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Special Section: The new Checklist of the Italian Fauna

The new Checklist of the Italian Fauna: Simuliidae

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SUMMARY

We present a dataset reporting the checklist of the species of the family Simuliidae (Diptera, Nematocera) for Italy, updating the one previously published in the series 'Checklist delle Specie della Fauna d'Italia' in 1995. The records of the updated checklist refer to the 70 species currently known from areas politically falling within the borders of Italy (belonging to 6 genera: 55 to *Simulium* genus, 8 to *Prosimulium*, 3 to *Metacnephia*, 2 to *Urosimulium*, 1 to *Greniera*, 1 to *Twinnia*) at the regional level (20 terrestrial units). The records refer to various freshwater lotic habitats, from glacier melting waters to large plain rivers. The previous checklist reported a total number of 71 species, of which one represented in Italy with 2 subspecies, belonging to 5 genera: 58 to *Simulium* genus, 9 to *Prosimulium*, 3 to *Metacnephia*, 1 to *Greniera*, 1 to *Twinnia*; *Urosimulium* genus was separated from *Prosimulium,* 8 species changed subgenus (since the former was disregarded), 1 new species was added, 2 species names were changed while 3 species and 1 subspecies were put in synonymy with other species. Scanning 18 papers we found published between 1997 and 2020, we could expand the regional records. The dataset is freely available from Lifewatch at https://www.lifewatchitaly.eu/en/initiatives/checklist-fauna-italia-en/checklist. The dataset will be dynamically updated with new records; this paper describes the state of the art of the dataset on December 2021.

INTRODUCTION

The project 'Checklist delle Specie della Fauna d'Italia' (Minelli et al. 1993-1995) and the following and related project "CKmap" (Stoch 2004; Ruffo & Stoch 2005) granted Italy to be one of the first countries to develop a complete checklist and distribution dataset of the animal species known for its territory. The aim of this data paper is to provide information on the updated checklist, limited to the family Simuliidae Newman, 1834 (Diptera, Nematocera), with the description of the state of the art of the updated dataset as it was in December 2021.

The project on the 'Updated Checklist of the Italian Fauna' started in 2020 (Bologna et al. 2022) and the process is now complete for the data on blackflies (Simuliidae, in Italian also known as "simulidi"). The database reported in this data paper (Supplementary file S1) will be continuously updated in the online webpage of LifeWatch, allowing for a dynamically updated knowledge on the occurrence of the fauna in the Country (Bologna et al. 2022).

The family Simuliidae, to date, is composed of about 2400 species (Adler 2021) of small dipterans (Figure 1) living during their preimaginal stages in several types of running freshwater, including snow melting waters, streams, and lotic habitats of large rivers, provided that there is a stable and smooth substrate to which they can anchor (Crosskey 1990). Adults are small flies with both sexes feeding on nectar, but females need a blood meal on warm-blooded vertebrates to lay eggs. Eggs are laid on stones or weeds by submerging females or freely laid on water surface. Larvae stay fixed or move on the substratum thanks to a peculiar system of hooks disposed in plates carried on two (aboral and oral) pseudopods, anchoring to some silk produced by the larva itself. They typically feed by passively filtering suspended particulate organic matter in running water thanks to a pair of cephalic fans. Pupae develop in the same habitat and present filamentous gills coming out their silk cocoon.

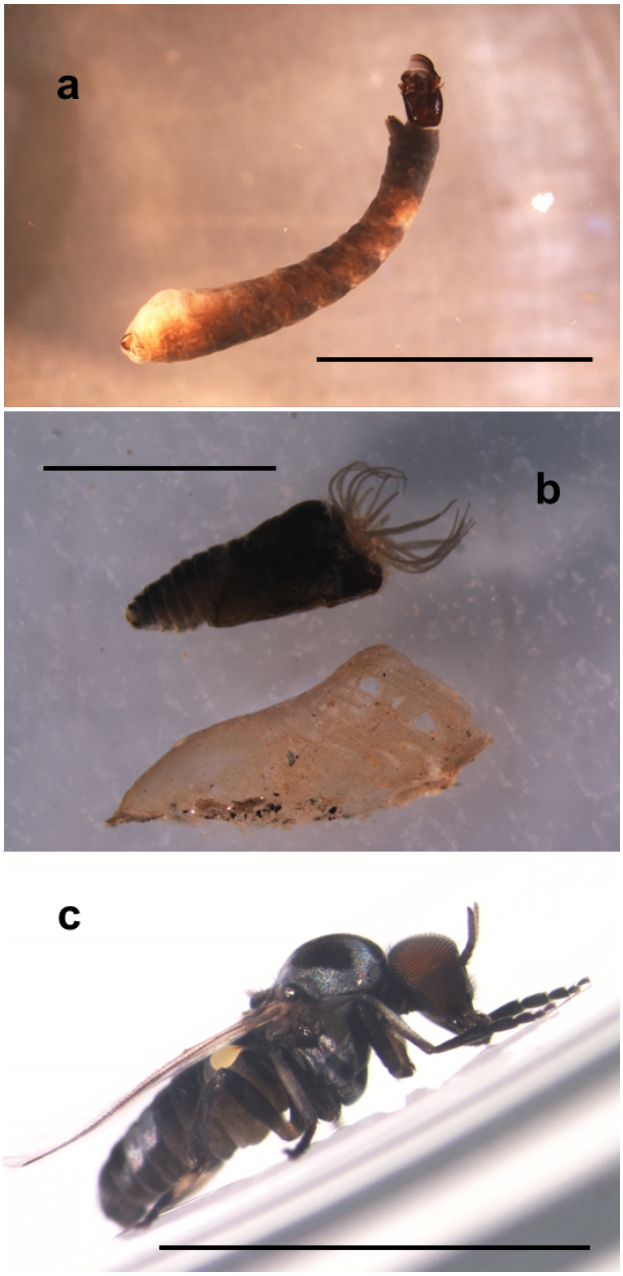

Figure 1. Images of different life stages of blackflies: a) larva of *Simulium carthusiense*, b) pupa of *Simulium liriense* with its cocoon, c) adult male of *Simulium erythrocephalum*. Scale bar = 0.5 cm. Photo by S. Ciadamidaro.

Blackflies are world-wide well-known pests due to bite of their female adults on humans and cattle (Adler & McCreadie 2002). While biting they inject anticoagulant saliva into the host animal, so that they can cause allergic

reactions (simuliotoxicosis) or be vectors of etiologic agents such as viruses, nematodes, and protozoa. Consequently, several studies were carried out in order to detect veterinarian and medical consequences of their blood-sucking habits, such as dermal reactions, cattle murrains (Ignjatovic-Cupina et al. 2006), or even transmission of serious diseases to people (e.g.: human river blindness; Richards et al. 2001).

Here we report the currently biogeographical knowledge for the known species of blackflies in Italy.

RESULTS

Summary statistics

The species list of the dataset accounts to 70 species of the Simuliidae family, with 55 species belonging to *Simulium* genus, 8 to *Prosimulium*, 3 to *Metacnephia*, 2 to *Urosimulium*, 1 to *Greniera* and 1 to *Twinnia*. *Simulium* Latreille, 1802 is the worldwide largest genus, and in Italy is represented by 8 subgenera: 1 species belongs to the subgenus *Boophtora*, 1 to *Byssodon*, 4 to *Eusimulium*, 1 to *Hellichiella*, 17 to *Nevermannia*, 21 to *Simulium* s.s., 5 to *Trichodagmia* and 5 to *Wilhelmia*. Species belonging to these subgenera are also traditionally ascribed to several species groups, often mentioned in specialist literature, which are pointed out in the "Taxon remarks" section of the checklist. Other genera present no subgenus. The previous checklist (Rivosecchi in Minelli et al. 1993-1995) reported a total number of 71 species and 1 subspecies belonging to 5 genera: 58 to *Simulium* genus, 9 to *Prosimulium*, 3 to *Metacnephia*, 1 to *Greniera* and 1 to *Twinnia*. In the period between 1995 and 2020, *Urosimulium* genus was separated from *Prosimulium,* 8 species changed subgenus (since the former was disregarded), 1 new species was added, 2 species names were changed while 3 species and 1 subspecies were put in synonymy with other species.

Northern Italy, with 47 species, presents the highest number of species, followed closely by Southern Italy with 44 species, Sicily with 18 and Sardinia with 16. The regions with the highest number of known species are Lazio (33), Piemonte (31) and Abruzzo (30), whereas for Valle d'Aosta and Puglia only 4 and 2 species are known, respectively (Figure 2). No studies are available to describe the blackfly fauna for San Marino Republic. 14 species are reported to be endemic of the Italian territories, while there is no record of blackfly alien species in Italy. It is highly probable that the number of species for some regions is still strongly underestimated, considering that the first two regions for species number (Lazio and Piemonte) are the main work locations of taxon specialists and, therefore, the subject of extensive research (Rivosecchi 1978; Ciadamidaro et al. 2012, 2016) like the one carried out by Rubtzov for Piemonte on behalf of the local university (Rubtzov 1956).

Dataset description

A simplified version of the dataset is given in the Supplementary file S1. The dataset includes information on 38 columns (Table 1). The first columns refer to the hierarchical taxa from Phylum to Family, followed by Genus and Genus authorship and Species and Species authorship, followed by columns for Subspecies. However, the latter category has not been widely used in the Simuliidae family historically, and in recent inventories (Adler 2020) no subspecies is accepted.

Two following columns report the species names as mentioned in the Fauna Europaea database (de Yong 2016).

Two columns report whether the species is currently known to be endemic to Italy or whether it is a recent alien introduction (no record for blackflies), according to the definition of the Secretariat of the Convention on Biological Diversity (2002).

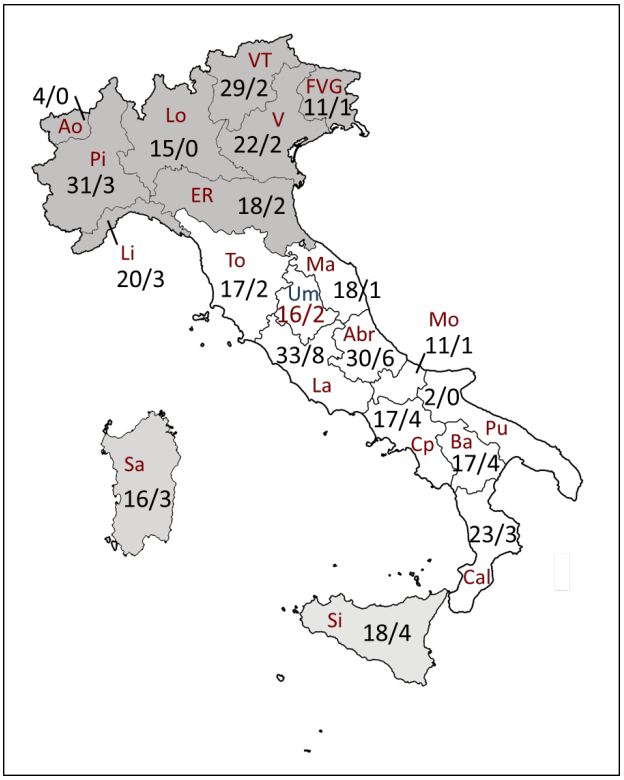

Figure 2. Territorial units (Regions) of Italy used for the checklist, with total number of species / number of Italian endemic species of blackflies for each region. Different shades of colour are used for the macro-areas Northern Italy, Southern Italy, Sicily and Sardinia.

The following columns report the known occurrence of blackflies in different geographical areas (Figure 2), according to the administrative regions of the country.

Two final columns report nomenclatorial changes occurred since the publication of the previous checklist by Rivosecchi (Minelli et al. 1995), the species group (if present) according to Adler's Inventory (2020), the chorotype changes and the literature reference used to expand the species list and the distribution of the species since Rivosecchi in Minelli et al. (1995).

Dataset information

Object name: Checklist of the Italian Fauna: Simuliidae

Characters encoding: Unicode (UTF-8)

Dataset citation: Ciadamidaro S., Mancini L., 2021. Simuliidae. In: Bologna M.A., Zapparoli M., Oliverio M., Minelli A., Bonato L., Cianferoni F., Stoch F. (eds), Checklist of the Italian fauna. Version 1.0. Last update: 2021-05-31.

Format name: xml, Extensible Markup Language, for the online version at LifeWatch Italy.

Format version: 1.0

Distribution: https://dataportal.lifewatchitaly.eu/view/urn%3Auuid%3Ac1f2ab37-61e4-48e9-b3a9-15bdbf002f9d

Date of creation: June 15th, 2020

Date of last revision: June 15th, 2020

Date of publication: June 15th, 2020

Update policy: July 23rd, 2021

Language: English

License of use: Creative Commons Attribution 4.0 International License

Metadata language: English

Metadata managers: Marco Bologna, Lucio Bonato, Fabio Cianferoni, Alessandro Minelli, Marco Oliverio, Fabio Stoch, Marzio Zapparoli & LifeWatch Italy.

Management details

Project title: The new Checklist of the Italian Fauna: Simuliidae

Database manager: Ciadamidaro S., Mancini L.; Marco Bologna, Lucio Bonato, Fabio Cianferoni, Alessandro Minelli, Marco Oliverio, Fabio Stoch, Marzio Zapparoli & LifeWatch.

Temporal coverage: anything published until 20th June 2020.

Record basis: Published records in the scientific and grey literature.

Funding grants: No funding was specifically available for the project on Simuliidae; funding for the update of the checklist of the Italian Fauna was obtained from LifeWatch Italy.

Table 1. Description of the dataset with specific information relative to definitions and storage type for each of the 38 columns of the dataset.

Variable (column)	Description	Storage type
Phylum	Phylum name, Arthropoda for all records	string
Class	Class name, Insecta for all records	string
Order	Order name, Diptera for all records	string
Family	Family name, Simuliidae for all records	string
Genus	Valid genus name, used according to Adler, 2021	string
Genus authorship	Genus descriptor, reported according to the rules of the ICZN	string
Species	Valid species name, used according to Adler, 2021	string
Species authorship	Species descriptor, reported according to the rules of the ICZN	string
Subspecies authorship	Subspecies descriptor, reported according to the rules of the ICZN	string
Fauna Europaea (name)	Species name as reported in Fauna Europaea	string
Endemic	Species known as endemic	binary
Alien	Species known as alien	binary
N	Occurrence of the taxon in Northern continental Italy (grouping: Friuli - Venezia Giulia, Veneto, Trentino - Alto Adige, Lombardia, Valle d'Aosta, Piemonte, Liguria, Emilia Romagna)	binary
S	Occurrence of the taxon in Southern continental Italy (grouping: Toscana, Marche, Umbria, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria)	binary
Si	Occurrence of the taxon in Sicily	binary
Sa	Occurrence of the taxon in Sardinia	binary
Ao	Occurrence of the taxon in Valle d'Aosta	binary
Pi	Occurrence of the taxon in Piemonte	binary
Lo	Occurrence of the taxon in Lombardia	binary
VT	Occurrence of the taxon in Trentino - Alto Adige	binary
V	Occurrence of the taxon in Veneto	binary
FVG	Occurrence of the taxon in Friuli - Venezia Giulia	binary
Li	Occurrence of the taxon in Liguria	binary
ER	Occurrence of the taxon in Emilia Romagna	binary
To	Occurrence of the taxon in Toscana	binary
Ma	Occurrence of the taxon in Marche	binary
Um	Occurrence of the taxon in Umbria	binary
La	Occurrence of the taxon in Lazio	binary
Abr	Occurrence of the taxon in Abruzzo	binary
Mo	Occurrence of the taxon in Molise	binary
Cp	Occurrence of the taxon in Campania	binary
Pu	Occurrence of the taxon in Puglia	binary
Bas	Occurrence of the taxon in Basilicata	binary
Cal	Occurrence of the taxon in Calabria	binary
RSM	Occurrence of the taxon in Repubblica di San Marino	binary
CV	Occurrence of the taxon in Città del Vaticano	binary
Taxonomic notes	Indication of species group (when present); Nomenclatorial changes from the previous checklist of Rivosecchi in Minelli et al. (1995); other notes	string
Distribution notes	Literature reference for the records in a geographical unit not reported by Rivosecchi in Minelli et al. (1995); Chorotype changes	string

Geographic information

General description: The dataset includes records from the national territory of Italy, including the two major islands Sardinia and Sicily, together with archipelagos and minor islands politically under the Italian legislation.

Geographic units: The geographical units within the Italian national territory for terrestrial records refer to the administrative boundaries of the 20 Italian regions, in addition to San Marino Republic and Vatican City. According to the geographical subdivision of Minelli et al. (1995), continental Italy was also divided in only two units, namely North (Friuli - Venezia Giulia, Veneto, Trentino - Alto Adige, Lombardia, Valle d'Aosta, Piemonte, Liguria, Emilia Romagna) and South (Toscana, Marche, Umbria, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria).

Bounding box: All areas falling under Italian administration (in addition to San Marino and Vatican City) from 35° 25' to 47° 06' N and from 6° 35' to 19° 20' E (WGS84 reference system) were included.

Sampling design: We did not perform any additional sampling to collect records of blackflies, but we used only published data or the first author's unpublished data.

Habitat type: Larvae and Pupae: several types of running freshwater, including snow melting waters, streams and lotic habitats of large rivers. Adults: flying insects, feeding, resting and ambushing warm-blooded hosts in vegetation typically not far from rivers.

Biogeographic region: Within the Palearctic realm, according to the definitions of the European Environmental Agency (2017), the dataset covers three European biogeographical regions: Alpine, Continental, and Mediterranean.

Countries: Italy, San Marino and Vatican City.

Quality control for geographic data: We checked that the georeferenced records and the published localities in the papers indeed matched the geographical units used for the checklist at the level of administrative regions for terrestrial records.

Literature records

General description: Mostly published records are included in the dataset, plus a small number of unpublished records by S. Ciadamidaro. A search through the literature was performed on 30th June 2020.

Literature search methods: We searched through Web of Science, Scopus, and Google Scholar for keywords ('blackfly' or 'Simuliidae', and 'Italy' or 'Italian'). We also scanned the abstract books of the 8 "International Simuliidae Symposiums" held between 1995 and 2018.

Literature list: The 9 papers published after the previous checklist by Rivosecchi in Minelli et al. (1995) and that provided blackfly records for new areas are: Adler et al. (2015), Ciadamidaro et al. (2016), Crosskey & Howard (1997), Hernández Triana (2011), Kúdela et al. (2018), Raastad et al. (2010), Rivosecchi et al. (2007), Rivosecchi & Maiolini (2012), Seitzn & Adler (2009). Grey literature papers published after the previous checklist and that provided blackfly records for new areas are: Adler (2020), Adler & Crosskey (2008), Ciadamidaro (2018), Ciadamidaro et al. (2012), Ciadamidaro et al. (2014), Favrin & Mattassi (2014), Ignjatović Ćupina et al. (2014), Kúdela et al. (2014), Rivosecchi et al. (2014).

Quality control for literature data: Some references were searched through the grey literature with online searches outside the three academic databases. In particular, "The Simuliid Bulletin" and the abstract books of "International Simuliidae Symposiums" held between 1995 and 2018 were important sources of data. Valuable information was obtained from Adler and Crosskey's annual world blackfly taxonomic and geographical inventories, which are now edited by Adler (2021). We do not claim that the checklist is absolutely complete, but that it is the best we could do. The dynamic nature of the online dataset at

LifeWatch will allow including potentially overlooked records.

Taxonomic information

General description: Only records reporting species were included, disregarding records at higher levels like genus, family, etc.

Taxonomic coverage: Any species of the family Simuliidae.

Taxonomic rank: Only species are reported; the dataset includes data also for higher categories for each species, including Phylum, Class, Order, Family, Genus and Species.

Taxon specialists: Simone Ciadamidaro, Laura Mancini.

Nomenclature: The adopted nomenclature followed the species names in Adler's Inventory "World blackflies (Diptera: Simuliidae): a comprehensive revision of the taxonomic and geographical inventory" – last version (2021) available from https://biomia.sites.clemson.edu/pdfs/blackflyinventory.pdf. Species authorships follow the rules of art. 51.3 of the 4th edition of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature, 1999) for the use of parentheses.

Taxonomic remarks: Any taxonomic change that occurred since the publication of the previous checklist (Rivosecchi in Minelli et al., 1995) is mentioned, according to the nomenclature of Adler's Inventory (2020). Species that were included in the previous checklist and are now considered not valid by Adler's Inventory are excluded from the dataset.

Quality control for taxonomic data: Taxonomic data were checked and updated to include revision of names, synonyms, and delimitation of genera, all conducted through a comparison with Adler's Inventory (2020).

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the Guest editors for the special section

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