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Oochrotus unicolor Lucas, 1852, in France: updated distribution, faunistics and ecology (Coleoptera, Tenebrionidae, Diaperinae)

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Abstract. – *Oochrotus unicolor* Lucas, 1852 (Coleoptera, Tenebrionidae) is a rarely collected and little-known myrmecophilous with reduced eyes darkling beetle, mostly living deep in the nests of seed-harvesting ants belonging to the genus *Messor* Forel, 1890 (Hymenoptera, Formicidae). As of now, few data are available and the distribution of the species in France needs to be updated, particularly due to the recent discovery of new localities and new administrative departments. *Oochrotus unicolor* is currently known in six Mediterranean departments: Pyrénées-Orientales, Aude, Hérault, Bouches-du-Rhône, Var and Alpes-Maritimes (from west to east), with a total of only 24 localities, including historical data. We detail and discuss the commensalism of the species. A distribution map and photos of adults are also provided.

Résumé. – *Oochrotus unicolor* Lucas, 1852, en France : répartition réactualisée, faunistique et autécologie (Coleoptera, Tenebrionidae, Diaperinae). *Oochrotus unicolor* Lucas, 1852 (Coleoptera, Tenebrionidae) est un myrmécophile rarement observé et méconnu, aux yeux réduits, presque absents, vivant principalement au fond des greniers de fourmis appartenant au genre *Messor* Forel, 1890 (Hymenoptera, Formicidae). Peu de données sont disponibles et la répartition de l'espèce en France nécessitait d'être actualisée, notamment en raison de la découverte récente de nouvelles localités et de nouveaux départements de présence. *Oochrotus unicolor* est donc actuellement connu dans six départements méditerranéens : Pyrénées-Orientales, Aude, Hérault, Bouches-du-Rhône, Var et Alpes-Maritimes (d'ouest en est), avec un total de seulement 24 communes de présence, données historiques comprises. Le commensalisme de l'espèce est détaillé et discuté. Une carte de répartition ainsi qu'une photographie de son habitus sont également fournis.

Keywords. – Insecta, Darkling beetle, myrmecophilous, *Messor barbarus* nests, hypogenous.

The Mediterranean region is known for its high species diversity and is considered a biodiversity hotspot (MYERS *et al.*, 2000). Many taxa exhibit high levels of speciation and endemism in this area. This is the case for many insect groups that have converged on a myrmecophilous lifestyle (ROBLA *et al.*, 2023).

The genus *Oochrotus* Lucas, 1852, is strictly Mediterranean, and includes only two myrmecophilous and hypogenous species. *Oochrotus unicolor* Lucas, 1852 (fig. 1) occupies the entire western basin of the Mediterranean while its vicariant *O. glaber* Demaison, 1905, is found in the north eastern basin of the Mediterranean in Greece

(Rhodes), Cyprus, Syria and Türkiye (IWAN *et al.*, 2020). Many subspecies of *O. unicolor* were described by CANZONERI (1961) and RALLO (1974) but do not appear to have a real taxonomic value. Indeed, most of them have been synonymized with the nominotypical form by SOLDATI & SOLDATI (2000).

Oochrotus unicolor was described from several localities of Algeria « Plateaux de Médéah et de Boghar, environs du cercle de La Calle, environs de Bône » (LUCAS, 1852). Since its description, the species has a poorly known distribution because of its rare collection and its lifestyle which makes it difficult to observe. In Italy, *O. unicolor* is reported from Tuscany, Lazio, southern Italy, Sardinia and Sicily (ALIQUÒ *et al.*, 2007). KOCHER (1958) reported it from northern and central Morocco, up to the foot of the High Atlas where it was found up to around 1400 m a. s. l. In Algeria, it seems confined to the northern part of the country (SOLDATI & SOLDATI, 2000) as in Tunisia (NORMAND, 1936).

In France, the species is restricted to the Mediterranean region and Corsica (SOLDATI & SOLDATI, 2014) where it reaches its northern distribution limit. It was rediscovered in this country (SOLDATI & SOLDATI, 2000) after 48 years without sightings, the last data dating back to 1951. SOLDATI (2007) reported it from the same four French departments and Corsica, with recent records only in the Pyrénées-Orientales while INPN (2023a) reported nine observations from France, in the Crau arid plain (Bouches-du-Rhône) and around Toulon (Var). The lack of knowledge of the precise distribution of this species in France, new reports, as well as its very recent discovery in a new Mediterranean department invite us to summarize its distribution and complete the data about its ecology.

MATERIAL AND METHODS

All the material examined comes from institutional or private collections indicated below, followed by the acronyms used in the text. The species has only been contacted 32 times despite the large number of collections studied and literature data, thus showing the difficulty in encountering it.

- Muséum national d'Histoire naturelle, Paris, France (MNHN): general collection;
- Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG): coll. C. Besuchet;
- Muséum d'Histoire Naturelle, Perpignan, France (MHNP): coll. P. Pellet;
- Laboratoire National d'Entomologie Forestière, ONF, Quillan, France (LNEF);
- Université des Sciences, Toulouse, France (UST): coll. J. Ribaut;
- collection C. Beaumont (Toulouse, France) (CB);
- collection H. Brustel (Clermont-le-Fort, France) (HB);
- collection F. Cabon (Toulouse, France) (FC);
- collection D. Delpy (Les Quatre-Routes-du-Lot, France) (DD);
- collection S. Fadda (Avignon, France) (SF);
- collection N. Gompel (Bonn, Germany) (NG);
- collection Thibault Le Pen (Aix-en-Provence, France) (LP);
- collection C. Perez (Istres, France) (CP);
- collection P. Ponel (Pourcieux, France) (PP);
- collection S. Puissant (Dijon, France) (SP);
- collection A. Sadorge (Saint-Maximin-la-Sainte-Baume, France) (AS);
- collection F. Soldati (Limoux, France) (FS);
- collection P. Sorlet (Cortevaix, France) (PS);
- collection H. Thomas (Mérignac, France) (HT).

Ochrotus unicolor is rarely reported in the literature. To complete the data from the examined collections, we were able to find some additional observations in CAILLOL (1914), LUCAS (1875), MAYET (1900), PARMENTIER *et al.* (2019) and SAINTE-CLAIRE DEVILLE (1914), supplemented by the INPN website (2023a).

Localities and their administrative departments are cited in alphabetical order. For a better standardization of all used data, dates of reports were reduced to the month in Roman numerals followed by the entire year, finding authors and acronyms of material depositories in brackets. Literature data are only used when they complete the material examined in the aim of favoring data verified by the authors.

RESULTS

Ochrotus unicolor is only reported in France in very xeric localities in the Mediterranean region (fig. 2) where it seems to be rare and sporadic. It was also formerly reported from Corsica (SAINTE-CLAIRE DEVILLE, 1914) without other precisions. We have never examined any specimen despite many field trips dedicated to darkling beetles on this island, carried out by one of the authors (FS). It should be noted that its main host ant, *M. barbarus*, is virtually absent from Corsica (INPN, 2023b). However, *O. unicolor* occurs in Sardinia.

Alpes-Maritimes. – Antibes (Caillol, 1914).

Aude. – Paziols, V.2023, F. Cabon (FC).

Bouches-du-Rhône. – Fos-sur-Mer, VI.2015, S. Fadda (INPN, 2023a). Istres, VI.2015, S. Fadda (SF). Istres, La Caspienne, V.2009, III.2011, C. Perez (CP). Istres, Coussouls de Crau natural reserve, VI.2023, F. Soldati (FS). Saint-Martin-de-Crau, VI.2012, D. Delpy (DD). Idem, III.2022, T. Le Pen (LP). Idem, Couloubri sheepfold, IX-X.2007, S. Fadda (SF). Idem, Coussouls de Crau natural reserve, VI.2023, H. Thomas (HT).

Hérault. – Surroundings of Béziers (Lucas, 1875). Gigean, IV.2022, A. Marquis (LP).

Pyénées-Orientales. – Argelès, IV.1999, F. Soldati (FS). Banyuls-sur-Mer, IV.1953, C. Besuchet (MHNG). Idem, V.1949, J. Ribaut (UST). Brouilla, V.1999, P. Sorlet (PS). Canet, X.1999, S. Puissant (SP). Idem, III.2001, S. Puissant & F. Soldati (FS, SP). Cerbère, V.1950, G. Tempère (NG). Collioure (Mayet, 1900). Laroque-des-Albères, IV-V.2019 (Parmentier *et al.*, 2019). Opoul-Périllos, V.2023, C. Beaumont & F. Cabon (CB, FC). Perpignan, without any date, P. Pellet (MHNP). Port-Vendres (Mayet, 1900). Rivesaltes, VIII.2002, F. Soldati (FS). Saint-Cyprien, IX-X.1999, H. Brustel & F. Soldati (FS, HB). Idem, VII.2000, F. Soldati (FS).

Var. – Le Cannet-des-Maures, X.2009, A. Sadorge (AS). La Garde, without any date, P. Veyret (LNEF). Hyères (Caillol, 1914). Puget-sur-Argens, IV.2017, S. Fadda (SF). Toulon, X.1947, Charpy (CP). Idem, V.1951, P. Hervé (PP).

DISCUSSION

This myrmecophilous species is usually found under stones in sandy soil from March to October, with seed-harvesting ants of the genus *Messor*, mainly *M. barbarus* (Linnaeus, 1767) (Hymenoptera, Formicidae). More occasionally, it can also be found in the nests of other species of the same genus, for example in the arid plain of the Crau. According to BERNARD (1968), *M. capitatus* (Latreille, 1798) and *M. sanctus* Emery, 1921 (Hymenoptera, Formicidae), the latter species however not present in France, can also host *Ochrotus*. The distribution in France of *M. barbarus* is clearly Mediterranean, mainly in coastal and sublittoral zones (INPN, 2023b) and follows the one of *O. unicolor*.

This depigmented and small-eyed beetle (SOLDATI & SOLDATI, 2000) lives preferentially in the waste dumps or chaff piles of *Messor* nests (PARMENTIER *et al.*, 2019) in subterranean chambers which can reach more than 1.5 meters deep. This is probably

the reason why it only appears to the surface after heavy rains and is thus found among the seeds accumulated near the entrance hole of the nests (fig. 3). Most observations were made in cool weather or after stormy rains, which supports this hypothesis. It is only detectable in *Messor* nests which entrance opens under a sunken stone. However, *Messor* nests generally have an exposed opening along the paths (SOLDATI & SOLDATI, 2000). Research and sifting in the accumulations of seeds around unsheltered nests have not yet made it possible to detect any individuals. When present under a stone, *Oochrotus* are found either on the lower surface of the rock or among the seeds near the entrance of the nest. PARMENTIER *et al.* (2019) sometimes noted high densities of *Oochrotus* in *Messor* nests. The species is a nest cleaner but not a predator of ants, even when they are dead, according to the dietary tests carried out by the same authors. It is a commensal whose consumption of seed debris in waste dumps may limit the development of pathogens. Individuals bears cuticular hydrocarbons close to those of its hosts which converge strongly with the recognition signals of ant workers, allowing it to be treated with a certain indifference (PARMENTIER *et al.*, 2019).

Oochrotus are generally accompanied by numerous silverfish (*Zygentoma*) and by beetle species belonging to the genera *Merophysia* Lucas, 1852, and *Cholovocera* Motschulsky, 1838 (Coleoptera, Endomychidae). Among silverfish, *Messor* ant-associated specialists are mainly *Neoasterolepisma* Mendes, 1988, spp. and *Tricholepisma aureum* (Dufour, 1831) in the Mediterranean countries (PARMENTIER *et al.*, 2022; ROBLA *et al.*, 2023). However, some generalist silverfish (genera *Proatelerina* Paclt, 1963, *Lepisma* Linnaeus, 1758, and *Ctenolepisma* Escherich, 1905) can also be associated with *Messor barbarus* (PARMENTIER *et al.*, 2022). It therefore appears that *Messor* nests shelter a wide diversity of myrmecophilous insects, as was demonstrated on the Maltese islands (CASSAR *et al.*, 2023).

By artificially reproducing specific conditions for lucifugous myrmecophilous animals, certain authors were able to bring numerous *Oochrotus* to the surface. LUCAS (1875) reported that P. Pellet was able to observe up to sixty individuals of *O. unicolor* by placing large stones or large bricks on the opening of the nests and not removing them until several days later. HERVÉ (1951) was able to capture about thirty individuals of these insects under a large flat stone that he had half buried near the entrance of a *M. barbarus* nest. But this type of experiment does not always provide results. As a matter of fact, one of the authors (FS) placed several large stones above the entrance to *Messor barbarus* nests in a locality where *O. unicolor* was found. Surveyed several weeks later, after heavy rains, no *Oochrotus* could be found under these stones and among the wet seeds near the entrance of the nests. Very specific microclimatic conditions should allow these beetles to be found on the surface, perhaps for short periods of time.

During dry periods, individuals must remain at depth or be massacred by *Messor* ants which are then excited by the heat (BERNARD, 1968). However, PARMENTIER *et al.* (2019) noted little aggressiveness from *Messor* towards *Oochrotus* and when attacks take place, they have limited effects due to the body structure of their hosts. Indeed, these authors showed, under experimental conditions, that *O. unicolor* protects itself physically thanks to its compact and rounded exoskeleton by lowering itself to the ground, thus preventing ants from catching it. It has relatively short legs and its antennae fold easily under its body does not provide ants with any attachment points.

Despite its relatively wide Mediterranean geographical distribution, *O. unicolor* remains a difficult species to observe, as evidenced by the few observations on a

national scale and the absence of the species in many collections. Its particular lifestyle and ecological requirements thus restrict the available data relating its occurrence despite strong prospecting pressure in the French Mediterranean departments. To our knowledge, the species has never been captured by a trapping system. However, some entomologists were able to find these myrmecophilous insects in abundance, by artificially reproducing the optimal conditions for them to come to the surface (LUCAS,

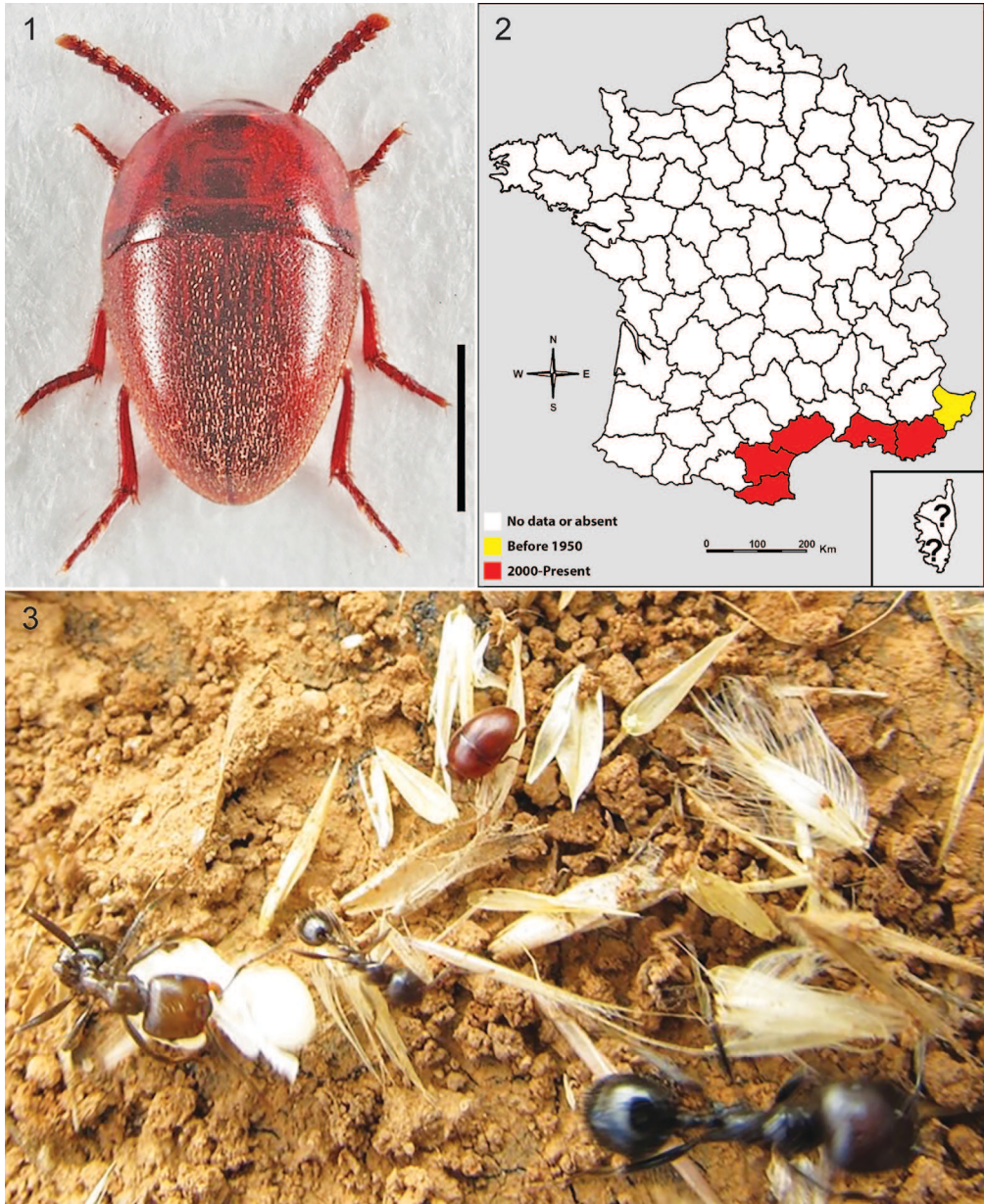


Fig. 1-3. - *Oochrotus unicolor* Lucas. - 1, Habitus, specimen from Paziols (Aude) (scale bar: 1 mm) (photo Frédéric Azémar). - 2, Updated distribution in France (map Fabien Soldati). - 3, Adult in a nest of *Messor barbarus* (Linnaeus) ants (photo Sylvain Fadda).

1875; HERVÉ, 1951). Furthermore, the use of a thermal vacuum cleaner also makes it possible to detect it (C. Perez, pers. comm.). Their role and their diet within colonies is now fairly well known thanks to the work of PARMENTIER *et al.* (2019), showing *Oochrotus* are useful commensals to *Messor* ants. Their cleaning of remains in seed dumps may limit the appearance of pathogens. Even if cases of aggression by ants towards *O. unicolor* have already been observed, their physical defense accompanied by chemical signals allows them to live on good terms with their hosts most of the time.

The very recent discovery of the species in the department of Aude, as well as the updating of its occurrence in other ones, suggest its potential presence in the Gard and Vaucluse departments and the confirmation of its presence in Corsica. Since the work of SOLDATI (2007), the number of departments of occurrence has increased from four to six and the localities have almost doubled. That said, *O. unicolor* remains a very sparsely distributed species in France, only known in 24 municipalities corresponding to 0.07% of the territorial potential.

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