



# Distribution of *Ptilophorus dufourii* (Latreille, 1818) in France, with remarks on the behaviour of adults (Coleoptera, Ripiphoridae)

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**Abstract.** – In 2021, numerous observations of *Ptilophorus dufourii* (Latreille, 1818) were made by the author, providing new information about the species' biology. The oviposition of the female was observed and is described in this article for the first time. Several other biological observations were made and are discussed in relation to the bibliography. The species' distribution in France is also provided, based on numerous data from various sources. These new observations may favour future ones, to finally understand the whole development cycle of *Ptilophorus dufourii* which, until now, remains poorly known.

**Résumé.** – Répartition de *Ptilophorus dufourii* (Latreille, 1818) en France, et remarques sur l'écologie des imagos (Coleoptera, Ripiphoridae). Au cours de l'année 2021, de nombreuses observations de *Ptilophorus dufourii* (Latreille, 1818) ont été effectuées par l'auteur, qui permettent d'apporter des précisions sur la biologie de l'espèce. La ponte a pu être observée et est décrite ici pour la première fois. Plusieurs autres observations sur la biologie ont été faites, et sont discutées en regard de la bibliographie existante. Des données de répartition de cette espèce en France ont aussi été compilées et sont présentées. Ces précisions devraient favoriser de nouvelles observations, permettant à terme comprendre la totalité du cycle de développement, jusqu'alors méconnu, de *Ptilophorus dufourii*.

**Keywords.** – Tenebrionoidea, oviposition, distribution, Mediterranean biogeographic region.

*Ptilophorus dufourii* (Latreille, 1818) is a member of the Ripiphoridae, a beetle family comprising nine species in metropolitan France, among them only one in the genus *Ptilophorus* Dejean, 1834 (BOUYON, 2014). This genus is currently composed of 24 species worldwide, which are distributed as follows: five in the Near East, five in the southern part of the African continent, eleven in Australia, one in North America, one in Yemen, and one in the Mediterranean area: *P. dufourii* (BATELKA, 2012).

*Ptilophorus dufourii* is between 3.8 and 11.2 mm long (HEITMANS *et al.*, 1994). In France, it is the only Ripiphoridae with elytra covering the entire abdomen. The body is black, except for the brown elytra, with faint longitudinal stria. A whitish pubescence is found on the whole body. The male's eight distal antennomeres are remarkably flabellate, unlike the female's, which are triangular.

All Ripiphoridae species with a documented biology are known to be parasitic at the larval stage (FALIN, 2002): some genera develop at the expense of wood-boring beetles (ŠVÁCHA, 1994), others in the nests of social or solitary Hymenoptera (CHAPMAN, 1870), and others on cockroaches (BESUCHET, 1965 ; JARRY & JARRY, 1963). Although hypothesised, this parasitic development has never been demonstrated for

*Ptilophorus* species, as information regarding their biology is still incomplete (BATELKA, 2012 ; MACRAE & HEINOLD, 2014 ; BATELKA *et al.*, 2022). However, BATELKA *et al.* (2022) described the primary larva, obtained after mating and oviposition in glass jars, and concluded that the morphology of the larva indicates it has a parasitic development.

Based on field observations and a literature survey, this article aims to provide new data on the biology of *Ptilophorus dufourii*.

## MATERIAL AND METHODS

The data mentioned in this article come from two different sources.

First, the numerous field work sessions made in the southeast of the department Hérault (southern France) in 2021, which allowed the observation of *Ptilophorus dufourii* *in situ*. For each contact, notes were taken on the number of individuals and their activities. Furthermore, some individuals were taken and observed under a binocular magnifying glass (×10 to ×40). Some eggs were also taken to try to make them hatch, and several branches on which eggs have been laid were also collected, with the same purpose.

The second source is the literature and museum survey, which allowed to provide details on the species geographical distribution and the adult activity period, and to eventually provide other observations. The following sources were consulted, in addition to the rest of the literature cited.

- Institutions: Musée des Confluences de Lyon (Lyon, Rhône, France); Muséum d'Histoire Naturelle de Marseille (Marseille, Bouches-du-Rhône, France); Muséum national d'Histoire naturelle (Paris, France) (MNHN); Laboratoire national d'entomologie forestière of the Office national des forêts (Quillan, Aude, France).

- References: Catalogue des Coléoptères de France (TRONQUET, 2014) (listed as *Ptilophorus dufourii*); Catalogue des Coléoptères de France (SAINTE-CLAIRE DEVILLE, 1935) (listed as *Evaniocera dufouri*); Coléoptères de l'Ardèche (BALAZUC, 1984) (listed as *Evaniocera dufouri*); Catalogue des Coléoptères de la Camargue et du Gard (THÉRON, 1975) (listed as *Evaniocera dufouri*); Catalogue des coléoptères de Provence (CAILLOL, 1914) (listed as *Evaniocera dufouri*).

The following references were also consulted, but no mention of *P. dufourii* were found: Catalogue des Coléoptères du bassin de l'Agout (Tarn) (GALIBERT, 1932), Catalogue des Coléoptères du Languedoc (MARQUET, 1897) and Catalogue des Coléoptères du Lot et des Causses du Quercy (BURLE *et al.*, 2022).

- Internet sources: OpenObs (OPENOBS, 2022), Inaturalist (INATURALIST, 2022) and GBIF (GBIF, 2022) (for internet sources, only data confirmed on picture by the author have been taken into account).

- Transmission of data by entomologists and by members of the internet forum insecte.org: Sandy Barberis, Alain Berly, Jean-David Chapelin-Viscardi, Jacques Coulon, Olivier Courtin, Michael Dierkens, Antoine Foucart, Felip Manyer i Ballester and Hervé Thomas.

## RESULTS

Results are presented in the following paragraphs. Several aspects of the species' biology are thus successively addressed, and the same arrangement of paragraphs is used in the discussion.

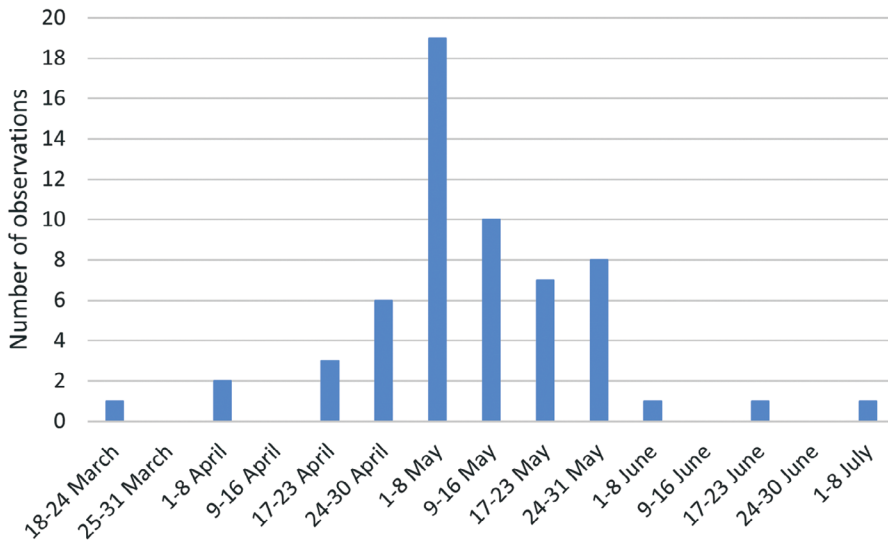
**Data collected.** – Data from the sources detailed in Material and methods are presented in the following list, ordered by French department (department number in brackets).

**Alpes-de-Haute-Provence (04).** Digne-les-Bains, in the area (P. Chrétien) [CAILLOL, 1914]; Valensole, Coulet de Bourre, sweeping, 26.IV.2020, 2 ♂ (J. Coulon) in coll. J. Coulon; Valensole, Coulet de Bourre, sweeping, 29.IV.2020, 4 ♂ (J. Coulon) in coll. J. Coulon; Valensole, Coulet de Bourre, sweeping, 2.V.2020, 5 ♂ (J. Coulon) in coll. J. Coulon; Valensole, Coulet de Bourre, sweeping, 3.V.2020, 8 ♂ (J. Coulon) in coll. J. Coulon; Valensole, Catalany, sweeping, 3.V.2021, 1 ♀ (J. Coulon) in coll. J. Coulon; Valensole, Catalany, sweeping and oak beating, 18.V.2021, 2 ♂, 10 ♀ (J. Coulon) in coll. J. Coulon. – **Ardèche (07).** Lagorce, la Fontaine du Cade, 6.V.1989, 1 ♂ (A. Foucart) in coll. M. Bellifa; Lagorce, 10.V.1997, 1 ex. (R. Allemand) in coll. R. Allemand; in the area of Lagorce and Vallon, on *Quercus ilex*, V [BALAZUC, 1984]; Lagorce, month of May (H. Bouyon) [DIERKENS & AUDIBERT, in press]. – **Aude (11).** Antugnac, 26.IV.1993, 1 ex. (T. Noblecourt) in coll. Laboratoire national d'entomologie forestière de l'Office national des forêts (LNEF); Antugnac, 17.V.1993, 1 ex. (T. Noblecourt) in coll. LNEF; Conilhac-Corbières, 16.V.2019, 1 ♂ (Y. Evenou) OpenObs; Conilhac-Corbières, 2.V.2022, 2 ♂ (O. Courtin) in coll. O. Courtin; Ginestas, 1.V.2012, 1 ex. (J. Touroult, A. Horellou) OpenObs; Gruissan, les Caunes, 43.12998N 3.09525E, sweeping herbaceous plants, 15.V.2021, 1 ♂ (S. Barberis) in coll. S. Barberis; Gruissan, les Caunes, beating *Pinus*, 15.V.2021, 1 ♂ (H. Thomas) in coll. H. Thomas; Moussan, les Hoches, 27.V.1976, 1 ex. (J.-L. Nicolas) in coll. J.-L. Nicolas; Narbonne, montagne de La Clape, IV.2002, 10 ♂ [Allemand & Berger 2004]. – **Bouches-du-Rhône (13).** Aix-en-Provence, before 1938 [SAINT-CLAIRE DEVILLE, 1935]; Le Puy-Sainte-Réparate, Saint-Canadet, in the meadows, 9.V, before 1845 [BOYER DE FONSCOLMBE, 1845]. – **Gard (30).** Aigues-Vives, 03.V.1972, 1 ♂ (J. Viallier) in coll. J. Viallier; Beauvoisin, Grand-Val, before 1975 [THÉRON, 1975]; Beauvoisin, Valladas de Sainte-Combe, 30.V.1987, 2 ♂ (P. Ponel) in coll. L. Bigot, n°MHN.12223.1.27.1 et MHN.12223.1.27.2 © coll. Muséum d'histoire naturelle de Marseille; Garons, before 1975 [THÉRON, 1975]; Gênerac, IV.1950, 10 ♀ (J. Théron) in coll. G. Audras; Gênerac, RD197 south of the village, 23.VI.2013, 1 ♂ (M. Dierkens) in coll. M. Dierkens; Gênerac, 25.V.1995, 1 ex. (A. & L. Michard) OpenObs; Nîmes, clos Gaillard, 2.V.2022, 1 ♂ (anonymous) INaturalist. – **Hérault (34).** Agde, 25.IV.2022, 1 ♂ (anonymous) INaturalist; Assas, Bois du Périé, 2.IV.1989, 1 ♂ (A. Foucart) in coll. M. Bellifa; Aumes, 2.V.2019, 1 ♂ (anonymous) INaturalist; Béziers, on *Silybum marianum* (L.) Gaertn., 1791, before 1912 (Marquet) [Bétis 1912]; Brissac, 28.V.1988, 1 ♀ (R. Allemand) in coll. R. Allemand; Castries, 3.VII.1956, 2 ♂ in coll. J. Briel, MNHN; Castries, 20.V.1958, 1 ♀, 1 ♂, in coll. J. Briel, MNHN; Cournonterral, 6.V.2022, 1 ♂ (anonymous) INaturalist; Entre-Vignes, sweeping and beating of *Ulmus* dead branches, 17.V.2021, 15 ♂, 10 ♀ (M. Bellifa); Ferrières-des-Verreries, 29.IV.2020, 1 ♂ (anonymous) INaturalist; Grabel, Valmaillargues, flying, 12.V.2022, 1 ♂ (M. Bellifa); La Boissière, on *Quercus*, 7.V.1963, 1 ♂ in general coll. Lyon; La Boissière, 14.V.2008, 1 ex. (A. & L. Michard) OpenObs; Lunel-Viel, route de Vêrargues, sweeping, 7.V.2021, 2 ♂ (M. Bellifa); Montaud, 05.V.2021, 1 ♂ (anonymous) INaturalist; Montpellier, Plan des 4 seigneurs, 26.V.2022, 1 ♂ (anonymous) INaturalist; Montpellier, Celleneuve, V.1952, 1 ♂, 1 ♀ (G. Audras) in coll. J. Viallier; Montpellier, Celleneuve, beating *Ulmus* dead branches, April-May, before 1953 [SCHAEFER, 1953]; Montpellier, Celleneuve, V.1952, 1 ♀ in coll. A. Condillier, n°MHN.13460.65.2 © coll. Muséum d'histoire naturelle de Marseille; Montpellier, Celleneuve, IV.1952, 1 ♂ in coll. A. Condillier, n° MHN.13460.65.1 © coll. Muséum d'histoire naturelle de Marseille; Notre-Dame-de-Londres, 7.V.1980, 2 ♂, 2 ♀ (J. Viallier) in coll. J. Viallier; Notre-Dame-de-Londres, 28.V.1988, 1 ♀ (R. Allemand) in coll. R. Allemand; Notre-Dame-de-Londres, 29.V.2013, ♂ (anonymous) OpenObs; Pignan, sweeping, 26.IV.2008, 5 ex. (J.-D. Chapelin-Viscardi) in coll. J.-D. Chapelin-Viscardi; Prades-le-Lez, domaine de Restinclières, 6.V.1996, 4 ♂ (A. Foucart) in coll. M. Bellifa; Prades-le-Lez, domaine de Restinclières, on sight on *Juniperus oxycedrus*, 20.IV.2021, 4 ♂, 3 ♀ (M. Bellifa) in coll. M. Bellifa; Prades-le-Lez, domaine de Restinclières, on sight on *J. oxycedrus*, 21.IV.2021, 3 ♂, 5 ♀ (M. Bellifa); Prades-le-Lez, domaine de Restinclières, on sight on *J. oxycedrus*, 23.IV.2021, 6 ♂, 15 ♀ (M. Bellifa); Restinclières, 14.V.2021, 1 ♂ (anonymous) INaturalist; Saint-Clément-

de-Rivière, resurgence of the Lèz, flying, 21.III.2021, 1 ♂ (M. Bellifa) in coll. M. Bellifa; Saint-Drézéry, edge of the Bérange river, beating *Crataegus* and *Fraxinus* and sweeping, 6.V.2021, 8 ♂, 5 ♀ (M. Bellifa); Saint-Gély-du-Fesc, on *Juniperus*, *Quercus*, etc, before 1953 [Schaefer 1953]; Saint-Guilhem-de-Désert, Lavagnes, beating old pear trees, 1980, 5 ♂ (J. Coulon) in coll. J. Coulon; Saint-Jean-de-Védas, 22.V.2022, 1 ♂ (anonymous) INaturalist; Saint-Martin-de-Londres, before 1953 [Schaefer 1953]; Sussargues, edge of the Valentibus river, sweeping and beating *Rosa sp.*, 14.V.2021, 16 ♂, 1 ♀ (M. Bellifa); Teyran, sweeping, 17.V.2021, 3 ♂ (M. Bellifa); Villeveyrac, le Peyrou, la Croix de Canat, in wasteland and scrubland, 12.V.2015, 1 ♂ (A. Berly); Villeveyrac, le Peyrou, la Croix de Canat, in wasteland and scrubland, 17.V.2017, 1 ♂ (A. Berly). – **Pyrénées-Orientales (66)**. Los Masos, beating *Pinus salzmani*, 1.VI.2000, 1 ♀ [GOURVES, 2000]; Ria-Sirach, before 1938 [SAINT-CLAIRE DEVILLE, 1938]; Rivesaltes, before 1938 [SAINT-CLAIRE DEVILLE, 1938]; Rivesaltes, chêne liège, 2.IV.1922, 1 ♂ (P. Jollus) in coll. Daillé, MNHN; Saint-Paul-de-Fenouillet, on sight, 23.IV.2021, 1 ♂ (F. Manyer i Ballester). – **Var (83)**. Fréjus, before 1912 (J.M. Jaubert) [BÉTIS, 1912]; Gonfaron, V.1953, 1 ♂ (G. Audras) in coll. G. Audras; Hyères, before 1912 (E. Mulsant) [BÉTIS, 1912]; La-Garde-Freinet, before 2013, 1 ex. (P. Gauret) [LEMAIRE *et al.*, 2017]; Le Luc, before 1912 (Robert, Aubert) [BÉTIS, 1912], (M. Pic) [CAILLOL, 1914]; Le Muy, 2.V.2005, 1 ex. (H. Bouyon) OpenObs; Les Mayons, les Escarscets, 13.V.1994, 1 ♂ (A. Foucart) in coll. M. Bellifa; Pierrefeu-du-Var, Montbel, before 1912 (Tholin) [BÉTIS, 1912]; Roquebrune-sur-Argens, la Bouverie, before 1912 (De Boissy, Lascols, Bétis) [BÉTIS, 1912]; Saint-Raphaël, before 1912 (Raymond) [Bétis 1912]; Toulon [CAILLOL, 1914]; Vidauban, 27.V.2013, 1 ex. (A. Horellou) OpenObs; Vidauban, 5.V.2015, 1 ex. (A. Horellou) OpenObs. – **Vaucluse (84)**. Mirabeau, 3.V.2008, 1 ♂ (anonymous) OpenObs.

**Adult activity period.** – In 2021, in Hérault department (France), the earliest observation of *P. dufourii* was made on 21.III.2021, late in the afternoon. It was a male, caught flying in a pine forest. Then, large numbers of males and females were seen from 20.IV.2021 to 17.V.2021, with oviposition of the female occurring throughout this period. No mating was noted.

Data from field observations, consulted collections and contacted entomologists shows that this species is active from late March to early July (fig. 1). Most individuals are found between late April to late May, and records in March, June and July are very rare.



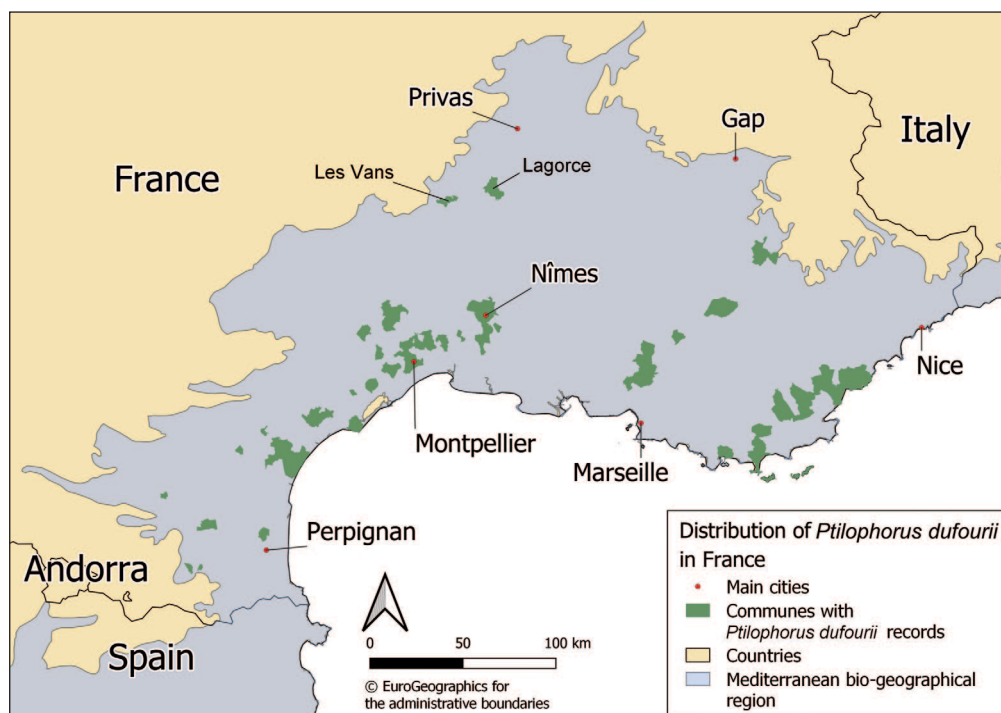
**Fig. 1.** – Graph showing the number of *Ptilophorus dufourii* (Latreille) observations according to the time of year, for French data. An observation is linked to a place and a date, regardless of the number of individuals seen; 59 observations were used.

**Distribution.** – The map (fig. 2) shows the location of field and literature data for France (the list of data is given in Material and methods). All the communes where at least one record of *P. dufourii* is known are included in the Mediterranean biogeographic region, as defined by the Habitats Directive (EUROPEAN ENVIRONMENTAL AGENCY, 2016).

**Species habitats.** – In 2021, the species was found in Hérault in a variety of habitats: *Pinus* forest, meadow bordered by a riparian forest, scrubland, wasteland with *Ulmus minor* Mill., 1768, and garrigue with low vegetation mainly composed of *Rosmarinus officinalis* L., 1753, *Juniperus phoenicea* L., 1753, *Juniperus oxycedrus* L., 1753 and young *Pinus halepensis* Mill., 1768 (fig. 3-6). These habitats host very different types of vegetation, as well as contrasting conditions of humidity and sunshine.

**Adult activity and capture conditions.** – Observations made in 2021 in the Hérault department show differing behaviour between males and females. Males are often observed in flight or positioned at the apex of branches or herbaceous stems. When sitting, their antennae are widely expanded, and the pronotum and head rotate laterally by almost 180°, like a radar (fig. 7). After a few minutes, they fly away to another support and start again.

Females are mainly observed on dead branches of living trees. These branches are most often of small diameter (less than 2 cm). Various tree and shrub species from different families are used: *Ulmus minor*, *Juniperus oxycedrus*, *Rosa* sp. and *Fraxinus angustifolia* Vahl, 1804. When females are active, they are observed probing the branches with their antennae.



**Fig. 2.** – Distribution map of *Ptilophorus dufourii* (Latreille) in France. A data is represented by the commune where the insect was observed. In blue, Mediterranean bio-geographical region [data from THE EUROPEAN ENVIRONMENTAL AGENCY (2016), countries boundaries from EUROSTAT (2016)]. Map created with QGIS.





**Fig. 3-6.** – Habitat of *Ptilophorus dufourii* (Latreille). – **3**, Garrigue with low vegetation. Males mainly on flight and at the apex of branches and herbs, females on dead branches of *Juniperus*. France, Hérault, Prades-le-Lez, 43.71815N 3.86088E. – **4**, Wasteland with *Ulmus minor* Mill., 1768. Males at the apex of herbs, females on dead branches of *Ulmus*. France, Hérault, Entre-Vignes, 43.6929N 4.09477E. – **5**, Meadow bordered by a riparian forest. Males at the apex of herbs, females on dead branches of *Rosa* sp. and *Fraxinus angustifolia* Vahl, 1804. France, Hérault, Sussargues, 43.71258N 3.98623E. – **6**, Wasteland with *Fraxinus angustifolia* Vahl, 1804. Males at the apex of herbs and branches, females on dead branches of *Fraxinus angustifolia*. France, Hérault, Lunel-Viel, 43.68654N 4.09583E.

During some field observations, in the morning, when the temperature was colder, both males and females were seen motionless on small branches of trees and shrubs, with their heads tucked against their ventral side (fig. 8).

Despite careful observation of males and females, no mating could be detected. This may be due to a lack of observations at the beginning of the adult's activity period, or due to brief mating or mating taking place in hidden places.

**Oviposition and eggs.** – The oviposition of the *Ptilophorus dufourii* female has been observed on several occasions, on *Juniperus oxycedrus* and *Ulmus minor*, always on dead twigs of living trees. The female slowly crawls along a branch probing it with her antennae, and when she encounters a crack in the bark or an emergence hole of a wood-boring insect, she stops and inserts her ovipositor (fig. 9). She can remain at a crack for up to 15 minutes before continuing to explore the branch to lay more eggs.

The eggs are usually laid in groups, rarely alone (fig. 10-11). They seem to be covered with a thin layer of transparent mucus, making them adhere to each other and to their substrate. They are translucent white and in the shape of very elongated ovals, like fine grains of rice, and are also very slightly arched. They are 870 µm long

and 150 µm wide at their widest point. Small branch sections with eggs were kept in a tube. However, for unknown reasons, no development was visible for several weeks, before they dried out.

The dissection of three females revealed approximately 300 eggs in each abdomen. This number should be taken with caution, considering that only three females were studied, and that they may have laid many eggs before the count was carried out. However, it does give an order of magnitude, and confirms that the eggs observed under the bark of the branches are *P. dufourii* eggs.

**Attempt to breeding.** – In addition to the egg-rearing test, five segments (of 30 cm long each) of *Ulmus minor* branches, on which oviposition had been observed in May, were collected at the end of August. The branches were then stored in a box until May 2022, and regularly examined to catch insects emerging from them. In May, apart from three Psocoptera, no insects were visible. All branches were then opened and carefully observed. Two imagos of *Anthaxia* (s. str.) *manca* (Linnaeus, 1767) (Coleoptera, Buprestidae), dead in the lodge, were found, as well as four emergence holes, probably made by the same species.

## DISCUSSION

**Adult activity period.** – The results show that adults of *Ptilophorus dufourii* have a spring activity and are not visible during the rest of the year. These observations agree with the phenology given in the literature. In these articles, data from Eastern Mediterranean countries (Greece, Türkiye, Armenia, Bulgaria, Iran, Jordan and Rumania) (BATELKA, 2007), Hungary (SZALÓKI *et al.*, 2012) and Spain (BARREDA, 2015 ; LOPEZ-COLON, 1997), are given. The specimens were collected between mid-March to late June.

Only the period of appearance between May and July, given by CAILLOL (1914), differs by one month from all other articles. Among the data collected, only one observation was done in July: two males found by J. Briel in Castries (Hérault), on 3.VII.1952.



**Fig. 7-9.** – *Ptilophorus dufourii* (Latreille). – 7-8, ♂: 7, on a small dead branch, its antennae well expanded; 8, on a small dead branch, motionless, with its head tucked up against the ventral side. – 9, ♀, laying eggs under the bark of a small dead branch of *Ulmus minor* Mill., 1768.





**Fig. 10-11.** – Eggs of *Ptilophorus dufourii* (Latreille). – 10, On a small dead branch, once the bark removed. The trace of a saproxylic insect larva is visible. – 11, Glued together on a piece of bark.

**Distribution.** – The distribution area of *P. dufourii* is circummediterranean, from the Iberian Peninsula to Türkiye, via North Africa (except for Libya and Egypt), and reaches the shores of the Caspian Sea in the east (LOPEZ-COLON, 1997 ; BATELKA, 2007, 2008). There are isolated records of the species as far north as Hungary (SZALÓKI *et al.*, 2012).

In mainland France, this species is distributed throughout the Mediterranean area: Languedoc, Roussillon and Provence (SAINTE-CLAIRE DEVILLE, 1935 ; BOUYON, 2014). This agrees with the data gathered for this article.

According to these data, the northernmost confirmed localities for France are Lagorce and Les Vans, in the Ardèche department (fig. 2), attested by several captures, in 1984, 1989 and 1997.



In addition, MULSANT (1856) mentions *P. dufourii* in the Beaujolais region (Rhône, France): a specimen taken by A. Foudras. This would move the distribution limit almost 200 km to the north. However, the record is old, geographically imprecise and considered as enigmatic (DIERKENS & AUBIBERT, in press). Pending a rediscovery in the Beaujolais, the current northernmost known locality for this species remains the south of Ardèche department.

**Species habitats.** – The plasticity in colonised habitats is consistent with the studies carried out on this species in Spain (LOPEZ-COLON, 1997, 1999 ; LOPEZ-COLON & BAENA, 1998 ; MURRIA BELTRAN & MURRIA BELTRAN, 1998 ; LOPEZ-COLON & BAHILLO DE LA PUEBLA, 2000 ; LOPEZ-COLON & BLASCO-ZUMETA, 2000), which revealed that the presence of *P. dufourii* is not directly linked to the habitat and the flora, but to another variable, possibly the larval host, as yet unknown. The habitats where *P. dufourii* was observed in 2021 (fig. 3-6) correspond to the description given by BATELKA *et al.* (2022): “*Ptilophorus dufourii* inhabits open-spaced biotopes in forested or semi-forested areas with permanent meadows or steppe”.

**Adult activity and capture conditions.** – The adult activity described in this article is consistent with the few observations noted in the literature. When information is available, individuals are either collected on sight, on the vegetation, by beating dead branches, especially oaks (MULSANT, 1856 ; CAILLOL, 1914 ; THÉRON, 1975), or by sweeping the herbaceous layer (BATELKA, 2012 ; J. Coulon, pers. comm.).

BATELKA *et al.* (2022) described the same behaviour of males sitting on the apex of herbaceous stems, with the antennae widely expanded. The observations present in this article show that females are often on dead branches of living trees, more or less motionless. If the weather is cold or windy, both males and females are found motionless on the vegetation.

In the genus *Ptilophorus*, another field observation is reported by MACRAE & HEINOLD (2014), on *Ptilophorus wrighthii* (LeConte, 1868). They described two females sitting motionless on dead branches of a living tree, but with no evidence of oviposition. They concluded it was a mate “calling” behaviour.

BATELKA (2012) notes that the sex ratio of specimens of several *Ptilophorus* species in the collections he has studied is very clearly in favour of males. He speculates this is due to collection methods, since males are very often collected by sweeping or by hand (when they are on the vegetation), while females would live hidden. The field observations described above may help to explain the observed imbalance: while males are effectively well detected by sweeping, females are captured by watching carefully the small dead branches of living trees, and their observation is otherwise accidental. It should be however reminded that all five females collected in Morocco were swept from grass when males were in flight BATELKA *et al.* (2022).

**Oviposition and eggs.** – The oviposition of *P. dufourii* female is described here for the first time. In MACRAE & HEINOLD (2014), two females of *P. wrighthii* were described sitting motionless on dead twigs of *Rhus aromatica* Aiton, 1789, and *Juniperus virginiana* L., 1753, with their ovipositor exerted. However, the authors concluded it was not an oviposition behaviour, due to the motionless of the specimens, and to the fact that the two tree species are in very taxonomically distant families. The observations made here demonstrate that taxonomically distant species could be used as egg-layer: Cupressaceae (*Juniperus oxycedrus*) and Ulmaceae (*Ulmus minor*).

There are several articles describing other Ripiphoridae oviposition behaviour. Some species, of the genus *Macrosiagon* Hentz, 1830 (Ripiphorinae), parasites of Hymenoptera, lay their eggs on inflorescences, on which the young larvae will then

cling to their host and be transported to a nest (ULYSSEA & ALBERTONI, 2020). Other species also lay eggs on dead wood: CHAPMAN (1891) describes the female of *Metoeus paradoxus* (Linnaeus, 1761) (Ripiphoridae) laying her eggs in cracks in the bark in autumn. ŠVÁCHA (1994) observed that the female of *Pelecotoma fennica* (Paykull, 1799) (Pelecotominae) inserts eggs into the xylem vessels at branch breaks or emergence holes of its hosts, beetles of the genus *Ptilinus* Müller, 1776 (Ptinidae).

The oviposition and eggs described in this article have many similarities with the information collected by previous authors. However, females of *P. dufourii* do not appear to insert their eggs into the xylem vessels, as does *Pelecotoma fennica*, but simply deposit them in cracks or under detached bark, as does *Metoeus paradoxus*.

The observation of the eggs agrees with the egg description by BATELKA *et al.* (2022), except for the size of the eggs: the length reported here is 0.875 mm *versus* 0.75 mm. It would be interesting to make further observations to study this variation.

**Attempt to breeding.** – Although there was no evidence for the presence of *P. dufourii* in this small sample, it shows that the eggs were laid on a branch where saproxylic beetles were developing. MACRAE & HEINOLD (2014) collected the branch of *Juniperus virginiana* on which the female was observed as well as other branches nearby, and two species of saproxylic beetles, a Buprestidae and a Cerambycidae, emerged after one year. However, no adults of *Ptilophorus* nor eggs were observed.

## CONCLUSION

The observations and the literature study confirm that *P. dufourii* adults have a spring activity, and are found in various habitats. In France, it is found throughout the Mediterranean bio-geographic region. It also appears that males and females have different activities, which impact their observation: males are active in the vegetation whereas females stand mainly on small dead branches of living trees.

For the first time, oviposition was observed. Females lay their eggs in crevices in the bark of small diameter dead branches, still on living trees. Trees and shrubs belonging to various families are used for oviposition. The location and mechanism of oviposition is quite similar to that described for other Ripiphoridae: *Pelecotoma fennica* and *Metoeus paradoxus*.

Neither the rearing of eggs nor the study of dead branches taken from the oviposition site provided any serious indication about the larval development of the species. However, in a recent article, BATELKA *et al.* (2022) described the first instar larva of *P. dufourii*, after collecting males and females. They used their precise description to discuss the systematic position of the species among Ripiphoridae. They have also shown that morphological characteristics of the first instar larvae, such as their small size and the modified cephalic structures, notably mandibles, suggest parasitic behaviour. This behaviour may be quite similar to the biology of *Pelecotoma fennica*: the larvae might feed on larvae or nymphs of saproxylic beetles, developing in the dead branches where the female of *P. dufourii* lays the eggs.

The large range of *P. dufourii*'s distribution, within various habitats, and the variable body size of adults (between 3.8 and 11.2 mm at least) may suggest that *P. dufourii* larvae can develop on different species (BATELKA *et al.*, 2022), as for instance species of *Anthaxia* Eschscholtz, 1829, such as *A. manca*, found on a branch on which eggs were laid.

However, it remains to be proven, and all aspects of the larval biology are still unknown. Hopefully, the information detailed in the present article will enable entomologists to make easier and better observations of *Ptilophorus dufourii*, to finally discover the whole development cycle of this species.

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