

## Notas / Notes

### First record of the leaf-gall inductor *Cystiphora sonchi* (Vallot, 1827) (Diptera: Cecidomyiidae) for Portugal and some notes about its Iberian distribution

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#### ABSTRACT

One frequent limitation in zoology and ecology studies is that the current spatial distribution of several species is only partially assessed, based on museum or amateurs' records, underestimating the real distribution of the species. Although this limitation could be partially solved by different tools (e.g., species distribution models), the correct functioning of many of such tools is related to the number of occurrences, requiring a minimum number of occurrences to be correctly validated. The genus *Cystiphora* Kieffer, 1892 (Diptera: Cecidomyiidae) has three species in the Iberian Peninsula and is mainly characterized by the induction of galls in species of sow-thistle (*Sonchus* spp.); this genus has an added value since some species are used as biocontrol against invasive sow-thistles in the Nearctic and Australasian regions. However, little is known about its actual distribution in Iberia. *Cystiphora sonchi* (Vallot, 1827) is a Palearctic species whose presence in Iberia Peninsula was until now restricted to four records in the East of Peninsula and in the Balearic Islands. We found three new populations of this species in Coimbra, central Portugal, adding a new species to the Portuguese fauna. Additionally, in order to complete as much as possible its current spatial distribution, a methodical search was carried in different Biodiversity Databases. These two approaches, expanded the distribution area of *C. sonchi* in the Iberian Peninsula, with five new occurrences (three for Portugal, one for Galicia and one for Andalusia) and establishing a new west limit in the current distribution of *C. sonchi* in the Palearctic region.

**Key words:** Diptera; Cecidomyiidae; *Cystiphora*; *Sonchus*; Portugal; Iberia; gall; spatial distribution.

#### RESUMEN

#### Primeros registros para Portugal del inductor de agallas foliares *Cystiphora sonchi* (Vallot, 1827) (Diptera: Cecidomyiidae) y algunas notas sobre su distribución en la Península Ibérica

Un problema habitual en los estudios de zoología y ecología es la evaluación parcial de la distribución espacial actual de muchas especies, pues subestima su distribución real al estar basada en los registros de naturalistas y de museos. Aunque esta limitación puede ser parcialmente resuelta por medio de diferentes herramientas (p.e. modelos de distribución de especies), el correcto funcionamiento de dichas herramientas está condicionado por el número de localizaciones disponibles, necesitando además de un número mínimo de ellas para que los modelos puedan ser validados. El género *Cystiphora* Kieffer, 1892 (Diptera: Cecidomyiidae), con tres especies en la Península Ibérica, está caracterizado principalmente por la formación de agallas en las especies de cerrajas (*Sonchus* spp.); sin embargo, poco se sabe acerca de su distribución actual en Iberia. Además, como valor añadido, varias de las especies que pertenecen a este género son utilizadas como agentes de lucha de control biológico contra las cerrajas invasoras en las regiones del Neártico y de Australasia. *Cystiphora sonchi* (Vallot, 1827) es una especie paleártica cuya presencia en la Península Ibérica estaba restringida hasta hoy a cuatro citas en el Este de la Península y en las Islas Baleares. Se encontraron

tres nuevas poblaciones de esta especie en Coimbra (Portugal centro), añadiendo una nueva especie a la fauna portuguesa. Además, con el objetivo de completar lo máximo posible su distribución, se realizó una búsqueda sistemática en diferentes bases de datos de biodiversidad. Con esos dos enfoques, se estableció un nuevo límite occidental del área de distribución de *C. sonchi* y se expandió su área de distribución actual en la Península Ibérica con cinco nuevos registros (tres para Portugal, uno para Galicia y uno para Andalucía).

**Palabras clave:** Diptera; Cecidomyiidae; *Cystiphora*; *Sonchus*; Portugal; Iberia; agalla; distribución espacial.

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Several studies highlight the importance of the Mediterranean basin as one of the thirty-four biodiversity hotspots in the world (Mittermeier *et al.*, 2004; Fonseca, 2009; Hewitt, 2011), probably because it was a climatic refugia during the Quaternary glacial cycles (Rand, 1948). Consequently, the fauna and flora of the Iberian Peninsula are quite well studied, but paradoxically, Fontaine *et al.* (2012) remark that Old World, and because of that, Iberian Peninsula, can be considered as an important reservoir of unknown species. Despite the importance of describing new species and improving knowledge on the spatial distribution of existing species, these aspects are often forgotten. The spatial distribution of several species in Old World is often only partially assessed, based on museum or amateurs' records, underestimating the real distribution of the species.

Cecidomyiidae is the second most species rich family of thread-horns (Diptera: Nematocera) in the world with particular importance in the Iberia where 292 species (out of the total 6200 reported species) occur (Gagné & Jaschhof, 2014; Carles-Tolrá, 2002; Sánchez *et al.*, 2012; Sánchez, 2016). This family is mainly characterized by the establishment of a highly specific trophic relationship between a fly and a plant species: the induction of a gall. This type of trophic specialism can be considered as an intermediate situation between parasitism and herbivory (Redfern & Shirley, 2011) because the gall is a reaction of the host-plant to the oviposition by the galler insect in their inner tissues. This reaction causes the growth of an abnormal plant structure that results from hypertrophy followed by hyperplasia of the vegetal cells, providing a nutritive tissue that feeds the galler larvae; simultaneously, the insect larvae induces a physiological cascade to promote the growth of the nutritional tissue by the host-plant (Nieves-Aldrey, 1998). In many cases, the specificity of the relationship is so high that the gall is considered as the extended phenotype of the inductor genes (Stern, 1995; Crespi *et al.*, 1997), allowing possible to identify the galler insect only by the presence of the gall and by its morphology. Some species within

this family are of concern for agriculture because they are considered pests of several crops (i.e. *Contarinia nasturtii* (Keiffer, 1888) on broccoli, *Stenodiplosis sorghicola* (Coquillett, 1899) on sorghum, *Contarinia maculipennis* Felt, 1933 on orchids, etc.). On the other hand, the high specificity between gallers and host-plants supports the use of gallers as biological control agents against invasive plant species, decreasing the probability of unwanted direct non-target effects on non-target species (Pearson & Callaway, 2003; Thomas *et al.*, 2004; López-Núñez *et al.*, 2017).

The genus *Cystiphora* Kieffer, 1892 belongs to Cecidomyiidae and includes six species in Europe, three of those recorded in Spain: *C. sanguinea* (Bremer, 1847), *C. schmidtii* (Rübsaamen, 1914) and *C. sonchi* (Vallot, 1827). All members of this genus are gall inductors on the leaves of several species of Cichorieae (*Asteraceae*) and some of them were introduced into Nearctic and Australasian Regions as biological control agents for introduced *Asteraceae* weeds (Carles-Tolrá, 2002; Skuhrová & Skuhrový, 2009; Gagné & Jaschhof, 2014); for example: *C. sonchi* and *C. taraxaci* (Kieffer, 1888) were introduced into Canada to control *Sonchus arvensis* L. and *Taraxacum officinale* (L.) Weber ex F.H. Wigg respectively; and *C. schmidtii* was introduced in Australia, California and Argentina against *Chondrilla juncea* L. (Gagné & Jaschhof, 2014).

The midge *C. sonchi* is a leaf-gall inductor in species of sow-thistle (*Sonchus arvensis* L., *S. asper* (L.) Hill, *S. oleraceus* L., *S. maritimus* L. and *S. tenerimus* L.), and in sporadic situations in bulbous hawkbeard (*Aetheorhiza bulbosa* Cass.) (Peschen, 1982; Peschen *et al.*, 1989). This is the single gall species induced by a midge described in sow-thistle; the gall is a dark red blotch with about 5 mm in diameter, located on the leaves. The larvae feed between the upper and lower epidermis of the leaf. In many cases, one leaf can harbor several blotch galls, distributed in rows throughout the leaf length. Depending on the season, the larvae can pupate in the leaf (in spring generations) or in the

ground (in winter generations); the adults emerge and after mating females lay the eggs on the underside of mature leaves, avoiding the youngest and oldest leaves (Peschken, 1982). This species was released for the first time in Canada, from 1981 to 2008, as a biological control agent against *S. arvensis*, which was accidentally introduced with imported seeds of fodder, promoting losses in crops production (Peschken, 1982). The occurrence of this species is mostly scarce, with some records of locally abundant, but it has an Euro-Siberian distribution, being recorded in almost 30 European and in five Asian countries (Peschken, 1982; M. Skuhrová, comm. pers., 2017). The presence of *C. sonchi* in Iberian Peninsula is only confirmed in Spain (Skuhrová *et al.*, 2006) on three localities in the Basque Country (in 1901), Catalonia (in 1902) and in Balearic Islands (in 1997; Fig. 1) (Trotter, 1902; Cogolludo, 1921; Skuhrová & Skuhrový, 2004; Blanes-Dalmau *et al.*, 2017). From Portugal there is only one dubious cite in Tavares (1907) pag. 129: “[...] *Cecidomyia*, probably new [...]” in *S. oleraceus*; but this material was not preserved and is not available to be confirmed.

We report for the first time *C. sonchi* for Portugal mainland, expanding its known distribution to the further west corner of Europe. Three populations were spotted in Coimbra (Portugal) (Figs. 1-2):

- (1) López-Núñez, FA, 2017; 40.19868333333333, -8.408333333333333; 10/X/2017; Rua Afonso Albuquerque, Bairro Norton de Matos, Coimbra, Portugal; 57 m a.s.l.; between 3 and 5 blotches on leaves of isolated individuals of *S. oleraceus* in the edges of the street sidewalk,
- (2) López-Núñez, FA, 2017; 40.211288888888895, -8.452769444444444; 10/X/2017; main building of Escola Superior Agrária (ESAC), Instituto Politécnico de Coimbra. Bencanta, Coimbra, Portugal; 43 m a.s.l.; 6 blotches on leaves on isolate individual of *S. oleraceus* in the left corner of the parking and
- (3) López-Núñez, FA, 2017; 40.216825, -8.450238888888888; 10/X/2017; Rua do Freixo s/n, greenhouse of ESAC, Instituto Politécnico de Coimbra, Coimbra, Portugal; 18 m a.s.l.; several blotches on leaves on several individuals of *S. tenerrimus*

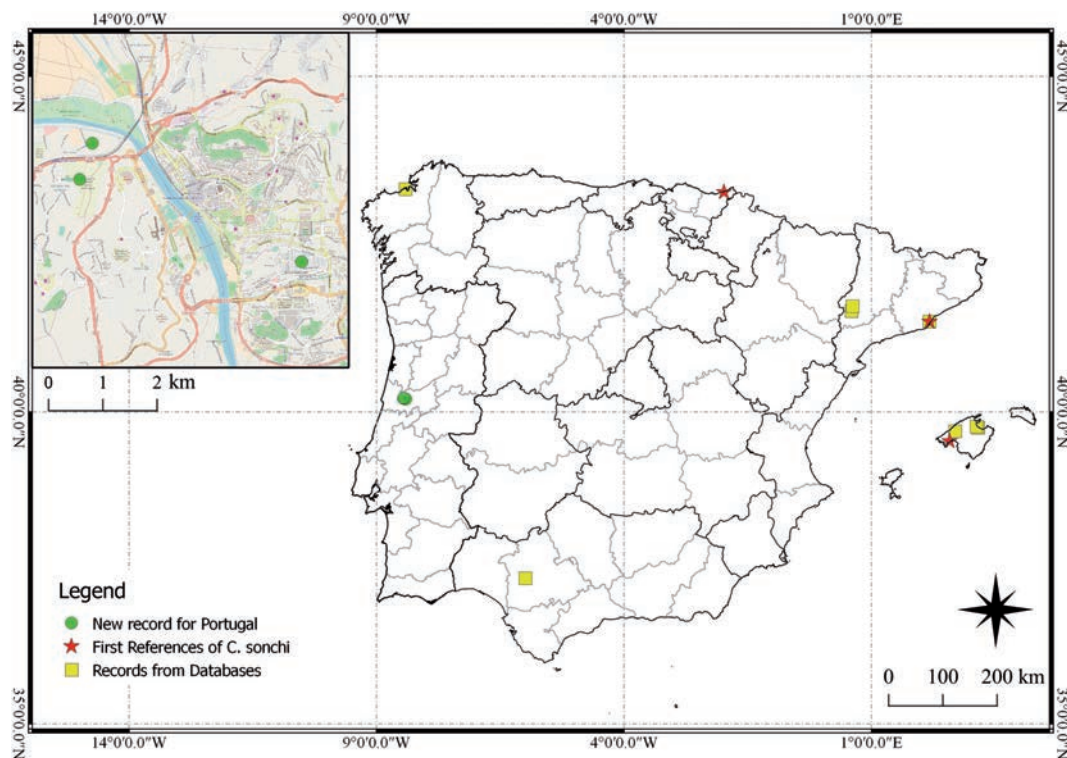


Fig. 1.— Updated distribution of *Cystiphora sonchi* (Vallot, 1827) in Iberian Peninsula based on literature, biodiversity databases and field observations during the period 1901-2017; some occurrences are roughly positioned due to the lack of accurate location (see Table 1 for more details). The inset frame shows a zoom of the occurrences recorded in Coimbra (Portugal).

Fig. 1.— Distribución actualizada de *Cystiphora sonchi* (Vallot, 1827) en la Península Ibérica durante el periodo 1901-2017, basada en los registros en la literatura, bases de datos de biodiversidad y observaciones de campo; algunas localidades están toscamente ubicadas debido a la falta de datos de localización más precisos (ver Tabla 1 para más detalles). El recuadro muestra una ampliación de las citas registradas en Coimbra (Portugal).



Fig. 2.— Example of several blotches of *Cystiphora sonchi* (red arrow) recorded on a leaf of *Sonchus oleraceus* L. in ESAC.

Fig. 2.— Ejemplo de varias pústulas de *Cystiphora sonchi* (flecha roja) registradas en la hoja de *Sonchus oleraceus* L. en la ESAC.

in the open area near the water well. Galls were identified following Dauphin (2012) and Chinery (2013) and confirmed to be *C. sonchi*.

Assuming that the three records of *C. sonchi* in Spain and the new records now confirmed in Portugal were most probably not representative of the real distribution of the species in the Iberian Peninsula, we did an additional search to increase distribution records. A systematic search was performed through the Global Biodiversity Information Facility (GBIF) ([www.gbif.org](http://www.gbif.org)) and a set of different citizen science biodiversity databases: iNaturalist ([www.inaturalist.org](http://www.inaturalist.org)), Naturdata ([naturdata.com](http://naturdata.com)), Biodiversity4all ([www.biodiversity4all.org](http://www.biodiversity4all.org)) and Biodiversidad Virtual (BV; [www.biodiversidadvirtual.org](http://www.biodiversidadvirtual.org)). iNaturalist and GBIF are global biodiversity databases, while the others are developed and focused in Portugal (Naturdata and Biodiversity4all) and in Spain (BV). In these databases, any registered citizen can upload a photograph of a species and a community of specialists can either identify the species or validate the identification made by the citizen. Although such citizen science database can carry some identification uncertainty by lacking of

specimens to examine (Gardiner *et al.*, 2012), in this case the clear morphology of the gall and its host-plant specificity confer a high confidence to the identification based on photographs. Records were only found in GBIF and in BV, in total of eight more records for Spain, two of them being a novelty for Spain and the rest contributed to extend its distribution area (Table 1, Fig. 1A).

Concluding, the three new populations in Portugal together with the new records in Spain expand the distribution of *C. sonchi* in the Iberian Peninsula, from the north-west (A Coruña, Spain) to the west (Coimbra, Portugal) and further south (Seville, Spain).

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Table 1.— Summary description of the occurrences of *Cystiphora sonchi* (Vallot, 1827) in Iberian Peninsula.Tabla 1.— Resumen descriptivo de los registros de *Cystiphora sonchi* (Vallot, 1827) en la Península Ibérica.

Locality	Latitude	Longitude	Altitude (m a.s.l.)	Collection date	Habitat	References
Rua Afonso Albuquerque, Coimbra, Portugal	40.198683333333333	-8.408333333333333	57	10/X/2017	Road margin	New record
ESAC, main buidling, Bencanta, Coimbra, Portugal	40.211288888888895	-8.452769444444444	43	10/X/2017	In a car parking, between sparse native forest and gardens	New record
ESAC, greenhouse, Rua do Freixo s/n, Coimbra, Portugal	40.216825	-8.450238888888888	18	10/X/2017	Near ruderal and garden plant species between meadows and orchards	New record
San Sebastian, Spain				VIII/1901		Trotter (1902); Cogolludo (1921)
Catalonia, Spain				VIII/1901		Trotter (1902); Cogolludo (1921)
Pedralbes, Catalonia, Spain				27/IX/1920		Bianes-Dalmau <i>et al.</i> (2017)
Alcúdia, Castillo Bendinat, Mallorca, Balearic Islands, Spain	39.546277777777775	2.578044444444444	50–70	19/VI/1997	Sparse forest with <i>Pinus halepensis</i> , <i>P. pinea</i> , <i>Pistacia</i> and <i>Ceratonia siliqua</i>	Skuhravá & Skuhravý (2004)
Paseo de las delicias, Seville, Spain	37.37645	-5.9923	8	08/V/2016	Near the river	BV (2017b)
Lérida, Catalonia, Spain				08/VII/2013	Pyrenaic population	BV (2017a)
A Coruña, Spain				02/VIII/2012	Road margin between wet meadow and orchards	BV (2017a)
Buñola, Mallorca, Balearic Islands, Spain	39.699233333333333	2.694841666666667	192	16/VI/2008	Meadow	BV (2017a)
Montoliu, Lérida, Catalonia, Spain	41.544611111111111	0.600388888888889	183	11/V/2010	Small dry hill with weeds and small shrubs	BV (2017a)
Barcelona, Catalonia, Spain				21/X/2010	Urban garden	BV (2017a)
Can Picafort, Mallorca, Balearic Islands, Spain	39.753888888888886	3.158505555555557	24	20/X/2015		GBIF (2017)
Son Bosc, Mallorca, Balearic Islands, Spain	39°46'20.15"N	3°7'29.73"E	0	19/X/2015		GBIF (2017)

## References

- Blanes-Dalmau, M., Caballero-López, B. & Pujade-Villar, J., 2017. Estudi de les gales de la col·lecció Vilarrúbia dipositada al Museu de Ciències Naturals de Barcelona. *Butlletí de la Institució Catalana d'Història Natural*, 81: 137–173.
- BV, 2017a. *Cystiphora sonchi*. Available at: [http://www.biodiversidadvirtual.org/insectarium/Cystiphora-sonchi-\(Bremi-1847\)-cat28208.html](http://www.biodiversidadvirtual.org/insectarium/Cystiphora-sonchi-(Bremi-1847)-cat28208.html) [Accessed October 23, 2017].
- BV, 2017b. Biodiversidad Virtual. CT: Cecidomyiidae. Available at: <http://www.biodiversidadvirtual.org/insectarium/CT-Diptera-Cecidomyiidae-cat28190.html> [Accessed October 23, 2017].
- Carles-Tolrà, M. (Coordinador). 2002. *Catálogo de los Díptera de España Portugal y Andorra (Insecta)*. Monografías SEA, vol 8, Sociedad Entomológica Aragonesa. Zaragoza. 323 pp.
- Chinery, M., 2013. *Britain's Plant Galls: A Photographic Guide*. Princeton University Press. Hampshire. 96 pp.
- Cogolludo, J., 1921. Contribución al conocimiento de las zoocécidas de España. *Trabajos del Museo Nacional de Ciencias Naturales, Serie Botánica*, 16: 1–117.
- Crespi, B. J., Carmean, D. A. & Chapman, T. W., 1997. Ecology and evolution of galling thrips and their allies. *Annual Review of Entomology*, 42: 51–71. <https://doi.org/10.1146/annurev.ento.42.1.51>
- Dauphin, P., 2012. *Guide des galles de France et d'Europe*. Editions Belin. 240 pp.
- Fonseca, C. R., 2009. The silent mass extinction of insect herbivores in biodiversity hotspots. *Conservation Biology*, 23(6): 1507–1515. <https://doi.org/10.1111/j.1523-1739.2009.01327.x>
- Fontaine, B., van Achterberg, K., Alonso-Zarazaga, M. A., Araujo, R., Asche, M., Aspöck, H., Aspöck, U., Audisio, P., Aukema, B., Bailly, N., Balsamo, M., Bank, R. A., Belfiore, C., Bogdanowicz, W., Boxshall, G., Burckhardt, D., Chylarecki, P., Deharveng, L., Dubois, A., Enghoff, H., Fochetti, R., Fontaine, C., Gargominy, O., Lopez, M. S., Goujet, D., Harvey, M. S., Heller, K., van Helsing, P., Hoch, H., De Jong, Y., Karsholt, O., Los, W., Magowski, W., Massard, J. A., McInnes, S. J., Mendes, L. F., Mey, E., Michelsen, V., Minelli, A., Nieto Nafría, J. M., van Nieukerken, E. J., Pape, T., De Prins, W., Ramos, M., Ricci, C., Roselaar, C., Rota, E., Segers, H., Timm, T., van Tol, J. & Bouchet, P., 2012. New species in the old world: Europe as a frontier in biodiversity exploration, a Test Bed for 21st century taxonomy. *PLoS ONE*, 7(5): e36881. <https://doi.org/10.1371/journal.pone.0036881>
- Gagné, R. J. & Jaschhof, M., 2014. *A Catalog of the Cecidomyiidae (Diptera) of the World*. 3rd Edition. Entomological Society of Washington. Washington, DC.
- Gardiner, M. M., Allee, L. L., Brown, P. M. J., Losey, J. E., Roy, H. & Smyth, R. R., 2012. Lessons from lady beetles: Accuracy of monitoring data from US and UK citizen-science programs. *Frontiers in Ecology and the Environment*, 10(9): 471–476. <https://doi.org/10.1890/110185>
- GBIF, 2017. GBIF Occurrence Download doi:10.15468/dl.qj4yyc accessed via GBIF.org.
- Hewitt, G. M., 2011. Mediterranean Peninsulas: The Evolution of Hotspots. In: F. E. Zachos & J. C. Habel (eds.). *Biodiversity Hotspots: Distribution and Protection of Conservation Priority Areas*. Springer. Berlin and Heidelberg: 123–147.
- Mittermeier, R. A., van Dijk, P. P., Rhodin, A. G. J. & Nash, S. D., 2004. *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Ecoregions*. Cemex and University of Chicago Press. Chicago.
- Peschken, D. P., 1982. Host specificity and biology of *Cystiphora sonchi* [DIP. : CECIDOMYIIDAE], a candidate for the biological control of *Sonchus* species. *Entomophaga*, 27(4): 405–415.
- Peschken, D. P., McClay, A. S., Derby, J. L. & DeClerk, R., 1989. *Cystiphora sonchi* (Bremi) (DIPTERA: CECIDOMYIIDAE), A new biological control agent established on the weed perennial sow-thistle (*Sonchus arvensis* L.) (COMPOSITAE) in Canada. *The Canadian Entomologist*, 121: 781–791. <https://doi.org/10.4039/Ent121781-9>
- Rand, A. L., 1948. Glaciation, an isolating factor in speciation. *Evolution*, 2(4): 314–321. <https://doi.org/10.2307/2405522>
- Redfern, M. & Shirley, P., 2011. *British Plant Galls*. 2nd edition. Field Studies Council Publication.
- López-Núñez, F. A., Heleno, R. H., Ribeiro, S., Marchante, H. & Marchante, E., 2017. Four-trophic level food webs reveal the cascading impacts of an invasive plant targeted for biocontrol. *Ecology*, 98: 782–793. <https://doi.org/10.1002/ecy.1701>
- Nieves-Aldrey, J. L., 1998. Insectos que inducen la formación de agallas en las plantas: una fascinante interacción ecológica y evolutiva. *Boletín de la Sociedad Entomológica Aragonesa*, 23: 3–12.
- Pearson, D. E. & Callaway, R. M., 2003. Indirect effects of host-specific biological control agents. *Trends in Ecology & Evolution*, 18: 456–461. [https://doi.org/10.1016/S0169-5347\(03\)00188-5](https://doi.org/10.1016/S0169-5347(03)00188-5)
- Sánchez, I., 2016. Nuevos datos sobre Cecidómidos (Diptera: Cecidomyiidae) de la provincia de Cádiz (Sur de España). *Revista de la Sociedad Gaditana de Historia Natural*, 10: 43–52.
- Sánchez, I., Skuhrová, M. & Skuhrový, V., 2012. Gall midges (Diptera: Cecidomyiidae) of Cádiz Province (South - Western Spain). *Boletín de la Sociedad Entomológica Aragonesa*, 51: 221–236.
- Skuhrová, M. & Skuhrový, V., 2004. Gall midges (Cecidomyiidae, Diptera) of Mallorca (Balearic Islands, Spain). *Boletín de la Asociación Española de Entomología*, 28(1–2): 105–119.
- Skuhrová, M. & Skuhrový, V., 2009. Species richness of gall midges (Diptera: Cecidomyiidae) in Europe (West Palaearctic): biogeography and coevolution with host plants. *Acta Societatis Zoologicae Bohemicae*, 73: 87–156.
- Skuhrová, M., Skuhrový, V., Blasco-Zumeta, J. & Pujade-Villar, J., 2006. Gall midges (Diptera: Cecidomyiidae) of the Iberian Peninsula 2. Zoogeographical analysis of the gall midge fauna. *Boletín de la Asociación Española de Entomología*, 30(1–2): 93–159.

- Stern, D. L., 1995. Phylogenetic evidence that aphids, rather than plants, determine gall morphology. *Proceedings of the Royal Society B: Biological Sciences*, 260: 85–89. <https://doi.org/10.1098/rspb.1995.0063>
- Tavares, J.S., 1907. Primeiro appendice á Synopse das zoocecidias portuguesas. *Brotéria*, 6: 109–134.
- Thomas, M. B., Casula, P. & Wilby, A., 2004. Biological control and indirect effects. *Trends in Ecology & Evolution*, 19(2): 61. <https://doi.org/10.1016/j.tree.2003.11.005>
- Trotter, A., 1902. Elenco di galle raccolte in Spagna. *Marcellia*, 1: 122–126.