The Bezzi Diptera collection at the Museo di Storia Naturale di Milano: a list of the named genera and species, with their present status

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Abstract - Mario Bezzi's collection of Diptera is probably the most important dedicated to this order of insects preserved in Italy and, in a scientific-historical view, one of the most important in the world. The aim of this work is to provide a complete list of the genera and species originally used by Bezzi and readable on the collection labels handwritten by Bezzi himself. A brief description of the collection and the methods used to acquire and check the names is given. The results obtained are discussed. Finally, a complete checklist of the taxonomic names found, and their current status is provided.

Key words: biodiversity, Italian entomological collections, historical collectors, museums, taxonomy.

Riassunto - La collezione di ditteri Bezzi del Museo di Storia Naturale di Milano: elenco dei generi e delle specie nominate, con il loro status attuale.

La collezione di Ditteri di Mario Bezzi è probabilmente la più importante dedicata a questo ordine di insetti conservata in Italia e, in prospettiva storico-scientifica, una delle più importanti al mondo. Lo scopo di questo lavoro è quello di fornire un elenco completo dei generi e delle specie originariamente utilizzati da Bezzi e leggibili sulle etichette della collezione scritte a mano dallo stesso Bezzi. Viene fornita una breve descrizione della collezione e dei metodi utilizzati per acquisire e verificare i nomi e i risultati discussi. Infine, viene fornita una lista completa dei nomi tassonomici trovati con un aggiornamento del loro stato attuale.

Parole chiave: biodiversità, collezioni entomologiche italiane, collezionisti storici, musei, tassonomia.

INTRODUCTION

Mario Bezzi (Milan, 1st August 1868 - Turin, 14th January 1927; Fig. 1) was a scientifically prolific Italian dipterologist, who gathered one of the most important Diptera collections currently kept in a recognized institution. Bezzi graduated in Natural Sciences at the University of Pavia, then he became a high school teacher, a job he continued unceasingly until his dramatic death (he committed suicide a few days after his appointment as zoology professor and director of the "Museo Zoologico dell'Università Reale di Torino"). However, despite his school duties, he never abandoned his life-long interest in flies, which he fruitfully cultivated in his spare time, albeit with a fully professional approach.

He published his first paper in 1890 (Parisi, 1927) as an undergraduate student, at the beginning focusing on the dipterofauna of Italy. Over time, Bezzi widened his interest to the fauna of the Italian colonies in Africa (Eritrea, Somalia and Libya) as well as to other exotic faunas.

Fig. 1 - Bezzi in a photographic portrait taken around 1906 when about thirty-eight. / Bezzi in un ritratto fotografico scattato intorno al 1906 quando aveva circa trentotto anni. (Biblioteca storica di medicina e botanica Vincenzo Pinali e Giovanni Marsili - Università degli studi di Padova - Archivio Phaidra: PUV1121341).

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He quickly became a renowned dipterologist entering in contact with many other world-fame specialists. Among his most important scientific contributions to the study of this order of insects, he curated four volumes of the six-volume 'Katalog der Paläarktischen Dipteren' (1903-1907), of which he was a co-editor together with T. Becker, J. Bischof, K. Kertesz and P. Stein. All in all, Bezzi wrote 230 scientific publications (Parisi, 1927; Rigato, 1995), many written in Italian, but also in English, French, German and Latin. He named some 1800 new taxa, including new families, genera, and more than 1000 species (Rigato, 1995).

In 1928, after Bezzi's death, his collection, originally kept in 653 cardboard boxes, was purchased by the Museo di Storia Naturale di Milano (Rigato, 1995). The collection was estimated to contain 82,000 specimens from all over the world, belonging in some 2,000 genera and several thousand species, with about 3,000 types (Rigato, 1995).

During the night between 13 and 14 August 1943, a Royal Air Force air raid hit Milan and heavily damaged the Museum. Because of the deflagration in the nearby park of ordinary bombs and, especially, of firebombs, the destruction was massive (Parisi, 1944; G. Chiozzi, pers. comm.). Luckily, most of the entomological collections had been previously moved to Minoprio, near Como, and the Bezzi collection lost only 11 Tipulidae and Limnobiidae boxes (Rigato, 1995) left behind at the Museum. The contents of these boxes, soaked in the water used to extinguish the fire, became irreparably mouldy and were consequently thrown away. Currently, 642 original boxes remain, stored in 298 standard entomological ones (Rigato, 1995).

Over the years, several dipterologists revised parts of the collection, leaving new identifications, type revisions, lectotype designations, and descriptions of new species (e.g. Bächli, 1988; Delfinado, 1969; Pont, 1970, 2013; Süss, 1984; Kehlmaier & Meyer, 2004; Rognes, 2011). However, most of the material collected by Bezzi has never been critically reviewed.

Until now, the only "key" to access the collection was a 1935 handwritten alphabetical index of genera, which was improved at later dates with further additions. As the boxes were numbered sequentially, each genus name is accompanied by the serial number(s) of the box(es) in which it is contained (Figs. 2, 3).

Anyway, while helpful on a practical level, the information in the 1935 list is outdated and far from comprehensive. In May 2014, during a visit to the museum, I became aware of the situation; then, I volunteered to aid to catalogue the collection. However, it soon became clear that a "real" scientific catalogue would have needed a great deal of painstaking work, that was out of my reach because it would have required the intervention of many different scientific specialists and an enormous amount of time.

Fig. 2 - The cover of the 1935 index of genera kept at the MSNM. / La copertina dell'indice dei generi redatto nel 1935 e conservato al MSNM.

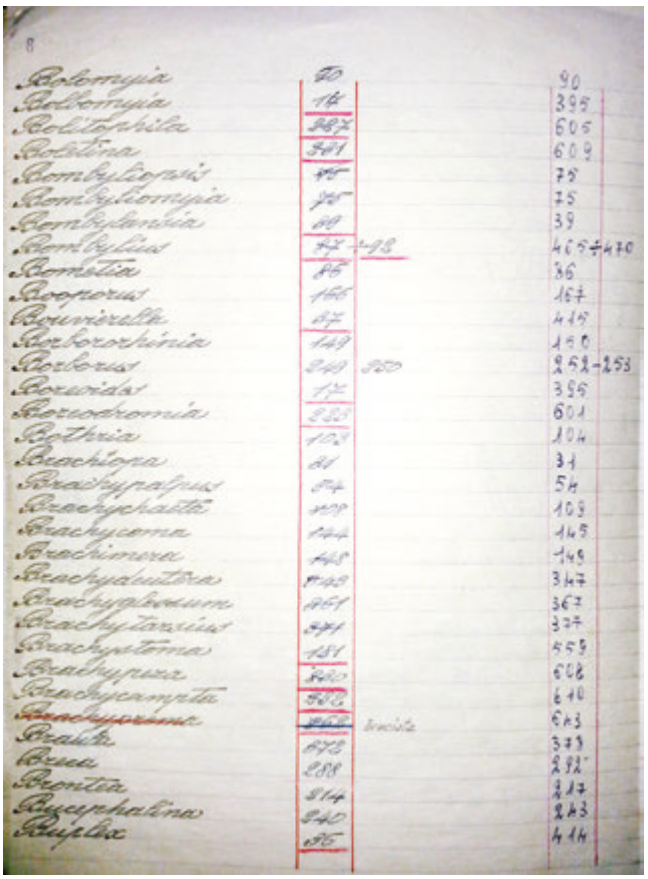

Fig. 3 - A sample page of the old index of genera. / Esempio di una pagina del vecchio indice dei generi.

Therefore, the most reasonable and convenient solution was to compile a working list of scientific names that could be obtained from the collection labels and to associate them, whenever possible, with the currently valid ones. The result would have been the publication of a complete list, intended as a tool to increase the accessibility of the Bezzi's collection to dipterologists worldwide.

The role of museum collections is strategic to the advancement of knowledge about life on our planet (Andreone *et al*., 2014). With that in mind, even a working catalogue of the Diptera preserved in a single important collection can stand as a small, but still significant contribution to the global effort to preserve biodiversity.

MATERIALS AND METHODS

Bezzi kept his mounted specimens in small cardboard boxes, each of which was a little smaller than half of a standard entomological box currently in use (26x39x6 cm). Today, most specimens can still be found in the original cartons with the lids removed and arranged two by two inside standard boxes (Fig. 4).

The remaining specimens were moved from their original containers to standard boxes, following their original arrangement (Rigato, 1995); each standard box now contains the equivalent of three of the old cardboard boxes (Fig. 5).

Currently, all taxonomically ordered Bezzi's specimens are stored in almost 300 standard entomological boxes arranged in three wooden cabinets (Fig. 6).

A fourth cabinet contains miscellaneous Diptera from all over the world, most of which are still unsorted and/or unnamed Bezzi's specimens. This material, which would require careful analysis by specialists, has not been considered in the present work.

Bezzi handwrote an identification label for each species in his collection (Fig. 7). Unfortunately, some labels are difficult to read and most specimens are poorly ordered. Furthermore, in some cases it is difficult to understand which species the label refers to (Figs. 8, 9).

Many of Bezzi's labels report the annotations "type", "cot.", "n. sp.", "parat." and others. I considered all specimens bearing labels with these annotations as alleged type specimens and marked them with an asterisk (*) in my list.

I organised my work into five steps.

1) I transcribed the 1935 handwritten index of genera and related information into digital format.

2) To check the validity or, at least, the availability of the names included in the 1935 list, I used the Nomenclator Query of *Systema Dipterorum* (henceforth respectively Nomenclator and SD), presently edited by Evenhuis & Pape (2024), a web-based checking tool for the scientific names of the Diptera of the world. After the first checking, more than 300 genera of the 1935 list were not found in the Nomenclator: they were probably misspelled or even unpublished.

3) Consequently, I have prepared an updated list of genera names checking the names of the handwritten index against those readable on the labels in the collection. For reasons of convenience and practicality, to minimize my presence at the museum, I took a high-resolution photograph of each box in the collection. In this way, most of the labels in a box were readable.

4) Whenever necessary, I directly examined the specimens whose names were unreadable from the photographs. The direct check proved to be crucial in clearing the 1935 list of names not present in the Nomenclator, most of which turned out to be spelling errors.

Fig. 4 - A standard entomological box with two Bezzi's boxes. / Due scatole di Bezzi in una scatola entomologica standard.

Fig. 5 - The specimens of three old Bezzi'a boxes transferred to a standard entomological box. / Una scatola entomologica standard contenente gli esemplari di tre vecchie scatole di Bezzi.

Fig. 6 - The third cabinet of Bezzi's collection. / Il terzo armadio della collezione Bezzi.

Fig. 7 - A well-ordered box (box # 5). / Una scatola ben ordinata (n. 5).

Fig. 8 - A crowded box (box # 317). / Una scatola affollata (n. 317).

Fig. 9 - A sample of hidden labels (box nr. 144). / Un esempio di etichette nascoste (scatola n° 144).

5) Finally, having a reliable list of genus names and a set of control tools developed for the work, I started adding species names to each genus and the number of specimens per species. To check the names, in addition to the Nomenclator, I also used other catalogues (Geller-Grimm, 2004; Pape, 1996) and databases available online (see Sitography). The bulk of this phase was virtually completed in early 2020, when only a few dozen names were still unresolved.

RESULTS AND DISCUSSION

From the labels, I have read 9475 univocal species names belonging to 2,196 genera and 123 families. Some 1,380 labels report a 'type' status. Thirty-nine species names have no associated specimens: probably loaned and never or not yet returned, destroyed by pests, or otherwise missing.

Of the species names, 825 are attributable to Bezzi, of which 40 were published in eight papers issued after his death: five in 1927, two in 1928 and one in 1929 (Evenhuis & Pape, 2024). The papers issued in 1927 and 1928 were possibly submitted to the publisher by Bezzi himself before his death. The 1929 paper, on the other hand, was delivered to the publisher by J. R. Malloch, who gathered the handwritten notes left by Bezzi (1929). The checklist of the entire collection is available online as supporting information (S1). All unresolved names are listed in S2.

Bezzi was mostly a collector of Brachycera. In fact, in his collection, Nematocera are represented by 454 species, accounting for less than 5% of the total. Even adding the 11 Nematocera boxes lost during WWII, this percentage would remain low.

Almost 1900 species names are associated with single specimens. However, as already mentioned, in many cases the attribution of specimens to a label is uncertain and, sometimes, some series are evidently made up of specimens belonging to more than one species. Some 30 species include more than 100 specimens and four more than 200. The most repre-

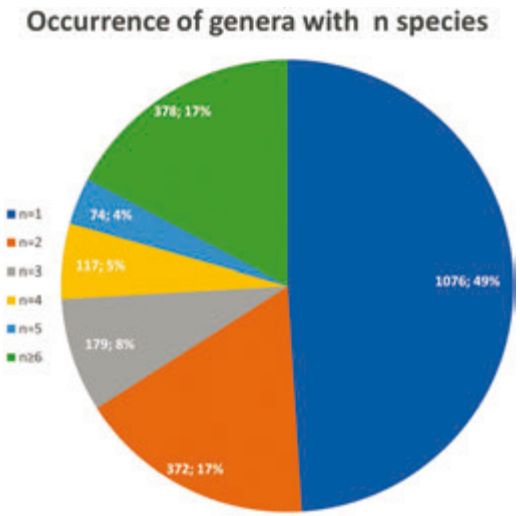

Fig. 10 - Occurrence of genera with *n* species / Numero di generi con *n* specie.

sented species is *Musca domestica* L. with 300 specimens.

Almost half (1076) of the genera in the collection are represented by a single species (Fig. 10). According to Bezzi's identifications, the five most species-rich genera are: *Empis* with 200 species, followed by *Tabanus* (189), *Rhamphomyia* (122), *Bombylius* (96), and *Syrphus* (83).

The distribution of the names in families is shown in Figs. 11 to 13. More than half of the genera are concentrated in eight families (Fig. 11), which account for half of the species represented in the collection (Fig. 12).

When considering the names readable on Bezzi's labels, only 4,298 of those genus-species combinations are valid today. The remaining combinations have either been fully synonymised or species epithets are currently combined with different generic names, or have not been resolved. Valid and available specific names in the collection sum up to 8,584 in 2,196 genera and 122 families.

Considering valid names, the top 8 families contain more than half of the total names (Fig. 13).

Last, I compared the numbers of families, valid genera, and species names in the collection with those recently listed by Pape *et al*. (2011) for the order Diptera, including *incertae sedis* and excluding fossils (Figs. 14-16; S3: Table 2:). Eleven families are fully represented in the collection in terms of genera. Ten of these families, anyway, include only one or two genera. These include the Austroleptidae, which are no longer represented in the collection.

Acknowledgements

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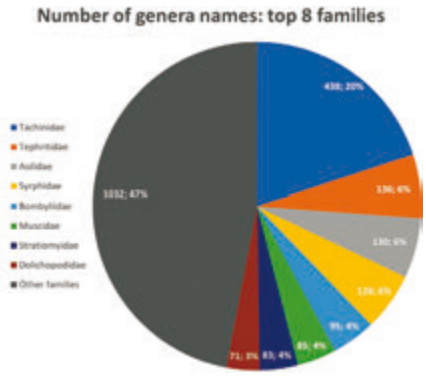

Fig. 11 - Number of genera in families: top 8 families. Based on Table 1 of S3. / Le 8 famiglie con il maggior numero di generi. Basato sulla Tabella 1 in S3.

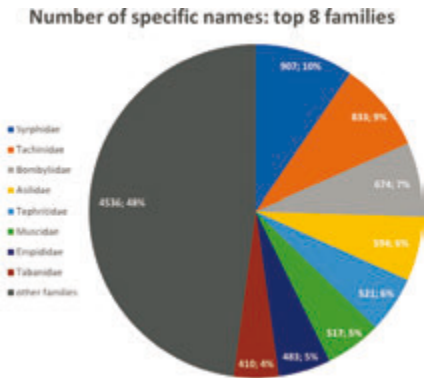

Fig. 12 - Number of species in families: top 8 families. Based on Table 1 of S3. / Le 8 famiglie con il maggior numero di specie. Basato sulla Tabella 1 in S3.

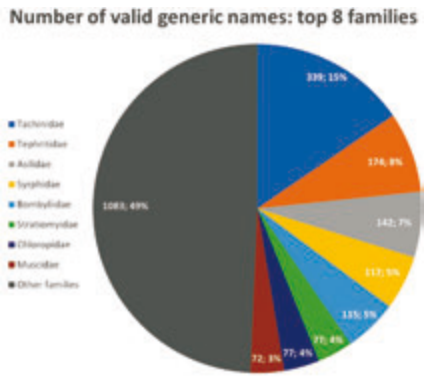

Fig. 13 - Valid names distribution in the eight most represented families. Based on Table 2 of S3. / Distribuzione dei nomi validi nelle otto famiglie più rappresentate. Basato sulla Tabella 2 in S3.

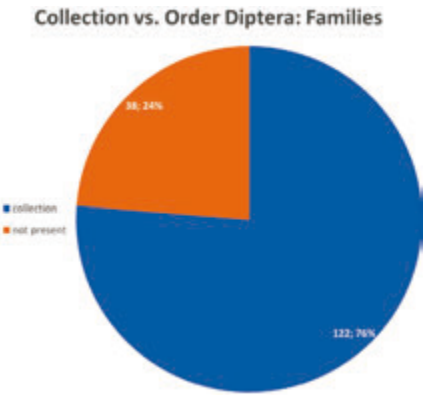

Fig. 14 - Number of families in the Bezzi's collection compared to the corresponding number in the world's dipterofauna. / Confronto fra numero di famiglie nella collezione Bezzi e quello corrispondente nella ditterofauna mondiale.

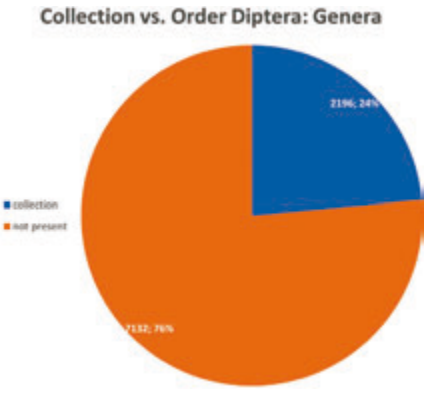

Fig. 15 - Number of genera in the Bezzi's collection compared to the corresponding number in the world's dipterofauna. / Confronto fra numero di generi rappresentati nella collezione Bezzi e quello corrispondente nella ditterofauna mondiale.

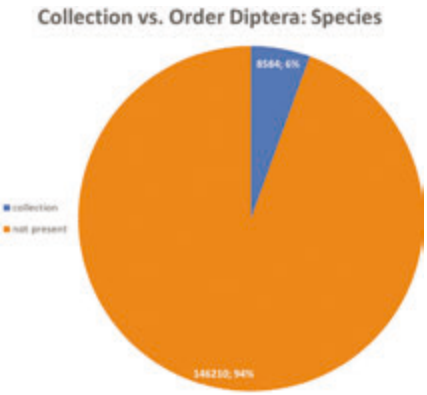

Fig. 16 - Number of species in the Bezzi's collection compared to the corresponding number in the world's dipterofauna. / Confronto fra numero di specie rappresentate nella collezione Bezzi e quello corrispondente nella ditterofauna mondiale.

draft of my manuscript. Jos Dils and David Gibbs identified some species of Bombyliidae. The following specialists also contributed to work out some doubtful names: Pierfilippo Cerretti (Università di Roma, Italy), Torsten Dikow (National Museum of Natural History, USA), Tony Irwin (Norwich, UK), Peter Kerr (California Department of Food and Agriculture, USA), Verner Michelsen (Natural History Museum of Denmark), Allen Norrbom (United States Department of Agriculture), and Adrian Pont (Oxford University Museum of Natural History, UK). Giovanna Olivieri, professional translator, kindly revised my manuscript spotting English flaws here and there, and Giorgio Chiozzi (Museo di Storia Naturale di Milano) gave useful suggestion for the submission of the printable version. Last but not least, I am deeply grateful to my wife Gabriella, who after my retirement saw me spending a significant part of my time among dead flies instead of being with her... without ever complaining too much!

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SUPPORTING INFORMATION

Additional Supporting Information may be found online for this article.

S1: Bezzi's Diptera Collection: list of genera and species names on labels. / La Collezione Ditterologica Bezzi: lista dei nomi dei generi e delle specie sulle etichette.
S2: Unresolved names. / Nomi irrisolti.
S3: Summary tables. / Tabelle riassuntive.