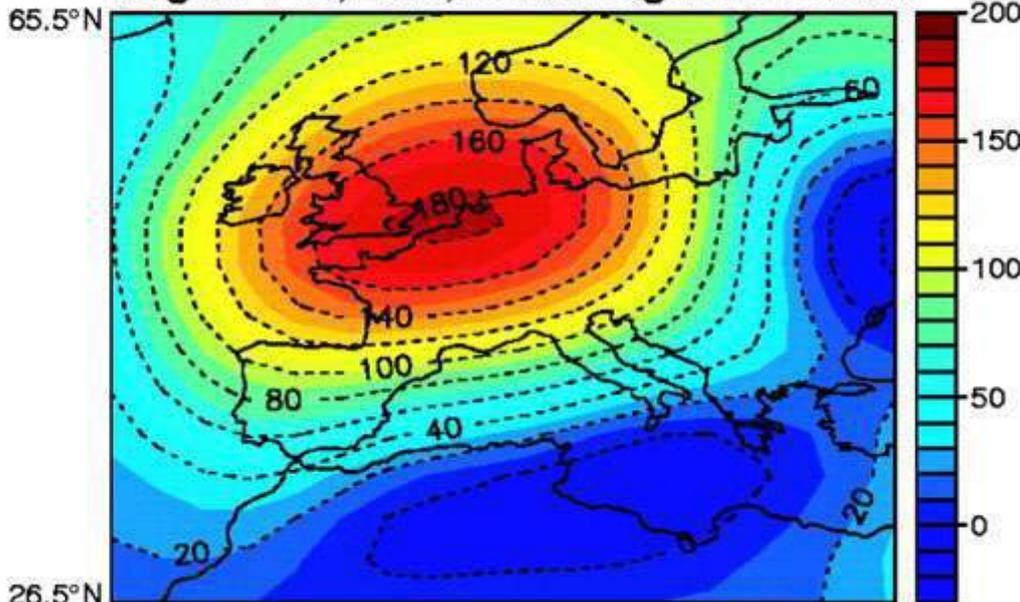


B Observed Heat Wave 500hPa Height Anomalies
August 1-13, 2003, minus August 1948-2003



Modelized frequency of heat waves 1948-2003

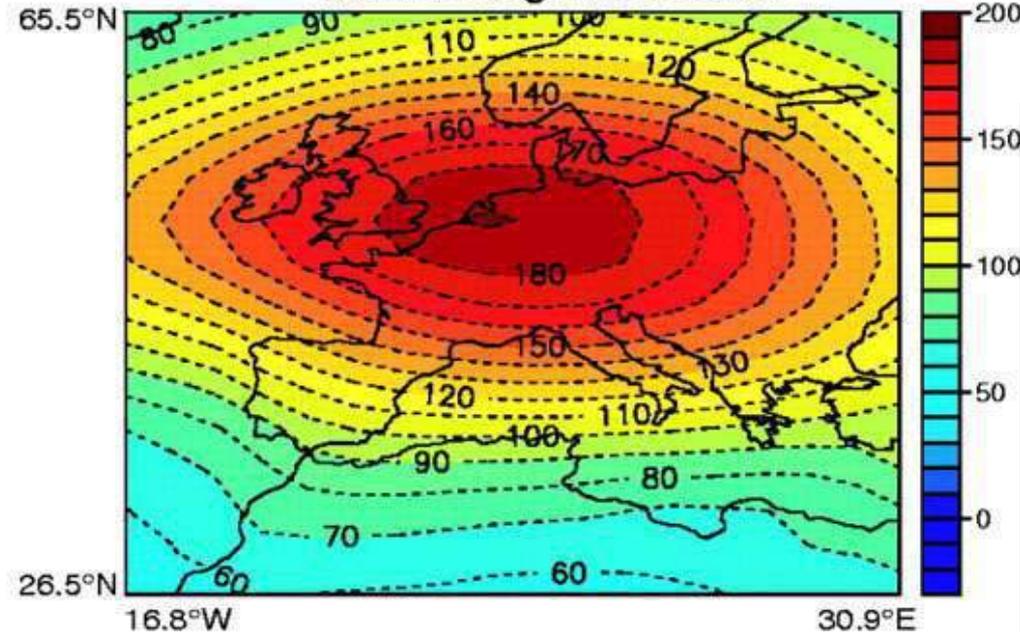
Downloaded from www.sciencemag.org on September 2, 2010

More Intense, More Frequent, and Longer Lasting Heat Waves in the 21st Century

Gerald A. Meehl* and Claudia Tebaldi

A global coupled climate model shows that there is a distinct geographic pattern to future changes in heat waves. Model results for areas of Europe and North America, associated with the severe heat waves in Chicago in 1995 and Paris in 2003, show that future heat waves in these areas will become more intense, more frequent, and longer lasting in the second half of the 21st century. Observations and the model show that present-day heat waves over Europe and North America coincide with a specific atmospheric circulation pattern that is intensified by ongoing increases in greenhouse gases, indicating that it will produce more severe heat waves in those regions in the future.

B Simulated Future Heat Wave
500 hPa Height Anomalies



The future is worrying !

Modelized frequency of heat waves in the Future



Bumble bees represent one of the most important groups of pollinators. In addition to their ecological and economic relevance, they are also a highly charismatic group which can help to increase the interest of people in realizing, enjoying and conserving natural systems. However, like most animals, bumble bees are sensitive to climate. In this atlas, maps depicting potential risks of climate change for bumble bees are shown together with informative summary statistics, ecological background information and a picture of each European species.

Thanks to the EU FP7 project STEP, the authors gathered over one million bumblebee records from all over Europe. Based on these data, they modelled the current climatic niche for almost all European species (56 species) and projected future climatically suitable conditions using three climate change scenarios for the years 2050 and 2100. While under a moderate change scenario only 3 species are projected to be at the verge of extinction by 2100, 14 species are at high risk under an intermediate change scenario. Under a most severe change scenario as many as 25 species are projected to lose almost all of their climatically suitable area, while a total of 53 species (77% of the 69 European species) would lose the main part of their suitable area.

Climatic risks for bumblebees can be extremely high, depending on the future development of human society, and the corresponding effects on the climate. Strong mitigation strategies are needed to preserve this important species group and to ensure the sustainable provision of pollination services, to which they considerably contribute.



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On the front cover:
Bombus hyperboreus, an Arctic bumblebee species that is threatened by global warming
© Photo: Goran Holmström

Climatic Risk and Distribution Atlas of European Bumblebees



Pierre Rasmont
Markus Franzén
Thomas Lecocq
Alexander Harpke
Stuart P.M. Roberts
Kees Biesmeijer
Leopoldo Castro
Björn Cederberg
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Simon G. Potts
Menno Reemer
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Jakub Straka
Oliver Schweiger



BioRisk 10
Special Issue





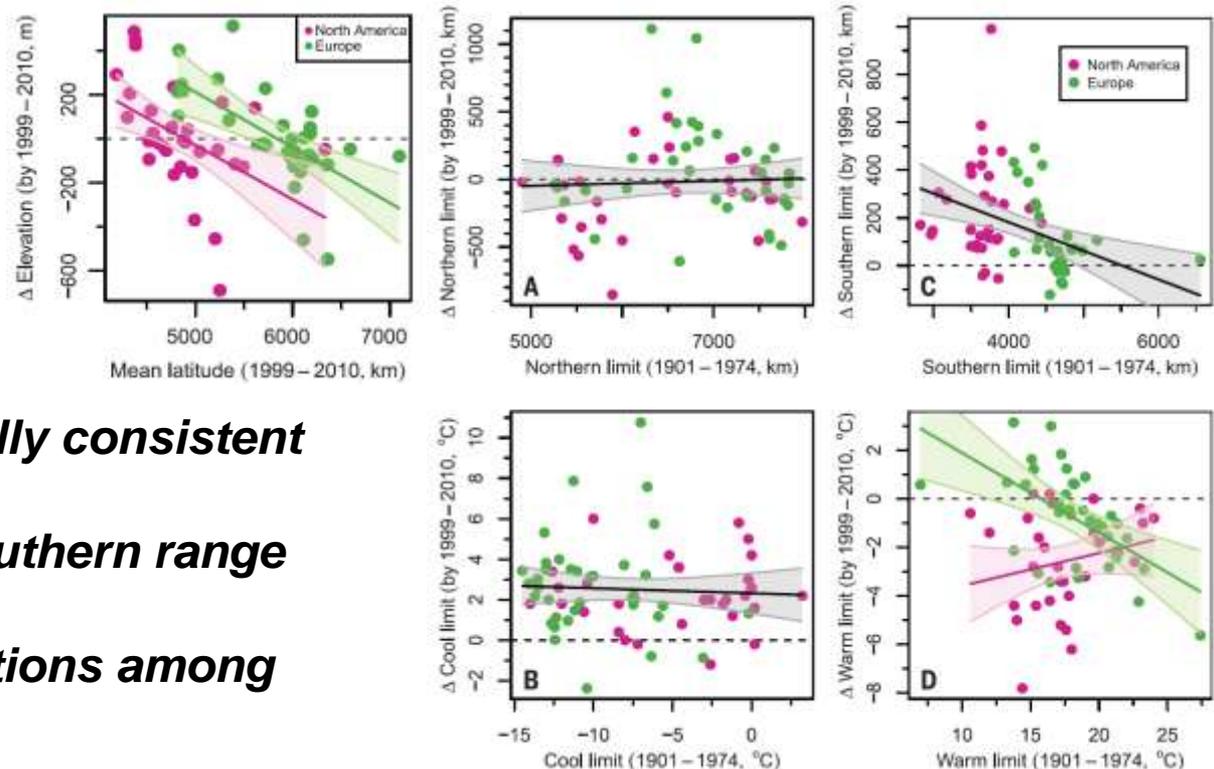
Climate change impacts on bumblebees converge across continents

J. T. Kerr, A. Pindar, P. Galpern, L. Packer, S. G. Potts, S. M. Roberts, P. Rasmont, O. Schweiger, S. R. Colla, L. L. Richardson, D. L. Wagner, L. F. Gall, D. S. Sikes, A. Pantoja.

Long-term observations across Europe and North America over 110 years.

Found cross-continentally consistent trends in :

- range losses from southern range limits;
- shifts to higher elevations among southern species.



With climate change, most species distributions will shift toward the North....



Pierre Pasmo

Bombus terrestris

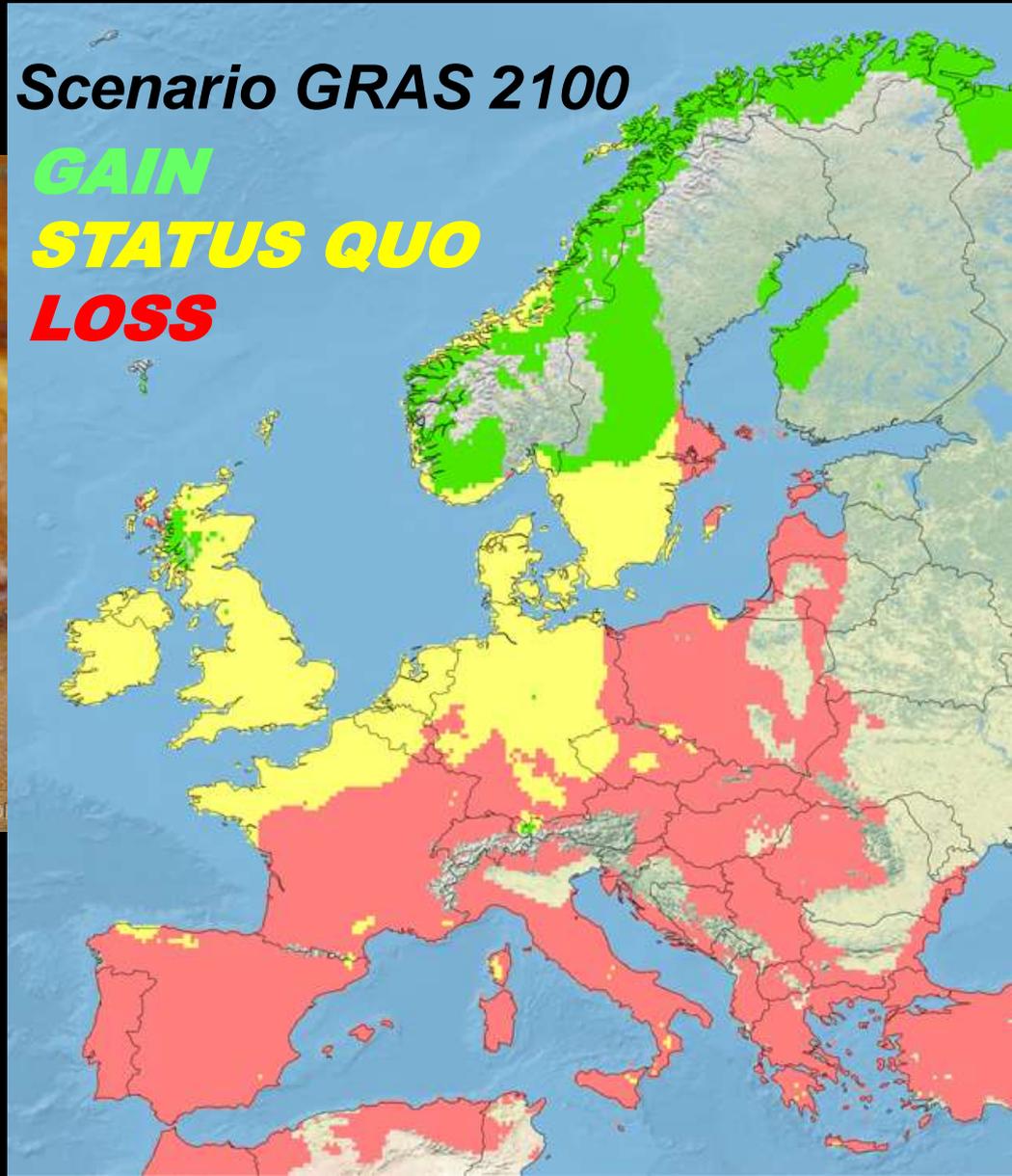
Rasmont et al. 2015

Scenario GRAS 2100

GAIN

STATUS QUO

LOSS



While most northern species will very likely vanish...



Bombus hyperboreus

Rasmont et al. 2015



A very small number of species will take advantage of climate change to expand their distribution....



Bombus argillaceus

Rasmont et al. 2015



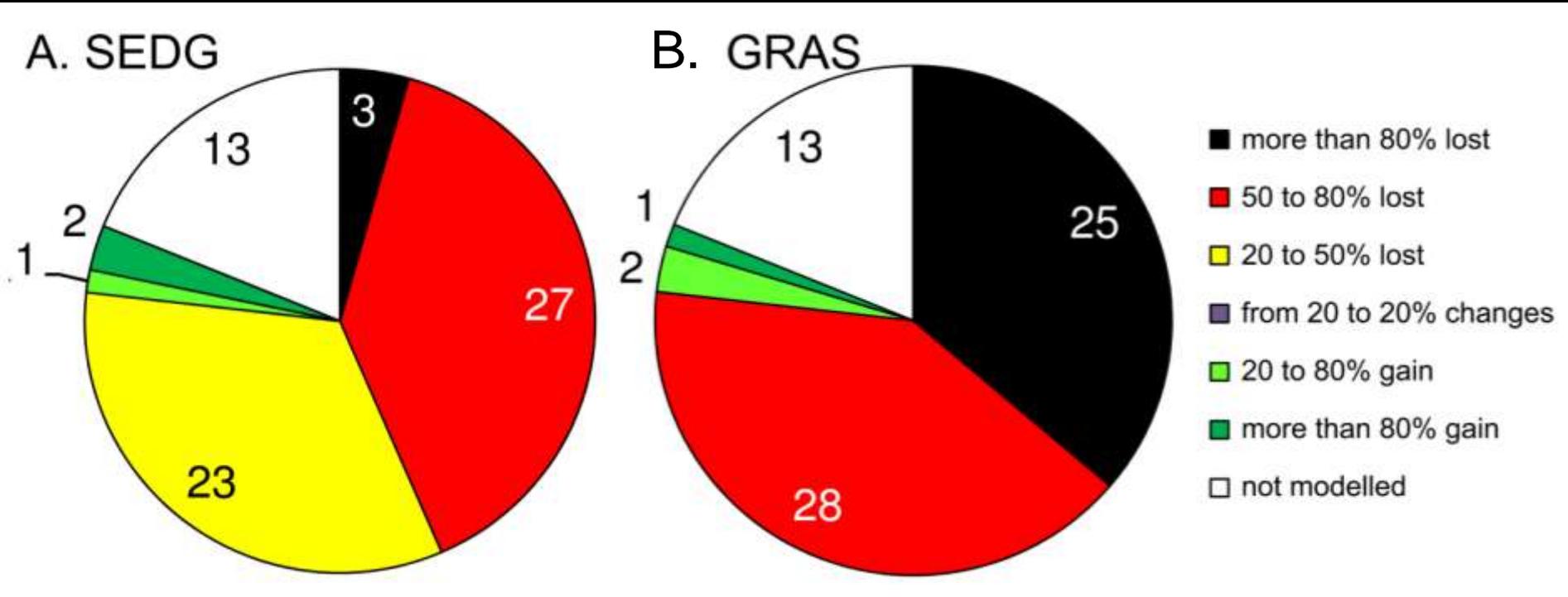
To summarize the situation...

In any cases, the projection appears dramatic.

At best

At worst

Rasmont et al. 2015

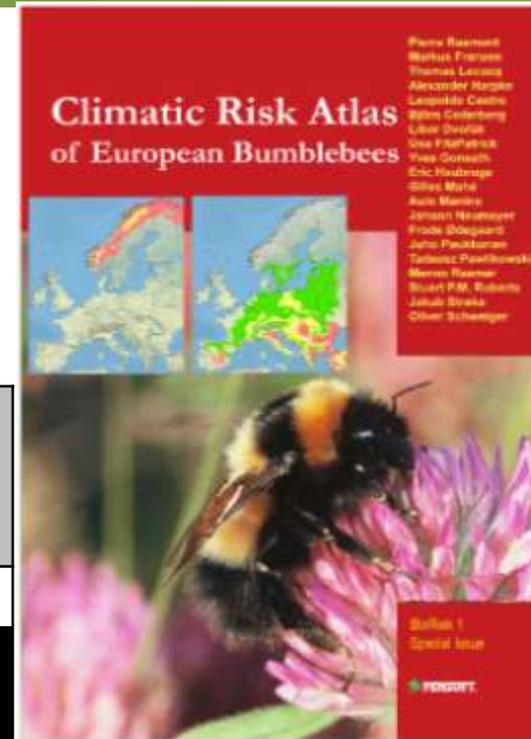


Projected fate of European bumblebee species in 2100



Climatic Risk Atlas of European Bumblebees

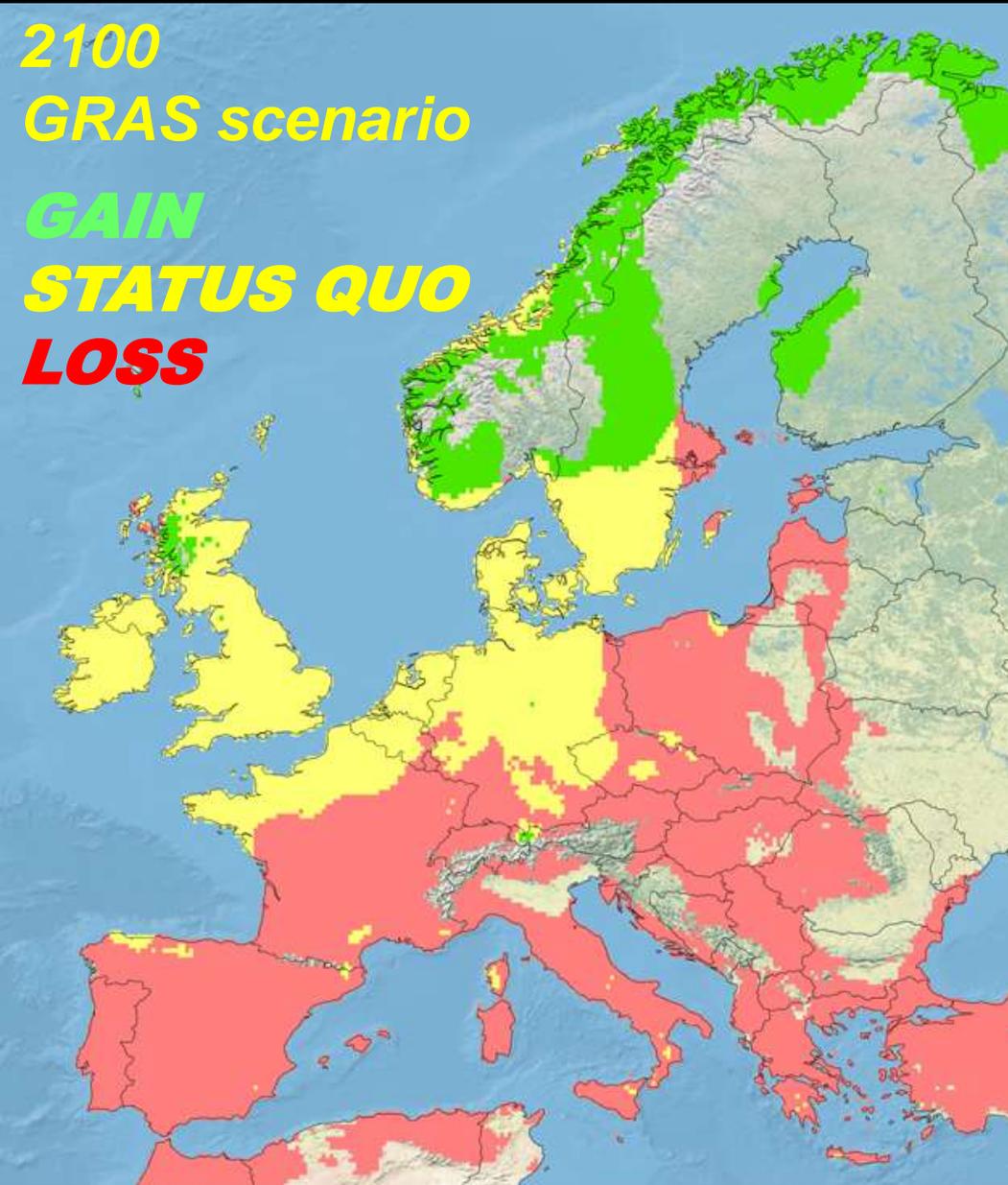
City surroundings



Rasmont *et al.* 2015

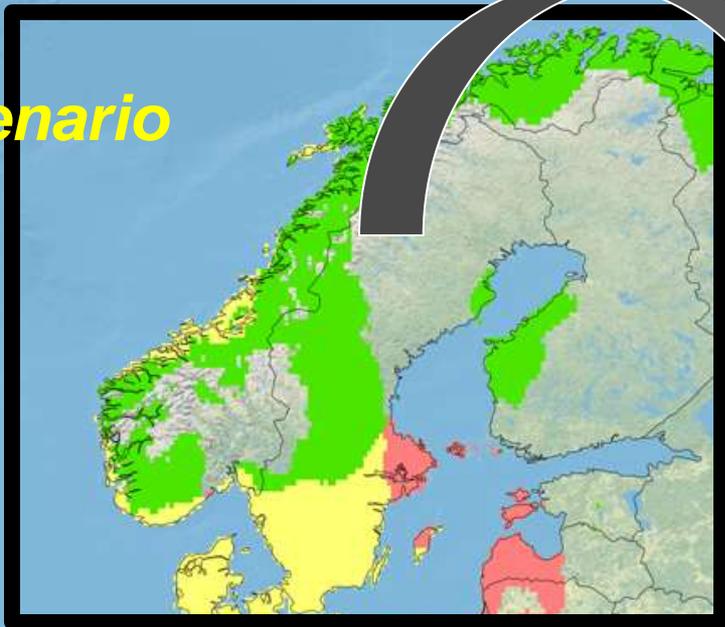
City	Present Actual sp. Nb	2100 % remaining	
		Best	Worst
Narvik	23	117.1	100.0
Stockholm	26	29.0	3.2
Berlin	16	37.9	17.2
London	25	39.1	17.4
Brussels	29	41.7	8.3
Paris	18	50.0	10.0
Bordeaux	5	37.5	0.0
Mont-Louis	35	104.8	73.8
Granada	9	25.0	2.5
...
Median	23	46.23	10.3



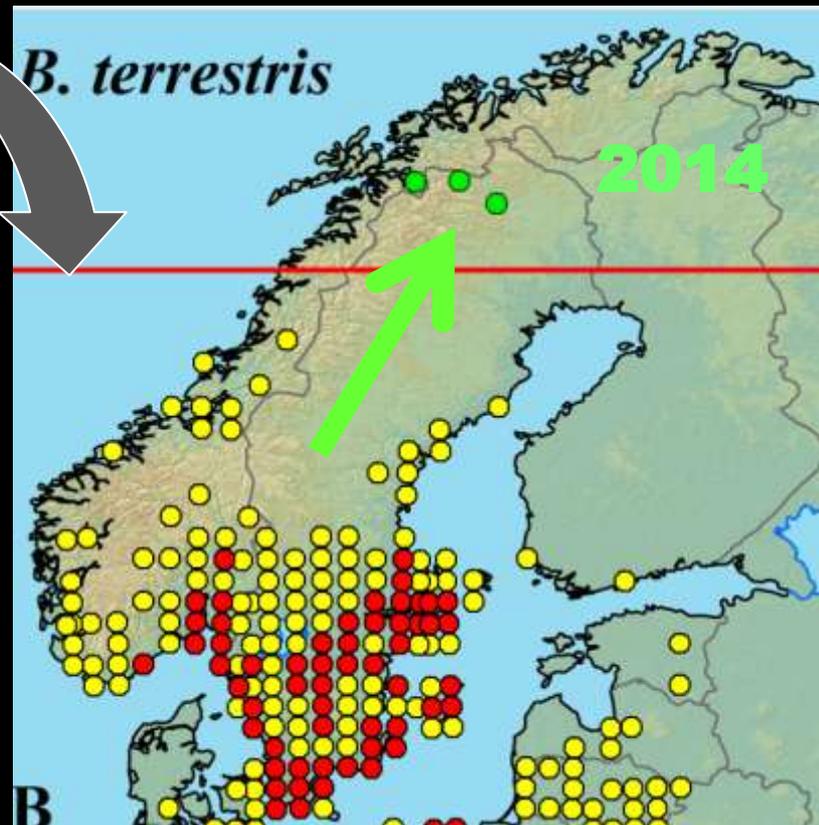


Projected area shift of *Bombus terrestris*

2100
GRAS scenario



B. terrestris



The change is already
on the move!

Martinet et al., 2016

Projected area shift of *Bombus terrestris*

Competition between arctic wildlife and new southern species

Norvège, Narvik, 1000 m asl



B. polaris



Martinet et al., 2016

Competition between arctic wildlife and new southern species

Norvège, Narvik, 1000 m asl



B. polaris



B. terrestris



Competition between arctic wildlife and new southern species

Norvège, Narvik, 1000 m asl

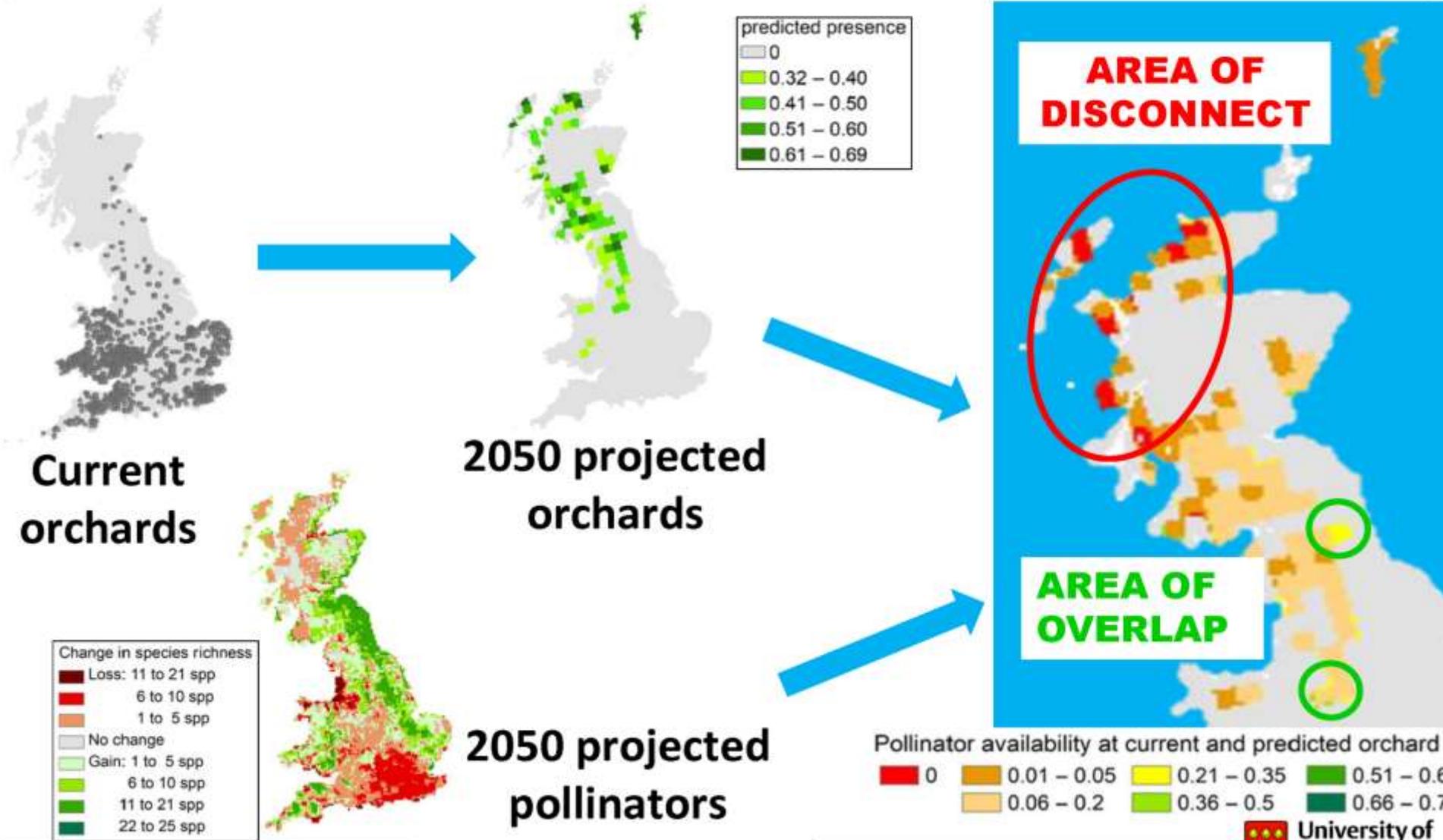


B. terrestris



Martinet et al., 2015

Orchards under climate change



We should reassess our present "Nature Conservation paradigm", mainly based on sanctuarising Natural Areas.

It should be replaced by a dynamic paradigm, with two very different concerns:

- Trailing edge conservation

How to maximize the survival of non-moving species in their original areas ?

- Leading edge conservation

How to manage the move of species toward their new areas ?

The trailing edge conservation is likely not very different from the present policy.

However, it should focus on microclimatic areas.

Such areas could play a "Noah's Arch" role for recovering the species AFTER the climatic crisis.



Figure 13.6 The Forêt de la Sainte-Baume, near Marseille (Photo Georges Millet). On the right, the canopy of the beech forest sheltered by the cliff; on the left, the dry Mediterranean vegetation.

The leading edge conservation

Should DEEPLY questions our present management of "invasive taxa".

While most of our present bumblebee species will disappear from temperate countries they are projected to be replaced by species from Balkan or Near-Orient

Bombus argillaceus *Bombus haematurus* *Bombus niveatus*



The leading edge conservation

Should DEEPLY questions our present management of "invasive species".

Southern species are already arriving !

Large Carpenter bee
Xylocopa pubescens,
arriving from Africa
and presently
invading Greece.



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*Thanks for
your attention*