Pisa University

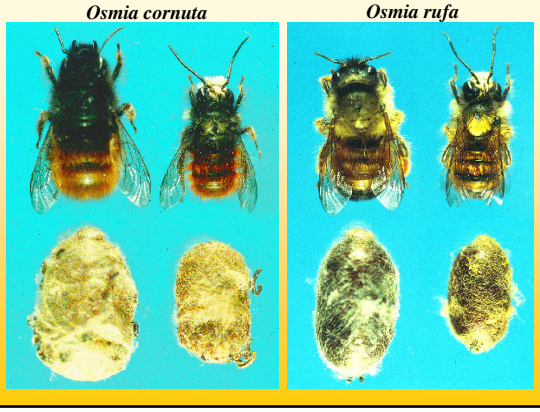
REARING AND USING *OSMIA* BEES FOR CROP POLLINATION: A HELP FROM A MOLECULAR APPROACH

Antonio Felicioli

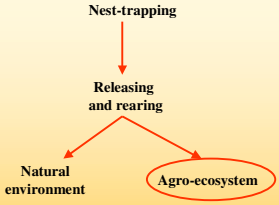
Workshop on Solitary Bees: Conservation, Rearing and Management for Pollination - Beberibe, Ceará April 26-30, 2004

Pisa University

Osmia cornuta *Osmia rufa*



Pisa University



THE RELEASING AND REARING METHOD

Pisa University

Pisa University

Pisa University

In this way it is possible to obtain a progeny output of two to five times the parental population

Pinzauti M., Felicioli A. (2002) –Atti del Convegno Finale, "Il ruolo della ricerca in Apicoltura".

Pisa University

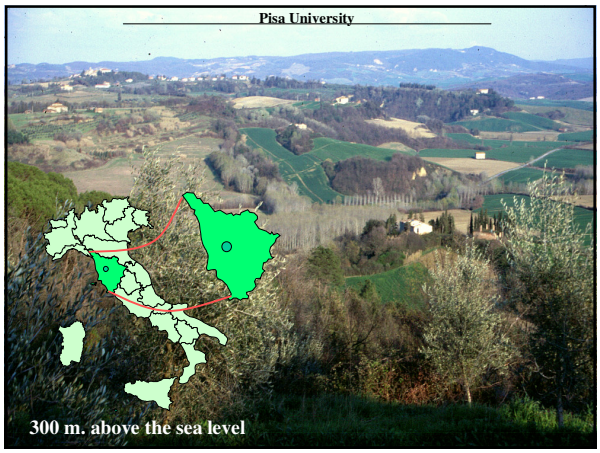
Nest-trapping

Releasing and rearing

Natural environment

Agro-ecosystem

Pisa University



Pisa University

Pisa University

For a good bee progeny output it is important then to choose environments with a large trophic source. In this way it is possible to increase the parental population from five to ten times.

Pinzauti M., Felicioli A. (2002) –Atti del Convegno Finale, "Il ruolo della ricerca in Apicoltura".

Pisa University

Nest-trapping

Releasing and rearing

Natural environment

Agro-ecosystem

Open field

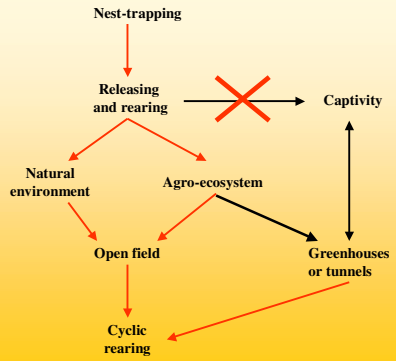
Cyclic rearing

Pisa University

Field developping of *Osmia* populations has the disadvantage of being restricted in time and space.

It is also affected by parasites, predators and nest destroyers.

Pisa University



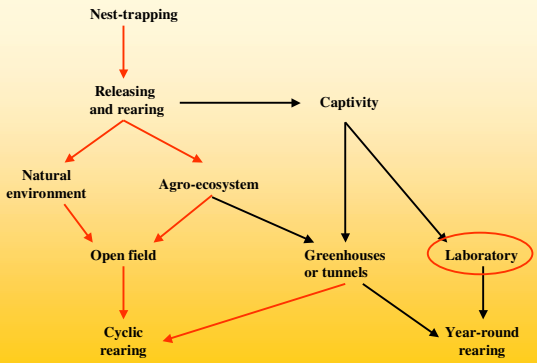
Pisa University

Pisa University

In this way it is possible to increase the parental population from five to ten times but only releasing a small number of cocoons.

Pinzauti M., Felicioli A. (2002) –Atti del Convegno Finale, "Il ruolo della ricerca in Apicoltura".

Pisa University



Pisa University

Luminosity conditions, population density, aging, sex-ratio, lack of knowledge in diapause and nutrition molecular mechanisms are the critical limiting factors in rearing *Osmia* bees in laboratory conditions.

Pisa University

The RR strategy is based on the SWOT system

S strength
W weakness
O opportunity
T threat

Pisa University

Gregarism, artificial nest acceptance and diapause.

S strength
W weakness
O opportunity
T threat

Biotic and abiotic limiting factors, dispersion and lack of technology.

Diapause modularity, nest handling, management of food sources.

Pesticide and parasite proliferation

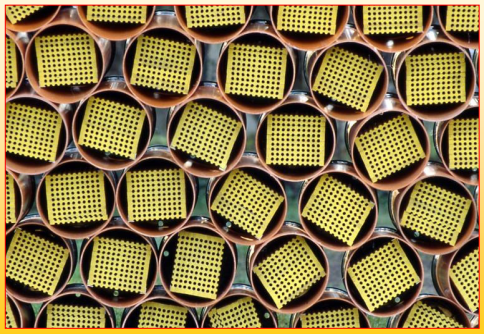
Pinzauti M. (2002) –In: Documentazione Apistica, II edizione, Roberto Stefanini, Livia Persano-Oddo, Anna Gloria sabatini (eds). CD-Rom.

Pisa University

The man-made nests

Pisa University

Assembled artificial trap-nest (AATN)



Pisa University

Arundo donax

Pisa University

Osmia cornuta

Percent of colonised tunnel per nest type at the end of the nesting season

Arundo donax	62 %
Assembled artificial trap-nest (AATN)	36 %
Recycled plastic	2 %

Pisa University

Osmia rufa

Percent of colonised tunnel per nest type at the end of the nesting season

Arundo donax	52 %
Assembled artificial trap-nest (AATN)	45 %
Recycled plastic	3 %

Pisa University

During the night the just emerged males colonize the old open tunnels but if new tunnels are available they will readily accept them first.

Females also prefer new tunnels, if available, to the old ones to nest.

The Assembled Artificial Trap-Nest (AATN) are differently accepted as nesting site by the bees according to the species but all of them always prefer canes.

Two months to one year old canes are better accepted by the bees than the fresh and still green newly cut ones.

Krunic', et al. (1995) -Arch. Biol. Sci. Belgrade, 47 (1-2): 59-66.

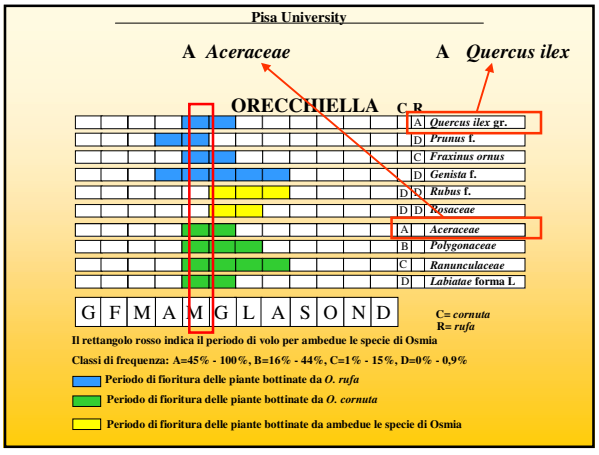
Pisa University

The pollen source

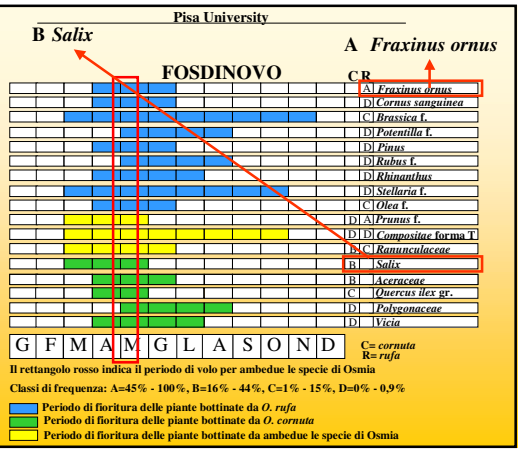
Pisa University

Pisa University

Pisa University



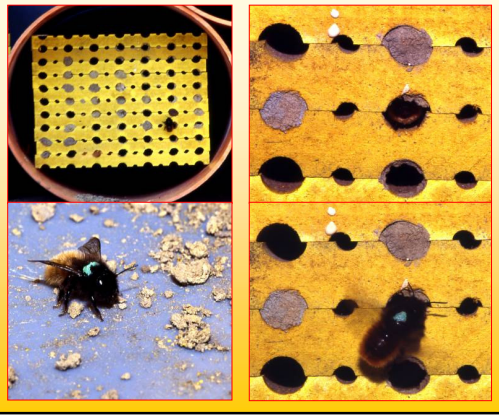
Pisa University



Felicioli et al. (1998) - Atti delle Giornate di studio sull'apicoltura Minoprio (Como). 125-130.

Nesting activity

and gregarism



A single female can nest in at least four tunnels at the same time it is a good general rule to allow at least 4 tunnels for every female released.

the presence of a nesting osmia female in a given area is a visual stimulus for other co-specific females to nest in the same area so it is useful to leave some colonized nests in loco in this way the newly emerged bees will start their activity in a nesting site where some females are already performing nesting activity.
In this case the old artificial nests must be substituted at least every two years in order to control parasites.

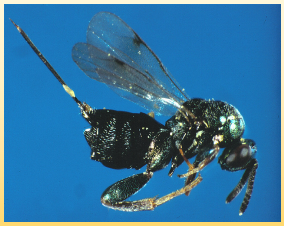
Felicioli et al. (1995) - Insects Social Life 1: 213-218.
Felicioli et al. (1996) –Frustula entomologica n.s. XIX: 132-138.

Parasites, predators and nest destroyers

Pisa University

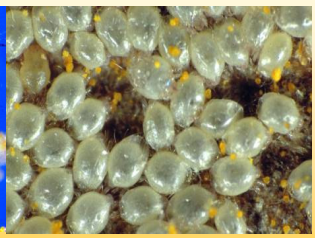
Pisa University

Pisa University



Pisa University

Pisa University



Pisa University

Pisa University

The most successful ways to fight these parasites are cocoon stripping and renewing of nesting material.

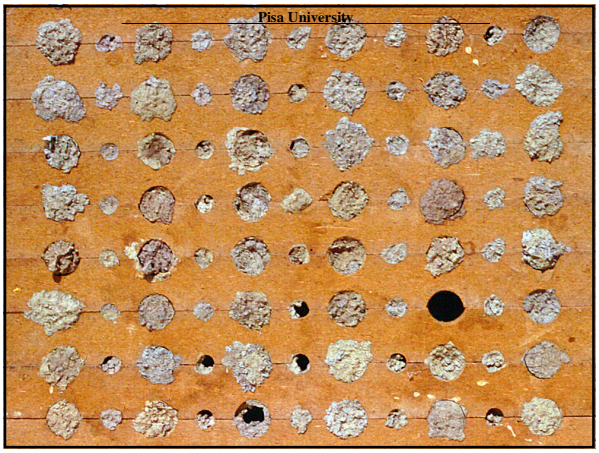
Krunic' et al. (1995) - Arch. Biol. Sci. Belgrade, 47 (1-2): 59-66.

Felicioli A., (2000) –In: Api e impollinazione, Regione Toscana, Firenze: 159-188.

Pisa University

Success !!

Pisa University



Pisa University

Pisa University

Stripping the cocoons

Pisa University

Pisa University

Pisa University

Pollination

Pisa University

Pisa University

Pisa University

Pisa University

Pisa University

Pisa University

Pisa University

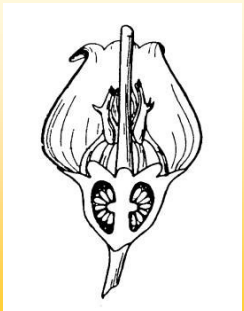
Pisa University

O. cornuta **show a great efficiency (175kg/ha) in pollinating off-season generation in white clover grown in a growth cabinet during winter (24°C/18°C day/night and 16 hours photoperiod) if utilised in a density of 5 females/m²**

Pisa University

Pisa University

Vaccinium ashei



Vaccinium corymbosum

Pisa University

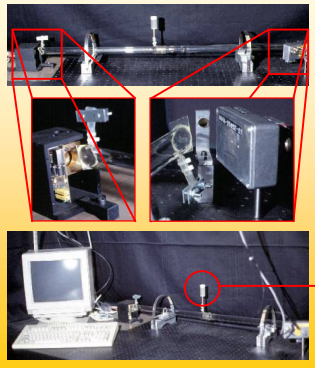
Felicioli A., (1996) - Colture protette. ANNO XXV n.3 pag.63-66.
Felicioli A., (2000) –In: Api e impollinazione, Regione Toscana, Firenze: 159-188.
Felicioli A., Pinzauti M. (2000) In: Api e impollinazione, Regione Toscana, Firenze: 247-261.
Pinzauti et al. (1997) - Acta Hort 437 pag. 329-333.

Pisa University

The molecular approach

Pisa University

The CO_2 infrared tunable diode laser



the pyrex absorption cell lenght 1 m. and a volume of 0.5 liter

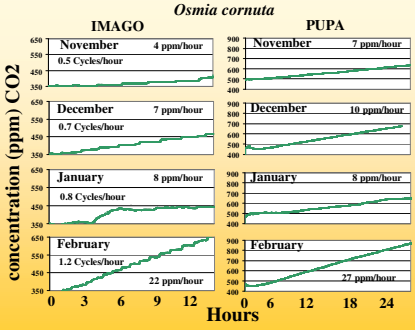
Emission wavelenght 2.004 micron

cocoon supporter

Felicioli et al. (2000) - In: "Proc. XXI Int. Congr. Ent.", Foz de Iguassù (Brasil).

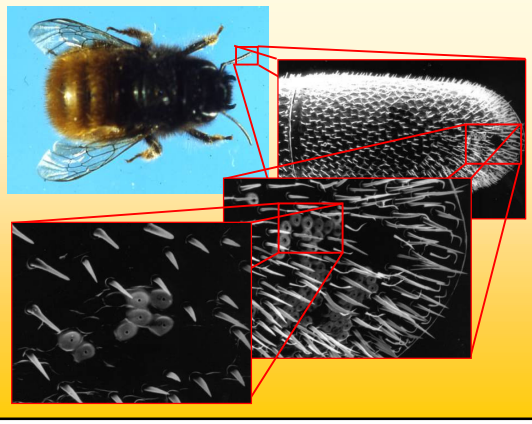
Pisa University

Osmia cornuta



Laser traces of CO_2 emission at 15 °C from a diapausing imago (left) and a diapausing pupa (right) in a 12 hours period (imago) and 24 hours period (pupa). Each record is the average of 60 measurements taken every 10 seconds.

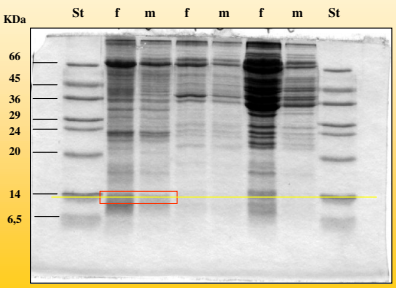
Pisa University



Pisa University

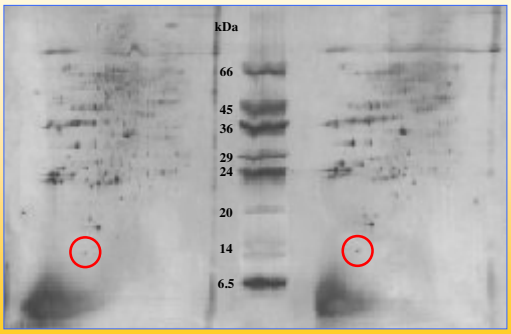
Osmia cornuta Antennal extracts

antenna head abdomen



Pisa University

pH 10 **Male** pH 3 pH 10 **Female** pH 3



2D-electrophoresis

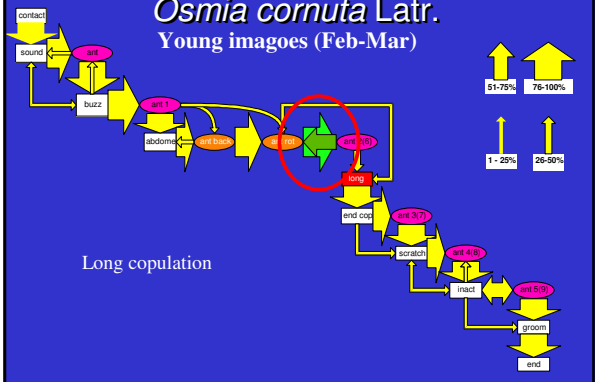
Pisa University

Mating behaviour, aging and sex-ratio

Pisa University

Osmia cornuta Latr.

Young imagoes (Feb-Mar)

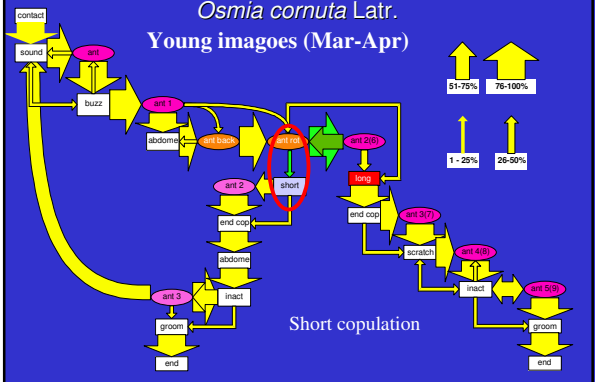


Long copulation

Pisa University

Osmia cornuta Latr.

Young imagoes (Mar-Apr)

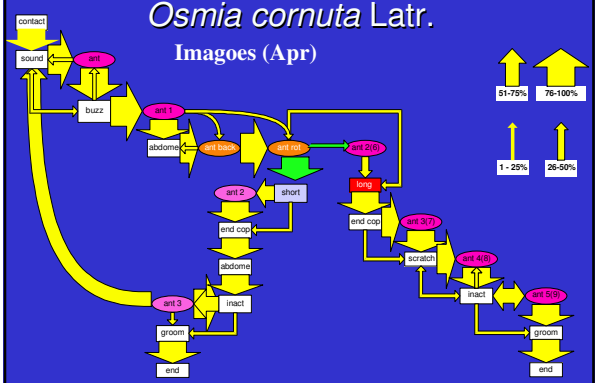


Short copulation

Pisa University

Osmia cornuta Latr.

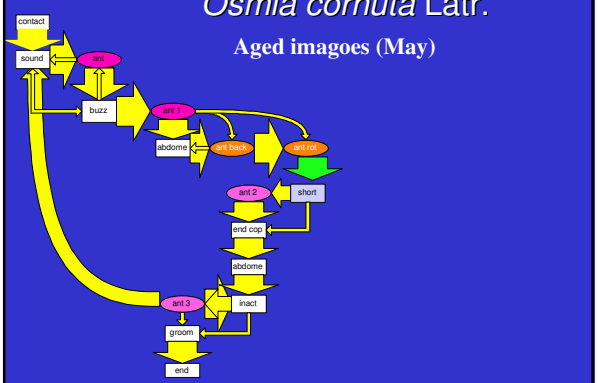
Imagoes (Apr)



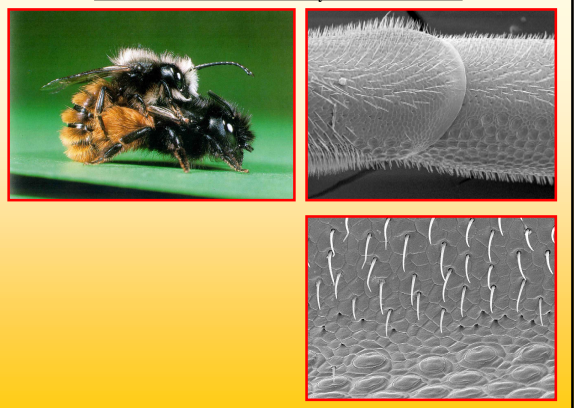
Pisa University

Osmia cornuta Latr.

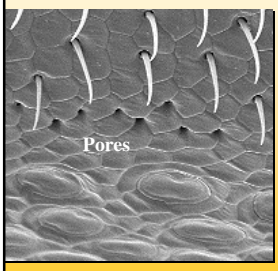
Aged imagoes (May)



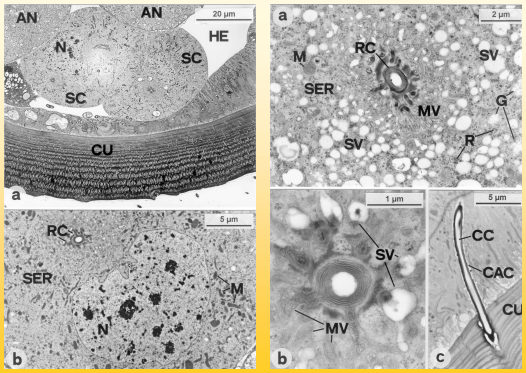
Pisa University



Pisa University



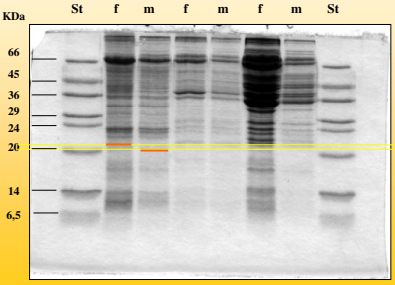
Pisa University



Pisa University

Osmia cornuta Antennal extracts

antenna head abdomen



Pisa University

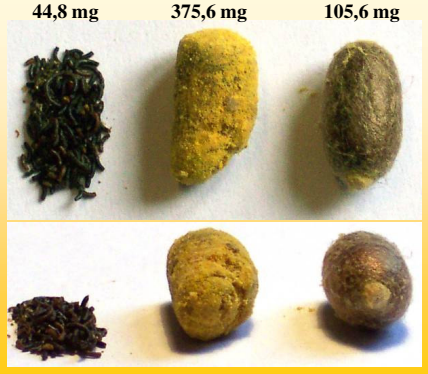
Digestive proteinases and Inhibition of pollen germination

Food type and quality is still one of the limiting factors in rearing osmia bees in captivity conditions (laboratory). In this context neither the choice criteria, nor the post-gathering treatment of the pollen by the bee, or the enzymatic digestive pool through the ontogenetic stages are known.

Pisa University

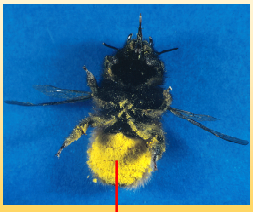
Pisa University

44,8 mg 375,6 mg 105,6 mg

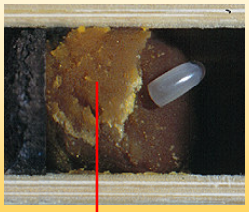


Pisa University

Strawberry pollen germination (%)



80,32%



15,20%

Pisa University

	Strawberry %	bluberry %
Pollen from stame	92.57	83.95
Pollen from stame with one drop of extraction buffer	83.47	76.91
Pollen from stame with osmia heads extract (female)	17.51	28.55

Pinzauti M., Marroni E. (2003) –Proceedings of the XXXVIII congress Apimondia 2003, Ljubliana Slovenija. CD-Rom

Pinzauti et al. (2002) Insect Social Life.

Pisa University

CONCLUSIONS

The knowledge of:

the aminoacid sequence of the different pattern of digestive proteases showed by Osmia throughout its larval phases could help in preparing a suitable artificial diet for larvae which permits to rear the bees indoors.

the role of CO_2 within tachitelic and horotelic metabolisms could allow the control of the diapause modularity and plasticity of solitary bees, permitting rearing all year round in spite of their usual annual rhythm.

Pisa University

The proteomic approach of the mating system and aging of these bees could permit an understanding of the sex-recognition mechanisms, to manage sex-ratio and to avoid dispersion.

Pisa University

Many thanks go to:

Francesco D'Amato,
Sabrina Ambroselli
Lucia Niccolini