BumbleBee Sub Group Annual Report 2023

of the IUCN Wild Bee Specialist Group

Edited by Paul Williams (BBSG Chair for Bumblebees)

BBSG IN 2023

The BBSG exists to foster the conservation of bumblebees and their habitats around the world especially through the IUCN Red-Listing process. In this tenth report of the BBSG's activities, 2023 has seen progress towards our goal of assessing the threats to all species of bumblebees worldwide using the IUCN Red List Criteria, particularly with a re-assessment of the European species.

THE BBSG AND THE *WILD BEE SPECIALIST GROUP* (WBSG)

Paul Williams

The BBSG is commissioned by the IUCN Species Survival Commission (SSC), with responsibilities centred around the Red List assessment of all bumblebee species world-wide (currently interpreted at *ca* 290 species). It has been running for more than two IUCN quadrennia and has completed first assessments for most of the species of the New World and Europe. These assessments have greatly advanced conservation action by identifying species at risk, allowing the most imperiled species to be listed at the national, state, and local scales, facilitating targeted projects for restoring and managing their habitats. Asia, with many more species and fewer specialists, remains a challenge. Surveys to map species distributions are now under way in many countries, which are compiling growing data bases of information on their bumblebees.

During 2020 a growing need was recognised by the IUCN-SSC for providing information on threats and conservation for all wild bees (*ca* 20,000 species), not just bumblebees. The SSC proposed for its *Species Strategic Plan Framework* for the next quadrennium that it would commission a more inclusive *Wild Bee Specialist Group* (WBSG), to cover all bees.

The breadth of the WBSG provides an opportunity to achieve more for the conservation of all bees world-wide. BBSG members are continuing actively the work on bumblebees, which is also helping through its conservation action all other wild bees as well. ●

Queen of the South American B. dahlbomii *at Maicolpue, Chile, one of the largest bumblebees in the world and Red List assessed as Endangered (photo by Maxi Köpcke).*

RECENT CHANGES AT THE BBSG

There have been several changes among officers of the BBSG in the last few years, as new people have taken up coordinating roles.

In the North American region, after being very active in supporting the BBSG since its inception, not least as regional coordinator for North America, and after seeing through the first round of assessments for the North American species, unfortunately Sheila Colla has asked to step back because of ill health. We wish her the very best and are enormously grateful for her contribution. Leif Richardson has kindly agreed to take up the position, to which he brings a wealth of experience and contacts leading networks of bumblebee atlas survey projects across North America.

In Europe, Pierre Rasmont has retired from bumblebee work after a long and illustrious career in bumblebee academia and after seeing through the first round of assessments of the European species. He is ably succeeded by Guillaume Ghisbain as regional coordinator, who has been one of the leads in re-assessing the European species this year.

For the Himalaya, Malkiat Saini has retired and is succeeded by Rifat Raina as regional coordinator. Rifat has started leading an exciting new survey of the bumblebees of the Indian Himalaya.

In Mesoamerica, Remy Vandame has moved sideways to take on a leading role in the WBSG and is succeeded at the BBSG by Oscar Martinez as regional coordinator. Oscar is involved with an active survey of Mesoamerican bumblebees.

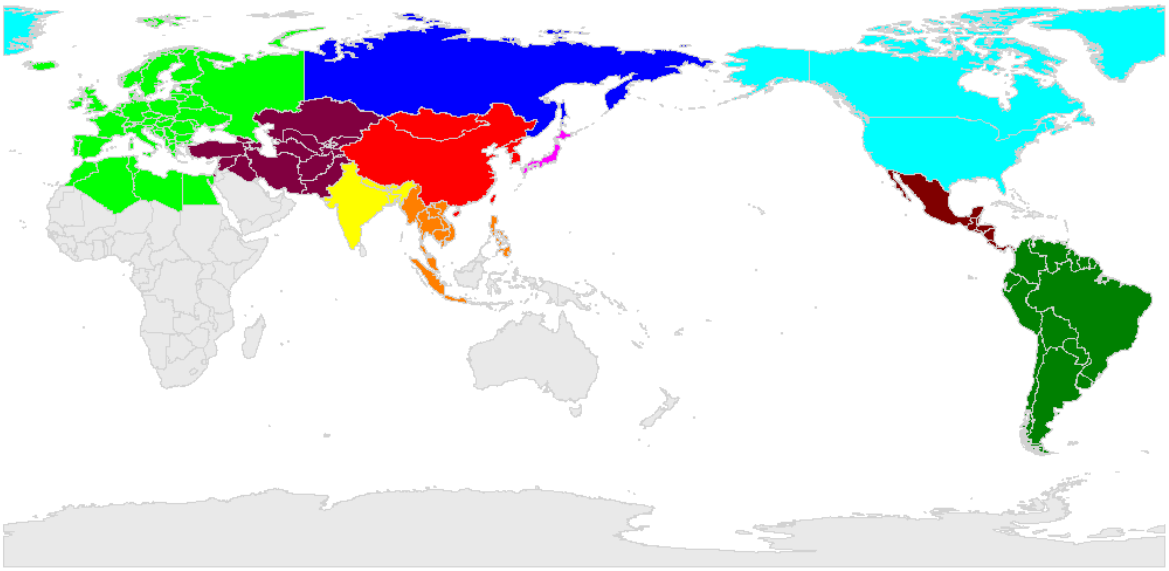
In Southeast Asia, we have had the very sad loss of Panuwan Chantawannakul. Chawatat Thanoosing has agreed to take up the position of regional coordinator. Chawatat is involved with an active survey of Southeast Asian bumblebees.

In Japan, Koichi Goka has stepped back and we welcome Yokoi Tomoyuki as regional coordinator. Yokoi is involved with an active survey of Japanese bumblebees.

We are all immensely grateful for the unpaid time and effort that everyone involved with our BBSG bee groups contributes.

The Endangered and oligolectic B. brodmannicus *visiting* Cerinthe *in the Alps (photo by Pieter Haringsma).*

PROGRESS TOWARDS GATHERING DATA INTO REGIONAL DATABASES FOR REGIONAL RED-LIST ASSESSMENTS



BBSG regions.

Below is an overview of the progress in compiling database information on bumblebee species distributions in our BBSG regions. This is a long-term process, requiring a lot of work to achieve good representative coverage and to do so with precision.

Please do contact me or other groups to see what can be done if you need help or advice. Many of the problems are experienced by all, so solutions may be out there to be shared. Let us know what information is most needed to help with your regional process.

BBSG region as at end 2023 (colour on map)	Approximate number of indigenous species present*	Number of indigenous species with database records	Total number of records	Number of species Red-List assessed	Number of species assessed 'Data Deficient'
East Asia (red)	124	122	50,341	0	-
West Asia (brown)	73	33	5500	0	-
North Asia (dark blue)	68	24	2392	0	-
Europe (light green)	67	67	1,728,865	67	6
Himalaya (yellow)	63	34	9740	0	-
North America (pale blue)	49	49	>800,000	46	5
Southeast Asia (orange)	27	23	1195	0	-
South America (dark green)	25	1	>3000	22	12
Mesoamerica (brown)	18	18	32,984	18	1
Japan (pink)	14	14	5258	0	-

** affected by variations in the species concepts adopted*

IUCN RED LISTING PROCEDURE

Rich Hatfield

Last year in this report we committed to providing a standard set of procedures for Red Listing bumble bees. As I began to pull these together, it occurred to me that with the varying levels of data available, a standard set of methods was going to be very difficult to outline. Each region, and indeed each species, may require different methods, depending on the range of the species, the number and date range of known occurrences, and the resources and tools available to the assessor. As such, instead of outlining procedures I will provide a list of resources that are available to you to help with the Red Listing process.

The first step will be to familiarize yourself with the Red Listing Categories and Criteria. Using that as a base point, you should determine which criteria you intend to apply to the species you are assessing. Then you can proceed to the Guidelines for Using the IUCN Red List Categories and Criteria which will help you determine what information you will need to gather, and suggestions for your analysis.

A newer tool available for Red Listing is the ability to use Species Distribution Models (using MaxEnt) to calculate range size (and thus range loss). This tool could be very useful if you have a limited amount of data — but as with any tool, should be used with the appropriate level of knowledge, to ensure consistency and accuracy. This paper, and references within, can help you understand how this tool can be applied to assessments. To help with assessments there are a few R (free software environment for statistical computing and graphics, it compiles and runs on a wide variety of UNIX platforms, Windows, and MacOS) packages (approved by the IUCN) available to help you:

- **rCAT:** A set of tools and functions to help with species conservation assessments (Red List threat assessments), based on point data.
  Includes: - Extent of occurrence - Area of Occupancy - Minimum Enclosing Rectangle - Geographic Projection Wizard - Batch processing of species
  - Documentation.
- **red:** Performs a number of spatial analyses based on either observed occurrences or predicted distribution.
  - Calculates AOO and EOO based on records or predicted distribution.
  - Allows the calculation of confidence limits for EOO, AOO and the RLI.
  - Spatial data of species occurrences, environmental or land cover variables can be either given by the user or automatically extracted from several online databases such as GBIF.
  - Extracts the names or ISO codes of countries of occurrence of a species based on either records or predicted distribution.
  - This article is very helpful in describing the options with the package, including Species Distribution Modeling: https://bdj.pensoft.net/article/20530/
  - Documentation.
- **REDLISTr:** Set of tools suitable for calculating metrics required for making assessments of species and ecosystems against the IUCN Red List of Threatened Species and the IUCN Red List of Ecosystems categories and criteria.
  - Focuses on metrics for Criterion A (rate of change) and Criterion B (EOO and AOO) only
  - **Primarily designed for the Red List of Ecosystems**, but can also support Red List

of Species through EOO, AOO and rate of change estimates
- Includes function which moves AOO grid to ensure moves possible AOO grids around to ensure that the AOO calculated is the smallest possible, and not subjected to the geometric uncertainty due
- For EOO, AOO and change in area, accepts coordinate files converted to R's spatial points format, or rasters (e.g. species distributions converted to tif rasters)
- Can calculate rate of change in abundance between two time points, which requires four variables: abundance in year x and abundance in year y.
- Calculates rate of change as Proportional Rate of Decline (PRD), Absolute Rate of Decline (ARD) and/or Annual Rate of Change (ARC)
    - Documentation.

No matter which analysis method you choose, you will need to submit a map of your species with your assessment. If you do not have a GIS license, QGIS is freeware that you can use to make maps and conduct spatial analysis. Other available software includes ArcGIS Pro (from ESRI) and R (also freeware) - though the latter is probably best for analysis, and not necessarily map making, unless you are an experienced user. There are many tools available to help along the way. If you are new to spatial analysis, you might find this webinar useful. It outlines many of the resources available to you, and provides the language you'll need to help find your way. In addition to the above, the IUCN provides this page, which outlines a number of additional tools available to you. This includes ESRI toolboxes, a standard set of base map features, an elevation raster layer, and empty shapefiles that will help you to ensure that your data are formatted correctly when you submit them to the IUCN.

If you need further assistance in figuring out what tools are best suited for your region/species group. Please do not hesitate to reach out to me. I'm happy to help provide as much guidance as I can.

References and further information

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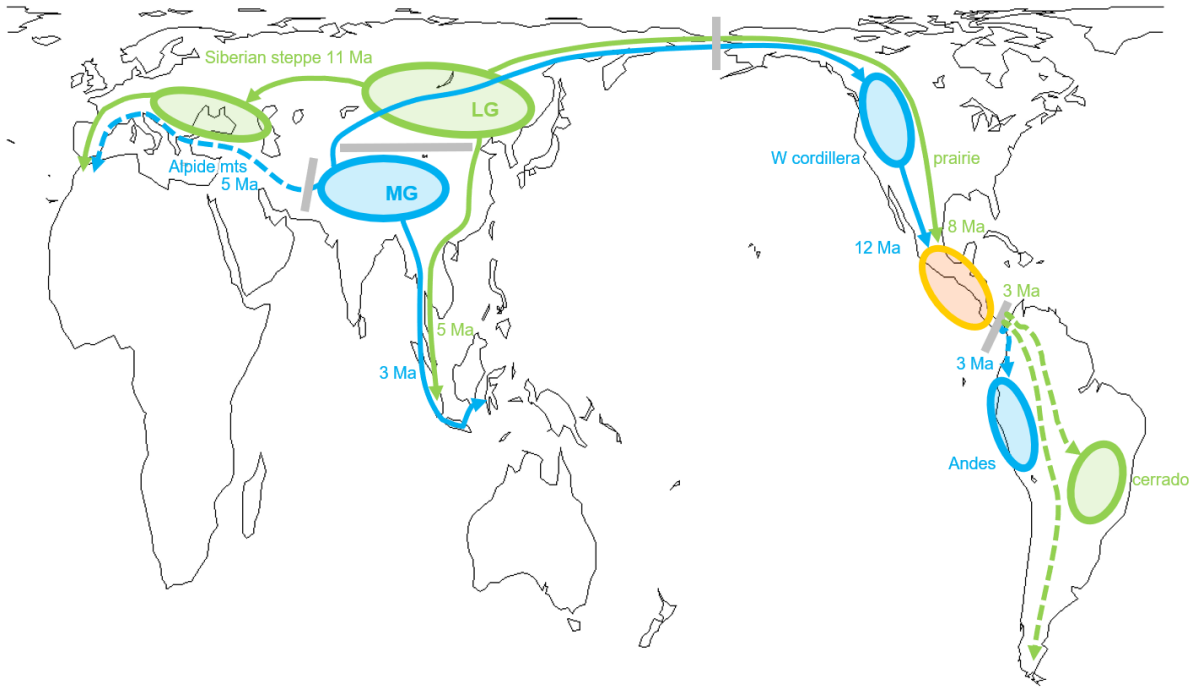
CAN BIOGEOGRAPHY HELP BUMBLEBEE CONSERVATION?

Paul Williams

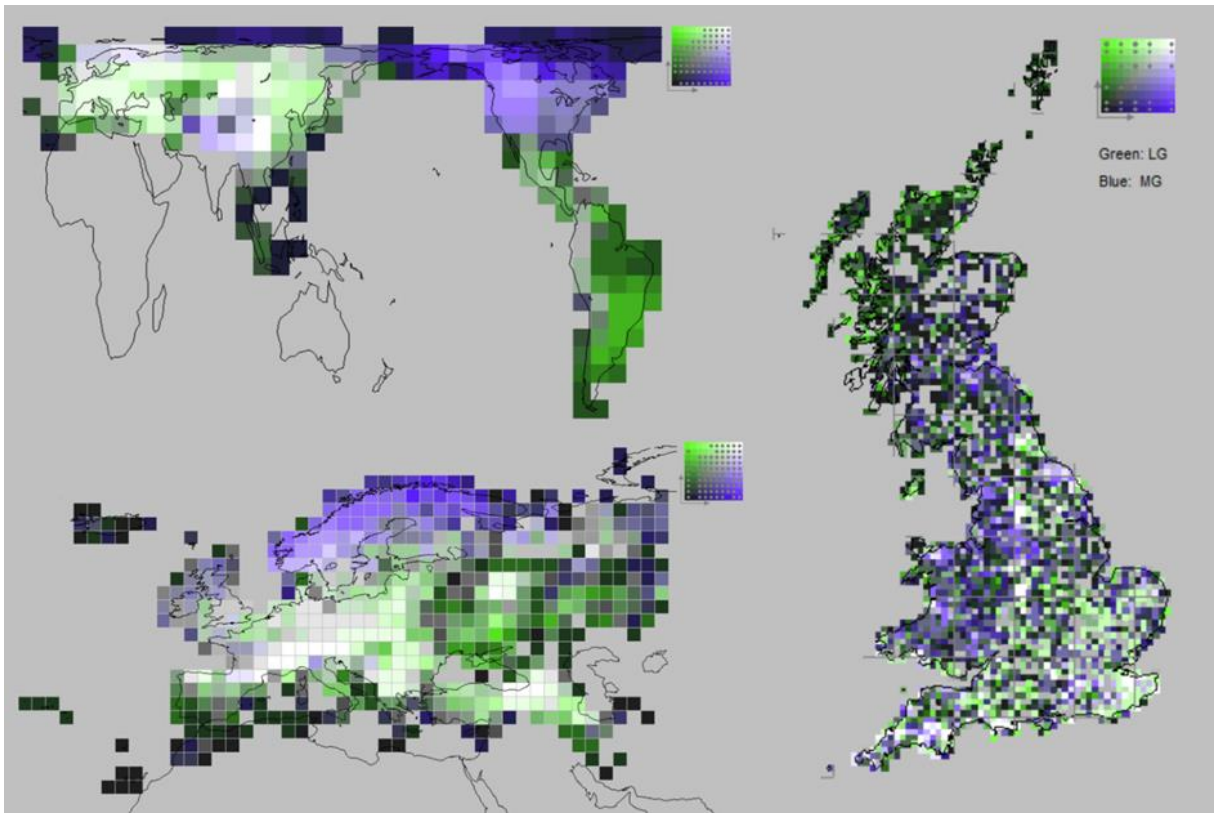
We need to understand species and their distributions not least because knowing the local species provides the essential 'what' and 'where' information to aid in their conservation. But understanding their evolutionary history and how they came to spread to be where they are also has the potential to tell us more about the 'how' of conservation: by helping us to see 'the woods', not just 'the trees', of their habitat needs.

As an example, biogeographical analysis associates two of the principal early evolutionary groups of bumblebees in their major global centres of diversity in Asia, with either (1) flower-rich lowland grasslands (such as in the Asian steppes), or (2) with flower-rich montane grasslands (such as in Himalayan subalpine meadows) (Williams 2023: maps below). This highlights their contrasting requirements for nest sites, for flowers of different depths, for pollen-plant families, and perhaps especially for the differing importance of early spring and late summer flowers for breeding success. Can a broader view of species groups help to filter out some of the less important idiosyncrasies from local case studies, to help give greater effect to conservation actions?



History of dispersal for the two principal bumblebee groups - principal outward dispersal corridors for Lowland Grassland (LG, green) and Montane Grassland (MG, blue) bumblebees, showing some of the changing barriers as grey rectangles (dispersal patterns estimated using DIVALIKE+J in BioGeoBEARS fitted with Bayesian methods). For simplicity, dispersals in the reverse directions are not shown.

A problem for the traditional focus on the conservation needs of individual bumblebee species is that potentially it could lead to many disparate case studies that may become difficult to integrate. For example, *B. distinguendus* is associated in Britain with Scottish machair vegetation, in Sweden with red clover seed farms, whereas in Inner Mongolia it is found visiting sunflowers in agricultural fields on the edge of semi-desert. Summarising this information in the recent book on European bumblebees, the authors wrote "it is not easy to understand the ecological requirements that make the species [*B. distinguendus*] so fragile" (Rasmont et al. 2021).



Biogeography of habitat preferences - the distributions of two of the principal evolutionary groups of bumblebees are compared (for the world, Europe, and Britain) as (1) the 'long-tongued' bumblebees linked with lowland grasslands (excess richness shown in green) and (2) the 'short-tongued' bumblebees linked with montane grasslands (excess richness shown in blue). Areas with many species of both groups are shown in white; areas with few of both in black; and areas with similar proportions of both in shades of grey.

But what if considering broader groups of species and their shared evolutionary history could help to clarify species' habitat requirements? Biogeography shows *B. distinguendus* to be one of the lowland grassland species that is likely to have dispersed into Europe westwards through the Russian steppe and North European Plain, implying that flower-rich tall grassland with suitably deep-corolla food plants, continuing to flower through the late-summer nesting season, is likely to be an important requirement.

Having these more broadly-shared habitat requirements clarified by biogeographical analyses may help not just in the management for species like *B. distinguendus* and its closest European relative *B. subterraneus*, but also for some other of its declining close relatives among the carder bees (*Thoracobombus*). This may explain why efforts to improve grassland habitats near Dungeness for *B. subterraneus* have been so successful in boosting some of the rare and declining carder bees (*B. muscorum, B. humilis*) as well as its relative *B. ruderatus* there (Gammans 2020). ●

References

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Williams PH (2023) Can biogeography help bumblebee conservation? *European Journal of Taxonomy* 890: 165-183. https://doi.org/10.5852/ejt.2023.890.2259

EAST ASIA

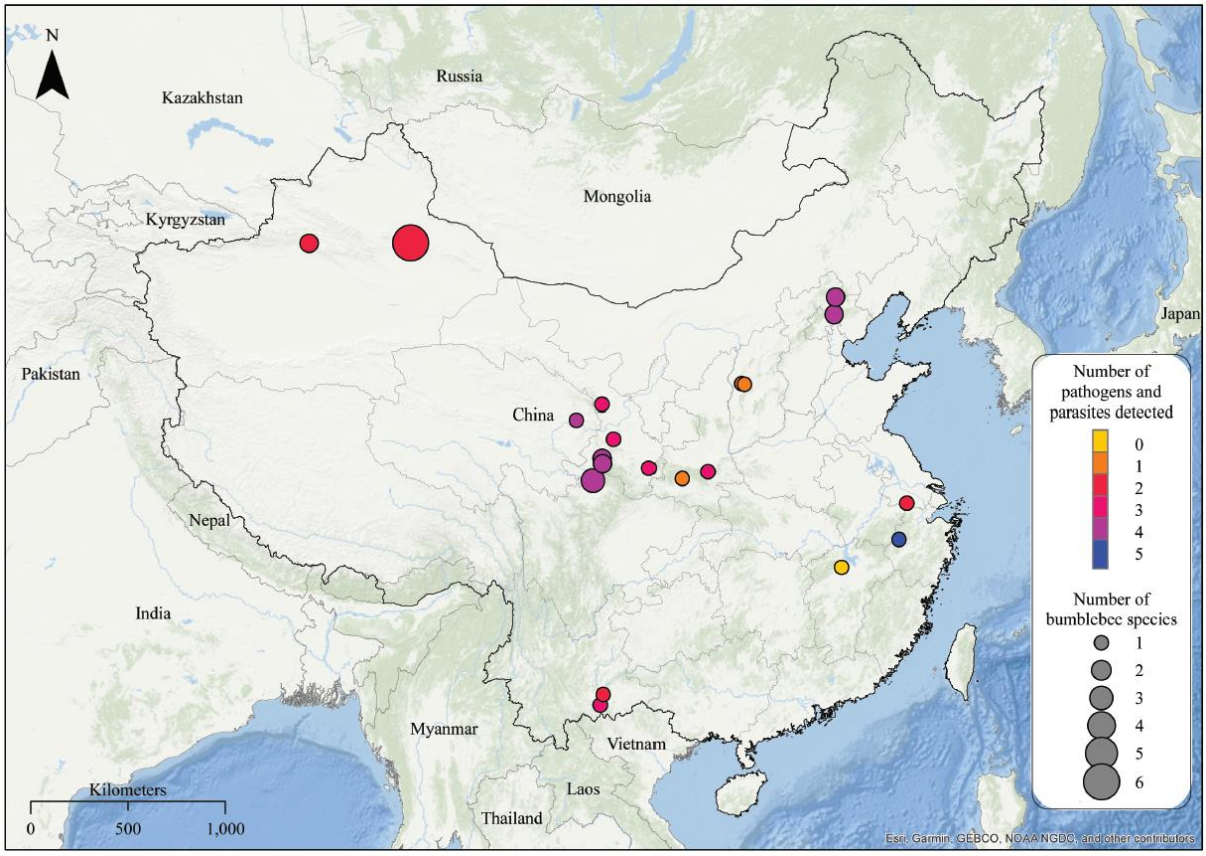
This has the largest and least well-known regional fauna, with approximately 127 species currently recognised (although several species groups are currently being revised). No species have yet been assessed for Red List status within East Asia. At least 26 species are considered endemic, so that more than 100 also need to be assessed beyond East Asia (some of these species extend only just cross the border into the Himalaya region or into the Southeast Asia region). Within East Asia, much effort has been put into recording and databasing species distributions, so that Red List assessments should be possible within the next few years.

The East Asian Region in 2023
Jiandong An

The work of IUCN Red list threat assessments for Chinese bumblebees has had to be postponed again in 2023 because of the illness of the PhD student who planned to do this work. But a new monitoring survey of bumblebees was made in the Zhejiang mountains of southeast coastal areas between March and December 2023. The results of the monitoring showed that the life histories are quite different of the three major bumblebee species in the region, the flying season of *B. breviceps* is much later in the year than that of *B. flavescens* and *B. bicoloratus*. The survey will be continued in the region in 2024 for the further study of conservation and pollination use of local bumblebees.

Bombus breviceps *visiting* Lablab purpureus *(Fabaceae) in Zhejiang of SE China in 2023 (photo by Haihong Zhang).*

In addition, we conducted a comprehensive survey of 13 pathogens from 22 abundant bumblebee species across China. The results show that nine pathogens had been detected from the bumblebee species in this study, with the black queen cell virus, *Apicystis bombi*, *Crithidia bombi*, and *Locustacarus buchner* showing high presence and prevalence in almost all of the sampled bumblebees. The remaining pathogens, including acute bee paralysis virus, Israeli acute paralysis virus, deformed wing virus, Sacbrood virus, and *Crithidia expoeki*, were detected in only a few bumblebee species. We did not detect the chronic bee paralysis virus, *Nosema bombi*, *Nosema apis*, and *Nosema ceranae* in this survey. Moreover, the infection rate of each pathogen varied across the bumblebee species. For example, the highest infection rates of black queen cell virus, deformed wing virus, *Apicystis bombi*, *Crithidia bombi*, and *Locustacarus buchner* were found, respectively, in *B. braccatus*, *B. soroeensis*, *B. lantschouensis*, *B. longipes*, and *B. lantschouensis*. We applied joint species distribution modeling to assess the determinants of pathogen community composition and to examine the presence and strength of pathogen–pathogen associations. The result shows that the host species explained most of the variations in pathogen occurrences and composition. This research will be helpful to further studies on threat assessment of the alien pathogens from the imported European bumblebee *B. terrestris* to native Chinese bumblebees.



Map of mainland China showing the sampling localities of the 22 bumblebee species for the detection of pathogens (Chen et al, 2023).

Revising bumblebee species in East Asia

During 2023, the species of the predominantly Asian subgenus *Alpigenobombus* were revised world-wide (Williams et al. 2023). The results support the European *B. mastrucatus* as a species separate from *B. wurflenii* in the Caucasus, but also support pronounced colour-pattern variation within several species in Asia (*B. breviceps s.l., B. grahami, B. kashmirensis, B. nobilis, B. sikkimi*). These bees are unique among bumblebees for having the mandible with six large pointed teeth, which they use for robbing flowers. The paper includes a discussion of flower robbing and some possible directions for further studies.

1 ***mastrucatus***

2 ***kashmirensis***

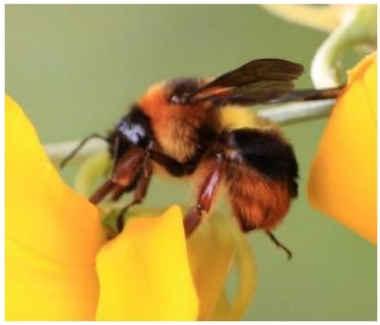
3 ***kashmirensis***

4 ***sikkimi***

5 ***nobilis***

6 ***genalis***

7 ***breviceps***



8 ***breviceps***

9 ***grahami***

Individuals of the revised subgenus Alpigenobombus*: 1* B. mastrucatus *unbanded worker Norway (photo Pieter Haringsma); 2* B. kashmirensis *white-banded worker China-Sichuan (photo Paul Williams); 3* B. kashmirensis *yellow-banded worker India-Zanskar (photo Paul Williams); 4* B. sikkimi *white-banded worker India-Arunachal Pradesh (photo Martin Streinzer); 5* B. nobilis *yellow-banded worker China-Yunnan (photo Zongxin Ren); 6* B. genalis *worker India-Arunachal Pradesh (photo Martin Streinzer); 7* B. breviceps *unbanded worker China-Yunnan (photo Paul Williams); 8* B. breviceps *orange-banded worker Thailand (photo Chawatat Thanoosing); 9* B. grahami *worker India-Arunachal Pradesh (photo Martin Streinzer).*

Identification guides for East Asia

Many of the species for the region are covered by guides to *The bumblebees of North China* (An et al. 2014) and *The bumblebees of Sichuan* (Williams et al. 2009).

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WEST ASIA

Approximately 73 species are currently recognised. No species has yet been assessed for Red List status within West Asia. Of the total, 10 species are considered endemic, so 63 need to be assessed beyond West Asia (many species are shared with Europe). Within West Asia, the fauna of Turkey is already well mapped and excellent progress is being made in Iran. In Central Asia there are many records in collections and in the literature that could be mobilised if funding were available.

The West Asian Region in 2023
Ahmet Murat Aytekin for Turkey

Studies in Turkey continue, especially on commercial rearing and on integrated taxonomic studies of bumblebees as in 2022. The field studies focused mostly in the Middle Anatolian and Marmara regions where the two main laboratories are located. Except for one PhD thesis, the main work concentrated on DNA analysis and floral choice by means from gut samples. Field studies continued mostly as planned this year and two new papers on the floral choices of the steppic species were published. Unfortunately very few projects were accepted during this period due to lack of taxonomists. We hope to continue with some new international projects in 2024, especially in Uzbekistan and Turkey. More paperwork for the collaborations with these local scientists is still needed, but we hope that it will start in the spring.

Male of B. fragrans *at Balıkdamı Sivrihisar, Eskişehir, Middle Anatolia (photo by Burcu Daşer-Özgişi and Çiğdem Özenirler).*

Queen of B. argillaceus *at Ankara (photo by Burcu Daşer-Özgişi and Çiğdem Özenirler).*

Ectoparasite on B. argillaceus *queen (photo by Burcu Daşer-Özgişi and Çiğdem Özenirler).*

Identification guides for West Asia

Most of the species of West Asia are covered by the guide to the *Bumblebees of Europe* (Rasmont et al. 2021).

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NORTH ASIA

Approximately 68 species are recognised. No species have yet been assessed for Red List status for North Asia. Of the total, only two species are currently considered endemic (many species are shared with Europe). Low endemism reflects the region's position at the crossroads among several other regions. Within North Asia, species distributions are being recorded and databased, so that some Red List assessments should be possible in the next few years.

The North Asian Region in 2023

Alexandr Byvaltsev

Unfortunately the North Asia team has been unable to report progress for 2023 because of difficulties with funding, although work on the web pages for the *Bumblebees of Russia* has continued.

Identification guides for North Asia

Many of the species of West Asia are covered by the key by Kupyanskaya (1995).

Reference

Kupyanskaya AN (1995) [Family Apidae]. In: Ler PA (ed) *[Key to insects of the Russian Far East]*, St Petersburg, pp. 551-580.

EUROPE

Approximately 67 species have been recognised in Europe (depending on the species concept accepted). Within Europe, distributions are relatively well recorded and databased, so that all species have been Red-List assessed. Baseline data are available (by arrangement) for comparison in the future.

The European Region in 2023

Guillaume Ghisbain / Paolo Rosa / Sara Reverté

Last courses for the identification of European bumblebees

2023 marked the last steps of the project SPRING (*Strengthening pollinator recovery through indicators and monitoring*), a project launched by the European Commission to strengthen taxonomic capacity with regard to pollinators, support preparation for the implementation of an EU Pollinator Monitoring Scheme EU-PoMS) and pilot the scheme in all 27 countries of the European Union. The long-term objective of this initiative is to detect significant changes in the abundance of pollinators, including bumblebees, across the European Union, using standardized sampling methods.

As part of this project, taxonomic training was organized in 2022-2023 to help volunteers to become the next generation of taxonomists in Europe. A total of 36 courses were given in Belgium, France, Germany, Greece, Hungary, Italy, Malta, Netherlands, Portugal, Serbia, Spain, and Sweden. These courses reached around 450 participants from 30 countries. Some of the sessions focused on bumblebees, for which participants were free to bring their specimens for identification and comparison with referenced collections. The 'bumblebee lesson' aimed to help participants become familiar with the most important diagnostic morphological characters of the genus, and then mostly focused on the identification of *Bombus* at the subgeneric level. Participants then learnt to identify the most common European species of bumblebees and to separate them from other closely related species, when feasible.

Taxonomic courses held in 2022-2023 as part of the SPRING project. With the help of taxonomists, students from all over Europe learnt to identify bumblebees.

Preparation of new identification tools for European bumblebees

2023 marked the third year of the European project ORBIT, a project commissioned by the Directorate General for Environment of the European Commission to develop resources for European bee inventory and taxonomy. The project has made progress in generating a centralised taxonomic facility for the identification of all European wild bees, including all bumblebee species. The project aims to make tools accessible to everyone to identify all European bees for facilitating large-scale studies on biodiversity patterns and responses of wild bees to anthropogenic pressures. So far, 1110 of the European bee species have a factsheet with information on their diagnostic characters, and 1324 species have high-quality macrophotographs of their habitus and diagnostic characters.

High-quality pictures of bumblebees are being taken at the University of Mons by Paolo Rosa, technical coordinator of this project (figures below). These pictures, focusing on diagnostic characters, should eventually be freely available by the end of 2024 and accompanied with data on the species' ecology and conservation. More information can be found at https://orbitproject.wordpress.com.

Images of a female of B. confusus *taken as part of the European project ORBIT. Left, oblique view of the head. Top right, lateral view of the habitus. Middle right, upper view of the habitus. Bottom right, detail of the upper part of the head. (Pictures by Paolo Rosa, copyright EU_ORBIT_2023.)*

Images of a female of B. subterraneus *taken as part of the European project ORBIT. Left, oblique view of the head. Top right, lateral view of the habitus. Bottom right, upper view of the habitus. (Pictures by Paolo Rosa, copyright EU_ORBIT_2023.)*

An updated checklist of the bumblebees of Europe

In the summer of 2023 the new annotated checklist of the wild bees of Europe was published (Ghisbain, Rosa et al. 2023), including the new checklist of European bumblebees. This work combined the efforts of 20 European taxonomists and ecologists, for a total of 2138 species of wild bees including 67 bumblebee species in Europe. The main changes compared to the last update on the European bumblebee fauna (cf. Nieto et al. 2014; Rasmont et al. 2015, 2017) are shown below. All these cases (except for 1 and 6) were already considered in the *Bumblebees of Europe and neighbouring regions* (Rasmont et al. 2021).

(1) The taxon *bisiculus* Lecocq, Biella, Martinet & Rasmont 2019 is now considered as conspecific with *B. lapidarius* based on the arguments of Williams et al. (2020).

(2) The taxon *reinigiellus* Rasmont, 1983 is considered infraspecific to *B. hortorum* based on genetic and semio-chemical evidence of Ghisbain et al. (2021).

(3) The taxon *konradini* Reinig, 1965 is considered as a valid species, separate from *B. monticola* based on genetic and semio-chemical evidence of Martinet et al. (2018).

(4) The taxon *xanthopus* Kriechbaumer, 1870 is (at least temporarily) considered as a valid species, separate from *B. terrestris* based on genetic evidence of Williams (2021).

(5) The taxon *mocsaryi* Kriechbaumer, 1877 is considered infraspecific to *B. laesus* based on genetic and semio-chemical evidence of Brasero et al. (2021).

(6) The taxon *pyrrhopygus* Friese, 1902 is considered as a valid species, separate from *B. polaris* based on the evidence of Williams et al. (2019). Only *B. pyrrhopygus* occurs in Europe.

(7) The taxon *pereziellus* Skorikov, 1922 is considered infraspecific to *B. muscorum* based on genetic and semio-chemical evidence of Lecocq et al. (2014).

(8) The taxon *perezi* Schulthess-Rechberg, 1886 is considered infraspecific to *B. vestalis* based on genetic and semio-chemical evidence of Lecocq et al. (2014).

After the publication of the checklist, another change occurred in the taxonomy of the European bumblebee fauna. *Bombus mastrucatus* Gerstaecker, 1869 is now considered as a valid species, separate from *B. wurflenii,* based on the evidence of Williams et al. (2023). Only *B. mastrucatus* occurs in Europe.

New country records for the European bumblebee fauna

Country records for the entire European bumblebee fauna were published in 2023 as part of a project providing such records for the complete bee and hoverfly species of Europe, which corresponds to ca 3000 pollinator species (Reverté et al. 2023). The completion of this fully open database required the joint efforts of more than 100 experts in bee and hoverfly taxonomy, ecology and conservation.

A new Red List of the European bumblebee fauna

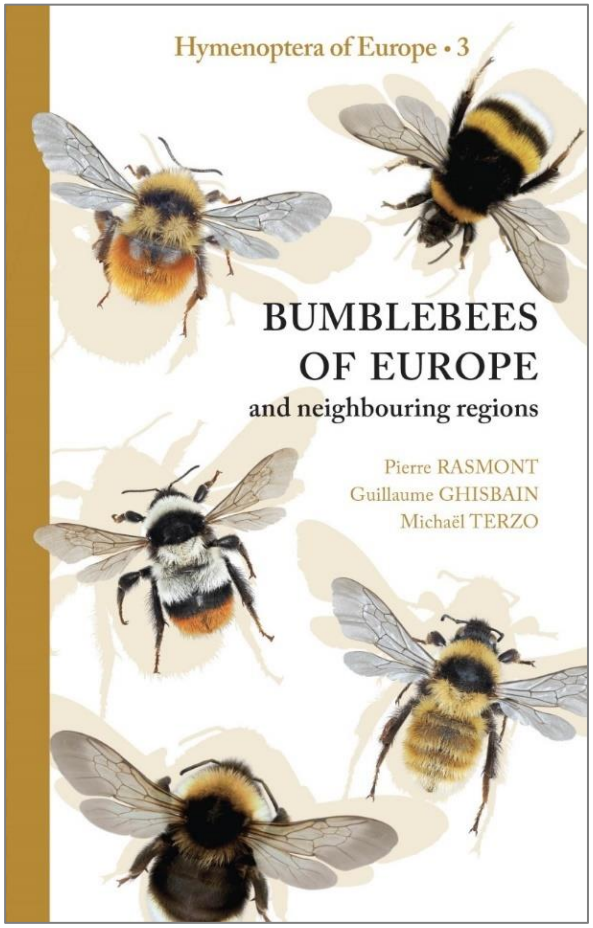
The last Red List of European wild bees was published in 2014 (Nieto et al. 2014) in collaboration with the International Union for Conservation of Nature (IUCN). This project highlighted that around a quarter of the bumblebee species of Europe are threatened with

extinction, with nearly half of the studied species showing decreasing population trends. Since 2014, critical advances have been made in terms of data acquisition and taxonomy for European bumblebees. On 11 December 2023, the extinction risk of all European *Bombus* was reassessed with the help of national and continental experts on bumblebee taxonomy, ecology and conservation.

Although the exact results of the workshop are still under embargo, we can announce that the proportion of Data Deficient bumblebee species will be reduced by two thirds based on new information available about the species. A substantial proportion of species will change from a *Least Concern* to *Near Threatened* status based on emerging risks related to global changes in land use and climate (cf. Ghisbain et al. 2023). Bumblebees still appear as a highly threatened genus of bees at the European scale.

This new IUCN assessment also highlighted the need to monitor carefully the population of some bumblebee species for which data are alarmingly scarce. Any new data on the following species are especially needed to refine the next assessments: *Bombus cullumanus, B. deuteronymus*, *B. mlokosievitzii*, *B. modestus*, *B. patagiatus,* and *B. saltuarius*. Please contact guillaume.ghisbain@umons.ac.be in case any new data on these species is available.

Identification guide for Europe



This book provides identification keys for 14 subgenera and for 79 species present in the West Palaearctic region. Each species is presented with notes on its distribution, habitats, cohabitations, courtship behaviour, nesting behaviour, flower preferences, inquiline relations and conservation. Taxonomic discussion is provided for all species of the region, considering recent findings. Original photos are included for each of the West Palaearctic species, with some extremely rare bumblebees photographed for the first time.

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HIMALAYA

Approximately 62 species are currently recognised. No species has yet been assessed for Red List status within the Himalaya. This region has relatively small extent for such a relatively rich fauna. Of the total, approximately 19 species are considered endemic (or near endemic, just crossing into the Qinghai-Tibetan Plateau), so at least 43 need to be assessed beyond the Himalaya (most in East Asia). Many records in the collections and literature could be mobilized if funding were available so that a red list assessment will be done in the next few years. Many surveys are urgently needed to improve and fill the database's gaps. There is a dire need for funding to generate more manpower for the future conservation of bumblebees.

The Himalayan Region in 2023

Rifat Raina

Bumblebees are wild pollinators in the high-altitude region and pollinate various wild plants as well as cultivated crops. These species occur at different elevations, ranging from 900–5000 m asl. The region from the North-West Himalayas to the North-East Himalayas in the Indian Himalayan region supports a range of conditions for their development and foraging. Various factors like habitat fragmentation, urbanisation, construction of dams, overgrazing, deforestation, and excessive use of pesticides, pose a serious challenge to conserving these bees. The broadly distributed species in the wild are being surveyed annually so that the current status of the bumblebee fauna of the Himalayan region can be elucidated.

A new bumblebee species record for the Indian Himalayan Region

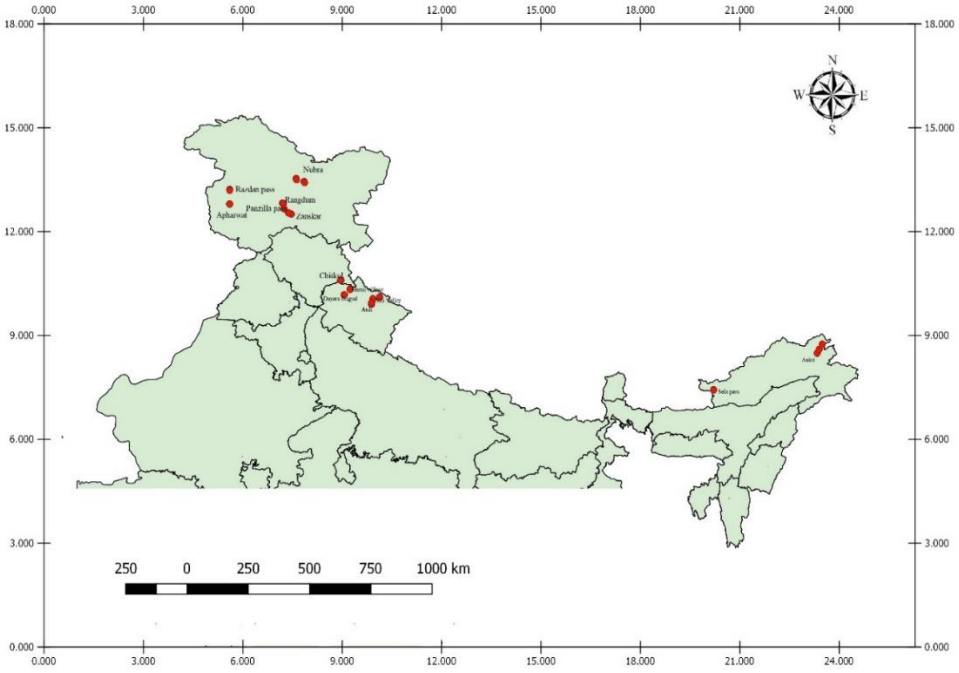
During 2023, the species *B. cryptarum* has been recorded from the Nubra Valley in Ladakh and from the Gurez Valley in Jammu and Kashmir. This species is added for the first time to the fauna for the Indian Himalayan Region (Raina et al. 2024).

New survey records

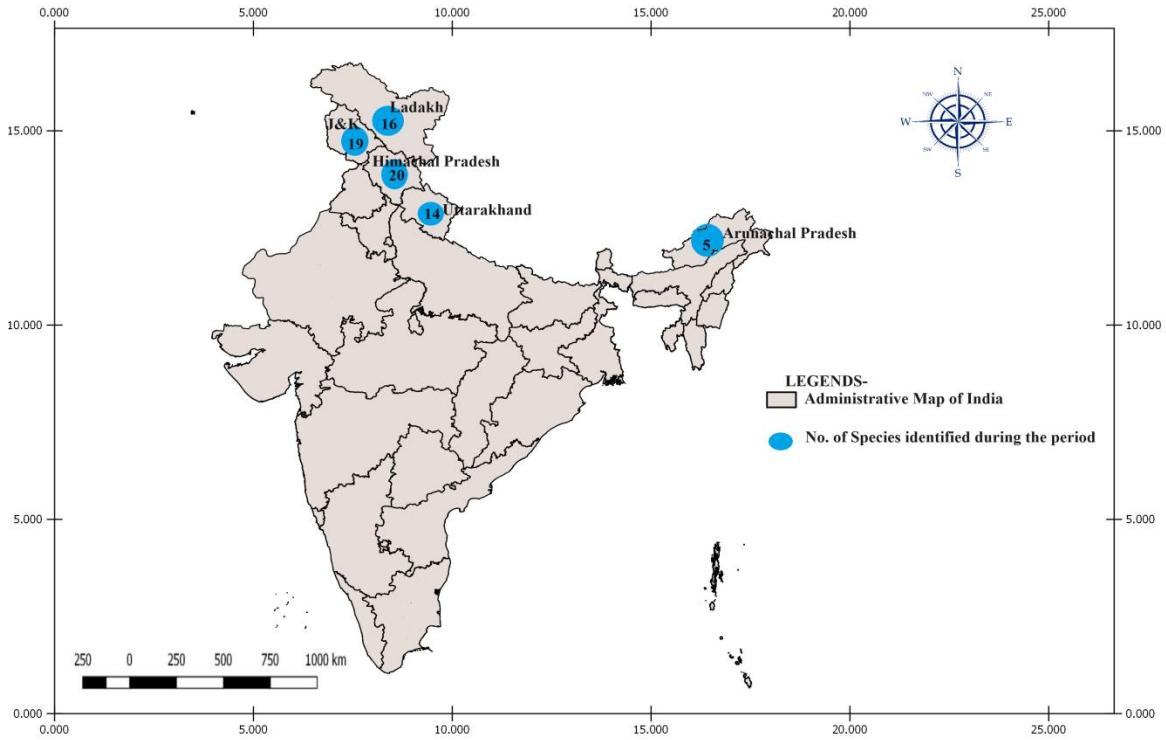
During the year 2023, a total of 4026 specimens of bumblebees have been examined and identified to 27 species. This sample was collected during 2022 from three states: Himachal Pradesh, Uttarakhand, Arunachal Pradesh, and the union territories of Jammu, Kashmir, and Ladakh. The species are: *B. albopleuralis, B. longiceps, B. avinoviellus, B. biroi, B.breviceps, B. cryptarum, B. difficillimus, B. eurythorax, B. ferganicus, B. festivus, B.flavescens, B. genalis, B. himalayanus, B. jacobsoni, B. keriensis, B. lepidus, B. melanurus, B. miniatus, B. morawitzianus, B. novus, B. parthenius, B. rufofasciatus, B. semenovianus, B. sikkimi, B. simillimus, B. tunicatus,* and *B. waltoni.* The current distributional status has been recorded and updated for the assessment of species' distributions in the Himalayas. The database of 34 species Himalayan bumblebees from over 9740 specimens has been generated for 2020-2023 and further work still needs to be done on the species' ranges and their assessment. Bumblebees are not easily identified without using identification keys because of mimicry in their colour patterns, so proper care must be taken during collection and preservation.

The survey localities in the Indian Himalayan Region that were assessed for the study from 2020–2023 have been used to suggest priority areas for conservation because these areas

show a high density of bumblebees (map below). The Himalayan region provides many habitats suitable for bumblebee nesting and foraging, which in turn helps to support the pollination and species' diversity of medicinal plants. Bumblebees show extraordinary adaptation to cool environments compared with many bees, which allows them to survive in harsh conditions such as the low temperatures at high elevations.



Map showing the areas prioritized for the conservation of bumblebees in the Indian Himalayan Region.



Map showing the numbers of species recorded per state from the Indian Himalayan Region in 2023.

Conservation and pollination

The Himalayan region is a biological hotspot rich for various flora and fauna. The diversity and distribution of bumblebees are updated also with an inventory of the food plants prevalent in the different mountain ecosystems of the Himalayan region. The broad range of vegetation types used, including tropical, subtropical, and temperate, make these insects very prominent pollinators. The maximum diversity of bumblebees is observed between the elevations of 2500–4500 m asl.

Bumblebees are considered to increase the yield for crops in many families of plants, such as Fabaceae, Solanaceae, Asteraceae, and Cucurbitaceae, e.g., *Solanum tuberosum, Solanum melongena, Pisum sativum,* and *Cucurbita* spp.. The Himalayas contain various medicinal plants that are important to human well-being. The current study provides information on bumblebees for conservation as well as for maintaining the diversity of medicinal plants in the Himalayan region. Bumblebees are known to pollinate important species of medicinal plants, such as *Rhododendron laponicum, Podophyllum hexandrum, Polygonatum multiflorum, Carum carvi, Inula racemose, Achillea millefolium, Meconopsis horridula,* and *Rhododendron grande, etc.*. Ten species of bumblebees have been noted as potential pollinators of various medicinal, ornamental, and agricultural plants in the Himalayan region. These species are *B. tunicatus, B. simillimus, B. albopleuralis, B. haemorrhoidalis, B. keriensis, B. longiceps, B. jacobsoni, B. rufofasciatus, B. melanurus,* and *B. miniatus.*

Public outreach

In 2023, awareness programmes or outreach activities were carried out under the campaign *Mission Life*, to enhance knowledge about these bees and their benefits to various stakeholders. On *World Bee Day* (20th May 2023), awareness programmes were conducted for college and University students. Pamphlets of advice for improving crop yield and pollination practices have been distributed among school and college students. The awareness program also demonstrated approaches towards the conservation of bumblebees.

World Bee Day awareness programmes.

Bumblebee species are decreasing gradually every year due to anthropogenic and natural activities. This gradual decline may affect the highland mountainous ecosystems and cause a serious threat to the Himalayan region. Much more attention is required to conserve the rare species of bumblebees and also to maintain the pollination of various medicinal and crop plants by them. However, in the Himalayan region, many localities are suitable for

nesting and habitat improvement for bumblebees. These localities are being targeted in the states of Uttarakhand, Himachal Pradesh, and Arunachal Pradesh, as well as in the territories of Ladakh, Jammu, and Kashmir, for conservation assessment for this economically important insect group.

Rifat Raina is highly indebted to Dr Dhriti Banerjee, Director of the Zoological Survey of India, for providing the necessary facilities. Thanks also to NMHS, MoEF&CC Govt of India for providing financial support under the project *Documentation, Conservation, and Utilization of Indigenous Mountain pollinators- with special reference to Himalayan Bumblebees.*

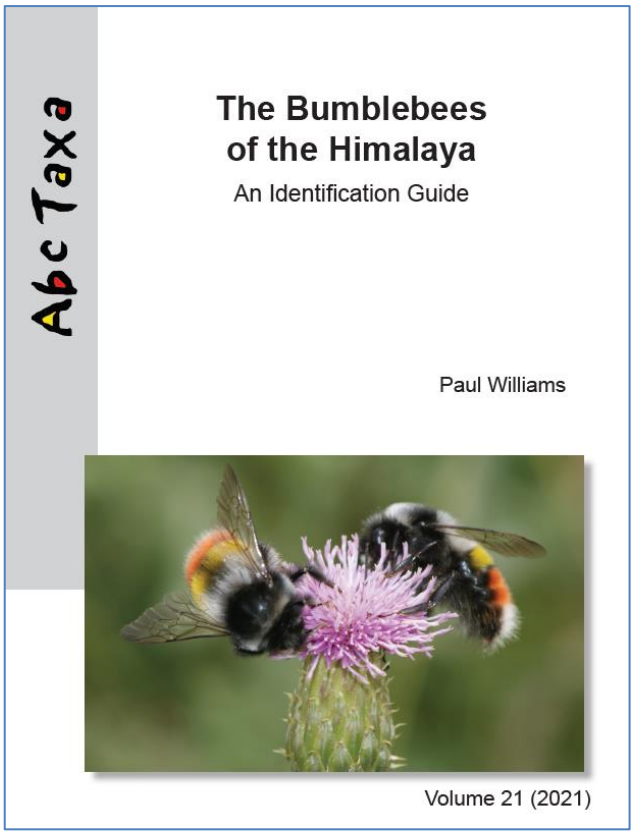
Bombus tunicatus

Bombus jacobsoni

Bombus rufofasciatus

Bombus simillimus

Identification guide for the Himalaya



This book, published in 2022, provides identification keys for the 10 subgenera and 62 species present within or on the edge of the Himalayan region. Each species is presented with notes on its taxonomy, identification, habitats, distribution, with illustrations of colour pattern variation, male genitalia, and summary maps. Taxonomic discussion is provided for all species of the region, considering the most recent findings, with the status of several species revised and one new species described. Summaries of the most common species by habitat are also provided.

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NORTH AMERICA

49 species are listed here up to the end of 2023. Almost all of these species have now been assessed for Red List status globally, although assessments of the species of the subgenus *Alpinobombus* and of the *lapponicus*-group need to be revised. Assessments of species listed as Data Deficient will be improved in future years as data gaps are filled, especially from parts of species ranges beyond North America (i.e. by bringing together experts from around the world). Within North America, distributions are relatively well recorded and databased, so that baseline data are readily available for comparison in the future.

The North American Region in 2023
Leif Richardson

As noted above, the North American section has benefited greatly from the work of Dr. Sheila Colla (York University), who is stepping away from the role of North America Regional Coordinator due to health issues. We thank Sheila for her substantial contributions to these efforts, and wish her a full and speedy recovery.

Red List Assessment Update

In 2023, 50 species of bumblebees were known to occur in North America, excluding Mexico. Of these, 46 were assessed for the IUCN Red List (2008-2014). However, nine of those species were assessed as Data Deficient and as a whole, these assessments are now more than 10 years old. Because of the marked recent increase in bumblebee collection data and known declines of some species, the North American species are due for a re-assessment. Priorities for this effort should include: *Alpinobombus* species, given previous data deficiency and a taxonomic revision completed since the previous assessments; and any newly described species (e.g. *B. kluanensis*), or those for which taxonomy has changed since the original assessment (e.g. *B. fernaldae*). Beyond these priorities, all originally assessed North American species should now be re-assessed. A priority for 2024 is to identify individuals who can contribute to these assessments. If you are interested in helping with this work, please contact Regional Coordinator Leif Richardson (leif.richardson@xerces.org).

Policy and Management Update

In 2023, the US Fish and Wildlife Service established the Center for Pollinator Conservation, which has the mission of implementing conservation initiatives that help pollinators, including bumblebees. It is anticipated that this institution will increase our ability to monitor US bumblebee populations and assess species status.

A North American bumblebee research society, *Building our Methods by Using Sound Science* (BOMBUSS), held its third biennial conference in San Cristobal de las Casas, Chiapas, where attendees discussed a variety of bumblebee conservation topics, including the need to produce Red List Assessments for our species.

Many new records of bumblebee occurrence continue to be generated through academic, government, and community science (citizen science) in North America. The iNaturalist platform logged nearly 140,000 new photo-vouchered bumblebee observations from the USA and Canada in 2023. Bumble Bee Watch, a project of the Xerces Society for Invertebrate Conservation and its partners, was active in 15 US states, generating more than

37,000 new records. Several other community science projects generated substantial new *Bombus* records data, including the Alaska Bee Atlas, the Oregon Bee Atlas, and the Wisconsin Bumble Bee Brigade.

We continue to see actions by both federal governments and many states/provinces to protect imperiled bumblebees. Increasing numbers of bumblebees are being added to state-level Species of Greatest Conservation Need lists, an action that may lead to state listing, increased funding for recovery, and other conservation outcomes. Some species have also been listed under state/provincial endangered species acts (see below). As one example, California has afforded endangered species protections to four species that are candidates for listing under the California Endangered Species Act (*B. crotchii, B. franklini, B. occidentalis,* and *B. suckleyi*).

Listed and Proposed Species

Bombus affinis: Endangered in Canada and USA. In 2023, as the result of a lawsuit, the US Fish and Wildlife Service was mandated to establish Critical Habitat for this species before the end of 2024.

B. bohemicus: Listed as Endangered in Canada.

B. franklini: Listed as Endangered in the US.

B. fraternus: Petitioned for US listing in 2022, and currently under review.

B. mckayi: Listed as Species of Special Concern in Canada.

B. morrisoni: Petitioned for US listing in 2023.

B. occidentalis: Species status assessment completed by US Fish and Wildlife; decision pending. Listed as Threatened in Canada.

B. pensylvanicus: Petitioned for US listing in 2021, and currently under review. Species of Special Status in Canada.

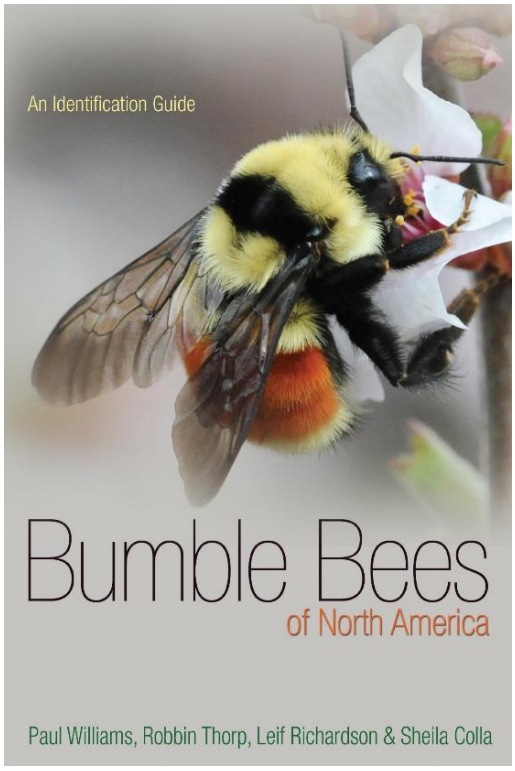
B. suckleyi: Petitioned for US listing in 2021, and currently under review. Listed as Threatened in Canada.

B. terricola: Listed as Species of Special Concern in Canada.

Bombus caliginosus *female at Lost Coast Headlands, Humboldt County (photo by L. Richardson).*

Learning to handle bumblebees, Catalina Island.

Identification guide for North America



This book provides identification keys for the 8 subgenera and 46 of the species present in the North American region. Each species is presented with notes on its identification, distribution, habitats, example food plants, behaviour, and parasitism by other bees, with illustrations of colour pattern variation, phenology, and maps. Taxonomic discussion is provided for all species of the region.

An update to the identification guide to the bumblebee species of North America is now being planned, to include revised taxonomy and a great wealth of new and revised distribution data.

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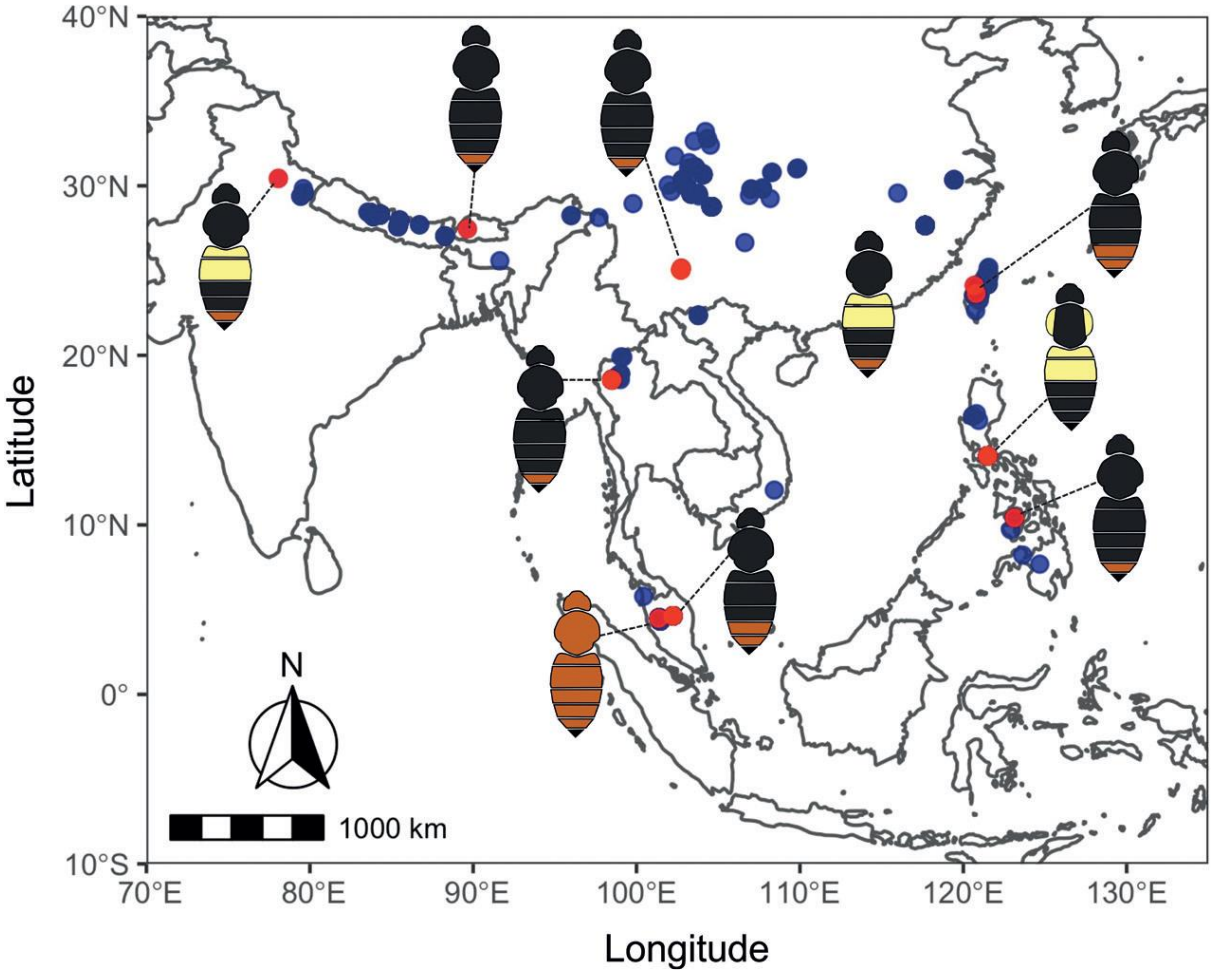
SOUTHEAST ASIA

Approximately 27 species are currently recognised. No species has yet been assessed for Red List status within Southeast Asia. Of the total, five species are considered endemic, so 22 need to be assessed beyond Southeast Asia. Many of these non-endemic species are restricted in Southeast Asia to the border regions with the East Asia region. Within Southeast Asia, progress is being made in the recording and databasing of bumblebee distributions.

The Southeast Asian Region in 2023

Chawatat Thanoosing / Jonathan Koch / Pham Hong Thai / Hliang Minoo / Johan Tial Cung

Bumblebees in Southeast Asia have not been assessed for their conservation status (IUCN Red List) yet, due to lacking occurrence data, extensive study of their threats, and taxonomic impediments to recognise species boundaries. In 2023, we confirmed the species status of *B. flavescens* in Southeast Asia as a single species with extensive colour-pattern variation, using molecular data and phylogenetic analyses (Thanoosing et al. 2023).



Map showing the distribution of B. flavescens *with the pattern of hair colour in the dorsal view. The blue dots represent the records from museum collections, literature, and GBIF database (n = 702). The red dots represent the localities of barcoded specimens.*

Due to the lack of bumblebee occurrence data, we ran a bumblebee survey in Nan Province, Thailand, in September 2023. In addition, more bumblebee specimens were examined that had been deposited in the Lee Kong Chian Natural History Museum (LKCNHM) in Singapore. The specimens, including *B. flavescens* and *B. montivagus*, were collected in Malaysia, mainly in the Cameron Highlands. We would like to thank Dr Wendy Wang, the curator of Entomology at LKCNHM, for allowing us to access the specimens.

To achieve the IUCN Red List assessment goal, we are continuing to record recent data from the field surveys and from the citizen science platforms (for example *iNaturalist*), historical data, and from museum specimens.

Bombus haemorrhoidalis *in Nan Province, Thailand (photo by Chawatat Thanoosing).*

Identification guide for Southeast Asia

A guide to the species of Southeast Asia is in preparation by Chawatat Thanoosing and collaborators.

Reference

Thanoosing C, Orr MC, Warrit N, Vogler AP, Williams PH (2023) A taxonomic re-assessment of the widespread oriental bumblebee *Bombus flavescens* (Hymenoptera, Apidae). *Journal of Hymenoptera Research* 96: 507–541. https://doi.org/10.3897/jhr.96.104715

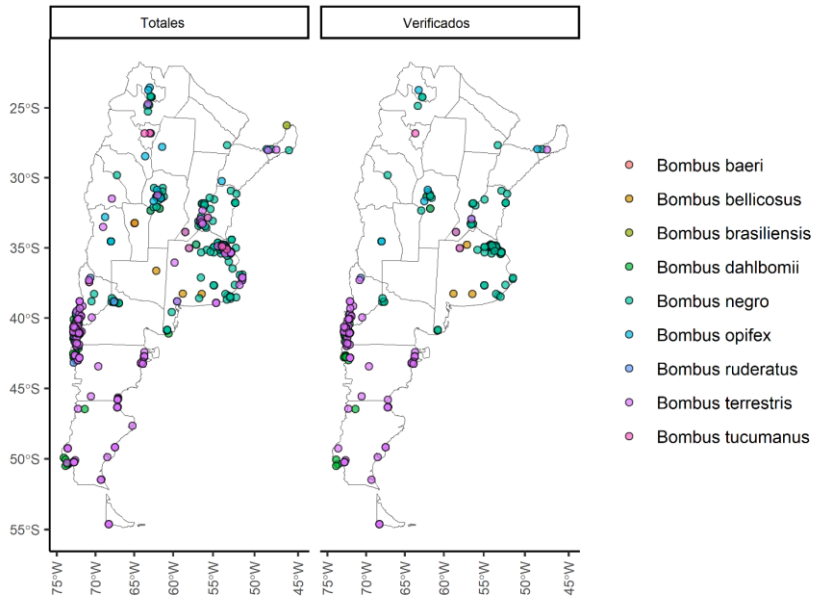
SOUTH AMERICA

Approximately 25 species are currently recognised. Most species have now been assessed for Red List status globally. Within South America, distributions are being recorded and databased, so that assessments may be updated in the next few years.

The South American Region in 2023
Carolina Morales

This report summarizes some of the progress, news and challenges regarding bumblebee conservation in South America, with a focus on Southern South America, and in particular on Argentina and Chile. No further bumblebee species assessment has been carried out in this region since 2016. An update of the assessment for the 12 species of the region previously assessed as *Data Deficient* (See BBSG Annual Report 2022) seems timely. Current efforts to gather present and historic species occurrences data are in line with that purpose.

During 2023 there has been great progress in increasing the number of photographic records of bumblebee species in Argentina, due to the expansion of the Citizen Science Project *ViUnAbejorro* ('I saw a bumblebee' in Spanish, ig: @viunabejorro, www.abejorros.ar) launched in 2021 with the support of grants from MBZ Species Conservation Fund, National Geographic (grants NGS-97579C-22 and NGS-57001R19), and Ministerio de Ciencia, Tecnología e Innovación de Argentina (grant citizen science N°97). The results of this project have been a core part of Victoria Campopiano Robinson Bachelor's degree thesis, entitled *Citizen Science and Control tools applied to the monitoring and management of a biological invasion* which was defended in 2023. One of the main findings was that according to photographic records many species reported as *Bombus* were actually *Xylocopa* or other genera, or belonged to a different *Bombus* species from the species reported, highlighting the importance of reliable and verified records in citizen science. In addition, when considering only those reports supported by verified photographs, *B. terrestris*, an invasive alien species in Argentina, introduced in Chile for crop pollination in the 1990s, was the species most frequently reported at the country level, even more frequent than all the 'black *Bombus*' together (maps below).



Comparison of bumblebee records according to citizen science project ViUnAbejorro*, (right) with photographic records and (left) without photographic records. Note that the category '*Bombus *negro' (negro, black in Spanish) involves many species covered with black hair, including* B. pauloensis *(synonym* atratus*) and* B. morio*. Source: Victoria Campopiano Robinson (2023) Ciencia ciudadana y herramientas de control a campo aplicadas al monitoreo y manejo de una invasión biológica. Unpublished thesis.*

In addition, a recent record of *B. baeri*, a mountain species very rare in Argentina, was reported through this platform (image below). Moreover, the presence of *B. terrestris* beyond the Patagonian Region in Argentina was confirmed by photographic records of this species in the Province of Mendoza, showing the potential of this tool to provide a first preliminary insight of the occurrence of rare species and the spread of invasive species. Scientific field surveys and specimen collections should confirm these findings.

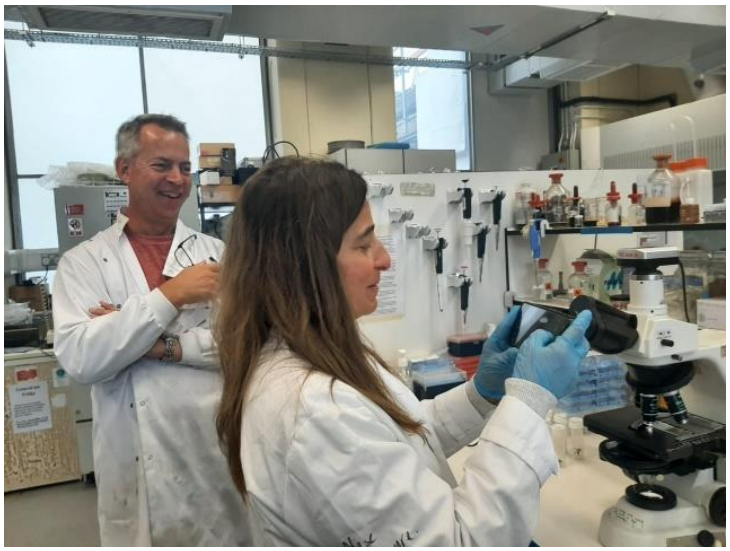
A male of B. baeri *at Cerro Colorado (3000m asl), San Antonio, Jujuy, North Argentina (photo by Claudia Martin, occurrence record reported to* ViunAbejorro*).*

In addition, during 2023 we made a great progress in terms of databasing bumblebee species of Argentina hosted in museum collections abroad. Specifically, Vicky Campopiano spent a week at the Museum of Natural History, London, digitizing the information for 512 specimens (identifications of these South American specimens by Paul Williams) belonging to seven species of *Bombus* (*B. dahlbomii* n= 348, *B. pauloensis* n= 120, *B. tucumanus* n= 1, *B. baeri* n= 2, *B. brasiliensis* n= 10, *B. bellicosus* n= 28, *B. opifex*= 3, photo below). We thank Joseph Monks, Suzanne Ryder and Paul Williams for help in accessing the collection and for supporting Vicky during her visit to London.

Vicky Campopiano with the amazing collection of older specimens of B. dahlbomii *at the NHM, London. Note the size of the queens of this species, one of the world's largest bumblebees.*

The information gathered by Victoria will allow us to update the distribution maps of Argentinean species and the future redlist assessment of these species. These goals are part of Victorias' application to a CONICET doctoral scholarship. Since the recently arrived government has suspended the scholarship program, the achievement of these goals will depend on getting support.

In August 2023, within the SURPASS2 project (Safeguarding Pollinators and Pollination Services, https://bee-surpass.org/), and with the support of UKRI (UK) and CONICET (Argentina), Marina Arbetman and Carolina Morales visited London to make progresses in bumblebee conservation related projects. They worked win collaboration with Reto Schmuki, Claire Carvell and Ben Woodcock at the Center of Ecology and Hydrology (CEH-UK) in the analyses of large-scale patterns of abundance of native and invasive bumblebees in South America, and they learned about bumblebee pathogens identification at Mark Brown's laboratory at Royal Holloway, University of London. This training will help to identify parasites in South American bumblebees. We are very thankful to Mark Brown and his team, Paul Williams, and all the CEH team for the warm reception and for sharing all their knowledge and passion on bumblebees.



Marina Arbetman and Mark Brown in his lab at Royal Holloway, University of London.

In Chile, field surveys by Rodrigo Barahona, Cecilia Smith, and other collaborators in Arica and Parinacota have revealed an expanded distribution of *B. terrestris* and provided new knowledge of the distribution, floral associations and habitat of *B. funebris* in this extremely dry and high altitude (>4000m asl) environment at the Atacama Desert.

Finally, during 2023 the Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has been launched. The Report is composed of (1) a Summary for Policymakers (SPM), approved by the IPBES Plenary at their 10th session in Sep 2023 in Bonn, Germany (IPBES-10); and (2) a set of six Chapters, which will subsequently be accepted by the IPBES Plenary. In this Assessment Report, the trade in bumblebee colonies for crop pollination as the driver that facilitates the introduction of invasive alien species was showcased in a Box in Chapter 3, focussing on drivers of invasions (All products of the assessment are available on Zenodo, https://zenodo.org/records/10127795). This is an important step towards increasing the global awareness on the risks and threats to native bumblebee faunas of introducing non-native bumblebee species outside of their natural ranges.

Identification guides for South America

The most recent keys intended to cover the species of all (or even to a large part of) South America were by Milliron (1973a,b).

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Montalva J, Hoagland B, Arbetman MP, Morales CL, Aizen MA, Vilela B, Silva DP (2023) Macroecological perspectives on the competition between the native and invasive bumblebees in southern South America under climate change. *Biological Invasions*, 1-12.

MESOAMERICA

Approximately 18 species are currently recognised, although several species groups are currently being revised, with the promise of several more species to be added soon. The Red List status for all 18 current species has now been assessed globally. Within Mesoamerica, distributions are being recorded and databased, so that Red List re-assessments should be possible in the next few years.

The Mesoamerican region in 2023
Oscar Martínez

This year, our team focus was on hosting the BOMBUSS 3.0 meeting in San Cristóbal de Las Casas, Chiapas, México in November. We held two short courses for bumblebee rearing (lead by Alejandra Martínez and Omar Argüello) and for bumblebee tagging and tracking (led by August Easton and James Crall). For the rest of the days, we had different sessions on conservation and Red Listing, rearing and pollination, locally-suitable species discussion, innovative methods in bumblebee ecology, genetics and taxonomy, citizen science and outreach, toxicology and pathogens, climate change, and bumblebee nesting. We had more than 70 people participating and engaging actively in these sessions and we want to thank everyone who was involved in the organization and as participants for making this event successful and amazing!

Participants at the BOMBUSS 3.0 meeting at San Cristóbal de Las Casas in November.

As we are working on the taxonomy and genetic analyses of Mesoamerican bumblebees, we are also working on some problems with species complexes in the region, using the molecular data at our disposal. This work is led by Philippe Saggot and Paul Williams, and we hope that this information will be useful for the Red List re-assessments in the near future.

Costa Rica

During 2023, work continues in Braulio Carrillo National Park in the Barva Volcano sector (which we have been monitoring since 2021), where the natural dynamics of the populations of *B. ephippiatus* and *B. volucelloides* are being monitored by means of individual counts. We are also collecting information on the flora visited by each species in order to compile a catalog of the flowering for food importance for the *Bombus* present in the Barva volcano.

The collections and observations have been made in the Braulio Carrillo National Park in the Barva Volcano sector and the *Bombus* laboratory has been established in the CINAT located in Barreal de Heredia.

Left, queen of B. ephippiatus*; right, male of* B. digressus.

Identification guide for Mesoamerica

Identification of the described species of Mesoamerica is covered in the *Bombus of México and Central America* by Labougle (1990). We ran a small class on identifying bumblebees from Mesoamerica for which a video is available http://bio2.elmira.edu/fieldbio/beemovies/index.html.

Reference

Labougle JM (1990) *Bombus* of México and Central America (Hymenoptera, Apidae). *Kansas University Science Bulletin* 54: 35-73.

JAPAN

Approximately 15 species are currently recognized. No species have yet been assessed for IUCN Red List status within Japan. There are about 14 species of native bumblebees living in Japan, and one species, *B. terrestris*, have invaded and colonized some regions such as the Hokkaido area. In the Japanese Ministry of the Environment Red List 2020, two bumblebee species are rank in the category NT (Near Threatened): *Bombus ignitus* and *B. cryptarum florilegus*. Although regional populations fluctuate, there are no species that are currently in danger of extinction and require urgent conservation measures. For *B. ignitus*, colony propagation is done in Japan for sale, and like *B. terrestris*, it is used for crop pollination work in greenhouses. According to the Ministry of the Environment, work has begun on the next Red List (the Fifth Red List of the Ministry of the Environment), which will be selected and evaluated in the future, with the aim of publishing it in 2024 or later based on the following *Red List Creation Guide*.

The Japanese Region in 2023
Tomoyuki Yokoi

Recent information about the current status of *B. cryptarum florilegus*

Here is a brief introduction regarding the current status and reports of native species in Japan. As for *B. cryptarum florilegus*, its distribution in Hokkaido has been reported in a study by Takahashi et al. (2010). Although conservation of the bumblebee species is an urgent priority, little was known about its actual status. A mature nest of the bumblebee was discovered by Fujimoto et al. (2022), and detailed nesting sites, colony size, and conditions in the nest.

In 2023, a series of research results on *B. cryptarum florilegus* were published. Kubo and Ono (2023) successfully reared this species indoors. They reared the bumblebee species under laboratory conditions and examined their nesting habits and colony development. As a result, five queens out of 15 bees successfully formed colonies, and new queens and males were produced from these colonies. According to them, improved rearing techniques are needed to produce large colonies in the future. Furthermore, Kubo et al. (2023) reported the presence of reproductive interference by *B. terrestris* as a cause of the decline of wild bumblebees on the Nemuro Peninsula. *Bombus terrestris* queens have escaped into the open and have become established throughout Hokkaido. T he research group investigated the cause of the increasing frequency of infertile individuals in native bumblebees. The results of the study revealed that the male bees of *B. terrestris* crossbreed with the queens of the native species of *B. hypocrita sapporensis* and *B. cryptarum florilegus* to make them sterile, and that the queens of the native species show attraction activity to the sex pheromone of the male of *B. terrestris*. While knowledge of the ecology of native bumblebees is accumulating, it has become clear that the negative impacts of non-native species are spreading significantly. In the future, it is desirable to accumulate information on various aspects such as distribution, life history, and behavior in order to conserve native bumblebees.

Progress of research

Although there has been no major movement toward understanding the actual status of wild bees and future conservation efforts, several groups of researchers are conducting surveys little by little. In Japan, in addition to domesticated bumblebees and honeybees, wild bees are also used for crop pollination. The solitary bee *Osmia cornifrons* is used to pollinate apples (photos below). In recent years, farmers and experimental stations have reported that the populations of the bee species in various regions are declining. Details are still unknown, but there is an urgent need to understand the causes of the decline, and the research group is investigating nesting sites and the nutritional and plant diversity of the food resources used by the bees.

Locations of Osmia cornifrons *nesting substrates: left, in an apple orchard in Aomori prefecture; right, under the eaves of a traditional Japanese house in Fukushima prefecture (photos by Masahiro Mitsuhata).*

It has been reported in the past that pesticide damage can occur when bee species habitats and agricultural production sites are adjacent to each other. An evaluation of the effects of pesticides on wild bee species is required. Worldwide, this has been done on European honeybee *Apis mellifera*, and there are many data supporting this. However, there have been no findings on wild bees inhabiting Japan. Seko et al. (2023) evaluated the mortality and acute toxicity (LD_{50}) of three common agricultural insecticides (clothianidin, fipronil, and diazinon) in six wild bee species (*Andrena prostomias*, *Apis cerana japonica*, *B. deuteronymus*, *B. honshuensis*, *B. hypocrita*, *Eucera* spp.). The acquisition of data evaluating the effects of insecticides on these wild bee species will be important for both agricultural production and the conservation of wild bee species. Further development of this research is expected.

Public Awareness Activities

In Japan, several activities were held to introduce information on bees, including bumblebees, to the general The executive committee announced that *The Bee Summit 2023* was to be held face-to-face for the first time in four years. The aims of the event are to learn more about bees, other pollinators, and the natural environment based on the accumulated scientific knowledge, to appreciate the value of bees, and to consider our food, agriculture, environment, and the future in light of the current situation for bees. This event was held at the Tsukuba International Congress Center in Tsukuba, Ibaraki Prefecture, on November 18–20, 2023 (photos below). The number of participants was slightly lower than last time, perhaps because the COVID-19 was still in effect. However, there were 1227 participants

from 43 prefectures in Japan and more than eight countries. To present the latest findings on honeybees and other pollinating insects, Hiroshi Ishii (University of Toyama) gave a keynote lecture on pollinators. In addition, Jeff Pettis, president of Apimondia, the world's largest beekeeping organization, gave a special lecture on honeybees. Seven other scientific symposia were held with a total of 27 speakers.

Photographs at the Bee Summit event in 2023 (photos by the Executive Committee of The Bee Summit).

There were many new participants from companies and beekeepers, and a wide range of age groups participated without bias, from preschoolers to adults. The number of teenagers was especially high, with two elementary school students presenting posters, and high school students presenting excellent research results that rivaled those of experts. In addition, Japanese junior high and high school students asked questions to Jeff Pettis, in English, demonstrating the power of activity by the younger generation. Participants included 13% professional beekeepers, 32% hobby beekeepers, 24% research and other activities, and 28% who were not beekeepers. The summit offered a variety of programs, including keynote speeches, special lectures, seven scientific symposia (27 lectures), a poster session (35 presentations), a national student beekeeping summit (18 schools), 10 programs for kids including a Science cafe, 20 programs for the public including a Honey marché and photo contest, four technical workshops for professional beekeepers, and a corporate exhibition. According to the executive committee, participants were able to adapt their age and knowledge of beekeeping to the event.

The total number of followers on social networking sites exceeded 2800, and the number of visits to the Bee Summit 2023 website exceeded 20,000. The executive committee commented that they believe this was more an opportunity to bring more attention to bees and to pollinators in general more than for the actual number of participants. Many local and other media outlets covered the event. The event was able to be distributed through newspapers, TV, and online news.

Other events were held to spread awareness about bumblebees. An insect exhibition was held at a radio tower in Tokyo (Skytree) from July to September 2023. Within this event, bumblebee hives were displayed and observation sessions were held (photos below).

Photographs at the insect exhibition at the radio tower in Tokyo (Skytree) with children trying to touch male of bumblebees in the cage (photos by Masahiro Mitsuhata).

Good handbooks and books are indispensable in raising awareness for conservation. *Guidelines for Giving Habitat to Bees* is already published by Pollination Services Society of Japan (PSSJ) in 2021. In addition, several books have been published by Japanese researchers, and the understanding of bees, including bumblebees, is becoming widely accepted by the public.

Insect declines are occurring worldwide, and in Japan, the decline of various species has become a problem. Companies, research institutions, and governments must work together with the same goal: to conserve wild bee species.

Identification guides for Japan

Identification of the species of Japan is mostly covered by Watanabe & Nagase (2022) and by Sakagami & Ishikawa (1969, 1972).

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The BBSG is making progress with species assessments in many parts of the world, but a great deal still remains to be done, especially in some of the most species-rich regions. This is a good time to share experiences on how best to overcome problems in applying IUCN Red List criteria to bumblebee data. We are especially looking forward to exploring ways to combine our quantitative analyses from different regions into global Red List assessments for the widespread species when data can be shared. As ever, let us know what you need and we will try to find a way to help. ●

London 21 February 2024