

Aspects of Centridine Biology (*Centris* spp.)
Importance for Pollination, and Use of *Xylocopa* spp.
as Pollinators of Greenhouse Tomatoes

Presented by
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Workshop on Solitary Bees: Conservation, Breeding and Management for
Pollination

Beckenburg, Ceará, April 26-30, 2004



INTERNATIONAL WORKSHOP ON SOLITARY BEES AND
THEIR ROLE IN POLLINATION
26 - 29 April, 2004
Ceará - Brazil
Ministério do Meio Ambiente

My sincere thanks!
to Breno Freitas, the organizing committee
and the Ministério do Meio Ambiente
for bringing me to Brazil and for the opportunity
to present ideas about Pollinator Initiatives
and talk about some of my favorite bees.

Centris and *Xylocopa*!



"The evidence is overwhelming that wild pollinators
are declining. Their ranks are being thinned not just
by habitat reduction and other familiar agents of
impoverishment, but also by the disruption of the delicate
"biofabric" of interactions that bind ecosystems together.
Humanity, for its own sake, must attend
to these pollinators and their countless dependant plant
species."

Edward O. Wilson
Foreword, *The Forgotten Pollinators*
Island Press, 1996/97



"Humanity is exalted not because we are so far above
other living creatures, but because knowing them well
elevates the very concept of life."

Edward O. Wilson, *Biophilia*, 1984, p. 22



Pollination and Pollinators,
Why does it matter?



Pollination of world's 1/4 million angiosperms,
1400 crop plants

1. Food, fiber, oil, medicinal plants
2. Food for wildlife etc.
3. Ecosystem services (pollination, bioturbation, biocycling)



Got pollination?

Threats to Pollinators & Pollination...

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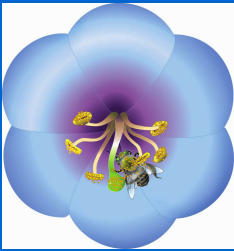
"HIPPO"
vs. "OPPIH"

- Habitat loss, disruption, fragmentation into habitat islands, traffic, city lights...
- Pesticides, herbicides, the "chemical chainsaw"
- Competition with other spp. (eg. Apis)
- Displacement by invasive animals and plants

- Protect HABITATS, as big as possible.
- Don't use pesticides, or spray at night.
- Plant locally adapted native wildflowers.
- Avoid using modern hybrid flowers.
- Leave dead trees and limbs standing.
- Create bee-nesting refuges (bare areas of sandy soil, vertical banks, dead wood).
- Offer nesting materials (mud, leaves, resins, sand).
- Install "bee condos" of drilled wood blocks.
- Plant flowers in clumps, overlap blooming.



Family: Apidae
Centris Fabricius
Neotropics, savannas, deserts, approximately
109 species in 12 subgenera (Michener, 2000)



Centris eisenii

- 12 Subgenera of Centris
- Acritocentris Snelling (4)
- Centris Fabricius (11)
- Exallocentris Snelling (1)
- Heterocentris Cockerell (17)
- Melacentris Moure (18)
- Paracentris Cameron (15)
- Ptilocentris Snelling (1)
- Ptilotopus Klug (12)
- Trachina Klug (15)
- Wagenknechtia Moure (4)
- Xanthemisia Moure (4)
- Xerocentris Snelling (7)

Epicharis
(closely related to Centris)
10 subgenera & 22 species



Nesting habits:

- Centris includes ground-nesters (odalous)
- Twig/wood-nesting (Usurp beetle burrows)
- Can be trap-nested in artificial nests

Forage Requirements:

- High quality pollen & nectar
- Floral oils, resins, sand, debris

Reproductive Biology of Centris

Largely protandrous (males emerge first)
Mating can occur at nests, at flowers or elsewhere.



Alternative mating strategies in some spp.
Dimorphic males (morphs). Large "metander" males detect, excavate and mate with pre-emergent virgin females, eg. *C. pallida* Fox.
Courtship behavior with complex post-insemination display, tactile/acoustic.
Females receiving complete display become unresponsive to other males.
System studied extensively by J. Alcock & S. Buchmann in AZ

Other tropical spp. studied by Frankie et al, Roubik, Freitas

Tropical Crops Suitable for Centris

"Nance" (*Byrsonima crassifolia*)
Barbados Cherry (*Malpighia glabra*)
Passion Flower (*Passiflora* spp.)



Byrsonima crassifolia ("Nance") "Murici" (in Brazil)



Byrsonima (~20 spp. Brazilian cerrado)

Byrsonima basiloba (Field Nance)
(wild harvested in Brazil)

Bunchosia argentea (Peanut Butter Fruit)

Malpighia glabra (Acerola, Barbados Cherry)



**Byrsonima*, *Malpighia* & *Anacardium* (cashew)
studied by Breno Freitas (1997-2002+)

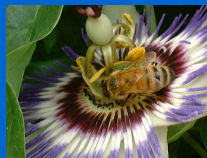
Passiflora edulis



Xylocopa



Epicharis schrottkyi



Apis

Tropical Centris (Hole-nesters) Suitable for commercial use as pollinators...

especially *Heterocentris* (red metasoma)

**Centris analis*
C. trigonoides
C. inermis?
C. dichotricas



C. analis at trap nests in Panama, D.Roubik

Advantages of Using Centris as Pollinators

- Large bees, carry lots of pollen (dry)
- Efficient pollinators, deliver large stigmatic loads
- Manageable in moveable nest blocks
- Morphological & behavior adaptations to visit oil-producing flowers (Malpighs)
- Can be trap-nested
- Populations can be increased

Disadvantages of Using Centris for Pollination of Commercial Crops



C. caesalpiniae, F, M

- Not commercially available
- Must trap nest and buildup populations
- Specialist pollinators, not as likely to visit and pollinate diverse crops
- Not suitable for use in greenhouses



Family: Apidae
Large Carpenter bees
Xylocopa
Approximately 471 spp.
in 31 subgenera
(Michener, 2000)



Arizona Carpenter Bees Studied as candidate pollinators of greenhouse crops

Xylocopa varipuncta Patton
(Subgenus Neoxylocopa)
[AZ, NV, CA, Mexico]

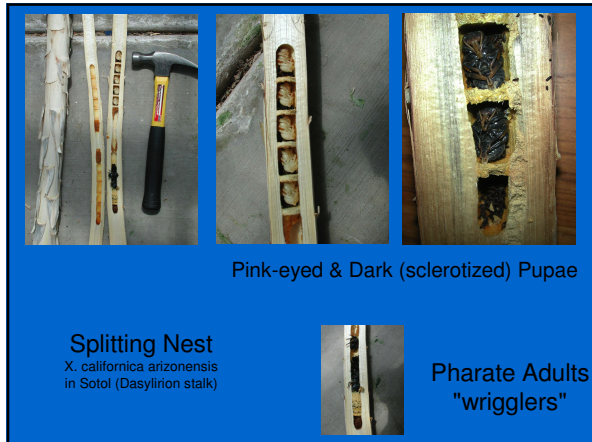
X. californica arizonensis Cresson
(Subgenus Xylocopoides)
[CA, TX, NV, UT, Mexico]



Stalking the Wild Sotol (Dasylirion)



Xylo. nests adj. to agric. plot

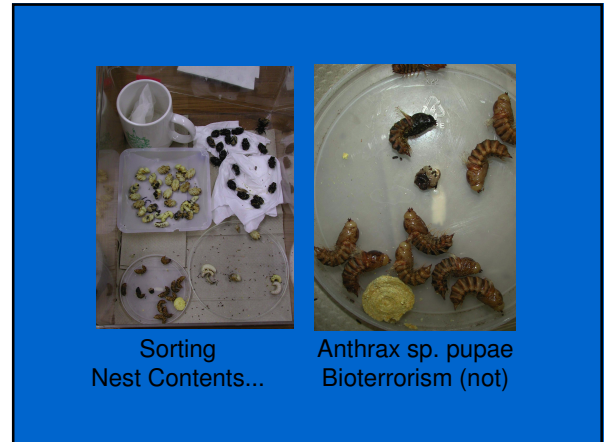


Pink-eyed & Dark (sclerotized) Pupae

Splitting Nest
X. californica arizonensis
in Sotol (Dasylirion stalk)



Pharate Adults
"wrigglers"



Sorting
Nest Contents...

Anthrax sp. pupae
Bioterrorism (not)

"Buzz Pollination"
About 8% of world's 270K angiosperms have poricidal anthers...
Not all bees can sonicate, Apis can't (rare in Andrenidae, Megachilidae)

"good vibrations"

Ptiloglossa jonesi (Colletid) buzzing S. rostratum

Lycopersicon esculentum requires floral sonication
Larger fruits from bee visits over electric vibrators

Mature flower
The mature flower appears as a bright yellow open cone and is ready for pollination. For best tomatoes, 3 to 5 flowers should be allowed to develop on a healthy vine.

Bees grasp androecium with mandibles, leaving brown marks "BEE KISSES" scored by growers to assess fruit set

Fertilized flower
Fertilized flowers are identified by the appearance of fruitlets on the calyx covered by dew-like beads clumping onto and pollinating the flower.

Univ. AZ Controlled Environment Hydroponic Tomato Greenhouses, Tucson, AZ

Using X. californica to buzz pollinate tomato

Problems to overcome when using Xylocopa for greenhouse pollination:
A nectar source (Luffa?) if tomatoes
Artificial flower feeders (eg. Amegilla)
Small numbers of individuals/nest
Long periods of female inactivity within nests
Not commercially available
Bees do not readily accept trap nests

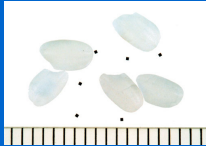
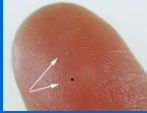
Advantages with Xylocopa:
Individuals live 2 to 3 years
Highly polylectic, Sonicate blossoms
Larvae, pupae and adults hardy
Easy to move nests

Future Plans for studying *Xylocopa* & *Bombus* as tomato pollinators:

Have already constructed simple "break the beam" IR sensors and dataloggers (total bee traffic/clock times)

Will experiment with sensors and latest RF tags from Hitachi. Tags are only 0.4 X 0.4 X 0.1mm and weigh 4mg "meu-chip", antenna integrated into chip

With these passive RF chips, individual birth-to-death dossiers on bees can be realized for central place foragers, or querying bees at flowers.



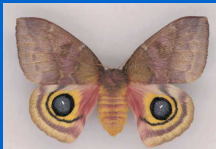
Stay Tuned... ...a new development

exciting new technical capability at
The Bee Works in Tucson, AZ

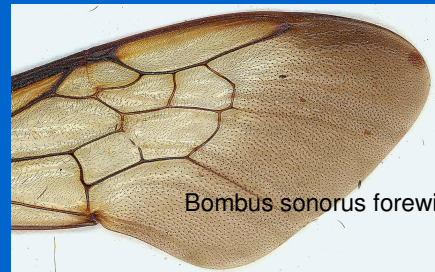


Honey, I blew up the pollinators...

By May 3rd, The Bee Works will have
a Creo flatbed scanner (14,000 dpi)
an Epson 9600 printer
Ability to create fine art Giclee prints

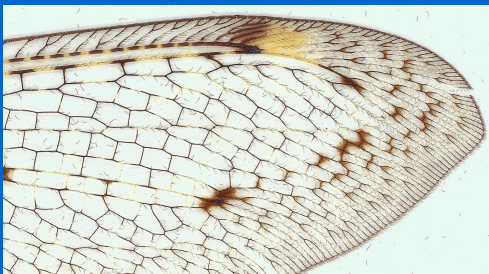


Extreme resolution
5600 to 14000 dpi (1.8 microns)
Take a 1/4 inch insect, enlarge to 40" across



Bombus sonorus forewing

Antlion




Swallowtail butterfly, individual wing scales

Goal is to produce image databases
 Excellent field guides and other books, e.g. an identification
 guide to SW bees...
 Coffee table books on pollinators
 Use images for NAPPC fund-raising
 Art exhibits, sales of Gicle fine art prints

next...

Conservation Handbook: A Guide to Understanding, Protecting, And Providing Habitat for Native Pollinator Insects

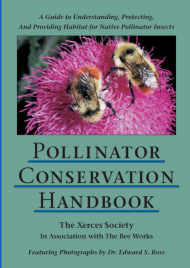


By
 Matthew shepherd, Stephen Buchmann,
 Mace Vaughn, Scott Hoffman Black

Published by The Xerces Society In
 Association with The Bee Works
 Sept. 2003

Conservation Handbook

Available online from
 The Xerces Society
www.xerces.org



145 pp.
 57 Color Photos, E. Ross

Non-Members: \$22.45
 (including S & H)
 *Conf. special in Brazil \$20 (10 copies)

New Book! (July, 2004)




"Pollinators of the Sonoran Desert"

By
 Nina Chambers, Yajaira Gray
 & Stephen Buchmann




Published by: Arizona-Sonora Desert Museum,
 In Partnership with the International Sonoran Desert
 Alliance and The Bee Works

The End...



Questions about my talk?

Don't worry, just 1 more presentation until lunch..
 & after that, 6 more until "HappBee Hour"
 A "Cachaca" anyone?