Bumblebee Sub Group Annual Report 2022

of the IUCN Wild Bee Specialist Group

Edited by Paul Williams (WBSG Deputy Chair for Bumblebees)

BBSG IN 2022

The BBSG exists to foster the conservation of bumblebees and their habitats around the world especially through the IUCN Red-Listing process. In this ninth report of the BBSG's activities, 2022 has been another unusual year as the pandemic has continued to interfere with field work for some people. But despite the difficulties, there has been progress towards our goal of evaluating the extinction risk of all species of bumblebees worldwide using the IUCN Red List Criteria.

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.

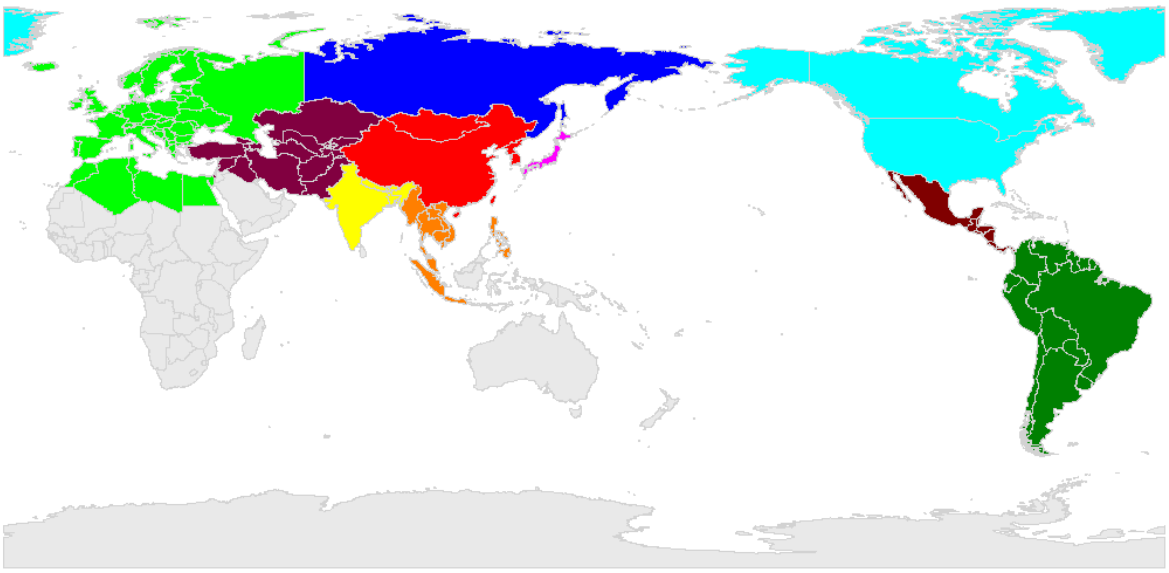
During 2020 a growing need was recognised by the IUCN-SSC for providing information on threats and conservation for all wild bees (*ca* 20,000 species), not just bumblebees. The SSC proposed for its *Species Strategic Plan Framework* for the next quadrennium that it would commission a more inclusive **Wild Bee Specialist Group** (WBSG), to cover all bees. The WBSG retains the BBSG as a subgroup, with Paul Williams as Deputy Chair for Bumblebees and Sarina Jepsen as Deputy Chair for Conservation. With its broader responsibilities, the leadership of the WBSG for the next quadrennium is held jointly by Simon Potts (University of Reading, UK) and Rémy Vandame (ECOSUR, Mexico) as Co-Chairs. Oscar Martinez and Rich Hatfield are the WBSG's Red List Authorities. We are all immensely grateful for the time and effort that everyone involved with our bee groups contributes.

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. ●

One of the most northerly distributed of all arctic bumblebees, B. pyrrhopygus. (Photo by G. Holmström.)

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

Paul Williams



BBSG regions.

Below is an overview of the progress in compiling database information on bumblebee species distributions in our BBSG regions. This has to be a long-term process, requiring a lot of work to achieve good representative coverage and to do it 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 2022 (colour on map)	Approximate number of species present*	Number of 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	757,510	67	6
Himalaya (yellow)	63	17	1775	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	-	-	-	-

** affected by variations in the species concepts adopted*

IUCN RED LISTING PROCEDURE

Paul Williams

Just a reminder that there are IUCN documents describing the Red List assessment procedure available online.

IUCN Red List criteria documents:
http://www.iucnredlist.org/documents/RedListGuidelines.pdf
This is the key document for the IUCN assessments. While the entire document is worthwhile, the key sections that relate to our analyses are highlighted below:

- 2.2: Nature of the Categories (page 7-10)
- 2.3: Nature of the criteria (page 13-15)
- 3.1: Data availability, inference and projection (page 16-17)
- 4.1 Population and population size (page 20)
- 4.5: Reduction (criterion A) (page 25-26)
- 4.9: Extent of occurrence (criteria A and B) (page 31-34)
- 5-5.1: Guidelines for Applying Criteria A (page 42-44)
- 10-10.3: Guidelines for Applying the Categories DD, NT, and NE (page 62-65)

Summary: http://www.iucnredlist.org/documents/2001CatsCrit_Summary_EN.pdf
- this one page document covers the criteria used by IUCN to evaluate extinction risk.

The *BBSG Annual Report 2017* includes an article describing the quantitative method used by the BBSG North American group to assess their fauna. This was designed to reduce some of the effects of sampling bias.

The IUCN Red List Criteria are the international standard for evaluating extinction risk in a manner consistent among regions and taxonomic groups. A key part of the IUCN framework is assessing changes that have occurred within the last 10 years (or three generations, whichever is longer). When considering the IUCN Red List Criteria for broadly distributed invertebrates with short lifespans and very few population data, some interpretation and use of best professional judgment is required. Some of the challenges in applying these criteria have been noted by others, most notably by Cardoso et al. (2011, 2012; but see Collen & Böhm 2012). Please direct any questions about these methods to Rich Hatfield (rich.hatfield@xerces.org) or Oscar Martinez.

Rich Hatfield, a BBSG Red List Authority, has kindly agreed to produce during 2023 a document summarising this protocol tailored to bumblebees to provide a resource for our future BBSG Annual Reports.

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EAST ASIA

This has by far the largest and least well-kown 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 2022

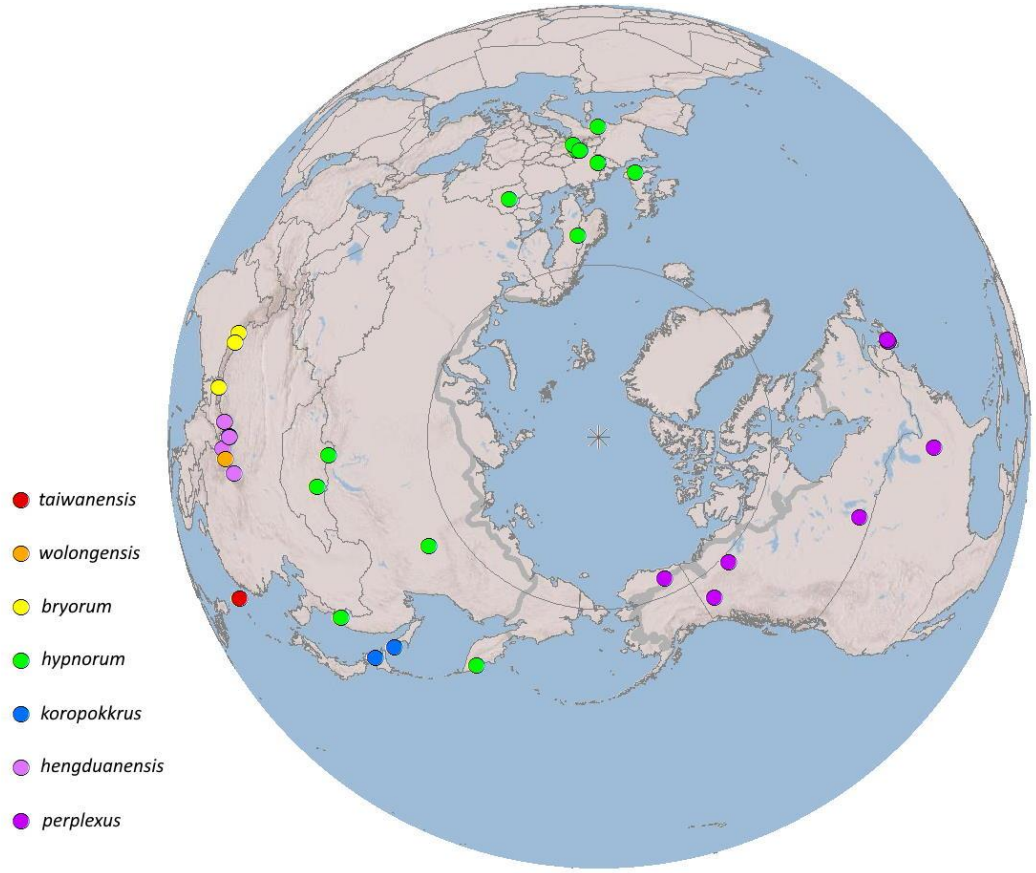
Jiandong An

Unfortunately the East Asia team is unable to report any progress for 2022. Plans for analysing bumblebee distribution have had to be suspended because of the pandemic and administrative responsibilities. Red List assessments are being planned, beginning with *B. atripes*.

Bombus atripes visiting Liriope sp. (Convallariaceae) in Jiangsu of southern China in 2019. (Photo by Hong Zhang.)

Three new bumblebee species in East Asia

During 2022, the *hypnorum*-group of *Pyrobombus* had three new species (below: *B. hengduanensis, B. taiwanensis*, and *B. wolongensis*) added for East Asia (Williams et al. 2022a,b).



Species of the hypnorum-group world-wide sampled for a barcode-coalescent analysis. The analysis was calibrated using the accepted species of the well-known, closely-related, North American vagans-group (not shown). The extent of occurrence of the separate species inferred is shown with differently coloured spots (colour key on the left). Relief map with hill shading, polar projection (north pole shown as a star), the international boundaries and the Arctic Circle are shown as narrow grey lines, and the northern tree line shown as a broad grey line.

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 2022
Alireza Monfared

Last year was one of the least rainy years in Iran. Although we traveled several times to the northern and northwestern provinces to sample bumblebees (below), we could only collect a small number of bumblebees. One of the problems in these areas was the development of land and pastures for housing and the destruction of natural areas where bumblebees live.

Sampling bumblebees in north and northwestern Iran.

ZGD co-activity

Last year we tested hives for the production of bumblebees (*B. terrestris*) to pollinate new crops such as tomato, blueberries, raspberries, papayas and strawberries, with positive results in greenhouses. This may help prevent the import of colonies from Biobest, which annually imports thousands of colonies into Iran, so that native bees are not eliminated from the field by competition. Domestic mass production of bumblebees is a priority for the scientific and technological vice president of Iran (Sattari) and was supported by the government, greenhouse keepers, and gardeners.

Mass production of bumblebees and sending them to greenhouses in the country has aroused the interest of many people. Many greenhouse owners did not know that we have these bees in Iran and thought that they existed only in Europe.

Mass production of bumblebees for sending them to greenhouses. Left, Kawsar and Ahmad, two people of the marketing division of our company. Right, mass production of tomato in greenhouse for export to Russia.

Establishment of our bumblebee hives in strawberry and blueberry greenhouses.

One of the advantages of our company is having a young and educated team eager for scientific and practical work. This team focused on rearing *B. terrestris* and in the near future we will do this with *B. lucorum* as well.

Our young and educated team in our Dena Bio-pollinator Company.

Blueberry is one of the most expensive fruits in Iran, imported from outside. Recently, a few greenhouses have started to produce this fruit in Iran. One of our good fortunes is the presence of one of the few blueberry production greenhouses in Yasouj. This has created an opportunity for us to be able to use our own reared bumblebees for pollination and performance testing as well as other research studies.

The greenhouses in Yasouj where we have started to produce blueberries. We are fortunate to have these greenhouses near our company.

The production and consumption of tomatoes in Iran has a long history. For many years ago, tomatoes were available in the market only in summer, although more recently importation has taken over. But recently, with the increase in the area under cultivation of greenhouse tomatoes, export of this product has started. The existence of tomato greenhouses (following page) in most cities of Iran, including Yasouj, has provided ample production as well as an opportunity for us to carry out research on bumblebees. In the photo on the left, our team is attaching tags to tomato flower buds.

Production of tomato in the Yasouj greenhouse was an opportunity for our research projects.

Strawberries (following page) in Iran also have a long history of cultivation, especially in the open in the southern regions, including Kerman and Hormozgan. For many years, this plant has been planted in short, traditional greenhouses. But for more than a decade now, greenhouse planting in tall greenhouses has become popular. The use of bumblebees in these greenhouses is now often seen in Iran. Due to the increase in the cultivated area of this plant, as well as for green pepper, the use of bumblebees is increasing rapidly.

Although some experts believe that the pollination of green pepper (following page) does not need bees, on snowy or cloudy days or in cold seasons, bumblebees are a very effective addition for forming fruit.

Identification guides for West Asia

Most of the species of West Asia are covered by the guide to the *Bumblebees of Europe* (see below).

Strawberries in Qom province and pollination by bumblebees.

The increasing use of bumblebees to pollinate all kinds of peppers, especially green peppers, is shown. We examine how bumblebees could be effective in cold seasons in greenhouse (greenhouse in Razband, Salafchegan, Qom).

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 2022

Alexandr Byvaltsev

Unfortunately the North Asia team has been unable to report progress for 2022. Plans for analysing bumblebee distribution have had to be suspended because of the pandemic.

New bumblebee species for North Asia

During 2022, the *hypnorum*-group of *Pyrobombus* had one new species (*B. koropokkrus*) recognised for Sakhalin in North Asia (Williams et al. 2022).

Identification guides for North Asia

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

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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 2022
Guillaume Ghisbain

New courses for the identification of European bumblebees

The European Commission launched the project **SPRING** (Strengthening pollinator recovery through indicators and monitoring) to strengthen taxonomic capacity with regard to pollinators, support preparation for the implementation of an EU Pollinator Monitoring Scheme and pilot the scheme in all 27 countries of the European Union. The project aims to contribute to the establishment of a scientifically robust European Pollinator Monitoring Scheme (**EU-PoMS**) aiming to detect any significant changes in the abundance of pollinators across the European Union, using standardized sampling methods. The project is currently recruiting and training coordinators and volunteers across Europe to collect data on pollinators from the field and to report it to the newly developed online database. In this context, advanced taxonomic training is being organised to help motivated volunteers to become the next generation of taxonomists in Europe. The Laboratory of Zoology of the University of Mons had the privilege in 2022 to host the first SPRING identification sessions.

One full day of each of these sessions focused on bumblebees, for which participants were free to bring in their collected material. The 'bumblebee lesson' first aimed to help participants to get familiar with the most important diagnostic morphological characters of this genus of bees, and then focused on the identification of *Bombus* to the subgeneric level. Participants were warmly invited to ask as many questions as needed, and to examine material from the collection of the Laboratory of Zoology. In the first sessions of 2023, participants will also learn to identify the most common European species of bumblebees and to separate them from other closely related species, when feasible.

Preparation of new identification tools for European bumblebees

2022 marked the second year of the European project **ORBIT**, a three-year project commissioned by the Directorate General for Environment of the European Commission to develop resources for European bee inventory and taxonomy. The project is currently generating a centralised taxonomic facility for the identification of all European wild bees, including all bumblebee species. Through ORBIT, the European Commission aims to make tools accessible to everyone to identify all European bees, which should facilitate large-scale studies on biodiversity patterns and

responses of wild bees to anthropogenic pressures.

In practice, high-quality pictures of bees (including bumblebees) are being taken at the University of Mons by Paolo Rosa, coordinator of this project at the European level (images below). These pictures, focusing on diagnostic characters, will eventually be accompanied with data on the species' ecology and conservation. This mine of information will be made publicly available online in 2024. More information can be found at https://orbit-project.eu.

Images of a queen of B. (Mendacibombus) mendax taken as part of the European project ORBIT. Top left, lateral view of the habitus. Top right, fine sculpture of the corbicula, a typical feature of the subgenus Mendacibombus. Bottom left, oblique view of the head, showing the size of the oculo-malar space and the colour of the head pilosity. Bottom right, detail of the typical labrum and mandibles. Copyright EU_ORBIT_2022, pictures by Paolo Rosa.

A new checklist of the bumblebees of Europe

A new annotated checklist of the bees of Europe, including the new checklist of European bumblebees, has been submitted in December 2022. This work, led by Guillaume Ghisbain and Paolo Rosa from the University of Mons, joined the efforts of 20 European taxonomists and ecologists, and totals > 2100 species of wild bees including 67 accepted bumblebee species on the continent. The publication of this work is expected in 2023.

Images of a male of B. (Mendacibombus) mendax taken as part of the European project ORBIT. Top left, dorsal view of the habitus. Top right, structure of the genitalia. Bottom left, oblique view of the head, showing the size of the oculo-malar space and the colour of the head pilosity. Bottom right , detail of the typical enlarged eyes of Mendacibombus and other features of the head. Copyright EU_ORBIT_2022, pictures by Paolo Rosa.

Preparation of a new continental Red List for European bees

The last Red List of European wild bees, in collaboration with the International Union for Conservation of Nature (IUCN), was published in 2014 (Nieto et al. 2014). This piece of work highlighted that around a quarter of the bumblebee species of Europe are threatened with extinction. In addition, nearly half of the studied species had decreasing population trends.

2022 saw the start of the preparation of a new European Red List of wild bees, for which important advances have been made in terms of data acquisition from both naturalists across the continent and from museum collections. Due to the taxonomic works that have occurred in the last few years on European bumblebees, the extinction risk of several species will need to be reassessed. Examples include *B. laesus* (shown to be conspecific with *B. mocsaryi* from DNA evidence in Brasero et al. 2021) and the Spanish taxon *reinigiellus* (shown to be conspecific with *B. hortorum* in Ghisbain et al. 2021) among others.

New publications related to bumblebee conservation in 2022

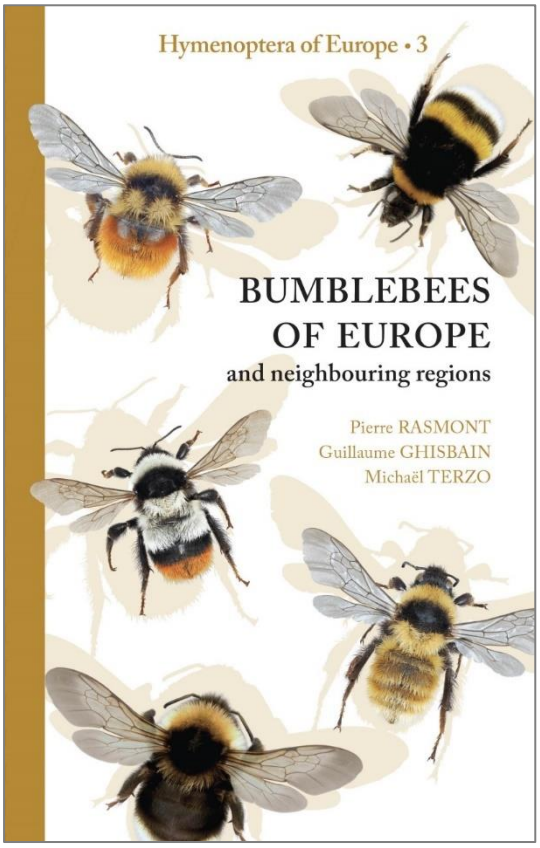
New works are increasingly demonstrating the adverse impacts of global changes on bumblebee populations and communities in Europe.

The deleterious consequences of habitat degradation (Brezinger et al. 2022; Dániel-Ferreira et al. 2022; Hart et al. 2022; Straub et al. 2022), chemical pollution with pesticides (Chole et al. 2022; Hunting et al. 2022; Rondeau & Raine 2022; Siviter & Muth, 2022; Varga-Szilay & Tóth 2022) and climate change (Gérard et al. 2022a; Miller-Struttmann et al. 2022) are being demonstrated, along with the need for a diversity of high-quality habitats to support bumblebee populations (Jachuła et al. 2022; Lindström et al. 2022; Whitehorn et al. 2022; Wintermantel et al. 2022).

Cognition impairment – an overlooked mechanism underlying bumblebee decline?

In a recently published paper, Maxence Gérard and colleagues (2022) investigated the effect of elevated temperature on the learning and memory capabilities of bumblebees. These bees were trained to associate different coloured lights with either a positive stimulus (sugar water, blue light) or a negative stimulus (a bitter quinine solution, yellow light). The individuals that learned this association would extend their tongue when they saw the blue light and would not extend their tongue when they saw the yellow light. Once the bumblebees had been allowed to make the association (they were given six trials), they were then left for an hour and then shown the lights again to see how well they remembered the association. The individuals that experienced the learning and memory tests in a room temperature of 32° C were much worse than the ones that experienced these tests at 25° C. After six trials, 55% of the workers from 25° C learned to extend their tongue when presented with the blue light but this dropped by half to 27% for bees at 32° C. We infer from this result that just an increase of 7° C is enough to impair the cognitive function of bumblebees. Future work will focus on trying to explore the effect of temperature on the foraging behaviour of bumblebees under more realistic conditions.

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 being photographed for the first time. ●

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HIMALAYA

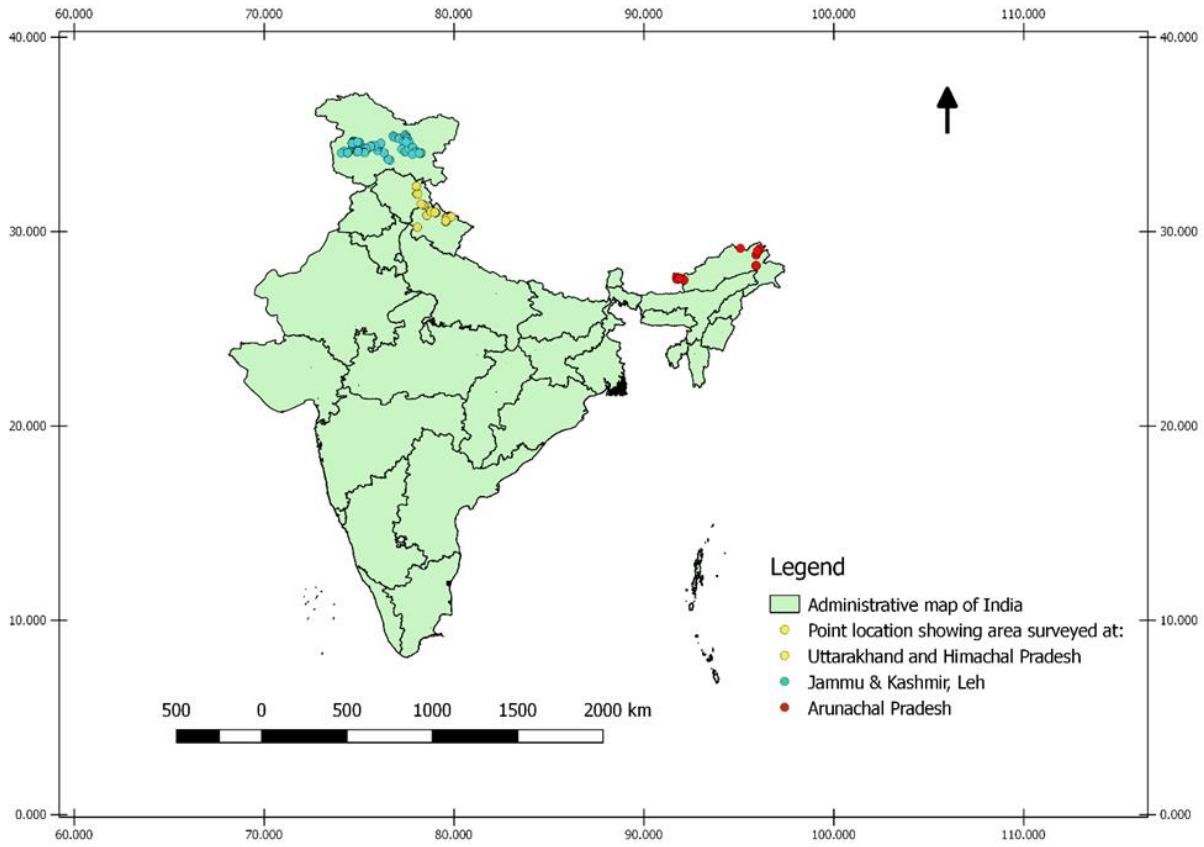
Approximately 62 species are currently recognised. No species has yet been assessed for Red List status within the Himalaya. This region has relatively small extent for such a relatively rich fauna. Of the total, approximately 19 species are considered endemic (or near endemic, just crossing into the 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 2022
Rifat Raina

New survey records

During 2022, three extensive surveys were undertaken extending from the Northwest Himalaya to the Northeast Himalayan region under the leadership of Rifat Raina. Sample collection was made with the help of project team members, namely Purnima Pathak, Keshav Kumar, and Trilok Jangid in the States of Arunachal Pradesh (from 10/05/2022 to 13/06/2022), Uttarakhand and Himachal Pradesh (from 22/06/22 to 31/07/2022), and the Union Territories of Jammu and Kashmir, Ladakh (from 05/08/2022 to 18/09/2022), exploring habitat in localities covering 14 districts. A total of 4293 bumblebee specimens were collected at different elevations ranging from 900–5000 m. The largest collection of bumblebee samples was from the Union Territory of Jammu and Kashmir (1308 specimens), followed by Uttarakhand (1080 specimens), Himachal Pradesh (963 specimens), the Union Territory of Ladakh (769 specimens), and Arunachal Pradesh (173 specimens). However, no bumblebees were encountered at Chang-la-pass at 5360 m. GPS handsets were used to record the coordinates of different habitats within the study sites (map below). The Himalayan region provides many suitable habitats for the nesting and foraging of bumblebees, which in turn helps to improve the species diversity and pollination efficiency of various medicinal plants. Bumblebees show extraordinary adaptation, which allows them to survive in harsh conditions, such as low temperatures with snow at high elevations.

These samples were processed by Purnima Pathak for detailed analysis. So far, a total of 3843 bumblebee specimens have been examined and identified to 23 species: *B. albopleuralis, B. cryptarum, B. eurythorax, B. eximius, B. ferganicus, B. festivus, B. flavescens, B. haemorrhoidalis, B. himalayanus, B. kashmirensis, B. keriensis, B. lemniscatus, B. lepidus, B. longiceps, B. melanurus, B. miniatus, B. novus, B. rufofasciatus, B. semenovianus, B. simillimus, B. skorikovi, B. tanguticus, B. tunicatus,* and *B. waltoni.* The rest of the collection is now being identified. The current distribution status has been recorded and updated for the assessment of species distributions in the Himalaya. Bumblebees are not easily identified without identification keys because of colour variation and mimicry**.**



Map showing the localities newly surveyed for the distribution of bumblebee species in 2022.

Pollination of crop and medicinal plants

Along with their food plants, data on the diversity and distribution of bumblebees are also updated with the inventory of the host plants prevalent in different mountain ecosystems of the Himalayan region. In the different vegetation types such as tropical, sub-tropical, and temperate, these species act as prominent pollinators. The maximum diversity of bumblebees is observed between the elevations of 2500–4500 m. Scanning of the pollen attached to the body of some important bumblebee species has been initiated in order to trace plant-pollinator interactions.

The Himalayan region is a global biodiversity hotspot, rich in flora and fauna, especially entomofauna. Bumblebees are considered important for increasing crop yield for many families of plants, including Fabaceae, Solanaceae, Asteraceae, Cucurbiteace, e.g. *Solanum tuberosum, Solanum melongena, Pisum sativum, Cucurbita* spp.. From the northwest Himalaya to the northeast Himalaya, this region contains medicinal plants that are important for human well-being. The current study is providing information for bumblebee conservation but also for maintaining the diversity of medicinal plants in the Himalayan region. Bumblebees are known to pollinate important medicinal plants, such as *Rhododendron laponicum, Podophyllum hexandrum, Polygonatum multiflorum, Carum carvi, Inula racemose, Achillea millefolium, Meconopsis horridula,* and *Rhododendron grande.* Ten species of bumblebees have been noted as potential pollinators of various medicinal, ornamental, and agricultural plants in the Himalayan region: *B. tunicatus, B. simillimus, B. albopleuralis, B. haemorrhoidalis, B. keriensis, B. longiceps, B. cryptarum, B. rufofasciatus, B. melanurus,* and *B. miniatus.*

Public outreach

During 2022, 12 awareness programs of outreach activities were carried out at the village/municipality level to enhance knowledge of bumblebees and their benefits in the Himalayan region, especially in Arunachal Pradesh, Uttarakhand, Himachal Pradesh, Ladakh, and Jammu & Kashmir. Pamphlets of advice for improving pollination practices and crop yield and have been distributed among the local people, panchayat members, and school and college students. This approach towards the conservation of bumblebees is also included in the awareness programme.

Bumblebees are decreasing gradually every year due to anthropogenic activities. This gradual decline may affect the mountain ecosystems and cause a serious threat in the Himalayan region. Much more attention is required to conserve rare species of bumblebees and also to maintain the pollination of medicinal and crop plants. In the Himalayan region, many localities are suitable for artificial nests and for habitat improvement for bumblebees. These localities are targeted in Uttarakhand, Himachal, and Arunachal Pradesh, as well as in Ladakh, Jammu and Kashmir during the last few surveys. We are working on developing this approach.

B. festivus.

B. cryptarum.

Razdan Pass 3650 m, Kashmir.

Changtang WLS Leh 4200 m, Ladakh.

Sela Pass 4200 m, Arunachal Pradesh.

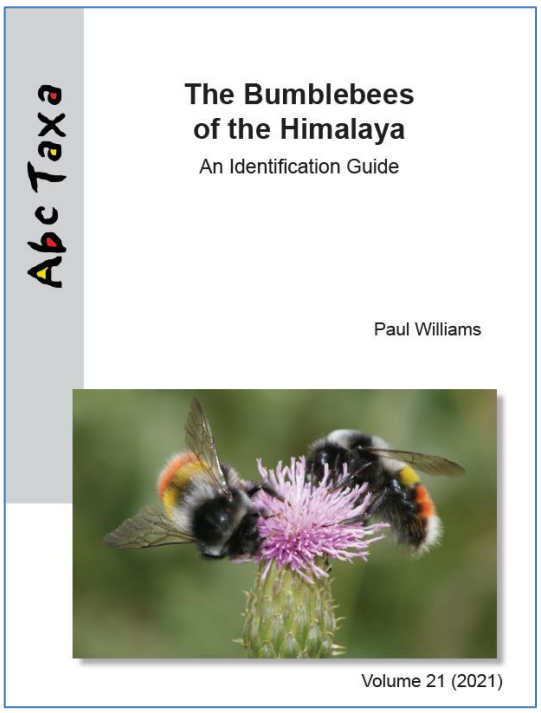
Awareness programme, Ladakh.

Rifat Raina is highly indebted to Dhriti Banerjee, Director ZSI Kolkata, 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 Bumblebee.*

One new bumblebee species discovered in the Himalaya

During 2022, the subgenus *Alpigenobombus* had one new species (*B. rainai*) described from the Himalaya (Williams 2022), named after Rifat Raina, our BBSG regional coordinator. Several other species have revised status (see below).

Identification guide for the Himalaya



This book, published this year, 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. Summaries of the most common species by habitat are also provided.

Reference

Williams PH (2022) *The bumblebees of the Himalaya*. AbcTaxa, Belgium. 197 pages. https://www.researchgate.net/publication/361184342_The_Bumblebees_of_the_Himalaya_-_an_Identification_Guide

NORTH AMERICA

49 species are listed here up to the end of 2022. 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 2022
Sheila Colla / Jonathan Koch / Elaine Evans / Leif Richardson / Tamara Smith

USA policy and management update: general

Public engagement in monitoring has contributed records of bumblebees of conservation concern from broad efforts including Bumble Bee Watch, the Backyard Bumble Bee Count, and iNaturalist, as well as from regional and state-wide efforts in the Pacific Northwest (Washington, Idaho, Oregon), California, Nebraska, Michigan, Missouri, Wisconsin, Utah, North Dakota, South Dakota, and Minnesota (https://www.bumblebeeatlas.org/). These efforts have extended the known occupancy for bumblebees of conservation concern, including *B. affinis*, *B. terricola*, and *B. fraternus*.

Led by James Strange, in collaboration with the NAPPC *Bombus* task force members, a new framework for a Clean Stock bumblebee program and risk assessment matrix was drafted as a white paper and can be found on the NAPPC *Bombus* task force webpage: *Developing a Commercial Bumble Bee Clean Stock Certification Program: A white paper of the North American Pollinator Protection Campaign Bombus Task Force*.

The US Environmental Protection Agency (EPA) is required by the Endangered Species Act to consult with the US Fish and Wildlife Service as to whether the pesticide products they regulate may have adverse impacts to listed species. In 2022, the EPA agreed to resolve a backlog of these consultations and will continue assessing pesticide product risk for listed species, including the two *Bombus* species currently listed as endangered, *B. affinis* and *B. franklini* (https://www.epa.gov/endangered-species). The EPA also has relevant initiatives in addition to the consultation work (e.g. the pilot species project includes *B. affinis*) https://www.epa.gov/endangered-species/implementing-epas-workplan-protect-endangered-and-threatened-species-pesticides.

There are also increasing protections at the state-level in addition to federal-level protections. For example, California is protecting species at the state level. In addition to federally protected species in the US, these include *B. morrisoni, B. caliginosus, B. crotchii*, and *B. suckleyi*. These additional protections will result in more research funding for *Bombus* conservation throughout the US.

Listed and proposed species

Rusty Patched Bumble Bee (B. affinis)

There is a final USFWS Recovery Plan for *B. affinis*. This document sets the downlisting criteria for *B. affinis* and provides a roadmap for recovery actions. The USFWS and partners

developed step-down recovery implementation strategies (RIS) for the five conservation units identified in the final recovery plan to help focus and plan near term recovery activities. The USFWS intends to update the RIS as the recovery program grows. Several conservation and research projects are already underway or being planned. An exciting find for this species in 2022 was a newly located population in Maryland, quite disjunct from other recently located populations. Many groups are surveying for *B. affinis* across its historical range or monitoring the species in areas with extant populations. USGS is working with USFWS to improve monitoring protocols to inform recovery targets. In recent years, biologists are leading efforts to monitor the Appalachia region for extant populations. Research project topics include population genetics, pathogens, eDNA detection, captive rearing, occupancy modeling, landscape ecology, habitat, and others.

Western Bumble Bee (B. occidentalis)

The Western Bumble Bee (*B. occidentalis*) Species Status Assessment (SSA) Expert Group has finished its monthly meetings. USFWS will finalize the SSA to inform a listing decision for this species shortly.

Franklin's Bumble Bee (B. franklini)

Franklin's Bumble Bee (*B. franklini*) is the second bumblebee listed under the US Endangered Species Act. The species was officially listed in September 2021. Despite ongoing searches, no new populations were located in 2022.

American Bumble Bee (B. pensylvanicus)

A petition to list the American Bumble Bee (*B. pensylvanicus*) is currently under review by the USFWS.

Suckley's Bumble Bee (B. suckleyi)

Suckley's Bumble Bee (*B. suckleyi*) was petitioned for listing under the U.S. Endangered Species Act, and will be assessed by the U.S. Fish and Wildlife Service in the future.

Plains Bumble Bee (B. fraternus)

In 2022, the Plains Bumble Bee (*B. fraternus*) was petitioned for listing under the U.S. Endangered Species Act.

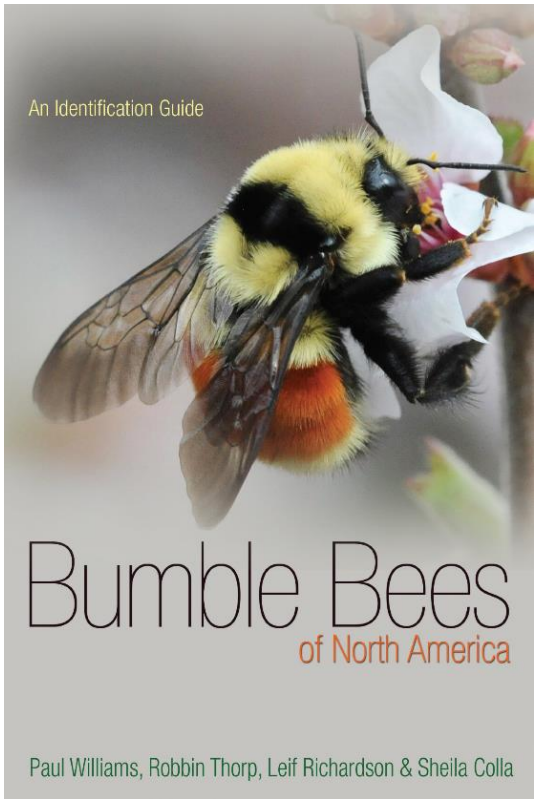
Canadian Policy and Management Update

There are approximately 42 bumblebee species known to occur in Canada. Some of these species have been considered and processed for federal protection by the Species At Risk Act, which legislates the listing and protection process. In Canada, species are assessed by an arms-length committee of scientists (COSEWIC), after which the government chooses to list the species after consideration of socio-economic consequences. Once listed, a species has a recovery strategy and management plan listed and is protected on federal property (but not on private or provincial property). There are also funds allocated for its conservation. Despite intense public interest, none of the assessed at-risk bumblebee species have been fully protected, despite over a decade from the first listing. The last known Canadian record for *B. affinis* is still 2009. *Bombus bohemicus, B. occidentalis* and *B. terricola* have been found more recently and continue to be found occasionally. Below lists the current status of the species that have been assessed in Canada.

On the ground conservation management in Canada includes work by Wildlife Preservation Canada (WPC), the main ENGO working on at-risk bumblebee conservation. They have developed a captive breeding program in collaboration with the African Lion Safari and work with universities on various research projects and field surveys. BumbleBeeWatch is run primarily in partnership with York University, WPC and the Xerces Society for Invertebrate Conservation. York University is working with the Canadian Wildlife Service to help develop a framework for minimizing pathogen spillover from the managed bee industries to wild insects through prioritizing hotspots and developing clean stock protocols for managed bees. Researchers at the University of Guelph are looking at pesticide impacts on wild bees and tracking bumblebee queen movement.

1. *B. pensylvanicus*, assessed at Special Concern 2018, not yet listed by the government
2. *B. bohemicus*, assessed as Endangered 2014, listed 2018, Recovery Strategy being drafted
3. *B. affinis*, assessed Endangered 2010, Listed 2012, Recovery strategy finalized in 2020, re-assessed in 2022 as Endangered
4. *B. suckleyi*, assessed Threatened, 2019, not yet listed by government
5. *B. occidentalis mckayi*, assessed Special Concern 2014, not yet listed by government
6. *B. occidentalis occidentalis*, assessed Threatened 2014, not yet listed by government
7. *B. terricola*, assessed Special Concern, 2015, Listed 2018, Management Plan being drafted

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 2022

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

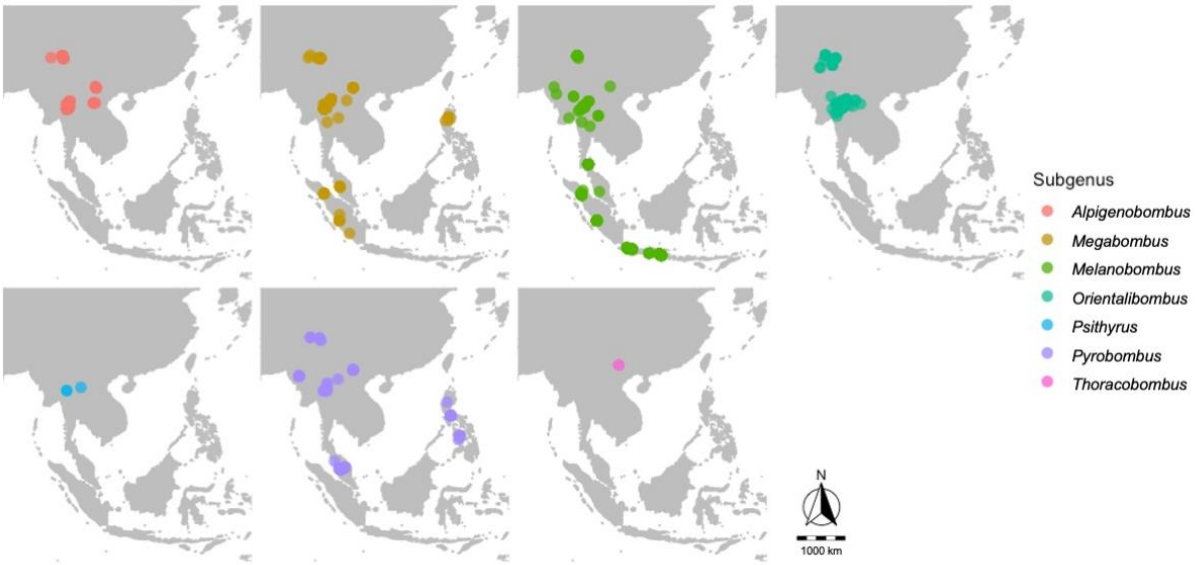
2022 was a difficult year for our team because we lost our regional coordinator, Panuwan Chantawannakul. We would like to honor her legacy for bumblebee research in our region, especially for bumblebee health.

Bumblebees in Southeast Asia have not yet been assessed for their conservation status (IUCN Red List), because occurrence data and extensive study of their threats has been lacking.

However, information on 1024 Southeast Asian bumblebee specimens from museum collections and recent field surveys has been digitized as part of Chawatat's PhD thesis. The records can be assessed online via the Natural History Museum (NHM) Data Portal (https://doi.org/10.5519/isxh6saw; Thanoosing, Vogler & Williams, 2022). These data will be used to estimate species distribution ranges (including EOO and AOO) and to help assess the conservation status of bumblebees by our regional group.

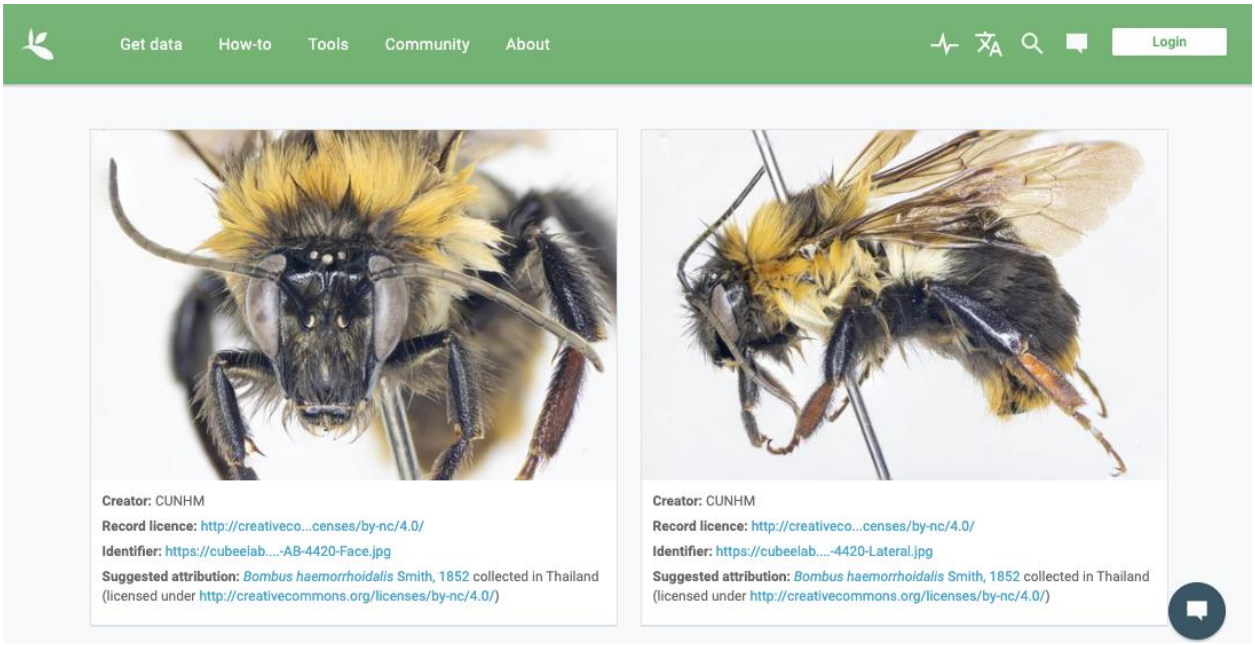
The bumblebee specimens collected in 2007–2008 from National Parks across Thailand, under the Thailand Inventory Group for Entomological Research (TIGER) project, have now been sorted and examined by the team from the Department of Biology, Chulalongkorn University (led by Natapot Warrit). These specimens have been digitized and the records are available from the GBIF database under the project *Database and digitization of bees from TIGER project* (Thailand) (https://doi.org/10.15468/p6zfzc; Nalinrachatakan et al. 2022). Among these bee specimens were 38 Thai bumblebee specimens.

As a next step, we aim to fill the gaps in the bumblebee occurrence data. Digitization of bumblebee specimens in museum collections will be vital to add more of the older records of bumblebees from Southeast Asia.



Distribution of bumblebee subgenera in Southeast Asia, based on records from museums and field surveys (Thanoosing 2022).

Sorting TIGER project bee samples at Queen Sirikit Botanic Garden, Chiang Mai, Thailand, in October 2022. (Photo by Natapot Warrit.)



Example of a B. haemorrhoidalis specimen record, available on the GBIF website (https://www.gbif.org/occurrence/3757860770), from the database and digitization of bees by the TIGER (Thailand) project (Nalinrachatakan et al. 2022).

Identification guide for Southeast Asia

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

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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 2022
Carolina Morales / Victoria Campopiano / Marina Arbetman

No further bumblebee species assessment has been carried out in this region since 2016. However, there has been some progress during the last year to improve knowledge of some of the bumblebee species inhabiting this region, the conservation of the native species, and the control of the invasive species, in particular the European bumblebee *B. terrestris*. Although the bumblebee fauna reaches its highest diversity in the mountain areas of tropical South America, this report focuses on study cases of southern temperate South America, where the BBSG has a more active presence and because it was not possible to request contributions of other BBSG members due to time constraints.

During 2022, the first project aimed to set up field techniques to cull populations of the invasive *B. terrestris* in protected areas was carried out in Parque Nacional Nahuel Huapi, which protects some of the last populations of the native *B. dahlbomii* (categorized as Endangered in IUCN red list) in Argentina. The project entitled *Saving the Patagonian Giant Bumblebee from extinction by removing its main threat, the invasive buff tailed bumblebee* was supported by a small research grant of the MBZ Species Conservation Fund (https://www.speciesconservation.org/, see the 2021 report for more details), led by Carolina Morales, and carried out by a team of researchers and students of the Pollination Ecology Group at the IINBIOMA (CONICET-Universidad Nacional del Comahue) and the staff of the National Parks. The project involved the active removal of *B. terrestris* queens early in the season, as well as monitoring worker abundance later in the season, to compare abundance with paired control sites where queens were not removed. More than 35 fieldwork days were completed during the 2021–2022 southern summer season. A total of 87 foundress queens were removed from four sites, succeeding in removing 46% of the observed queens. We are currently at the stage of data processing and analysis, to evaluate the feasibility of the tool to reduce the local abundance of *B. terrestris*.

In addition, the Citizen Science initiative focused on bumblebees of Argentina called ‘Vi Un Abejorro’ (Spanish for ‘I saw a bumblebee’, www.abejorros.ar) launched in 2021 has experienced a great impulse. This initiative is coordinated by the undergraduate student Victoria Campopiano, under the supervision of Marina Arbetman and Eduardo Zattara. Vi un Abejorro has reached national coverage, with more than 1300 occurrence records from 22 of the 23 provinces of the country. The results of this project are part of Victoria’s Bachelor’s degree thesis and will be published soon in a scientific journal (see more details in the BBSG Report 2021).

At the end of 2022, a project by the same research group and led by Marina Arbetman was financed by the National Geographic Society. This project aims to collect information on the genetic diversity of native and invasive bumblebees and their parasites (from field campaigns, museum collections, and our own collections from different periods) to evaluate how healthy their populations are, and to what degree their health is impacted by a continuous influx of imported commercial colonies. Then we aim to make the public aware

of the importance of native pollinators and the threat posed by invasive species, by reinforcing the ongoing citizen science project above. With this project we aim to develop the capacity to breed native bumblebees to work for the recovery of native populations and potentially to provide farmers with an environmentally friendly alternative to the deployment of invasive exotic species.

At a regional scale, the Sociedad Latinoamericana de Investigación en Abejas (SOLATINA, https://solatina.org/) launched a working group on bumblebees. The working group was formally constituted during the IV Workshop of the Society, held in Cusco, Perú in November 2022. Members of SOLATINA from more than 10 countries expressed their interest in participating in this group.

Finally, the first book compiling citizen science experiences focused on pollinators in southern South America was published in 2022, with the participation of researchers from Argentina, Brazil, Chile, and the UK. The book *Citizen Science and Pollinators in South America*, has been published in the context of SURPASS 2 project (Safeguarding pollinators and pollination services, https://bee-surpass.org/) funded by the Newton Fund Latin America Biodiversity Program) and the support of UKRI (UK), FAPESP (Brazil), CONICET (Argentina) and ANID (Chile). Versions in Portuguese and Spanish, both printed and digital are available for free download: https://doi.org/10.4322/978-65-86819-20-5.100001.pt, https://doi.org/10.4322/978-65-86819-21-2.100001.es.

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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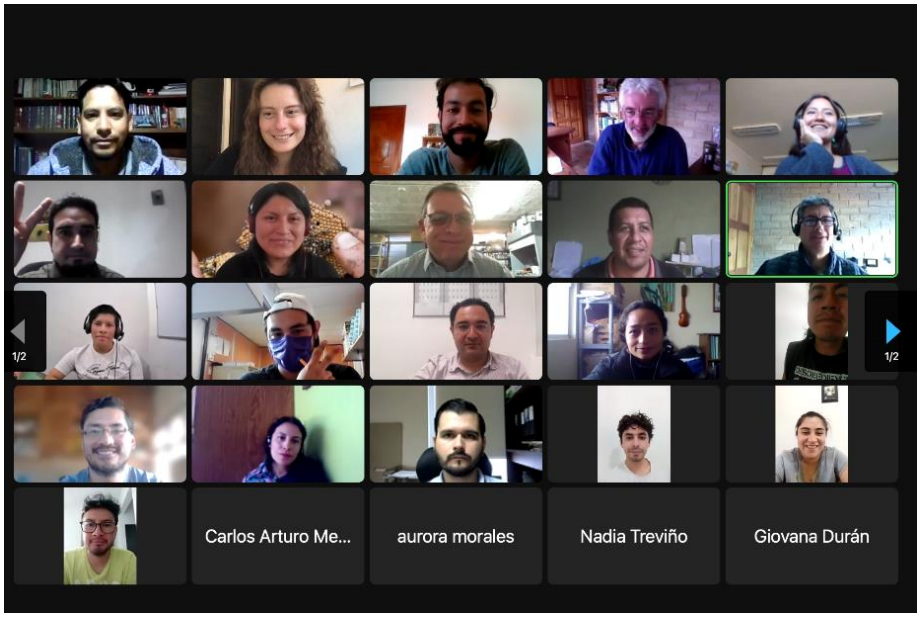
MESOAMERICA

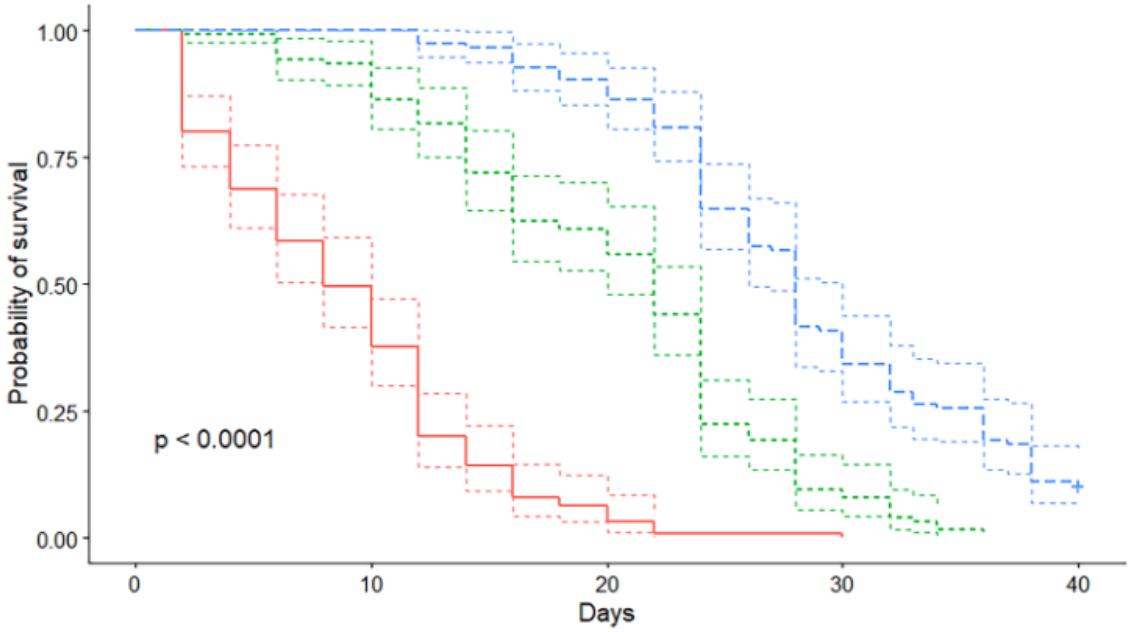
Approximately 18 species are currently recognised, although several species groups are currently being revised, with the promise of several more species to be added soon. The Red List status for all 18 current species has now been assessed globally. Within Mesoamerica, distributions are being recorded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

The Mesoamerican region in 2022
Oscar Martínez

The Ecosur team continues to focus on the breeding of the native bumble bee *B. ephippiatus*. This was the basis for two workshops (below) we held, coordinated by Alejandra Martínez with other members of the Bee Team collaborating for these events. One was held in person in June 2022 and the other was held through a video conference in December 2022.



Last year (2021), Alejandra defended her masters thesis and later in 2022, alongside her co-authors, published *Effects of imidacloprid on survival and nest development in the neo-tropical bumblebee Bombus ephippiatus* (Martínez de Castro Dubernard et al. 2022). They demonstrated that in microcolonies of a neotropical bumblebee, survival was affected by exposure both at low and high doses of imidacloprid. They also showed a negative relationship between the number of workers and brood in queenright colonies and the amount of imidacloprid in food.



Probability of survival with confidence intervals for B. ephippiatus workers exposed to food contaminated with imidacloprid at different concentrations (red, high dose; green, low dose; blue, control with no pesticide).

As part of his Ph.D. thesis, Oscar Martinez continued working with Mam people from the Tacana region. We found more nests of *B. wilmattae* and we have measurements of humidity and temperature inside the nest. We hope to publish the results of these study this year. We also held a workshop with the people from the community of Benito Juárez El Plan, they shared their discussed their perception of bumblebees. They usually find nests when they are working in the field, and while some of them remove them, others try not to harm them. Kids have a special relationship with bumblebees, so that when they find nests, they try to get the honey. Finally, Ruth Hernández (below) is working with the pollen and honey of this species for her bachelor thesis. She wants to understand the characteristics of bumblebee honey and the flowers they visit. We hope that this information will contribute to bumblebee conservation.

[PW - coalescent analysis of COI barcodes by Duennes et al. (2017) does not support *B. wilmattae* as a species separate from *B. ephippiatus*.]

Finally, the BOMBUSS 3.0 meeting will be held in San Cristóbal de Las Casas, Chiapas, México in November 2023. We are more than happy to host this event and it will be great to share all the experience there is from the different research done in recent years since the 2019 meeting when it was held in Toronto, Canada.

Left, bumblebee honey processed at Ecosur by Ruth Hernández. Right, bumblebee nest in the wild and relocated in a nest box.

Building Our Methods
By Using Sound Science

Bumble bees have become a research model organism in different fields related to crop pollination, conservation and other academic fields.

BOMBUSS is a meeting that brings researchers together to discuss different methodologies and the need and potential for their standardization.

After Logan, Utah in 2017 and Toronto, Ontario in 2019, the 3rd edition will take place in Mexico in 2023.

BOMBUSS 3.0

Construyendo Nuestros Métodos
con Ciencia Pertinente

Los abejorros se han convertido en organismos modelo para el estudio, como polinizadores de cultivos, y como objetivos de conservación.

BOMBUSS es una reunión para juntar a investigadores para discutir metodologías y la necesidad y el potencial para su estandarización.

Después de Logan, Utah en 2017 y Toronto, Ontario en 2019, la 3ra edición tendrá lugar en México en 2023.

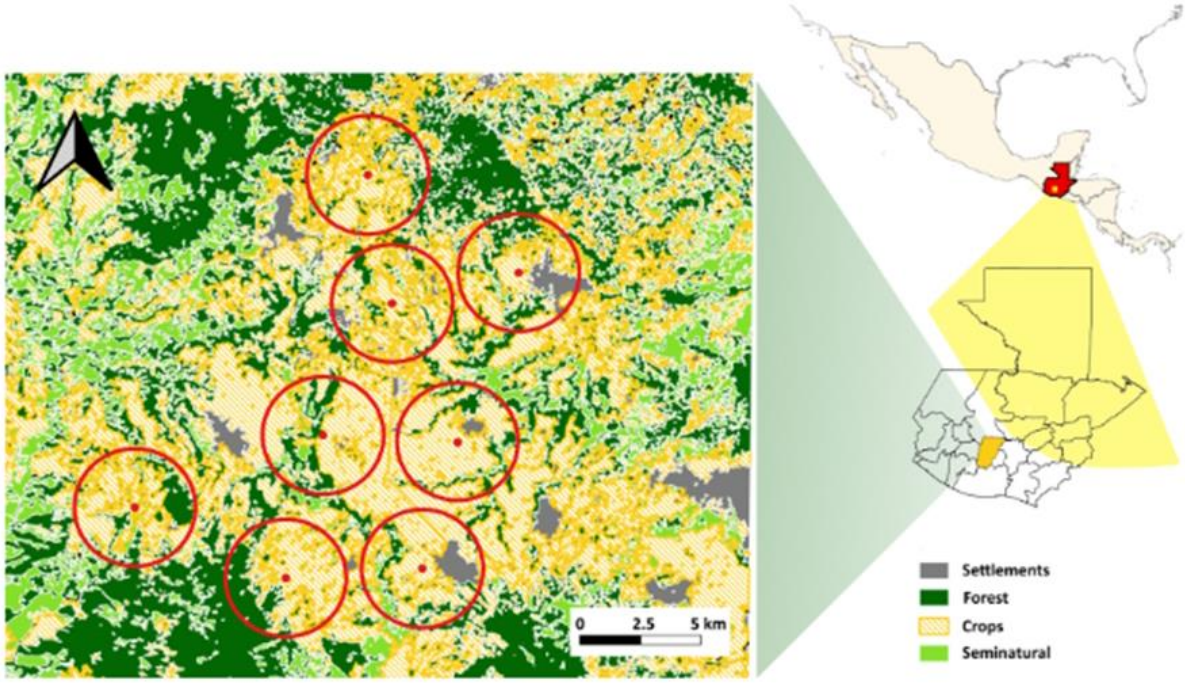
San Cristóbal de Las Casas, Chiapas, Mexico
November 14-17, 2023

Follow us
Siguenos

Guatemala

In Guatemala, during 2022, the Unidad de Biodiversidad team led by Natalia Escobedo from the Universidad de San Carlos de Guatemala continued making efforts towards collecting bees including bumblebees throughout the country, especially in the western highlands. Most collections were made in agricultural areas, mixed with forest remnants and human settlements. Our team collected approximately 100 specimens of bumblebees.

Recently published work from our team showed local-scale effects of agricultural management on the most abundant species in the agricultural highlands (Escobedo-Kenefic et al. 2022). The presence of flowering weeds had a positive effect on the abundance of *B. ephippiatus*.



Locations of study sites in the highlands of Guatemala. The red dots represent the analysis units, red circles represent the 2 km buffers used to obtain the landscape-scale variables. Dark green, forest; light green, semi-natural vegetation; yellow, seasonal agriculture; grey, human settlements.

Finally, efforts to curate and review bumblebee specimens in the Colección de Abejas Nativas de Guatemala have continued. In 2023, the team expects to expand their work on the importance of bumblebees and other native bees in agroecosystems, and on their functional-trait roles in natural ecosystems.

Costa Rica

In Costa Rica, during 2022 as part of the regional program of Apiculture and Meliponiculture and the program of Integrated Meliponiculture, Eduardo Herrera, Johan van Veen, Ingrid Aguilar and Mario Gallardo worked with bumblebees. From the Tropical Apicultural Research Center of the National University of Costa Rica, the thesis study *Breeding of Bombus ephippiatus (Apidae, Bombini) under controlled conditions in Costa Rica* by Eduardo Herrera continued. This will finish its experimental stage in the first quarter of 2023, to be presented later in the year.

Work also continued in Braulio Carrillo National Park in the Barva Volcano sector, where the natural dynamics of the populations of *B. ephippiatus* and *B. volucelloides* are being monitored by counting individuals. We are also collecting information on the flora visited by each species in order to compile a catalog of the important food plants for the *Bombus* present in the Barva volcano.

Where is the work being done?

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

Progress

Currently the thesis on *Rearing of Bombus ephippiatus (Apidae, Bombini) under controlled conditions in Costa Rica* is in the last experimental stage, ready for data analysis and for the presentation of the results. The counts of *Bombus* are planned to be carried out for a period of three years, and 2023 will be the second year of data collection.

What is expected for this year?

During 2023 we expect to conclude the current thesis and continue laboratory observations on the life cycle of *B. ephippiatus*.

Left, rearing bumblebees at CINAT. Right, bumblebee nest in the CINAT lab.

Continuation of monitoring of wild Bombus populations at Barva Volcano

We initiated a new study proposal to seek funding for *Bombus* sampling throughout Costa Rica and to contribute to the analysis of the status of *Bombus* populations within the country. It is intended to include the following institutions: CINAT-UNA, ECOSUR, CATIE, SINAC.

Left, B. ephippiatus queen. Right, B. volucelloides queen.

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 by subgenera. Please visit the website where the video will be uploaded soon http://bio2.elmira.edu/fieldbio/beemovies/index.html.

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JAPAN

Approximately 15 species are currently recognized. There are about 14 species of native bumblebees living in Japan, and one species, *B. terrestris*, has invaded and colonized some regions such as Hokkaido. No species has yet been assessed for IUCN Red List status within Japan. In recent years, Suzuki-Ohno and her group have been actively estimating the distribution and predicting the occurrence of native species (Suzuki-Ohno et al. 2020, 2021). Although regional populations fluctuate, there are no species currently in danger of extinction or require urgent conservation measures. According to the information from the Japanese Ministry of the Environment Red List 2020, there are two bumblebee species that rank in the category NT (Near Threatened): *B. ignitus* and *B. florilegus*. According to the Japanese Ministry of the Environment, work on the next Red List in Japan has begun, which will be selected and evaluated in 2024 or later.

[PW – There is strong evidence that the taxon *florilegus* is a black-tailed part of the widespread (Holarctic) and variable species *B. cryptarum,* as supported by species coalescents from the COI gene*:* Williams et al., 2012; Williams 2021]

The Japanese Region in 2022
Tomoyuki Yokoi

In Japan, *B. ignitus* is used for commercialized crop pollination. In tomato production, another bumblebee species, *B. terrestris*, which has been imported into Japan since the 1990s and has been used by many farmers. However, permission for the use of *B. terrestris* is now regulated under the Invasive Alien Species Act, and in 2019, the Ministry of the Environment changed the permit criteria. From 2020, the number of *B. ignitus* shipped will exceed that of *B. terrestris* so the switch from *B. terrestris* to *B. ignitus* is gradually taking place. Moreover, *B. ignitus* is being used in areas where this species does not normally occur, so there is a risk that it will become a domestic invasive species.

As for *B. florilegus*, its distribution in Hokkaido has been reported in a study by Takahashi et al. (2010). No activities or studies related to the distribution or conservation of *B. florilegus* have progressed this year.

In Japan, a general awareness of bumblebees, except for honeybees, is not deeply established, and there are few major conservation projects or conservation organizations. On the other hand, in recent years research has been conducted on the effects of pollination by native species on crops. While research has been conducted overseas on many crops and bee species, there have been few cases in Japan where sufficient verification or other studies has been conducted. In the spring of 2022, the National Agriculture and Food Research Organization (NARO) developed a survey method, which was published as an *Enhanced Revision of the Pollinating Insect Survey Manual to Help Pollinate Fruit Trees and Fruit Vegetables*. Through a series of field surveys, it revealed that the wild bumblebee *B. ardens* makes a significant contribution to the pollination of persimmon throughout Japan (image below). For persimmon, the main pollinator has traditionally been considered to be the European honeybee. Therefore, in many orchards, honeybee hives were introduced during the flowering period to promote pollination. On the other hand, visits by wild bee species, including bumblebees, have also been reported on persimmon. No nationwide survey has been conducted, and the overall state of the insect fauna pollinating persimmon and their role in Japan is not yet clear. Kamo et al. (2022) investigated the species and

frequency of flower-visiting insects in persimmon orchards, from the Tohoku region to the Kyushu region in Japan, and found that *B. ardens* was the major flower-visiting insect for persimmon in addition to the European honeybee. Moreover, pollinating efficiency was equivalent between bumblebees and honeybees. The results of this study indicate that if frequent visits by bumblebees are observed in persimmon orchards by surveying flower-visiting insects, sufficient fruit-set rates can be expected without the introduction of honeybees.

B. ardens visiting a female flower of persimmon. (Photo by Aoi Nikkeshi.)

If the survey manual developed by NARO can be promoted for easy bee surveys and monitoring at the farmer and citizen levels, it could be expected to lead to the confirmation of new distributions and improved conservation in the future. Efforts to conserve wild bumblebees and other bee species are being promoted from the citizen level. In Japan, the *Guidelines for Giving Habitat to Bees* has now been published by the Pollination Services Society of Japan (PSSJ) in 2021. Both handbooks will help to raise public awareness of bumblebees in Japan.

In a study to promote the use of citizen science and the use of photos, Suzuki-Ohno et al. (2022) investigated the accuracy of bumblebee species identification using deep learning (AI) with biologists. As a result, they reported that deep learning and expert collaboration improved the reliability of species identification. Such new attempts can be expected to be linked to the bumblebee conservation movement.

In Japan, a ‘Bee Summit‘ was held in 2017 and 2019 as a large-scale event to connect bee experts and citizens. The aims of the event are to learn more about bees, other pollinators, and the natural environment, based on the accumulated scientific knowledge, and to appreciate the value of bees, and to consider our food, agriculture, environment, and the

future in light of the current situation for bees. The executive committee has announced that another Bee Summit will be held in Japan in 2023, and preparations are underway. In 2022, they held pre-events online, at which more than 600 people, including apiarists, farmers, students, scientists, many companies, and other interested people (below).

Bee Summit pre-event in 2022. (Photos by the Executive Committee of the Bee Summit.)

The presence and importance of bumblebees in Japan is understood from an agricultural perspective, and the research results from NARO are relevant to this. On the other hand,

honeybees were generally understood as the familiar bee, although recently bumblebees have been gaining recognition, through the widespread use of handbooks and illustrated books. Based on this trend, researchers are expected to become more active, not only in distribution surveys of bumblebees in Japan, but also in conservation activities.

New bumblebee species for Japan

During 2022, the *hypnorum*-group of *Pyrobombus* had one new species (*B. koropokkrus*) recognised for Japan (Williams et al. 2022).

Identification guides for Japan

Identification of the species of Japan is otherwise 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 7 February 2023