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DOI: https://doi.org/10.3897/arphapreprints.e99673

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Abstract

Background

Many insect species have shown dramatic declines over the last decades, as a result of man-related environmental changes. Many species which were formerly widespread are now rare. To document this trend with evidence, old records of collected specimens are vital.

New information

We provide here the data on 9752 bee (Hymenoptera: Apoidea) specimens hosted in several museums of south-east France: Musée des Confluences in Lyon, Muséum d'Histoire Naturelle de Marseille, Muséum d'Aix-en-Provence and the Muséum Départemental du Var in Toulon. Most of the specimens (9255) come from France, and include data on 552 named species. For most of these specimens the geographical location, including geographical coordinates, is based on the locality (town or village) where they were collected. The specimens were captured from the beginning of the nineteenth century to 2018. The identifications of 1440 specimens, mainly belonging to the genus *Bombus*, are considered reliable, as these were performed or been checked since

2009. All the other reported identifications are the original ones given by the original collectors.

Keywords

Hymenoptera, bees, Museum, France, record, Apoidea, *Bombus,* Apidae, Halictidae, Andrenidae, Megachilidae, Colletidae, Melittidae

Introduction

There has been a dramatic decline of insect populations over the last 70 years, both in terms of abundance (Hallmann et al. 2017, Seibold et al. 2019) and diversity (Raven and Wagner 2021). To document the past occurrences of species in areas where they have now decreased or vanished, entomologists mostly rely on material preserved in collections (e.g., Decker et al. 2020, Mathiasson and Rehan 2020). Museum materials are what remains of past ecosystems; for some species they represent the last testimony of their presence in a region or country, and it appears crucial to extract as much information as possible from these specimens (Raven and Miller 2020), such as photographs of key specimens. In many natural history museums around the world, there are thousands of specimens stored in collections for which we barely have any information. This is particularly the case for insects, which are difficult to preserve because of pests and difficult to identify due to the taxonomic impediment (Engel et al. 2021). Yet, the importance of insects in the functioning of ecosystems should urge precise monitoring of museum collections contents. In the present time of rapid anthropogenic ecological changes at all scales, we must find ways to preserve these specimens as well as we can for as long as we can. They are vulnerable to degradation and loss from pests (Verlinden 2020), humidity (Clary 1991), fire (Escobar 2018), and the simple ravages of time. While renewing efforts to protect them, we need to make them more accessible through digitization, including imaging (Paterson et al. 2016) and, for a representative series of specimens, the sequencing of COI and other genes.

Among the various roles of insects in ecosystems, the pollination process is a key component, both in natural and man-made ecosystems (Hristov et al. 2020). Among pollinators, Hymenoptera is often considered as the most important insect order to pollinate flowers, followed by Diptera and Lepidoptera (Walton et al. 2020). Among Hymenoptera, Anthophila (bees *sensu lato*) is the main group of pollinators. The French bee fauna includes currently 978 species (Ropars, pers. comm.). However, this number is in constant evolution, and the available information about the actual diversity of bees within the French territory, both current and past, is still very incomplete. The design and implementation of effective conservation measures rely on the knowledge of both current and historic distribution of species (Schatz et al. 2021), which in turn relies on the knowledge on the bee species distribution within the French territory.

The aim of the present paper is to document the collections of Apoidea hosted by the Musée des Confluences in Lyon, the Muséum d'Histoire Naturelle de Marseille, the Muséum d'Aix-en-Provence and the Muséum Départemental du Var in Toulon (Table 1). The Musée des Confluences, holds the second most important Natural history collection in France, after the Paris Museum National d'Histoire Naturelle. It was founded in 1772 (Clary 1995). The Marseille Museum, founded in 1819, currently holds a collection of ca. 84,000 zoological specimens (Lima and Médard 2021). The Aix Museum was founded in 1838 (Sepulveda and Dutour 2006), and hosts an important collection of insects collected in the vicinity of Aix-en-Provence in the nineteenth century (Dusoulier 2006).

Ultimately, the knowledge of past occurrences of bees will be of outmost importance for documenting the evolution of bee richness and their distribution in France and to set the basis for a future French red list of bees which still does not exist to this day.

General description

Purpose: The aim of this publication is to make public the records of Apoidea stored in the four natural history Museums of south-east France. Researchers will therefore know where the specimens are stored, how numerous they are, and when and where they were collected. Information on who identified the specimens and when is also given, as this is important given the on-going changes in the taxonomic treatment of many species (Gargominy et al. 2021, Rasmont et al. 2017). The past status of species now rare may then be assessed at a regional level, and the original specimens may then be localized, studied and reidentified if needed.

Project description

Title: Apoidea collections in the natural history museums of south-east France.

Sampling methods

Description: All available data on the Apoidea specimens stored in the four natural history Museums were input into a table format. Most original label s include location (usually the municipality), date (sometimes only partly, such as the month), collector and an assigned species name. As the taxonomy of the Apoidea has dramatically changed over the last 150 years, we believe that an important part of the old material should be reidentified according to current knowledge. This could be done only for a part of the specimens: Bumblebees (*Bombus*) in the Musée des Confluences were recently revised by MI, GM and FV, and all specimens at the MDV were identified since 2009; their *identificationVerificationStatus* column was coded "1". The data on all the other specimens have retained their original species identification, and the *identificationVerificationStatus* column was coded "0".

The collectors of Apoidea specimens in the four Museums were: René Grilat (?-1915) [2645 specimens], Georges Audras (1881 -1970) [2028 specimens], Maurice Dauzet

(1927-2021) [1752 specimens], Claudius Côte (1881-1956) [821 specimens], Jean Timon-David (1902-1968) [606 specimens], Pierre Réal (1922-2009) [392 specimens], Jean-Hubert Chabrier (1791-1884) [240 specimens], Claude Dufay (1926-2001) [133 specimens], Philippe Grivot [131 specimens], Nicolas Bermante [128 specimens], Jacques Hamon (1926-2022) [56 specimens], Guy Chavanon (born 1951) [78 specimens], Robert Gonon (1908-1994) [53 specimens], Roland Allemand (1950-2013) [29 specimens], and several others.

Sampling description: On top of the data given on the original label, we have added the department (French administrative division) and the coordinates of the center of the locality where each specimen was collected (columns *decimalLatitude* and *decimalLongitude*). This gives an approximation of ca. 5 km, depending on each locality size. All species names were checked with the most recent list of European bee species (Nieto et al. 2014). If a species name given on the label was not found on this reference list, a search of a possible synonym was performed, mostly from http://westpalbees.myspecies.info and the current name mentioned in the scientificName column, whereas the name given by the original identifier was put into the *previousIdentifications* column.

Quality control: The specialists whose recent identifications we relied on are Holger Dathe, Robert Fonfria, David Genoud, Michael Kuhlmann, Gérard Le Goff, Hugues Mouret, Alain Pauly, Stephan Risch and Erwin Scheuchl in the collections of the Toulon Museum, and MI, GM and FV for 1297 specimens in MHNL.

Step description: The collections of Apoidea in the Natural History Museums of Aix-en-Provence, Lyon, Marseille and Toulon were surveyed systematically. A total of 9752 specimens were recorded. A total of 1377 French specimens were either checked in the Lyon Museum or identified recently by various specialists, as in the case of the specimens from Porquerolles (Hyères, Var) in MDV.

For all other specimens, the nomenclature was checked against the list of European bees used for the IUCN red list (Nieto et al. 2014). If the original species name did not appear in this reference list, a search was done on http://westpalbees.myspecies.info and https://www.bwars.com/search/node/Caelioxis websites to find the name currently used for names recognized as synonyms. If the original name could not be assigned to a current name unambiguously or if no identification had been given, no current species name was given in the data set.

As much as possible, the locality of origin of the specimen was identified, and its latitude and longitude given by the website https://www.geoportail.gouv.fr/ was input. In a few cases, such as passes or forests between neighbouring localities, the precise coordinates of the location were input. In the CSV dataset format, fields are seaprated by tabs, all encoding is UTF-8, which allowed for all diacritic signs to be retained. Apostrophes (') were used wherever appropriate in locality names. Uncertain readings from the labels are indicated by a question mark in the *verbatimEventDate* and *verbatimLocality* fields. If the locality name was uncertain, no coordinates were given.

Geographic coverage

Description: The Apoidea specimens mainly come from south-east France (Fig. 1), but also include specimens from 24 other countries: Algeria [10], Germany [7], Austria [6], Brazil [2], Ivory Coast [2], Spain [8], United Kingdom [22], Greece [10], Guatemala [1], The Netherlands [31], Hungary [3], Indonesia [1], Italy [4], Luxembourg [2], Morocco [8], Romania [1], Slovakia [2], Switzerland [6], Chad [1], Czech Republic [46], Tunisia [15], Turkey [9], USA [1] and former Yugoslavia [2]. The country of origin of 296 specimens could not be traced. The 9256 specimens from France come from 61 departments (Table 2), mainly Rhône (4253 specimens), Loire (1141 specimens), Bouches-du-Rhône (874 specimens) and Ain (554 specimens). The localities of 139 specimens could not be traced to a department.

Coordinates: ; .

Taxonomic coverage

Description: Specimens of at least 552 species are present in the collections of the four surveyed natural history Museums. The specimens belong to the families Apidae [3153 specimens], Halictidae [1866 specimens], Andrenidae [1597 specimens], Megachilidae [1092 specimens], Colletidae [527 specimens] and Melittidae [52 specimens]. Only eleven species are represented by at least 50 specimens in the collections of the four natural history Museums (Table 3).

Taxa included:

Rank	Scientific Name	Common Name
superfamily	Apoidea	bee
family	Apidae	
family	Halictidae	
family	Andrenidae	
family	Megachilidae	
family	Colletidae	
family	Melittidae	

Temporal coverage

Single date: .

Notes: The oldest specimens are those collected by Jean-Hubert Chabrier (1791-1884), hosted in MHNAix, which presumably come mostly from the first half of the nineteenth century, but do not bear any date information (Dusoulier 2006). The most recent specimens are those of Maurice Dauzet (1927-2021) who collected until 2018 and later donated his collection to the Musée des Confluences in Lyon. The historic distribution of the data shows that apart from the 250 specimens from Chabrier's collection, most of the specimens come from the 20th century and the first 20 years of the 21st century (Fig. 2).

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Data resources

Data package title: Apoidea at the Lyon, Marseille, Aix-en-Provence and Toulon Museums

Resource link: https://doi.org/10.5281/zenodo.7456986 [NOTE TO REVIEWERS : LINK will be open upon publication of this paper. This file is temporarily submitted as supplementary material on this manuscript. Zenodo allows updates to be uploaded as updates become available]

Number of data sets: 1

Data set name: Apoidea at four Museums of SE France : Apoidea_data_SE_France.csv

Download URL: https://doi.org/10.5281/zenodo.7456986

Data format: CSV (tab delimited values)

Data format version: Darwin core, so that it could be transferred later into GBIF as the identifications are checked and more precise locations entered.

Description: The whole data set (Suppl. material 1) includes 9752 Apoidea specimens from the Muséum d'Histoire Naturelle d'Aix en Provence (MHNAix), the Musée des Confluences, Lyon (MHNL), the Muséum d'Histoire Naturelle de Marseille (MHNM) and the Muséum Départemental du Var, Toulon (MDV). This dataset uncludes 2741 recently identified individuals and 9256 with geolocalization within France (Table 1).

Column label	Column description
occurrenceID	Individual identification: combination of Museum name, collection identification, box number and specimen number within each box.

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basisOfRecord	The specific nature of the data record (i.e. PreservedSpecimen)
eventDate	Event date in the format YYYY-MM-DD
Year	Year of capture if known
Month	Month of capture if known
Day	Day of capture if known
verbatimEventDate	Date of capture, if known, in format DD/MM/YYYY. Missing data are indicated by ?
scientificName	Lowest taxonomic rank possible, usually the species name. If the species is unknown, the genus or family names are given.
Kingdom	Kingdom (i.e. Animalia)
Phylum	Phylum (i.e. Arthropoda)
Class	Class (i.e. Insecta)
Order	Order (i.e. Hymenoptera)
family	Family name
genus	Genus name
specificEpithet	Species epithet of the scientificName
sex	Male (M) or Female (F)
taxonRank	Taxonomic rank of the most specific name in the scientificName
IdentifiedBy	Name of the entomologist who identified the specimen, if indicated by the label
dateIdentified	Year of identification, if known
identificationVerificationStatus	Whether (coded 1) or not (coded 0) the identification was recently (since 2009) checked
decimalLatitude	Geographic latitude (in decimal degrees) of the location
decimalLongitude	Geographic longitude (in decimal degrees) of the location
geodeticDatum	coordinate system and set of reference points upon which the geographic coordinates are based (i.e. WGS 84)
coordinateUncertaintyInMeters	Uncertainty in coordinates. As the coordinates are usually those of the locality of the record, uncertainty is in the range of 5000 m
Country	Country of capture, in French, as indicated by the label
countryCode	Two letter country code of the specimen origin
stateProvince	French departmental administrative division. In the case of non French data, any relevant country administrative subdivision
locality	Location of capture, usually the locality
verbatimLocality	Any geographical indication on the label

InstitutionCode	Museum where the specimen is held
CatalogNumber	Box identifier within each Museum
occurrenceRemarks	Any ecological data or comment on the label
recordedBy	Name of collector (i.e. *legit* information)
OrganismQuantity	Number of individuals bearing the same label (usually 1)
OrganismQuantityType	individuals
previousIdentifications	Species name originally given by the original collector, if different from scientificName
georeferencedBy	Identity of the person who added the Latitude and longitude data, i.e. Meunier, Jean-Yves
georeferenceProtocol	How the georeference was computed, i.e. from label data (verbatimLocality)
georeferenceSources	Georeference code was inferred from geoportail.fr
georeferencedDate	Georeference work was performed in 2021
language	The data set is mainly written in French, apart from column headings, which are in English
CollectionCode	Identifier of collection within each Institution where specimens are held
locationRemarks	Several localities could not be identified unambiguously, this is indicated by “localité incertaine” in this field

Additional information

Specimen preservation methods

Dried and pinned specimens.

Abbreviations used throughout

MHNAix: Muséum d’Histoire Naturelle d’Aix en Provence (Bouches-du-Rhône)

MHNL: Musée des Confluences, Lyon (Rhône)

MHNM: Muséum d’Histoire Naturelle de Marseille (Bouches-du-Rhône)

MDV: Muséum Départemental du Var, Toulon (Var)

Publishing organizations

Musée des Confluences, Lyon (MHNL),

Muséum d'Histoire Naturelle de Marseille (MHNM),

Muséum d'Histoire Naturelle d'Aix-en-Provence (MHNAix),

Muséum Départemental du Var, Toulon (MDV).

Museum identifiers

MHNL, MHNM, MHNAix, MDV.

Contacts

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data set management

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General discussion

All together the studied collections hold a total of 9752 Apoidea specimens at the time of writing. A total of 9255 specimens are from mainland France or Corsica and 295 specimens have no locality information. All the following analyses is based on mainland France and Corsica data only.

Unfortunately, 5002 of the 9255 French specimens do not bear a date of collection. For some of these, the time frame was guessed using the biographic data of the collectors. If we hypothesize that the specimens from the Chabrier Collection were collected during the first half of the 19th century, and the ones from Côte Collection during the first half of the 20 th century, most of the specimens were collected since 1900, equally divided (about 1500 specimens) in each of the time spans 1900-1949, 1950-1999 and 2000-2018. The 4253 specimens with accurate collection data (day, month, year) date from 1881 to 2018.

The temporal distribution of the data according to the IUCN criteria of the European fauna (Nieto et al., 2014) shows that most specimens belonging to endangered species were collected in the years 2000-2018 (Fig. 3, Fig. 4). Only one specimen captured between 1950 and 1999 belonged to an endangered species (*Trachusa interrupta*) whereas a total of seven endangered species specimens were collected since 2000 (belonging to the species *Trachusa interrupta*, *Colletes collaris*, *Lasioglossum breviventre* and *Lasioglossum laeve*). On the other hand, four endangered species have no data since 1950:

Lasioglossum quadrisignatum, *Lasioglossum subfasciatum*, *Melitta melanura* and *Osmia maritima*, leaving the question open as to whether they still occur in France.

From the recently checked 1301 *Bombus* specimens from MHNL, 713 did not bear any previous identification label at the species level. Amongst the 588 *Bombus* specimens bearing identification labels, 362 (62%) had an identification label which matched the recent species check; all the other specimens had their original identification corrected. This underlines the need for experts to check Museum collections in order to validate their data. The work of presenting the basic data allows the experts to know how many specimens there are in the surveyed Museums, and also when and where the specimens come from.

Acknowledgements

We wish to thank the staff at the four Museum who made the recording of specimens in their care possible. Robert Mesibov gave valuable advice for formatting the data into GBIF format.

Author contributions

Study design: BG, data input: JYM, identification of *Bombus* specimens: GM, MI and FV, data analysis and formatting: GN, writing up: GN and BG, collection management: HL, VP, YD, JM. All authors commented and agreed on the final manuscript.

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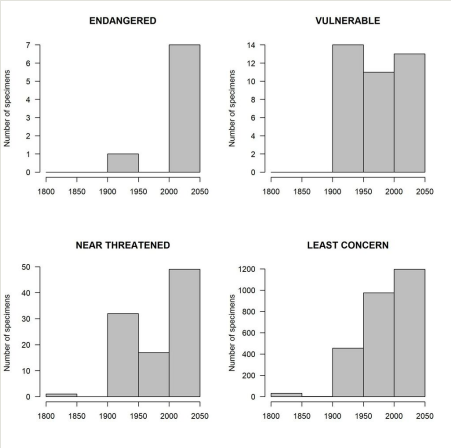

Figure 4.

Period of capture according to the European IUCN criterias for all surveyed Apoidea specimens.

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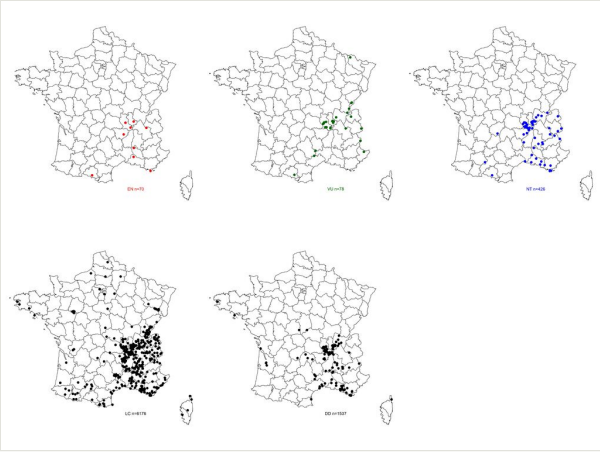

Figure 3.

Distributions of Apoidea specimens according to European IUCN criterias.

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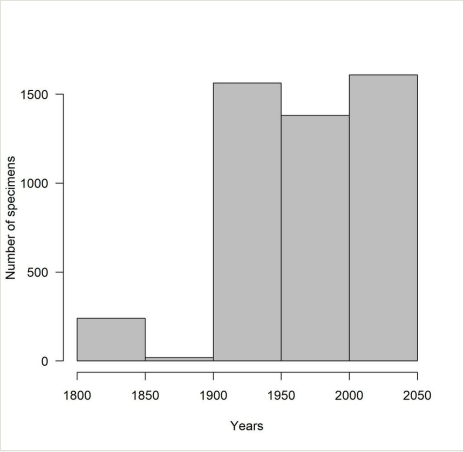

Figure 2.

Periods of captures of surveyed Apoidea specimens in the four Museums

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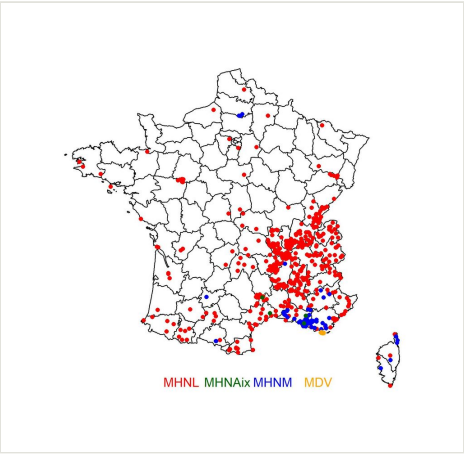

Figure 1.

Geographical distribution of the surveyed specimens in France, according to the holding Museums.

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Table 1.

Number of French Apoidea specimens by Museum.

Museum	Total number of specimens	Number of specimens from France	Number of French geolocalized specimens	Number of specimens identified since 2000
MHNAix	255	243	153	0
MHNL	8790	8312	8239	2646
MHNM	612	606	589	0
MDV	95	95	95	95
Total	9752	9256	9076	2741

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Table 2.

Numbers of French Apoidea specimens, sorted by French departments.

Departments	N
Ain	554
Aisne	1
Allier	4
Alpes-de-Haute-Provence	29
Alpes-Maritimes	16
Ardèche	80
Ariège	28
Aude	5
Aveyron	4
Bouches-du-Rhône	874
Cantal	5
Charente	4
Charente-Maritime	10
Cher	1
Corrèze	24
Corse	14
Corse-du-Sud	10
Doubs	86
Drôme	296
Essonne	3
Finistère	18
Gard	73
Gers	14
Gironde	29
Guyane française	1
Haute-Corse	31
Haute-Garonne	15
Haute-Loire	308
Haute-Saône	64
Haute-Savoie	71
Hautes-Alpes	36
Hautes-Pyrénées	8
Hérault	76
Indre	2

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Isère	219
Jura	155
Landes	3
Loire	1141
Loiret	2
Lozère	2
Manche	1
Morbihan	5
Moselle	1
Pas-de-Calais	1
Puy-de-Dôme	11
Pyrénées-Atlantiques	6
Pyrénées-Orientales	23
Rhône	4253
Saône-et-Loire	1
Sarthe	41
Savoie	114
Seine-et-Marne	1
Seine-Maritime	2
Somme	8
Tarn-et-Garonne	2
Territoire de Belfort	11
Var	243
Vaucluse	63
Vendée	7
Vosges	6
Yvelines	1
Unknown	139
TOTAL	9256

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Table 3.

Species with more than 50 French specimens

Species	Number of specimens
Bombus lapidarius	161
Bombus lucorum	141
Bombus pascuorum	141
Apis mellifera	92
Bombus terrestris	79
Bombus pratorum	75
Bombus sylvestris	62
Bombus soroeensis	56
Andrena flavipes	53
Halictus scabiosae	52

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Supplementary material

Suppl. material 1: Apoidea data from four Museums of SE France

Authors: Jean-Yves Meunier, Benoît Geslin, Mehdi Issertes, Gilles Mahé, Frédéric Vyghen, Harold Labrique, Yves Dutour, Vincent Poncet, Jérémy Migliore & Gabriel Nève

Data type: occurrences

Brief description: This data set includes 9752 specimens from Musée des Confluences in Lyon, Muséum d'Histoire Naturelle de Marseille, Muséum d'Aix-en-Provence and the Muséum Départemental du Var. This dataset includes 2741 identified Apoidea specimens identified since 2000 and 9256 specimens with geolocalization data within France.

Format is CSV (tab delimited values), Darwin core.

Download file (2.80 MB)