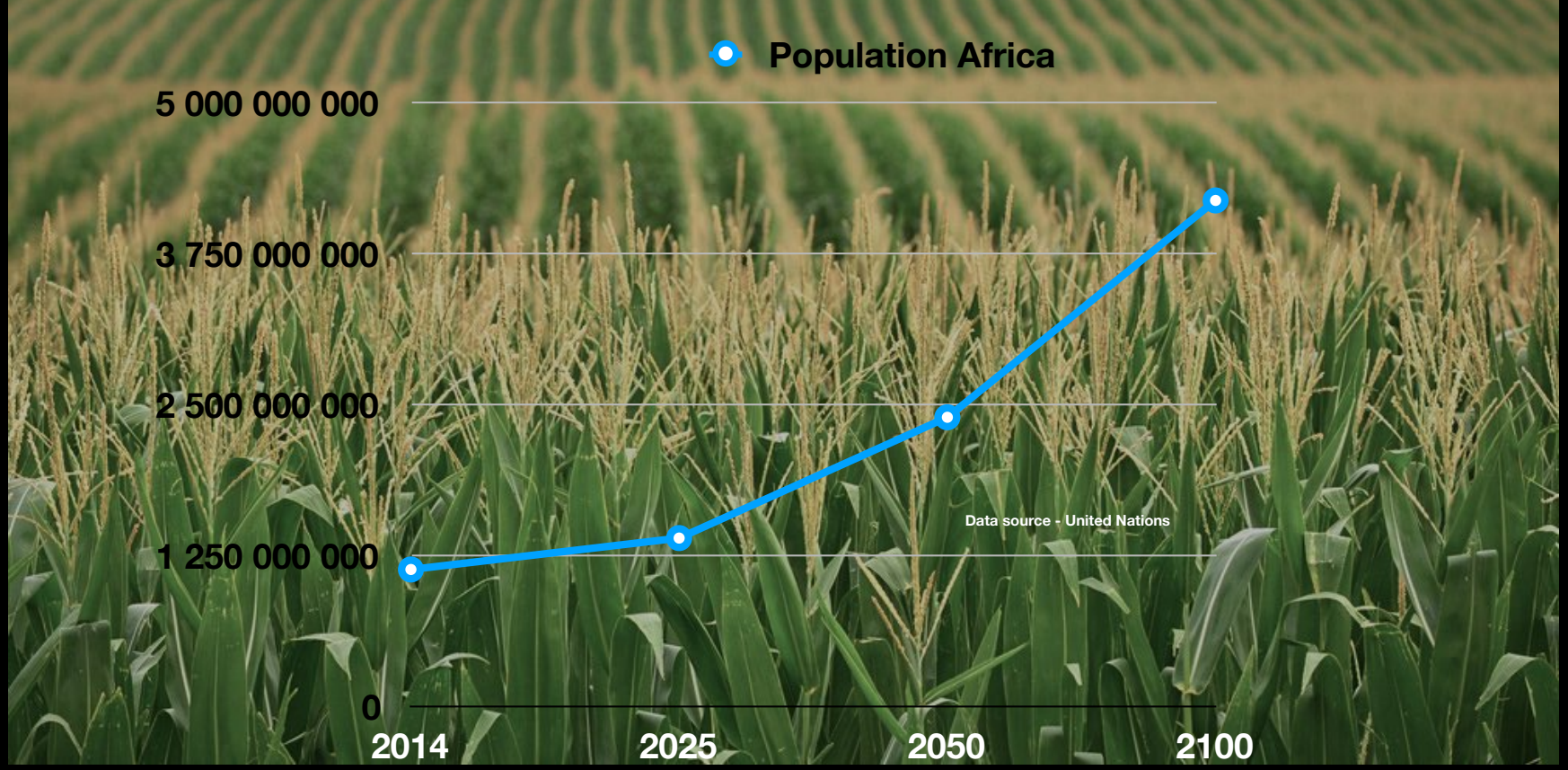
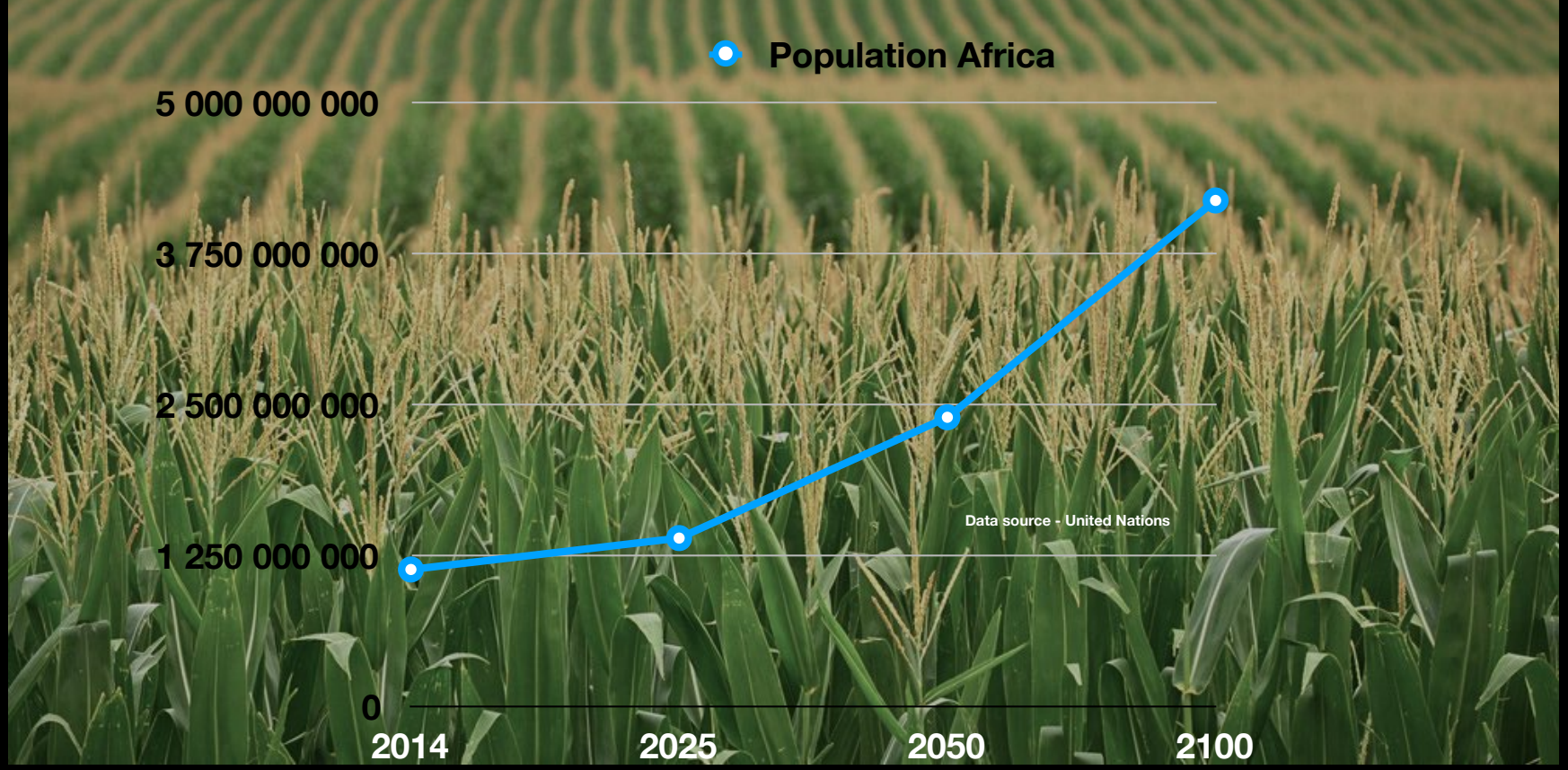
Neonicotinoids - Overview of general considerations specific to Africa

Christian Pirk


Population Africa
5 000 000 000
3 750 000 000
2 500 000 000
1 250 000 000
0
2014
2025
2050
2100
Data source - United Nations



More demand for pesticides and more demand for pollination/ honey bees

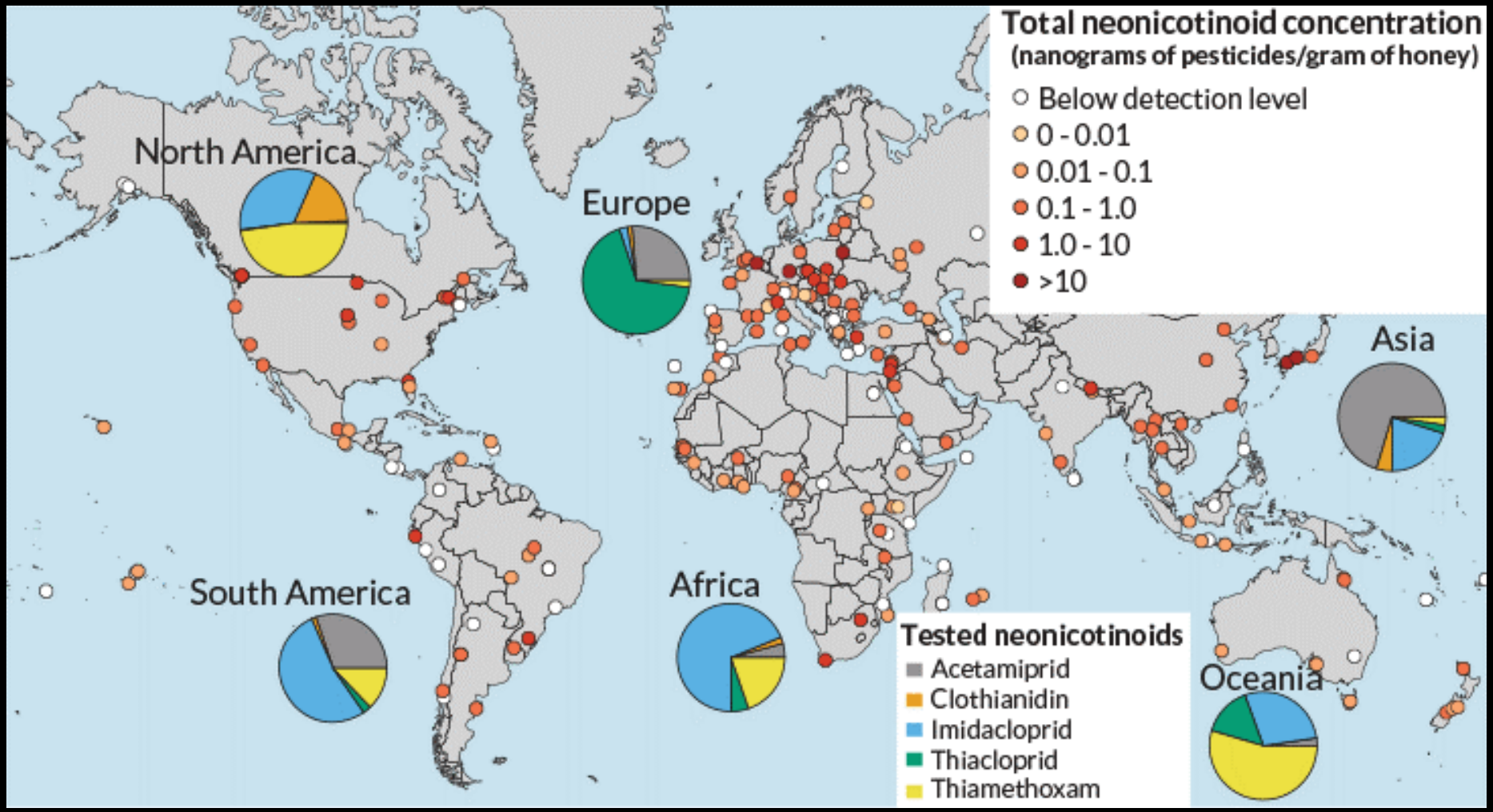
Pesticides South Africa

Over 105 neonicotinoid products

Insecticides South Africa

Over 130 imidacloprid products

Neonicotinoids in honey



subsistence beekeeping/ harvesting in Africa

Food webs- Insects as human food in Southern Africa

Legislation for the Use of Insects as Food and Feed in the South African Context

Saliou Niassy, Sunday Ekesi, Sheryl L. Hendriks, and Anjanette Haller-Barker

A. Halloran et al. (eds.), *Edible Insects in Sustainable Food Systems*,
https://doi.org/10.1007/978-3-319-74011-9_29

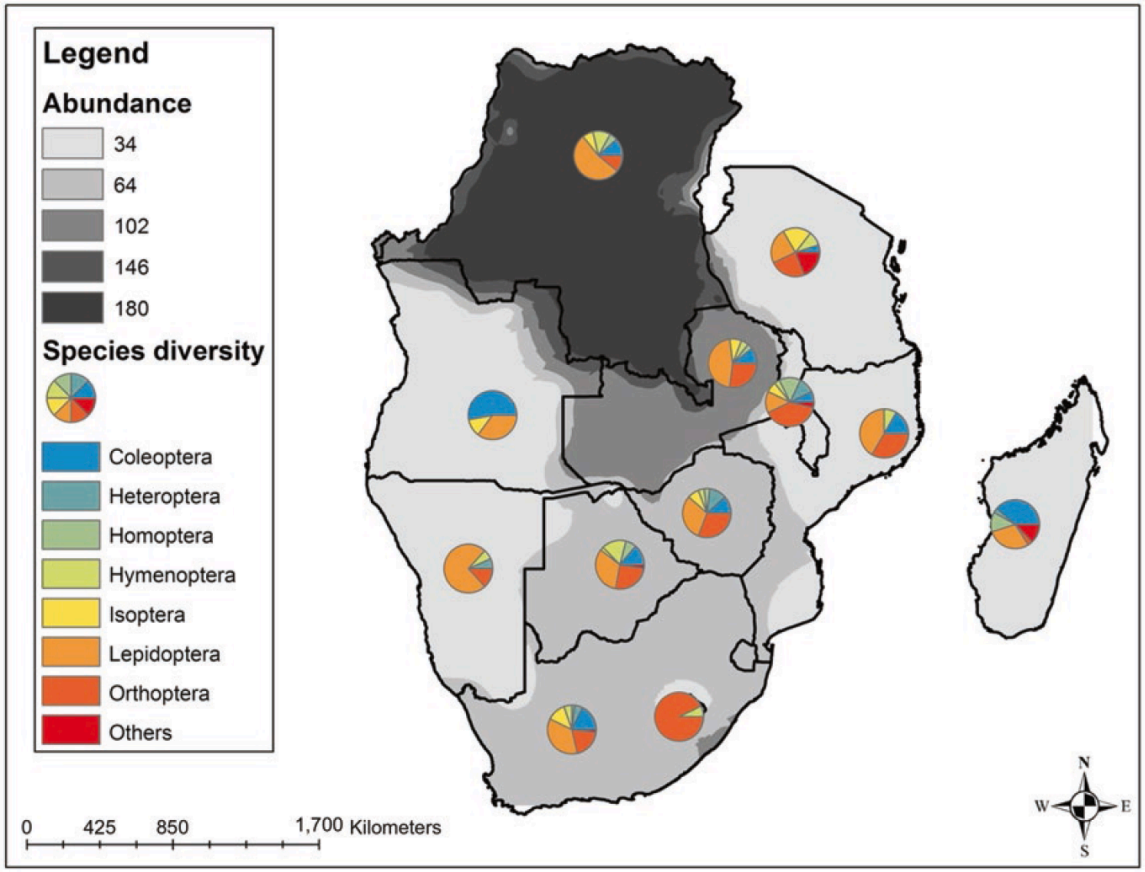
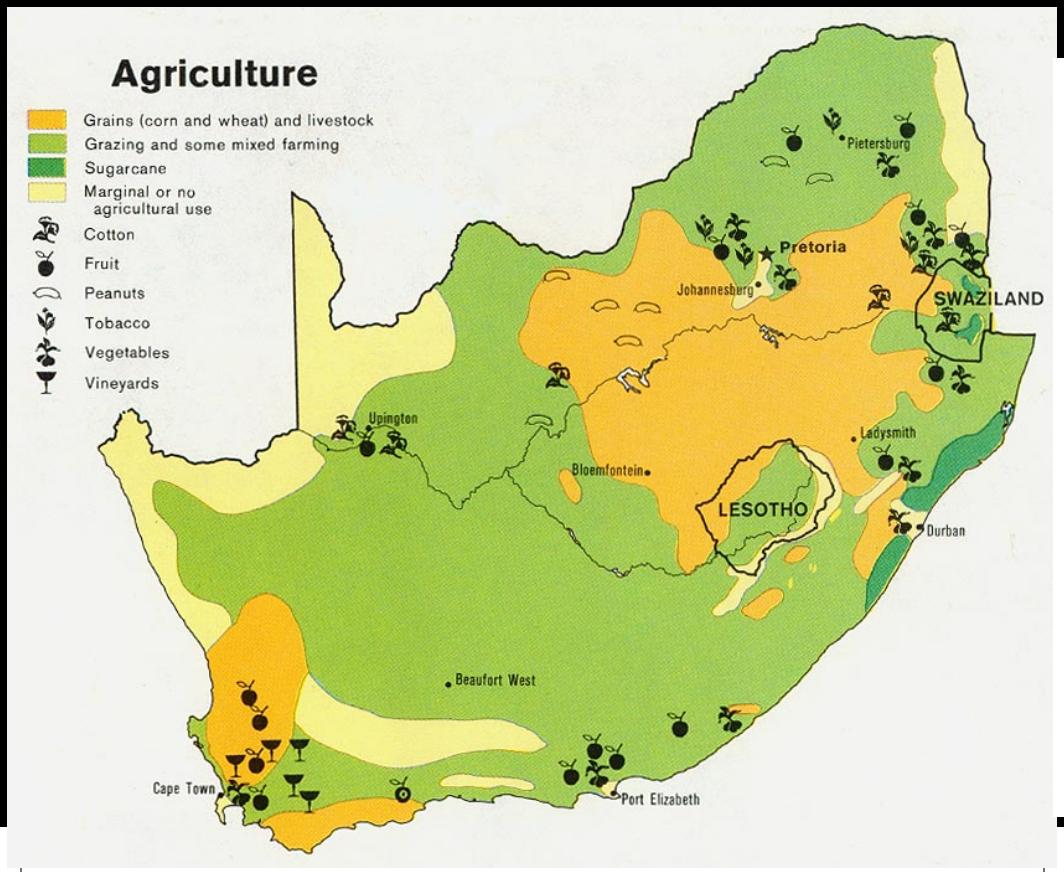
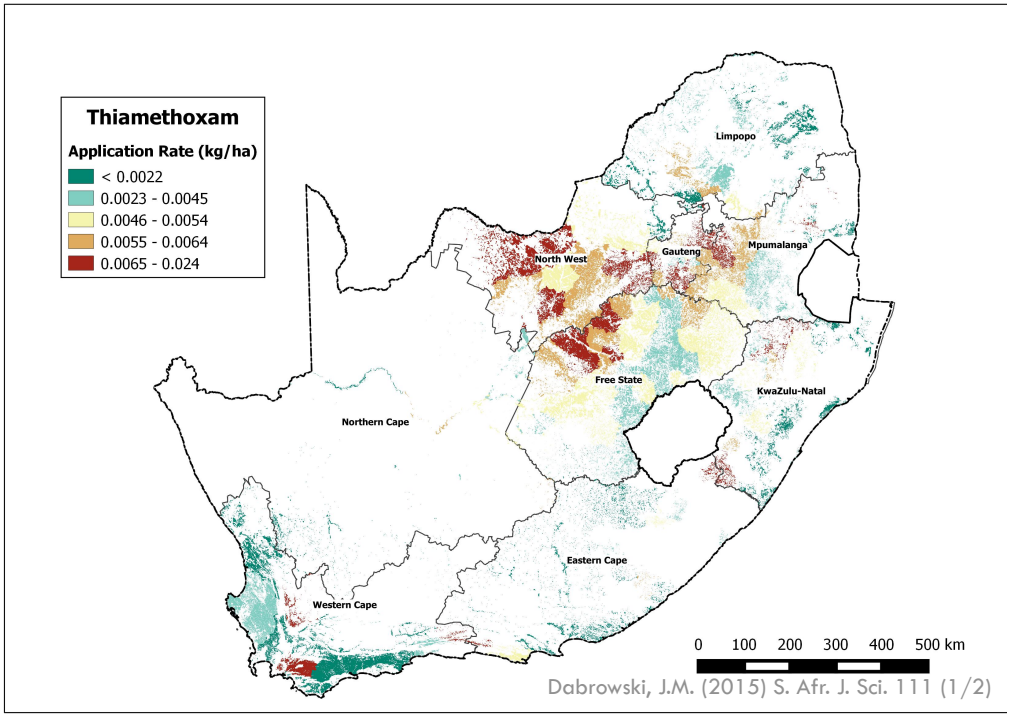
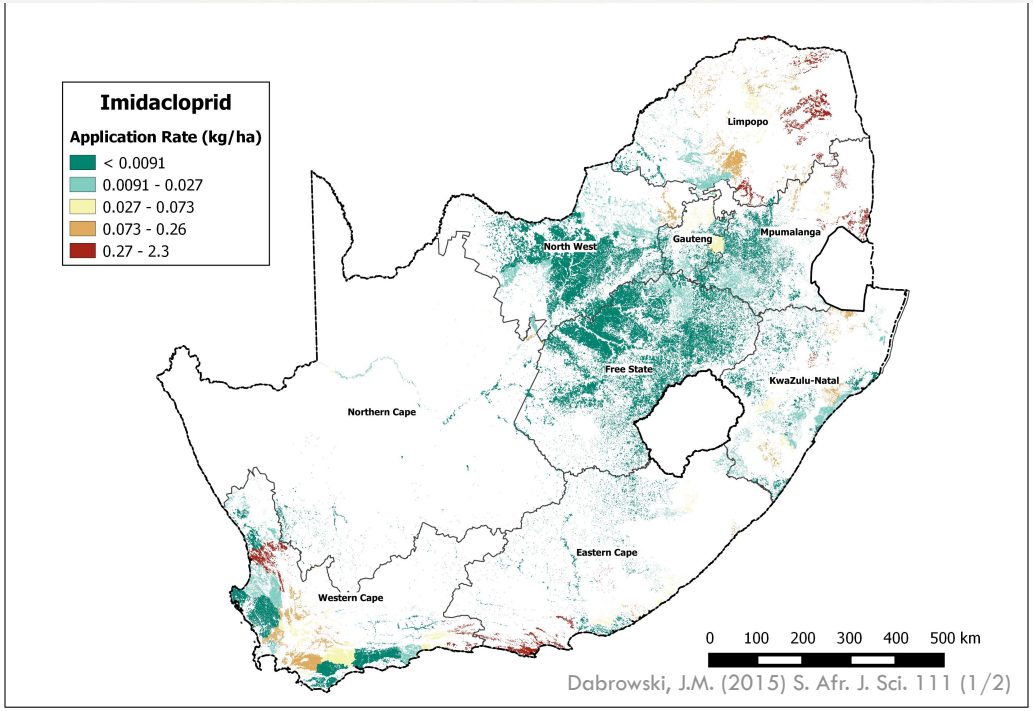


Fig. 2 Diversity and abundance of main groups of edible insects in southern Africa





Dabrowski, J.M. (2015) S. Afr. J. Sci. 111 (1/2)



Dabrowski, J.M. (2015) S. Afr. J. Sci. 111 (1/2)

Risk assessment data
From the EU and Australia

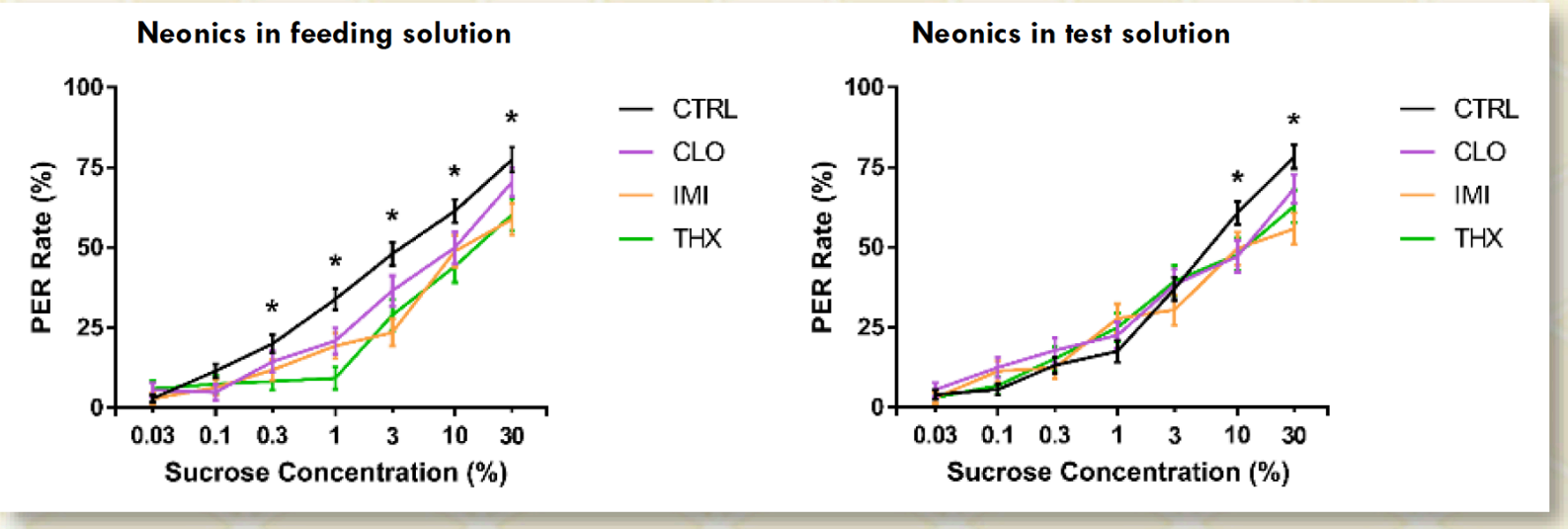
Lack of local RA studies

“Pesticide Act”
Act 36 of 1947

Effects of neonicotinoids on African bees

Honey bee sensitivity to sucrose

- In <u>both</u> cases, bees have **reduced sucrose responses.**
- Suggests bees cannot properly taste sugar, but **can taste** neonics.
- Bees encountering neonic treated crops for the first time may be biased regarding the actual quality of nectar, affecting foraging efficiency and overall pollination services.



Démares, F. *et al.* (2018) J. Insect Physiol. 108:25-30

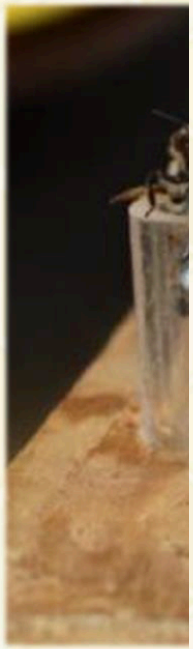
Additional effects of Thiamethoxam

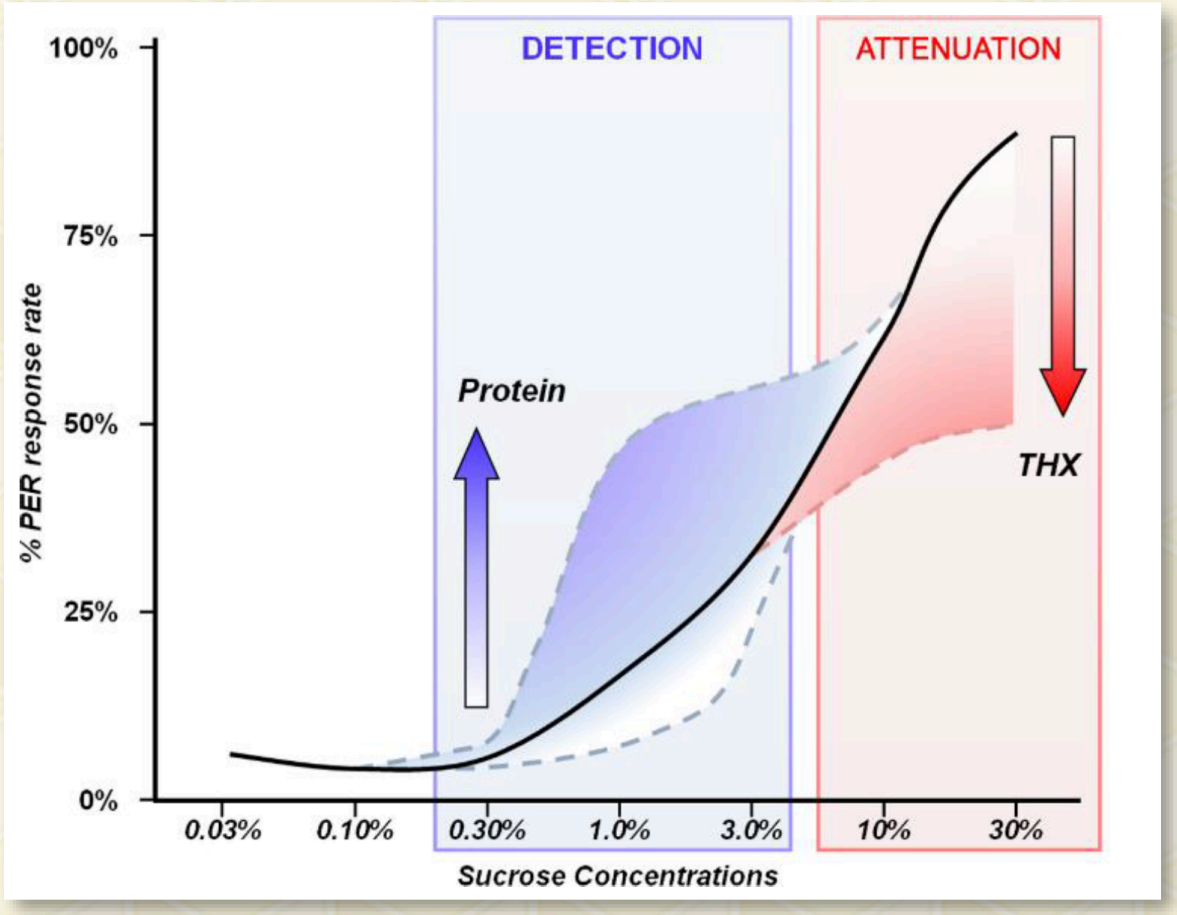
- Combined effect of one neonicotinoid (**THX**) and nutrition on bees:
  - Sucrose sensitivity (nectar).
  - Survival & nutrition – balanced *vs* unbalanced diets.

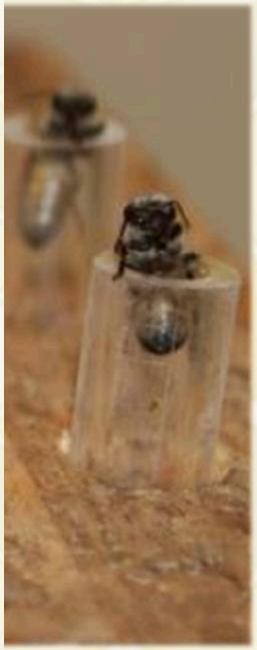
Démares, F. *et al.* (2016) PLoS ONE 11(6)

Additional effects of Thiamethoxam

- Combined effect of one neonicotinoid (**THX**) and nutrition on bees:
  - ► Sucr
  - ► Surv



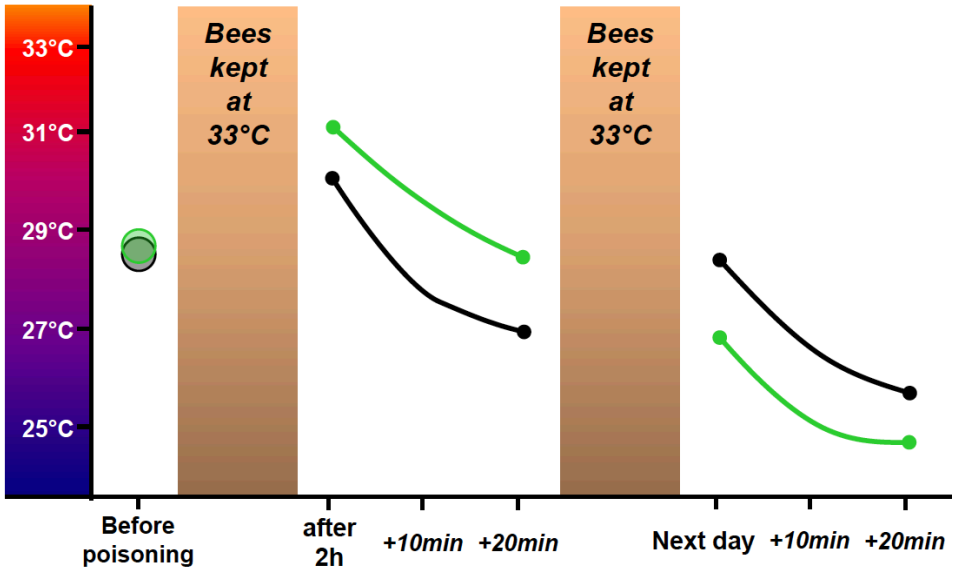


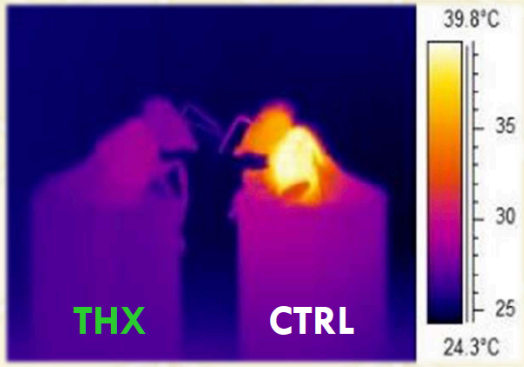


Démares, F. *et al.* (2016) PLoS ONE 11(6)

Démares, F. *et al.* (2016) PLoS ONE 11(6)

THX – effect on thermoregulation





- Biphasic effect of **THX** = **impairs** the ability to **regulate body temperature**

Tosi, S. *et al.* (2016) J. Insect Physiol. 93-94:56-63

Effects of neonicotinoids on African bees

Web of Science
Search “bees” & “neonicotinoid”

☐ USA (161)	☐ INDIA (7)	☐ IRAN (2)
☐ ENGLAND (120)	☑ EGYPT (6)	☐ PORTUGAL (2)
☐ GERMANY (62)	☐ FINLAND (6)	☐ SAUDI ARABIA (2)
☐ FRANCE (54)	☐ HUNGARY (6)	☐ UKRAINE (2)
☐ CANADA (52)	☐ IRELAND (6)	☑ ALGERIA (1)
☐ ITALY (48)	☐ TAIWAN (5)	☐ BELIZE (1)
☐ PEOPLES R CHINA (43)	☐ ARGENTINA (4)	☐ COSTA RICA (1)
☐ BRAZIL (34)	☐ GREECE (4)	☐ CROATIA (1)
☐ SPAIN (28)	☐ SLOVENIA (4)	☐ ESTONIA (1)
☐ SWITZERLAND (21)	☐ THAILAND (4)	☑ ETHIOPIA (1)
☐ NETHERLANDS (20)	☐ TURKEY (4)	☐ ISRAEL (1)
☐ BELGIUM (18)	☑ MALAWI (3)	☑ KENYA (1)
☐ SCOTLAND (16)	☐ MEXICO (3)	☐ NORTH IRELAND (1)
☐ AUSTRALIA (14)	☐ NORWAY (3)	☐ PAKISTAN (1)
☐ POLAND (14)	☐ AUSTRIA (2)	☐ SERBIA (1)
☐ JAPAN (13)	☐ CHILE (2)	☑ SUDAN (1)
☑ SOUTH AFRICA (10)	☐ CZECH REPUBLIC (2)	☐ URUGUAY (1)
☐ SWEDEN (8)	☐ DENMARK (2)	☐ WALES (1)

Pollinator studies

Table 2. The economic vulnerability to pollinator loss, as calculated by Gallai and colleagues (2009), is the ratio of the economic value of insect pollinators of the 100 most important commodity crops for human consumption to the total economic value of those crops. As in Gallai et al. (2009), regions with high vulnerability to pollinator loss (≥10%) are highlighted in bold. The number of papers refers to data-sets used in the meta-analyses, after duplicates were removed, from each geographic region.

Geographical region and sub-region (following FAO, <www.fao.org>)	Vulnerability of region	Number of papers contributed to meta-analyses
Africa		
Central Africa	7	1
East Africa	5	7
North Africa	**11**	**1**
South Africa	6	12
West Africa	**10**	**0**
Asia		
Central Asia	**14**	**0**
East Asia	**12**	**24**
Middle East Asia	**15**	**7**
Oceania	7	35
South Asia	6	8
South East Asia	7	21
Europe		
European Union (25 members)	**10**	**123**
Non EU25	**12**	**14**
North America		
Bermuda, Canada and USA	**11**	**171**
South and Central America		
Central America and Caribbean	7	58
South America	6	71

Africa 21

Urgent need for research in Africa

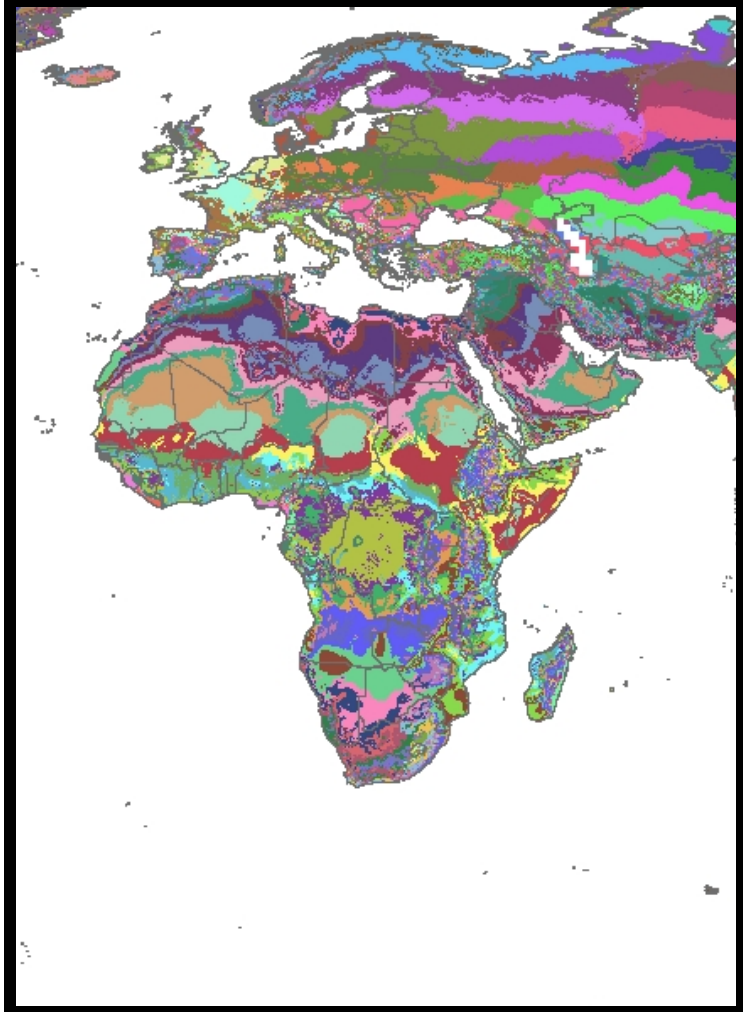
Europe 137

Economic and ecological implications of geographic bias in pollinator ecology in the light of pollinator declines

C. R. Archer, C. W. W. Pirk, L. G. Carvalheiro and S. W. Nicolson

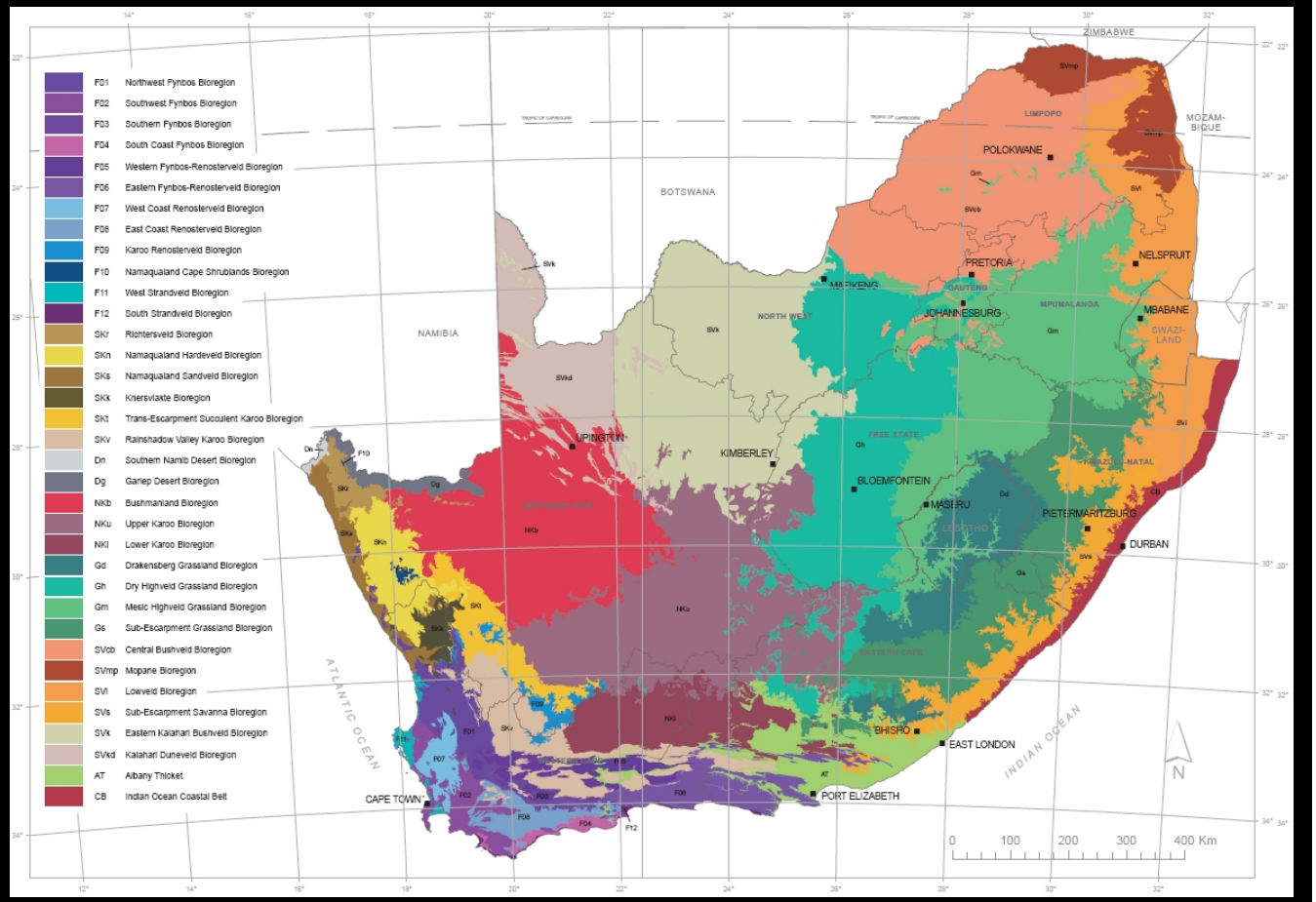
Oikos 123: 401–407, 2014
doi: 10.1111/j.1600-0706.2013.00949.x

Biodiversity

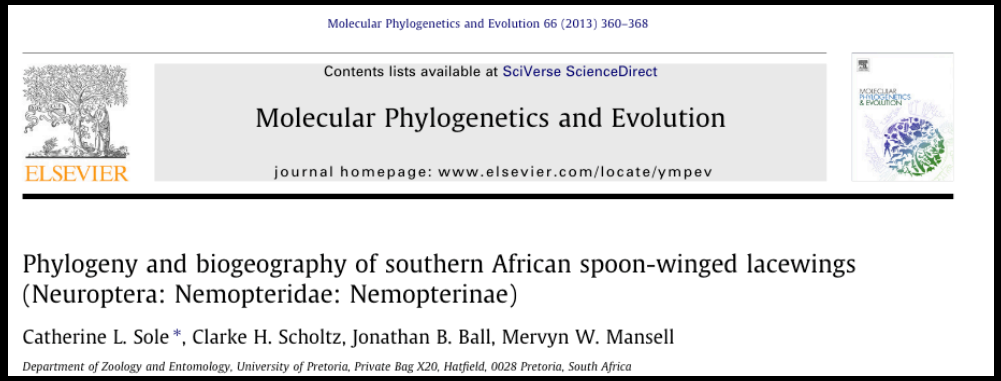


Environmental Stratification

(Metzger et al 2013)



Pictures lacewings Neuroptera -
For more information contact Prof Sole
catherine.Sole@up.ac.za
Prof Sole - Systematic & Evolutionary Entomology (UP) & Invertebrate expert IUCN conservation genetics specialist group (CGSG)) @ConGenAfrica



Molecular Phylogenetics and Evolution 66 (2013) 360–368

Contents lists available at SciVerse ScienceDirect

Molecular Phylogenetics and Evolution

journal homepage: www.elsevier.com/locate/ympev

Phylogeny and biogeography of southern African spoon-winged lacewings (Neuroptera: Nemopteridae: Nemopterinae)

Catherine L. Sole *, Clarke H. Scholtz, Jonathan B. Ball, Mervyn W. Mansell

Department of Zoology and Entomology, University of Pretoria, Private Bag X20, Hatfield, 0028 Pretoria, South Africa

Pictures baboon spiders -
For more information contact Prof Sole
catherine.Sole@up.ac.za
Prof Sole - Systematic & Evolutionary Entomology (UP) & Invertebrate expert IUCN conservation genetics specialist group (CGSG)) @ConGenAfrica

Karoo Biogaps project
Prof C Sole (UP)

Picture galloping dung beetle -
For more information contact Prof Sole
catherine.Sole@up.ac.za
Prof Sole - Systematic & Evolutionary Entomology (UP) & Invertebrate expert IUCN conservation genetics specialist group (CGSG)) @ConGenAfrica

497 described species of dung beetles
In South Africa - very high endemic rate dung beetles & Neuroptera

Apis mellifera scutellata - South Africa To East Africa

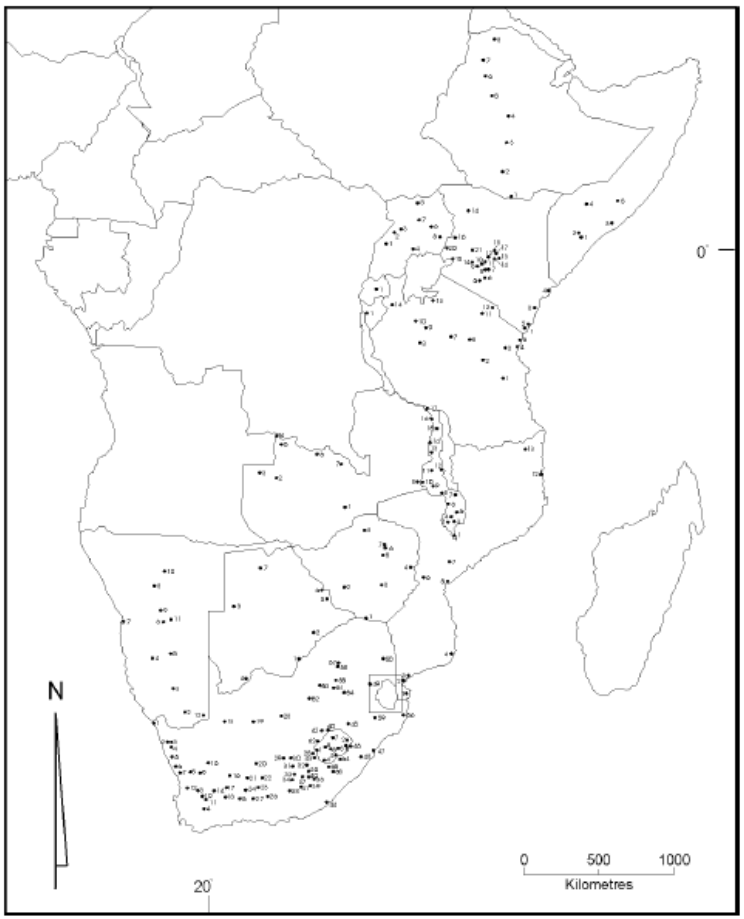


Figure 1 - Map of eastern Africa indicating the localities at which worker honeybees were collected for analysis in our study. Note that for each country the numbering system for localities always begins with "1" to avoid overlapping. Map numbers for each country correspond to the geographical and biological information in Table I.

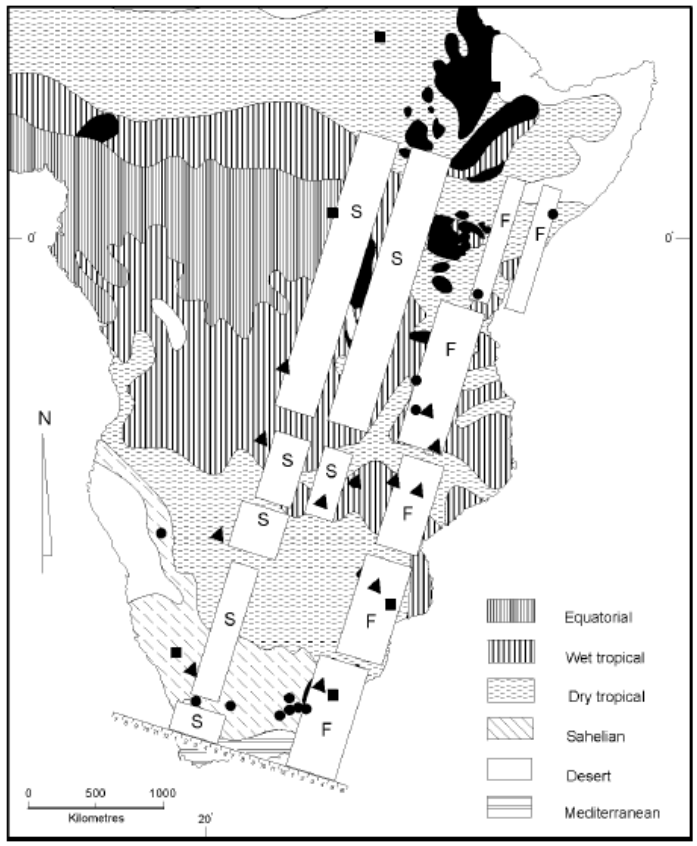
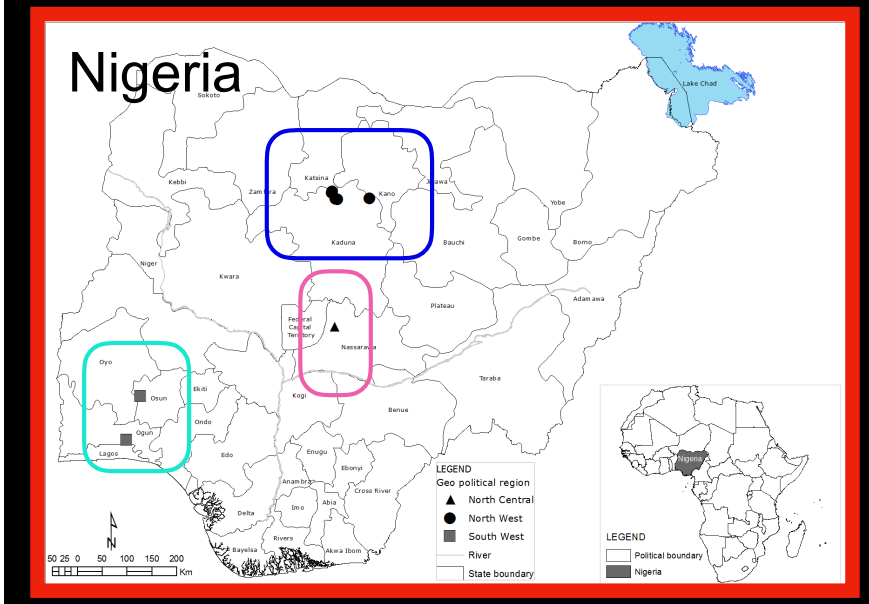


Figure 5 - Map of regions of high morphometric variance in relation to the major zones of vegetation (biomes) in eastern Africa. High variance domains are primarily associated with transitional areas between biomes. Symbols as in Figure 3. (Map modified from van Chi-Bonnardel, 1973).

Hepburn & Radloff 2000 - Genetics and Molecular Ecology

Locally adapted populations of Honey bees

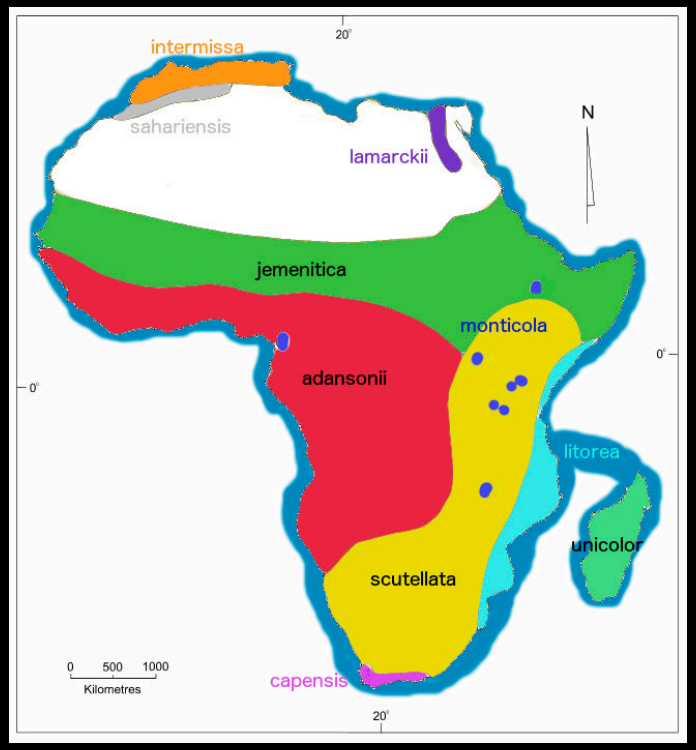


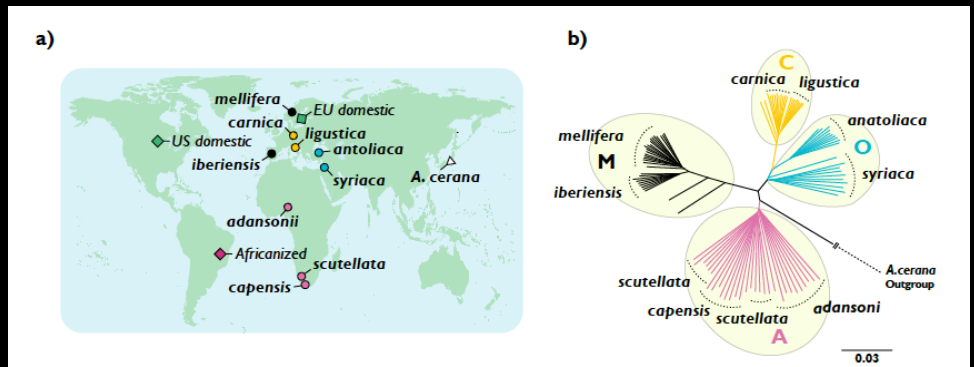
Two distinct pheromone clusters

Two different sub-species?

Genetically different

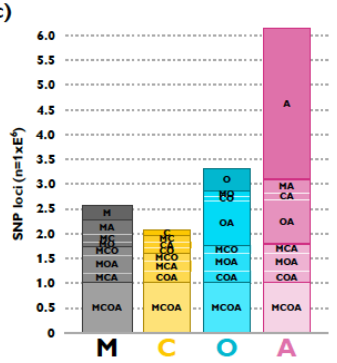
(Rasolofoarivao et al 2015)



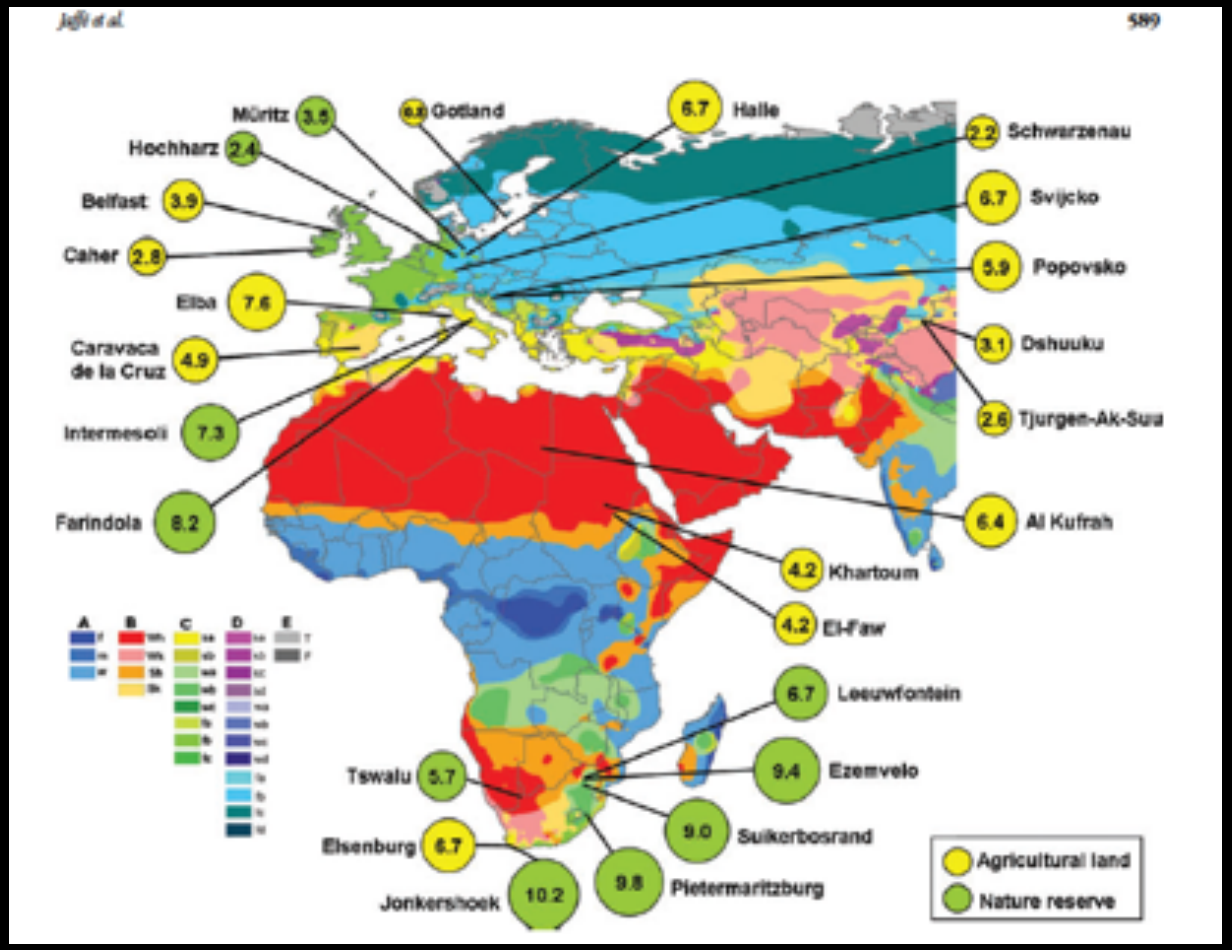


Genetic diversity

Is high in Africa



Wallberg et al (2014).
Nat Genet, 48, 1081-1088



(Jaffe et al 2010)

Estimated 310 million colonies vs 11.5 million in Europe
South Africa over 10 million colonies (Dietemann et al 2009)

Fundamental difference between Europe and Africa

Europe: 99% of bees
Belong to somebody

Fundamental difference between Europe and Africa

Europe: 99% of bees
Belong to somebody

You can move them

Fundamental difference between Europe and Africa

Fundamental difference between Europe and Africa

Fundamental difference between Europe and Africa

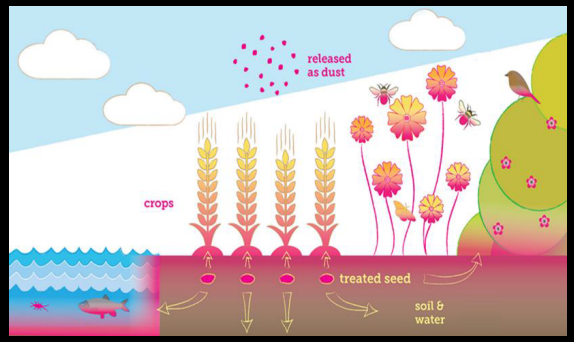
Fundamental difference between Europe and Africa

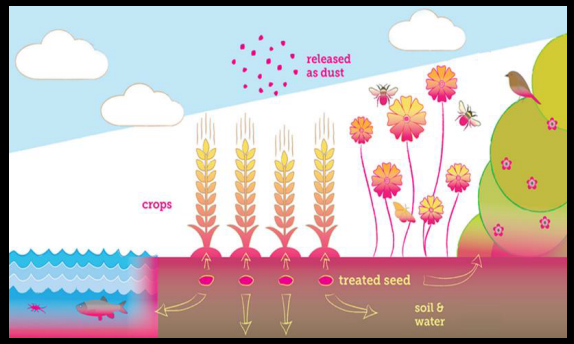
They can move

Africa: 95% of bees are wild

Fundamental difference between Europe and Africa

Wild honey bee population - exposed to pesticides





Fundamental difference between Europe and Africa

Pollinator populations - exposed to pesticides

Carpenter bee

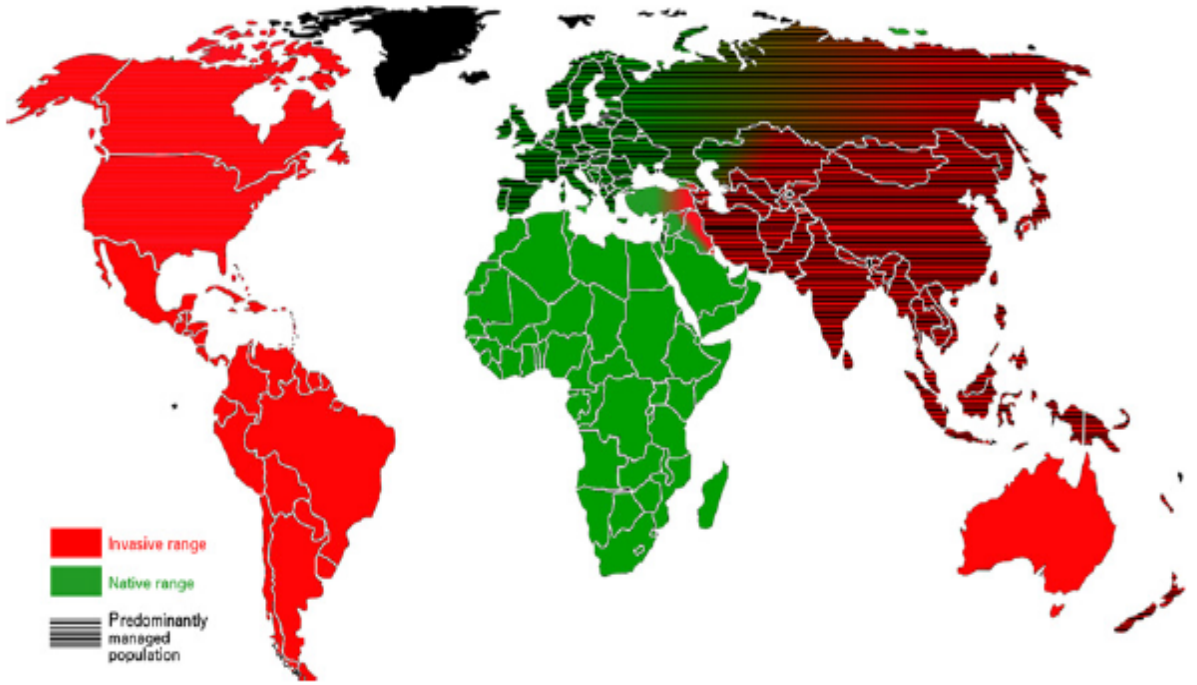
Leafcutter bee

Sweat bee / Solitary bee

Stingless bees

Fundamental difference between Europe and Africa

Wild honey bee population - need to know densities



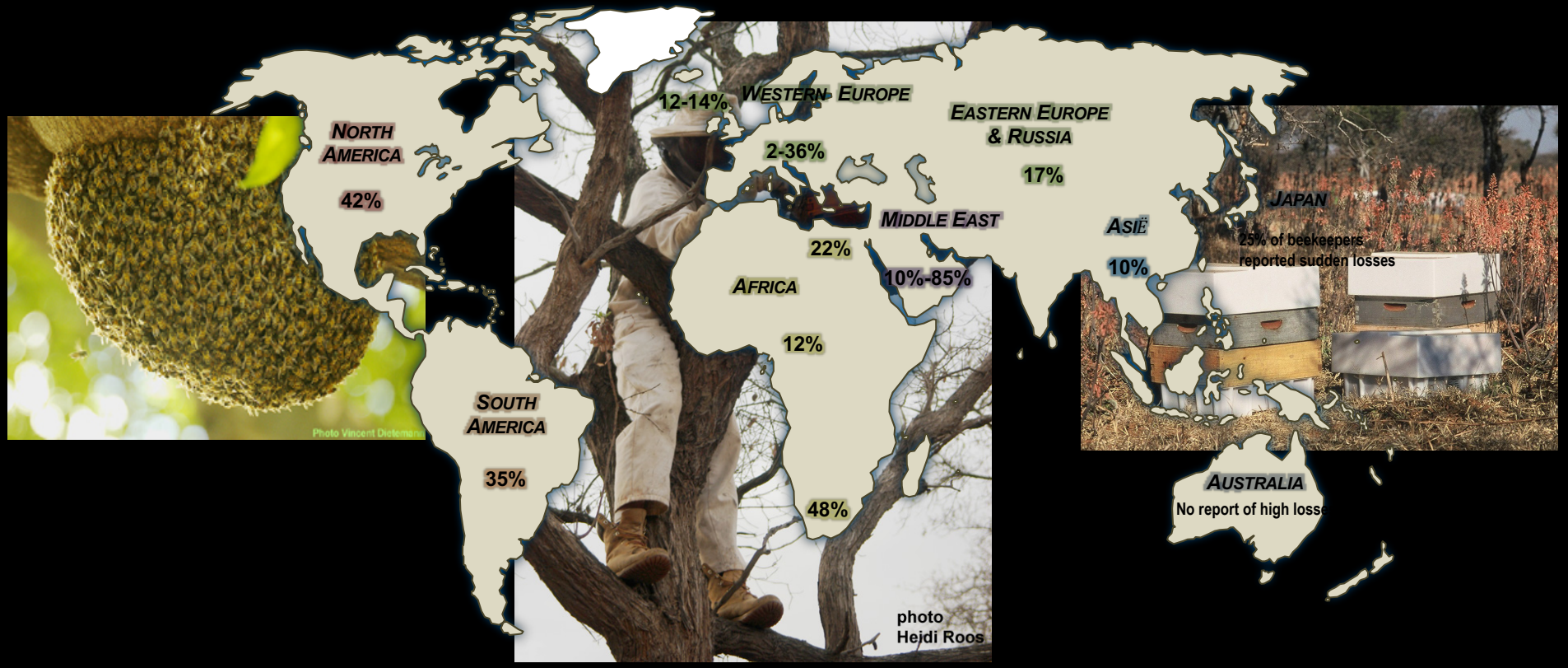
Fundamental difference between Europe and Africa

Wild honey bee population - harvest from the population

Are the bee population used in a sustainable way?

Fundamental difference between Europe and Africa

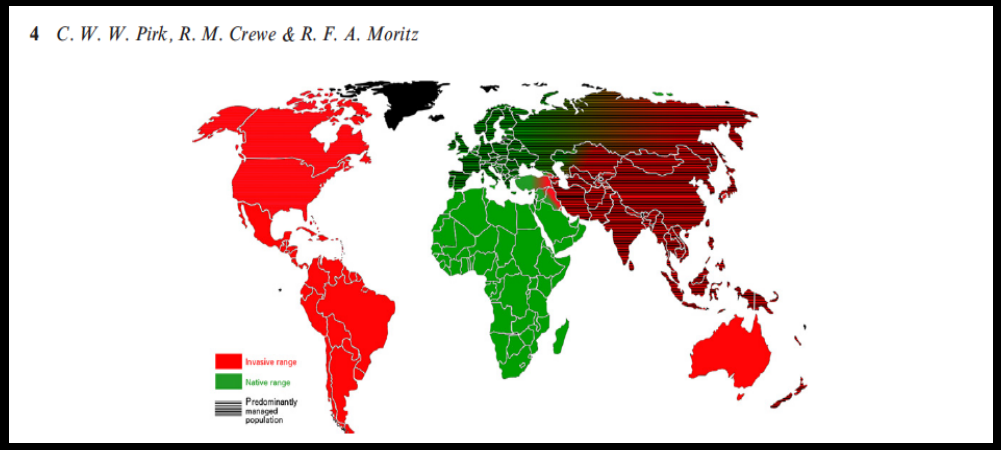
Wild honey bee population - harvest from the population



Some problems like overfishing in the oceans?
Beekeepers “refills” boxes -> selection?

Fundamental difference between Europe and Africa

Wild honey bee population - need to know densities



Need for a comprehensive dataset on how many colonies and where they are

Climate change will make agriculture more challenging

Agriculture in Africa will become more intensive => more use of pesticides/ neonicotinoids but also higher demand for the pollination services of honey bees.

Different economical realities/ possibilities in different parts of Africa

Effects of neonicotinoids in light of
diversity in floral and fauna
climatic diversity / gradients
biodiversity with a high level of endemism
growing human population
95% of honeybees are wild
biodiversity of insects is second to nothing in South Africa

Little is currently known about the pollinator populations, especially honey bees, and their sustainable use.

Work on Baboon spiders, Neuroptera and dung beetles thanks to Prof Catherine Sole (Systematic & Evolutionary Entomology (UP) & Invertebrate expert IUCN conservation genetics specialist group (CGSG)) @ConGenAfrica

SIRG
Prof Robin Crewe
Dr AA Yusuf
Dr Hannelie Human
Dr Ezette du Rand
Prof Sue Nicolson
Fiona Mumoki
Cathy Bester
SIRG extraordinary & former
Prof Robin Moritz
Prof Peter Neumann
Dr Vincent Dietemann
Dr Fabien Démares
Dr Simone Tosi

Social Insects Research Group

Alexander von Humboldt Stiftung/Foundation

NRF

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