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Can foreign breeds help to solve
the problem of bee diseases?

Beekeeping and conservation of
wild honeybees?

Robin FA Moritz
Institut für Biologie

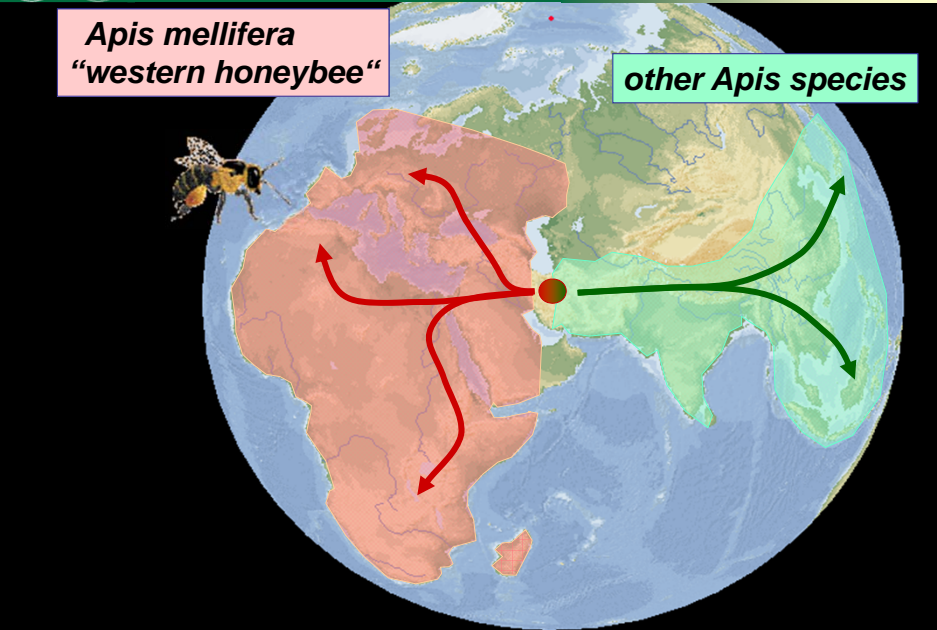
University of Pretoria



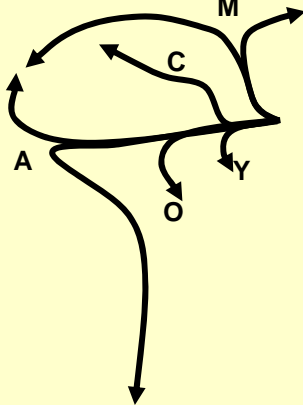
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Apis mellifera
"western honeybee"

other *Apis* species




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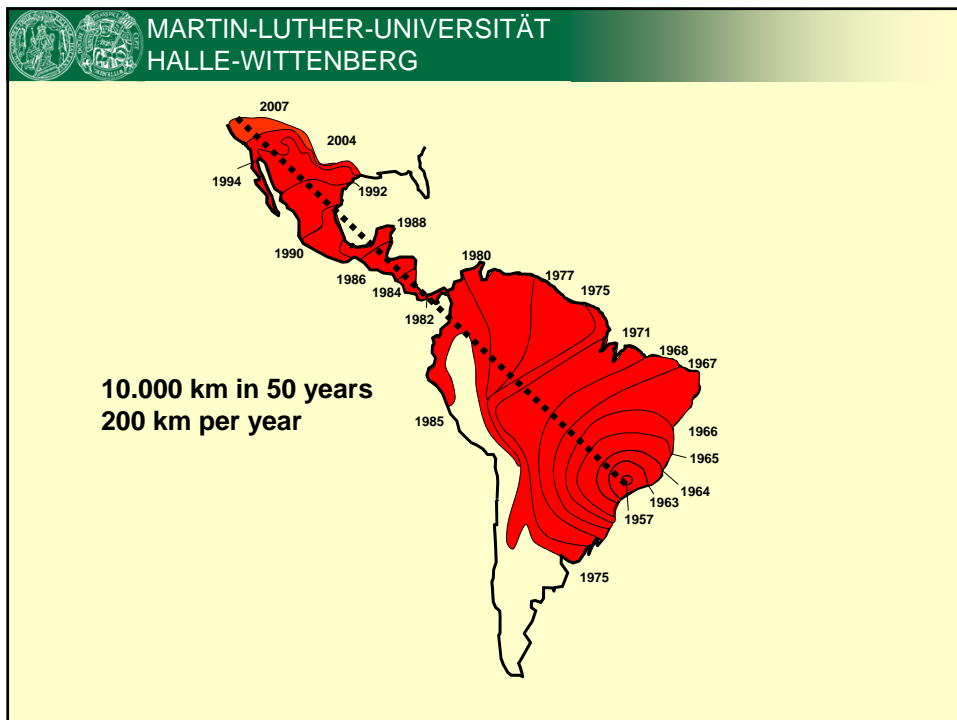
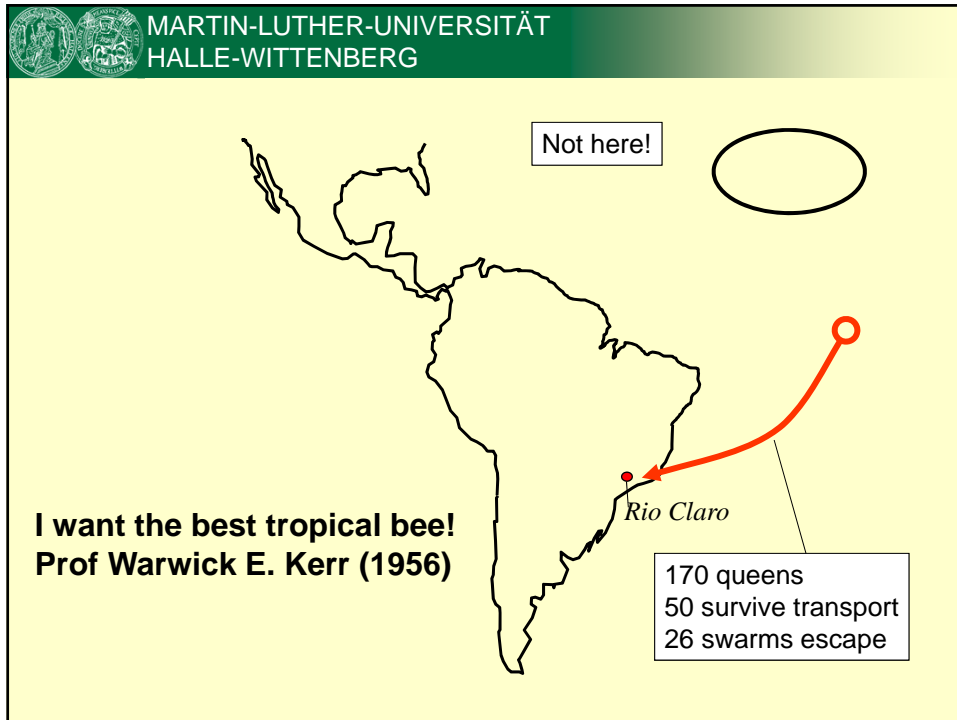
**A few famous
breeds seem to
come from Europe**

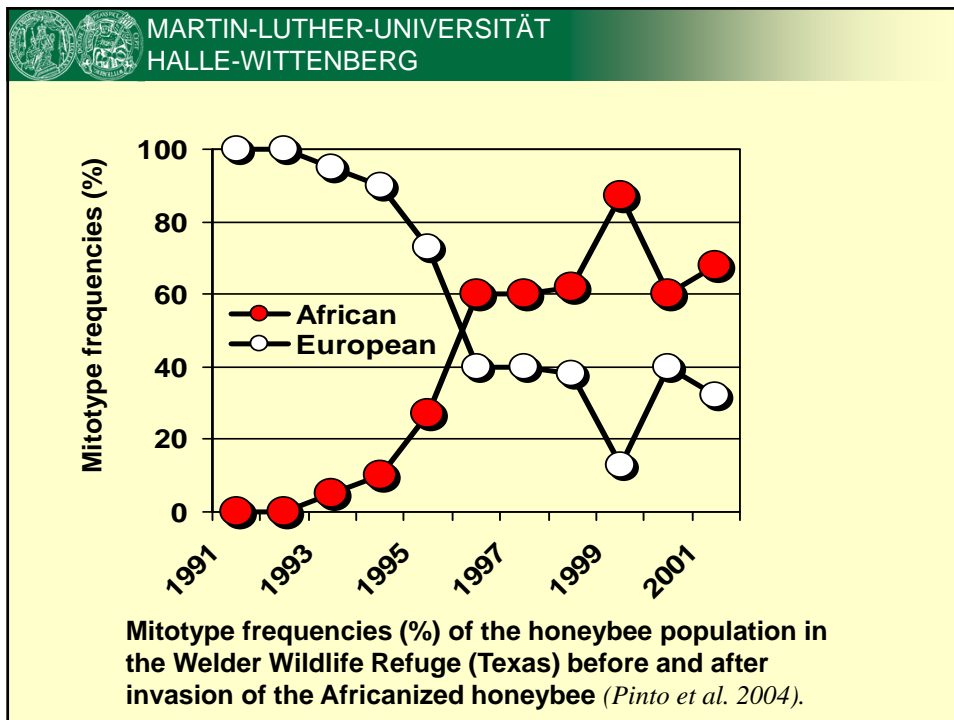
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**Carniolan bees don't sting but
produce a lot of honey
...that is the one!**

**Prof F. Ruttner
Oberursel**





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Fitness differences between European and African honeybees

- **more swarms per colony** (Winston et al. 1981)
- **more migratory swarms and seasonal migrations** (Smith 1960, Hepburn & Radloff 1998)
- **fitter drones** (Otis et al. 2002)
- **smaller colonies and shorter generation time** (Hepburn and Radloff 1998)
- **colony usurpation** (Danka et al. 1992; Vergara et al. 1993; Schneider et al. 2004)
- **more intense defensive behaviour** (Hepburn & Radloff, 1998)
- **better disease resistance** (Varroa; Pinto et al 2004)



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Can foreign breeds help to
solve the problem of bee
diseases in Africa?

Differences between European & African honeybees

- ☛ **more migratory swarms and seasonal migrations** (*Smith 1960, Hepburn & Radloff 1998*)
- ☛ **better disease resistance** (*Pinto et al 2004*)

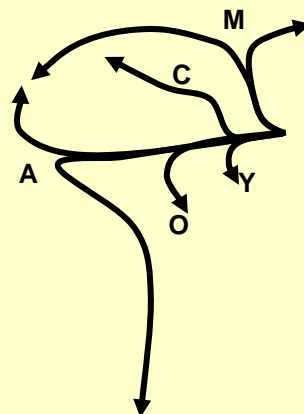
no.. absolutely not

**.....do use African honeybees
(certainly south of the Sahara)**



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Beekeeping and
conservation of
wild honeybees?



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Counting hives is easy....

13 hives

... but how to count wild colonies?


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Determine the number of colonies through foraging workers

Water foragers
(~500 m radius,
Park 1926)



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Determine the number of colonies through foraging workers

Nectar and pollen foragers
(~2 km radius, *Visscher and Seeley 1982*)

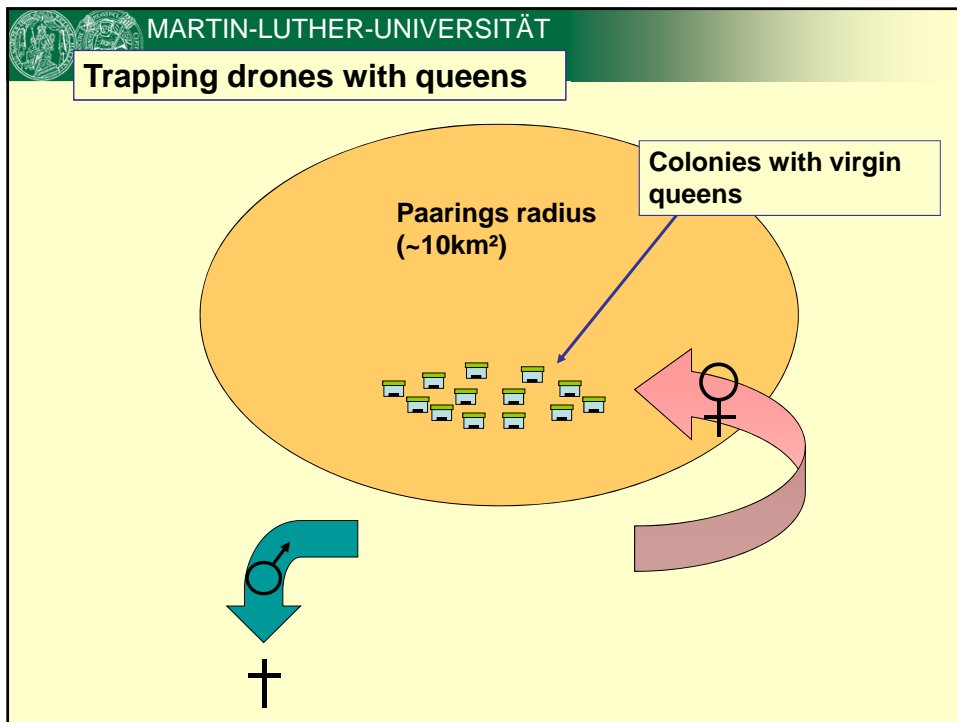
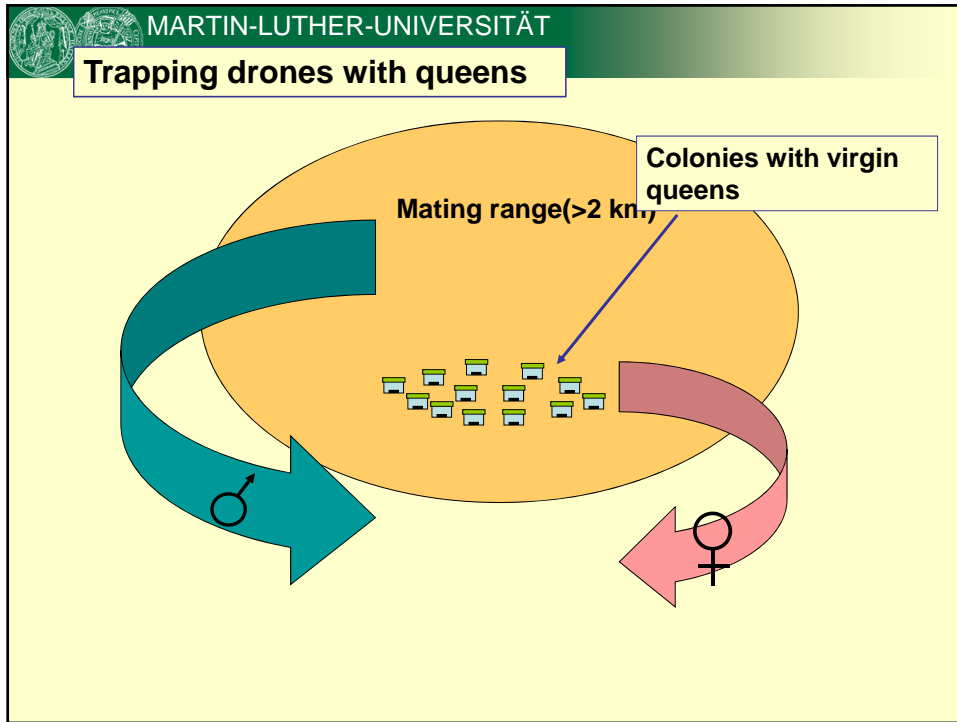
foraging workers recruit!
Severe underestimate of colonies.
A more randomized sample would be much better

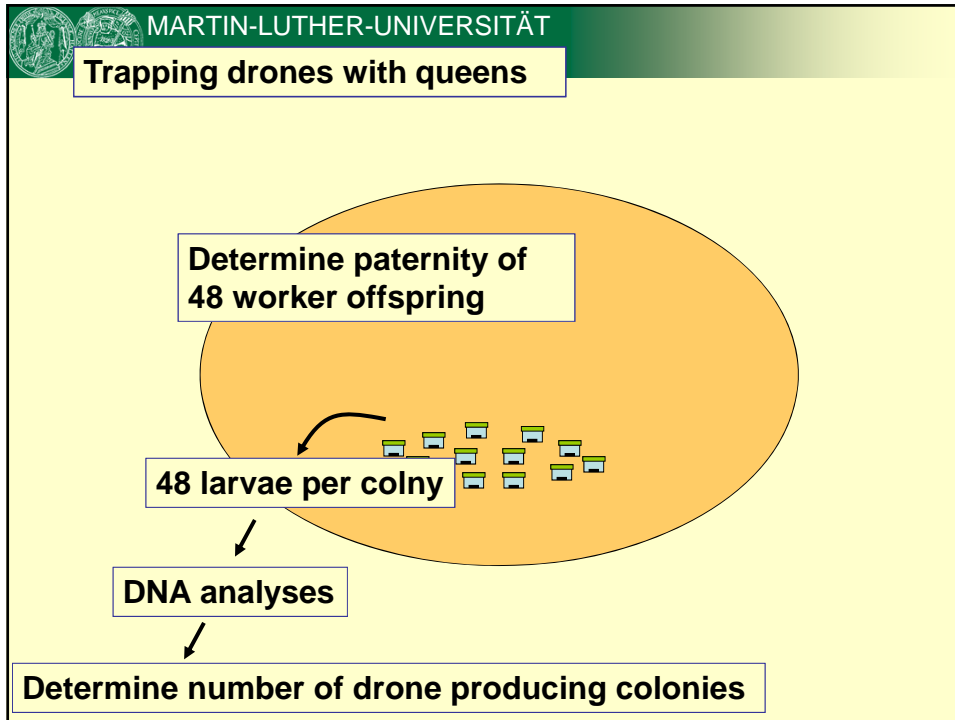
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queens mate with many males at drone congregation areas.

If we only could catch the drones..

foto van G Koeniger







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How can we determine colony density from drone samples?

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26 October 2006 | www.nature.com/nature | £10 | THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

nature

The Honeybee Genome Consortium (2006)

HONEYBEE GENOME makes it easy!
A blueprint for social organization



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dinucleotid repeat (GA)₇

short "tandem repeat" DNA

in *Apis mellifera*

GAGAGAGAGAGAGA	6246
AT AT AT AT AT AT AT	10549
GCGCGCGCGCGCGC	3
AC AC AC AC AC AC AC	641

.....are frequent in the honeybee genome

...we also call them microsatellites..

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GAGAGAGAGAGAGA

GAGAGAGAGAGA Sometimes a repeat motif is lost

GAGAGAGAGAGAGA GA Sometimes we gain a motif

a „slot“

-

+

a gel

8 repeats GA_8

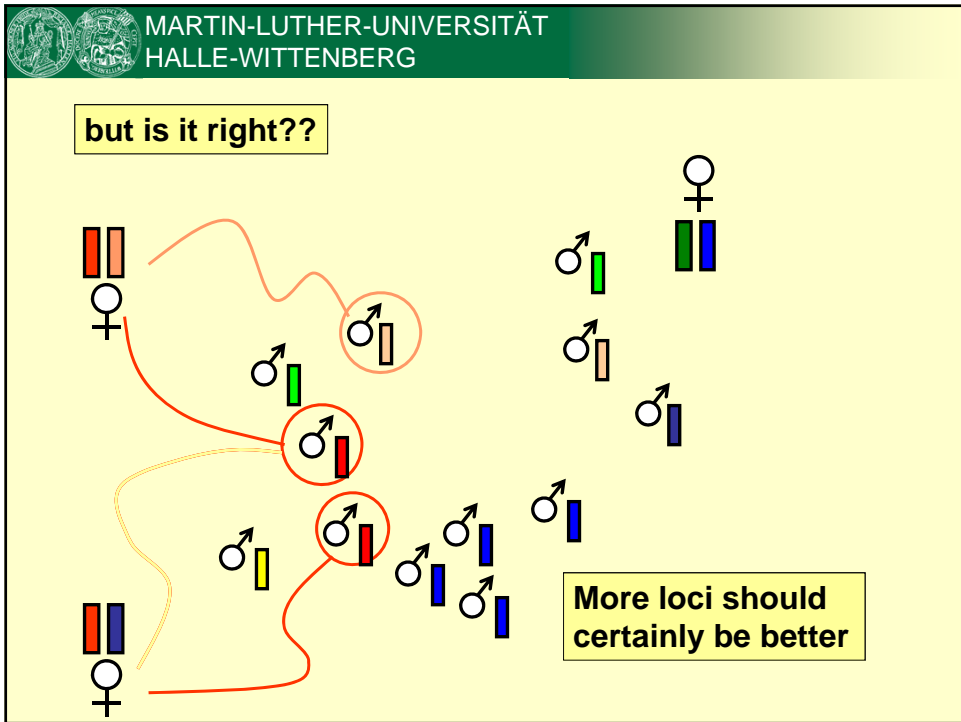
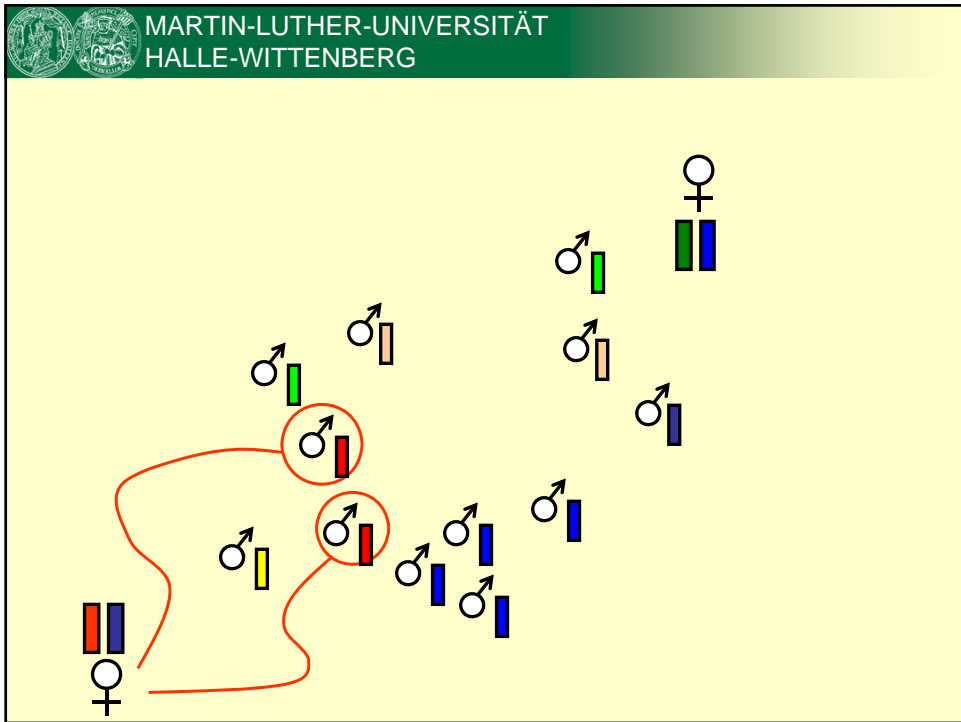
7 repeats GA_7

6 repeats GA_6

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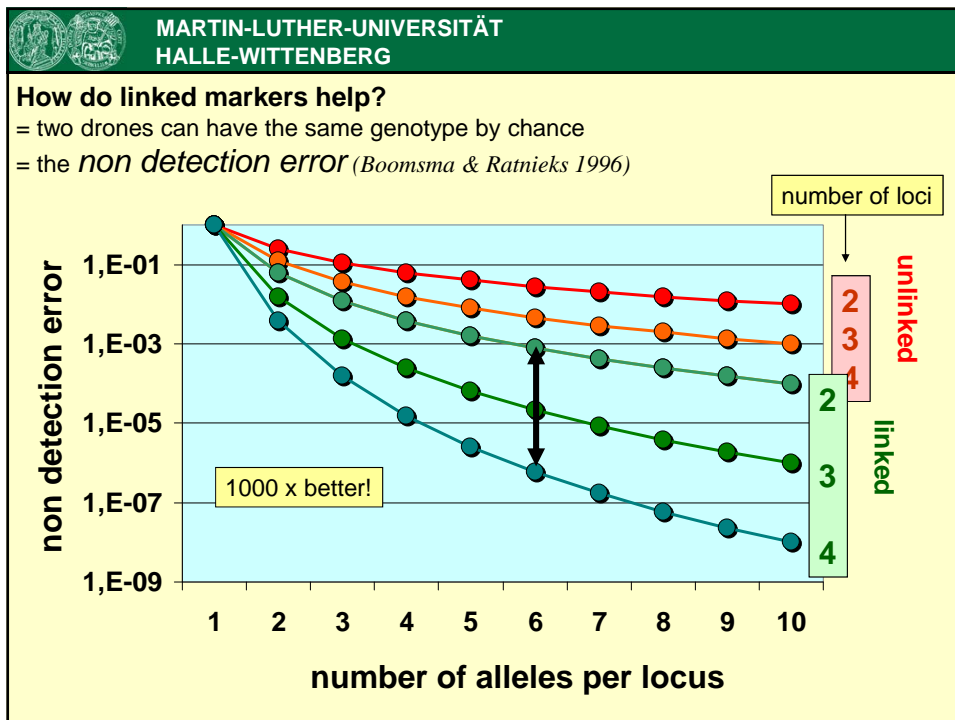
This is how it looks in a gel (if all goes well)

This is how it looks in a DNA „sequencer“ (if all goes well)



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Using sets of tightly linked loci we can considerably enhance the precision of the analysis



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What is the status of endemic honeybee populations?

Are there too many colonies (beekeeping)?


or are there too few (habitat destruction)?

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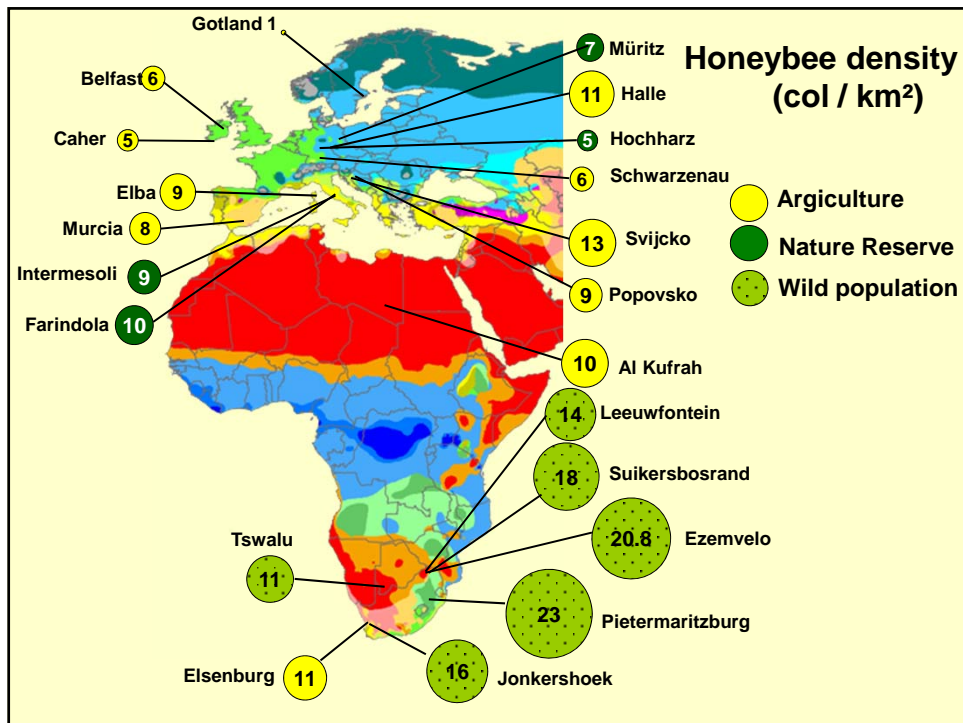
Tswalu Kalahari



Jonkershoek



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Wild honeybee populations in Africa are

- ☞ **2-4 times larger**
- ☞ **50% more heterozygous**
- ☞ **twice as genetically diverse**

as European populations

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populations in Europe are genetically less variable and much smaller as expected from wild populations....

.... in spite of intensive apiculture!

.... because of different climates ?

.... because of diseases?

.... because of beekeeping?

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Al Kufrah Libya

10 vs. 5 colonies per km²

Are there enough beekeepers to ensure a sufficient density of honebees ?



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Al Kufrah Libya

10 vs. 5 colonies per km²

**Is there enough landscape to ensure a
sufficient density of honebees ?**

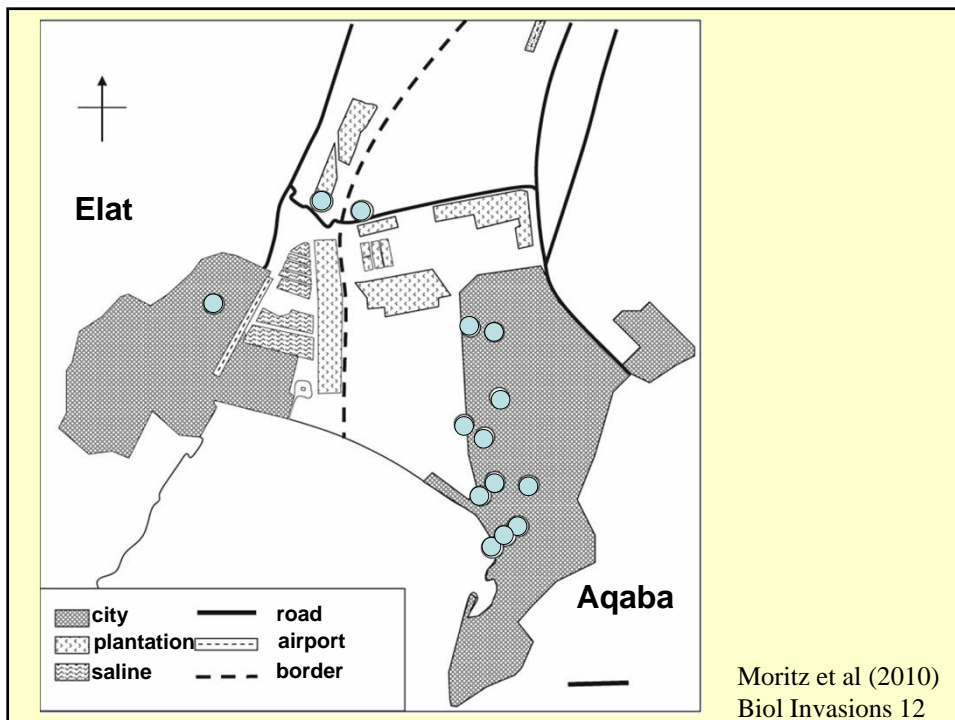


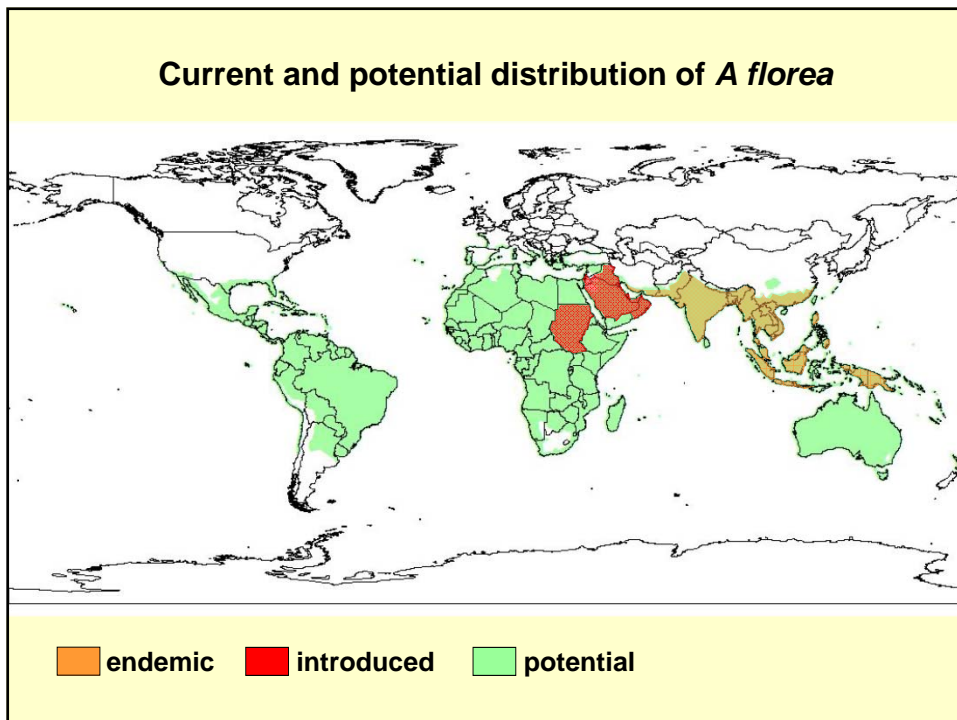
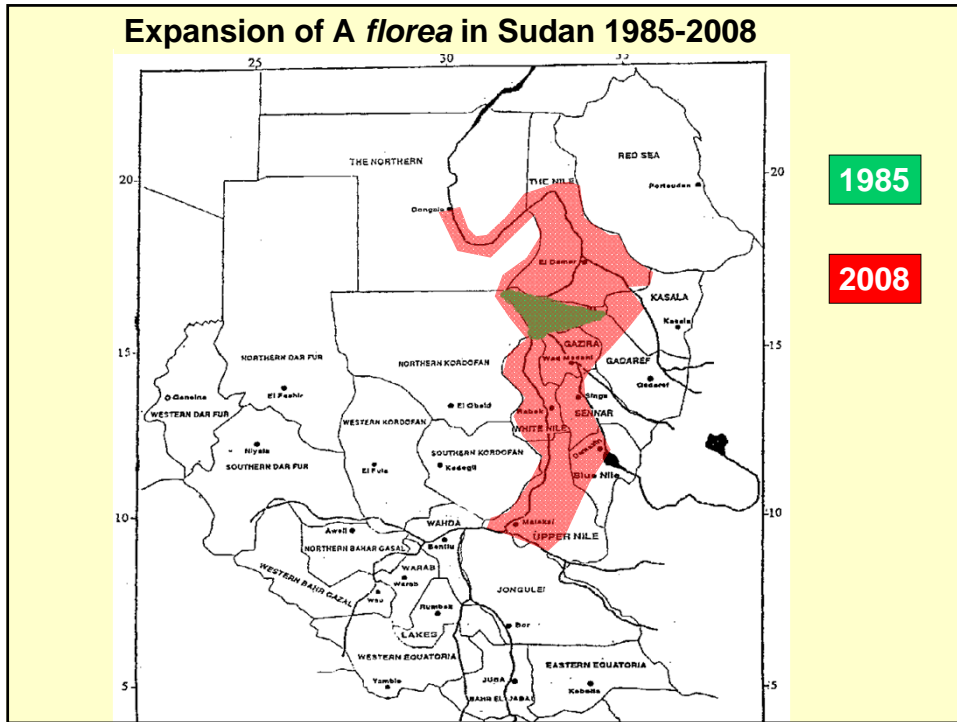
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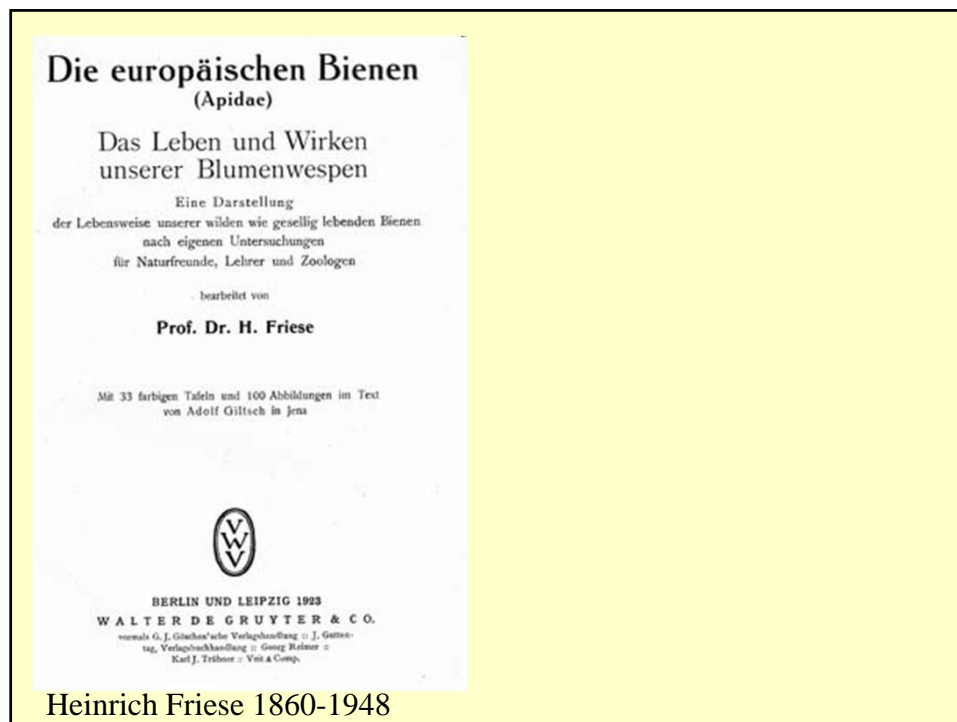
**the true desert for
honeybees is in Europe
not in Africa**



The invasion of the dwarfs: *Apis florea*







Heinrich Friese 1860-1948

Is it a bad invasion?

Probably not:

A florea lives in sympatry with *A cerana* in Asia

A florea has not caused pathogen spill over in Sudan (in spite of almost three decades after invasion)

A florea is not competitive for nesting sites

A florea may just be one of those pollinators that are not in global decline

THANK YOU!