Bumblebee Specialist Group Report 2019

Edited by Paul Williams (Co-Chair, UK) and Sarina Jepsen (Co-Chair, USA)

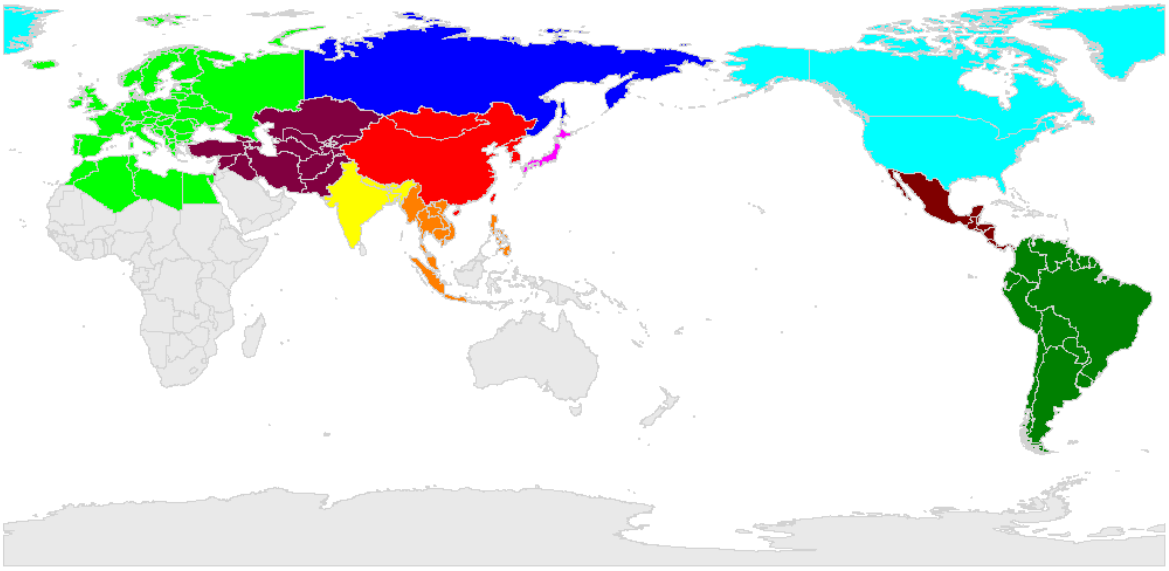
BBSG IN 2019

The BBSG exists to foster the conservation of bumblebees and their habitats around the world. In this seventh report of the BBSG's activities, 2019 has been a busy year, with continuing progress towards our goal of evaluating the extinction risk of all ca 265 species of bumblebees worldwide using the IUCN Red List Criteria. Red List assessments have contributed to advances in species protection in both North and South America.

Where are we now? – Progress with Red List assessments world-wide

In our first eight years, the BBSG has made substantial progress in its mission to evaluate the extinction risk of all bumblebees according to Red List criteria and publish species profiles on the IUCN Red List, especially in Europe and in the Americas. In this report we follow up the situation in each BBSG region – to look at the challenges and opportunities ahead, especially to plans to re-assess the species.

It is important to appreciate that the situation is very different in different BBSG regions, with different levels of knowledge of the bumblebees and very different numbers of specialists available to work on the project, and with different levels of support. We are keen to look for opportunities for BBSG members to support one another across regions to help make progress towards our common goal, especially as we seek to move from regional to global assessments of each species. We invite regional coordinators to contact us to let us know which factors limit your ability to accomplish red list assessments for the bumblebee fauna of your region, so that we may have a complete picture of the situation.



BBSG regions.

One of the first requirements for Red List assessment is to obtain a strongly supported list of species, the first units to be assessed. Bumblebees are well known for their colour variation and for the long history of contentious discussion of their taxonomy, especially for the less intensively studied but much more diverse Asian fauna. Although this discussion of taxonomy is expected to continue, there are current projects to improve our understanding of several groups, covering the species of subgenera including *Melanobombus, Sibiricobombus, Alpigenobombus*, and some *Pyrobombus* and some *Thoracobombus*.

Robbin Thorp's contribution to bumblebee conservation

When Robbin Thorp passed away last June, the bumblebee conservation community experienced a great loss. He served as the regional co-coordinator for the IUCN Bumblebee Specialist Group in North America and dedicated his life to the study and conservation of bumblebees. Many have already recognized his role as a bee expert, an educator and a taxonomist. Since meeting Robbin a couple of decades ago, we knew him primarily as a dedicated advocate for the conservation of bumble bees and as a kind and humble expert.

Robbin began monitoring bumblebees in the Siskiyou Mountains of southern Oregon in the late 1990s, and during this time, witnessed a precipitous decline in Franklin's bumblebee (*B. franklini*) and the Western bumblebee (*B. occidentalis*). He continued to monitor the bumblebee community in this region for two decades, looking for Franklin's bumblebee. Concerned that he may be documenting this species' extinction, he spoke out frequently about this, and engaged many in the bee research community to investigate anecdotal reports of declines in close relatives of Franklin's bumblebee. He developed a hypothesis about the cause of these declines, which was investigated by Sydney Cameron and her team.

Robbin was a passionate advocate for bumblebee conservation. In the early 2000s, he developed comments to the California Department of Food and Agriculture regarding why commercial bumblebees (*B. impatiens*) should not be allowed into California for open field pollination. These comments were submitted and the agency ultimately made the decision for which Robbin Thorp and others advocated. Following this, Robbin worked with Xerces Society staff to coauthor numerous documents – petitions, letters, policy statements, Red List profiles, and status assessments – to further the conservation of bumblebees. Two of those petitions that he co-authored to list Franklin's bumblebee and the Rusty patched bumblebee (*B. affinis*) under the U.S. Endangered Species Act were successful: the Rusty patched bumblebee is now protected as an endangered species in the U.S., and Franklin's bumblebee has been proposed for the same level of protection. Robbin also advocated for changes in regulations of commercial bumblebees to protect wild bumblebees from

pathogens they may harbor – he coauthored another petition, exchanged multiple letters with government officials, and met in person with both regulators and industry representatives to advocate for wild bumblebees.

In addition to his research and advocacy work, Robbin made significant and lasting contributions to our understanding of the systematics and distribution of bumblebees in North America. In 1983 Robbin was the lead author of *Bumble Bees and Cuckoo Bumble Bees of California*, which served as a guide for countless graduate students and researchers as they began their exploration of bumblebee ecology in California. More recently, Robbin co-authored *Bumble Bees of North America,* a comprehensive treatise that sits on the desk of bumblebee researchers throughout the country, and has helped to make this group of animals more approachable for enthusiasts and community scientists.

Perhaps most significantly, but harder to measure, are the effects that Robbin had on the people with whom he interacted. While we've shared some of our experiences, there are countless others that have been inspired by his work. His collaborative approach has helped to launch the research programs of innumerable scientists who continue to live his legacy and contribute to bee ecology and conservation. He reached so many students through teaching at UC Davis, as an Emeritus Professor, and as an instructor for the Bee Course. UC Davis helped to gather some comments from these collaborators in an obituary published shortly after his passing. I'm sure there are many others whose voices are not captured here, or in the UC Davis tribute. Robbin was always willing to meet, share his expertise, and support bee conservation efforts. He was extraordinarily generous with his time, and accessible. He leaves a lasting bee conservation legacy.

EUROPE

Approximately 66-70 species have been recognised in Europe recently, depending on the species concept accepted. All of the species recognised prior to 2017 have been assessed for Red List status within Europe (see the BBSG Annual Report for 2013 and 2014), of which at least nine are endemic to the region, so 56 species need to be assessed beyond Europe. Within Europe, distributions are relatively well recorded and databased, so that baseline data are available (by arrangement) for comparison in the future. Two new species were added recently from molecular studies: *B. konradini* in Italy (Martinet *et al*. 2018) and *B. glacialis* in Novaya Zemlya (Potapov *et al*. 2017).

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NORTH AMERICA

48 species are recognised here, including the species newly described in 2016, *B. kluanensis* from the subarctic north west and a new species of the subgenus *Pyrobombus* from Alaska (REF??). All currently recognised species have now been assessed for Red List status globally, although the species of the subgenus *Alpinobombus* 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 (e.g. 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.

North American Region in 2019

Sheila Colla / Rich Hatfield

The North American bumblebees were mostly assessed five or more years ago now. It is time to consider updating these assessments with the best available scientific evidence. This October BOMBUSS 2.0 will be held at York University in Toronto, ON Canada (https://wildlifepreservation.ca/bombuss-program/). The aim of this meeting will be to gather academics, conservation practitioners, students and others to determine next steps and knowledge gaps with respect to North American bumblebee conservation and management. We will have a session to discuss updates of the IUCN Red List.

In Canada, *B. pensylvanicus* was assessed was assessed as Special Concern, but it not yet listed. Two subspecies of *B. occidentalis* were assessed as Vulnerable and Special Concern, but are also not yet listed. *Bombus terricola* is assessed and federally listed as Special Concern. *Bombus affinis* continues to be listed as Federally Endangered and is up for 10 year review next year.

The United States continues to use information gleaned through the IUCN Red Listing process to inform bumblebee policy and management. Much of this work continues to be focused on the Rusty patched bumblebee (*B. affinis,* CR), which is listed as an endangered species under the US Endangered Species Act (ESA). This spring, the U.S. Fish and Wildlife Service (USFWS), in coordination with the Conservation Planning Specialist Group, will host a workshop intended to discuss the merits and challenges associated with a captive breeding program, and to discuss other alternatives should the need for ex situ solutions arise. The USFWS, with input provided by many partners, is developing a Draft Recovery Plan for *B. affinis*, which will provide broad level criteria and actions to conserve the species. In October 2019, the USFWS proposed *B. franklini* (CR) for listing under the ESA; the USFWS continues to evaluate the petition to list *B. occidentalis* (VU). In August 2019, the USFWS determined that *B. terricola* (VU) was not warranted for endangered species protection. In addition to federal efforts, in October 2018, four bumble bees were petitioned (*B. crotchii*, EN; *B. suckleyi*, CR; *B. occidentalis occidentalis*, NE; *B. franklini*, CR) for endangered species protection under the California Endangered Species Act. In April 2019 those petitions were accepted by the California Fish and Game Commission, and a formal review process is underway. Conservation management for bumblebees continues throughout much of the United States with collaborations between NGOs, universities, and federal and state agencies. For example, the Pacific Northwest Bumble Bee Atlas, funded by the USFWS to gather information on *B. occidentalis* (VU), *B. morrisoni* (VU), and *B. suckleyi* (CR), is using large-scale habitat projects on state lands and observations from community scientists to build evidence-based habitat recommendations for land managers in Oregon, Idaho and Washington. Similar efforts are ongoing in Nebraska, Wisconsin, Minnesota, and Maine.

Recent Publications

Gibson SD, Bennett K, Brook RW, Langer SV, MacPhail VJ, Beresford DV (2018) New records and range extensions of bumble bees (*Bombus* spp.) in a previously undersampled region of North America's boreal forest. *Journal of the Entomological Society of Ontario* 149.

Herrmann JD, Haddad NM, Levey DJ (2018) Mean body size predicts colony performance in the common eastern bumble bee (*Bombus impatiens*). *Ecological entomology* 43(4):458-462.

Hicks BJ, Pilgrim BL, Perry E, Marshall HD (2018) Observations of native bumble bees inside of commercial colonies of *Bombus impatiens* (Hymenoptera: Apidae) and the potential for pathogen spillover. *Canadian Entomologist* 150(4):520-531.

Hughes A. (2018) Survey of the critically endangered Rusty Patched Bumble bee (*Bombus affinis*) at Midewin National Tallgrass Prairie (USDA-FS) Ill. [Online] https://digitalcommons.olivet.edu/pence_boyce/2/

Jacobson MM, Tucker EM, Mathiasson ME, Rehan SM 2018) Decline of bumble bees in northeastern North America, with special focus on *Bombus terricola*. *Biological conservation* 217:437-445.

Johnson SA, Tompkins MM, Tompkins H, Colla SR (2019) Artificial Domicile Use by Bumble Bees (*Bombus*; Hymenoptera: Apidae) in Ontario, Canada. *Journal of Insect Science* 19(1):7.

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Koch JB, Rodriguez J, Pitts JP, Strange JP (2018) Phylogeny and population genetic analyses reveals cryptic speciation in the *Bombus fervidus* species complex (Hymenoptera: Apidae). *PloS one* 13(11):e0207080.

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Phelps JD, Strang CG, Gbylik-Sikorska M, Sniegocki T, Posyniak A, Sherry DF (2018) Imidacloprid slows the development of preference for rewarding food sources in bumblebees (*Bombus impatiens*). *Ecotoxicology* 27(2):175-187.

Rowe L, Gibson D, Landis D, Gibbs J, Isaacs R (2018) A Comparison of Drought-Tolerant Prairie Plants to Support Managed and Wild Bees in Conservation Programs. *Environmental entomology* 47(5):1128-1142.
Strange JP, Tripodi AD (2019) Characterizing bumble bee (*Bombus*) communities in the United States and assessing a conservation monitoring method. *Ecology and Evolution*, 9(3), 1061-1069
Saunders ME, Smith TJ, Rader R (2018) Bee conservation: key role of managed bees. *Science* 360(6387):389-389.
Vaudo AD, Farrell LM, Patch HM, Grozinger CM, Tooker JF (2018) Consistent pollen nutritional intake drives bumble bee (*Bombus impatiens*) colony growth and reproduction across different habitats. *Ecology and evolution* 8(11):5765-5776.

MESOAMERICA

Approximately 18 species are currently recognised, although several species groups are being revised, with the promise of several more species to be added soon. The Red List status for all 18 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.

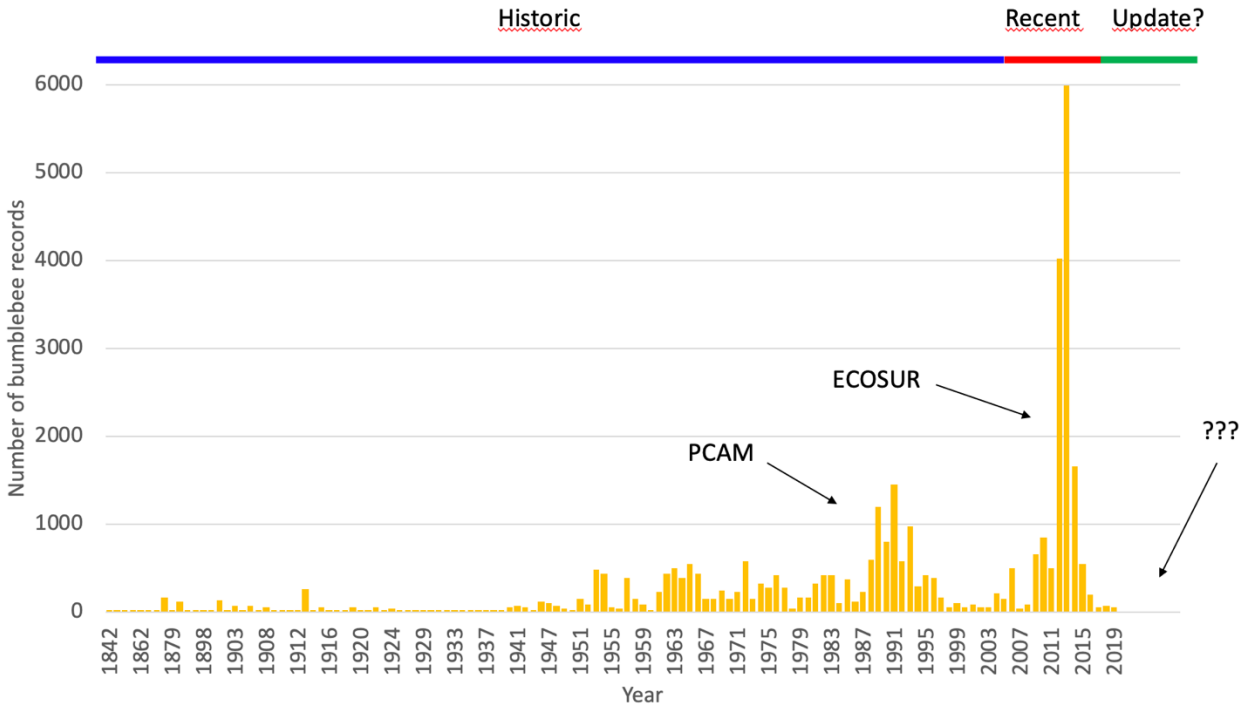
Mesoamerican Region in 2019

Rémy Vandame

The main activities of the Mesoamerican group in 2019 have been in the fields of taxonomy, sampling, databasing, rearing, and recommendations to policy makers.

In terms of taxonomy, the region hosts 30 species, i.e. 23 known species, five species awaiting description, and two species to be split from known species. All of these seven species are being redescribed from morphology and genetic analyses.

Sampling is still being performed at low intensity, focussing on those regions hosting rare or new species, or regions that historically were undersampled. The bee collection at El Colegio de la Frontera Sur (Ecosur), in Chiapas, southern Mexico, now possesses close to 13,000 bumblebee specimens. Different databases have been incorporated within that of Ecosur, so that the database of bees of Mesoamerica now holds more than 400,000 records, including more than 36,000 bumblebees (see below). However, the lack of funds for surveys in Mexico and Central America is a concern, because it is not yet possible to generate enough data to represent the distribution of the species, and thus the Red List status for each of them cannot yet be updated.



Development of the Ecosur bumblebee database.

Relative to rearing, a small facility has been built at Ecosur in order to develop the rearing of local colonies of *B. ephippiatus*. The main challenge is to achieve high levels of reproductive success, based on finding the best conditions of temperature, humidity, and food. A technical manual has been written, and is now a support for training people interested in rearing native species of bumblebees (below).

Manual for the rearing of B. ephippiatus.

In the field of public policy, a document has been written by scientists from Guatemala, Costa Rica and Mexico, first to analyze the risks from exotic bumblebee species to trade in the region, mainly *B. impatiens* and *B. huntii* (see below), and then to establish a number of recommendations to be considered for public regulation, which can be summarized as follows:

(1) Stop trade in exotic bumblebee species in Mesoamerica (i.e. *B. impatiens*, in addition to *B. terrestris*, trade in which is currently prohibited) within 5 to 7 years from the issue of this opinion, that is, between 2024 and 2026. This time is considered sufficient for companies to adapt their management system for the use of any of the native species.

(2) Invest the necessary resources in research for the management and sustainable local breeding of bumblebees in a way that avoids predating wild populations, namely *B. huntii* and species belonging to the *B. ephippiatus-wilmattae* complex, to have bumblebee species and start with the replacement of exotic species in the next 3 years, that is in 2023. This time will allow for a move to a commercial stage between 2023 and 2026.

(3) For the *B. ephippiatus-wilmattae* complex, consider natural boundaries (Isthmus of Tehuantepec, IT, and the Depression of Nicaragua, DN) as limits, beyond which the queens or colonies of the four lineages recognized in this region should not be introduced. In return, allow the moving and marketing of the local lineages within each of the three regions (Costa Rica; Nicaragua to Chiapas region; Mexico north of the IT).

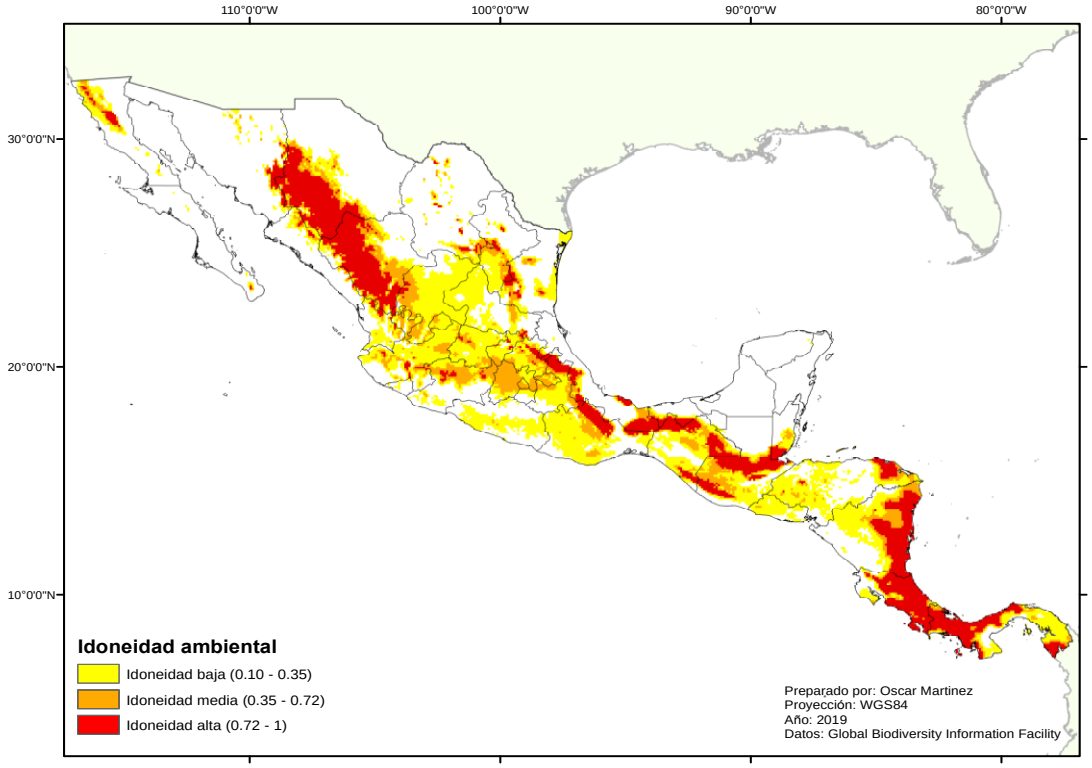
(4) For *B. huntii*, considering that there is a low risk of establishment and invasion when introducing this species of elevated sites in the warm and temperate regions where bumblebees are usually managed to pollinate protected agriculture, and therefore, consider that it is possible to move queens or colonies in Mexico north of IT. However, it is important to establish such a limit at the IT, considering that the species could be established in the highlands of Chiapas and Guatemala, where it would be exotic.

(5) Ensure strict biosecurity to prevent the escape, establishment and dispersal of queens and bumblebee males, if taken outside of these original ranges, to carry out scientific research related to their management or for the study of their biology.

(6) Establish a pathogen study protocol, to limit the spread of pathogens in the region, as well as a nestbox disposal protocol to prevent the spread of pathogens or dispersal of queens and males in the environment.

(7) Regulate the collection of queens from wild nests, limiting this practice to the very initial stages of the management of native species, excluding resorting to such collection routinely.

(8) In general, design and implement a plan for the management and sustainable use of bumblebees in each country, which considers each and every one of the previous recommendations.



Potential distribution of the exotic species B. impatiens in Mesoamerica, according to different modeling variables (contact the authors for details and alternative scenarios).

SOUTH AMERICA

Approximately 26 species are currently recognised, with two species newly described in 2015 (one of these needs confirmation). The other 24 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.

South American Region in 2019

Carolina L. Morales / Cecilia Smith Ramirez / Marina Arbetman / José Montalva / Sheena Salvarey

During 2019 South American members of the BBSG have been strongly involved in research and outreach activities related to bumblebee conservation and management.

In Uruguay, in the last years, there have been advances in research on different aspects of biology and behaviour of native species *B. atratus* and *B. bellicosus*. BBSG Member Sheena Salvarey (Facultad de Ciencias, Universidad de la República) has carried out the first study aimed to determine the role of these native species on yields of two crops of economic relevance in Uruguay. In pollination essays in different varieties of tomato (*Solanum lycopersium*) cultivated in different regions of the country, she and her team found that bumblebee visits increased fruit set 13-47% compared to unvisited flowers, and significantly increased the size and quality of the fruits. In addition, they showed that factors like the incidence of light in greenhouses, in particular, the degree of UV filter of the cover films

influenced bumblebee behaviour, affecting their orientation, time of foraging and flight. In a related study, they found that *B. atratus* colonies 'out-phased' from the natural colony cycle produced red clover (*Trifolium pratense*) seed yields of 400 kg/ha.

Additionally, they investigated the internal organization of bumblebee colonies, larval phases, feeding requirements, and other aspects like their pathogens, needed for future planes of crop pollination using native bumblebees. *Bombus atratus* is a native species that is also commercialized in Uruguay by an Argentinean Company. By screening natural and laboratory reared (following their own small scale method) colonies they found a multiplicity of pathogens, including microsporidian *Nosema ceranae* and *Tubilonosema pampeana*, a conopid dipteran, a nematode *Sphaerularia bombi*, foretic acari *Tyrophagus putrescentinae*, *Pneumolaelaps longanalis*, *Kuzinia* spp. and *Parasitellus fucorum*, and viruses like DWV BQCV, SBV and ABPV. No differences were found between colonies from the field and those reared at small scale in the laboratory. It is necessary to advance our knowledge on the dynamic and relation between the different pathogens and the impact they may have on the colony, and evaluate the potential sanitary risks of commercial rearing of the different species. These are among their future goals, as well as to increase knowledge on their role as pollinators of native and agricultural ecosystems.

In the two southernmost countries of South America, Argentina and Chile, researchers are actively involved in research, education and outreach activities related to the increasing impacts of invasive *B. terrestris* in the region.

In Argentina, the Group of Pollination Ecology at INIBIOMA (CONICET-Universidad Nacional del Comahue) has expanded collaborations with other research groups of Chile, USA and UK, has received two important National Geographic grants focused on *B. dahlbomii* conservation and joined a large international project (SURPASS2), aimed to study, among others, the impact of *B. terrestris* on native ecosystems, and the extent of its invasion.

Marina Arbetman, a BBSG Member is leading the NATGEO project 'Is continuous importation of European bumble bees driving the Patagonian bumble bee to extinction?', which has the following goals: 1) survey the extent of invasion of *B. terrestris* in Argentina and Chile and compare it with results from previous surveys; 2) study changes at the genetic structure and diversity of *B. terrestris* populations over space and time during the course of multiple introduction events; and 3) assess whether new pathogen and/or new pathogen variants have accompanied successive invasion pulses. The international research team is composed of Carolina Morales, Eduardo Zattara, Marcelo Aizen (Argentina), Maureen Murúa (Chile), and Amy Toth (USA). In addition, Marina is also co-leading together with acoustic specialist Candace Galen (USA), and the participation of four research groups, from Argentina, USA and Chile, the collaborative NATGEO Explorers Project 'Bee listeners: a collaborative initiative for conservation of the world's largest bumblebee using acoustic monitoring', aimed to apply and validate acoustic recognition of unique bumblebee species based on features of their flight and pollination buzzes. As part of the continuous collaboration established with Amy Toth, a new paper has been published on the role of phenotypic plasticity on social insects' conservation and invasion.

Research groups of Argentina, Brazil , Chile and UK, are involved in SURPASS2 (Safeguarding Pollination Services in a Changing World: theory into practice). This 3-year project builds on

the SURPASS project (Newton Phase 1). The SURPASS2 goal is to deliver evidence for the creation of resilient pollination services for sustainable economic growth, improved human health and wellbeing as well as positive environmental and agricultural outcomes. This will be addressed by five main objectives, co-designed with academics and stakeholders that establish interconnected work packages that build capacity to manage pollination services and provide tangible outcomes. This will be delivered through 4 work packages with specific aim: WP1- monitoring populations and understanding their distributions; WP2 - understand how the environment in which pollinators live affect them, and how it affects their capacity to provide crop pollination; WP3 - understanding national scale deficits in pollination for key crops and identifying areas where pollination services are at high risk; WP4- develop a national scale predictive framework to support policy goals of maximising benefits for agricultural productivity provided by pollination and enhance the sustainability and resilience of socio-ecological systems. SURPASS2 is a co-funded project, involving four research councils and foundations, NERC (UK), CONICET (Argentina), FAPESP (Brazil) and CONICYT (Chile). Funding: £1.4m via NERC grant NE/S011870/1. In the context of WP2, the Group of Pollination Ecology at the INIBIOMA (CONICET-Universidad Nacional del Comahue (Argentina) and various research groups from Chile at the Universidad Pontífica de Valparaíso, Universidad de la Frontera, and Universidad Mayor de Santiago, are carrying out large scale monitoring of native and invasive bumblebees to evaluate the effect of *B. terrestris* spread on native bumblebees' distribution and abundance.

In Chile, the BBSG Member José Montalva has studied the importance of native Chilean bumblebee *B. dahlbomii* for the Mapuche people's 'cosmovision', including the use of its honey in their culture. The results of his research were presented in the Ethnobotanic Congress of Cincinnati (https://www.econbot.org/home/meetings/economic-botany-2019.html) and accepted for publication.

The research Group lead by Cecilia Smith Ramirez (Universidad de Los Lagos) have been studying bean pollinators in Valdivia, Chiloé and Valparaiso, where they found different pollinator richness visiting bean flowers, and contrasting incidence of nectar robbing by *B. terrestris*. In addition, they carried out the 19th pollinators census in native forests of *Eucryphia cordifolia*, where they found the lowest relative abundance of *B. dahlbomii* compared to *B. terrestris* of the whole time series. They made the third survey of bumblebees in the Altiplano in the border with Bolivia, where they found that *B. terrestris* is overlapping the natural range of native species *B. funebris*, a species that inhabited the coastal valleys (Lluta and Azapa) of north Chile, until the nineties. However, this species is not found there since the valleys have been used for intensive agriculture with use of irrigation, pesticides and greenhouses with *B. terrestris* colonies. These greenhouses are suspected to be the source of this invasive species in the Altiplano.

Cecilia and Rodrigo Barahona, another Chilean researcher strongly committed to insects' conservation, gave a lecture on the impact of *B. terrestris* on the community of native pollinators at the University of Tarapaca and a talk to local communities in the regions of Aysen, and Valparaiso, and published an outreach note in the digital newspaper El Mostrador on the threat of *B. terrestris* importation on *B. funebris* and *B. dahlbomii*.

The scientific community of Chile has been doing a great effort to increase the awareness of the decision makers on the impacts of *B. terrestris* commerce and invasion on Chilean

ecosystems. They have recently published a paper (in Spanish), where they provide a list of the key arguments supporting the claim for a stop on *B. terrestris* importation. Moreover, they have had meetings with the Secretary of Agriculture and Livestock (SAG), and representatives of the Congress. In November, 2019, they submitted a request to the Congress of Chile (Honorable Cámara de Diputados) asking for stopping the importations of commercial colonies, which was signed by >30 scientific societies, NGOs and naturalist associations of Chile, and Argentina, and supported by a Senator and a Deputy in the Congress. In addition, they launched the claim 'Save *B. dahlbomii*' in the open platform change.org, which has already received >5000 signatures.

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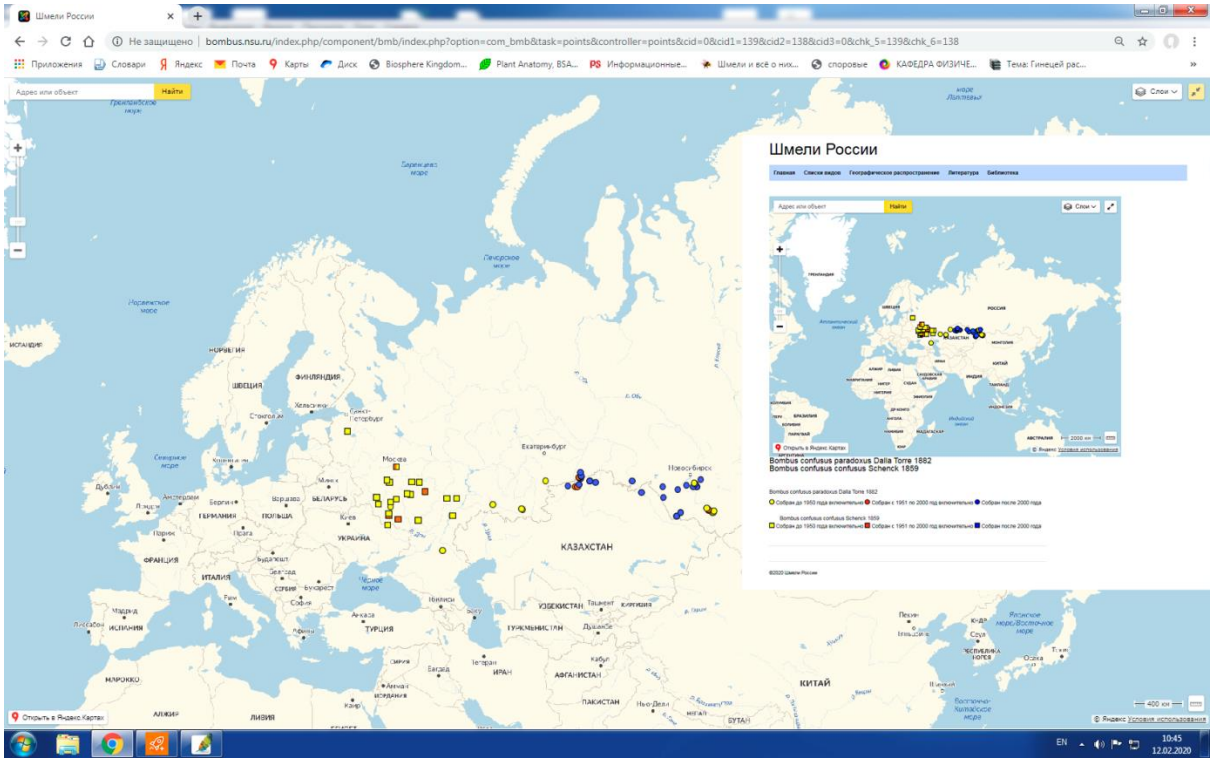
NORTH ASIA

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

North Asia Region in 2019

Alexandr Byvaltsev / Vladimir Molodstov



Screenshot of the page with the distribution map for B. confusus s. str. (squares) and B. confusus paradoxus (circles) in Russia according to http://bombus.nsu.ru *(records of paradoxus from Khakassia and Krasnoyarsk region are still missing).*

We continue to evaluate the diversity of bumblebees of Russia. The website 'Шмели России' ('Bumblebees of Russia') was created in 2012 (http://bombus.nsu.ru). The initiative was funded by the Grant of the President of Russia MK-5168.2012.4 in 2012. The main aim of this project is mapping of distribution of bumblebees species across the country. By the project deadline (end of 2013) the distribution maps of 14 taxa were created. After that the project developed slowly, but in 2019 we have made good progress.

The list of species was updated according to Annotated Catalogue of the Hymenoptera of Russia (2017) and 90 taxa are now included. The distribution maps are available for 24 taxa (some recent data are not yet included), details for 15 of them are presented. Some photos were also added.

The site is available only in Russian, but we hope to create an English version in the future.

The distribution maps are based mainly on the collection of the Zoological Institute RAS (St. Petersburg), Federal Scientific Center of the East Asia Terrestrial Biodiversity FEB RAS

(Vladivostok), Zoological Museum of Moscow State University (Moscow), Institute of Systematics and Ecology of Animals SB RAS (Novosibirsk) and the research collection of Byvaltsev Alexandr, deposited at Novosibirsk State University (Novosibirsk). The data from some personal collections are also included – Evgeniy Akulov (Krasnoyarsk) and Svyatoslav Knyazev (Omsk). There are 2392 registrations for 10967 specimens now in the database.

The user can choose up to three species for displaying on one map simultaneously. The option for browsing of species registrations by administrative division of Russia is also implemented. Records for three periods are displayed in different colours: before 1950, between 1951 and 2000, and after 2000.

In 2020 we plan to develop the site and hope to reach of 50% of the species in the Russian list.

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JAPAN

Approximately 14 species are currently recognised. No species have yet been assessed for Red List status within Japan. Of the total, only one species is currently considered endemic, so 13 need to be assessed beyond Japan. There are many records in collections and in the literature that could be mobilised if funding were available, but field surveys are urgently needed.

Japanese Region in 2019

Kouichi Goka for Japan

In Japan, we have decided to add a pesticide risk assessment for terrestrial organisms in the Pesticide Regulation Act. So, we have enacted the test guideline for ecological risk assessment for pollinators, which will take effect from April in 2020.

In this test guideline, the target species will be *Apis mellifera* and wild bumblebees for the present. We, the National Institute for Environmental Studies, have used data on ecological risks for constructing the risk assessment system. We have collected acute toxicity data, colony toxicity data and pesticide exposure data through laboratory and field experiments. Until now, we have revealed that there are not large differences in sensitivities to many insecticides between *A. mellifera* and bumblebees by acute toxicity tests.

On the other hand, colony toxicity values (insecticide dose) are so much lower than the acute toxicity value for almost all insecticides. These results strongly indicate the necessity of

chronic toxicity tests for pollinator ecological risk assessment. Furthermore, we could detect the insecticide residue in bumblebee colonies in the field, which suggests that insecticide exposure of wild bees should be considered. We are now researching the correlation between the environmental residue value of pesticides and diversity of wild pollinators including bumblebees in the field in Japan.

As an invasive alien species, the introduced European bumblebee *B. terrestris* has continued spreading in Hokkaido Island, and has invaded even a World Natural Heritage area, Shiretoko Peninsula. Interestingly, the European bumblebee has never been established in Honshu Island and the southern Islands. The reason is considered to be differences in the quantity of flower resources.

On the other hand, the Japanese Government has moved to switch from the European bumblebee to the native *B. ignitus* for agricultural pollination. So, Japan has introduced a lot of artificial colonies of *B. ignitus* reared in Europe. In Japan, as we do not have the capacity for producing the artificial colonies of bumblebees on a commercial scale, so we need to entrust the production of *B. ignitus* colonies to European companies developing biological materials like Koppert. So, we should regard the commercial colonies as alien livestock.

Furthermore, we cannot use *B. ignitus* colonies in Hokkaido Island where alternative pollinator colonies are strongly needed, because originally *B. ignitus* never inhabited Hokkaido Island. As a result, *B. ignitus* colonies have been sold in the other Islands south of Hokkaido. We consider that a mass introduction of a commercial strain into native habitat will cause genetic disturbance in the natural populations of *B. ignitus*.

The commercial producers of bumblebee colonies in Japan have kept distributing imported *B. ignitus* colonies in spite of never having taken responsibility for the introduction and release of the Europe species.

WEST ASIA

Approximately 73 species are currently recognised. No species have 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. Within West Asia, the fauna of Turkey is already well mapped (many species shared with Europe) and good 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.

West Asia Region in 2019

Ahmet Murat Aytekin for Turkey

Bombus terrestris in Niğde Province in 2019. (Photo by Çiğdem Özenirler.)

Difficult times continue in the region, due to the loss of researchers and the decline in research funds in 2019. Fortunately instead of governmental resources non-governmental funds are trending to increase. Two new projects began funded by companies interested in bumblebee pollination; both in 2020 with the flowering period.

Studies in Turkey continue, more on commercial rearing and on integrated taxonomic studies of bumblebees this year also. The Turkish Scientific Council is still funding the project *Investigation of genome-wide expression profiles of antennal chemoreceptors during the development of bumblebee (Bombus terrestris L.).* A paper including limited data about *B. terrestris* from Turkey was also published by Silva *et al*. in 2019. With the help of these studies we are more hopeful about receiving some more data in 2020 and we never lose our hope. A very important change for the location of a collection has made with the help of very brave colleagues and students in June 2019. We were able to move the personal collection of Murat Aytekin to İstanbul, University Department of Zoology, whose curator is Dr Fatih Dikmen now. The collection was at risk of serious damage at Hacettepe University but is now safe. The collection is open for colleague. Morphometric data from this collection and others have been transferred previously to the University of Mons. These should help new researchers to publish data in the coming years. In 2020 studies on bumblebee morphometrics will continue.

To give many more details of bumblebee systematics, the site www.muratayteki n.com is now completely rebuilt to include more data and publications and I will seek to keep it updated more frequently. However there have been no recent data added on the status of bumblebees in Turkey. A new study now accepted for publication is listed below for the interest of our colleagues.

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Alireza Monfared for Iran

This year was a year of very high precipitation in Iran, especially in the areas of bumblebee habitat in the north and north west of Iran.

Bumblebee sampling

In 2019 at the end of the winter, we started to collect specimens of *B. haematurus* from northern Iran (Mazandaran Province) for a project shared with Mons University. In a new survey, we studied our collection of 4,500 bumblebee specimens sampled from 21 provinces of Iran between 1996-2019. The results show that at present we have 33 species of bumblebees in Iran representing 11 subgenera. In addition, we recorded two species new for the Iranian fauna, which we will describe in a coming publication.

Collecting bumblebees in the north of Iran in February 2019, late winter in Mazandaran. Alireza with an Msc student who is very active and enthusiastic.

Iranian Pollinator Insect Museum (IPIM) - Yasouj University

By collecting and adding specimens to the Iranian Pollinator Insect Museum in 2019 we now have a collection of more than 50,000 specimens of Iranian Apoidea. Of these, more than 4,500 specimens of bumblebees have been collected from all over Iran. This year this museum has had many visitors. Bumblebee specimens are a central attraction for visitors.

EAST ASIA

Approximately 124 species are currently recognised, although several species groups are being revised, with the promise that more species will be added soon. No species have yet been assessed for Red List status within East Asia. Of the total, 23 species are considered endemic, so 101 need to be assessed beyond East Asia (some species just crossing the border into the Himalaya region or to the South East Asia region). Within East Asia, much effort has been put into recording and databasing distributions, so that Red List assessments should be possible within the next few years.

East Asia Region in 2019

Jiandong An / Jiaxing Huang / Muhammad Naeem

Heterogeneity of climatic and topographical factors support more than 50% of the world known bumblebee species in East Asia. This heterogeneity in environmental factors affects intraspecific variation of species, their assemblages within different geographic regions, responses to environmental changes, as well as their pollination services. Hence, multiple studies were designed to highlight the impact of such heterogenous stresses on bumblebee species in the East Asian Region in 2019.

For analyzing the intraspecific colour pattern variation in bumblebee species, 506 specimens of differently colored *B. bicoloratus*-like species were selected here and were identified from morphology. This identification was further confirmed from genes by analyzing 1–3 bees from each colour pattern of *B. bicoloratus*. Finally, the distribution of this polymorphism species (*B. bicoloratus*) was also estimated by including climatic and elevation factors. Similarly, the assemblages of 125 bumblebee species were estimated within different biogeographic regions of China. The collection data of 125 bumblebee species from 2002 to 2019 was obtained from our collection at the Institute of Apicultural Research, Chinese Academy of Agricultural Sciences (most identified by Paul Williams). All the data as well as other climatic and topographical factors were overlaid on 3° longitude × 3° latitude grid cells for the whole of China in order to identify the different bumblebee biogeographic regions. After that, indicator species from those geographic regions and their suitable habitats were identified for their long-term monitoring and conservation. For the estimation of their responses to future environmental changes, distribution data for the 29 endemic bumblebee species with more than five occurrence records of East Asia were collected together with current and future (2050s & 2070s) climate and landcover-change data.

Pollination performance was estimated for solar greenhouse agriculture using the Chinese bumblebee *B. lantschouensis* and for *Apis mallifera*. Microclimates of solar greenhouses, pollen release, and pollen-foraging behaviour were observed.

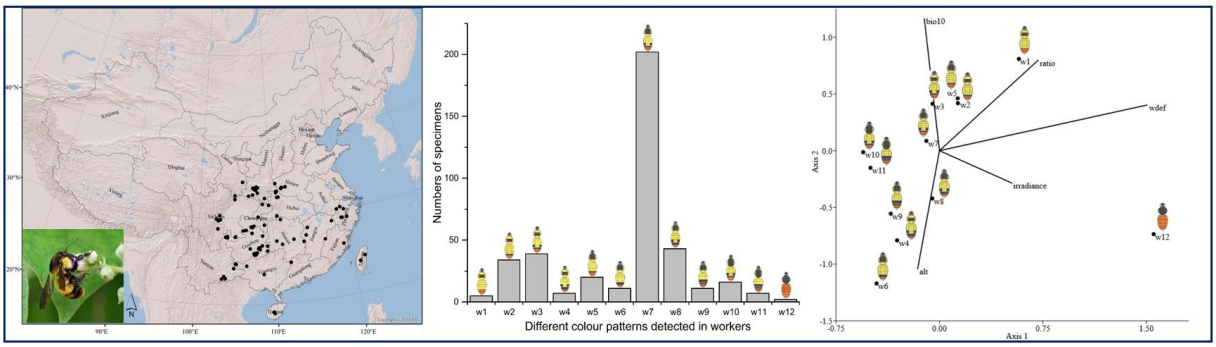
Results indicated that intraspecific colour-pattern variation is present within the species *B. bicoloratus*. This species is distributed mainly in subtropical and tropical areas of southern China. The distribution of the different colour patterns is heavily skewed, with 50.9% of the workers sharing the same colour pattern. The distinct colour pattern of *B. bicoloratus* workers from the islands (Hainan and Taiwan) is highly correlated with high climatic irradiance.

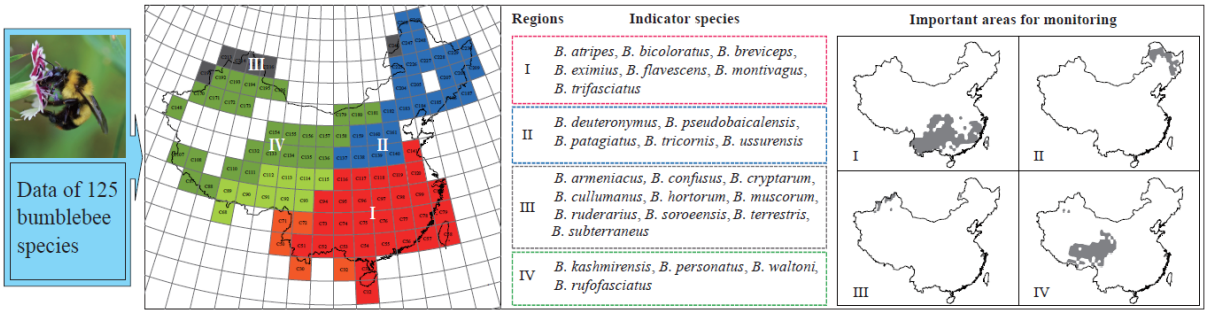
Four biogeographic regions were identified for bumblebees within China: South China, North China, the Mongolian Plateau, and the Tibetan Plateau. We found that 14, 13, 12 and 12

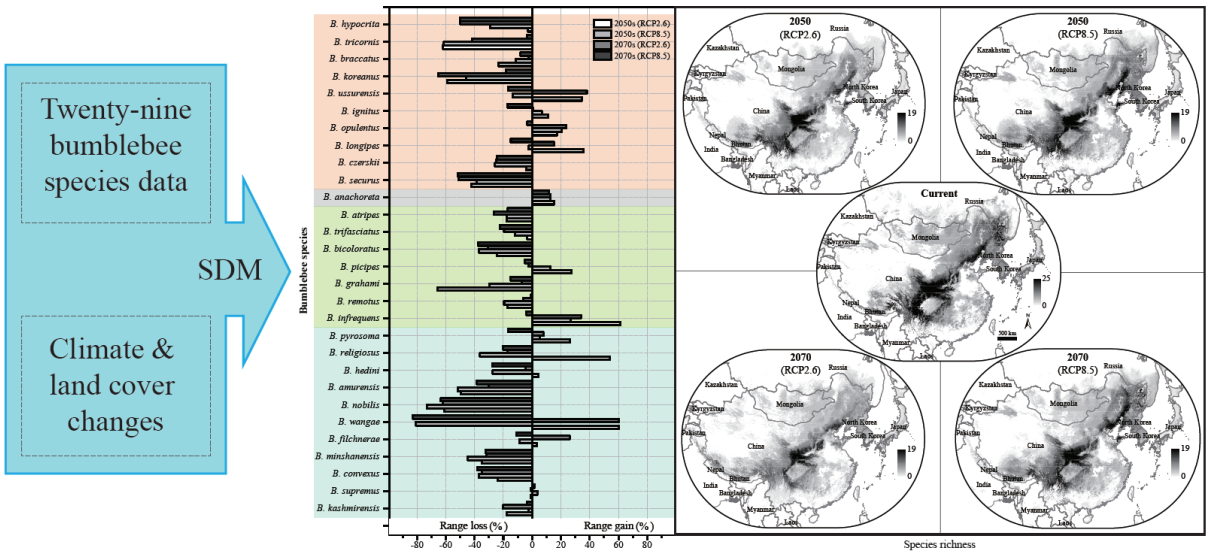
species were associated with the regions of South China, North China, the Mongolian Plateau, and the Tibetan Plateau respectively. In addition, among these species, seven, five, ten and four species were identified as important indicator species for South China, North China, the Mongolian Plateau and the Tibetan Plateau, respectively.

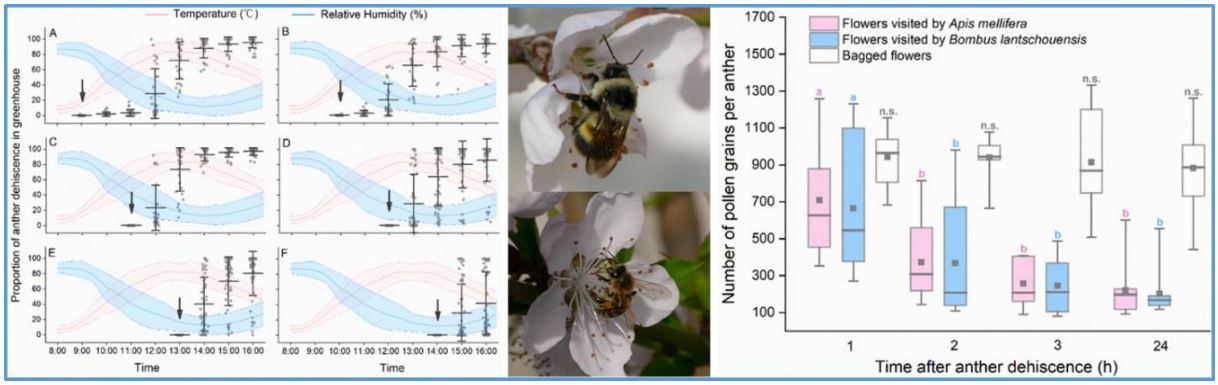
For the response estimation, from 29 bumblebee species, 17–27 (59–93 %) of the species showed range contraction. A decrease in species richness from 25 to 19 species in the highest region of central China was also detected due to range shifts of 17 km to 574 km. Furthermore, one (3.44%), three to five (10–17 %), and two to eight (7–28 %) of the 29 bumblebee species were predicted to become either critically endangered, endangered, or vulnerable in the future (2050s & 2070s), respectively (formal Red List assessments have yet to be made). Our study highlights the strong impact of environmental changes on species distributions and we suggest strategies for the conservation of vulnerable species that include protecting the regions of high species richness and the most dominant land cover within the current range to mitigate the threat of environmental changes.

For pollination-performance analysis, our results showed that the microclimatic factors had a significant effect on anther dehiscence and on bee foraging behaviour. The proportion of dehisced anthers increased with increasing temperature and decreasing relative humidity and peaked from 11:00 hr to 14:00 hr, coinciding with the peak pollen-collecting activity of the bees. On sunny days, most pollen grains were collected by the two pollinators within two hours after anther dehiscence, at which time the viability of pollen had not yet significantly decreased. Our study helps us to understand better the relationship between food resources and pollinator foraging behaviour and to make better use of bees for pollination in greenhouse agriculture.









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HIMALAYA

Approximately 52 species are currently recognised. No species have yet been assessed for Red List status within the Himalaya. Of the total, nine species are considered endemic, so 43 need to be assessed beyond the Himalaya (most in East Asia). There are many records in collections and in the literature that could be mobilised if funding were available, but field surveys are urgently needed.

Himalaya Region in 2019

Malkiat Saini / Rifat Raina

Bombus tunicatus is an indigenous and unique Old World Himalayan bumblebee species with a broad distribution range that stretches over the Himalaya, covering the states of Himachal Pradesh, Uttarakhand, Sikkim and West Bengal, as well as the two union territories of Jammu, Kashmir and Ladakh. Its elevational range surpasses any other Indian species, with a presence from as low as 1380 m up to 4180 m. It is the first bumblebee to emerge in spring, coinciding with the flowering of various orchards and crops, ornamental trees and many other wild and cultivated plants of economic importance. With a larger number of workers per colony compared with other species, its pollination potential is immense and it is active over a broad season, from the middle of March to the end of September. As far as the choice of food plants is concerned, it is the most generalist bumblebee in the sense that it forages for nectar and pollen from a wide range of flowers of herbs, shrubs, and trees. Although few data are available, considering its behaviour, distribution, food preference, elevational range, and population size, it should be easily exploited for glasshouse farming of various commercial crops, including tomatoes, peas, etc., to increase yields.

Bombus tunicatus: left queen, and right male. *(Photos by R. Raina.)*

Bombus tunicatus foraging. (Photos by R. Raina.)

SOUTH EAST ASIA

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

South East Asia Region in 2019

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

During 2019-2020, we published work on the microsporidia present in bumblebees in Thailand. We found *Nosema cerana* in *B. montivagus* (5.35%), *B. haemorrhoidalis* (4.76%), and *B. breviceps* (14.28%) and *Nosema bombi* in *B. montivagus* (14.28%), *B. haemorrhoidalis* (11.64%), and *B. breviceps* (28.257%).

A bumblebee survey was made in Doi Inthanon National Park, Chiang Mai, during June and July 2019, in collaboration with Chulalongkorn University and the Department of National Parks, Wildlife and Plant Conservation of Thailand. Seven species of bumblebees have been recorded in this National Park. The new survey is part of the data collection for Chawatat Thanoosing's PhD research. The survey included agricultural and village areas, and reserved forests where different bumblebee species have been recorded. In the agricultural and village areas, *B. haemorrhoidalis*, *B. montivagus* and *B. breviceps* were recorded and it was observed that they visited agricultural crops and ornamental plants in tourist areas in the National Park. In the reserved forests, two species were recorded in this survey, *B. eximius* and *B. rotundiceps*. Native plants including *Hypericum hookerianum*, *Rubus chevalieri* and *Saurauia napaulensis* have been observed as food plants of *B. eximius*. A new record for *B. rotundiceps* is the first in nearly 60 years in Thailand, since the previous record published by Sakagami and Yoshikawa in 1961. Nevertheless, two other previously recorded species, *B. flavescens* and *B. bellardii,* were not seen during the survey.

We have also made a preliminary survey of the diversity of bumblebees in Myanmar. A high diversity of bumblebees has been found there. Our team has expanded to include Dr Hliang Minoo (University of Veterinary Science, Yezin, Myanmar) and Dr Johan Tial Cung Ling (Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, China) who are joining our group this year.

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Bombus breviceps on Crotalaria juncea which local people planted for soil improvement in Ban Khun Wang, Doi Inthanon, Chiang Mai, Thailand. (Photo by Chawatat Thanoosing.)

Bombus montivagus visited ornamental plants, Salvia splendens in the Royal Agricultural Station Inthanon, Chiang Mai, Thailand. (Photo by Chawatat Thanoosing.)

Bombus eximius on a Saurauia napaulensis flower at the summit of Doi Inthanon (at 2565 m), Chiang Mai, Thailand. (Photo by Chawatat Thanoosing.)

A male B. rotundiceps was collected during the survey at Doi Inthanon, Chiang Mai, Thailand. (Photo by Chawatat Thanoosing.)

Bumblebee on Roscoea cautleoides flower at the border of Myanmar and China. (Photo by Johan Tial Cung Ling.)

THE BBSG IN 2020

We are making progress with species assessments in some regions of the world, but much remains to be done, especially in the most species-rich regions, in Asia. 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. As ever, let us know what you need and we will try to find a way to help.

London 16 March 2020