as cosmopolitan, but Borowski & Węgrzynowicz (2007) listed Europe, Canada, USA, Siberia, and introduced into Argentina and Australia. It must also have been introduced into Canada and USA. According to Adlbauer (1998) it is also found in North Africa, and as far East as Turkmenistan. This was formerly the most common endemic species in Europe, but has been replaced in synanthropic habitats by *L. brunneus* (Halperin & Geis 1999).

**Hosts:** Recorded in Iran from dried wood of *Alnus*, *Carpinus* (Betulaceae), *Fagus*, *Quercus* (Fagaceae), *Populus* (Salicaceae), *Ulmus* (Ulmaceae), and other broad leaf trees, and also furniture (Adeli 1972; Modarres Awal 1997). In addition, Gerberg (1957) records the species in North America reared from Juglandaceae, Myrtaceae, Oleaceae, Rhamnaceae, and the gymnosperm families Cupressaceae and Pinaceae. Adlbauer (1998) notes that it can be found in lumber yards and processed wooden products.

### ***Lyctus pubescens* Panzer, 1793**

**Distribution in Iran:** West Azarbaijan (Samin *et al.* 2015).

**General distribution:** Throughout Europe, except the North, North Africa, East to Turkey, Armenia, Azerbaijan, Kazakhstan and Russia.

**Biology:** This species is recorded from *Robinia* (Fabaceae), *Quercus* (Fagaceae) and *Vitis* (Vitaceae) (Adlbauer 1998). Liu (2010) has listed a specimen bred from furniture made from *Fraxinus* sp. (Oleaceae).

### ***Lyctus suturalis* Faldermann, 1837**

**Distribution in Iran:** Mazandaran (Samin *et al.* 2015).

**General distribution:** Armenia, Azerbaijan, Belarus, Georgia, India (Kashmir), Kazakhstan, Russia (Caucasus), Tajikistan, Turkmenistan, Ukraine, Uzbekistan (Borowski 2007; Borowski & Węgrzynowicz 2007; Samin *et al.* 2015).

**Biology:** Not reported, but should be similar to other species of *Lyctus*.

## **Tribe Trogoxylini Lesne, 1921**

### **Genus *Trogoxylon* LeConte, 1862**

#### ***Trogoxylon impressum* (Comolli, 1837)**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Mediterranean region, Middle East, Turkmenistan, Caucasus. Introduced into USA and Argentina.

**Biology:** The species is recorded from *Pistacia* (Anacardiaceae), *Quercus* (Fagaceae), *Juglans* (Juglandaceae), *Ficus* (Moraceae), *Populus* (Salicaceae) and *Vitis* (Vitaceae) (Adlbauer 1998; Bahillo de la Puebla *et al.* 2007; Baena & Zuzarte 2013), and is presumably polyphagous. The larvae feed preferentially in dry sapwood, and several generations may succeed each other in the same piece of wood (Bahillo de la Puebla *et al.* 2007).

## **Subfamily Psoinae Blanchard, 1851**

### **Tribe Psoini Blanchard, 1851**

#### **Genus *Stenomera* Lucas, 1850**

##### ***Stenomera assyria* Lesne, 1895**

**Distribution in Iran:** Iran (no locality cited) (Borowski & Węgrzynowicz 2007).

**General distribution:** Cyprus, Turkey, Iraq, Syria.

**Biology:** Unknown. The only other species in the genus, *Stenomera blanchardi* Lucas, 1895 has been found breeding in cut branches of *Zizyphus lotus* (Rhamnaceae) (Lesne 1896).

## Discussion

The bostrichid beetles have a world-wide distribution but are mainly found in tropical and arid areas (Liu 2010). More than half of Iran has an arid or semi-arid climate, and should be suitable habitat for bostrichids. At present, 4 subfamilies, 8 tribes, 18 genera and 31 bostrichid species have been recorded from the country (Table 1). The most species-rich genera are *Lyctus* (5 species), *Enneadesmus* and *Sinoxylon* (4 species). The majority of genera (11) are represented only by a single species. Further studies will certainly increase the number of species in the Iranian fauna. The fauna includes 14 genera and 23 species of the bostrichiform subfamilies (Bostrichinae and Dinoderinae) which are wholly xylophagous (see Introduction), and 4 genera and 8 species of the lyctiform subfamilies (Lyctinae and Psoinae) which mate and oviposit on the host surface (see Introduction).

Compilation of distributional data from numerous sources, including Beeson and Bhatia (1937), Halperin and Damoiseau (1980), Halperin and Geis (1999), Borowski (2007), Borowski and Węgrzynowicz (2007), Bahillo de la Puebla *et al.* (2007), Baena *et al.* (2013), and others, indicate that there are 31 species in Iran, 29 species in Israel, 39 species in the Iberian Peninsula-Balearic islands (Spain + Portugal) fauna, and 74 species in India. These countries to the West (Israel, Iberian Peninsula) and East (India) of Iran were chosen for comparison because their bostrichid fauna is comparatively well-known. Calculation of Sørensen coefficients of similarity (Southwood & Henderson 2000) (Table 2) indicate that the Iranian bostrichid fauna has considerably greater affinity with the Mediterranean region faunas of the Iberian Peninsula and Israel to the West than with the fauna of India to the East. These coefficients ignore the different areas and climates of the countries and should be treated only as an indication of affinity.

**Table 1.** List of Bostrichidae recorded in Iran.

Bostrichinae:	
Apatini	<i>Apate monachus</i> Fabricius, <i>Phonapate nitidipennis</i> (Waterhouse)
Bostrichini	<i>Amphicerus bimaculatus</i> (Olivier), <i>Bostrichus capucinus</i> (Linnaeus), <i>Lichenophanes varius</i> (Illiger)
Sinoxylini	<i>Calopertha truncatula</i> (Ancy), <i>Sinoxylon anale</i> Lesne, <i>S. crassum</i> Lesne, <i>S. perforans</i> (Schrank), <i>S. pugnax</i> Lesne, <i>S. sexdentatum</i> (Olivier)
Xyloperthini	<i>Enneadesmus auricomus</i> (Reitter), <i>E. forficula</i> (Fairmaire), <i>E. obtusidentatus</i> (Lesne), <i>E. trispinosus</i> (Olivier), <i>Paraxylogenes pistaciae</i> Damoiseau, <i>Scobicia chevrieri</i> (Villa & Villa), <i>S. pustulata</i> (Fabricius), <i>Xylogenes dilatatus</i> (Reitter), <i>X. mesopotamicus</i> Lesne, <i>Xylopertha reflexicauda</i> (Lesne), <i>X. retusa</i> (Olivier)
Dinoderinae:	
Dinoderini	<i>Rhyzopertha dominica</i> (Fabricius), <i>Stephanopachys linearis</i> (Kugelann)
Lyctinae:	
Lyctini	<i>Acantholyctus cornifrons</i> (Lesne), <i>Lyctus brunneus</i> (Stephens), <i>L. cavicollis</i> LeConte, <i>L. linearis</i> (Goeze), <i>L. pubescens</i> Panzer, <i>L. suturalis</i> Faldermann
Trogoxylini	<i>Trogoxylon impressum</i> (Comolli)
Psoinae:	
Psoini	<i>Stenomera assyrica</i> Lesne

**Table 2.** Sørensen coefficients of similarity for the bostrichid faunas of Iran, Israel, Iberian Peninsula-Balearic Islands, India.

Country	Iran	Israel	Iberia-Balearic	India
Iran	–			
Israel	0.53	–		
Iberian Peninsula-Balearic Islands	0.49	0.62	–	
India	0.11	0.17	0.16	–

In recent years, more instances of bostrichids as pests have been reported from the Mediterranean area (Kinawy *et al.* 1991; Helal & El-sebay 1994; Bonsignore 2012; Bento 2015; Andreadis *et al.* 2016), and more species of forest trees are being attacked (Akşit *et al.* 2005; Mifsud *et al.* 2012; Buse *et al.* 2013; Luna Murillo & Obregón 2013; Sarikaya 2013; Kollár 2014). The similarity of the Iranian fauna to that of the Mediterranean area suggests that more pest problems due to bostrichids can be expected in Iran in the future.

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