

The northernmost record of *Ischiodon aegyptius* (Wiedemann, 1830) (Diptera, Syrphidae, Syrphinae) with possible evidence of its reproduction in Europe

Najsjeverniji nalaz vrste *Ischiodon aegyptius* (Wiedemann, 1830) (Diptera, Syrphidae, Syrphinae) s mogućim dokazom o reprodukciji u Europi

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Abstract

The genus *Ischiodon* Sack, 1913 (Diptera: Syrphidae) are small to medium-sized wasp mimic hoverflies with only four species worldwide: *Ischiodon aegyptius* (Wiedemann, 1830), *I. astales* Mengual, 2018, *I. feae* (Bezzi, 1912), and *I. scutellaris* (Fabricius, 1805). In Europe, *I. aegyptius* and *I. scutellaris* occur, but only in the southern part of the continent. In this article, we present the northernmost record of *I. aegyptius*, which is also the first finding of this species in the Balkan Peninsula. One larva was found in 2010 in Budva, Montenegro (a city on the Adriatic coast), on lemon tree twigs in association with the aphid *Aphis spiraeicola* Patch, 1914. The month of collection was May, before summer, when the adults probably migrate from Africa, suggesting that the species may be a resident in this part of Europe, at least temporarily. A brief description, photographs of the specimen, and short taxonomic notes are provided. The additional new records of *I. aegyptius* from Libya were presented. Notes are given on its potential reproduction in Europe and on its possible importance in the biological control of aphids.

Keywords: Adriatic, aphidophagous, Mediterranean

Sažetak

Rod *Ischiodon* Sack, 1913 (Diptera: Syrphidae) male su do srednje velike muhe koje oponašaju ose, sa samo četiri vrste diljem svijeta: *Ischiodon aegyptius* (Wiedemann, 1830), *I. astales* Mengual, 2018, *I. feae* (Bezzi, 1912), i *I. scutellaris* (Fabricius, 1805). U Europi se javljaju *I. aegyptius* i *I. scutellaris*, ali samo u južnom dijelu kontinenta. U ovom članku predstavljamo najsjeverniji nalaz vrste *I. aegyptius*, koji je ujedno i prvi nalaz ove vrste na Balkanskom poluotoku. Jedna je ličinka pronađena 2010. godine u Budvi, Crna Gora (grad na jadranskoj obali), na grančicama limuna u vezi s lisnom uši *Aphis spiraeicola* Patch, 1914. Mjesec sakupljanja bio je svibanj, prije ljeta, kada odrasle jedinke vjerojatno migriraju iz Afrike, što sugerira da bi vrsta mogla biti rezident u ovom dijelu Europe, barem privremeno. Daje se kratak opis, fotografije primjerka i kratke taksonomske bilješke. Prikazani su dodatni novi nalazi *I. aegyptius* iz Libije. Dane su napomene o njezinom potencijalnom razmnožavanju u Europi, te o njezinoj mogućoj važnosti u biološkoj kontroli lisnih uši.

Ključne riječi: Jadran, afidofagnost, Sredozemlje

Introduction - Uvod

The hoverflies (Syrphidae) are a large, globally distributed family of Diptera. The European fauna includes about 1,000 species divided into three subfamilies: Syrphinae, Microdontinae, and Eristalinae (Speight, 2020). Hoverflies are an ecologically important group of insects because they provide various ecosystem services, such as pollination, predation of aphids or other phytophagous insects, and participate in the decomposition of dead matter (Larson et al. 2001, Rojo et al. 2003).

The genus *Ischiodon* Sack, 1913 (Diptera, Syrphidae) is a small but widely distributed hoverfly genus that includes only four species: *Ischiodon aegyptius* (Wiedemann 1830), *I. astales* Mengual, 2018, *I. feae* (Bezzi, 1912), and *I. scutellaris* (Fabricius 1805) (Vockeroth, 1969; Mengual, 2018). All species of this genus are small to medium-sized, wasp-mimic hoverflies. The genus *Ischiodon* could be separated from all other genera by the following combination of characters: squamae are without long hairs, anterior part of mesopleuron and hypopleuron are bare, a mesoscutum with well-developed lateral yellow bands, a distinctly marked abdomen, wings without microtrichia, and, in males only, the presence of digitate or spine-like protuberances on the hind trochanter (Vockeroth 1969). The identification key for all known species is provided by Mengual (2018). The range of the genus includes almost the entire African continent, the Oriental and Australasian regions, some southern parts of Mediterranean Europe, and some islands. *Ischiodon astales* and *I. feae* are restricted to Madagascar and Cape Verde, respectively, while *I. aegyptius* and *I. scutellaris* have a much wider distribution and are both also found in Europe (Mengual 2018, Speight 2020). *Ischiodon scutellaris* occurs in Europe in the eastern Mediterranean, Greece (including the islands of Chios, Crete, Irakleia, Lesbos), Georgia, Turkey, and Ukraine (Crimean peninsula) (Likov 2018, Speight 2020), while *I. aegyptius* has been recorded in Cyprus, southern Spain (including the Canary and Balearic Islands), Madeira (not mainland Portugal), southern Italy, Corsica (not mainland France), and Greece (only on the island of Samos) (Rojo et al. 1997, Pita and Gomes 2003, Mengual 2018, Lebard et al. 2019, Van Steenis et al. 2019, 2021, Speight 2020).

Material and methods – Materijali i metode

The specimen was collected during the survey of Aphidiinae parasitoid wasps in Montenegro in 2010. A larva of this species was collected from lemon tree twigs infested with aphids and transferred to a plastic box covered with muslin cloth for ventilation. The larva was later reared under laboratory conditions and fed with aphids from the same colony. After adult hatching, the specimen was stored dry in the collection of the Institute of Zoology, University of Belgrade – Faculty of Biology, Belgrade, Serbia. Photographs of the specimen were taken with Nikon D5600 with AF –S VR Micro–NIKKOR 105mm f/2.8G IF–ED macro lens (Nikon Corp. Tokyo, Japan). The specimens from Libya were collected in the same manner as specimen from Montenegro, as a part of research on Aphidiinae parasitoid wasps. The specimens were collected from pomegranate and oleander tree twigs infested by aphids. The rearing was conducted in the same manner. All the Libyan specimens were stored dry in the same collection of the Institute of Zoology, University of Belgrade – Faculty of Biology, Belgrade, Serbia. Identification was performed using the keys in Speight and Sarthou (2017) and Mengual (2018). The distribution map was created using data from the following references: Dirickx (1994), Rojo et al. (1997), Pita and Gomes (2003),

Láska et al. (2006), Birtele et al. (2010), Mielczarek et al. (2010), De Courcy Williams et al. (2011), Sarıbiyık (2014), Ricarte and Marcos–García (2017), Likov (2018), Mengual (2018), El–Hawagry and Gilbert (2019), Lebard et al. (2019), Van Steenis et al. (2019, 2021), Vujić et al. (2019), Dawah et al. (2020), Sahib et al. (2020), Speight (2020), and Rego et al. (2022).

Results - Rezultati

Ischiodon aegyptius (Wiedemann, 1830) (Figure 1)

Material examined. MONTENEGRO • 1 larva (1 ♀ reared); Budva; 17.05.2010; leg. A. Petrović; collected from *Citrus × limon* (L.) Osbeck, feeding on *Aphis spiraeicola* Patch, 1914; LIBYA • 1 larva (1 ♂ reared); Misurata; 09.10.2010; leg. A. H. Shukshuk; collected from *Punica granatum* L. feeding on *Aphis* sp.; 10 larvae (7 ♂♂ and 3 ♀♀ reared); Zliten, Kadoosh; 32.466688, 14.566638, 9 m.a.s.l.; 18.04.2010; leg. A. H. Shukshuk; collected from *Nerium oleander* L. feeding on *Aphis nerii* Boyer de Fonscolombe, 1841.

Taxonomic notes. The morphological characters of the examined specimen from Montenegro completely correspond to the typical characters for the female of *Ischiodon aegyptius* in the keys Speight and Sarthou (2017) and Mengual (2018). Both authors mentioned the pattern on the abdominal tergite 2 as a feature for separating *I. aegyptius* and *I. scutellaris*: a typical female of *I. aegyptius* has a transverse, yellow band (connected in the midline of the tergite), while a typical female of *I. scutellaris* has a pair of transverse, yellow marks (separated in a midline of the tergite). Mengual (2018) also concluded that distinguishing females of these two species is difficult, due to variability in the pattern of tergite 2. Our specimen has a transverse yellow band on tergite 2, broadly connected in a midline of the tergite (Figure 1). In addition, the specimen was compared with *I. aegyptius* females from Libya and no significant differences were found.

Brief description of specimen from Montenegro. General appearance: body is small (length: 7.5 mm), slender; head (Figure 1A): eyes are separated on the frons (female), bare, large, face and genae are uniformly yellow, frons is yellow with distinct blackish mid–line, vertex is black and shiny, antennae are yellowish, third segment yellowish–brownish, arista missing due to damage, postocular orbitae are dusted silvery and with long, pale hairs; thorax (Figure 1B–D): mesoscutum is black, shiny, with numerous black, long, erect hairs and wide, yellow lateral bands, scutellum is yellowish, slightly darker in the middle part, with numerous long, pale hairs, especially at posterior margin, wings are translucent and without microtrichia, halteres are bright yellow, legs are almost completely yellow, hind femora are with slightly darker medio–apical part; abdomen (Figure 1B–C): tergites are mainly black, T2–4 with yellow bands, widely connected in the mid–line and connected to the lateral margin of tergites, T5 yellow at anterior, lateral and posterior margin, black in the middle, other tergites uniformly black with yellow lateral and posterior margins, sternites are yellowish, slightly darker in the mid–line.

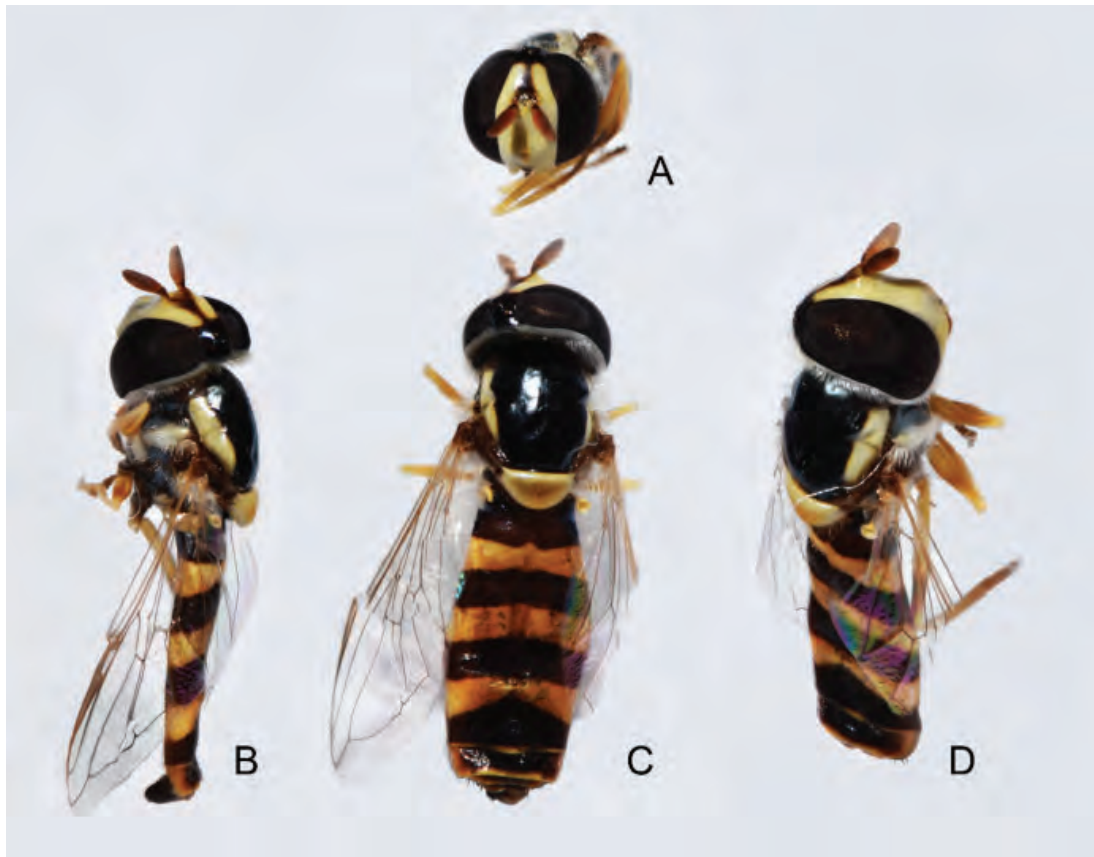


Figure 1. The female of *Ischiodon aegyptius* (Wiedemann, 1830) from Budva, Montenegro; a) head, frontal view; b) habitus, lateral view; c) habitus, dorsal view; d) habitus, dorsolateral view (specimen length 7.5 mm) (photo: A. Petrović).

Slika 1. Ženka *Ischiodon aegyptius* (Wiedemann, 1830) iz Budve, Crna Gora; a) glava sprijeda, frontalna strana; b) habitus, lateralna strana; c) habitus, dorzalna strana; d) habitus, dorzilateralna strana (duljina primjerka 7,5 mm) (foto: A. Petrović).

Habitat, biology, and trophic association. The habitat where *I. aegyptius* larva was found in Montenegro was a private yard with cultivated lemon trees. The larva was found in association with the aphid *Aphis spiraecola* on a lemon tree, *Citrus × lemon*, in the settlement of Budva located on the Adriatic coast. The specimens from Libya were collected in urban areas of the country from *Punica granatum* and *Nerium oleander* shrubs in association with *Aphis* sp. and *A. nerii*, respectively.

Discussion - Rasprava

According to Speight (2020), in Europe the adults are found exclusively during the summer months, suggesting that *I. aegyptius* is not a resident species, but also states that in favorable seasons populations can be temporarily established. In analyzing the available published data, we were unable to confirm the previous statement. Specimens of *I. aegyptius* were collected in southern Europe from May to November (e.g. 21.05.2004. Cerro del Barronal, (Spain); 07.11.2009. Lampedusa (Italy)) (Carles–Tolrá and Aguirre–Segura, 2007; Birtele et al. 2010). The larva collected in Montenegro was found in May, before summer, so it can indicate reproduction and the possible existence of an overwintering population. However, further research is needed to confirm the presence of a year-round population in Montenegro. Larvae collected in Libya were found in April and October, which is consistent with the species being present there year-round (Speight, 2020).

The record presented in this article is the first of *I. aegyptius* from Montenegro, but also the mainland area of the Balkan Peninsula. So far, the species has been recorded only in a few localities in Europe, mainly in the western Mediterranean (Rojo et al. 1997, Pita and Gomes 2003, Mengual 2018, Lebard et al. 2019, Speigh 2020) (Figure 2). Recently, Van Steenis et al. (2021) published data on the occurrence of this species on the island of Samos (Greece). In addition to Samos, there are also some scarce records from the central and eastern Mediterranean, such as Cyprus, Corsica (France), and Lampedusa (Italy) (Birtele et al., 2010; Van Steenis et al., 2019). *Ischiodon aegyptius* is not yet recorded in most Mediterranean islands, such as Malta, and almost all Greek and Croatian islands (Vujić et al. 2019, Popović et al. 2020, Ebejer and Gatt 2021). It is also still absent from some parts of the continental Mediterranean where its presence is expected, such as mainland Portugal (Van Eck 2016) (Figure 2).

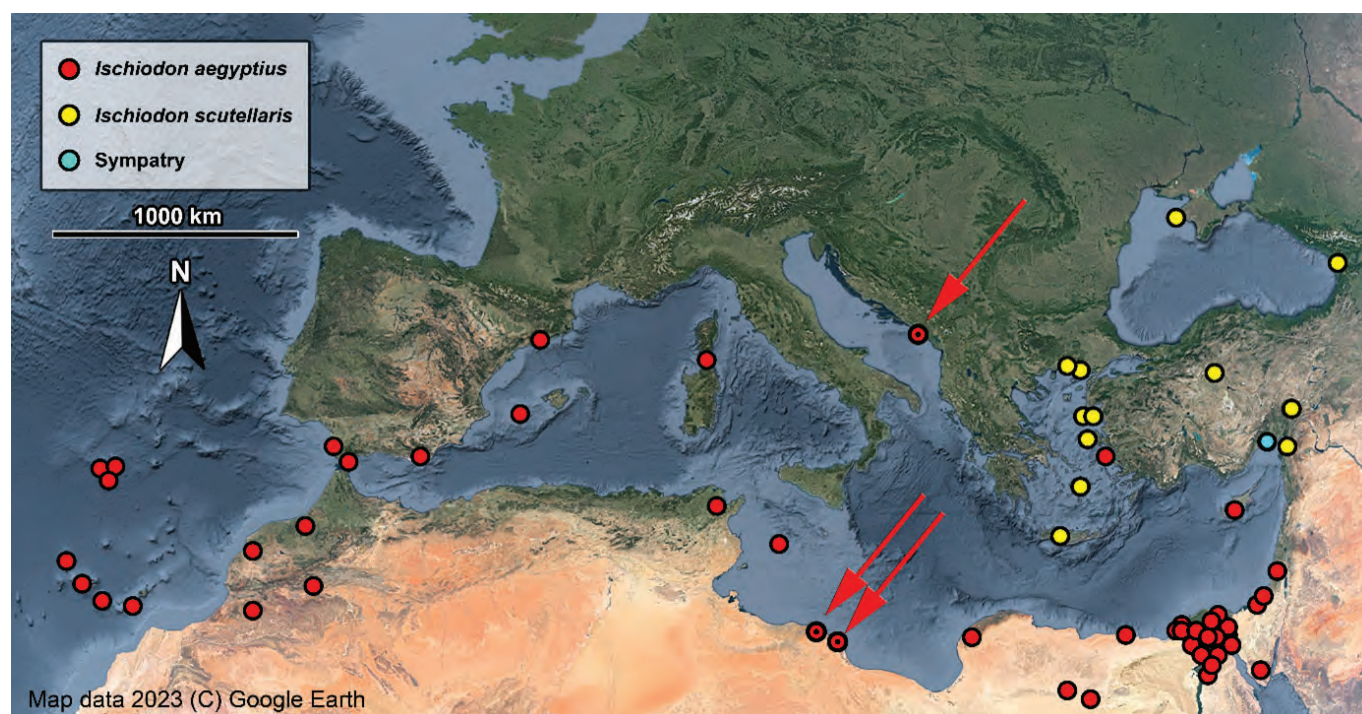


Figure 2 The distribution map of *Ischiodon aegyptius* (Wiedemann, 1830) and *I. scutellaris* (Fabricius, 1805) in the Mediterranean area; red target circle (indicated by red arrow) – new records of *I. aegyptius*; red circles – published records of *I. aegyptius*; yellow circles – published records of *I. scutellaris*; blue circle – the locality where both species occur sympatrically.

Slika 2. Karta rasprostranjenosti *Ischiodon aegyptius* (Wiedemann, 1830) i *I. scutellaris* (Fabricius, 1805) u sredozemlju; crveni ciljni krug (označeni crvenom strelicom) – novi zapisi *I. aegyptius*; crveni krugovi – objavljeni zapisi o *I. aegyptius*; žuti krugovi – objavljeni zapisi o *I. scutellaris*; plavi krug – lokalitet gdje se obje vrste pojavljuju simpatrično.

Sympatric populations of *I. aegyptius* and *I. scutellaris* are still not recorded in Europe, although it is very likely that both species occur in some places in the Aegean area. The island of Samos (where *I. aegyptius* occurs) and the islands of Chios and Irakleia (where *I. scutellaris* occurs) are only about 70 and 160 km apart, respectively (Likov 2018, Van Steenis et al. 2021). The areas where both species have been recorded are in the Cilician Plain and Adana Province in Turkey (Figure 2) and in the United Arab Emirates in the Arabian Peninsula (Saribiyik 2014, Mengual 2018). The Middle Eastern region is also a likely region for sympatric occurrence of both species, but this cannot be determined due to a significant lack of faunistic data. The specimen from Montenegro is the first record of *I. aegyptius* for the mainland of the Balkan Peninsula

region and the northernmost known locality where the species occurs. This locality is relatively distant from all other precise records in Europe, more than 800 km from Corsica, about 845 km from Samos, and about 930 km from Lampedusa. The northernmost records so far were from Corsica (France) and Moya, Barcelona (Spain), both about 100 km further south.

Although *Ischiodon aegyptius* was recorded in Europe (as *Xanthogramma catalanicum* Andreu, 1926) (Andreu 1926) almost a century ago, records of this species are still so sparse that no definite conclusions can be drawn. We can assume that *I. aegyptius* has probably become a permanent species in Mediterranean Europe, especially due to the fact that global warming is accelerating faster than predicted (Xu et al. 2018). In the context of accelerated global warming, species of the genus *Ischiodon*, particularly *I. aegyptius*, can potentially play an important role in the biological control of aphids, primarily in the Mediterranean region. It is not unrealistic to expect that *I. aegyptius* will permanently inhabit a larger area of the European coast in the near future, possibly replacing the usual aphidophagous syrphids.

In general, hoverfly larvae are well-known and effective biological control agents against plant pests (mainly aphids), both in the field and in greenhouses (Leroy et al. 2010). Compared to other aphid predators or parasitoids, syrphids can detect aphid colonies earlier in the season, and females can lay eggs over a large area due to their high mobility (Almohamad et al. 2009).

Larvae of *Ischiodon* species are non-selective, aphidophagous, and are known to be predators of various aphid species as well as some caterpillars (Rojo et al. 2003). Both *I. aegyptius* and *I. scutellaris* have been studied as potential biological control agents (e.g. Joshi et al. 1998, Sharanabasappa et al. 2007, Tapa-Yotto 2013, Faheem et al. 2019), and both showed promising results (Tapa-Yotto 2013, Faheem et al. 2019, Speigh, 2020).

Ischiodon aegyptius could be treated as a rare migrant species in Europe, but we could also benefit from its presence by reducing aphid colonies on economically important plants. Interestingly, Tapa-Yotto (2013) found that *I. aegyptius* does not attack aphid mummies parasitized by *Lysiphlebus testaceipes* Cresson, 1880 (Hymenoptera: Braconidae), which may be of great importance for biological control.

Additional surveys throughout Mediterranean Europe are needed in order to confirm our assumptions, and some of the future research should be directed towards the biocontrol potential of *Ischiodon aegyptius*.

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References - Literatura

- Almohamad, R., Verheggen, F.J., Haubruge, E. 2009. Searching and oviposition behavior of aphidophagous hoverflies (Diptera: Syrphidae): A review. *Biotechnology, Agronomy and Society and Environment*. 13(3): 467–481.
- Andreu, J. 1926. Notas dipterológicas. Una lista de Sírfidos para contribuir al conocimiento de los dípteros de España. *Boletín de la Sociedad Entomológica de España* 9: 98–126.
- Birtele, D., Zito, P., Pisciotta, S., Sajeva, M. 2010. Syrphidae (Diptera) from Lampedusa island. *Naturalista siciliano*. 34(3–4): 209–218.
- Carles–Tolrá, M., Aguirre–Segura, A. 2007. Algunos dípteros capturados en el parque natural Cabo de Gata–Níjar (Almería, España) (Insecta, Diptera). *Boletín Sociedad Entomológica Aragonesa*. 41: 197–202.
- Dawah, A.H., Abdullah, A.M., Ahmad, S.K., Al–Dhafer, H., Turner, J. 2020. An overview of the Syrphidae (Diptera) of Saudi Arabia. *Zootaxa*. 4855(1): 001–069.
- De Courcy Williams, M.E., Toussidou, M., Speight, M.C.D. 2011. Hoverflies (Diptera, Syrphidae) new to Greece from the Rhodope Mountains of Thrace and eastern Macedonia, including *Simosyrphus scutellaris* new to Europe. *Dipterists Digest*. 18: 181–198.
- Dirickx, H.G. 1994. Atlas des Diptères syrphides de la région méditerranéenne. Documents de travail de l'Institut royal des Sciences naturelles de Belgique. 317 pp.
- Ebejer, M., Gatt, P. 2021. A checklist of the Diptera (Insecta) of the Maltese Islands. *Zootaxa*. 5018(1): 001–075.
- El–Hawagry, M.S., Gilbert, F. 2019. Catalogue of the Syrphidae of Egypt (Diptera). *Zootaxa*. 4577(2): 201–248.
- Faheem, M., Saeed, S., Sajjad, A., Razaq, M., Ahmad, F. 2019. Biological parameters of two syrphid fly species *Ischiodon scutellaris* (Fabricius) and *Episyrphus balteatus* (DeGeer) and their predatory potential on wheat aphid *Schizaphis graminum* (Rondani) at different temperatures. *Egyptian Journal of Biological Pest Control*. 29: 2. <https://doi.org/10.1186/s41938-019-0105-0>
- Joshi, S., Ballal, C.R., Rao, N.S. 1998. An Efficient and Simple Mass Culturing Technique for *Ischiodon scutellaris* (Fabricius), an Aphidophagous Syrphid. *Indian Journal of Plant Protection*. 26(1): 56–61.
- Larson, B.M.H., Kevan, P.G., Inouye, D.W. 2001. Flies and flowers: taxonomic diversity of anthophiles and pollinators. *The Canadian Entomologist*. 133(4): 439–465.
- Láska, P., Pérez–Bañón, C., Mazánek, L., Rojo, S., Ståhls, G., Marcos–García, M.A., Bičík, V., Dušek, J. 2006. Taxonomy of the genera *Scaeva*, *Simosyrphus* and *Ischiodon* (Diptera: Syrphidae): Descriptions of immature stages and status of taxa. *European Journal of Entomology*. 103(3): 637–655.
- Lebard, T., Canut, M., Speight, M.C.D. 2019. Première observation en France d'*Ischiodon aegyptius* (Wiedemann, 1830) et découverte en Corse d'*Eumerus narcissi* Smith, 1928 (Diptera, Syrphidae). *Revue Française d'Entomologie Générale*. 1(3): 203–210.
- Leroy, P.D., Verheggen, F.J., Capella, Q., Francis, F., Haubruge, E. 2010. An introduction device for the aphidophagous hoverfly *Episyrphus balteatus* (De Geer) (Diptera: Syrphidae). *Biological Control*. 54(3): 181–188.
- Likov, L. 2018. *Hoverfly fauna* (Diptera: Syrphidae) of Greece. Doctoral dissertation, Novi Sad.
- Mengual, X. 2018. A new species of *Ischiodon* Sack (Diptera, Syrphidae) from Madagascar. *African Invertebrates*. 59(1): 55–73.
- Mielczarek, Ł., Popov, G., Lezhenina, I. 2010. New records of the Hover–Flies (Diptera, Syrphidae) from Crimea and Ukraine. *Vestnik Zoologii*. 44(6): 494.
- Pita, M., Gomes, A. 2003. Notes on the syrphid fauna of Madeira Archipelago and the Salvage Islands (Diptera, Syrphidae). *Vieraea*. 31: 33–38.
- Popović, M., Vasić, N., Koren, T., Burić, I., Živanović, N., Kulijer, D., Golubović, A. 2020. Biologer: an open platform for collecting biodiversity data. *Biodiversity Data Journal*. 8: e53014.
- Rego, C., Smit, J., Aguiar, A.F., Penado, A., Boieiro, M. 2022. A pictorial key for identification of the hoverflies (Diptera: Syrphidae) of the Madeira Archipelago. *Biodiversity Data Journal*. 10: e78518.
- Ricarte, A., Marcos–García, M.A. 2017. A checklist of the Syrphidae (Diptera) of Spain, Andorra and Gibraltar. *Zootaxa*. 4216(5): 401–440.
- Rojo, S., Gilbert, F.S., Marcos–García, M.A., Nieto, J.M., Mier, M.P. 2003. A World Review of Predatory Hoverflies (Diptera, Syrphidae: Syrphinae) and their Prey. *Cibio, Alicante*. 319 pp.

- Royo, S., Isidro, P.M., Perez–Bañón, C., Marcos–García, M.A. 1997. Revision of the hoverflies (Diptera: Syrphidae) from the Azores archipelago with notes on Macaronesian syrphid fauna. *Arquipélago. Life and Marine Sciences*. 15A: 65–82.
- Sahib, S., Driauach, O., Belqat, B. 2020. New data on the hoverflies of Morocco (Diptera, Syrphidae) with faunistic and bibliographical inventories. *Zookeys*, 971: 59–103.
- Sarıbiyık, S. 2014. Check list of Turkish Flower Flies (Diptera: Syrphidae). *Munis Entomology and Zoology*. 9(1): 570–585.
- Sharanabasappa, S., Kulkarni, K.K.A., Mallapur, C.P., Gundannavar, K.P., Kambrekar, D. 2007. Feeding potential of *Ischiodon scutellaris* (Fabricius) (Diptera: Syrphidae) on green peach aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae). *Journal of Biological Control*. 21: 177–178.
- Speight, M.C.D. 2020. Species accounts of European Syrphidae, 2020. *Syrph the Net, the database of European Syrphidae (Diptera)*, vol. 104, *Syrph the Net publications*. 314 pp.
- Speight, M.C.D., Sarthou, J–P. 2017. StN keys for the identification of the European species of various genera of Syrphidae 2017. *Syrph the Net, the database of European Syrphidae (Diptera)*, Vol. 99. *Syrph the Net publications*. 139 pp.
- Tepa–Yotto, G.T. 2013. *Lysiphlebus testaceipes* (Cresson) (Hymenoptera: Braconidae: Aphidiinae) in Benin: its potential as a biological control agent for integrated aphid management in vegetable systems. PhD Thesis, Norwegian University of Life Sciences, Norway.
- Van Eck, A. 2016. Hoverflies (Diptera, Syrphidae) new to the fauna of mainland Portugal, with an updated hoverfly checklist. *Boletín de la Sociedad Entomológica Aragonesa*. 59: 187–203.
- Van Steenis, J., Van der Ent, L–J., Ssymank, A., Van Zuijen, M.P., Van Steenis, W. 2021. Additional records of hoverflies (Diptera: Syrphidae) from Samos island, Greece. *Entomologia Hellenica*. 30: 43–63.
- Van Steenis, J., Van Zuijen, M.P., Van Steenis, W., Makris, C., Van Eck, A., Mengual, X. 2019. Hoverflies (Diptera: Syrphidae) of Cyprus: results from a collecting trip in October 2017. *Bonn zoological Bulletin*. 68(1): 125–146.
- Vockeroth, J.R. 1969. A revision of the genera of the Syrphini (Diptera: Syrphidae). *Memoirs of the Entomological Society of Canada*. 62: 1–176.
- Vujić, A., Speight, M., De Courcy Williamns, M., Rojo, S, Stähls, G., Radenković, S., Likov, L., Miličić, M., Pérez–Bañón, C., Falk, S., Petanidou, T. 2019. Atlas of the Hoverflies of Greece. Brill. 384 pp.
- Xu, Y., Ramanathan, V., Victor, D.G. 2018. Global warming will happen faster than we think. *Nature*. 564: 30–32.