

KBBE.2013.1.3-02: Sustainable apiculture and conservation of honey bee genetic diversity

OUR

- **POTENTIAL**
- **PREVIOUS STUDIES**
- **and PROPOSALS**

That concern:

- **HONEYBEE PRESERVATION**
- **and MAINTAINING OF HONEYBEE BIODIVERSITY**

Jerzy Demetraki-Paleolog

Previously:

Drosophila + laboratory animals.

Environmental genetics (GxE int. + selection),

From 15 years up till now:

Honeybee behaviour and genetics, GxE int.

Endemic bee preservation,

Scientific Activity

- University professor

(bee sciences and environmental genetics)

- President - Polish Bee Research Association,

- Head of the Laboratory of Environmental and Experimental Biology

University of Life Sciences in Lublin, Poland

Dept. of Biological Basis of Animal Production

Laboratory of Environmental and Experimental Biology

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- National Science Centre grant No. N N311 542140 in 2011-2014.

Laboratory of Environmental and Experimental Biology

Poultry Science Team; 3 researchers

Bee science Team; 4 researchers

EXPERIMENTAL FIELD STATION; – 3 persons of the technical staff



Primitive
Green-legged

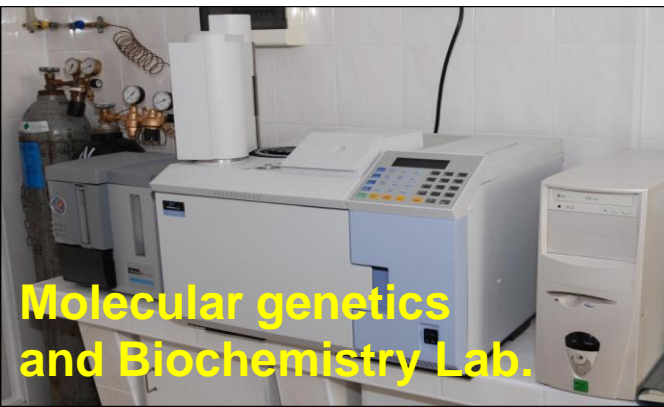


80 bee colonies
including
Eur. black bees



Flying cages –
isolated environments

Laboratory Section – 1 person of the lab. staff



Molecular genetics
and Biochemistry Lab.



Insemination Lab.



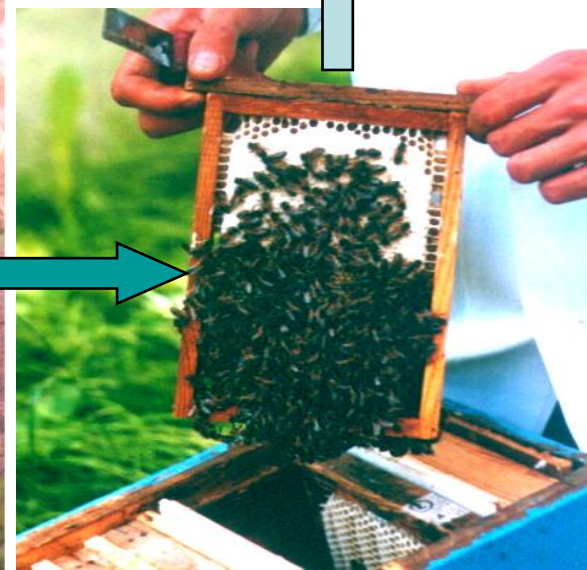
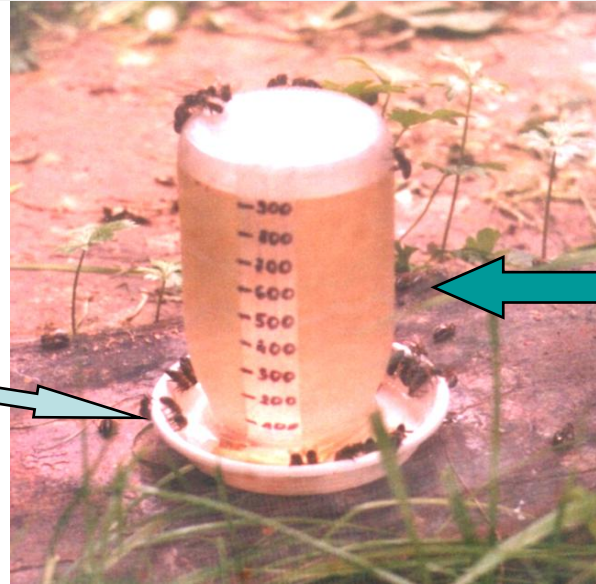
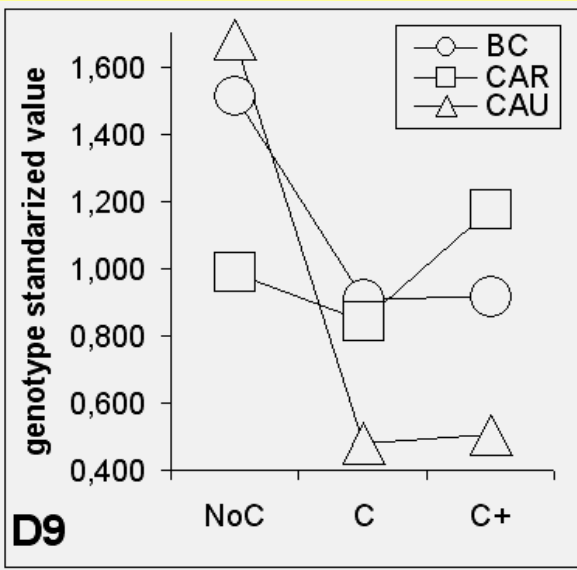
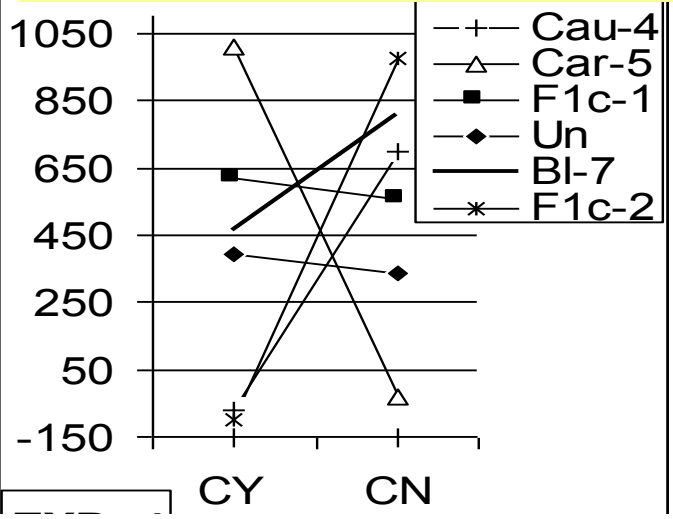
Cage experiments -
conditioned chamber

Topic 1: G X E:

When we import the stranger bees we change environment not only for them but also for the native bees.

Other bees are an important environmental factor – competition

Examined trait was: bee abilities to competing

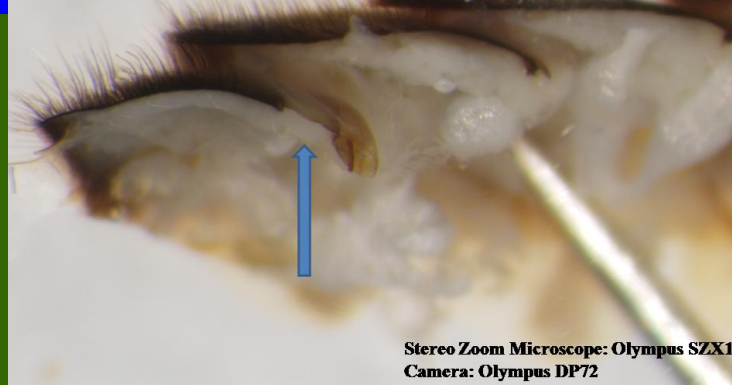


- we considered several other behavioral traits.
- We tried to construct the behavioral standards for different bees
- We try to combine these traits with, morphometric, genetic and biochemical characteristics

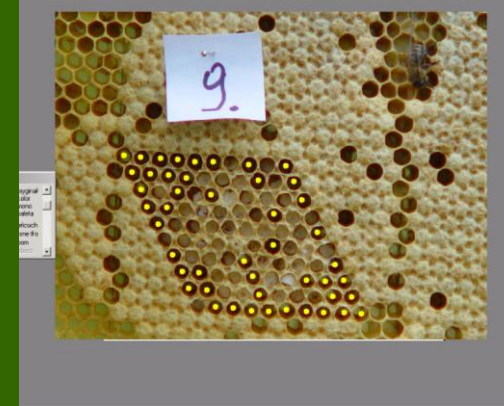
Digital film + ultra violet



Histology + biochemistry



Photos + digital processing

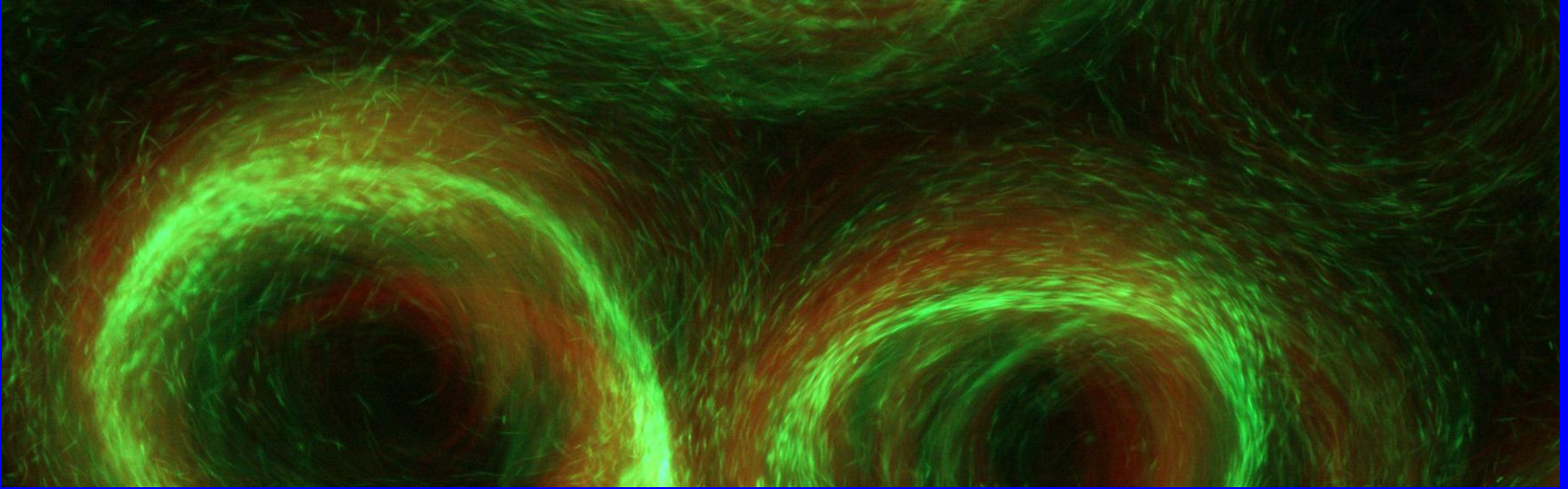


Our first proposal is to continue these studies to study and maintain not only the morphometric and genetic diversity but also behavioral and biochemical diversity

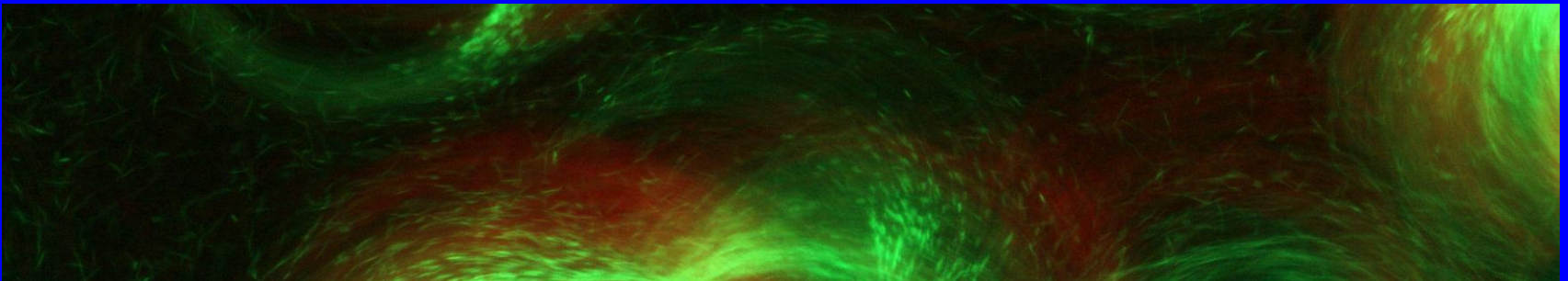
Films + digital processing



Topic 2: One of the important aspects of maintaining the bee biodiversity is the drone competition and also the sperm competition.

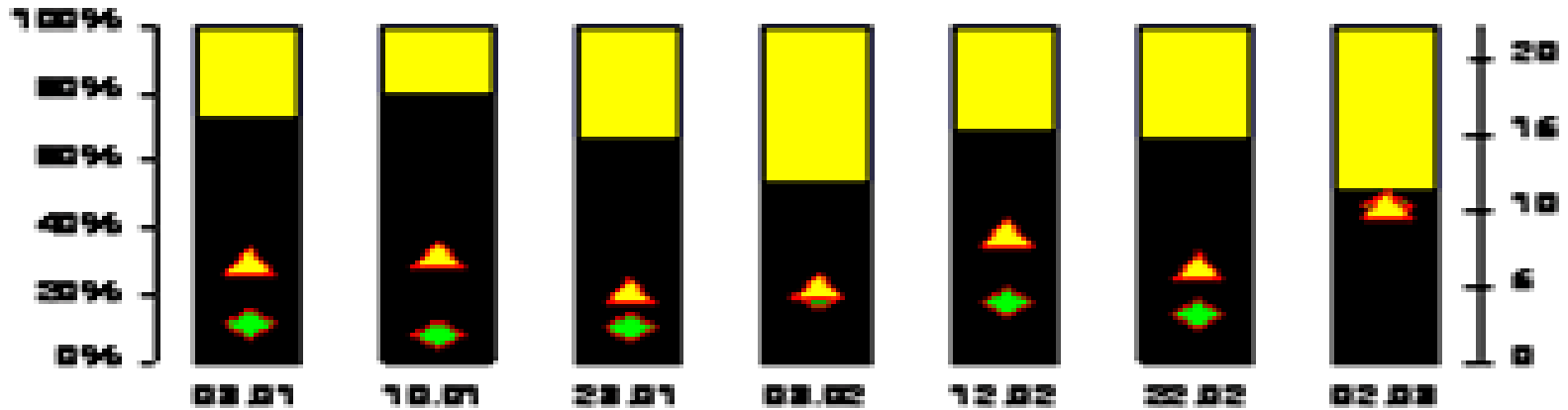


Our proposal is to continue these studies because the sperm competition is very important aspect of biodiversity



Topic 3: Bee hazards – winter losses

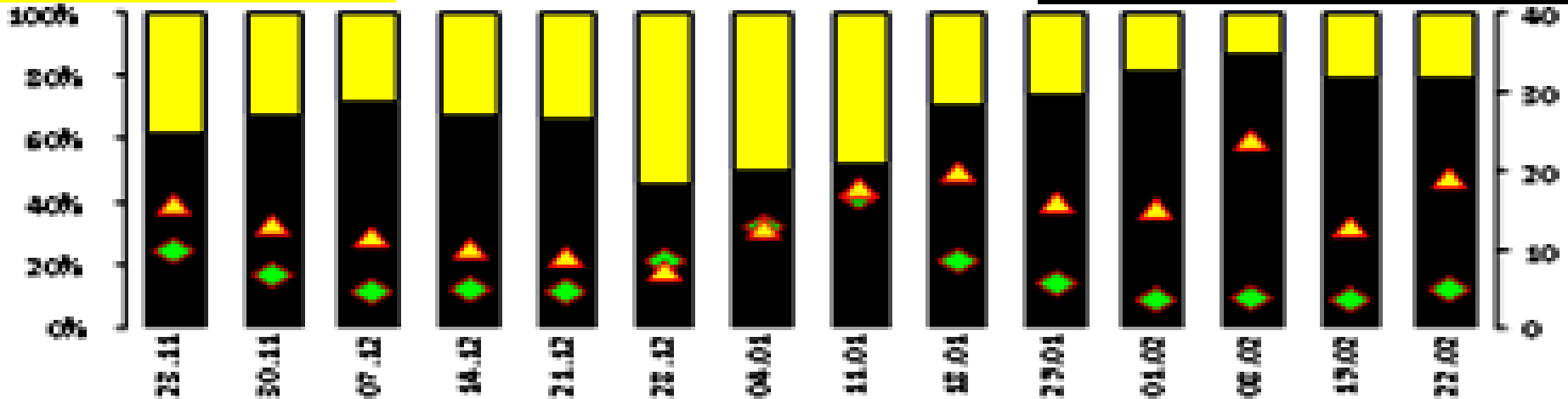
Bee winter out-flying *versus* winter fall - CCD?



Yellow - winter fall

2006/2007

Black – out-flying bees



Varroa? Nosema?
Weather?

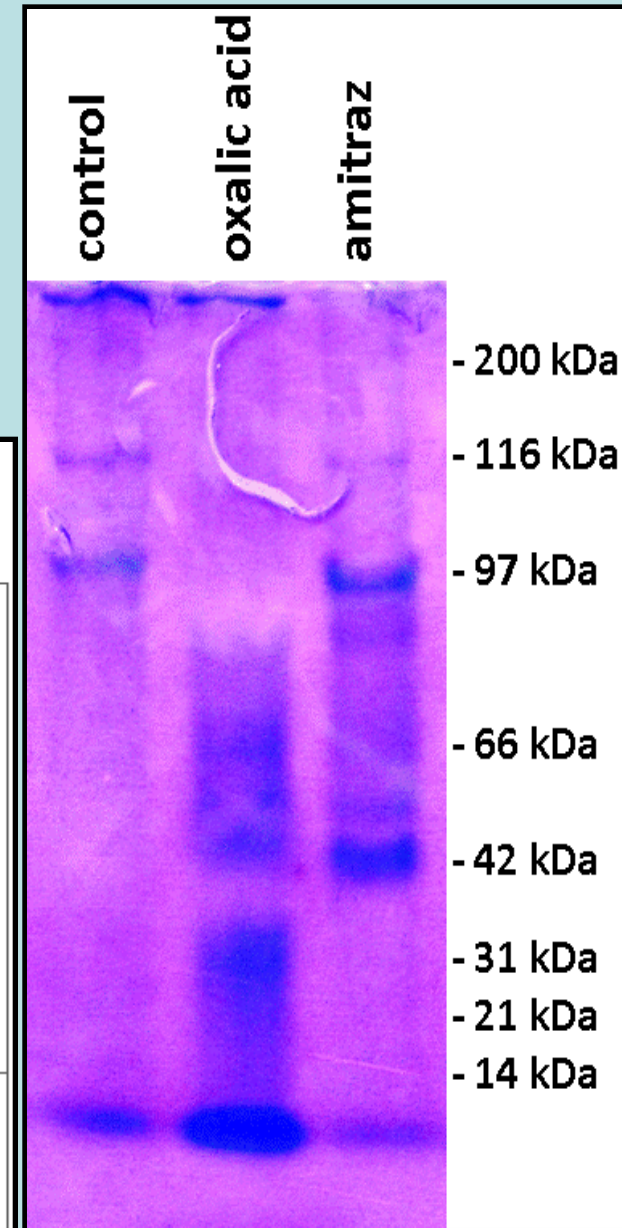
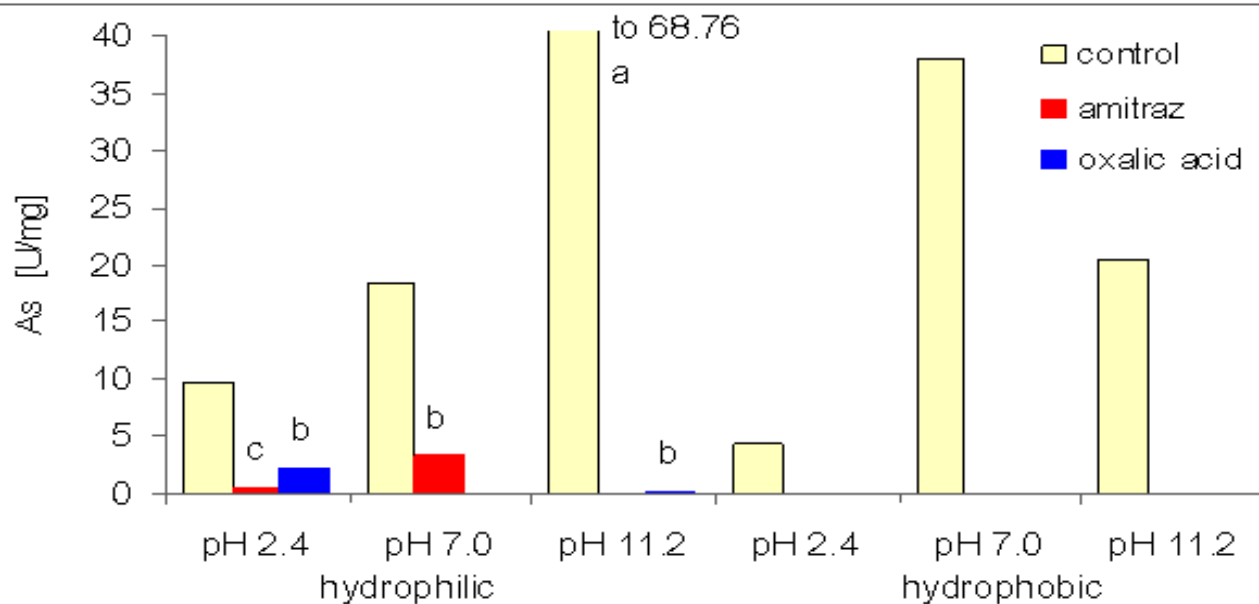
2007/2008

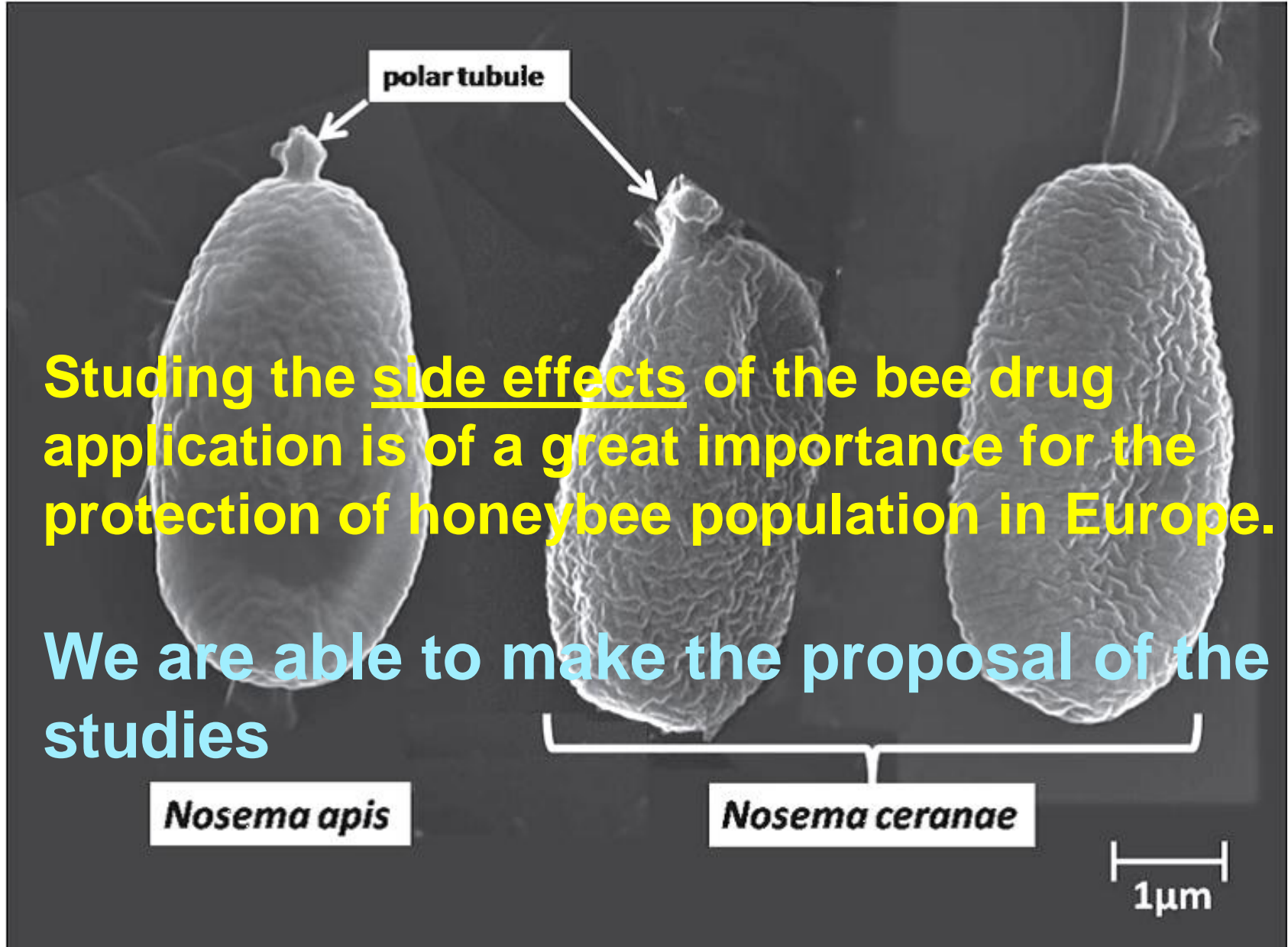
Varroa destructor is main bee hazard

– treatment for *Varroa* has side effects

The apian cuticle proteolytic barrier is poorly known but important bee resistance system. It protects bees against fungi and some of the bacteria

Activities of natural protease inhibitors on the cuticle of workers treated with varroacides





Studying the side effects of the bee drug application is of a great importance for the protection of honeybee population in Europe.

We are able to make the proposal of the studies

Treatments for *Varroa mites* increased the *Nosema* infestation.

Topic 3: Bee hazards - *Varroa destructor*

Selection of the *Varroa* resistant bees – and nature of the resistance

- **Bee population; 5 years of selection for resistance to *Varroa*; no treatment for *Varroa***
- **Criterion – survival / fecundity**
- **Native European bees lived at the cell size (4,9mm).**
- **Natural cell size (4,9mm) *versus* commonly used, cell size (5,4mm)**

Selection at the natural cell size combs was more efficient.

To learn more about the honeybee resistance (*Varroa*) we examine:

in bees:	In <i>Varroa</i> mites
hygienic behaviour,	Morphometry
development duration (egg to adult)	Individual development and longevity
worker longevity	<i>Varroa</i> biochemistry
<i>Varroa</i> , virus, Nosema, infestation,	
nest temperature	
How larvae and pupa fill the cells (Free space)	
winter losses	
honey/pollen yield	
colony build up and strength.	

Plans and proposal for the future;

to continue selection and employ biochemical, genetic, and histological analysis and also economic traits.

Percentage of the colony winter losses; 2011/12.

Grup	Natural/selected; 4,9mm no treatment	Standard/unselected; 5,4mm no treatment	Standard/unselected; 5,4mm treated for Varroa
Winter losses	30%	Over 90%	0%

Hygienic behaviour; dead brood removal / 24h; 2011

Grup	Natural/selected; 4,9mm no treatment	Standard/unselected; 5,4mm no treatment	Standard/unselected; 5,4mm treated for Varroa
Removed pupa no.	81 of 100 killed.	46 of 100 killed.	65 of 100 killed.

Length of the development cycle (egg-adult); 2011

Grup	Natural/selected; 4,9mm no treatment	Standard/unselected; 5,4mm treated for <i>Varroa</i>
Length of the cycle	19,5	24,6

Body widths and lengths [in μm] of *V.destructor* females; 2011.

		Mean	SE
width	Natural; 4,9mm	1665.3^a	0.013
	Standard; 5,4mm	1716.1^b	0.003
length	Natural; 4,9mm	1121.4^a	0.008
	Standard; 5,4mm	1147.4^b	0.003



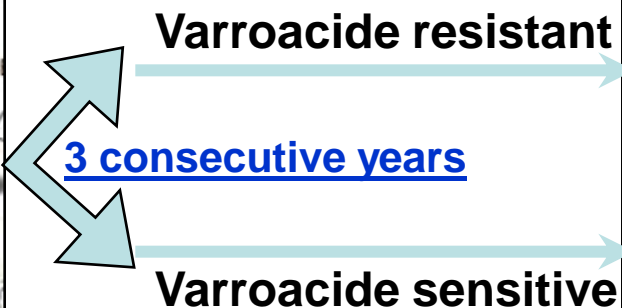
Each medal has both sides.

-Drug resistant mites

One of the greatest bee hazards in UE

- 1. What is a nature of such a resistance and how to avoid it ?**
- 2. What is the parasite biodiversity?**

4 drug types were considered



Morphometry – several traits

Genetic analysis:

- mt DNA (4 genes)
- mutation analysis
- DNA methylation
- haplotype analysis

Biochemistry:

- Several markers/enzymes
- Anti oxidative potential
- Cuticle proteolytic barrier

Resistant *Varroa* mites:

- Tend to be smaller
- Have changed cuticle proteolytic system activity
- Had more mutation
- Often but not always have decreased fertility
- Had lower DNA methylation ???

Our proposal is:

to continue our work on the *Varroa* resistant bee population and to study the nature of the resistance

and on the other hand

to study the mite drug resistance and the mite biodiversity

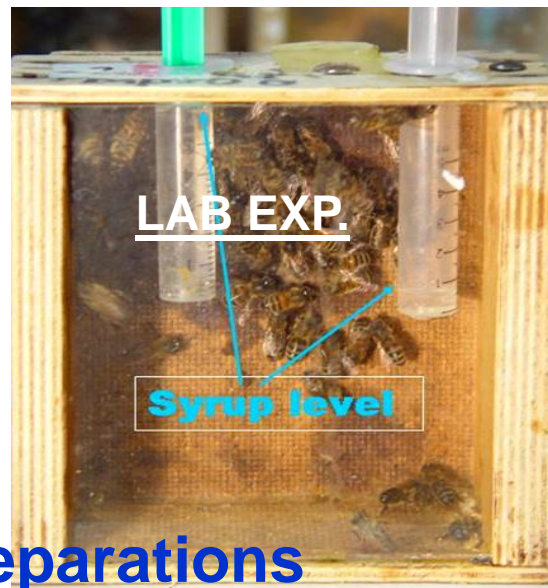
employing:

Combined analysis of the phenotypic, biochemical and genetic traits.

Brain research: *KBBE.2013.2.2-01*: WP2013

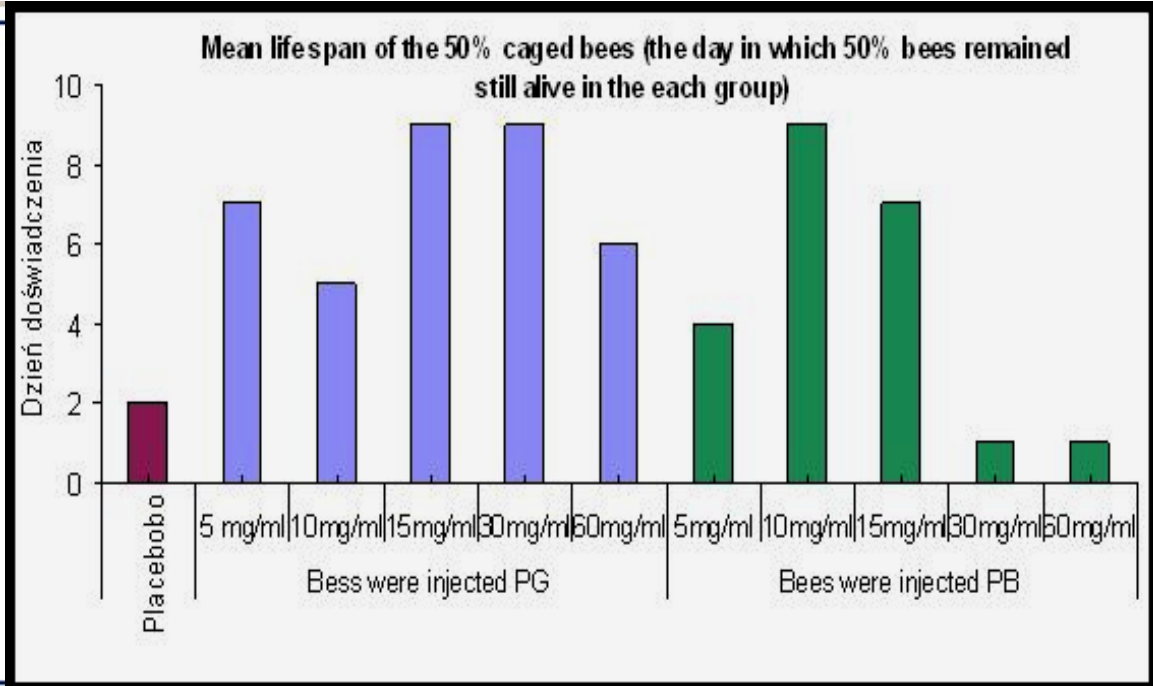
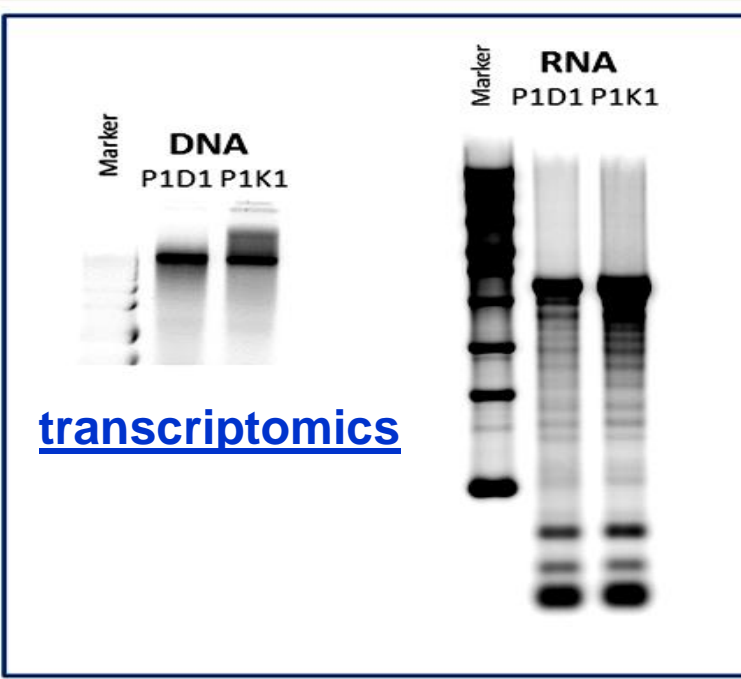
relations between the brain functions and the food intake.

Honeybees are an excellent model for the brain researches including epigenetics.



1. Making bee brain preparations
2. Brains' tissues processing
3. DNA analysis
4. RNA analysis

Supplemented diet in **larva** changed a lot in **adult bees**:



More than 30 genes in adult bee brain have changed expression

PROPOSAL: We can cooperate on this field