

Research article

Submitted: February 14th, 2022 – Accepted: April 4th, 2022 – Published: May 15th, 2022
DOI: 10.13133/2284-4880/715

Shore fly communities from Ria de Aveiro, with new records for Portugal (Diptera: Ephydriidae)

Catarina PRADO E CASTRO^{1,*}, Vasco SANTOS¹, Olga M.C.C. AMEIXA^{1,*}

¹*Ecomare, Centre for Environmental and Marine Studies (CESAM), Department of Biology, University of Aveiro, 3810-193 Aveiro, Portugal – catarinapcastro@ua.pt; vasco.miguel@live.ua.pt; olga.ameixa@ua.pt*

*Corresponding authors

Abstract

Saltmarshes are considered one of the most productive habitats in the world and exhibit a spatial zonation of its vegetation, from the intertidal flats to the seawall or dunes providing habitats to specific invertebrate assemblages adapted to regular submergence by seawater, and the resulting high soil salinity. These ecotones are essential to support coastal food webs and in providing nursery areas, for fish, crustaceans, and birds. Ria de Aveiro coastal lagoon has been the focus of considerable research, but despite being part of Nature 2000 network, and being a Long-Term Ecological Research (LTER) site, insects have been systematically neglected. In this work we present new shore flies (Ephydriidae) records from Ria de Aveiro saltmarshes, Portugal. Field collections were carried in seven locations along Ria de Aveiro saltmarshes areas by sweep-netting the dominating halophyte vegetation in September 2020. A total of 243 Ephydriidae specimens from 8 genus and 17 species were collected. From these, 9 species are new records for Portuguese territory, 3 of them to the Iberian Peninsula. This work contributes to increase the dipterological knowledge regarding Ephydriidae diversity in southern Europe, and to identify potential halophyte plant pests since several Ephydriidae species are phytophagous.

Key words: shore flies (Ephydriidae), saltmarshes, wetlands, ecotones, faunistic, Iberian Peninsula.

Introduction

The Ephydriidae, commonly known as shore flies, are small to medium size individuals, with a dull or dark colouration. This family presents unusual diverse morphological characters, making it difficult to characterize (Mathis & Zatwarnicki 1998), although the adults often have swollen and convex face (Oosterbroek 2006). The arista is bare to dorsally pubescent, or pectinate (bearing dorsal branches or rays), true vibrissae are absent, but facial setae are often developed. Wing has humeral and subcostal breaks, lacking anal vein and anal cell (Zatwarnicki 2011).

This family is mostly associated to aquatic and semi-aquatic habitats, and especially adapted to saline concentrations (Mathis & Zatwarnicki 1998). In fact, Ephydriidae are known to inhabit harsh environments for most life forms such as alkaline and salt lakes (Collins 1980), one species, *Diasemocera petrolei* (Coquillett, 1899), can even be found in petroleum pools, and there are also records of Ephydriidae in the desert, far away from any water body (Dawah et al. 2019).

Adults are generally found close to the soil in humid or wet habitats and feed on organic matter such as algae, honeydew or carrion. Most larvae feed on bacteria, algae and

yeasts, some other species prefer decaying animal tissue or excrements. A few species are predators, while others are leaf miners (Mathis & Zatwarnicki 1998; Oosterbroek 2006). Some species have been recorded as crop and greenhouse pests (Foote 1995). There are species which offer biocontrol solutions for instance against aquatic weeds (e.g. Foote 1995; Doyle et al. 2002; Grodowitz et al. 2004).

Ephydriidae is one of the most rich and diverse acalyptrate Diptera families, with almost 2000 species spread worldwide (Mathis & Zatwarnicki 1995; Mathis et al. 2017; Dawah et al. 2019). Most species are found in one or two zoogeographic regions and only a few are subcosmopolitan (Mathis & Zatwarnicki 1998).

In Portugal the information regarding Diptera species, as with many insect groups, is very limited. The publication, in 2002 of the *Catálogo de los Díptera de España, Portugal y Andorra (Insecta)* (Carles-Tolrá 2002), was a landmark in the study of the group. Forty-one species of Ephydriidae were reported for Portugal (Zatwarnicki 2002) at the time. Several species were more recently added, in latest studies (Carles-Tolrá et al. 2009; Carles-Tolrá & Rosado 2009; Zatwarnicki & Mathis 2011; Zatwarnicki 2018; Dawah et al. 2019), so now accounting a total of 46 species.

We report herewith 9 new species for Portugal, collected along Ria de Aveiro saltmarshes. Three of them are also new to the Iberian Peninsula. This information contributes to a better knowledge of this Diptera family in southern Europe.

Material and Methods

Study area

Ria de Aveiro is a shallow coastal lagoon located in the north-west coast of Portugal (40°38'N, 08°45'W), connected to the Atlantic Ocean through a single inlet. Ria de Aveiro (Fig. 1) has approximately 45km long by 10km wide covering an area up to 83 km² of wetlands (during high tide) (Lillebø et al. 2015). Ria de Aveiro provides a variety of biotopes with high biological diversity, comprising large seagrass and salt marsh areas, most upstream areas are characterized by freshwater marshes, forests and

“bocage” landscape. Ria de Aveiro is a LTsER - Long Term Socio-economic & Ecosystem Research platform and part of Natura 2000 Network with two Special Protection Areas (the lagoon area and the adjacent marine area).

Insect collection

Field collections were carried in September 2020, in 7 selected sites along Ria de Aveiro (Fig. 1). These were carried by sweeping the halophyte vegetation cover, mostly dominated by *Atriplex patula* L., *Halimione portulacoides* L., *Juncus maritimus* L., *Limonium vulgare* Mill. *Spartina maritima* (Curtis) Fernald., *Spartina patens* (Aiton) Muhl., *Tamarix africana* Poir. Collections were carried in days with clear sky and during periods of low tide. For each host plant, we collected three samples, each corresponding to 100 sweeps, a total of 300 sweeps per plant host. The content of the sweep net was collected with the help of an insect aspirator and placed into plastic flasks. The flasks were identified with the location, name of the host plant, date, and the number of replicate

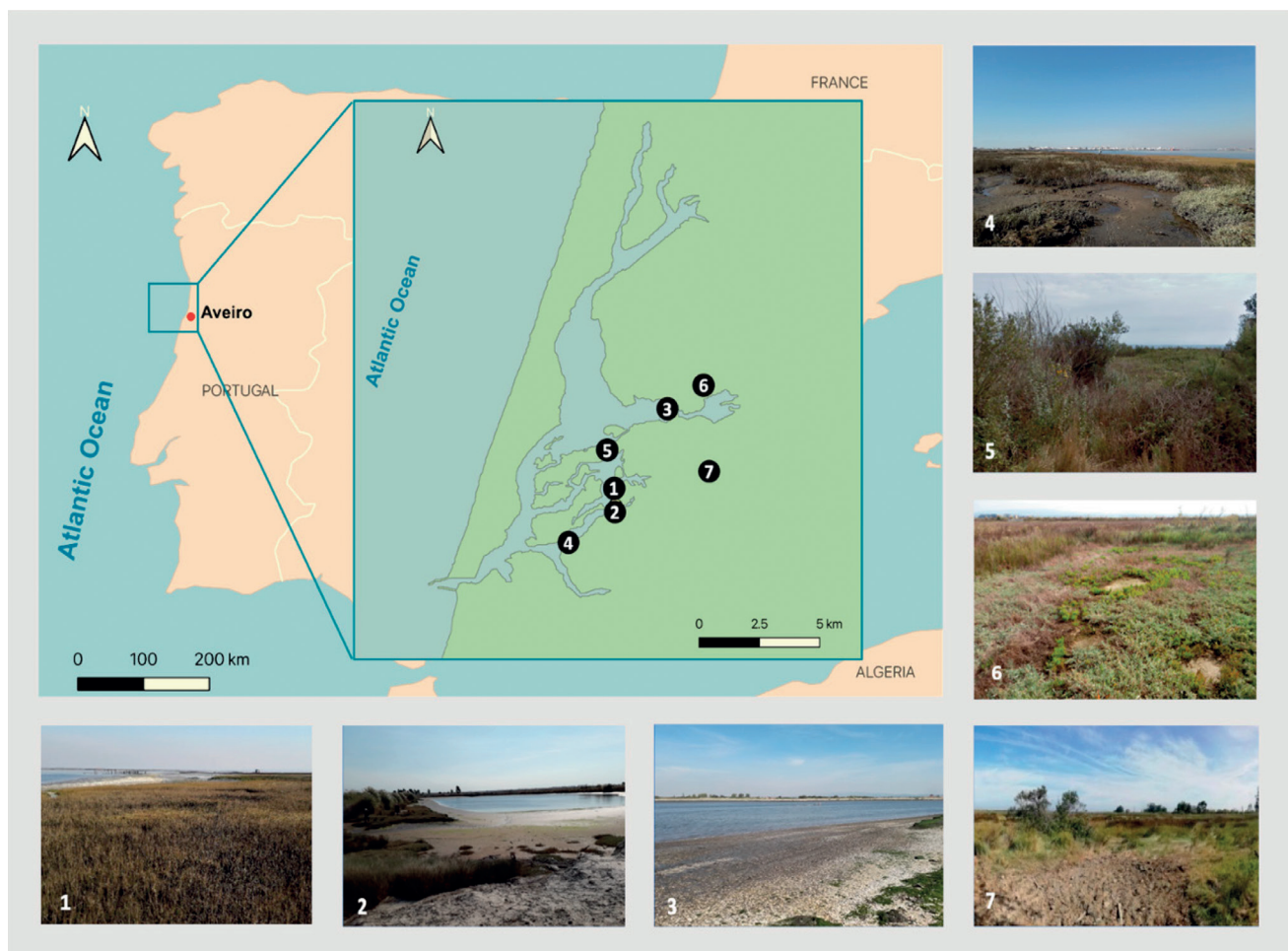


Fig. 1 – Sampling area location; sampled sites: 1, Foz do Rio Novo, dominated by *Spartina maritima* (Curtis) Fernald.; 2, Salinas, dominated by *Halimione portulacoides*, *Juncus maritimus* (Lam) and *Sarcocornia perennis* (Mill.) A.J. Scott, *Phragmites australis* (Cav.) Trin ex. Steud.; 3, Bico dominated by *H. portulacoides* L. and *J. maritimus* L.; 4, Reboxo dominated by *H. portulacoides*, *S. perennis*, *S. maritima* and *Limonium vulgare* Mill. 5, Farinha, dominated by *J. maritimus* and *H. portulacoides*; 6, Cambeia dominated by *H. portulacoides*, *Salicornia ramosissima* J. Woods, and *Tamarix africana* Poir.; 7, Cacia dominated by *J. maritimus*, *H. portulacoides* and *Atriplex patula* L.

Table 1 – Abundance of Ephydriidae collected from the different sampled sites in Ria de Aveiro, in September 2020.

Species	Sampled site	Number of specimens
<i>Atissa</i> sp.	7	1
<i>Clanoneurum cimiciforme</i>	1, 2, 3, 6, 7	16
<i>Diasemocera fratella</i>	5	1
<i>Diasemocera glabricula</i>	7	1
<i>Diasemocera maritima</i>	1, 2, 4	134
<i>Diasemocera nana</i>	7	1
<i>Glenanthe ripicola</i>	2	9
<i>Glenanthe</i> sp.	4	3
<i>Philotelma defectum</i>	6, 7	2
<i>Psilopa compta</i>	2, 7	3
<i>Psilopa nitidula</i>	1, 4, 6	8
<i>Psilopa obscuripes</i>	4, 6	3
<i>Psilopa rutilans</i>	1, 2, 6, 7	15
<i>Psilopa</i> sp.	2, 3, 4, 6, 7	39
<i>Psilopa thora</i>	1, 2, 4	5
<i>Scatella ciliata</i>	7	1
<i>Schema acrosticalis</i>	6	1

(3 replicates per sampled host plant). Since this sampling was carried by visiting most of the sites by boat, in order to preserve the insects, the samples were placed in a thermal container at - 4°C and transported to the laboratory, where the collected specimens were preserved in a fridge at -20°C until identification. The specimens were later sorted and sent to J.-H. Stuke for species identification. They are now deposited in the entomological collection of the Departamento de Biologia da Universidade de Aveiro (Aveiro, Portugal).

Results

A total of 243 Ephydriidae specimens from 8 genus and 17 species were collected in this study (Table 1). Among these, 9 are new records for Portuguese territory and 3 of them for the whole Iberian Peninsula.

Diasemocera fratella Becker, 1903

Specimens examined: 07.IX.2020, 1 ♀. **Monte Farinha** (40°42'19.3"N 8°40'33.6"W), saltmarsh area on *Halimione portulacoides*.

Comments: Afrotropical and Palaearctic distribution (Zatwarnicki 2018). First record for the Iberian Peninsula.

Diasemocera glabricula (Fallén, 1813)

Specimens examined: 10.IX.2020, 1 ♂. **Cacia** (40°41'44.2"N 8°37'31.4"W), saltmarsh area, on *Halimione portulacoides*.

Comments: Palaearctic species (Zatwarnicki 2018). First record for Portugal.

Diasemocera nana Loew, 1860

Specimens examined: 10.IX.2020, 1 ♂. **Cacia** (40°41'44.2"N 8°37'31.4"W), saltmarsh area, on *Halimione portulacoides*.

Comments: Afrotropical and Palaearctic distribution (Zatwarnicki 2018). First record for Portugal.

Philotelma defectum Haliday 1833

Specimens examined: 10.IX.2020, 1 ♂, 1 ♀. **Cambeia** (40°44'08.0"N 8°37'40.7"W) and **Cacia** (40°41'44.2"N 8°37'31.4"W), saltmarsh area, on *Juncus maritimus*.

Comments: Holarctic distribution (Mathis et al. 2009). Larvae of this species are unknown, adults have been collected in salt meadows, salt marshes, alkaline playas, and along the shores of a pond. Specimens are generally uncommon in collections, but common in partially alkaline or saline habitats (Mathis et al. 2009). In a saltmarsh in Central Europe, this species was collected from March to November with greatest abundance in September but with an earlier peak in May (Kubátová-Hiršová 2005). First record for the Iberian Peninsula.

Psilopa compta (Meigen, 1830)

Specimens examined: 07.IX.2020 and 10.IX.2020, 3 ♂. **Salinas** (40°40'35.0"N 8°40'20.0"W) and **Cacia** (40°41'44.2"N 8°37'31.4"W), saltmarsh area on *Spartina patens* and *Atriplex patula*.

Comments: Holarctic distribution (Zatwarnicki 2011). Larvae of the genera *Psilopa* are known to mine leaves of saltmarsh plants (Foote 1995). First record for Portugal.

Psilopa obscuripes Loew, 1860

Specimens examined: 07.IX.2020 and 10.IX.2020, 3 ♂. **Reboxo** (40°39'42.9"N 8°41'39.9"W) and **Cambeia** (40°44'08.0"N 8°37'40.7"W), saltmarsh area on *Halimione portulacoides*, *Limonium vulgare*.

Comments: Palaearctic (Mathis & Zatwarnicki 1995). Larvae of the genera *Psilopa* are known to mine leaves of saltmarsh plants (Foote 1995). First record for Portugal.

Psilopa thora Dahl, 1973

Specimens examined: 07.IX.2020, 5 ♂. **Foz do Rio Novo**, **Salinas** (40°40'35.0"N 8°40'20.0"W), and **Reboxo** (40°39'42.9"N 8°41'39.9"W) on saltmarsh area, on *Spartina maritima*, *Halimione portulacoides*, *Juncus maritimus*.

Comments: Palaearctic: Afghanistan, Canary Islands, Greece (Zatwarnicki 2018). Larvae of the genera *Psilopa* are known to mine leaves of saltmarsh plants (Foote 1995). First record for the Iberian Peninsula.

Scatella ciliate Collin, 1930

Specimens examined: 10.IX.2020, 1 ♂. **Cacia** (40°41'44.2"N 8°37'31.4"W), saltmarsh area, on *Atriplex patula*.

Comments: Western-European with extension to Tunisia (Zatwarnicki 2011). Larvae of saltmarsh-inhabiting species of genera *Scatella* are known to feed on algae growing on marsh soils (Foote 1995). New species for Portugal.

Schema acrosticalis (Becker, 1903)

Specimens examined: 10.IX.2020, 1 ♀. **Cambeia (40°44'08.0"N 8°37'40.7"W)**, saltmarsh area, on *Jun-
cus maritimus*.

Comments: Palaearctic distribution (Mathis et al. 2017). Trophic ecology of this species is not known (Foote 1995). New species for Portugal.

Discussion:

Saltmarshes face many threats, either from natural or anthropogenic origin, and are among the fastest disappearing ecosystems worldwide (Bridgham et al. 2006). The vegetated saltmarshes, its mudflats, and saltpans provide a diverse range of habitats for several organisms, including insects, the most abundant and diverse animal group (Ameixa et al. 2020). For this reason, such threats can cascade into plant and animal diversity that depend on these ecosystems and their provided ecosystem services (Ameixa et al. 2018). Despite its importance, the knowledge regarding insect communities in saltmarshes is limited.

Albeit some *Psilopa* specimens could not be identified to species level because they were females, 9 new species were recorded for Portugal, 3 of them for the Iberian Peninsula (*Diasemocera fratella*, *Philotelma defectum* and *Psilopa thora*). This work contributes to increase the faunistic and ecological knowledge regarding Ephydriidae in Ria de Aveiro saltmarsh areas. Due to the lack of consistent collecting and sparse faunistic data, any reliable conclusions about Portuguese Ephydriidae fauna are restricted. Further records are expected, since no important work, up to now, has been done dedicated to this group in Portugal and a considerable number of additional species occur in Spain (Zatwarnicki 2002). This knowledge is also paramount in the context of halophyte plant production since several species are phytophagous and can represent potential pests.

Acknowledgments – Acknowledgments go to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020), through national funds; to project SUSHI (CENTRO-01-0145-FEDER-030818), co-funded by Centro 2020 program, Portugal 2020, FEDER, through FCT/MCTES; to PORBIOTA (POCI-01-0145-FEDER-022127), financed by FCT through PIDAC national funds and co-funded by the FEDER. OMCCA is funded by national funds (OE), through FCT, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19. The authors thank to Felipe Lourenço and Aldiro Pereira for field sampling help and Jens-Hermann Stuke for Ephydriidae identification.

References

- Ameixa, O.M.C.C., Soares A.O., Soares, A.M.V.M., Lillebø, A.I. (2018) Ecosystem Services Provided by the Little Things That Run the World. In: Selected Studies in Biodiversity. Bülent Şen and Oscar Grillo. (eds.), IntechOpen. DOI:10.5772/intechopen.74847
- Ameixa O.M.C.C., Sousa A.I. 2020. Saltmarshes: Ecology, Opportunities, and Challenges. In: Filho W.L., Azul A.M., Brandli L., Salvia A.L., Wall, T. (eds), Encyclopedia of the UN Sustainable Development Goals. Life Below Water. Switzerland. Springer, Cham. Doi: https://doi.org/10.1007/978-3-319-71064-8_79-1
- Bridgham S.D., Megonigal J.P., Keller J.K., Bliss N.B., Trettin, C. 2006. The carbon balance of north American wetlands. *Wetlands*, 26: 889–916, Doi: [https://doi.org/10.1672/0277-5212\(2006\)26\[889:TCBONA\]2.0.CO;2](https://doi.org/10.1672/0277-5212(2006)26[889:TCBONA]2.0.CO;2)
- Carles-Tolrá M. 2002. Catálogo de los Díptera de España, Portugal y Andorra (Insecta). Monografías de La Sociedad Entomológica Aragonesa, 8: 1–323.
- Carles-Tolrá M. 2009. *Athyroglossa ordinata* Becker: género y especie nuevos para Portugal (Diptera, Ephydriidae). *Boletín de La Sociedad Entomológica Aragonesa*, 45: 236.
- Carles-Tolrá M., Rosado J. 2009. Algunos dípteros de Portugal capturados mediante trampas de emergencia (Insecta, Diptera). *Boletín de La Sociedad Entomológica Aragonesa*, 44: 343–348.
- Collins N. 1980. Population ecology of *Ephydra cinerea* Jones (Diptera: Ephydriidae), the only benthic metazoan of the Great Salt Lake, USA. *Hydrobiologia*, 68: 99–112.
- Dawah H.A., Ahmad S.K., Abdullah M.A., Zatwarnicki T. 2019. An overview of the Ephydriidae (Diptera) of Saudi Arabia. *Zootaxa*, 4711(3): 401–445, Doi: <https://doi.org/10.11646/zootaxa.4711.3.1>
- Doyle R.D., Grodowitz M., Smart R.M., Owens C. 2002. Impact of herbivory by *Hydrellia pakistanae* (Diptera: Ephydriidae) on growth and photosynthetic potential of *Hydrilla verticillata*. *Biological Control*, 24(3): 221–229, Doi: [https://doi.org/10.1016/S1049-9644\(02\)00024-5](https://doi.org/10.1016/S1049-9644(02)00024-5)
- Foote B.A. 1995. Biology of shore flies. *Annual Review of Entomology*, 40: 417–442, Doi: <https://doi.org/10.1146/annurev.en.40.010195.002221>
- Grodowitz M.J., Smart M., Doyle R.D., Owens C.S., Bare R., Snell C., Freedman J., Jones H. 2004. *Hydrellia pakistanae* and *H. balciunasi*, insect biological control agents of hydrilla: boon or bust. *Proceedings of the XI International Symposium on Biological Control of Weeds (27 April-2 May 2003)*, Canberra, Australia, pp. 529-538. CSIRO Entomology, Canberra, Australia.
- Kubátová-Hiršová H. 2005. Temporal patterns in shore fly (Diptera, Ephydriidae) community structure in a salt marsh habitat. *Ecological Entomology*, 30: 234–240, Doi: <https://doi.org/10.1111/j.0307-6946.2005.00602.x>
- Lillebø A.I., Ameixa O.M.C.C., Sousa L.P., Sousa A.I., Soares J.A., Dolbeth M., Alves F.L. 2015. The physio-geographical background and the ecology of Ria de Aveiro (chapter 3), pp. 21–29. In: Lillebø A.I., Stålnacke P., Gooch G.D. (eds), *Coastal Lagoons in Europe: Integrated Water Resource Strategies*. IWA Publishing, London. Doi: <https://doi.org/10.2166/9781780406299>

- Mathis W.N., Zatwarnicki T. 1995. World catalog of shore flies (Diptera: Ephydriidae). *International Memoirs of Entomology*, 4: 1–423.
- Mathis W.N., Zatwarnicki T. 1998. Family Ephydriidae, pp. 537–570. In: Papp L., Darvas B. (eds), *Contributions to a Manual of Palaearctic Diptera: Higher Brachycera*. Vol. 3. Science Herald, Budapest.
- Mathis W., Zatwarnicki T., Kubátová-Hiršová H. 2009. A revision of the shore-fly genus *Philotelma* Becker (Diptera: Ephydriidae). *Insect Systematics & Evolution*, 40(2): 121–158, Doi: <https://doi.org/10.1163/187631209X416714>
- Mathis W.N., Zatwarnicki T., Stuke J.-H., Deeming J.C. 2017. Order Diptera, family Ephydriidae. A conspectus on shore-flies from the United Arab Emirates. *Arthropod Fauna of the UAE*, 6: 636–761.
- Oosterbroek P. 2006. *The European Families of the Diptera: Identification-Diagnosis-Biology*. KNNV Publishing, Utrecht, the Netherlands, 205 pp.
- Zatwarnicki T. 2002. Ephydriidae, pp. 164–166. In: Carles-Tolrà M. (ed), *Catálogo de los Diptera de España, Portugal y Andorra (Insecta)*. Monografías SEA, Vol 8. Zaragoza.
- Zatwarnicki T. 2011. The Ephydriidae of Sardinia (Diptera), pp. 733–748. In: Nardi G., Whitmore D., Bardiani M., Birtele D., Mason F., Spada L., Cerretti P. (eds), *Biodiversity of Marganai and Montimannu (Sardinia)*. Research in the framework of the ICP Forests network. Conservazione Habitat Invertebrati 5. Sommacampagna, Verona: Cierre Edizioni, 896 pp.
- Zatwarnicki T. 2018. Solving the puzzle of taxonomic position of the petroleum fly by resurrection of *Diasemocera* Bezzi from *Psilopa* Fallén (Diptera: Ephydriidae) with proposed specific and generic synonymies. *Annales Zoologici*, 68(3): 527–552, Doi: <https://doi.org/10.3161/00034541ANZ2018.68.3.012>
- Zatwarnicki T., Mathis W.N. 2011. Heterogeneity in shore flies – the case of *Glenanthe* Haliday (Diptera: Ephydriidae) in the Old World. *Annales de la Société Entomologique de France*, 47 (3-4): 418–443, Doi: <https://doi.org/10.1080/00379271.2011.10697735>

