

INTERPACIAL INTERNACIAL INTERNAL INTERN

INTERACT Stations

- 1 Sverdrup Research Station
- 2 Netherlands' Arctic Station
- 3 UK Arctic Research Station
- 4 CNR Arctic Station "Dirigibile Italia"
- 5 Czech Arctic Research Station of Josef Svoboda
- 6 Polish Polar Station Hornsund
- 7 Finse Alpine Research Centre
- 8 Bioforsk Svanhovd Research Station
- 9 Svartberget Research Station
- 10 Tarfala Research Station
- 11 Abisko Scientific Research Station
- 12 Kilpisjärvi Biological Station
- 13 Kevo Subarctic Research Station
- 14 Värriö Subarctic Research Station
- 15 Pallas-Sodankylä Stations
- 16 Kolari Research Unit
- 17 Oulanka Research Station
- 18 Kainuu Fisheries Research Station
- 19 Hyytiälä Forest Research Station (SMEAR II)
- 20 Alpine Research and Education Station Furka
- 21 Station Hintereis
- 22 Sonnblick Observatory
- 23 Krkonoše Mountains National Park
- 24 Karkonosze National Park
- 25 M&M Kłapa Research Station
- 26 Khibiny Educational and Scientific Station
- 27 Beliy Island Research Station
- 28 Labytnangi Ecological Research Station
- 29 Mukhrino Field Station
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- 31 Kajbasovo Research Station
- 32 Khanymey Research Station
- 33 Aktru Research Station
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- 35 Evenkian Field Station
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- 52 M'Clintock Channel Polar Research Cabins
- 53 Flashline Mars Arctic Research Station
- 54 Polar Environment Atmospheric Research Laboratory
- 55 CEN Ward Hunt Island Research Station
- 56 CEN Bylot Island Field Station
- 57 Igloolik Research Center
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- 59 CEN Boniface River Field Station
- 60 CEN Umiujag Research Station
- 61 CEN Whapmagoostui-Kuujjuarapik Research Station
- 62 CEN Radisson Ecological Research Station
- 63 CEN Clearwater Lake Research Station
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- 65 Labrador Institute Research Station
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INTERACT is a circumarctic network of terrestrial field bases in Arctic, alpine and neighbouring forested areas. The network is funded for 2011-2015 by EU's Seventh Framework Programme as "Integrating Activity" under the theme "Research Infrastructures for Polar Research".

INTERACT has an overarching concept of strategically sampling the great environmental variation throughout northern areas. This concept is illustrated in the graphic below which shows the location of the **INTERACT** Stations within environmental space, defined by temperature and precipitation ranges. Much of research within this book seeks to understand how this environmental space is changing.

Mean annual air temperature (°C)









INTERACT Stories of Arctic Science

Editors: Terry V. Callaghan Hannele Savela

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Edited by: Terry V. Callaghan^{1,2,3} & Hannele Savela⁴

Reviewers: Elmer Topp-Jørgensen⁵, Margareta Johansson¹, Kirsi Latola⁴, Morten Rasch⁶ & Luisella Bianco⁷

- ¹ The Royal Swedish Academy of Sciences
- ² University of Sheffield, UK
- ³ Tomsk State University, Russian Federation
- ⁴ Thule Institute, University of Oulu, Finland
- ⁵ Department of Bioscience, Aarhus University, Denmark
- ⁶ Department for Geosciences and Natural Resource Management, University of Copenhagen, Denmark
- ⁷ CLU, Italy

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Consequence of climate change on the fate of Arctic-alpine bumblebees

Baptiste Martinet, Nicolas Brasero, Syndonia Bret-Harte & Pierre Rasmont

Wild bees are important pollinators of both domestic and wild plants, and are suffering from a dramatic decline in both diversity and abundance around the world. While much of their decline is likely due to reductions in their habitat caused by human activities, climate warming is likely to pose another challenge to wild bees, especially bees that live in Arctic and alpine regions. The Arctic is warming faster than any place on Earth, and current alpine habitats are decreasing in size as warming moves the environmental envelope up the mountains to higher elevations and into progressively smaller areas. Thus, Arctic and alpine bees may be especially at risk. To better conserve wild bees that live in Arctic and alpine areas, we need to know their current population status, and also how they will respond to climate warming.

At present, bumblebees are the only type of bees that are abundant in Arctic and alpine areas. These robust, hairy, and social bees show adaptations that allow them to regulate their body temperature and thrive in the coldest areas of the world that are inhabited by insects. Also, they are major pollinators in cold regions. The Alpinobombus sub-genus of bumblebees, the focus of our study, is one of the largest and most threatened sub-genera of Arctic and alpine bumblebees and has members around the circumpolar Arctic. Yet, even within this sub-genus, our prior results in Europe indicate that some Alpinobombus species are very threatened (e.g. Bombus polaris), while others are not (e.g. B. balteatus). In order to better characterize the phylogeny (genetic relationships) of these bees and their need for conservation, and to assess their physiological response to climate warming, we needed to collect bees from around the Arctic. This led us to request a Transnational access award through INTER-ACT, which brought us to the Tarfala and Abisko stations in Sweden, and Toolik Field Station in Alaska, USA.

AIMS OF THE PROJECT

Our goal was to collect living bumblebees from as many species as possible from different parts of the Arctic to clarify their phylogenetic relationships, and test their responses to climate change over both short and long time horizons.

WHAT DID WE DO?

We collected male bumblebees of as many species as possible, and a few females to establish captive breeding colonies, from each Arctic site. We collected mostly males to avoid decreasing the bee populations, because there are more males than needed for breeding. Back in the laboratory in Belgium, genetic and chemical analyses will be run on the males, and morphological features (aspects of body shape) will be measured. These data will help in defining the phylogenetic relationships between the species. Also, experiments to measure bumblebee response to heat stress in the short-term will be run. Correlations between species distribution, density, and climate data over the last 200 years will be used to assess long-term changes in bumblebee species and the need for conservation.

WHERE DID WE WORK?

In our prior work (including support from INTERACT), we had collected samples from several places in the European alpine and Arctic, including the Alps, the Pyrenees, and the Apennine Mountains, and from northern Sweden, northern Finland, and northern Norway. However, we did not have any samples from the North American Arctic. Although bumblebee species are assumed to have

Scenery at Toolik Fiels Station Nikolds Braserot

Conservation status of the 68 European bumblebee species (From Rasmont, Roberts & Michez, 2014).



a pan-Arctic distribution, this had not

been verified. Thus, we went to the Toolik Field Station (•48), in the Alaskan Arctic, to collect bumblebees from a part of the Arctic that has not been explored (with respect to bees).

WHAT DID WE FIND?

Of the five Alpinobombus species that are thought to occur in Alaska, we were able to collect multiple individuals of three species at Toolik Field Station (see the table below). We also collected numerous individuals (264) of other sub-genera of bumblebees, for a total of 10 species (see the table below). This is a very high diversity of bees in such a small area. Two species that we collected (*Bombus hyperboreus* and *B. polaris*) have the IUCN (International Union for Conservation of Nature) status of "vulnerable" in Europe. These bees will greatly expand our knowledge of bee diversity and the genetic, chemical and morphological characteristics of these species across the Arctic.

WHY ARE THE RESULTS IMPORTANT?

It is generally assumed that Arctic bumblebee species occur throughout the entire circumpolar Arctic. Thus, a species that is endangered in one part of the Arctic could theoretically find a refuge in another part. However, the distinction between Arctic bumblebee species is presently based largely on morphological characters, and it is possible that there may be a lot of genetic variation between individual local populations in the Arctic. This could change our concepts of what units (species vs. populations) are appropriate for conservation. Our work will allow us to distinguish between these alternatives, and assist in international bee conservation.

THE ADVENTURE

Two Belgian guys (Nicolas and Baptiste) working on the systematics and ecology of bumblebees in the Zoology Laboratory of the University of Mons in Belgium flew for more than 15 hours from Brussels via Chicago and Anchorage. The cold and windy weather reminded us that we were in Alaska. After few hours, a pickup took us to the Toolik Field Station. The landscape was awesome, nothing on the horizon except the distant mountains and Arctic tundra out of sight. At the Toolik Field Station we were warmly welcomed by Chad Diesinger, the facility supervisor. It was really impressive to see the logistics (accommodation, food, equipment) of this isolated station. The ambiance and work atmosphere of the station were very nice, a well-organized community in the middle of nowhere!

The most annoying and discomforting thing was the presence of lots of mosquitoes everywhere surrounding the station, which was surprising for August. But what would we not do to help science progress!



Distribution map of some European Arctic and Arctic-alpine Alpinobombus (bumblebee) species: Red dots: records before 1950, yellow dots: records from1950 to 1990; green dots: records since 1990 (From Rasmont and others 2015).



(a) Bombus hyperboreus and (b) Bombus jonellus (Pierre Rasmont).

Таха	Collecting sites	Males	Females
Bombus hyperboreus	Toolik Field Station	4	0
Bombus neoboreus	Toolik Field Station	13	0
Bombus polaris	Toolik Field Station	27	3
Bombus rufocinctus	Toolik Field Station	1	0
Bombus centralis	Fairbanks	8	1
Bombus flavifrons	Toolik Field Station	5	5
Bombus jonellus	Toolik Field Station	50	35
Bombus melanopygus	Toolik Field Station	5	0
Bombus sylvicola	Toolik Field Station	68	37
Bombus flavidus	Toolik Field Station	2	0
		TOTAL · 264	

Bumblebees collected near Toolik Field Station, Alaska in summer 2014.

Further information

Baptiste Martinet¹, Nicolas Brasero¹, Pierre Rasmont¹ & Syndonia Bret-Harte²

¹ University of Mons, Belgium, ² University of Alaska Fairbanks, USA

Contact: pierre.rasmont@umons.ac.be

Rasmont, P., Franzen, M., Lecocq, T. and others 2015. Climatic Risk and Distribution Atlas of European Bumblebees. Sofia: Pensoft, 236p.

INTERACT

International Network for Terrestrial Research and Monitoring in the Arctic

INTERACT is a circumarctic network of more than 75 terrestrial field bases in Arctic, alpine and neighbouring forest areas.

The main objective of INTERACT is to provide a circumarctic platform for identifying, understanding, predicting and responding to current environmental changes that take place in the Arctic and neighbouring areas. The INTERACT stations host over 5,000 researchers annually, facilitating toplevel research and monitoring programmes within a wide range of scientific disciplines from natural sciences to the human dimension.

The book takes the reader on a journey through the Arctic and neighbouring alpine and forest areas, and reveals the excitement and adventure that the researchers both enjoy and endure. The book consists of seven highly illustrated sections focusing on landscape-forming processes, glaciers and permafrost environments, ground processes that store and release greenhouse gases, the ecology of land and freshwater, and the Peoples of the Arctic. These topics are all interconnected and together contribute to the "Arctic System" – a system of great importance to the global community but one that is changing dramatically.

Let's INTERACT

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