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## An exploratory survey and assessment of the hoverfly diversity (Diptera: Syrphidae) from the Pyrenees of Girona, Spain

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**Abstract:** Syrphidae are pollinators, pest predators and decomposers in European ecosystems. Camprodon (Girona province, Spain) is a valley with rich vegetation and high habitat diversity in the eastern Pyrenees. However, hoverfly biodiversity in this valley was poorly known. To explore the high potential of this area for Syrphidae, a survey with hand-net was undertaken in July/August 2020 in the valley. The list of Syrphidae species from the valley increases to 88, whilst that of the Girona province now extends to 119 species. *Chrysotoxum lessonae* Giglio-Tos, 1890 is reported for the first time from the Iberian Peninsula. The specimens of *Xylota tarda* Meigen, 1822 and *Cheilosia hypena* (Becker, 1894) represent the first documented records of these species for the Iberian Peninsula and Spain, respectively; i.e. these two species were known to occur in the Iberian Peninsula and Spain but without further locality details. A total of 19 species were new to the region of Catalonia and 23 to the Girona province. *Cheilosia* Meigen, 1822 was the genus with the highest number of species recorded, as expected from the combination of mountains, diversity of forest vegetation, and presence of rivers/streams of the Camprodon valley. Faunistic results from this fieldwork are relevant to knowledge of Diptera from Catalonia, a region of Spain where this insect family is understudied.

**Keywords:** Flowerflies - *Cheilosia hypena* - *Chrysotoxum lessonae* - distribution - Catalonia - Camprodon valley - checklist.

### INTRODUCTION

As popular pollinators and pest predators (Rojo *et al.*, 2003; Marshall, 2012; Doyle *et al.*, 2020), Syrphidae are often surveyed at the local scale (e.g. Sommaggio & Corazza, 2006; Sánchez-Heredia *et al.*, 2017; Miličić *et al.*, 2018; Lorenzo *et al.*, 2020). Local surveys are relevant to the understanding of biodiversity in complex ecosystems and contribute to knowledge of regional species lists. Regional lists provide a framework for expert systems to assess the conservation of habitats (Speight & Castella, 2001; Monteil, 2010; Speight *et al.*, 2020).

The massif of the Pyrenees extends east-west over 440 km, forming a natural border between France and Spain, in southwestern Europe. With 19 000 km<sup>2</sup> and a maximum altitude of 3404 m, the Pyrenees are a complex ecosystem with many mountains, U-shaped glaciated valleys, rivers, lakes and a diverse flora and fauna.

The Pyrenees can be divided into three parts, Eastern, Central, and Western. North to south, they are divided into the axial or medial Pyrenees, and the pre-Pyrenean or external mountains (Guixé & Llobet, 2016). The north slope of the Pyrenees (France, and the ‘Vall d’Aran’ in Spain) is more humid, less continental, and with typically Eurosiberian forest, whilst the south slope (Spain) has a Mediterranean influence, with less diverse and more reduced forest (Vázquez & Fernández-Prieto, 2002). In Spain, the Pyrenees are divided into five provinces, with the easternmost part in the Girona province, Catalonia (Ricarte & Marcos-García, 2017).

The studies of Diptera in Catalonia are scattered, both temporally and geographically, and Pyrenean hoverflies are not an exception. Apart from the consequences for our ecological understanding of the Pyrenees, this scattered knowledge has also prevented the popularisation of hoverflies, as shown by their absence from field guides to

the regional fauna (Guixé & Llobet, 2016). Cuní (1881) was the first to record hoverflies from the Catalonian Pyrenees. Diptera were poorly studied in Catalonia throughout the 20th century (Pujade-Villar, 2011), with only a little fieldwork undertaken in the Pyrenees to collect hoverflies (van Doesburg, 1951; Leclercq, 1971; Lucas, 1976). The 21st century brought new hoverfly records to light from the Catalonian Pyrenees, but most of these were based on specimens collected earlier, usually in the 1970s (Marcos-García *et al.*, 2007, 2011; van Steenis & Lucas, 2011; Ricarte & Nedeljković, 2020). Camprodon is one of the most popular valleys of the eastern Pyrenees, with diverse vegetation and habitats (Sacadas-i-Lluís, 2009). The first hoverfly records from this valley are those of the Rev. José Andreu from 1926. However, just over a dozen species were reported from this valley prior to the present sampling (Andreu, 1926; Gil Collado, 1930; Lucas, 1976; Barkalov & Ståhls, 1997; Marcos-García *et al.*, 2007, 2011; van Steenis & Lucas, 2011; Ricarte & Nedeljković, 2020). The aim of the present study was to improve our knowledge of the hoverflies from the Girona province by undertaking an exploratory survey and faunistic assessment in its Pyrenean part (Camprodon valley) and reviewing all the available literature.

## MATERIAL AND METHODS

### Study area

Camprodon valley ('Valle de Camprodón' in Spanish) is located in the axial eastern Pyrenees. This hilly valley is in the eastern part of the Ripollès region, Girona province (abbreviated as 'GI' hereinafter), Spain. The climate is typical Pyrenean, humid and rainy. The Ter river, which rises at high altitudes in this valley, is also the main water course in it. All along the valley, there are some scattered small villages and there is a ski resort at about 2000 m asl. The diverse vegetation of the Camprodon valley is dominated by a mosaic of woodlands and grasslands as a result of a long history of human use. The montane and subalpine altitudinal zones are represented in the valley. Montane vegetation (700-1600 m asl) consists mainly of deciduous forest of *Quercus* spp. and *Fagus sylvestris* L., as well as forest of red pine (*Pinus sylvestris* L.). The dominant species in the understory of the montane forest is the common box (*Buxus sempervirens* L.). Montane vegetation of riversides includes *Salix*, *Populus* and *Alnus* trees. Subalpine vegetation (1600-2300 m asl) is dominated by forests of black pine (*Pinus uncinata* Ramond ex A. DC.) that are usually more open at higher altitudes, with alpenrose (*Rhododendron ferrugineum* L.) in the understory. Grasslands are also typical of the subalpine zone (Sacadas-i-Lluís, 2009). The sampling sites of the present study within the Camprodon valley are detailed in Table 1. Sites belong to four different villages, Camprodon, Llanars, Setcases, and Vilallonga de Ter.

### Fieldwork and hoverfly identification

Adult hoverflies were collected by Antonio Ricarte and Zorica Nedeljković using hand-nets, from 29 July to 3 August 2020. Vegetation and especially flowers (e.g. *Heracleum sphondylium* L., *Hypericum* sp., *Eupatorium cannabinum* L., *Knautia* sp., *Pastinaca* sp.) were inspected for hoverflies in sunny areas, and also on some hilltops (S3, S14). Specimens were kept in tubes in the freezer until defrosting in the lab for preparation. Specimens were pinned and labelled following the usual techniques (Galante & Marcos-García, 2004). A bar code label was assigned to each specimen and the information databased in an Excel file. Bar code numbers were written for each specimen (as a single code) or series of specimens (as a range of codes) in the examined material. Every code starts with 'CEUA' plus a number of zeros and then the actual code number (e.g. CEUA00050300), but only the number is indicated in the list of examined material.

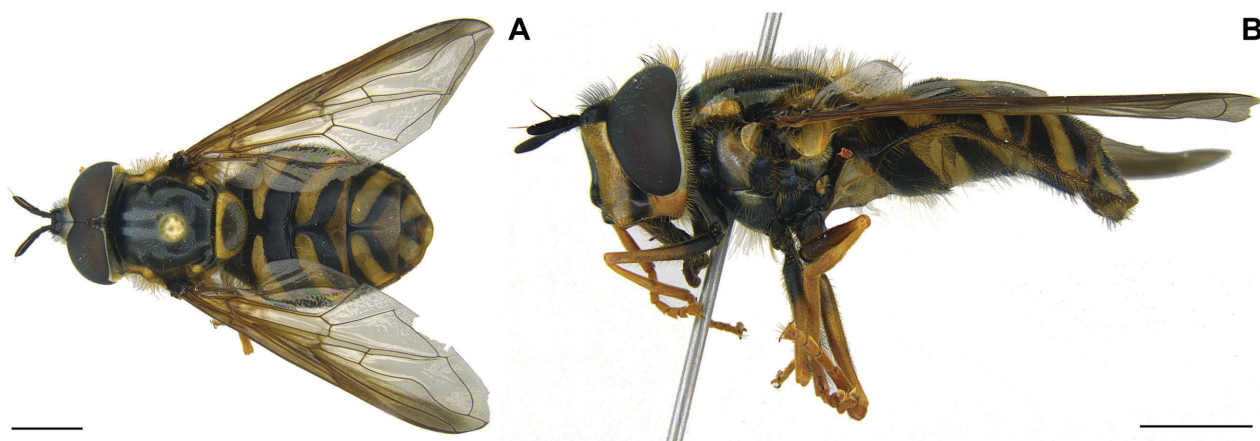
Specimens were identified to the species level by Antonio Ricarte and Zorica Nedeljković, except otherwise stated. The literature used for identification is Nielsen (1970), Violovitsh (1974), Dušek & Láska (1976), Goeldlin de Tiefenau (1976), Marcos-García & Láska (1983), Vujić (1992), Vujić & Šimić (1995-1998), Goeldlin de Tiefenau (1996), Barkalov & Ståhls (1997), Verlinden (1999), Vujić (1999), van Steenis (2000), Hippa *et al.* (2001), Sommaggio (2001), Claussen & Ståhls (2007), Ståhls *et al.* (2008), Barkalov (2009), Bartsch *et al.* (2009a, b), Ricarte *et al.* (2010), van Veen (2010), van Steenis & Lucas (2011), Nedeljković *et al.* (2013), Vujić *et al.* (2013), Haarto & Ståhls (2014), van Steenis *et al.* (2016), Speight & Sarthou (2017), Vujić *et al.* (2017), Nedeljković *et al.* (2018), and van Steenis *et al.* (2020). When it was necessary to confirm the species identification, male genitalia were dissected with entomological pins. They were cleared in a hot solution of KOH for up to 5 min, immersed in acetic acid to remove excess KOH, washed in 70% alcohol, and stored in microvials containing glycerine. When specimens were dry, they were first relaxed in a humid chamber before genitalia removal. All specimens are deposited in the CEUA-CIBIO collection, University of Alicante, Spain. Hoverflies were photographed in the field by Antonio Ricarte (except where otherwise stated) with a camera Canon® PowerShot SX730 HS. A pinned specimen of *Chrysotoxum* Meigen, 1803 was illustrated (Fig. 1) with photos produced as stacks of individual images made with a camera (Leica DFC 450) attached to a binocular stereomicroscope (Leica M205 C). Stacks were made in Leica Application Suite X (LAS X)®, v. 3.0.4.16529.

### Taxonomic and faunistic assessments

For the collected hoverflies, the faunistic novelty of each species (Appendix) was assessed on the basis

Table 1. Sampling sites in the eastern Pyrenees of Girona province (Spain) during July/August 2020 field work. The dates when each site was visited is also presented.

Site code	Site	Latitude	Longitude	Altitude (m)	Date/s
S1	Camprodon, 'Roureda de can Pascal' and vicinity	42.313253°	2.386996°	975	01.08.2020
S2	Llanars, L'Escón guesthouse	42.321504°	2.343851°	998	29.07.2020
S3	Llanars, La Creueta	42.324524°	2.339819°	1138	29.07.2020
S4	Llanars, riverside of 'la Riera de Feitús', near 'Font del tir', on flowers of <i>Heracleum sphondylium</i>	42.329624°	2.346578°	1007	29.07.2020
S5	Llanars, route Llanars-Camprodon, Ter riverside	42.317926°	2.350075°	964	29.07.2020
S6	Setcases, track up to the water store	42.381322°	2.301701°	1317	30.07-02.08.2020
S7	Setcases, Vallter 2000 sky centre	42.422851°	2.267581°	2000-2100	30.07.2020
S8	Setcases, Vall de Querlat, crossroads with the Espinavell track	42.394433°	2.289479°	1460	30.07.2020
S9	Vilallonga de Ter, track to La Abella	42.328649°	2.311320°	1055	03.08.2020
S10	Vilallonga de Ter, Vilallonga-Setcases road, roadside vegetation	42.354237°	2.292147°	1161	
S11	Vilallonga de Ter, 'Ribera de Tregurà' riverside	42.336798°	2.289106°	1157	31.07.2020
S12	Vilallonga de Ter, Ter riverside, near Vilallonga-Setcases road	42.357085°	2.292184°	1166	01-02.08.2020
S13	Vilallonga de Ter, Ribera de Tregurà, on flowers of <i>Pastinaca</i> at the roadsides	42.341194°	2.296101°	1113	31.07.2020
S14	Vilallonga de Ter, Tregurà de Dalt, near aerial	42.347625°	2.281892°	1557	31.07.2020

Fig. 1. *Chrysotoxum lessonae* male, from Camprodon valley, Girona province, Spain. (A) Dorsal view. (B) Lateral view. Scale bar = 2 mm.

of Ricarte & Marcos-García (2017) plus all other subsequent faunistic references. The Iberian Peninsula is here interpreted as the unit encompassing the mainland parts of Spain and Portugal together, plus Andorra. First documented records are also indicated in order to make locality details available for those species that had imprecise records in previous literature. A full list of material examined is provided for each species by using the site codes of Table 1. Collection dates are written in the examined material lists only for the specimens caught in S6 and S12, because these sites were visited on more than one day. For the taxonomic classification of the species collected, the arrangement of subfamilies used – indicated after each species name – follows Mengual *et al.* (2015). Genus and species names generally follow Speight (2020).

### Checklist of Girona hoverflies

The species collected in this study are also presented in the broader frame of an updated checklist of the hoverflies from Girona province. Localities and references are provided for every species in the checklist. The following localities are listed, based on both literature and the present study: L1, Arbucias; L2, Blanes; L3, Caldes de Malavella; L4, Camprodon; L5, Caralps; L6, Cerdaña; L7, Empalme; L8, Figueras; L9, Flassa; L10, La Bisbal; L11, La Molina; L12, Llanars; L13, Massanas; L14, Massanet de la Selva ‘Maçanet-Massanes station’; L15, Mollo; L16, Nuria; L17, Pals; L18, Puigcerdà; L19, Ribas; L20, Ribas de Freser; L21, Rosas; L22, San Cristóbal de Tosas; L23, San Juan de las Abadesas; L24, San Marsal; L25, Sant Ilari de Sacalm; L26, Sarrià; L27, Setcases; L28, Sils; L29, Torroella; L30, Viladrau; L31, Vilallonga de Ter; L32, ‘Between Campodron and Setcases’; L33, 13 km south to Girona city. Locality L4 includes the sampling site S1 of the present study; L12 includes S2, S3, S4, S5; L27 includes S6, S7, S8; L31 includes S10, S11, S12, S13, S14 (Table 1).

The following references were reviewed (numbers are used in the checklist to identify each individual reference): 1, Cuní (1880); 2, Cuní (1881); 3, Cuní (1885); 4, Antiga, 1888; 5, Andreu (1926); 6, Gil Collado (1930); 7, Leclercq (1963); 8, Leclercq (1971); 9, Lucas (1974); 10, Lucas (1976); 11, Goeldlin de Tiefenau (1989); 12, Barkalov & Ståhls (1997); 13, Marcos-García *et al.* (2002); 14, Marcos-García *et al.* (2007); 15, van Eck (2010); 16, Marcos-García *et al.* (2011); 17, van Steenis & Lucas (2011); 18, Álvarez-Fidalgo *et al.*, 2018; 19, van Steenis *et al.* (2020); 20, Ricarte & Nedeljković (2020). Marcos-García *et al.* (1998) is not included in the list of references because it does not provide information on the localities within provinces. Dirickx (1994) also omits locality details for species but does provide maps with distribution points, so is not cited in this checklist, except for comments on the distribution of certain species.

Regarding specific references, the following questions should be noted: *a)* Cuní (1881) reported hoverflies from the Spanish Cerdaña, which is divided between the Lleida and Girona provinces and he did not specify where each species was collected. Since he was based on Puigcerdà (Girona) for fieldwork, we assume here that all species belong to GI. *b)* Gil Collado (1930) reports hoverflies from ‘Ribas’ and ‘Rivas’, one from Madrid (Rivas?) and other from GI (Ribas? i.e. Ribas de Freser? Ribas valley?), however both names are written as ‘Ribas’ in the locality index of Gil Collado (1930), and Ribas/Rivas also appear to be inconsistently used throughout his monograph. Thus, we include Ribas in the present checklist when there were enough grounds to believe that the species was collected in the Ribas of GI.

All species are numbered and presented in alphabetical order, including the species reported in the present work (indicated as ‘present study’). Genus and species names in the checklist follow Speight (2020), which can be consulted together with Peck (1988) for authority and year of each taxon. Where species names used in the historical literature under review have been superseded, those are given after the current name and are preceded by (=).

## RESULTS

### New hoverfly records from the Camprodon valley

*Baccha elongata* (Fabricius, 1775) (Syrphinae)

**Examined material:** 108852; 1 male; S5. – 108851; 1 male; S6; 31.07.2020.

*Ceriana conopsoides* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108188; 1 male; S6; 31.07.2020; on flowers of *Heracleum sphondylium*.

*Cheilosia aerea* Dufour, 1848 (Eristalinae)

**Examined material:** 108792; 1 male; S6; 31.07.2020.

*Cheilosia barbata* Loew, 1857 (Eristalinae)

**Examined material:** 108791, 108790, 108809; 3 males; 108801, 108814, 108816-108818; 5 females; S6; 30.07.2020. – 108804-108808; 5 males; 108800, 108820; 2 females; S6; 31.07.2020. – 108803; 1 male; 108813; female; 02.08.2020. – 108812, 108819; 2 females; S9. – 108811; 1 female; S10.

*Cheilosia hypena* Becker, 1894 (Eristalinae)

**Examined material:** 108320; 1 male; S6; 30.07.2020. – 108325-108328; 4 males; S6; 108321-108324; 4 females; S6; 31.07.2020; 108778, 108779; 2 males; S6; 02.08.2020. – 108310; 1 male; 108329; 1 female; S5. – 108777; 1 female; S1. – 108776 (1 female); S11.

*Cheilosia illustrata* (Harris, 1776) (Eristalinae)

**Examined material:** 108770; 1 male; 108772, 108789; 2 females; S6; 30.07.2020; on flowers of *Heracleum sphondylium*. – 108771; 1 male; S6; 02.08.2020; on flowers of *Heracleum sphondylium*.

*Cheilosia laticornis* Rondani, 1857 (Eristalinae)

**Examined material:** 108785; 1 male; 108784; 1 female; S6; 30.07.2020.

*Cheilosia latifrons* (Zetterstedt, 1843) (Eristalinae)

**Examined material:** 108810; 1 female; S6; 30.07.2020. – 108829; 1 female; S6; 02.08.2020; 108828; 1 female; S9. – 108802; 1 female; S1.

*Cheilosia longula* (Zetterstedt, 1838) (Eristalinae)

**Examined material:** 08773; 1 male; S11; det. I. Ballester.

*Cheilosia proxima* (Zetterstedt, 1843) (Eristalinae)

**Examined material:** 108788; 1 male; S3.

*Cheilosia scutellata* (Fallén, 1817) (Eristalinae)

**Examined material:** 108826; 1 male; 108824; 1 female; S5. – 108827, 1 male; S4. – 108825; 1 female; S6; 30.07.2020.

*Cheilosia variabilis* (Panzer, 1798) (Eristalinae)

**Examined material:** 108787; 1 female; S6; 30.07.2020. – 108786; 1 female; S7.

*Cheilosia vernalis* (Fallén, 1817) (Eristalinae)

**Examined material:** 108794, 108795; 2 males; S6; 31.07.2020. – 108793; 1 female; S12.

*Cheilosia vicina* (Zetterstedt, 1849) (Eristalinae)

**Examined material:** 108775; 1 male; S6; 30.07.2020. – 108774; 1 female; S7.

*Cheilosia vulpina* (Meigen, 1822) (Eristalinae)

**Examined material:** 108780; 1 male; S3. – 108798; 1 male; S5. – 108797; 1 female; S4. – 108799; 1 male; 108796; 1 female; S13. – 108783, 108782; 2 males; S6; 31.07.2020. – 108781; 1 male; 108802; 1 female; S1; 01.08.2020.

*Chrysogaster solstitialis* (Fallén, 1817) (Eristalinae)

**Examined material:** 108234; 1 male; 108269, 108268; 2 females; S3. – 108236; 1 male; 10830-108232, 108240; 4 females; S6; 30.07.2020. – 108237, 108233; 2 males; 10841-108244; 4 females; S6; 31.07.2020; 108235; 1 male; S10. – 108267; 1 female; S9.

*Chrysotoxum arcuatum* (Linnaeus, 1758) (Syrphinae)

= *Chrysotoxum fasciatum* (Müller, 1764)

**Examined material:** 108548; 1 female; S6; 31.07.2020.

*Chrysotoxum bicinctum* (Linnaeus, 1758) (Syrphinae)

**Examined material:** 108549; 1 male; S11. – 108530; 1 female; S9.

*Chrysotoxum elegans* Loew, 1841 (Syrphinae)

**Examined material:** 108546; 1 male; S4; 108547; 1 male; S6; 30.07.2020. – 108545; 1 male; S6; 31.07.2020. – 108544; 1 male; S13.

*Chrysotoxum festivum* (Linnaeus, 1758) (Syrphinae)

**Examined material:** 108295; 1 female; S9.

*Chrysotoxum lessonae* Giglio Tos, 1890 (Syrphinae)

(Fig. 1)

**Examined material:** 108296-108298; 3 males; S12.

*Chrysotoxum volaticum* Séguy, 1961 (Syrphinae)

**Examined material:** 108531; 1 female; S14.

*Dasysyrphus albostrigatus* (Fallén, 1817) (Syrphinae)

**Examined material:** 108887; 1 female; S11; 108888; 1 male; S12. – 108885; 1 male; 108886; 1 female; S9.

*Episyrphus balteatus* (de Geer, 1776) (Syrphinae)

**Examined material:** 108834; 1 female; S5. – 108833; 1 male; S11.

*Eristalinus sepulchralis* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108208; 1 female; S1.

*Eristalinus taeniops* (Wiedemann, 1818) (Eristalinae)

**Examined material:** 108206; 1 male; S9.

*Eristalis arbustorum* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108170; 1 male; S13.

*Eristalis interrupta* (Poda, 1761) (Eristalinae)

= *Eristalis nemorum* Linnaeus, 1758

**Examined material:** 108211; 1 female; S6; 30.07.2020; 108212; 1 male; 01.08.2020. – 108149; 1 female; S5. – 108210; 1 female; S11. – 108142; 1 female; S12.

*Eristalis jugorum* Egger, 1858 (Eristalinae)

**Examined material:** 108152; 1 female; S8. – 108167; 1 male; S6; 30.07.2020. – 108311; 1 male; S6; 02.08.2020. – 108141, 108312, 108313; 3 females; S10.

*Eristalis lineata* (Harris, 1776) (Eristalinae)

= *Eristalis horticola* (de Geer, 1776)

**Examined material:** 108133; 1 female; S6; 30.07.2020.

*Eristalis pertinax* (Scopoli, 1763) (Eristalinae)

(Fig. 2A)

**Examined material:** 108143, 108144, 108148; 3 males; 108147; 1 female; S4. – 108150, 108216, 108215; 3 males; S1. – 108169; 1 male; S10. – 108158, 108214; 2 males; S6; 30.07.2020. – 108213; 1 male; 108140; 1 female; S6; 02.08.2020.



Fig. 2. Hoverfly species from Camprodon valley, Girona, Spain. (A) *Eristalis pertinax*, male, flowers of *Eupatorium cannabinum*, Setcases. (B) *Ferdinandea cuprea*, female, flowers of *Hypericum* sp., Vilallonga de Ter. (C) *Milesia crabroniformis*, male, Camprodon. Photos A, B by Antonio Ricarte, C by M. Carbonell.

***Eristalis similis*** (Fallén, 1817) (Eristalinae)

**Examined material:** 108131; 1 male; S3. – 108130; 1 female; S5. – 108145, 108146; 2 males; S4. – 108156; 1 male; 108137; 1 female; S7. – 108134, 108135, 108153, 108157, 108159; 5 males; 108136; 1 female; S6; 30.07.2020. – 108155; 1 male; S6; 31.07.2020. – 108151; 1 female; S1. – 108168; 1 male; S12; 01.08.2020. – 108543; 1 male; S14.

***Eristalis tenax*** (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108132, 108120; 2 males; S3; 108138; 1 male; 108154; 1 female; S7. – 108139; 1 male; S6; 30.07.2020.

***Eumerus grandis*** Meigen, 1822 (Eristalinae)

**Examined material:** 108275; 1 male; S6; 30.07.2020. – 108274; 1 male; S6; 02.08.2020.

***Eumerus ornatus*** Meigen, 1822 (Eristalinae)

**Examined material:** 108229; 1 male; 108222, 108223; 2 females; S12. – 108227; 1 male; 08221; 1 female; S6; 30.07.2020. – 108224-108226, 108228; 4 males; S6; 31.07.2020.

***Eupeodes corollae*** (Fabricius, 1794) (Syrphinae)

**Examined material:** 108832; 1 male; S7. – 108830, 108831; 2 females; S6; 30.07.2020. – 108849; 1 female; S11. – 108848; 1 female; S9.

***Eupeodes luniger*** (Meigen, 1822) (Syrphinae)

**Examined material:** 108844; 1 male; S6; 30.07.2020. – 108842, 108843; 2 males; S6; 31.07.2020. – 108841; 1 female; S11. – 108840; 1 male; S9.

***Eupeodes latifasciatus*** (Macquart, 1829) (Syrphinae)

**Examined material:** 108847; 1 male; S6; 02.08.2020.

***Ferdinandea cuprea*** (Scopoli, 1763) (Eristalinae)

(Fig. 2B)

**Examined material:** 108204, 108200; 2 males; 108218; 1 female; S12; 02.08.2020. – 108202; 1 female; S1; 01.08.2020; 108201; 1 male; S10. – 108219, 108217; 2 females; S9. – 108203; 1 male; S6; 02.08.2020.

***Helophilus pendulus*** (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108162; 1 female; S6; 31.07.2020. – 108161; 1 male; S4. – 108160, 108179; 2 males; 108178; 1 female; S5. – 108178; 1 female; S11.

***Lapposyrphus lapponicus*** (Zetterstedt, 1838)

(Syrphinae)

**Examined material:** 108845; 1 male; S6; 30.07.2020. – 108846; 1 male; S6; 31.07.2020.

***Leucozona glaucia*** (Linnaeus, 1758) (Syrphinae)

**Examined material:** 108884; 1 female; S6; 30.07.2020; on flowers of *Heracleum sphondylium*. – 108883;

1 female; S6; 31.07.2020; on flowers of *Heracleum sphondylium*.

*Melangyna compositarum* (Verrall, 1873) (Syrphinae)  
Examined material: 108869; 1 female; S6; 31.07.2020.

*Melangyna umbellatarum* (Fabricius, 1794)  
(Syrphinae)  
Examined material: 108850; 1 female; S10.

*Melanostoma mellinum* (Linnaeus, 1758) (Syrphinae)  
Examined material: 108520; 1 male; S3. – 108523, 108522; 2 females; S2. – 108539; 1 male; 108521; 1 female; S6; 30.07.2020.

*Melanostoma scalare* (Fabricius, 1794) (Syrphinae)  
Examined material: 108538; 1 male; 108533; 1 female; S3. – 108535; 1 male; 108534; 1 female; S5. – 108536, 108537; 2 males; 108532; 1 female; S6; 30.07.2020.

*Meligramma cincta* (Fallén, 1817) (Syrphinae)  
Examined material: 108868; 1 female; S7; 30.07.2020. – 108867; 1 female; S8. – 1088661; 1 female; S6; 31.07.2020.

*Meliscaeva auricollis* (Meigen, 1822) (Syrphinae)  
Examined material: 108863; 1 male; S2. – 108860, 108870, 108878; 3 males; 108861, 108862, 108871, 108876, 108879; 5 females; S6; 30.07.2020. – 108874; 1 female; S6; 31.07.2020. – 108875; 1 female; S6; 01.08.2020. – 108877, 108889; 2 males; S7. – 108873, 108872; 2 females; S8.

*Meliscaeva cinctella* (Zetterstedt, 1843) (Syrphinae)  
Examined material: 108865; 1 female; S7. – 108864; 1 male; S6; 31.07.2020.

*Myathropa florea* (Linnaeus, 1758) (Eristalinae)  
Examined material: 108165; 1 male; 108166, 108164; 2 females; S4. – 108163; 1 male; S6; 30.07.2020. – 108205; 1 male; S1.

*Orhonevra nobilis* (Fallén, 1817) (Eristalinae)  
Examined material: 108263; 1 male; S6; 30.07.2020. – 108265, 108264; 2 males; S6; 31.07.2020.

*Paragus haemorrhous* Meigen, 1822 (Syrphinae)  
Examined material: 108836; 1 male; S12; 02.08.2020. – 108835; 1 male; S6; 30.07.2020.

*Paragus pecchiolii* Rondani, 1857 (Syrphinae)  
Examined material: 108837; 1 male; S12; 02.08.2020.

*Paragus tibialis* (Fallén, 1817) (Syrphinae)  
Examined material: 108821-108823, 108838, 108839; 5 males; S3.

*Parasyrphus vittiger* (Zetterstedt, 1843) (Syrphinae)  
Examined material: 108510, 108524; 2 males; 108525-108529; 5 females; S7.

*Pipiza festiva* Meigen, 1822 (Pipizinae)  
Examined material: 108273; 1 male; S9.

*Pipiza noctiluca* (Linnaeus, 1758) (Pipizinae)  
Examined material: 108272; 1 male; S6; 30.07.2020.

*Pipizella viduata* (Linnaeus, 1758) (Pipizinae)  
Examined material: 108288; 1 male; 108287, 108285, 108284; 3 females; S6; 31.07.2020. – 108286; 1 male; S6; 30.07.2020. – 108282, 108281; 2 males; 108283, 108280, 108299; 3 females; S10.

*Platycheirus albimanus* (Fabricius, 1781) (Syrphinae)  
Examined material: 108515; 1 male; S7. – 108514; 1 male; S6; 30.07.2020. – 108513; 1 male; S6; 02.08.2020. – 108511; 1 female; S13. – 108512; 1 male; S9.

*Scaeva dignota* (Rondani, 1857) (Syrphinae)  
Examined material: 108882; 1 male; S9.

*Scaeva pyrastris* (Linnaeus, 1758) (Syrphinae)  
Examined material: 108516; 1 female; S6; 30.07.2020. – 108518; 1 female; S14. – 108517; 1 female; S9.

*Scaeva selenitica* (Meigen, 1822) (Syrphinae)  
Examined material: 108519; 1 male; S6; 31.07.2020. – 108880; 1 female; S6; 02.08.2020. – 108881; 1 female; S9.

*Sericomyia bombiforme* (Fallén, 1810) (Eristalinae)  
Examined material: 108172, 108171; 2 males; S6; 30.07.2020. – 108180; 1 male; 108181; 1 female; S12, on flowers of *Knautia* sp.; 02.08.2020.

*Sphaerophoria scripta* (Linnaeus, 1758) (Syrphinae)  
Examined material: 108854; 1 female; S2. – 108853; 1 male; S5.

*Sphegina elegans* Schummel, 1843 (Eristalinae)  
Examined material: 108266; 1 male; S10; 01.08.2020.

*Spilomyia manicata* (Rondani, 1865) (Eristalinae)  
Examined material: 108189; 1 male; S6; 30.07.2020; on flowers of *Heracleum sphondylium*.

*Syritta pipiens* (Linnaeus, 1758) (Eristalinae)  
Examined material: 108198, 108199; 2 males; S3; 108197; 1 male; S5.

*Syrphus ribesii* (Linnaeus, 1758) (Syrphinae)  
Examined material: 108315; 1 male; S3; 108316; 1 female; S7. – 108314; 1 female; S6; 02.08.2020.



*Syrphus torvus* Osten-Sacken, 1875 (Syrphinae)

**Examined material:** 108302, 108301; 2 males; 108304-108306; 3 females; S7. – 108300, 108317, 108318; 3 males; 108303, 108319; 2 females; S6; 30.07.2020.

*Syrphus vitripennis* Meigen, 1822 (Syrphinae)

**Examined material:** 108307; 1 male; S4. – 108308; 1 female; S7. – 108309; 1 female; S13.

*Triglyphus primus* Loew, 1840 (Pipizinae)

**Examined material:** See Ricarte & Nedeljković (2020).

*Volucella bombylans* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108177; 1 female; S3.

*Volucella inanis* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108176; 1 male; S6; 31.07.2020. – 108187; 1 male; S6; 01.08.2020. – 108185, 108184; 2 males; S10. – 108186; 1 male; S12; 02.08.2020.

*Volucella pellucens* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108173; 1 male; 108175; 1 female; S8; 108174; 1 female; S6; 31.07.2020. – 108182; 1 female; S12; 02.08.2020.

*Volucella zonaria* (Poda, 1761) (Eristalinae)

**Examined material:** 108183; 1 male; S6; 01.08.2020.

*Xanthandrus comtus* (Harris, 1776) (Syrphinae)

**Examined material:** 108858, 108859; 2 females; S6; 31.07.2020. – 108857; 1 female; S6; 02.08.2020. – 108856; 1 male; 108855; 1 female; S12; 02.08.2020.

*Xanthogramma citrofasciatum* (de Geer, 1776)  
(Syrphinae)

**Examined material:** 108292; 1 female; S12; 02.08.2020. – 108294, 108293; 2 males; S14.

*Xanthogramma dives* (Rondani, 1857) (Syrphinae)

**Examined material:** 108290; 1 male; S10. – 108291; 1 male; S9.

*Xylota segnis* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108191, 108195; 2 males; 108194; 1 female; S6; 31.07.2020. – 108192, 108193; 2 males; S6; 02.08.2020.

*Xylota sylvarum* (Linnaeus, 1758) (Eristalinae)

**Examined material:** 108196; 1 male; S6; 31.07.2020.

*Xylota tarda* Meigen, 1822 (Eristalinae)

**Examined material:** 108190; 1 female; S9. – 108209; 1 male; S12; 02.08.2020.

### Taxonomic and faunistic assessment of the new hoverfly records from Camprodon valley

Excluding the records of *Triglyphus primus* Loew, 1840, which represented the first finding of this genus from Spain (Ricarte & Nedeljković, 2020), one (*Chrysotoxum lessonae*) species is new to the Iberian Peninsula, 19 are new to Catalonia, and 23 to GI. First documented records from Spain and the Iberian Peninsula are given for *Cheilosia hypena* and *Xylota tarda*, respectively, meaning that their presence in Spain and the Iberian Peninsula was previously reported in the literature, but without locality details (Appendix).

A total of 81 hoverfly species of 38 genera were identified. The two main subfamilies (Eristalinae and Syrphinae) had a similar number of genera recorded (16 and 19 respectively). Of all genera, 34 were represented by only 1-3 species, while the genus *Cheilosia* Meigen, 1822 had the highest number of species in the study (13 spp.), followed by *Eristalis* Latreille, 1804 (7 spp.) and *Chrysotoxum* Meigen, 1803 (6 spp.).

Taking into consideration the altitudinal zoning indicated in the study area section and Table 1, most species represented in the study were absent from the subalpine zone, where the only exclusive species was *Parasyrphus vittiger*. All species except *P. vittiger* were found in the montane zone. Twelve species were shared between the two sampled altitudinal zones (Fig. 3).

### Hoverfly checklist of the Girona province (Table 2)

See the meaning of the locality and reference codes in the Material and Methods section.

Species	Locality (reference/s)
<i>Baccha elongata</i> = <i>Baccha obscuripennis</i> = <i>Baccha obscuripennis</i>	L1 (1; 4; 6), L12, L27 (present study)
<i>Ceriana conopsoides</i>	L27 (present study)
<i>Ceriana vespiformis</i>	L19 (6)
<i>Cheilosia aerea</i>	L27 (present study)
<i>Cheilosia albitarsis</i>	L19, L23 (5; 6)
<i>Cheilosia barbata</i>	L27, L32 (present study)
<i>Cheilosia flavipes</i>	L5 (5; 6)
<i>Cheilosia fraterna</i>	L18, L19 (5; 6)
<i>Cheilosia impressa</i>	L19 (5; 6)
<i>Cheilosia hypena</i>	L4, L12, L27, L32 (present study)
<i>Cheilosia illustrata</i>	L27 (present study)
<i>Cheilosia laticornis</i>	L14 (15), L27 (present study)
<i>Cheilosia latifrons</i>	L4, L27, L32 (present study)
<i>Cheilosia longula</i>	L32 (present study)
<i>Cheilosia mutabilis</i>	L17 (7)

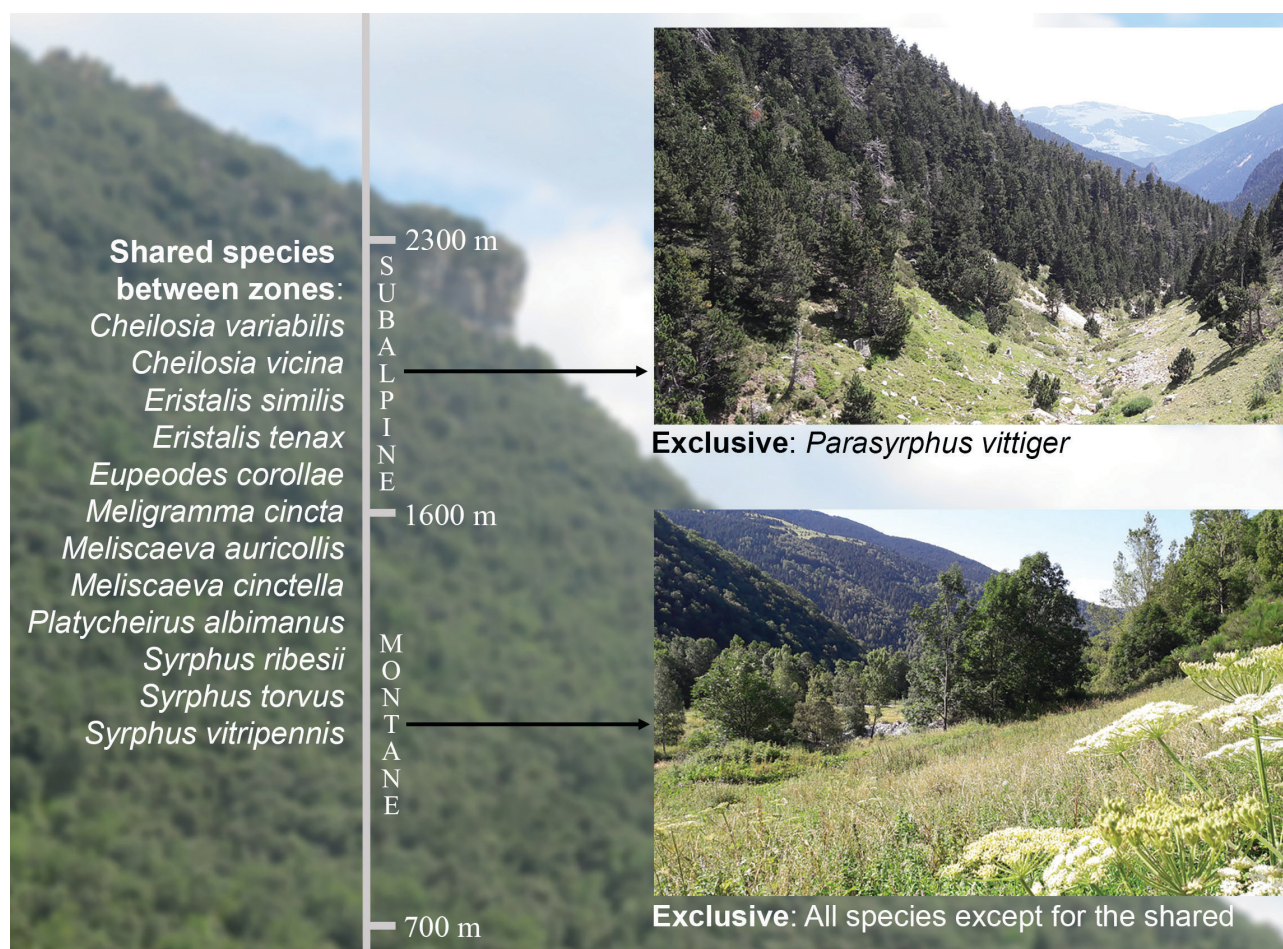


Fig. 3. Distribution of hoverfly species by altitudinal zones (subalpine and montane) from the catch in Camprodon valley, eastern Pyrenees (Spain) in July/August 2020. For each zone, an on-site picture of the representative landscape/vegetation is shown. Species shared between zones are listed on left. Species exclusive of each zone on right.

Species	Locality (reference/s)	Species	Locality (reference/s)
<i>Cheilosia personata</i>	L32 (12)	<i>Chrysogaster solstitialis</i>	L1, L6 (6), L12, L27, L32 (present study) <i>Notes.</i> Cuní (1880, 1881) listed <i>C. coemiteriorum</i> from Arbucias and Cerdaña, but Gil Collado (1930) listed instead <i>C. solstitialis</i> from these two localities, and <i>C. coemiteriorum</i> (as <i>C. chalybeata</i> ) only from Setcases. Here, we follow Gil Collado (1930) until Cuní's material can be studied.
<i>Cheilosia proxima</i>	L12 (present study)	<i>Chrysotoxum arcuatum</i>	L27 (present study)
<i>Cheilosia scutellata</i>	L7 (3; 4; 6), L12, L27 (present study)	<i>Chrysotoxum bicinctum</i>	L27 (19), L32 (present study)
<i>Cheilosia soror</i>	L14 (15), L19 (5)	<i>Chrysotoxum elegans</i>	L12, L27, L32 (present study)
<i>Cheilosia variabilis</i>	L27 (present study)	<i>Chrysotoxum festivum</i>	L32 (present study)
<i>Cheilosia vernalis</i>	L27 (present study), L31 (5; 6), L32 (present study)	<i>Chrysotoxum intermedium</i>	L8 (8)
<i>Cheilosia vicina</i>	L27 (present study)	<i>Chrysotoxum lessonae</i>	L32 (present study)
<i>Cheilosia vulpina</i>	L12 (present study), L19 (5; 6), L27, L32 (present study).		
<i>Chrysogaster coemiteriorum</i> = <i>Chrysogaster chalybeata</i>	L1 (4), L27 (5; 6)		

Species	Locality (reference/s)	Species	Locality (reference/s)
<i>Chrysotoxum volaticum</i>	L15, L20, L25 (19), L32 (present study)	<i>Lejogaster tarsata</i>	L3 (3; 4; 6)
<i>Dasysyrphus albostrigatus</i> = <i>Syrphus albostrigatus</i> var. <i>confusus</i>	L31 (5; 6), L32 (present study)	= <i>Chrysogaster splendidus</i> = <i>Chrysogaster (Liogaster) splendida</i>	
<i>Episyrphus balteatus</i> = <i>Syrphus balteatus</i>	L12 (present study), L17 (7), L21 (3), L32 (present study)	<i>Leucozona glauca</i>	L27 (present study), L30 (18)
<i>Eristalinus aeneus</i> = <i>Eristalis aeneus</i> = <i>Eristalis (Lathyrrophthalmus) aeneus</i>	L21 (3), L8 (8), L19, L21 (6)	<i>Melangyna compositarum</i>	L27 (present study)
<i>Eristalinus sepulchralis</i> = <i>Eristalis sepulchralis</i>	L4 (present study), L9, L10, L29 (7)	<i>Melangyna umbellatarum</i>	L32 (present study)
<i>Eristalinus taeniops</i>	L32 (present study)	<i>Melanostoma mellinum</i> = <i>Melanostoma mellina</i>	L1 (1; 6), L3, L21 (3; 6), L6 (2; 6), L12, L27 (present study)
<i>Eristalis arbustorum</i>	L6 (2), L32 (present study), L34 (8)	<i>Melanostoma scalare</i> = <i>Melanostoma gracilis</i>	L1 (1; 6), L6 (2; 6), L12, L27 (present study), L31 (5; 6)
<i>Eristalis lineata</i> = <i>Eristalis horticola</i>	L4 (6), L27 (present study), L31 (5; 6)	<i>Meligramma cincta</i>	L27 (present study)
<i>Eristalis interrupta</i>	L12, L27, L32 (present study)	<i>Meliscaeva auricollis</i>	L12, L27 (present study)
<i>Eristalis jugorum</i>	L27, L32 (present study)	<i>Meliscaeva cinctella</i>	L27 (present study)
<i>Eristalis pertinax</i>	L4, L12, L32 (present study)	<i>Merodon avidus</i> A sensu Marcos-García <i>et al.</i> (2007)	L13 (14)
<i>Eristalis similis</i>	L4, L12, L27, L32 (present study)	<i>Merodon clavipes</i>	L24 (4)
<i>Eristalis tenax</i>	L1 (1), L12 (present study), L3 (3), L6 (2), L27 (present study)	<i>Merodon funestus</i>	L33 (14)
<i>Eumerus grandis</i>	L27 (present study)	<i>Merodon rufus</i>	L5, L20, L27 (16)
<i>Eumerus ornatus</i>	L27, L32 (present study)	<i>Merodon unguicornis</i>	L27 (14)
<i>Eumerus ovatus</i> = <i>Eumerus bicolor</i>	L24 (4; 6)	<i>Milesia crabroniformis</i> (Fig. 2C)	L1 (1; 4), L4 (present study)
<i>Eumerus sogdianus</i>	L20, L32 (9)	<i>Myathropa florea</i> = <i>Helophilus floreus</i> = <i>Myiathropa florea</i>	L3 (3; 6), L4 (present study), L6 (2; 6), L12 (present study), L17 (7), L27 (present study), L31 (5)
<i>Eupeodes corollae</i> = <i>Syrphus corollae</i> var. <i>fulvifrons</i>	L27, L32 (present study), L31 (5; 6)	<i>Neoascia podagrica</i>	L19 (6)
<i>Eupeodes latifasciatus</i>	L27 (present study)	<i>Orhtonevra nobilis</i>	L27 (present study)
	<i>Notes.</i> Marcos-García <i>et al.</i> (1998) also reports this species from the province of Girona as a pers. com. of Levy.	<i>Paragus albifrons</i>	L1 (1; 4; 6)
<i>Eupeodes luniger</i> = <i>Syrphus luniger</i>	L4 (6), L27 (present study), L31 (5), L32 (present study)	<i>Paragus haemorrhous</i> = <i>P. tibialis</i> var. <i>trianguliferus</i>	L31 (5; 6), L32 (present study)
	<i>Notes.</i> Although this species was reported from Viladrau by Andreu (1926), Gil Collado (1930) omits this record for reasons unknown to us.	<i>Paragus pecchiolii</i> = <i>P. majoranae</i>	L8 (13), L32 (present study)
<i>Ferdinandea cuprea</i>	L4, L27, L32 (present study)	<i>Paragus strigatus</i>	Unknown. <i>Notes.</i> Marcos-García <i>et al.</i> (1998) reports this species from the province of Girona as a pers. com. of Levy. The record from Palafolls (Barcelona province) by van Eck (2010) is here excluded, because it was incorrectly linked to the Girona province.
<i>Helophilus trivittatus</i>	L10 (7), L19 (6)	<i>Paragus tibialis</i>	L1 (1; 6), L4 (6), L12 (present study), L21 (3; 6)
<i>Helophilus pendulus</i>	L12, L27, L32 (present study)	<i>Parasyrphus vittiger</i>	L27 (present study)
<i>Lapposyrphus lapponicus</i>	L27 (present study)	<i>Pipiza festiva</i>	L32 (present study)
<i>Lejogaster metallina</i> = <i>Chrysogaster (Liogaster) metallina</i>	L6 (2; 6)	<i>Pipiza noctiluca</i>	L27 (present study)
		<i>Pipizella annulata</i>	L16 (17)
		<i>Pipizella brevis</i>	L16 (9; 17)
		<i>Pipizella pennina</i> = <i>Pipizella microapicalis</i>	L15, L27, L32 (9; 17)

Species	Locality (reference/s)
<i>Pipizella viduata</i>	L27, L32 (present study)
<i>Pipizella zeneggenensis</i> = <i>Pipizella lata</i>	L4, L11, L18, L22 (10), L27 (10; 17), L32 (10)
<i>Platycheirus albimanus</i>	L27, L32 (present study)
<i>Platycheirus ambiguus</i> = <i>Melanostoma ambigua</i> = <i>Melanostoma ambiguum</i>	L3 (3; 6)
<i>Platycheirus fulviventris</i>	Unknown. <i>Notes.</i> Marcos-García <i>et al.</i> (1998) reports this species from the province of Girona as a pers. com. of Levy.
<i>Platycheirus manicatus</i>	L16 (5; 6)
<i>Riponnensia splendens</i> = <i>Chrysogaster splendens</i>	L31 (5; 6)
<i>Scaeva dignota</i>	L32 (present study)
<i>Scaeva pyrastris</i> = <i>Catabomba pyrastris</i> = <i>Lasyophiticus pyrastris</i> = <i>Syrphus pyrastris</i>	L5 (5; 6), L6 (2; 6), L27, L32 (present study), L34 (8)
<i>Scaeva selenitica</i> = <i>Catabomba selenitica</i> = <i>Lasyophiticus seleniticus</i>	L27 (present study), L31 (5; 6), L32 (present study)
<i>Sericomyia bombiforme</i>	L27, L32 (present study)
<i>Sphaerophoria interrupta</i> = <i>Melithreptus menthastri</i> = <i>Sphaerophoria menthastri</i>	L1 (1; 6), L6 (2; 4; 6)
<i>Sphaerophoria laurae</i>	L5, L16 (11)
<i>Sphaerophoria rueppellii</i> = <i>S. flavicauda</i>	L17 (7), L31 (5; 6)
<i>Sphaerophoria scripta</i> = <i>Melithreptus scriptus</i> = <i>S. scripta</i> (var. <i>nigricoxa</i> , var. <i>nitidicollis</i> , var. <i>scripta</i> )	L9 (7), L12 (present study), L17 (7), L21 (3), L26, L29 (7), L31(5), L34 (8)
<i>Sphaerophoria taeniata</i> = <i>Melithreptus taeniatus</i> = <i>Sphaerophoria menthastri</i> var. <i>taeniata</i>	L6 (2; 6)
<i>Sphegina elegans</i>	L32 (present study)
<i>Spilomyia manicata</i>	L27 (present study)
<i>Syrirta pipiens</i>	L1 (1), L6 (2), L12 (present study)
<i>Syrphus excisus</i>	L19 (6), L28 (5)
<i>Syrphus ribesii</i>	L6 (2; 6), L12, L27 (present study)
<i>Syrphus torvus</i>	L27 (present study)
<i>Syrphus vitripennis</i> = <i>S. ribesii</i> var. <i>vitripennis</i>	L12 (present study), L27 (present study), L31 (5; 6), L32 (present study)
<i>Triglyphus primus</i>	L27 (20)
<i>Volucella bombylans</i> = <i>V. bombylans</i> var. <i>plumata</i>	L12 (present study), S27 (5; 6)
<i>Volucella elegans</i>	L31 (6)

Species	Locality (reference/s)
<i>Volucella inanis</i>	L6 (2; 6), L27 (present study), L31 (5; 6), L32 (present study)
<i>Volucella pellucens</i>	L27, L32 (present study)
<i>Volucella zonaria</i>	L1 (1), L3 (3), L6 (2), L27 (present study)
<i>Xanthandrus comtus</i>	L27, L32 (present study)
<i>Xanthogramma citrofasciatum</i> = <i>Xanthogramma festiva</i>	L4 (6), L32 (present study)
<i>Xanthogramma dives</i>	L2 (14), L32 (present study). <i>Notes.</i> For this species, we follow the criteria of Ricarte & Marcos-García (2017), who consider as valid only the identifications of <i>X. dives</i> after Speight & Sommaggio (2010).
<i>Xylota segnis</i>	L27 (present study)
<i>Xylota sylvarum</i>	L27 (present study)
<i>Xylota tarda</i>	L32 (present study)

#### Doubtful records

*Platycheirus europaeus* Goeldlin de Tiefenau, Maibach & Speight, 1990  
*Notes.* Speight (2020) states that *P. europaeus* is present in Spain, without further precision. Dirickx (1994) provides a distribution map for this species with a presence dot in Catalonia, but the position of this dot is also imprecise.

*Sphegina clavata* (Scopoli, 1763) & *Sphegina chunipes* (Fallén, 1816)  
*Notes.* Thompson & Torp (1986) and Dirickx (1994) each provide a distribution map with a presence dot in Catalonia for these two species. The position of this dot is imprecise, but is likely to be within the province of Girona.

*Sphegina elegans*  
*Notes.* Thompson & Torp (1986) provide a distribution map with a presence dot in Catalonia, very close to the French/Spanish border, and apparently in the Girona province. However, Dirickx (1994) provides a different map without the above-mentioned dot, but with another dot clearly placed on the French side of the Pyrenees. Provenance data for examined material would be necessary to discern whether the dots in Thompson & Torp (1986) and Dirickx (1994) are the same or not.

#### DISCUSSION

As a result of this short survey in the Camprodon valley, 81 hoverfly species were identified, including *T. primus*, the discovery of which was reported by Ricarte & Nedeljković (2020). The number of known species to this valley now stands at 85, plus *Milesia crabroniformis* (Fabricius, 1775), which is known to the authors of the present paper by a photo taken in Camprodon, on 4 October 2020, by M. Carbonell (Fig. 2C). In addition,

there are also records of a species of *Merodon* Meigen, 1803 and a species of *Rhingia* Scopoli, 1763 collected in the course of this fieldwork but not included in the Results because they are still under taxonomic scrutiny (Ricarte *et al.*, in prep.). In total, 88 species are known for the Camprodon valley. The checklist of hoverflies from the Girona province expands from 73 to 119 species as a result of the new records from Camprodon valley. Girona is now one of the best-known Spanish provinces in terms of number of hoverfly species recorded (Ricarte & Marcos-García, 2017).

Leclercq (1971) provided records of 49 hoverflies collected in the Pyrenees, mainly of the Huesca province, from July/August, i.e. the same period of the year when our sampling took place. More than half (55%) of the species reported by Leclercq (1971) and all genera were shared with our 2020 list. *Cheilosia* was the genus with the highest number of species reported by Leclercq (1971). From the seven *Cheilosia* species reported by him, just one was shared with the 2020 sampling in Camprodon. On the one hand, differences in species composition might be due to the fact that many species of Leclercq (1971) were collected in early July, whilst the 2020 sampling was in late July. On the other hand, detected differences in species composition may actually respond to differences between the surveyed Pyrenean valleys and habitats of Huesca and Girona. Specifically, *Cheilosia* hoverflies are known to be sensible to changes in the woodland landscape (Popov *et al.*, 2017), in part because their larvae, according to species, feed on different plants and fungi (Rotheray, 1993).

From the 81 species reported from the Camprodon valley in 2020, eight were saproxylic, i.e. with larvae dependent on trees (*Ceriana* Rafinesque, 1815, *Ferdinandea* Rondani, 1844, *Myathropa* Rondani, 1845, *Sphegina* Sack, 1928, *Spilomyia* Meigen, 1803, and *Xylota* Meigen, 1822). The proportion of saproxylic species (11%) is unexpectedly low from the Camprodon valley, where forests form a significant element of the vegetation. Although the present study only provides a partial overview of the hoverfly biodiversity of the Camprodon valley, we suggest that land use changes due to the expansion of urban areas and the road network, as well as promotion of agricultural and tourism activities may have had an effect in the woodlands of this popular valley, with reduction of forest cover (mainly in the lower parts of the valley, and around the ski resort), and mature trees becoming scarcer and more isolated; mature trees are crucial for the development of a rich saproxylic community (Micó, 2018).

Hoverfly genera with aquatic larvae such as *Eristalis* Latreille, 1804 (Rotheray, 1993) appear to flourish in the montane ecosystem of the valley (e.g. 7 species of *Eristalis*), where water courses are abundant and water flow is slower than at higher altitudes. In these conditions, breeding sites for *Eristalis* are abundant. However, in the subalpine zone, only *Eristalis similis* and

the cosmopolitan *Eristalis tenax* were reported, possibly due to the lower availability of breeding sites in this altitudinal zone of the valley. In the subalpine zone, water courses are smaller and their water flow is faster, due to steeper slopes (pers. obs. of Antonio Ricarte). The only hoverfly species found exclusively in the subalpine was *P. vittiger* (Fig. 3), being in accordance with its preferred environment, the conifer forest, which is dominant at these altitudes (Sacasas-i-Lluís, 2009). The larva of *P. vittiger* feeds mainly on conifer aphids and this is why its presence is correlated with conifers. Nonetheless, *P. vittiger* can occasionally be found in deciduous forest (Speight, 2020).

The genus with the highest number of species found was *Cheilosia*. Hoverflies of this genus prefer mountains, forests and the proximity of rivers and streams (Vujić, 1996), just as in the Camprodon valley. The only species of *Cheilosia* found in the subalpine zone were *C. variabilis* and *C. vicina*, both already recorded from the Pyrenees of Huesca province (Leclercq, 1971; Marcos-García, 1985). The species *C. vicina* belongs to the subgenus *Nigrocheilosia* Shatalkin, 1975, which is typical of high altitudes (Vujić, 1996). *Cheilosia variabilis* is an abundant species in southern parts of its range and occurs in a wide variety of forest types (Vujić, 1996). In addition, the presence of *Cheilosia hypena* is here confirmed from the Spanish Pyrenees. Speight (2020) mentioned that this species was present in this massif but there was no published record from Spain known to us. The finding of *Cheilosia proxima* is also important from a faunistic point of view. Séguy (1961) indicated that this species was present in Catalonia, but without further precision. Apart from this, the only published records of *C. proxima* known to us are from the León and Guipúzcoa provinces (Marcos-García, 1989, 1990a, b; Kehlmaier, 2002). Records of other *Cheilosia* species such as *C. vulpina*, which were previously reported only from 4-5 provinces of Spain (Ricarte & Marcos-García, 2017), are also important to better understand the true distribution of these species in the Iberian Peninsula.

Even though the 2020 sampling was short, faunistic results were remarkable in comparison with studies using longer periods of hand-net sampling in other parts of Spain. For example, in Cabañeros National Park, 82 species were collected by hand-netting during 468 hours of sampling in 13 months (Ricarte & Marcos-García, 2008). The reasons for such a similar result after such different sampling efforts might be due to the sampling designs, which resulted from different research aims, but could also be due to an effect of the diversity of the hoverfly community in each study area. Nonetheless, the results presented here suggest that short surveys conducted by experienced collectors during periods of high insect activity may suffice in the purpose of rapidly evaluating the biodiversity interest of a poorly studied area and/or for taking quick conservation decisions in threatened ecosystems or insect groups with well known

requirements. Further fieldwork in other periods of the year are necessary to complete the inventory of species present in the biodiverse Camprodon valley.

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## APPENDIX

First faunistic data on the hoverflies from the eastern Pyrenees of Girona province (Spain) collected in July/August 2020. (\*) indicates the first documented record of a species for a geographical unit, i.e. the species was known from a geographical unit but without further locality details and this is the first time that locality details are provided. *Triglyphus primus* is omitted from this list because its records were advanced in a different publication.

	Nested geographical units in ascending order				
	New to:	Girona	Catalonia	Spain	Iberian Pen.
<i>Chrysotoxum lessonae</i>		■	■	■	■
<i>Xylota tarda</i> *		■	■	■	■
<i>Cheilosia hypena</i> *		■	■	■	
<i>Ceriana conopsoides</i>		■	■		
<i>Cheilosia aerea</i>		■	■		
<i>Cheilosia barbata</i>		■	■		
<i>Cheilosia illustrata</i>		■	■		
<i>Cheilosia longula</i>		■	■		
<i>Cheilosia proxima</i> *		■	■		
<i>Cheilosia vicina</i>		■	■		
<i>Chrysotoxum arcuatum</i>		■	■		
<i>Chrysotoxum elegans</i>		■	■		
<i>Eristalis similis</i>		■	■		
<i>Eumerus grandis</i>		■	■		
<i>Eumerus ornatus</i>		■	■		
<i>Helophilus pendulus</i>		■	■		
<i>Melangyna umbellatarum</i>		■	■		
<i>Meligramma cincta</i>		■	■		
<i>Meliscaeva cinctella</i>		■	■		
<i>Sericomyia bombiforme</i>		■	■		
<i>Scaeva dignota</i>		■	■		
<i>Sphegina elegans</i> *		■	■		
<i>Cheilosia latifrons</i>		■			
<i>Cheilosia variabilis</i>		■			

	Nested geographical units in ascending order				
	New to:	Girona	Catalonia	Spain	Iberian Pen.
<i>Chrysotoxum festivum</i>		██████████			
<i>Eristalinus taeniops</i>		██████████			
<i>Eristalis interrupta</i>		██████████			
<i>Eristalis jugorum</i>		██████████			
<i>Eristalis pertinax</i>		██████████			
<i>Ferdinandea cuprea</i>		██████████			
<i>Lapposyrphus lapponicus</i>		██████████			
<i>Melangyna compositarum</i>		██████████			
<i>Meliscaeva auricollis</i>		██████████			
<i>Orthonevra nobilis</i>		██████████			
<i>Parasyrphus vittiger</i>		██████████			
<i>Pipiza festiva</i>		██████████			
<i>Pipiza noctiluca</i>		██████████			
<i>Pipizella viduata</i>		██████████			
<i>Platycheirus albimanus</i>		██████████			
<i>Spilomyia manicata</i>		██████████			
<i>Syrphus torvus</i>		██████████			
<i>Volucella pellucens</i>		██████████			
<i>Xanthandrus comtus</i>		██████████			
<i>Xylota segnis</i>		██████████			
<i>Xylota sylvarum</i>		██████████			