

NEW DATA ON THE DISTRIBUTION OF *LIPARA* MEIGEN, 1830 (DIPTERA: CHLOROPIDAE) AND ITS GALL-INQUILINE CHLOROPIDS IN THE IBERIAN PENINSULA

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ABSTRACT

The genus *Lipara* Meigen, 1830 (Diptera: Chloropidae) is known for its ability to induce galls in *Phragmites australis* (Cav.) Trin. ex Steud., 1841 (Poaceae). Such galls are important microhabitats that give a resource to other Chloropid species that live in them. In the Iberian Peninsula, the *Lipara* galls and their associated fauna remain unstudied. Here, new records of *Lipara lucens* Meigen, 1830, *L. similis* Schiner, 1854 and their gall inquilines, *Calamoncosis minima* (Strobl, 1893) and *Cryptonevra flavitarsis* (Meigen, 1830) in the Iberian Peninsula are presented, combining both, field sampling and photosharing website information. *Lipara lucens*, *C. minima* and *Cr. flavitarsis* are recorded for the first time from the Spanish mainland. Although they are an overlooked group of species, they seem to be widespread in the Iberian Peninsula.

Key words: *Calamoncosis minima*; photosharing; Chloropidae; *Cryptonevra flavitarsis*; Diptera; gall-inquilines; Iberian Peninsula; *Lipara*; new records.

RESUMEN

Nuevos datos sobre la distribución de *Lipara* Meigen, 1830 (Diptera: Chloropidae) y sus clorópidos inquilinos en la península ibérica

El género *Lipara* Meigen, 1830 (Diptera: Chloropidae) tiene la capacidad de inducir agallas en *Phragmites australis* (Cav.) Trin. ex Steud., 1841 (Poaceae). Dichas agallas son microhábitats importantes que aportan recursos a otros clorópidos que viven dentro de ellas. En la península ibérica, las agallas de *Lipara* y la fauna asociada no han sido bien estudiadas. En este trabajo se recogen nuevas citas de *Lipara lucens* Meigen, 1830, *L. similis* Schiner, 1854 y sus inquilinos, *Calamoncosis minima* (Strobl, 1893) y *Cryptonevra flavitarsis* (Meigen, 1830) en la península ibérica, combinando muestreos en campo, con información disponible en portales fotográficos. Se citan por primera vez en la España peninsular *L. lucens*, *C. minima* y *Cr. flavitarsis*. A pesar de que son un grupo que ha sido poco estudiado, estas especies parecen estar ampliamente distribuidas por la península ibérica.

Palabras clave: *Calamoncosis minima*; Chloropidae; *Cryptonevra flavitarsis*; Diptera; inquilinos de agallas; *Lipara*; península ibérica; portales fotográficos; nuevas citas.

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Introduction

Grass-flies (Diptera: Chloropidae) are a widely distributed Diptera family occupying a vast range of habitats, although most species prefer open habitats such as grasslands and wetlands (Nartshuk & Andersson, 2013; Nartshuk, 2014) and most of them live on Poaceae and Cyperaceae (Nartshuk, 2014). There are many studies about this group in Europe, some of them focused on the Mediterranean region (Collin, 1946; De Bruyn, 1989; Nartshuk, 2004, 2011, 2012, 2013; Nartshuk & Andersson, 2013), although the knowledge of the chloropid fauna of the Iberian Peninsula remains incomplete (De Bruyn, 1999; De Bruyn & Báez, 2002; Nartshuk, 2004; Nartshuk *et al.*, 2013; Ebejer & Andrade, 2015).

Among Chloropidae genera, *Lipara* Meigen, 1830 has attracted the attention of entomologists for its ability to induce cigar-like apical galls on *Phragmites australis* (Cav.) Trin. ex Steud., 1841 (Poaceae) (Chvála *et al.*, 1974). There are four recognized species in Europe: *L. lucens* Meigen, 1830, *L. pullitarsis* Doskočil & Chvála, 1971, *L. rufitarsis* Loew, 1858 and *L. similis* Schiner, 1854. Their biology, taxonomy, ecology and distribution has been well studied in Europe (Mook, 1967; Chvála *et al.*, 1974; De Bruyn, 1987; Grochowska, 2006, 2007, 2013; Nartshuk, 2013), although, up to now, there are few records in the Iberian Peninsula and the Balearic Islands. Thus, Nartshuk (2004) recorded for the first time the genus *Lipara* (*L. similis*) in the Province of Castellón (Spain). Later, Ebejer (2006) cited *L. lucens*, *L. rufitarsis* and *L. similis* in Mallorca (Balearic Islands, Spain) and finally, Ebejer & Andrade (2015) recorded *L. lucens* from the district of Aveiro (Portugal). Thereby, the knowledge of *Lipara* species distribution and biology in the Iberian Peninsula remains inadequate.

Its life cycle is well understood (Chvála *et al.*, 1974), as well as the development of the gall (Vandevyvere & De Bruyn, 1998). All *Lipara* species are univoltine and lay the eggs on *P. australis* leaves. After hatching, the phytophagous first instar larvae climbs to the stem apex and installs itself in the upper rolled leaves of the stem. The larva feeds on the enrolled leaves, starting the gall induction. Thereby, the newly formed internodes are shortened and thickened (Figs. 2C-D). In the case of *L. lucens* and *L. pullitarsis*, once the gall is completely developed, the third-instar larvae gnaws through the shoot apical meristem and feeds on the hypertrophied parenchyma. On the other hand, *L. rufitarsis* and *L. similis*, remain in the upper rolled and hardened leaves and feed on the panicle. Finally, the larva goes into diapause inside the gall until next spring, when it pupariates and later the adult emerges.

The galls of *Lipara*, especially those of *L. lucens*, also serve as microhabitats and important refuges for other chloropids and other insects such as Hymenoptera, Coleoptera or Lepidoptera (De Bruyn, 1985; Nartshuk & Andersson, 2013;

Heneberg *et al.*, 2014; Bogusch *et al.*, 2015, 2016; Astapenková *et al.*, 2017).

Materials and Methods

As galls are the extended phenotype of the cecidogenic organism (Stone & Schönrogge, 2003), it is enough to sample galls induced by *Lipara* in *P. australis* in order to identify the species. In this way, it is also possible to find the associated chloropids living as inquiline in those galls. Between January and October of 2017, one-year-old galls were sampled in several localities throughout Spain (Table 1). They were kept individually in Petri dishes at room temperature until adult fly emergence. The galls were identified using the key of Chvála *et al.* (1974), and the chloropids inhabiting them were identified using keys of Grochowska (2007) and Nartshuk & Andersson (2013).

Additionally, the photography collection of the “Banco Taxonómico y Faunístico Digital de los Invertebrados Ibéricos” (BTFDII) (Biodiversidad Virtual, 2017) were reviewed in order to look for *Lipara* records from other Spanish localities (see Table 1).

New data of *Lipara* and other associated chloropids were displayed on a blank map of the Iberian Peninsula and the Balearic Islands (Instituto Geográfico Nacional, 2017) using ArcGis 10.5 (ESRI, 2016).

Results

The recorded species are listed, indicating the source of the individuals or galls examined (see Table 1 for localities). In the case that *Lipara* spp. individuals emerged from the collected galls, this is indicated in square brackets, preceded by the total number of galls collected. If the collector was different from the author, this is indicated.

GALL-FORMING CHLOROPIDS

Lipara lucens Meigen, 1830 (Figs. 1A, 2A, 2C)

MATERIAL EXAMINED: 1 gall: [21], 23-VI-2007, David Molina, leg. (BTFDII: image 12288); 1♂, 1♀: [2], 12-V-2009, Jordi Clavell, leg. (BTFDII: image 76825); 1 adult: [6], 17-IV-2010, Arturo López Gallego, leg. (BTFDII: image 220119); 1 gall: [19], 17-VII-2010, David Molina, leg. (BTFDII: image 142504); 1 adult: [9], 5-V-2012, Matilde Martínez, leg. (BTFDII: image 335977); 1 adult: [8], 7-V-2012, Juan Manuel Casanova, leg. (BTFDII: image 337392); 1 adult: [12], 2-V-2014, Ferran Turmo, leg. (BTFDII: image 573233); 1 adult: [22], 6-V-2014, Constantino Escuer, leg. (BTFDII: images 574353, 574354 and 574355); 1 adult: [7], 26-IV-2015, Nacho Cabellos, leg. (BTFDII: image 699602); 4 galls: [16], 8-I-2017; 13 galls (1♂, 4♀♀): [14], 11-III-2017; 2 galls (1♂): [17], 11-IV-2017, Moreno-González & Cuesta-Segura, leg.; 3 galls (1♂): [11], 17-IV-2017; 3 galls (2♀♀): [5], 8-V-2017, Cuesta-Segura, leg.; 8 galls: [4], 11-VI-2017, Cuesta-Segura, leg.;

Table 1.— Localities in which galls of *L. lucens* and *L. similis* were found. The circle (o) indicates that the information was obtained from the data base of the BTFDII; the asterisk (*) indicates that the information was obtained from the field. The coordinates are based in ETRS89.

Tabla 1.— Localidades españolas en las que se encontraron las agallas de *Lipara lucens* y *L. similis*. El círculo (o) indica que los datos se obtuvieron de la base de datos del BTFDII; el asterisco (*) indica que los datos se obtuvieron del campo. Las coordenadas se basan en ETRS89.

Province	Locality	UTM 10x10	Province	Locality	UTM 10x10
ÁLAVA	* [1] Vitoria	30TWN24	LÉRIDA	o [12] Alós de Balaguer	31TCG34
BARCELONA	o [2] San Joan Despí	31TDF18	NAVARRA	* [13] Viana	30TWN40
	o [3] Viladecans	31TDF26	PALENCIA	* [14] Baños de Cerrato	30TUM74
BURGOS	* [4] Briviesca	30TVN71	* [15] Dueñas	30TUM73	
	* [5] Quintanavides	30TVN60	* [16] Hontoria de Cerrato	30TUM83	
CIUDAD REAL	o [6] Daimiel	30SVJ33	* [17] Olmos de Ojeda	30TUN83	
	o [7] Daimiel	30SVJ43	TERUEL	* [18] Arcos de las Salinas	30SXK62
CUENCA	o [8] La Alberca de Zancara	30SWJ36	VALENCIA	o/* [19] El Saler	30SYJ35
ISLAS BALEARES (MALLORCA)	o [9] Muro	31SEE00	ZAMORA	* [20] Benavente	30TTM75
LA RIOJA	* [10] Haro	30TWN11	ZARAGOZA	o [21] Peñafior	30TXM82
LEÓN	* [11] Villavente	30TTN92	o [22] Perdiguera	30TXM92	

2 galls: [13], 19-VIII-2017, Oteo-Mijancos, leg.; 3 galls [1], 7-IX-2017; 1 gall [19], 22-X-2017.

The galls of this species were robust and cigar like, with 8 to 14 shortened internodes and showing a hairy layer in its upper zone (Fig. 2C). The larvae or pupae were found living inside the internodes, below the growing point. The adults (Fig. 2A) were about 6 to 8.5 mm.

DISTRIBUTION: widely distributed in Europe and in the Mediterranean region. Previously reported in the ibero-balearic region from Mallorca island (Spain) (Ebejer, 2006) and the district of Aveiro (Portugal) (Ebejer & Andrade, 2015).

BIOLOGY: The adults emerged from galls from April to early June. The photographs of BTFDII were taken from mid April to mid May.

Lipara similis Schiner, 1854 (Figs. 1B, 2B, 2D)

MATERIAL EXAMINED: 1 adult: [2], 22-V-2016, Jordi Clavell, leg. (BTFDII: image 800994); 4 galls: [14], 11-III-2017; 2 galls

(1♂, 1♀): [17], 11-IV-2017, Moreno-González & Cuesta-Segura, leg.; 2 galls (1♂, 1♀) [20], 14-IV-2017; 3 galls: [11], 17-IV-2017; 2 galls (1♀): [14], 24-IV-2017; 1 gall (1♂) [15], 26-IV-2017; 1 gall: [10], 28-IV-2017, Oteo Mijancos, leg. 1 gall: [5], 8-V-2017, Cuesta-Segura, leg.; 1 gall: [4], 11-VI-2017, Cuesta-Segura, leg.; 2 galls [1], 7-IX-2017; 1 gall [19], 22-X-2017; 4 galls [18], 17-X-2017.

The galls of this species were thin and cigar like. They had 3 shortened internodes (4 in some cases), and the upper ones were shorter than the basal. They lacked a hairy layer on the internodes (Fig. 2D). The larvae or the pupae were found living between the enrolled and hardened upper leaves, above the growing point. The adults (Fig. 2B) were about 4 to 6 mm long

DISTRIBUTION: widely distributed species in Europe and in the Mediterranean region. Previously reported in the ibero-balearic region from the province of Castellón (Nartshuk, 2004) and Mallorca Island (Ebejer, 2006) (Spain).

BIOLOGY: The adults emerged from galls from late April to early May. The photograph of BTFDII was taken in mid May.

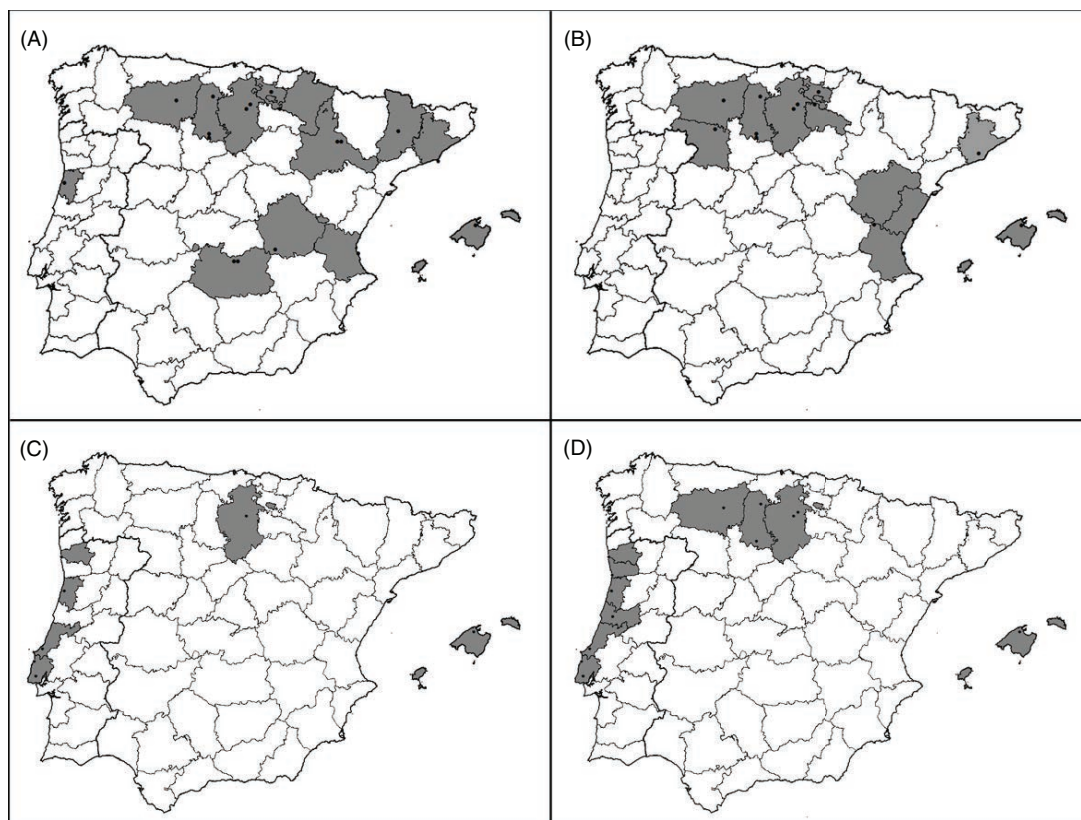


Fig. 1.— Known distribution of (A) *Lipara lucens*, (B) *L. similis*, (C) *Calamoncosis minima* and (D) *Cryptonevra flavitarsis* in the Iberian Peninsula and Balearic Islands. The points indicate the site where they were recorded and the shadowed provinces indicate in which province they are present.

Fig. 1.— Distribución conocida de (A) *Lipara lucens*, (B) *L. similis*, (C) *Calamoncosis minima* y (D) *Cryptonevra flavitarsis* en la península ibérica e islas Baleares. Los puntos indican el lugar en el que se citaron y las provincias sombreadas, aquéllas en las que está presente.

INQUILINE CHLOROPIDS

Calamoncosis minima (Strobl, 1893) (Fig. 1C)

MATERIAL EXAMINED: 3♂♂, 2♀♀: [6], 8-V-2017, Cuesta-Segura, leg.

All individuals live and pupate on the rolled upper leaves of the *Lipara lucens* galls. The adults were about 3 mm long.

DISTRIBUTION: widely distributed Palearctic species. Previously reported in the ibero-balearic region from Mallorca Island (Spain) (Ebejer, 2006) and the districts of Aveiro, Braga, Leiria, Lisboa and Porto (Portugal) (Ebejer & Andrade, 2015).

BIOLOGY: Living in the rolled upper leaves of *Lipara lucens* galls, feeding on the inner part of the leaf. The adults emerged during mid June.

Cryptonevra flavitarsis (Meigen, 1830) (Fig. 1D)

MATERIAL EXAMINED: 12♂♂, 6♀♀: [15], 11-III-2017; 1♀: [19], 11-IV-2017, Moreno-González & Cuesta-Segura, leg.; 2♂♂, 1♀:

[12], 17-IV-2017; 2♀♀: [5], 8-V-2017, Cuesta-Segura, leg.; 2♀♀: [4], 6-VI-2017, Cuesta-Segura.

All individuals live and pupate in the rolled upper leaves of the *Lipara lucens* galls. The adults were 2 to 2.5 mm long.

DISTRIBUTION: widely distributed Palearctic species. Previously reported in the ibero-balearic region from Mallorca Island (Spain) (Ebejer, 2006) and the districts of Aveiro, Braga, Coimbra, Leiria, Lisboa and Porto (Portugal) (Ebejer & Andrade, 2015).

BIOLOGY: Lives in the rolled upper leaves of *Lipara lucens* galls, feeding on the inner part of the leaves. The adults emerged from early April to early June.

Discussion

Chloropids are poorly studied in many areas (De Bruyn, 1999) and thereby, their knowledge is still poor. In this work, the knowledge on the distribution of *Lipara* and other gall-inquiline chloropids

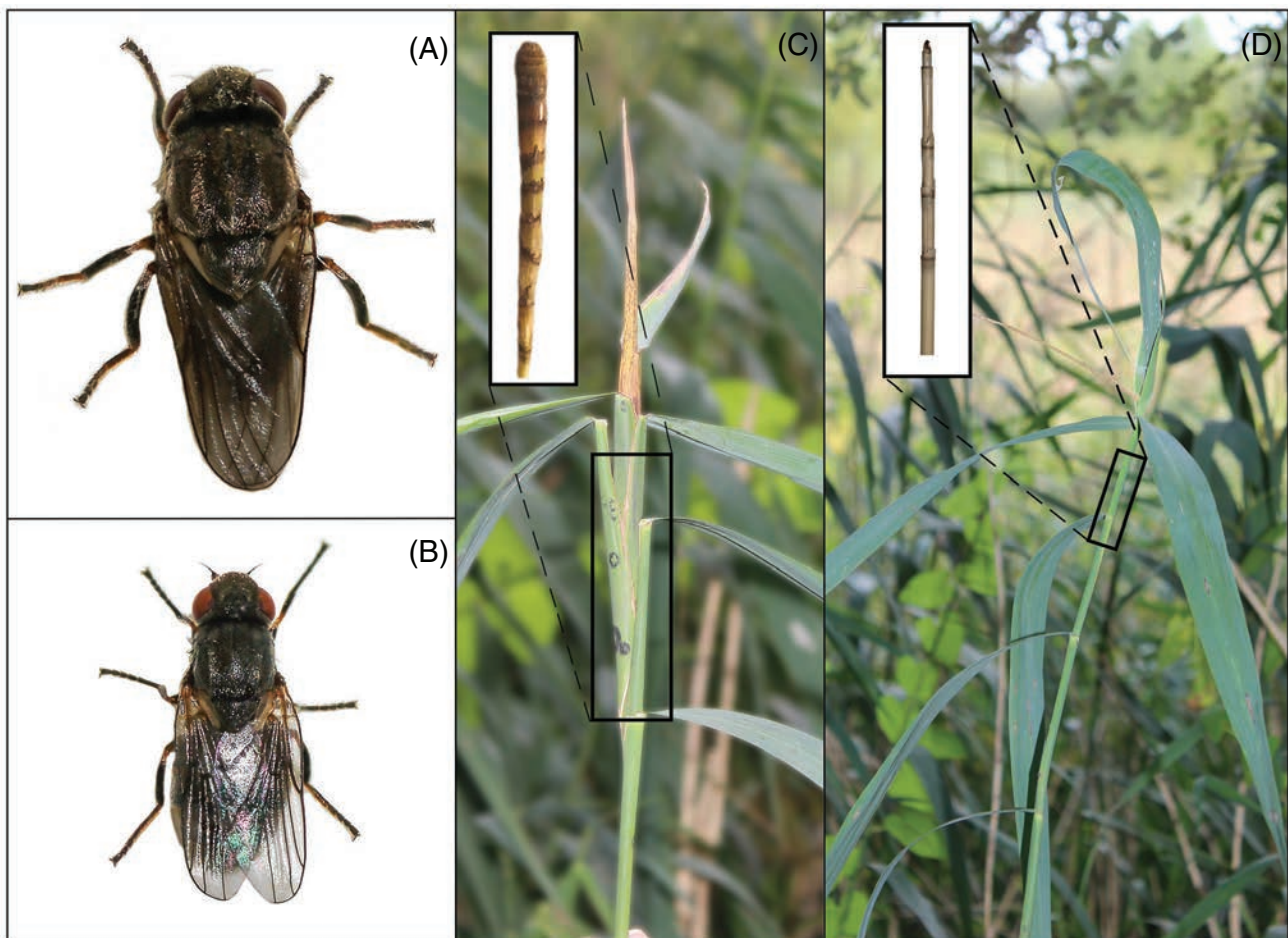


Fig. 2.— Adults of *Lipara lucens* (A) and *Lipara similis* (B), and its galls (C and D respectively). In the galls pictures, detail of the galls are shown after removal of the leaves.

Fig. 2.— Adultos de *Lipara lucens* (A) y *Lipara similis* (B), y sus agallas (C y D, respectivamente). En las fotografías de las agallas se muestra el detalle de la agalla después de eliminar las hojas.

is extended. Thus, *L. lucens*, *Cr. flavitarsis* and *C. minima* are recorded for the first time from the Spanish mainland. They seem to be widespread in the iberobalearic region, since they have been found from Portugal (Ebejer & Andrade, 2015) to the Balearic Islands (Ebejer, 2006) and in many provinces of Spain (Nartshuk, 2004). Furthermore, most of the Iberian Peninsula has a Mediterranean bioclimate (Rivas-Martínez *et al.*, 2004) and freshwater habitats are characterized by seasonal flood and dry periods (Gasith & Resh, 1999). These features are suitable for *Lipara* species, since they prefer *Phragmites* growing in temporary flooded sites (Mook, 1967; Chvála *et al.*, 1974; De Bruyn, 1987).

Many of the inquiline chloropids that can inhabit *Lipara* galls (Nartshuk & Andersson, 2013) have already been documented in the Iberian Peninsula, although they have not always been recorded inhabiting galls: *Calamoncosis minima*, *C. duiensis*, *Cryptonevra flavitarsis*, *Cr. nigratarsis*, *Elachiptera cornuta*, *Eribolus hungaricus* and *Incertella zuecheri* (De Bruyn & Báez, 2002; Ebejer, 2006; Ebejer

& Andrade, 2015). However, in this study, only two of them (*C. minima* and *Cr. flavitarsis*) have been recorded associated with *Lipara lucens* galls. Thus, *Cr. flavitarsis* seems to be a common inquiline of *L. lucens* galls in the study area, living in the rolled leaves of the upper part of the gall (Nartshuk & Andersson 2013). On the other hand, based on the results, *C. minima* is more difficult to find living in *Lipara* galls.

It can be pointed out that the information available on the Internet turned out to be a useful source in the taxonomic (Zeegers & Álvarez Fidalgo, 2016), biogeographic (Pérez Hidalgo *et al.*, 2009; García-Barros *et al.*, 2011) and ethological studies (Olivero & Robillar, 2017). Nevertheless, such information should be up-to-date, reliable and comprehensive (Carling & Harrison, 1996). In this study, the records of BTFDII were useful to refine the distribution of *Lipara* spp. in the Iberian Peninsula. Nevertheless, further studies are necessary in order to improve the knowledge of the biology, distribution and associated fauna of *Lipara* spp.

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