

The new Checklist of the Italian Fauna: Mecoptera

AGOSTINO LETARDI

*National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA),
Casaccia Research Centre, Via Anguillarese 301, I-00120 Roma (Italy)*

corresponding author, email: agostino.letardi@enea.it

Keywords: Bittacidae, Boreidae, Panorpidae, scorpionflies, species list

SUMMARY

We present a data set reporting the checklist of the species of the order Mecoptera for Italy, updating the one previously published in the series ‘Checklist delle Specie della Fauna d'Italia’ in 1995. The updated checklist comprises 11 taxa at the species and subspecies level, currently known from national Italian territories (7 Panorpidae, 2 Bittacidae, 2 Boreidae). The records are at the regional level and refer to various terrestrial habitats. The previous checklist reported 10 taxa (6 Panorpidae, 2 Bittacidae, 2 Boreidae): no taxa were removed because currently considered not valid and one was added, after scanning 16 papers published between 1993 and 2020 and expanding the regional records. The data set is freely available from LifeWatch Italy at <https://www.lifewatchitaly.eu/en/initiatives/checklist-fauna-italia-en/checklist>. The data set will be dynamically updated with new records; this paper describes the state of the art of the data set on December 2021.

INTRODUCTION

Thanks to the pioneering work carried out towards the end of the last century, achieved thanks to the project ‘Checklist delle Specie della Fauna d'Italia’ (Minelli et al. 1993-1995), the animal biodiversity of our country was one of the first to be exhaustively listed, photographing the situation of that period. The aim of this data paper is to provide information on the updated checklist, limited to the order

Mecoptera, with the description of the state of the art of the updated data set as it currently stands 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 the order Mecoptera. The database reported in this data paper will be continuously updated in the online platform of LifeWatch Italy, allowing for a dynamically updated knowledge

on the occurrence of the fauna in the country (Bologna et al. 2022).

The order Mecoptera is a small, relict group of holometabolous insects generally called “scorpionflies” because the males of some families have bulbous genitalia on an upturned abdominal tip, which resembles a scorpion’s stinger. Today, there are only approximately 737 extant species, distributed among 39 genera and nine families (Bicha 2018). However, during their long evolutionary history, Mecoptera inhabited almost all the continents during the Permian and continued to be one of the most abundant groups of insects until the Cretaceous, when they declined in abundance to the recent level. The order is peculiar for this reason, with seven of its nine extant families having one to a score of species, with the remaining two families – Bittacidae, with essentially a Southern Hemisphere distribution (and possible Gondwanan origin), and Panorpidae, with mostly a Northern Hemisphere distribution (and possible Laurasian origin) – containing 91% of the species. Moreover, it is subject of debate whether the Mecoptera form a single clade, or whether the Siphonaptera (fleas) are inside that clade, so that the traditional “Mecoptera” is paraphyletic (Meusemann et al. 2020). Concerning the present checklist, scorpionflies are here considered in their traditional meaning, without the inclusion of Siphonaptera, considering three families observed in Italy, i.e. Boreidae, Bittacidae, and Panorpidae (Willmann 2012) (see Fig. 1), which show different morpho- and ecological characteristics. For example, most mecopteran larvae have compound eyes like those of hemimetabolous larvae, but boreid larvae appear to have only stemmata. Scorpionflies diet is diverse too: adult bittacids are predaceous; panorpids are saprophagous, and boreids are phytophagous.

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

A simplified version of the checklist is given in Supplementary File S1.



Figure 1. Representative scorpionflies: a) the boreid *Boreus hyemalis* (Linnaeus, 1767), b) the bittacid *Bittacus italicus* (Müller, 1766), c) the panorpid *Panorpa annexa* McLachlan, 1869. Photo courtesy of Pierre Tillier (a, b) and Marcello Romano (c).

RESULTS

Summary statistics

The species list accounts to 11 taxa at the species and subspecies level, with 2 taxa of Bittacidae, 2 of Boreidae, and 7 of Panorpidae. The previous checklist (Bernardi Iori et al. 1995) reported 10 taxa: 2 Bittacidae, 2 Boreidae, 6 Panorpidae. The current update includes one more taxa, with some nomenclatorial changes occurred since 1995.

Northern Italy and Southern Italy count the same biodiversity, with 9 species (Fig. 2). The regions with the highest number of known species (7) are Piemonte, Veneto and Trentino-Alto Adige, whereas for Puglia no species are known. No species are known for Vatican City too, but recently *Bittacus hageni* (Brauer, 1860) has been reported for San Marino Republic (Fig. 3).

Data set description

The data set includes 40 fields (Table 1). The first fields refer to the hierarchical taxa from Phylum to Family, followed by Genus and Genus authorship, Species and Species authorship, and eventually, when necessary, Subspecies and Subspecies authorship.

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

Two fields report whether the species is currently known to be endemic to Italy or whether it is a recent alien introduction, according to the definition of the Secretariat of the Convention on Biological Diversity (2002).

The following fields report the known occurrence of scorpionflies in different geographical areas (Fig. 2 and 3).

Two final fields report nomenclatorial changes occurred since the publication of the previous checklist by Bernardi Iori et al. (1995) and the literature references used to expand the

species list and the distribution of the species since Bernardi Iori et al. (1995).

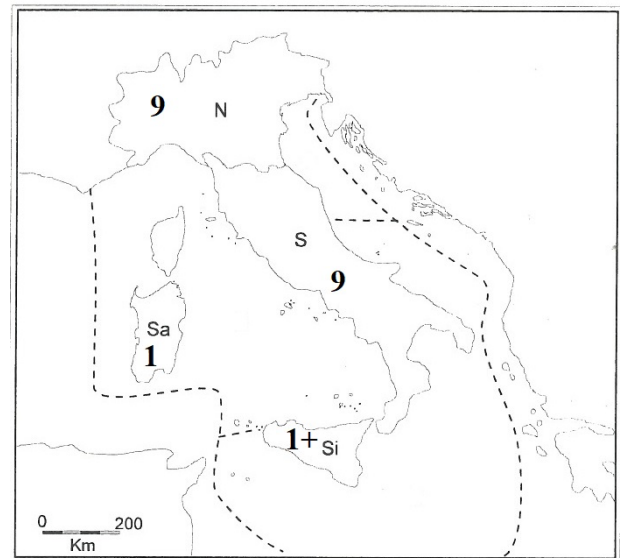


Figure 2. Geographical units of Italy used for the checklist, with number of species of Mecoptera for each of them. The + sign in Sicily means the doubtful presence of a second species.



Figure 3. Regional units of Italy, San Marino Republic and Vatican City, used for the checklist, with number of species of Mecoptera for each unit (San Marino Republic and Vatican City in red colour). The + sign in Calabria and Sicily means the doubtful presence of a second species.

Table 1. Description of the data set with specific information relative to definitions and storage type for each of the 40 fields of the data set.

Variable (field)	Description	Storage type
Phylum	Phylum name, Arthropoda for all records	string
Class	Class name, Insecta for all records	string
Order	Order name, according to Willmann (2012)	string
Family	Family name, according to Willmann (2012)	string
Genus	Valid genus name, followed the species names in the world checklist for Mecoptera (Penny & Byers 1979) and subsequent revisions	string
Genus authorship	Genus descriptor, reported according to the rules of the ICZN	string
Species	Valid species name, followed the species names in the world checklist for Mecoptera (Penny & Byers 1979) and subsequent revisions	string
Species authorship	Species descriptor, reported according to the rules of the ICZN	string
Subspecies	Valid subspecies name, followed the species names in the world checklist for Mecoptera (Penny & Byers 1979) and subsequent revisions	string
Subspecies authorship	Subspecies descriptor, reported according to the rules of the ICZN	string
Fauna Europaea (name)	Species name as reported in FaunaEuropaea	string
WoRMS (AphiaID)	Species AphiaID as reported in WoRMS	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	Nomenclatorial changes from the previous checklist of Bernardi Iori et al. (1995)	string
Distribution notes	Literature reference for the records in a geographical unit not reported in Bernardi Iori et al. (1995)	string

Data set information

Object name: The new Checklist of the Italian Fauna: Mecoptera

Characters encoding: Unicode (UTF-8)

Data set citation: Letardi A., 2021. Mecoptera. In: Bologna M.A., Zapparoli M., Oliverio M., Minelli A., Bonato L., Cianferoni F., Stoch F. (eds), The new 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: July 23rd, 2021

Language: English

License of use: Creative Commons Attribution 4.0 International License

Metadata language: English

Metadata managers: Marco A. 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: Mecoptera

Database manager: Letardi A.; Marco A. Bologna, Lucio Bonato, Fabio Cianferoni, Alessandro Minelli, Marco Oliverio, Fabio Stoch, Marzio Zapparoli & LifeWatch Italy

Temporal coverage: Anything published until 15 June 2020.

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

Funding grants: No funding was specifically available for the project on Mecoptera; funding for the update of the Checklist of the Italian fauna was obtained from LifeWatch Italy.

Geographic information

General description: The data set includes records from the national territories 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 territories for terrestrial records refer to the administrative boundaries of the 20 Italian regions, in addition to San Marino Republic and Vatican City. Continental Italy was also divided in 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 Republic 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 scorpionflies, but we used only published data or verified personal communications.

Habitat type: Any type of habitat where scorpionflies can be found was considered (Bicha 2018). These include all terrestrial habitats. The terrestrial habitats refer to lush, herbaceous vegetation growing in the shade of forests, often along slow-moving streams, under or near shrubs or trees that provide protection from direct sun (bittacids and panorpids, although in mountainous areas, the former generally seem to prefer lower elevations than do the latter); lichens and mosses in snowy, mountains areas (boreids).

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

Countries: Italy, San Marino, 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.

Literature records

General description: Only published records are included in the data set. A search through the literature was performed on 15th June 2020.

Literature search methods: We searched through Web of Science, Scopus, and Google Scholar for keywords ('scorpionflies' or 'Mecoptera') and ('Italy' or 'Italian').

Literature list: The 16 papers published after the previous checklist by Bernardi Iori et al. (1995) and that provided scorpionflies records for new areas, not previously reported in Bernardi Iori et al. (1995), are: Allegro (1996), Casali & Santi (2020), Letardi (1997, 1998, 2002, 2003a, 2003b, 2004, 2005, 2007, 2009), Letardi & Malzefz (2001), Letardi & Vigna Taglianti (2003), Sforzi et al. (2019), Terzani & Mazza (2012), Willmann (2012).

Quality control for literature data: Additional references were searched through the grey literature with online searches outside the three academic databases and no new records were found. In addition, we scanned the cited references of each paper and we did not find additional overlooked records. 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 data set at Lifewatch will allow including potentially overlooked records.

Taxonomic information

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

Taxonomic coverage: Order Mecoptera, intended in its traditional inclusion of Panorpidae, Bittacidae, and Boreidae, and the exclusion of Siphonaptera (Willmann 2012).

Taxonomic rank: Only species and subspecies are reported; the data set reports higher taxa for each species, including Phylum, Class, Order, Family, Genus.

Taxon specialist: Agostino Letardi.

Nomenclature: The adopted nomenclature followed the species names in the world checklist for Mecoptera (Penny & Byers 1979) and subsequent revisions. 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 (Bernardi Iori et al. 1995) is mentioned, according to the updated nomenclature of the Mecoptera.

Quality control for taxonomic data: Taxonomic data were checked and updated to include revision of names, synonyms, delimitation of genera and higher taxa, all conducted through a comparison with the world checklist for Mecoptera (Penny & Byers 1979) and subsequent revisions.

ACKNOWLEDGEMENTS

We thank the 'Comitato Scientifico per la Fauna d'Italia', who pursued the updates for the checklist of the Italian Fauna. We thank Marcello Romano and Pierre Tillier for providing the photos of Fig. 1.

REFERENCES

- Allegro, G. (1996). Osservazioni sul comportamento del Picchio rosso maggiore, *Picoides major*, in pioppeto durante periodo di riproduzione. Rivista italiana di Ornitologia, 66(1), 17-27.
- Bernardi Iori, A., Kathirithamby, J., Letardi, A., Pantaleoni, R.A., & Principi M.M. (1995). Neuropteroidea (Megaloptera, Raphidioptera, Planipennia), Mecoptera, Siphonaptera, Strepsiptera - In: Minelli, A., Ruffo, S. & La Posta, S. (eds) Checklist delle specie della fauna italiana, 62. Calderini, Bologna.
- Bologna, M.A., Bonato, L., Cianferoni, F., Minelli, A., Oliverio, M., Stoch, F. & Zapparoli, M. (2022) Towards the new Checklist of the Italian fauna. Biogeographia – The Journal of Integrative Biogeography, 37, ucl001. DOI: 10.21426/B637156271
- Bicha, W. J. (2018). Biodiversity of Mecoptera. pp. 705-720. In: Foottit, R. G., & Adler, P. H. Insect Biodiversity: Science and Society, Volume II. John Wiley & Sons Ltd, 1024 pp.
- Casali, S. & Santi, F. (2020). Segnalazioni faunistiche n. 184 - *Bittacus hageni* (Brauer, 1860) (Insecta: Mecoptera: Bittacidae). Quaderno di Studi e Notizie di Storia Naturale della Romagna, 52: 271-272.
- de Jong, Y. (2016). Fauna Europaea. Fauna Europaea Consortium. Checklist dataset DOI: 10.15468/yml1bx accessed via GBIF.org on 2021-05-23.
- European Environmental Agency (2017). Biogeographical regions in Europe. European Topic Centre on Biological Diversity (ETC/BD). Permalink: 3431629fe50049a7b995d125aad9c71d
- International Commission on Zoological Nomenclature (1999). International Code of Zoological Nomenclature, fourth edition. The International Trust for Zoological Nomenclature, London. Available at: <https://www.iczn.org/the-code/the-international-code-of-zoological-nomenclature/the-code-online/>
- Letardi, A. (1997). Mecoptera - In: Zapparoli, M., (a cura di). Gli Insetti di Roma. Quaderni dell' Ambiente, 6, 237-238.
- Letardi, A. (1998). *Bittacus hageni* Brauer, 1860 in Veneto (Mecoptera, Bittacidae). Bollettino del Museo Civico di Storia Naturale, Venezia, 48, 125-126.
- Letardi, A. (2002) Megaloptera, Neuroptera, Mecoptera p.105 - In: Mason, F., Cerretti, P., Tagliapietra, A., Speight, M.C.D., & Zapparoli, M. (eds). Invertebrati di una foresta della Pianura Padana, Bosco della Fontana, Primo contributo. Conservazione Habitat Invertebrati 1 - Gianluigi Arcari Editore, Mantova, 176 pp.
- Letardi, A. (2003a). Nuovi dati sulla distribuzione peninsulare ed insulare italiana di Mecotteri (Mecoptera). Frustula Entomologica n.s. 24 (37), 99-102.
- Letardi, A. (2003b). Neuropterida, Mecoptera p.122-123. In: Cerretti, P., Tagliapietra, A., Tisato, M., Vanin, S., Mason, F., & Zapparoli, M. (eds). Artropodi dell'orizzonte del faggio nell'Appennino Settentrionale, Primo contributo. Conservazione Habitat Invertebrati 2. Gianluigi Arcari Editore, Mantova, 256 pp.
- Letardi, A. (2004). L'andamento del volo di *Panorpa cognata* e *Panorpa communis* (Mecoptera, Panorpididae). In: Cerretti, P., Hardersen, S., Mason, F., Nardi, G., Tisato, M., & Zapparoli, M. (eds). Invertebrati di una foresta della Pianura Padana, Bosco della Fontana. Secondo contributo. Conservazione Habitat Invertebrati, 3. Cierre Grafica Editore, Verona: 181-184.
- Letardi, A. (2005). Insecta Mecoptera. In: Ruffo, S., & Stoch, F. (eds). Checklist e distribuzione della fauna italiana. Memorie del Museo Civico di Storia Naturale di Verona, 2 serie, Sezione Scienze della Vita 16: 237-238.
- Letardi, A. (2007). Rafidiotteri, Neurotteri e Mecotteri del Parco e delle aree adiacenti (Raphidioptera, Neuroptera, Mecoptera), pp. 297-305. In: Nardi, G. & Vomero, V. (eds). Artropodi del Parco Nazionale del Vesuvio: ricerche preliminari. Conservazione Habitat Invertebrati, 4. Cierre edizioni, Verona.
- Letardi, A. (2009). Neurotteri e Mecotteri delle Riserve Naturali "Agoraie di Sopra e Moggetto" (Liguria, Genova) e "Guadine Pradaccio" (Emilia-Romagna, Parma) (Megaloptera, Raphidioptera, Neuroptera, Mecoptera). Bollettino dell'Associazione Romana di Entomologia, 64(1-4), 281-291.
- Letardi, A. (2021). Insecta Mecoptera. 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. Available at: <https://www.lifewatchitaly.eu/en/initiatives/checklist-fauna-italia-en/checklist/>
- Letardi, A., & Maltzeff, P. (2001) Neurotteridi e Mecotteri della Tenuta Presidenziale di Castelporziano e delle aree limitrofe (Neuroptera, Raphidioptera, Mecoptera). *Bollettino dell'Associazione Romana di Entomologia*, 56(1-4), 49-62.
- Letardi, A., & Vigna Taglianti, A. (2003). Il genere *Boreus* in Italia, nuovo per la fauna appenninica. *Bollettino dell'Associazione Romana di Entomologia* 58, 95-100.
- Meusemann, K., Trautwein, M., Friedrich, F., Beutel, R. G., Wiegmann, B. M., Donath, A., Podsiadlowski, L., Petersen, M., Niehuis, O., Mayer, C., Bayless, K. M., Shin, S., Liu, S.-l., Hlinka, O., Quang Minh, B., Kozlov, A., Morel, B., Peters, R. S., Bartel, D., Grove, S., Zhou, X., Misof, B., & Yeates, D. K. (2020). Are fleas highly modified Mecoptera? Phylogenomic resolution of Antliophora (Insecta: Holometabola). *bioRxiv* 2020.11.19.390666; DOI: 10.1101/2020.11.19.390666
- Minelli, A., Ruffo, S., & La Posta, S. (eds) (1993-1995). Checklist delle specie della Fauna d'Italia. Ministero dell'Ambiente, Comitato Scientifico per la Fauna d'Italia. Calderini Editore.
- Penny, N.D., & Byers, G.W. (1979). A Check-list of the Mecoptera of the world. *Acta Amazonica*, 9(2), 365-388.
- Secretariat of the Convention on Biological Diversity (2002). Decision VI/23: Alien species that threaten ecosystems, habitats and species. Document UNEP/CBD/COP/6/23. Convention on Biological Diversity Secretariat, Montreal, Canada. Available at: <https://www.cbd.int/decision/cop/?id=7197>
- Sforzi, A., Bastianini, M., Benocci, A., Bonari, G., Bruni, G., Canovai, R., Cantini, D., Chelazzi, L., Chiodini, E., Cianferoni, F., Colombini, I., Fanciulli, P.P., Fastelli, P., Forbicioni, F., Lenzini, L., Letardi, A., Marcelli, M., Martelli, C., Montera-stelli, E., Monti, F., Mori, E., Nappini, S., Paoli, L., Petrucci, E., Porciani, M., Rizzo Pinna, V., Selvi, F., Spilinga, C., & Vitillo, C. (2019). Bioblitz 2016 Lago dell'Accesa. *Atti del Museo di Storia Naturale della Maremma*, 24, 77-111.
- Terzani, F., & Mazza, G. (2012). Le *Panorpa* Linnaeus, 1758 del Parco nazionale delle Foreste casentinesi, monte Falterona e Campigna (Mecoptera: Panorpidae). *Onychium*, 9, 108-110.
- Willmann, R. (2012). Fauna europaea: Mecoptera. Fauna europaea version 2.5, <http://www.eur.org>

Submitted: 21 February 2022

First decision: 20 April 2022

Accepted: 20 April 2022

*the Guest editors for the special section
"The new Checklist of the Italian Fauna":*

*Marco A. Bologna, Lucio Bonato,
Fabio Cianferoni, Alessandro Minelli,
Marco Oliverio, Fabio Stoch, Marzio Zapparoli*