Informe final* del Proyecto JU005
Décimo simposio internacional de la international Commission Plant-Bee Relationships (Comisión Internacional para las relaciones Planta-Abeja)

Responsable:	Dr. Carlos Hernán Vergara Briceño
Institución:	Fundación Universidad de las Américas Puebla
Dirección:	Ex-Hacienda Santa Catarina Mártir, San Ándres Cholula, Pue, 72820, México
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Fecha de inicio:	Junio 15, 2011
Fecha de término:	Febrero 8, 2012
Principales resultados:	Reunión académica, informe final.
Forma de citar el informe final y otros resultados:**	Vergara Briceño C. H. 2011. Décimo simposio internacional de la international Commission Plant-Bee Relationships (Comisión Internacional para las relaciones Planta-Abeja). Fundación Universidad de las Américas Puebla. **Informe final SNIB-CONABIO proyecto No. JU005.** México, D.F.

Resumen:

El Simposio contó con la participación de 89 personas registradas y entre 20 y 30 asistentes no registrados. Entre los participantes extranjeros se contó con la presencia de investigadores y estudiantes de Canadá, Estados Unidos de América, Guatemala, Argentina, Brasil, Nueva Zelanda, Australia, India, Israel, Kenia, Estonia, Alemania, España, Francia, Dinamarca, Inglaterra, Suiza y Polonia, así como una representante de la Food and Agriculture Organization de las Naciones Unidas (FAO).

Durante el Simposio se presentaron 55 ponencias orales y 32 carteles y se realizaron dos paneles de discusión.

Como complemento del Simposio, se llevó a cabo un Taller Canadá - América Latina, sobre posibles colaboraciones en investigación de la polinización de plantas de importancia económica, auspiciado por NSERC-CanPolin (National Sciences and Engineering Research Council of Canada-Canadian Pollination Initiative), el cual contó con la participación de 14 investigadores y estudiantes de instituciones canadienses y 10 investigadores o estudiantes de instituciones de Guatemala, Brasil y México.

- * El presente documento no necesariamente contiene los principales resultados del proyecto correspondiente o la descripción de los mismos. Los proyectos apoyados por la CONABIO así como información adicional sobre ellos, pueden consultarse en www.conabio.gob.mx
- ** El usuario tiene la obligación, de conformidad con el artículo 57 de la LFDA, de citar a los autores de obras individuales, así como a los compiladores. De manera que deberán citarse todos los responsables de los proyectos, que proveyeron datos, así como a la CONABIO como depositaria, compiladora y proveedora de la información. En su caso, el usuario deberá obtener del proveedor la información complementaria sobre la autoría específica de los datos.

INFORME FINAL
JU005

Décimo Simposio de polinización organizado por la Internacional de la International Commission Plant-Bee Relationships (Comisión Internacional para las relaciones Planta-Abeja). Universidad de las Américas Puebla, Ex - Hacienda Santa Catarina Mártir, San Andrés Cholula, Puebla del 27 al 29 de junio de 2011

1. Informe de actividades realizadas

El simposio dio inicio el lunes 27 de junio de 2011 a las 8:30 a.m. con palabras de bienvenida del Dr. Luis Ernesto Derbez Bautista, rector de la Universidad de las Américas Puebla y se desarrolló según el siguiente programa:

Lunes 27

8:30-10:00	Sesión de apertura
10:00-10:30	Descanso
10:30-1:00	Bionomía, Biosistemática y Biodiversidad de abejas y Polinización
1:10-2:20	Comida
2:30-3:30	Fitotecnia y sistemas de apareamiento
3:30-4:00	Descanso
4:00-5:00	Polinización en la India: casos de estudio
5:00-6:30	Estado sanitario de las colonias manejadas de *Apis mellifera* y Polinización de cultivos

Martes 28

8:30-10:00	Efecto del uso del suelo sobre la biodiversidad de abejas
10:00-10:30	Descanso
10:30-12:00	Polinización en invernaderos
12:00- 1:00	Abejorros y Polinización en invernaderos en México
1:00-2:00	Comida
2:00-3:00	Polinizadores y polinización en las ciudades: jardines, parques y el ambiente urbano.
3:00-3:30	Descanso
3:30-5:45	Polinización de cultivos en la agricultura moderna Agriculture
5:45-7:30	Cena
7:30-8:30	Organización y educación – Panel de discusión

Miércoles 29

8:30-10:00	Conservación y polinización
10:00-10:30	Descanso
10:30-12:00	Estimación de las interacciones de polinización para el funcionamiento de los ecosistemas
12:00-1:00	Polinización y comercio nacional e internacional.
1:00-2:00	Comida
2:00-3:30	Efectos de los plaguicidas sobre abejas diferentes de *Apis*. Pánel de discusión
3:30-4:00	Descanso
4:00-5:00	Polinización en selvas
5:00-6:00	Sesión de carteles

2. Aspectos relevantes del congreso

El Simposio contó con la participación de 89 personas registradas y entre 20 y 30 asistentes no registrados. Entre los participantes extranjeros se contó con la presencia de investigadores y estudiantes de Canadá, Estados Unidos de América, Guatemala, Argentina, Brasil, Nueva Zelanda, Australia, India, Israel, Kenia, Estonia, Alemania, España, Francia, Dinamarca, Inglaterra, Suiza y Polonia, así como una representante de la Food and Agriculture Organization de las Naciones Unidas (FAO).

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3. Memorias del Simposio

Las memorias in extenso del Simposio serán publicadas como un número especial del Journal of Pollination Ecology (http://www.pollinationecology.org/), el cual aparecerá a fines de 2011 o principios de 2012.

4. Ejercicio de los gastos con fondos de CONABIO

El informe financiero se presenta por separado

5. **Copia de todas las impresiones publicitarias del evento y de su programa.**

Se anexan documentos en formato PDF del Programa General del Simposio, del cartel que se utilizó para el mismo y una carta constancia emitida a uno de los particpantes, como muestra de la papelería que se utilizó durante el evento.

Elaboró

Responsable del proyecto

Nombre: CARLOS HERNAN VERGARA BRICEÑO
Grado académico y puesto: Ph. D. Profesor Titular de Tiempo Completo

X International Symposium of Pollination

UDLAP Cholula, 27-30 June, 2011

I.C.P.B.R.
INTERNATIONAL COMMISSION FOR PLANT-BEE RELATIONSHIPS

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X International Symposium of Pollination
UDLAP Cholula, 27-30 June, 2011




Program & Abstracts

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The cover: the cover of the program depicts the god Xochipilli the god of art, games, beauty, dance, flowers, and song in Aztec mythology. His name contains the Nahuatl words *xochit ("flower") and pill* (either "prince" or "child"), and hence means "flower prince". As the patron of writing and painting, he was called Chicomexochitl "Seven-flower", but he could also be referred to as Macuilxochitl "Five-flower". His wife was the human girl Mayahuel and his twin sister was Xochiquetzal. As one of the gods responsible for fertility and agricultural produce, he was also associated with Tlaloc (god of rain), and Cinteotl (god of maize). Xochipilli corresponds to the Tonsured Maize God among the Classic Mayas.

The sculpture shown in the cover is at the Mexican National Museum of Anthropology. It is surrounded by a honey bee, a Mexican bumble bee, an agave-visiting bat and a hummingbird, all representative of the main groups of animal pollinators in Mexico.

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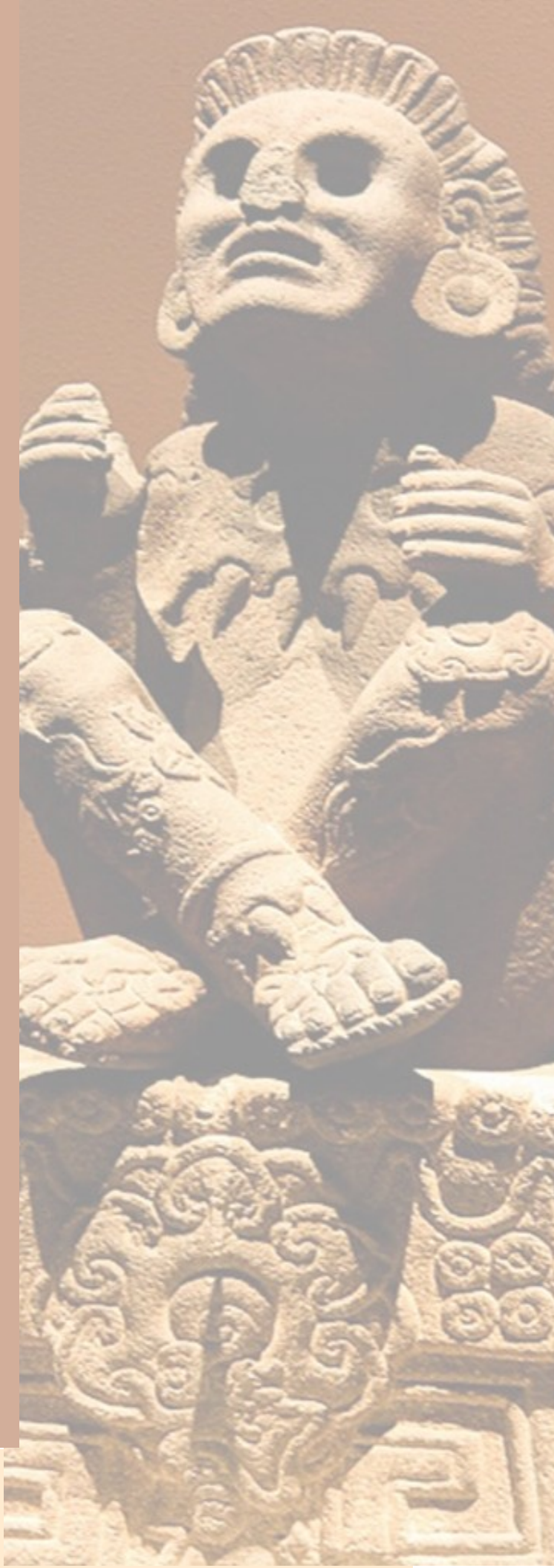

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UDLAP - for providing the general conference location and hospitality services

Cholula Ethnobotanical Gardens - for providing the location for the Crop Pollination Workshop Thursday June 30, 2011

Timetable

	Monday 27th	Tuesday 28th	Wednesday 29th
8:30-10:00	Welcome and Opening Session	Land Use effect on Bee Biodiversity	Conservation Issues in Pollination
10:00-10:30	**Break**		
10:30-12:00	Bees, Bionomics, Biosystematics, & Biodiversity in Pollination	Pollination in Greenhouses	Assessing Pollination Interactions for Ecosystem Function
12:00-1:00		Bumblebees in Greenhouse Pollination in Mexico	Pollination Issues for National & International Policies, Trade
1:00-2:00	**Break**		
2:00-3:30	Plant Breeding, Mating Systems & the Interfaces with Pollinators	Pollinators & Pollination in the City: Gardens, Parks, and the Urban Environment	Exploring pesticide effects on non-Apis bees
3:30-4:00	**Break**		
4:00-5:00	Pollination in India: modern case studies?	Issues in Crop Pollination for Modern Agriculture	Pollination in the forest
5:00-6:00	Health status of managed *Apis mellifera* colonies and pollination of agricultural crops		Poster Session
6:00-7:30	Social and Supper	Social and Supper	Social and Supper
7:30-8:30		Organization and Education	ICPBR Business Meeting

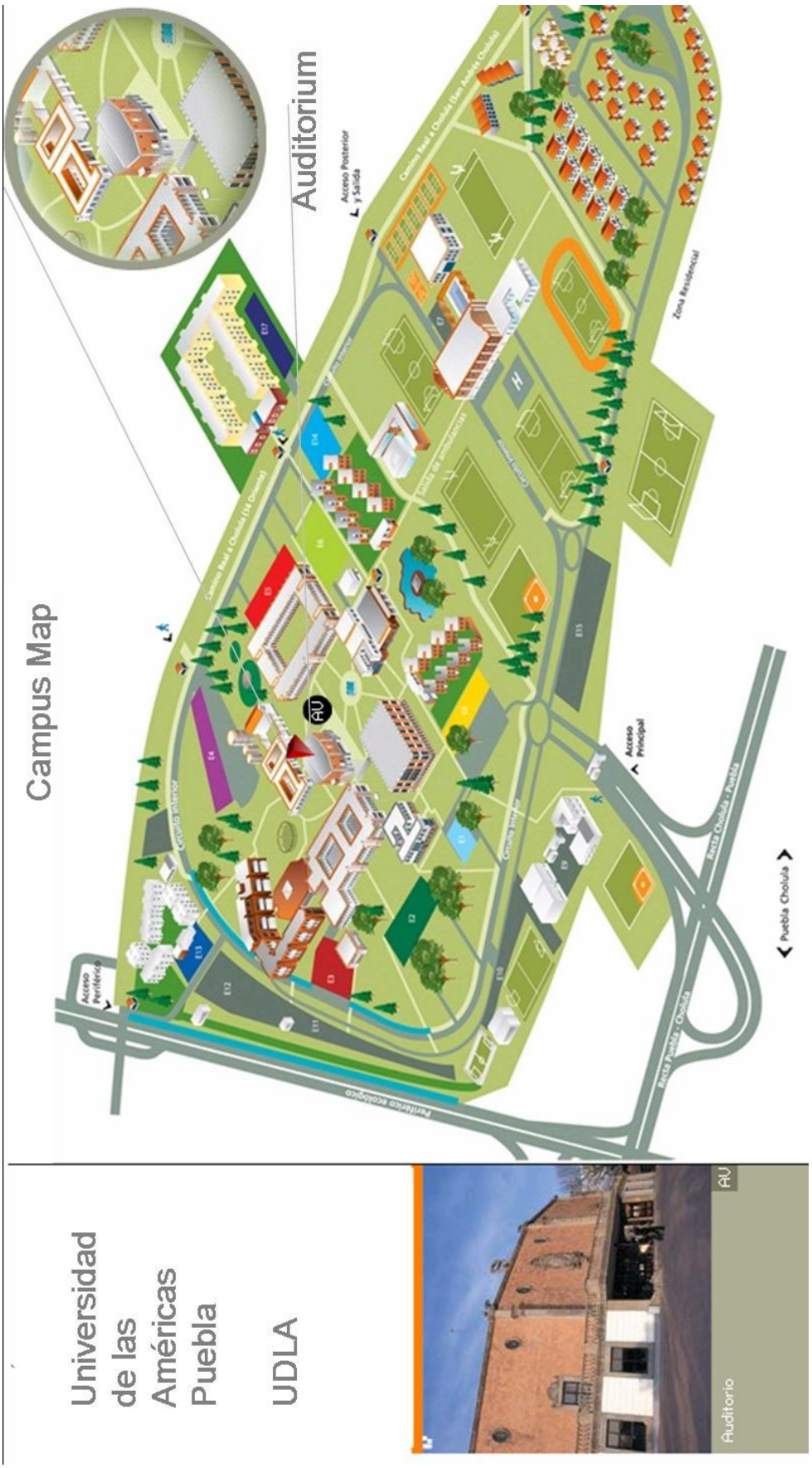
Venues

The Auditorium at UDLAP

The Symposium will be held at la Universidad de las Américas Puebla (UDLAP) with the session taking place in the Auditorium.

Latin American and Canadian Crop Pollination Workshop will be held at the Cholula Ethnobotanical Gardens

JARDÍN ETNOBOTÁNICO


Campus Map
Auditorium
Universidad de las Américas Puebla
UDLA
Auditorio
AU
Acceso Principal
Acceso Posterior y Salida
Acceso Periférico
Periférico ecológico
Recta Cholula - Puebla
Puebla Cholula
Zona Residencial

Schedule

Monday, June 27, 2011

8:00-8:30 Registration

8:30-10:00 Opening Session
Master of ceremonies: Carlos Vergara

8:30-8:35 Introducing authorities and special guests
8:35-8:40 Welcome and opening message by Dr. Luis E. Derbez, Rector of UDLAP
8:40-8:45 Message from Carlos Vergara
8:45-9:00 Break
9:00-10:00 Introduction and key note address from ICPBR Chair Peter Kevan

10:00-10:30 Coffee Break

10:30-1:00 Bees, Bionomics, Biosystematics, & Biodiversity in Pollination
Moderator: Ricardo Ayala

10:30-10:50 **Natural Protected Areas and the ecosystem services of pollination in Mexico**
Virginia Melendez

10:50-11:10 **Diversity of bees in Mexico, conservation and importance as pollinators**
Ricardo Ayala

11:10-11:30 **Managing Pests and Diseases in Commercial Bumblebee Production**
Alfonso Torres

11:30-11:50 **Stingless bees for beekeeping and crop pollination in Mexico, considerations for maintaining genetic diversity**
Javier Quezada

11:50-12:10 **The study of native bees in Guatemala: diversity, ecology and applicability**
Natalia Escobedo Kenefic, Enríquez, Eunice; Yurrita, Carmen Lucía; Dardón, María José; Vásquez, Mabel;

Armas, Gabriela; Maldonado, Carlos; Bracamonte, María Fernanda; Rodríguez, Gabriela

12:10-12:30 **A Revision of the Cleptoparasitic Bee Genus *Coelioxys* (Hymenoptera: Megachilidae) in Canada***
Nick de Silva

12:30-12:50 **First report of oil collecting bees in three species of Papilionoideae (Leguminosae) ***
Ángela V. Etcheverry, Trinidad Figueroa-Fleming, Alberto H. Abrahamovich, Diego Lopez-Spahr, Carolina Yañez, María Mercedes Alemán and Dulce María Figueroa-Castro

12:50-1:10 **Biotic Resource Needs of Specialist Orchid Pollinators ***
Robert W. Pemberton

1:10-2:20 LUNCH

2:30-3:30 Plant Breeding and Mating Systems

Moderator: TBA

2:30-2:50 **Studies of intraplant pollen supply in modern and wild genotypes of sunflower (*Helianthus annuus*)? ***
Astiz, V., A.C. Fernández, P.A. Marinangeli, A. Flemmer and L.F. Hernández

2:50-3:10 **Pollination in the carrot family (Apiaceae): how specialized can a (morphologically) generalized plant be? ***
Marcin Zych

3:30-4:00 BREAK

4:00-5:00 Pollination in India: modern case studies

Moderator: Sudhendu Mandal

4:00-4:15 **Biodiversity of pollen, pollinators and conservation**
Dr. Sudhendu Mandal

4:15-4:30 **Studies on the pollination calendar and atmospheric pollen flora of allergenic plants of Asansol Industrial Belt, West Bengal, India ***
Anindita Mandal and Sudhendu Mandal

4:30-4:45 Floral biology and pollination of *Solanum sisymbri folium* Lamk. *
Sudhendu Mandal, Subrata Mondal and Kakali Biswas

4:45-5:00 Floral biology and pollen dispersal of *Pentapetes phoenicea* Linn.*
Sudhendu Mandal, Subrata Mondal and Sandip Choud hury

5:00-6:30 Health Status of managed *Apis mellifera* colonies and pollination of agricultural crops
Moderators: Jeff Petis and Peter Neumann

5:00-5:15 Honey bee colony losses in North America
Jeff Pettis

5:15-5:30 Honey bee viruses, newcomers or permanent residents*
Nor Chejanovsky

5:30- 5:45 *Nosema ceranae* has existed in Mexico since at least 2004*
Ernesto Guzmán-Novoa

5:45-6:00 Honey bee colony losses in Brazil and disease diagnosis efforts *
Erica W. Teixeira

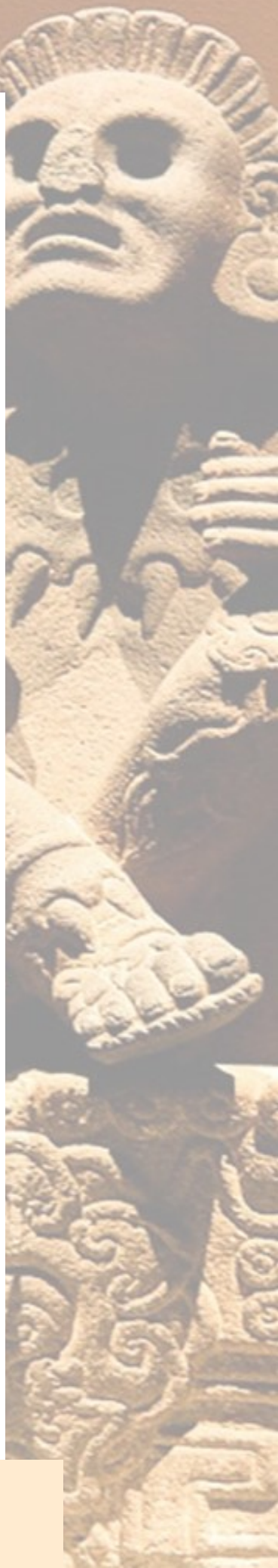
6:00-6:15 Colony losses in Europe and the COLOSS network
Peter Neumann *

6:15-6:30 An Epidemiological approach to understanding colony losses?
Dennis van Engelsdorp

Tuesday June 28, 2011

8:30-10:00 Land Use Effect on Bee Biodiversity
Moderators: Remy Vandame and Javier Quezada

8:30-8:45: Bee diversity along a forest regeneration gradient in western Kenya *
M. W. Gikungu, D. Wittmann, D. Irungu & M. Kraemer



8:45-9:00: Drivers of non-Apis pollinators in California almond orchards and their benefit for almond pollination *
Claire Brittain

9:00-9:15: The effect of coffee agriculture on bee diversity in Dak Lak, Vietnam *
H. T. Ngo

9:15-9:30: The effects of fire on bee communities in Oak Savannah habitat in Southern Ontario, Canada*
Alana N. Taylor-Pindar and Dr. Laurence Packer

9:30-9:45 Agricultural landscape fosters rich native bumble bee diversity and abundance in Western USA*
Sujaya Rao and W. P. Stephen

9:15-9:30: Land use effect in coffee landscapes for the conservation of native bees*
J.A. Florez, R. Vandame, R. Ayala

9:30-9:45 Diversity of native bees in habanero pepper (*Capsicum chinense*) cultivars in relation with the surrounding land scape in the Yucatan Peninsula, México*
J. Quezada-Euán, G. Javier, Jessica Pérez-Balam, R.J. Paxton, and R. Ayala

10:00-10:30 BREAK

10:30-12:00 Pollination in Greenhouses
Moderators: Les Shipp and Patricia Nunes-Silva

10:30-10:40 Introduction

10:40-11:10 Alliances between beneficial insects, plants and fungi pollinate, protect, and promote crop production*
Peter Kevan

11:10-11:25 Crop pollination in greenhouses and the use of stingless bees in Mexico *
Virginia Meléndez Ramírez, Ricardo Ayala and Laura Meneses Calvillo

11:25-11:40 The potential use of *Melipona fasciculata*, a stingless bee, for buzz pollination: what do vibration characteristics tell us?*
Patrícia Nunes-Silva, Michael Hnrcir, Les Shipp, Peter G. Kevan and Vera Lucia Imperatriz-Fonseca

11:40-11:55 **Impact of Greenhouse Tomato Floral Volatiles on Bumble Bee Pollination ***
L. Shipp, A. Morse, P. Kevan, S. Khosla and B. McGarvey

12:00- 1:00 **Bumblebees in Greenhouse Pollination in Mexico –**
Moderators: Carlos Vergara

12:00-12:20 **Evaluation of the efficiency of *Bombus ephippiatus* Say (Hymenoptera, Apidae) as a greenhouse pollinator of tomato (*Lycopersicon esculentum* (Mill.) ***
Carlos Hernán Vergara, Paula Fonseca-Buendía

12:20- 12:40 **Biobest in Mexico: history and perspectives**
Luis Javier Díaz, Biobest

12:40 – 1:00 **Ephippol, Mexican bumble bees for greenhouse pollinators**
Ignacio Cuadriello

1:00-2:00 LUNCH

2:00-3:00 **Pollinators and Pollination in the City: Gardens, Parks, and the Urban Environment**
Moderator: Marianna Horn

2:00-2:12 **A comparison of pollinator biodiversity between green spaces, industrial areas and residential land -use zones in urban, southern Ontario, Canada***
Marianna Horn

2:12-2:24 **Developing habitat and management techniques for bees on utility lands: industry partnerships for pollinator conservation ***
Vicki Wojcik

2:24-2:36 **The URBAN BEES Project***
Hugues Mouret, Charlotte Visage, Michael Kuhlmann, Frédéric Vyghen, Laurent Guilbaud, Michaël Henry, Caroline Sabah-, Laura Fortel & Bernard E. Vaissière

2:36-2:48 **Stingless bees in archaeological sites in southeastern Mexico ***

Chavier De Araujo Freitasa, Jorge A. González Aceretoa, Jaime Abed Cesinb

2:48-3:00 **Effects of human settlements and green areas at multiple spatial scales on the diversity and abundance of bumblebees***
Isabel Diaz-Forero, Valdo Kuusemets, Marika Mänd

3:00-3:30 BREAK

3:30-5:45 **Issues in Crop Pollination for Modern Agriculture**
Moderators: Bernard Vaissière and Breno M. Freitas

3:30-3:45 **Honey bees role in pollination and its impacts on yield of canola***
Hussain Ali

3:45-4:00 **Bee pollination of the sour cherry varierty "Stevnsbaer" (*Prunus cerasus*)***
Lise Hansted

4:00-4:15 **Bee pollinators of entomophilous crops in SW Virginia***
Nancy Adamson

4:15-4:30 **The abundance and distribution of native bees on New Zealand crops***
Brad G. Howlett and Melanie K Walker

4:30- 4:45 **Current status of insect pollination in mango***
Shashi Sharma

4:45-5:00 **Potential pollinators: a study of the floral visitors of coriander *Coriandrum sativum* L. (Apiaceae) in Mitidja area (Algeria)***
Leila Bendifallah, Salah Eddine Doumandji and Kamel Louadi

5:15-5:30 **Refining the economic valuation of animal pollination in agriculture at a national scale***
Marie Harruis, Fabrice Allier, Nicola Gallai and Bernard E. Vaissière

5:30-7:30 SOCIAL AND SUPPER

7:30-8:30 Organization and Education – Panel Discussion

Peter Kevan – CANPOLIN, ICPBR, IUBS
Vicki Wojcik – NAPPC and Pollinator Partnership
Ed Spevak – St. Louis Zoo and IUCN

Wednesday June 29, 2011

8:30-10:00 Conservation Issues in Pollination
Moderator: Rufus Isaacs

8:30-8:50 Integrating flowering plants into intensive fruit and vegetable systems for sustainable crop pollination: challenges and opportunities
Rufus Isaacs, Julianna Tuell, Brett Blaauw, Neal Williams, Kimiora Ward, Jamie Ellis, Acres Pence, and Jaret Daniels

8:50-9:10 The spatial and temporal effects of insecticides on pollinators in Britain – a large scale approach
Claire Brittain, Vighi, M., Bommarco, R., Roberts, S.P.M., Thomas, M., Sørensen, P.B., Gyldenkærne, S., Settele, J. & Potts, S.G.

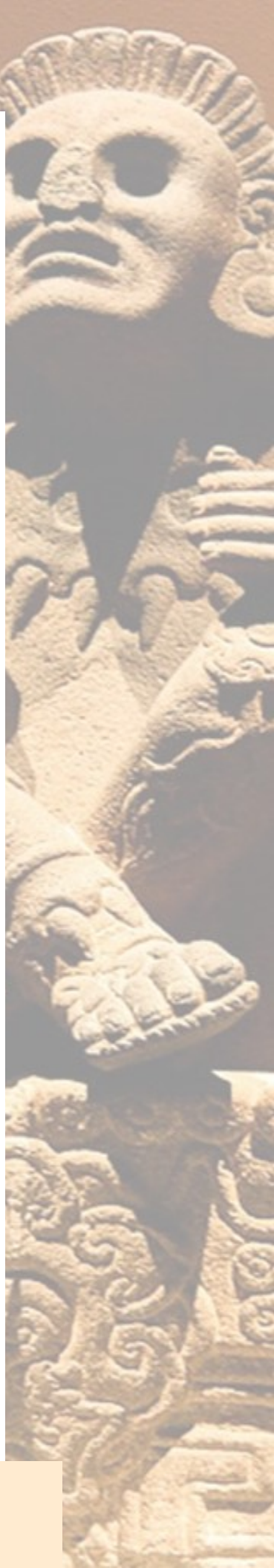
9:10-9:30 Species traits and the sensitivity of bees to environmental change
Neal Williams

9:30-9:50 Does size matter? Pollinators' efficiency in critically endangered fritillary (*Fritillaria meleagris* L., Liliaceae) *
Marcin Zych, Małgorzata Stpiczyńska, Katarzyna Roguz, Krystyna Jędrzejewska-Szmek and Jan Goldstein

10:00-10:30 BREAK

10:30-12:00 Assessing Pollination Interactions for Ecosystem Function
Moderator: Blandina F. Viana

10:30-10:45 Pollination within the landscape context: what do we know and what should we know? *
Blandina F. Viana, Danilo Boscolo, Eduardo Mariano Neto, Luciano E. Lopes, Ariadna V. Lopes, Patrícia A. Ferreira, Camila M. Pigozzo & Luis Primo



10:45-11:00 **Modeling pollinators across agricultural landscapes ***
Christina Kennedy, Eric Lonsdorf, Neal Williams, and Claire Kremen

11:00-11:15 **A flower-visitation web of Papilionoideae (Leguminosae) from Northwestern Argentina**
Ángela V. Etcheverry, Trinidad Figueroa-Fleming, Diego Lopez-Spahr, Carolina Yañez, María Mercedes Alemán and Dulce María Figueroa-Castro

11:15-11:30 **Plants and bees mutualistic networks in three ecosystems in Santa Catarina, southern Brazil**
Cristiane Krug and Isabel Aves dos Santos

11:30-11:45 **Pollination networks along a successional gradient of tropical dry forest ***
Martha Lopezaraiza-Mikel, Yunuén García Rojas, Arely Vázquez and Mauricio Quesada

12:00-1:00 Pollination Issues for National & International Trade

Moderator: Vernon Thomas

12:00-12:10 **Introduction**

12:10-12:25 **The potential role of the North American Free Trade Agreement in pollinator protection ***
McCavour, M.J., Kevan, P., and Greene, D.F.

12:25-1:00 **Pollinating Species, Commodity Values, Trade and Policy Considerations ***
Vernon Thomas and Peter G. Kevan

1:00-2:00 LUNCH

2:00-3:30 Exploring pesticide effects on non-*Apis* bees - Panel Discussion

Barbara Gemmill-Herren - FAO
Sheila R. Colla - York University
Dino J. Martins - Kenya
Mary Gikungu - National Museum of Kenya

3:30-4:00 BREAK

4:00-5:00 Pollination in the Forest
Moderator: Márcia Motta Maués

4:00-4:12 Pollination strategies of Amazonian trees*
Márcia Maués

4:12-4:24 Why do Australian *Acacias* offer free food? Pollinators in an ant-*Acacia* mutualistic system within a longitudinal gradient across Victoria*
Angélica Elizabeth Martínez-Bauer and Martin Burd

4:24-4:36 Impact of the Africanized honey bee on population size, nectar and pollen sources of solitary bees*
David W. Roubik and Rogel Villanueva-Gutiérrez

4:36-4:48 Pollination Services in Mexico*
Quesada Mauricio, Ashworth Lorena, Aguilar Ramiro, Casas, Alejandro, Oyama Ken

4:48-5:00 Birds and bees on flowering trees *
Peter Kevan

5:00-6:00 POSTER SESSION (listed in alphabetical order by first authors, also see Poster Abstracts section)

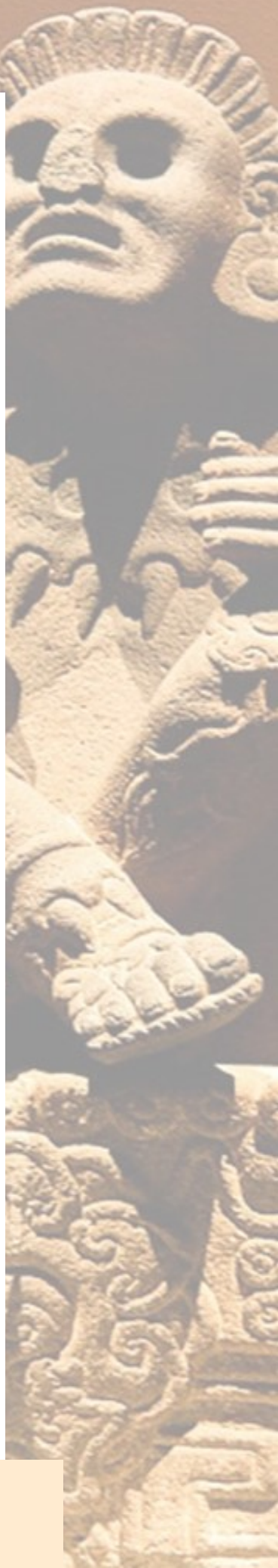
Sandra Aracely Aguilar-García, Dulce María Figueroa-Castro and Pedro Luis Valverde - Flower orientation and male reproductive traits in *Pachycereus weberi* (Cactaceae)

Anne Alix and Mark Miles - Pesticide use in crops and pollinators: protection goals and related regulatory tools

Isabel Alves-dos-Santos, Mardiore Pinheiro, Guaraci Duran Cordeiro, Cristiane Krug, Maria Cristina Gaglianone – Monitoring the bee fauna in crops: a purpose to evaluate the deficit of pollinating bees in Brazil

Marcelo Casimiro Cavalcante, Marcia Motta Maués, Breno Magalhães Freitas – Pollination and pollinators of Brazil Nut (*Bertholletia excelsa*) in a crop of the central rain forest

Eribel Bello Cervantes, Silvia Guzmán Jiménez, Sombra Patricia Rivas-Arancibia, Hortensia Carrillo-Ruiz, Dulce María Figueroa-Castro, and Agustina Rosa Andrés-



Hernández - Effect of antropogenic perturbation on the community of floral visitors of *Bursera copallifera* (Burseraceae)

Madeleine Chagnon, Michel Girard and Domingos de Oliveira - Is fruit set in cranberry crops limited by plant resource or by pollination?

Sheila R. Colla - Pesticide Exposure Routes for Bumblebees (*Bombus* spp.)

Natalia Escobedo Kenefic and Enríquez Cotón, María Eunice - Seasonality of the use of Cardamom pollen by the bees of Laguna Lachua National Park Zone of Influence

Carla Essenberg - Explaining variation in pollinator responses to flower density: nonlinear effects and scale-dependence

Ángela V. Etcheverry, Trinidad Figueroa-Fleming, Diego Lopez-Spahr, Carolina Yañez, María Mercedes Alemán and Dulce María Figueroa-Castro - A flower-visitation web of Papilionoideae (Leguminosae) from Northwestern Argentina

Barbara Gemmill-Herren and Antonio Felicioli - Pesticide Exposure Routes for 'Leaf-cutter Bees – Megachilidae

Miriam Gimenes, Joicelene Regina Lima da Paz- Pollination of *Ipomoea carnea* subsp. *Fistulosa* (Mart. Ex Choisy) DF Austin (Convolvulaceae) by bees and moths in the disturbed area in the semiarid northeastern region of Brazil

Jitendar Kumar Gupta – Community Learning and Innovation: Wild Pollinators and Pesticides on Apples in Himachal Pradesh, India

N.K. Joshi - Policy framework for conserving pollinators in traditional agricultural production systems

Anna K. Kirk - BLUEPOLL: Modeling honey bee and bumble bee pollination and subsequent crop yields in highbush blueberry (*Vaccinium corymbosum*)

Gail MacInnis - Modelling long-distance anemophilous pollen dispersal: contamination of seed orchards and non-GE agricultural crops

Carla Tatiana de Vasconcelos Dias Martins, Nerimar Barbosa Guimarães, Magda Mangabeira de Oliveira Feitoza, Tamires Almeida da Silva, Amanda Pricilla Batista Santos, Lúcia Helena Piedade Kiill - Reproductive Biology *Portulaca umbraticola* Kunth Portulacaceae) in Petrolina, PE, Brazil

Dino J. Martins - Pesticide Exposure Routes for 'Sweat Bees' - Halictidae

M. Miles - Pesticides and Honey Bees – the risk assessment process in the European Union

Marisa Navarro-Pérez Ana Ortega-Olivencia, Tomás Rodríguez-Riaño, José L. Pérez-Bote, Josefa López, Francisco J. Valtueña, and Carlos Mayo- Cohort of Hymenoptera pollinators on two endemic large-flowered *Scrophularia* species in W Mediterranean

Ha N. Nguyen, Amy Boyd, Michelle Zjhra, Robert Raguso, Peter Palmiotto - Specialized on generalists – attraction characteristics of early spring flowering *Trillium cuneatum*

Roberta C. F. Nocelli, Thaisa C. Roat, Andrigo M. Pereira, Stephan M. Carvalho, Elaine C. M. Silva-Zacarin, Osmar Malapsina - Pesticide Exposure Routes for Brazilian stingless bees

Mary Lucy Oronje - Pollination needs and the role of solitary bees on seed set and quality of Crotalaria brevidens Benth in Kakamega, Western Kenya

Colin Phifer and Elizabeth Stacy – Alone but not apart? The pollination ecology of dioecious shrubs in a fragmented forest

Liliana Ramírez-Freire, Glafiro José Alanís Flores, Ricardo Ayala Barajas, Humberto Quiroz Martínez and Carlos Gerardo Velazco Macías - Bees of the genus *Xylocopa* (Hymenoptera: Apidae) in state of Nuevo Leon, Mexico

Nar B. Ranabhat - Potential bee flora of Central Nepal

Amanda Pricilla Batista Santos, Tamires Almeida da Silva, Daniela Pionório Vilaronga Castro, Magda Oliveira Mangabeira Feitosa, Carla Tatiana de Vasconcelos Dias Martins, Lúcia Helena Piedade Kiill - Pollination Ecology Of *Arrojadoa rhodantha* (Gurk) Britton & Rose (Cactaceae) in Petrolina, PE, Brazil

Mohamed Shebl Abd Elfattah - The biodiversity of the genus *Andrena* and their floral association collected from Kazakhstan and Kyrgyzstan

J. van der Steen, I. Roessink, R. Nocelli, O. Malaspina, M. Kasina, M. Gikungu – Method to determine the acute contact LD50 of pesticides to non-standard social and solitary bees

Harold van der Valk, Irene Koomen, Barbara Gemmill-Herren, Tjeerd Blacquière - Aspects determining risk of pesticides to wild bees: structured assessment for focal crops

Francisco J. Valtueña, Ana Ortega-Olivencia, Tomás Rodríguez-Riaño, José L. Pérez-Bote, Josefa López, Carlos Mayo, and Marisa Navarro-Pérez - Behaviour of bumble bees and wasps visiting two large flowered *Scrophularia* species in the Iberian Peninsula

Mace Vaughn - Opportunities for non-Apis bees to inform pollinator risk assessment

Natalia Veiga - Large-Scale Fire Effects on Wild Bee Diversity in Northeastern Argentina

6:00-7:30 SOCIAL AND SUPPER

7:30-8:30 ICPBR Business meeting

See Business meeting agenda (page 57)

Thursday June 29, 2011

9:00-12:00 Latin American and Canadian Crop Pollination Workshop

See agenda (page 59)

Bees, Bionomics, Biosystematics, & Biodiversity in Pollination

A REVISION OF THE CLEPTOPARASITIC BEE GENUS *COELIOXYS* (HYMENOPTERA: MEGACHILIDAE) IN CANADA

Nick de Silva

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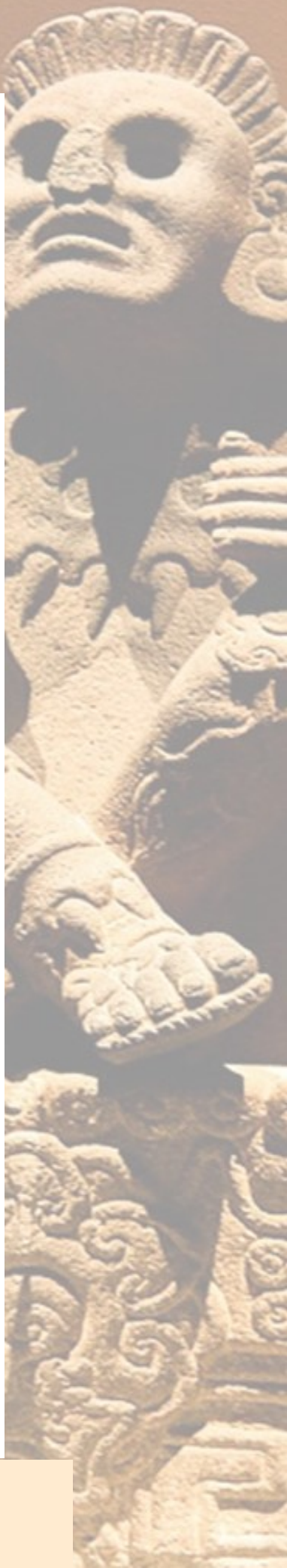
Bees of the genus *Coelioxys*, like many other cleptoparasitic bee groups, are relatively poorly studied. Despite being among the most common cleptoparasitic bees, uncertainties pertaining to species level classification still exist. Represented by over 480 species worldwide, these parasitic bees are known to attack multiple genera including *Centris*, *Megachile*, and *Xylocopa*. Some species are natural enemies of important crop pollinators such as C. sodalis which attacks the alfalfa pollinating *M. rotundata*, while others have been noted for their adept parasitisation of the cranberry pollinating M. addenda in North America. Still others are a significant cause of mortality for several species of cavity nesting pollinators in Central America. While it is understood that the relationships between pollinators and their natural enemies is critical, the taxonomic understanding of these cleptoparasites in Canada has been basic at best. In North America, north of Mexico, roughly 45 species have been recorded and until recently only 14 species have been recognized in Canada. Recent collecting and the examination of specimens from many museum collections have contributed to over 2000 specimens studied. Many of these specimens have been DNA barcoded, resulting in over 300 high quality sequences. The combined approach of using morphological and DNA barcode data has revealed a total of 18 species within 6 subgenera occurring in Canada, including 4 new species records and some considerable species range extensions.

FIRST REPORT OF OIL COLLECTING BEES IN THREE SPECIES OF PAPILIONOIDEAE (LEGUMINOSAE)

Ángela V. Etcheverry[1], Trinidad Figueroa-Fleming[1], Alberto H. Abrahamovich [2], Diego Lopez -Spahr[1], Carolina Yañez[1], María Mercedes Alemán[1] and Dulce María Figueroa-Castro[3]
[1]Cátedra de Botánica, Laboratorio de Biología Reproductiva, Facultad de Ciencias Naturales, Universidad Nacional de Salta, Avenida Bolivia 5150, 4400 Salta, Argentina; avetcheverry@yahoo.com.ar; [2]Laboratorio de Apidología, División Entomología, Museo de La Plata, Universidad Nacional de La Plata, Paseo del Bosque, 1900 La Plata, Argentina; [3]Laboratorio de Biología Vegetal, Escuela de Biología; Benemérita Universidad Autónoma de Puebla; Blvd. Valsequillo y Av. San Claudio, Edif. 112A, Ciudad Universitaria, Col. Jardines de San Manuel; C.P. 72570, Puebla, México.

Floral oils are alternative flower reward to pollen and nectar that are offered by some flowers to oil-collecting bees. Up to now the literature cited eleven families of Angiosperms. We report oil sources in flowers of Papilionoideae (Leguminosae) for the bee genus *Arhysoceble* (Hymenoptera, Apidae, Tapinotaspidini), *Centris* (Hymenoptera, Apidae, Centridini) and *Tetrapedia* (Hymenoptera, Apidae, Tetrapediini) in the Lerma Valley within the Salta Province, Argentina. Females of *Arhysoceble dichroopoda* and *Centris mourei* were observed on flowers of *Zornia contorta*. Females of *Arhysoceble picta* were observed on flowers of *Desmodium incanum* and females of *Tetrapedia* sp. in flowers of *Aeschynomene americana*. This is the first report of oil collecting bees of the genus *Arhysoceble* on flowers of Papilionoideae. The cited bee species are presumably pollinators of the cited plant species.



BIOTIC RESOURCE NEEDS OF SPECIALIST ORCHID POLLINATORS

Robert W. Pemberton

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Orchid pollinators have highly varied life histories with complex biotic resource requirements, about which we have limited knowledge. Among the specialist orchid pollinators are insect predators and parasitoids with specific prey types such as aphids and subterranean scarab larvae; oligolectic bees that collect pollen from limited sources such as bellflowers; euglossine bees and butterflies that collect particular plant chemicals for reproduction and self-defense; oil-collecting bees that provision their brood cells with floral oils from a few plants; bees that collect rare floral resins to construct their nest and brood cells; moths and butterflies that require specific larval host plants; mosquitoes and horse flies that need blood; and fungus gnats and carrion flies tied to fungi and dead animals. Loss of critical biotic resources and relationships can reduce the abundance of orchid pollinators and/or their effectiveness. Protection of large, plant rich, pesticide-free orchid habitats is key to conserving essential pollinator resources.

Plant Breeding and Mating Systems

STUDIES OF INTRAPLANT POLLEN SUPPLY IN MODERN AND WILD GENOTYPES OF SUNFLOWER (*HELIANTHUS ANNUUS*)?

Astiz, V.[1], A.C. Fernández [2], P.A. Marinangeli[1,2], A. Flemmer[1] y L.F. Hernández[1,3]

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Sunflower plants grown under optimal conditions always form incomplete developed fruits (IDF). Our objective was to identify, qualitatively and quantitatively, the intraplant pollen supply and its possible relationship with the generation of fully developed fruits (FDF) and IDF. Sunflower plants were grown under irrigation and fertilization in the Agronomy Dept.-UNS (Bahía Blanca, Argentina: 38º 45' S., 62º 11' W.) in a factorial combination of two hybrids and three planting dates (PD). Close to anthesis, pollen grains per flower (P/F) were counted. Postanthesis viability was assessed using Alexander stain. At harvest, FDF and IDF were counted. In the first and third PD, the study was done in capitulum sectors (external [ES], medium [MS] and internal [IS]). Both hybrids showed similar results. In the two extreme PD there were differences in the IS: Number of IDF (higher in the third) and number of (P/F) (higher in the first). Considering the whole capitulum, the number FDF was higher in the first and second PD, while the number of (P/F) was higher the in the second PD. In all cases the higher number of FDF were observed in the ES and MS and the higher number of FDI predominated in the IS. Pollen viability of the two hybrids in the three PD was not significantly different between capitulum sectors. The formation of FDI would not depend on pollen intraplant supply as both, pollen availability and its quality, was not limiting in the two genotypes. It is not known whether failure of pollen germination could occur. The highest number of (P/F) observed in the IS of the capitula in both genotypes may respond to a legacy of the species strategy to invest resources in the sporophytic generation during the late stages of anthesis for the purpose of not competing with photoassimilate supply in the proximal regions of the capitulum which has ovaries in active development at that stage. Our preliminary results also indicate that in wild and inbred lines of sunflower, the distribution of the amount of P/F in the capitulum would be similar.

POLLINATION IN THE CARROT FAMILY (APIACEAE): HOW SPECIALIZED CAN A (MORPHOLOGICALLY) GENERALIZED PLANT BE?

Marcin Zych

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Plants of the family Apiaceae (=Umbelliferae), due to their open flowers and easily available nectar, have been usually placed among the species regarded as 'promiscuous' in terms of pollination systems. In fact many of them may be characterized by wide range of flower visitors from several taxonomic orders, suggesting generalist character of their pollination system. However recent findings show that the actual number of anthophilous taxa should not be equalized with the number of their efficient pollinators. Studies of pollination biology of three common European taxa (*Heracleum sphondylium* subsp. *sphondylium*, *H. sphondylium* subsp. *sibiricum*, *Angelica sylvestris*) have shown that (1) key pollinators are restricted to a few dipteran groups (*A. sylvestris* à muscid and syrphid flies) or even species (*H. sphondylium* à *Eriozona syrphoides, Lucilia* sp pl.), which suggests functional or ecological specialization, (2) all three plants share a large part of the visiting insect taxa which suggest similar attraction strategy (3) a large proportion of insect visitors utilize flower resources but do not provide pollination service, for instance due to preferences towards one of a flower sexual phases. Based on these results and new literature data the paper discusses the concept of specialization/generalization in pollination systems of the umbellifers and difficulties in determining their efficient pollinating agents.

Pollination in India: Modern Case Studies

STUDIES ON THE POLLINATION CALENDAR AND ATMOSPHERIC POLLEN FLORA OF ALLERGENIC PLANTS OF ASANSOL INDUSTRIAL BELT, WEST BENGAL, INDIA

Anindita Mandal and Sudhendu Mandal

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Environmental bio-particulate matters or biopollutants are significantly related with the eco-geographical and meteorological factors of a particular biozone to cause several allergic disorders. Flowering and Pollination calendar reveals the characteristic alteration of quality and quantity and nature of pollen and spore in the air which is pre-requisite for diagnosis and therapeutic treatment of allergic disorders. The present paper deals with the monitoring and recording of seasonal variation of flowering periods of angiosperms growing in the locality and to make an index about the pollination mechanism of the local flora of Asansol Industrial belt, West Bengal, India for the first time. The bio-particulate matters have been recorded using a specific pollen sampler. Some of the recorded allergenic plants are: *Phoenix sylvestris, Cocos nucifera, Ageratum conyzoides, Amaranthus spinosus, Parthenium hysterophorus, Ricinus communis, Argemone mexicana, Cynodon dactylon, Eragrostis tenella, Xanthium strumarium, Chenopodium album, Cassia fistulosa , Azadirachta indica, Eleusine indica, etc.* Amongst the airborne pollen types, the grass pollen grains constitute 35.0% of the total recorded. The 3-colporate type, i.e. Fabaceous types (excluding Mimosaceae) constitute 11.6% of the total count and the pantoporate type (i.e. Amaranthaceae, Chenopodiaceae and Convolvulaceae collectively) constitute 16.5%. The remaining types collectively constitute 36.9% of the total count.

FLORAL BIOLOGY AND POLLINATION OF *SOLANUM SISYMBRIFOLIUM* LAMK

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Department of Botany, Visva-Bharati University, Santiniketan -731235, India; smandalbot@gmail.com

The present paper deals with flower morphology, anthesis, pollen production, pollen ovule ratio, foraging behaviour of flower visitors, pollen germination (in vitro and in vivo) and stigma receptivity of *Solanum sisymbrifolium* belonging to the family Solanaceae, which is a medicinally important plant. The flowers open in between 5.00 to 7.00 hrs. As soon as flowers open, different insects like Thrips, *Ceratina viridissima, Apis* sp., *Amegilla* sp., *Xylocopa* sp. And a few members of Lepidoptera, Diptera, Coleoptera visit flowers to collect forage materials and help in pollination. A single flower produces an average of 4475266 pollen grains and pollen per ovule ratio was obtained 14918:1. The maximum (90%) pollen germination along with 1305 um tube development was observed in 20% sucrose solution supplemented with 100 ppm boric acid. *In vivo* pollen germination showed that the stigma receptivity was maximum (70%) at first day after anthesis and showing 90.54% *in vivo* germinating pollen along with 140 um pollen tube over stigma head.

FLORAL BIOLOGY AND POLLEN DISPERSAL OF *PENTAPETES PHOENICEA* LINN.

Sudhendu Mandal, Subrata Mondal and Sandip Choudhury

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The present study reveals the flower morphology, pollen production, anthesis and pollen dispersal of *Pentapetes phoenicea* Linn. Belonging to the family Sterculiaceae. It flowers during August to November and a single flower produces 1,83,000 pollen grains. Flowers are showy, scarlet, 2.5-3.0 cm. In across, solitary, axillary which start to open at 9.30hrs. to 10.30 hrs. Generally. Anther dehisces by longitudinal slit after flower opening and discharge pollen explosively. Fertile stamens 15, in 5 groups of 3 each, alternating with 5 leafy staminodes. Maximum 195/m^3 atmospheric pollen incidence was noticed at 11.30hrs at the distance of 2.5 mts. from the source. Nectar was secreted in the corolla base continuously, which is considered to be the chief floral reward to visitors. Fruit set were 42%, 28% and 7% in natural open, netting and bagging condition respectively. Floral characters such as protogynous nature, anther level much below the stigma, presence of leafy staminodes which act as barrier to auto-pollen deposition, stigma emerges out prior to the unfolding of the corolla to receive pollen from geitono and xeno sources, explosive pollen dispersal and fruit-set in different condition revealed that *Pentapetes phoenicea* is an entomophilous as well as anemophilous plant.

Health Status of Managed Apis mellifera Colonies and Pollination of Agricultural crops

HONEY BEE VIRUSES, NEWCOMERS OR PERMANENT RESIDENTS

Nor Chejanovsky

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Viruses infecting honey bees were associated with beehive decline and substantial colony losses worldwide. Two types of viral-induced pathologies were linked to substantial colony losses: paralysis and deformed wing syndrome. The viruses most frequently associated with paralysis are the

Acute bee paralysis virus (ABPV), the Kashmir bee virus (KBV), the Israeli acute paralysis virus (IAPV) and the Chronic bee paralysis virus (CBPV). The Deformed wing virus (DWV) was associated with the deformed wing syndrome. Different type of bioassays, immunological, virological and cell biology techniques were recruited to learn the mechanisms underlying the above viral infections. These studies revealed that in most cases the above viruses are present as dormant (covert) infections that may become activated upon exposure of the honey bee colonies to still undefined stress factors. For some of the above viruses *Varroa destructor* serves as a vector and an elicitor of infection. The recent introduction of molecular techniques like qualitative and quantitative RT-PCR enabled further progress in understanding the nature and basis of the viral-induced pathologies. The present knowledge and future prospective for further advance in understanding the impact of viral infections on honey bee health will be discussed.

NOSEMA CERANAE HAS EXISTED IN MEXICO SINCE AT LEAST 2004

Ernesto Guzmán-Novoa

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Nosema apis, a spore-forming fungus of the Phylum Microsporidia, was formerly thought to be the only *Nosema* species to infect the midgut epithelial cells of adult honey bees. It was, however, recently discovered that another microsporidian parasite, *N. ceranae*, also infects western honey bees. *N. ceranae* has been linked to the collapse of colonies in some beekeeping regions of Europe. Samples of honey bees that were collected in 2004 in four states of central Mexico to study the spread of what was then thought to be exclusively *N. apis* were used in this study. We used a newly developed PCR-assay to diagnose the samples and to present the first report of the presence of *N. ceranae* infecting Africanized honey bees in Mexico. This is also the report of the oldest Africanized honey bee samples infected with *N. ceranae*. Out of 99 samples analyzed under the microscope, 68 were *Nosema*-positive and 50 % of them were randomly chosen for further molecular diagnosis. Based on the PCR products obtained, 32 of the samples analyzed were *N. ceranae* and only two were *N. apis*. These results show that this parasite has in fact been long established and widespread in Mexico's high plateau and could be the historical cause of Nosemosis in Mexico.

HONEY BEE COLONY LOSSES IN BRAZIL AND DISEASE DIAGNOSIS EFFORTS

Erica W. Teixeira

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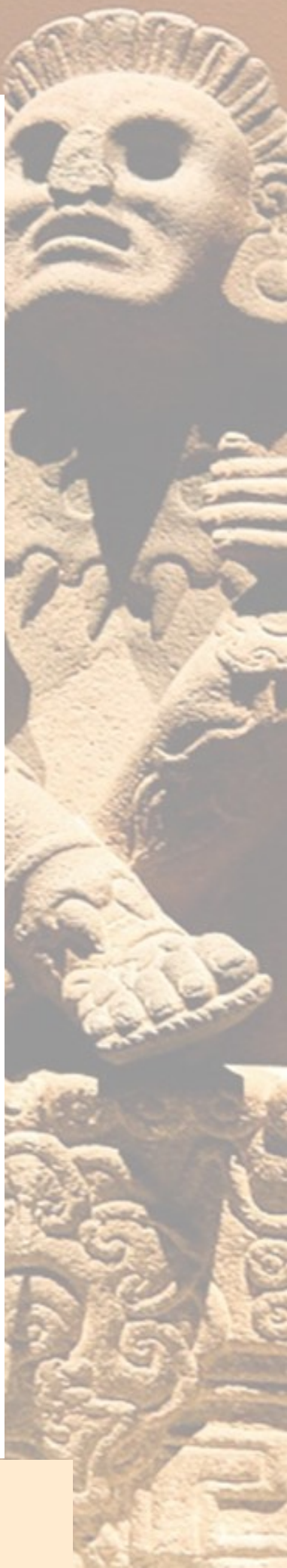
In Brazil, though the Africanized honey bees are considered resistant and tolerant to most bee pathogens and parasites, in recent years considerable losses have been reported in some localities, especially in the southern and southeastern states. Since the phenomenon that is affecting honey bees around the world (characterized by the depopulation or sudden losses of hives) has been observed also in Brazil (although with less intensity/profile), we proposed a project aiming to determine possible causes for such decline or losses, and in particular to test the likelihoods of specific predicted causative agent(s) for this condition. Alternative approaches, including genetic screening can be extremely useful and can accelerate important discoveries related with the current problem. Here we present an overview about our effort trying to find this weakening and mortality of honey bee colonies. Insecticides are among the main problems for world agriculture, and probably also in Brazil (accidents have been reported). Viruses were identified (Acute bee paralysis virus - ABPV, Black queen cell virus - BQCV, and Deformed wing virus - DWV) in analyzed bees, and a multiplex RT-PCR assay was developed and validated. The first results indicated that ca. 26 % of the samples carried Israeli Acute Paralysis Virus (IAPV) too, and some isolates for this virus were found. Previously Filamentous Virus - FV and Cloudy Wing Virus - CWV had been found by the immunodiffusion technique. *Nosema ceranae*, *Melissococus pluton*, *Leptomonas apis*, and *Spiroplasma apis* were also



detected. No symptoms of the American Foul Brood were detected until now (after the isolated related focus in 2006) and analysis of honey samples showed negative results. Chalk Brood disease was detected, but causing low economical losses as well as European Foul Brood. *Nosema ceranae* is present in many apiaries, showing high prevalence. In the last decade we did not observe *N. apis*. *Varroa destructor* is present throughout apiaries in this region, but causing no direct economical damages. One of the main sanitary problems of the Africanized bees is the disease caused by the toxic effects of the *Stryphnodendron* spp pollen in the Atlantic Forest and Savannah regions. As Sac Brood Virus has not been detected in these colonies and the symptoms are similar, this disease has been called as Brazilian Sacbrood-like disease. Beekeepers lose, sometimes, all colonies during less than one-month period. Today, the selection for resistance is under evaluation. Other brood mortality has been also observed during the last years showing anomalous symptoms. Replacement of the queens from beehives showing any disease symptoms (susceptible) has been recommended, avoiding chemotherapeutic drugs use. There is a critical need to increase the number of technicians and laboratories dedicated to bee pathology in the various regions of the country in order to have a better control of the sanitary situation in the apiaries. Pathological, epidemiological, and wide-spread studies remain to be conducted once no single pathogen seems overly predominant in declining bee colonies also without a clear indication of the causes.

COLONY LOSSES IN EUROPE AND THE COLOSS NETWORK

Peter Neumann

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Over the last years, elevated winter losses of managed honey bee, *Apis mellifera*, colonies have been reported from Europe, but the underlying reasons remain poorly understood. Besides the ubiquitous ectoparasitic mite *Varroa destructor*, which undoubtedly plays a key role, there are numerous additional drivers of colony mortality. Moreover, complex interactions between individual drivers are inevitable (e.g. between viruses and *V. destructor*), which exceeds research facilities of individual laboratories and entire countries. Local efforts to limit honey bee decline are probably doomed and internationally coordinated ones are required. Therefore, the COLOSS network (prevention of honeybee COlony LOSSes) has been established to explain and to prevent large scale losses of honey bee colonies via identification of the underlying factors and development of emergency measures and sustainable mitigation strategies. COLOSS concerts national activities and comprises of all relevant stakeholders with the aim to create transnational synergies. It currently consists of 266 individual members from 53 countries in four working groups (monitoring and diagnosis, pests and pathogens, environment and beekeeping, genetic diversity and vitality). The networking is facilitated through conferences but more important also through workshops, training schools and short term scientific missions between collaborating laboratories. An important part of the network is the development of standards in monitoring and bee research in from of a BEE-BOOK, which will be developed online. Dissemination of results is at the core of COLOSS and the network will transfer results to all stakeholders responsible for bee health.

Land Use Effect on Bee Biodiversity

BEE DIVERSITY ALONG A FOREST REGENERATION GRADIENT IN WESTERN KENYA

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Changes in bee species richness and diversity were studied along a forest regeneration gradient in seven sites in Buyangu Nature Reserve, Kakamega Forest. In each site, 12 belt transects of 100 M length and 2 M width were established. The selected sites ranged from relatively undisturbed primary to late secondary forests, bush lands and the surrounding farming areas. A total of 4,485 individuals were identified from 234 species of bees represented in four families. Renyi diversity index, a more robust index than either Shannon or Simpson's Index was used to analyse bee diversity because of its sensitivity to both rare and common species. One-way measures of ANOVA were calculated on bee diversity and species richness, with study sites and year as independent factors. The highest species richness and bee diversity were recorded in the open areas followed by secondary forests while evenness was higher in forested sites. There was a general similarity between sites in bee species composition, especially between those of almost similar vegetation structure. This similarity was suspected to have important implications in promoting current understanding of ecological resilience of bees in tropical ecosystems. Thus, the future of forest biodiversity conservation and the pollination service are dependent on strategic and holistic management of natural forests, secondary forests and the neighbouring agro-ecosystems.

DRIVERS OF NON-APIS POLLINATORS IN CALIFORNIA ALMOND ORCHARDS AND THEIR BENEFIT FOR ALMOND POLLINATION

Claire Brittain, Alexandra Klein, Claire Kremen, Neal Williams, Robbin Thorp, Stephen Hendrix

Given the problems with honey bee health and colony losses in the U.S., relying solely on the pollination services of a single species may not be sustainable in the long-term. In California almond orchards, we investigated the effect of organic management and surrounding natural habitat on flower visitation and fruit set. Data were collected in 22 almond orchards (14 conventional, 8 organic) surrounded by different proportions of natural or semi-natural habitat. Five of the conventional orchards with little surrounding natural habit had an adjacent strip of semi-natural vegetation and were included to represent a realistic management option for orchards in intensive landscapes. Flower visitor abundance was recorded for honey bees and wild insect visitors (wild bees, hover flies (Syrphidae) and all other insects). The abundance of wild insect visitors was positively related to the proportion of surrounding natural habitat. Fruit set was also greater in orchards with a high proportion of surrounding natural habitat. The presence of a strip of semi-natural vegetation in orchards with little surrounding natural habitat increased the richness of insect groups observed and the abundance of flies visiting flowers. Organic management increased the abundance of hover flies visiting flowers, particularly in isolated orchards. Our results indicate that almond orchards in areas with a high proportion of natural habitat receive additional 'free' pollination services from wild flower-visiting insects, which can improve fruit set. In isolated landscapes there is potential for a strip of nearby semi-natural vegetation to increase the abundance of wild pollinators, primarily flies, visiting almond flowers. We discuss these findings in the context of wild insects providing functional complementarity to the pollination service from managed honey bees.

THE EFFECT OF COFFEE AGRICULTURE ON BEE DIVERSITY IN DAK LAK, VIETNAM

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The expansion of agricultural landscapes poses a threat to biodiversity in countries such as Vietnam

where conservation and sustainability are major concerns. Vietnam is the second highest producer of coffee worldwide and there are plans to expand land use for coffee production. Bees are the most important pollinators and are crucial for maintaining natural and agricultural ecosystems. They are known to augment coffee production by up to 50%. The native bee fauna in Vietnam has not been well-studied. We used Malaise Traps to sample the bee fauna in two national parks and six agricultural sites (coffee) along a distance gradient (100m, 500m, and 800m) from forest edge in Dak Lak, Vietnam. This is the highest coffee producing region in Vietnam. Traditional diversity indices are used to assess and compare species diversity and abundance among sites. Preliminary results suggest the bees sampled in the national parks to be most different from those sites furthest away (i.e. 800m) and agriculture and distance from forests to be strong factors in shaping bee communities.

THE EFFECTS OF FIRE ON BEE COMMUNITIES IN OAK SAVANNAH HABITAT IN SOUTHERN ONTARIO, CANADA

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Bees are the most important animal pollinators. Recently, biodiversity surveys have indicated declines in bee populations worldwide. However, the causes for these declines are poorly known despite the ecological and economic significance of bees. This may be partly because different species respond differently to the same ecological disturbance. Therefore, quantifying whether bee communities are healthy or suffering from perturbances is one of the most important endeavors to ensure pollination services are sustained. The response to fire by pollinators, particularly bees, has rarely been examined. Surprisingly, even though fire has been re-introduced to oak savannah habitat in Southern Ontario, the effects have not been studied until recently. The purpose of our work is to provide insight into how bee faunas respond to fire, examine how bee communities re-colonize a habitat after a fire, assess whether fire is a positive or negative disturbance to bee communities overall and whether it impacts different guilds, or species within a guild, in different ways. Preliminary results show bee diversity increased post-fire, suggesting that fire is a useful restoration tool for bees in oak savannah habitats. Solitary ground nesters were the most common bees found in each site in both localities. Social ground nesting bees in both localities were found in higher abundance octaves than in lower octaves. In contrast to social ground nesters, cleptoparasites and *Bombus* species were more common in lower abundance octaves than in higher octaves. The freshly burned sites at Pinery Park and Turkey Point revealed that cleptoparasites were one of the first guilds to respond after fire. The preliminary results show that bee guilds do not respond the same way to fire.

AGRICULTURAL LANDSCAPE FOSTERS RICH NATIVE BUMBLE BEE DIVERSITY AND ABUNDANCE IN WESTERN USA

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Agricultural landscapes are believed to be poor in foraging resources required for sustaining bumble bees since their colonies live for several months while crop bloom lasts for just a few weeks. However, bumble bee studies in cropping systems have largely focused on a single crop. In the current study, our objectives were to determine bumble bee diversity and abundance in two crops that bloom in sequence, namely, blueberries in spring and red clover seed crops in summer. The study was conducted in commercial fields in the Willamette Valley, an agriculture dominated region in western Oregon on the west coast of the United States. At least six bumble bee species were observed both in traps and during visual counts in both crops. The number of bees captured/day increased from 6/trap in blueberries to >30/trap in red clover. Based on visual count data, an average of 1 bumble bee/min foraged on blueberries and 15-30 bees/min on red clover during peak bloom. Thus, contrary to reports from elsewhere, a rich fauna of bumble bees is flourishing in western Oregon. Bumble bee colony development in the area is likely sustained through the practice of farming

bee-pollinated crops that bloom in sequence, and in synchrony with foraging by queens and workers. Based on our studies, we recommend integration of multiple agro-ecosystems or native plants that bloom in sequence for sustaining and building bumble bee populations.

LAND USE EFFECT IN COFFEE LANDSCAPES FOR THE CONSERVATION OF NATIVE BEES

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Most research on bee biodiversity in coffee plantations has focused on two variables: the principal has been the shadow management of the plantation (i.e. coffee without shade trees) and the second, less explored, the number and proximity of forest surrounding. However, the combined effect of the landscape and its components on the diversity of bees has been little explored. The main objective of this work was to study these interactions at different spatial scales of the landscape. In general it was observed that the overall explanation of the abundance of individuals at the genus level improved as the landscape analysis radius increases and tended to stabilize from 600 m, with a slight peak at 1400 m (distance analyzed in logarithmic series: 30, 50, 80, 120, 180, 260, 400, 600, 900, 1400, 2000 m). Performing a canonical correspondence analysis (CCA) it was shown that of the seven land uses described, the greatest effect on the richness and abundance of bee is due to simple coffee areas and *milpas* (traditional cornfields) in the landscape, while others land uses showed less though consistent and strong effects.

DIVERSITY OF NATIVE BEES IN HABANERO PEPPER (*CAPSICUM CHINENSE*) CULTIVARS IN RELATION WITH THE SURROUNDING LANDSCAPE IN THE YUCATAN PENINSULA, MÉXICO

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Habanero pepper (*Capsicum chinense*) is one of the most important cash crops in the Yucatan Peninsula and is positively influenced by bee pollination resulting in larger production and quality of the fruit. Across the Yucatan, the original forest has been subjected to various degrees of deterioration which may have an influence on bee diversity and abundance. We surveyed the bee fauna present during the flowering season in 24 habanero pepper cultivars distributed across the Yucatan. Transects were used to characterize the landscape surrounding each cultivar with the aim of estimating the correlation of landscape matrix with bee diversity and abundance. A total of 911 specimens were collected, belonging to 37 genera and 67 species which represent ca. 78% of the species reported for the Peninsula. The most representative genera were *Lasioglossum*, *Exomalopsis* and *Melisodes*. A correlation analysis showed non-significant relationship between overall bee diversity and abundance and the proportion of forests surrounding the cultivars. This results could be attributed to the use of small scale production in which secondary forests are common part of the landscapes in the Yucatan. However, current research is focusing on evaluating the effect of pollinator diversity and abundance on crop production in the same cultivars.

Pollination in Greenhouses

ALLIANCES BETWEEN BENEFICIAL INSECTS, PLANTS AND FUNGI POLLINATE, PROTECT, AND PROMOTE CROP PRODUCTION

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When you sink your teeth into a luscious greenhouse-grown tomato, thank a bumblebee for pollinating tomato flowers. Bumblebees are essential world-wide for pollination of greenhouse grown vegetable crops. Apart from being great pollinators because of their ability to obtain and disperse pollen, they can also be used to disseminate other tiny particles, notably fungal spores. Although some fungi are plant pathogens, others can be used, as biological control agents, to fight crop pests. Using special dispensers on the fronts of bumblebee hives placed into greenhouses for crop pollination, fungal and microbial biological control agents can be disseminated onto the target crop plants where they attack other fungal pests, such as grey mould (*Botrytis*) as well as a suite of insect pests, such as tarnished plant bug, peach aphid, white fly, and thrips. By mixing two biological control agents, such as *Clonostachys rosea* and *Beauvaria bassiana*, the formulations are safe for the bumblebee vectors, suppress pathogenic fungal infestations and populations of pest insects, and allow for effective pollination of crops such as tomato and bell pepper. The same sort of technology is being used on field crops such as strawberries, raspberries, blueberries, possible apples and pears, and some oil seed crops like sunflower and canola for which honeybees are the primary vector-pollinators. The R & D presented in this seminar has come about from the results of pioneering efforts in Canada at the University of Guelph, Agriculture & AgriFood Canada, and private industry.

CROP POLLINATION IN GREENHOUSES AND THE USE OF STINGLESS BEES IN MEXICO

Virginia Meléndez Ramírez, Ricardo Ayala y Laura Meneses Calvillo

Crop pollination in greenhouses is a common practice in many parts of the world, currently some bees species of the genus *Bombus* spp and *Apis mellifera* are used, this causes additional costs to producers, the introduction of alien species and the dispersal of diseases among bees, so it is necessary to assess the pollination efficiency of native bees species. In Mexico, an option is the use of managed social bees, commonly called stingless bees (Apidae-Meliponinae). In this paper we review the results obtained experimentally with the use of stingless bees and other species of bees in pollination of economically important crops in Mexico and Yucatan. Experiments were conducted in greenhouses and we evaluated environmental conditions, foraging activity and pollination efficiency measured by the Spears index or quantity and quality of fruits or seeds. The stingless bees species used, include *Partamona bilineata*, *Nannotrigona perilampoides* and other species, such as *Apis mellifera* and *Bombus impatiens*. In general, the results suggest that the stingless bees need a period of adaptation to the greenhouse (one to two weeks) and environmental conditions have an effect on foraging bees (mainly temperature and light intensity). The stingless bees have high pollination efficiency in *Cucurbita moschata* (squash) crops, the results indicated that *P. bilineata* is an efficient pollinator to produce fruit and seeds. In *Lycopersicon esculentum* (tomato) and *Capsicum chinense* (habanero chile), *Bombus impatiens* and *Nannotrigona perilampoides* were efficient pollinators (PE = 0.78 and 0.71 respectively), both species performed better than mechanical vibration, considering the variables measured (fruit set, seed number and fruit size). The stingless bee native to each region, are efficient in pollination and can be used to reduce the producers costs and prevent the spread of diseases in the Mexican tropic. Nevertheless, it is necessary to evaluate the different densities of bee colonies for each crop and greenhouses size.

THE POTENTIAL USE OF *MELIPONA FASCICULATA*, A STINGLESS BEE, FOR BUZZ POLLINATION: WHAT DO VIBRATION CHARACTERISTICS TELL US?

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Angiosperms that have flowers with poricidal anthers require vibration to release their pollen and bees, such as *Melipona* and *Bombus* vibrate their thoracic muscles while visiting flowers in order to obtain it (buzz pollination). Vibration characteristics such as frequency and velocity are considered important for the mechanism of pollen release. Thus, the physical characteristics of bees' vibration may indicate which pollinators could be used for crops that are buzz pollinated. We compared the frequency (Hz) and the velocity amplitude (mm/s) of vibrations produced by *Melipona fasciculata* (Mf; in Brazil) and *Bombus impatiens* (Bi; in Canada) during eggplant (*Solanum melongena* L., Solanaceae) pollination and the amount of pollen that these bees removed from the anthers during the first visit to the flower. Vibrations were recorded using a laser vibrometer and pollen counting of virgin and visited flowers was done using a particle counter. Mean frequency (Hz) of vibrations was statistically different between bee species (Mf: 267.5±12.2, n=30; Bi: 349.8±22.5, n=16; Mann-Whitney, p=0.0001), but velocity amplitude was not (Mf: 233.5 ± 19.5, n=30; Bi: 218.9±25.2, n=16; Mann-Whitney, p=0.0758). Mean number of pollen grains per flower was not statistically different for Brazilian (255,308±97,423 n=15) and Canadian (327,990±95,123, n=9) plants (Mann-Whitney, p=0.1011). Also, the mean number of pollen grains remaining after one visit of Mf and Bi was not statistically different (Mf: 91,004±69,585, n=30; Bi: 107,952±118,343, n=13; Mann-Whitney, p=0.7112). These results indicate that Mi could be used for eggplant pollination in Brazil, considering the fact that they are capable of removing the same amount of pollen from flowers and perform vibrations with similar velocity amplitudes as Bi. Also, previous field observations found Mf pollinating eggplants in Brasil. Therefore, Mf may be as efficient as Bi as a buzz pollinator.

IMPACT OF GREENHOUSE TOMATO FLORAL VOLATILES ON BUMBLE BEE POLLINATION

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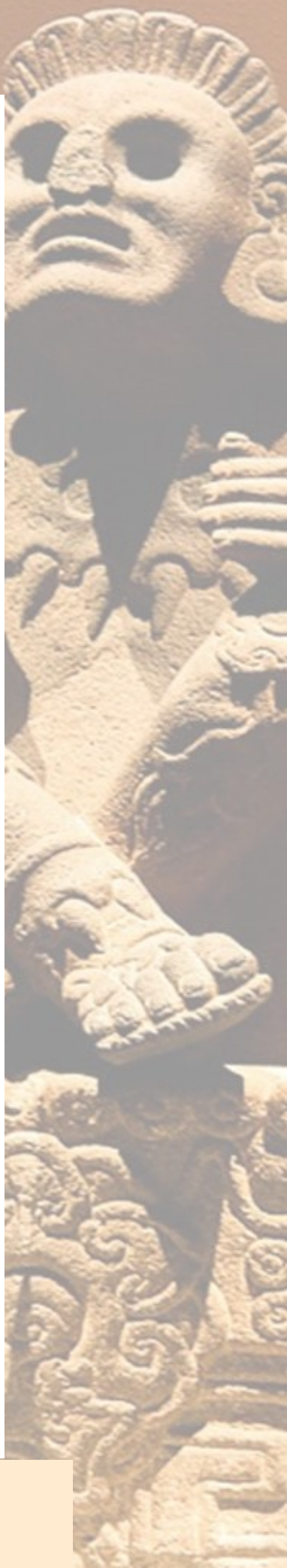
Commercially-produced bumble bees are the standard production practice for pollination of greenhouse tomatoes. However, at certain times of the season, pollination may not always be adequate as bees will leave the greenhouse to forage on flowers of other plants. This study investigates tomato's floral characteristics and their affect on bumble bee pollination by (1) determining which plant floral advertisements could be used by the bees to estimate pollen availability and (2) identifying temporal changes in floral volatiles which correspond to peak bumble bee activity. Flower size (petal length, anther cone width and anther cone length) and floral scent (release of β-phellandrene, 2-carene, α-pinene and p-cymene) were evaluated to identify the pollinator-important characteristics of tomato flowers. Our results indicate that (1) bumble bees preferred to pollinate flowers which produce less β-phellandrene and 2-carene in comparison to flowers producing more of these volatiles; (2) flower size and floral scent are not likely used by the bees to estimate pollen availability; and (3) components of tomato's floral scent are produced less during peak bumble bee activity. β-phellandrene and 2-carene may be anti-herbivory volatiles and reduced production during peak bee activity may help to facilitate pollination of tomato. Pollinator-repellent volatiles may help to protect flowers from damage caused by over-pollination.



Bumblebees in Greenhouse Pollination in Mexico

EVALUATION OF THE EFFICIENCY OF *BOMBUS EPHIPPIATUS* SAY (HYMENOPTERA, APIDAE) AS A GREENHOUSE POLLINATOR OF TOMATO (*LYCOPERSICON ESCULENTUM* (MILL.)

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The Mexican native bumblebee *Bombus ephippiatus* Say was evaluated as a potential pollinator of greenhouse tomatoes (*Lycopersicon esculentum* (Mill)). The experiments were performed from May thru December 2004 in a 1,000-m2 greenhouse, in ¨Puebla, México, planted with tomatoes of the cultivar Mallory (Hazera ®). Two colonies of *Bombus ephippiattus Say*, reared in the laboratory from queens captured in the field were used for the experiments. A second 1,000-m2 greenhouse, with no bumble bee colonies, was used as a control. Four treatments were carried out on different plant and /or greenhouses: pollination by bumble bees (BP), hand-pollination (HP), pollination by mechanical vibration (VP) and no pollination (NP, bagged flowers, no vibration). We measured percentage of flowers visited by bumble bees, number of seeds per fruit, maturing time, sugar contents, fruit weight and fruit shape. In the greenhouse with bumblebee colonies, 100% of the flowers were visited by bumblebees, as measured by the degree of anther cone bruising. The following table summarizes the results of comparing the response variables for the treatments.

Average± S.D. of the response variables. Values followed by the same letter are not significantly different from each other. (Tukey HSD, p<0.05)

Treatment	Maturation Time (Days)	Fresh weight (g)	% sugars (° Brix)	Number of seeds/fruit	Roundness
BP	55.45 ± 18.7 [a]	60.84± 22.9 [b]	4.93 ± 1.9 [a]	201.00 ± 80.5 [a]	0.81± 0.06 [a]
NP	46.50± 17.3 [b]	59.36± 22.2 [b]	4.70 ± 1.7 [b]	139.03 ± 60.1 [b]	0.88 ± 0.07 [a]
HP	49.71 ± 19.6 [a]	57.72 ± 21.5 [a]	5.79 ± 3.1 [c]	141.28 ± 25.3 [c]	0.80 ± 0.05 [a]
VP	49.76 ± 18.6 [a]	62.60± 23.7 [b]	4.97 ± 1.8 [d]	159.32 ± 31.1 [d]	0.81 ± 0.03 [a]

BIOBEST IN MEXICO: HISTORY AND PERSPECTIVES

Luis Javier Diaz

Biobest Mexico

Biobest is a Belgian group, founded in 1987 by Rolland De Jonghe, specialized in pollination by biological agents (honey bees and bumble bees) and in biological control using animal predators. Biobest started as a hobby by Dr. De Jonghe, who experimented with reproduction of bumblebees in his garden and later used the colonies produced in greenhouses, where positive results regarding pollination were obtained. In a period of over 20 years, Biobest has become a world-class player, a recognized company within its sector. Biobest is known by its innovative approaches, creativity and flexibility. For the last 7 years the company has grown with an investment of over € 20 millions. The group Biobest is constantly expanding its worldwide operation. Through its five production units in Belgium, Mexico, Morocco,

Turkey and Canada, its commercialization and technical support branches in France and Spain, and its distribution network, Biobest is active in more than 50 countries.
The bumble bee colonies produced by Biobest are sold in Mexico since 2002,and in 2009 Biobest México, in a joint venture with Distribuciones Imex, S.A. de C.V. opened a production plant that aims to cover the Mexican and Central American markets. Currently Biobest rear over 68,000 bumble bee colonies a year, mainly to be used in tomato greenhouses, a small number of colonies is kept for further reproduction and others are used for research. Even though there are over 11,000 ha of greenhouses in México, only about 5,000 ha are pollinated using bumblebees. Biobest is working on developing Mexican native species of bumble bees as pollinators, but there are no results to show yet. By using bumble bees for Pollination, the amount of pesticides used in the greenhouses has been diminished, and the amount of chemicals in the tomato fruit that are commercialized is now much lower tan in previous years.

EPHIPPOL, ABEJORROS MEXICANOS PARA LA POLINIZACIÓN DE TOMATES EN INVERNADEROS

Ignacio Cuadriello

Bombus ephippiatus is a Neotropical bumble bee with a wide distribution in Mexico. *Bombus ephippiatus* is a phylogenetically close relative of *Bombus impatiens*, a Neartic bumble bee species that is reared and used extensively for the Pollination of greenhouse tomatoes in Mexico.*B. ephippiatus* has been successfully reared by us and colonies of this species are being used efficiently in several greenhouses in Mexico. Recently, the companies that import B. impatiens into Mexico have shown interest in producing colonies *B. ephippiatus.* We have provided Queens of *B. ephippiatus* to one of these companies. The biology of *B. ephippiatus* shows significant differences as compared to the biology of *B. impatiens*. Queen collecting for *B. ephippiatus* can be performed at the nests, because once the daughter Queens return from the mating flights, they go back to the mother colony, where they stay for an extended period of time. Colonies in the field get reactivated constantly by daughter queens, so colonies tend to be perennial. We have been able to reactivate colonies in the laboratory by using daughter queens mated in captivity. In a similar fashion, one colony that had been used in the greenhouse for tomato pollination, was reactivated with two daughter queens after the mother queen died. According to our experience, *B. ephippiatus* seems to have advantages over temperate species of bumble bees regarding rearing it in captivity: it does not have diapause, and the colonies reactivate spontaneously. This opens the possibility for *B. epjhippiatus* colonies (which have bigger numbers of workers in shorter times than temperate species colonies) to be used without interruption in Mexican greenhouses. In this way, the cost of purchasing bumble bee colonies would be reduced. Currently, some greenhouse small companies are starting to rear their own *B. ephippiatus* colonies, overcoming in this way the difficulties of having to purchase colonies produced commercially at high costs, and depending on the commercial producers in times of scarcity of colonies.

Pollinators and Pollination in the City: Gardens, Parks, and the Urban Environment

A COMPARISON OF POLLINATOR BIODIVERSITY BETWEEN GREEN SPACES, INDUSTRIAL AREAS AND RESIDENTIAL LAND-USE ZONES IN URBAN, SOUTHERN ONTARIO, CANADA

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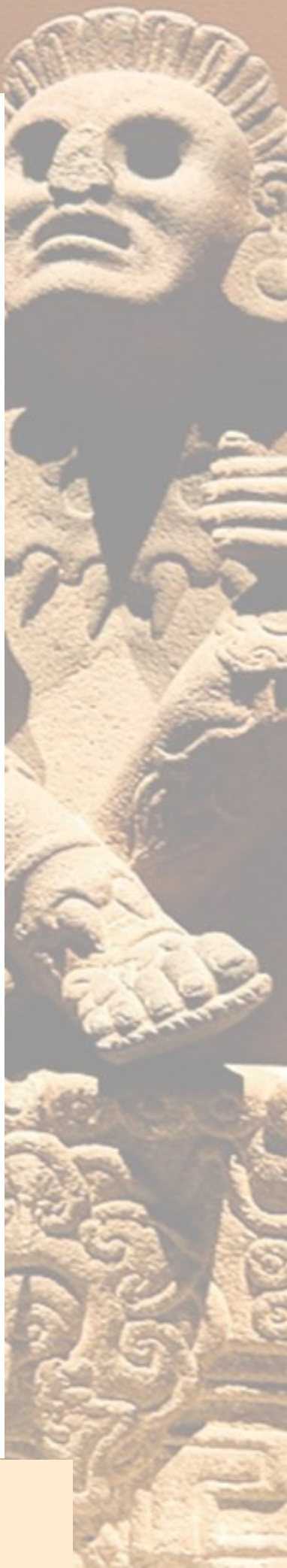

Pollinators, especially bees, have been suffering massive population declines. This project investigates abundance and diversity of bees in the urban setting. Twenty sites in Kitchener, Waterloo, Cambridge and Guelph, Ontario, in four types of city land-use zone (green, industrial, new residential and old residential) were assessed over the summers of 2007 and 2008. Three sampling techniques were used: pan traps, trap nests and netting. Over 107 species of bees from 25 genera, and all six of the bee families found in Canada were collected as identified using traditional taxonomy. The distribution of these species and their abundances did not vary by city land-use. Diversity and abundance of bees do, however, seem to depend on relatively small changes in site location (50 metres), and therefore future investigations should replicate to a higher degree to account for slight variations within each land-use zone. The presence of naturalized areas within any land-use zone had a significant impact on the abundance and diversity of bees. This supports the theory that even slight variations in habitat and resources within an area may impact its biodiversity, and thus any city that wishes to improve its pollinator populations may do so by introducing naturalized areas. Though plant diversity was negatively correlated with bee diversity and abundance, it is unlikely that the presence of plants actually damages the bee populations.

DEVELOPING HABITAT AND MANAGEMENT TECHNIQUES FOR BEES ON UTILITY LANDS: INDUSTRY PARTNERSHIPS FOR POLLINATOR CONSERVATION

Vicki Wojcik

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The millions of acres running underneath transmission corridors and over top of gas lines are potential pollinator habitats. The needs of pollinating species – herbaceous early successionary habitat – are also the ideal management conditions for utilities. The American River Parkway Pollinator Project is a collaborative effort between the utility industry and conservation organizations to: 1. Develop habitat sites to increase local populations of ecologically and agriculturally important bees. 2. Test alternative methods of utility landscape management for success in pollinator habitat development by the impact that these habitat improvement techniques will have on the richness and abundance of local native bee populations. 3. Test the impact of parallel food resource augmentation and nest site installation. 4. Create a transferable landscape management plan that can be used by other utilities to provide mutual benefits to customers and important wildlife such as pollinators. Over the next three years, habitat development techniques will be implemented and monitored to develop best practices for multi-stakeholder conservation. **Benefit to Industry**: Low growing native plant communities can provide safe, economical and accessible energy while also lowering costs for the utility and its ratepayers. Without the need for routine cutting, the utility's carbon footprint is lowered, along with the burning of fossil fuels by mowers and other maintenance equipment, which reduces air pollution and fuel costs. Soil disturbance, erosion and stream sedimentation are also minimized. **Benefits to Bees**: Utility corridors can be managed to restore native prairie, meadow and shrub habitats that provide food and shelter for pollinators. Increasing habitat opportunities within a highlight modified landscape can provide more refugia for important species, especially wood nesting species that often are limited by available nesting sites. Reducing use of herbicides and favoring selective removal will create a more diverse feeding landscape for local bees. Project success would pave the way for a potential for a network of pollinator habitat across the country.

URBANBEES: A 5-YEAR EUROPEAN LIFE+ PROJECT TO DEVELOP ACTION PLANS FOR BEES IN URBAN HABITATS

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In the framework of the European LIFE+ Biodiversity program, the 2010-2014 project URBANBEES aims to conserve and enhance the abundance and diversity of wild bees in urban habitats in Europe. To do so, the main objectives of the program are to (i) develop and validate an action plan to conserve and enhance wild bee diversity in urban habitats using nesting devices and appropriate management methods in parks and recreation areas that will be tested and assembled to reach a validated plan reproducible in other European cities ; (ii) disseminate this validated action plan throughout Europe; (iii) increase favorable habitats for wild bee populations, by integrating the network of biological corridors and reducing the genetic isolation of bee populations; and (iv) raise urban public awareness for biodiversity using bees and their ecological and economic importance to favor the joined presence of man and nature in cities. The program is being conducted over the urban community of Grand Lyon in central France (ca. 1.3 million inhabitants over 515 km^2). URBANBEES includes preparatory actions in 16 study sites in dense urban and residential urban areas to assess the importance of bee biodiversity in urban habitats, and to establish a set of baseline data to test the effects of the concrete actions on wild bee populations. Concrete management actions consist in installing, maintaining and monitoring the effectiveness of different nesting devices for wild bees in 8 of these sites for the second season and the remaing 8 sites for the third season, as well as developing and testing appropriate management of parks and recreation areas to conserve wild bee populations. Communication actions are also a strong component of URBANBEES to disseminate information about all other actions, and making all stakeholders of urban areas aware about the importance of wild bee biodiversity.

STINGLESS BEES IN ARCHAEOLOGICAL SITES IN SOUTHEASTERN MEXICO

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The stingless bees are part of the great diversity of individuals that provide pollination services to the environment, and have been found in a variety of cavity nesting in the archaeological area of southeastern Mexico. We identified nests of stingless bee species, and evaluated these sites as places for research and conservation of pollinators. 24 archaeological sites were inspected in five states to locate species of stingless bees nesting in structures, monumental buildings and trees in Mayan ruins: Yucatán (12), Campeche (6), Quintana Roo (4), Chiapas (1) y Tabasco (1). Archaeological structures visited by tourists were reviewed to locate lines of flight of bees, to identify the nest entrance and species. We found 191 nests, 182 of stingless bees and 9 of *A. mellifera*. The 26.75% of the nests were *Partamona* sp., 22.51% of *Trigona* (*Friesiomelitta*) *nigra*, 21.46% of N*annotrigona perilampoides*, 12.04% of *Scaptotrigona pectoralis*, 5.75% of *Plebeia* sp., 4.70% of *Apis mellifera*, 3.66% of *Cephalotrigona sexmeniae*, 1.04% of *Trigona fulviventris*, 1.04% of *Trigonisca* sp. and 1.04% of *Lestrimelitta niitkib*. The 73.85% of the nests were found in the monumental structures and buildings, a 25.65% in tree cavities, and 0.52% nesting on the ground. The nests of *A. mellifera* in the archaeological sites are eliminated to prevent accidents to people (Africanized honeybees). The number of nests appears to be related to several factors: archaeological surface area, age of restoration of monuments and buildings, presence of water sources and vegetation. Archaeological areas create the conditions for the maintenance of biodiversity, especially stingless native bees, and are a resource for education and research that can generate knowledge and promote environmental conservation.

EFFECTS OF HUMAN SETTLEMENTS AND GREEN AREAS AT MULTIPLE SPATIAL SCALES ON THE DIVERSITY AND ABUNDANCE OF BUMBLEBEES

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The abundance and distribution of species are influenced by processes that occur at multiple spatial scales. Some drivers of biodiversity loss, such as habitat destruction and fragmentation, for example, occur at large spatial scales, and that is why multiple scales studies are currently needed. Human settlements contribute to the fragmentation of the landscape with the creation of roads and residential areas, causing a reduction in the amount of green areas and suitable habitats. In contrast, the presence of green areas and gardens in urban environments seems to favour wild bees.
In our study, we analysed how the presence of human settlements and green areas at different spatial scales influences the total diversity and abundance of bumblebees, and the abundance of each species separately. We determined the species richness and the abundance of bumblebees in Ida-Viru County, Northeast Estonia, and calculated the proportion of human settlements and green areas in the surrounding landscape at four spatial extents: 250 m, 500 m, 1000 m and 2000 m radius. The field work was done during the summers of 2008 and 2009, in 22 semi-natural meadows. In total, we found 597 individuals belonging to 22 species of bumblebees (gen. *Bombus*) in our study sites, including 5 species of cuckoo bumblebees (subgen. *Psithyrus*). In general, we found a strong positive relationship between the total abundance of bumblebees and the proportion of human settlements. However, when the data were analysed for each species separately, we found that some species were affected positively, while others seem to have negative relationships with the proportion of human settlements and green areas at different spatial scales.

Issues in Crop Pollination for Modern Agriculture

HONEY BEES ROLE IN POLLINATION AND ITS IMPACTS ON YIELD OF CANOLA (*BRASSICA NAPUS* L.)

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Honey bees play an important role in the pollination of agriculture crops. It has been estimated that upto 30-35% increase in yield could be obatained if honey bees colonies are kept in the fields or orchards. A pollination trail was conducted at Agricultural Research Insitute Tarnab during 2010 on Canola. In this trial 20 plants were selected randomly in the field. Among them ten were covered with wire gauz cages and 10 were left open. Results in the harvesting of the crop were observed that the covered plants had small size of pod and complete seed formation was not made as compared to uncovered plants. Seeds obtained from the pollinated plants were 1.43 times more than non-pollinated plants. It is concluded that honey bees has a great role in pollination and increase the yield.

BEE POLLINATION OF THE SOUR CHERRY (*PRUNUS CERASUS*) VARIETY 'STEVNSBAER'

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Stevnsbær is a self-pollinated variety of sour cherries (*Prunus cerasus*) and one of the major fruit crops in Denmark. Yield is very variable and sometimes very low. Growers are divided on the value of bee pollination in ensuring stable high yield. Whereas some growers always place *Apis mellifera* colonies in their orchards, others never do. To investigate the value of bees as pollinators of 'Stevnsbær', a project on bee pollination of Stevnsbær was initiated in 2009 based on a preliminary study in 2007. Different pollination treatments were compared. For the clones Birgitte and Viki fruit set on 1) branches freely pollinated and 2) branches excluded from bees were compared. For Birgitte fruit set and yield on caged trees with 1) *A. mellifera*, 2) *Bombus terrestris*, 3) *Osmia rufa*, 4) no bees and 5) uncovered open pollinated trees were compared. Fruit set was significantly higher both for Birgitte and Viki on branches where flowers had been freely pollinated compared to branches where bees had been excluded by net. Transect counting during flowering showed the presence of bees, mainly *A. mellifera*, collecting nectar and pollen in the flowers. The positive effect of bee pollination on fruit set on branches was reflected in significantly higher fruit set and higher yields from trees pollinated by *A. mellifera*, *B. terrestris* and *O. rufa* compared to trees where bees had been excluded. Caged trees pollinated by *A. mellifera and B. terrestris* also had higher fruit set and yields compared to uncovered open pollinated trees.

THE ABUNDANCE AND DISTRIBUTION OF NATIVE BEES ON NEW ZEALAND CROPS

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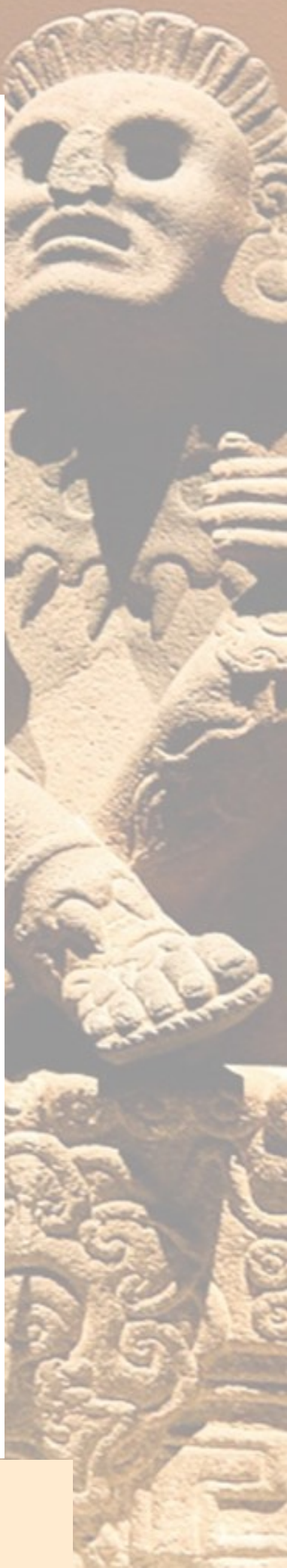
There are 40 known bee species contained within New Zealand's biogeographical region. Of the 27 native species, ten have been recorded visiting vegetable seed crops. Recent work has demonstrated that native bees are effective pollinators of crops, thereby, providing a potentially valuable ecosystem service to crop production. However, little information has been published on their distribution and abundance within different crop species. We observed and sampled native bee species visiting the flowers of five mass flowering commercial seed crop species grown in fields across the South and North Islands. These were Carrot (*Daucus carota*) (14 fields), Pak Choi (*Brassica rapa* var. *chinensis*) (41 fields), Onion (*Allium cepa*) (31 fields), Radish (*Raphanus sativus*) (6 fields) and White Clover (*Trifolium repens*) (7 fields). Nine native bee species were identified actively foraging on onion, five on pak choi, three on carrot and one each on radish and white clover. In most cases, the abundance of native bees within crop fields was low compared to other flower visitors of similar size (body length > 3 mm), representing < 5% of individuals observed in 69 fields. However, in one onion field, native bees represented 37.2% of flower visitors. Overall, native bees represented a mean 8.1% of flower visitors observed across onion fields, 4.4% across pak choi, 3.9% across carrot, 0.8% across white clover and 0.4% across radish. *Lasioglossum sordidum* was the most abundant and widespread species occurring on all five crops in fields located from Auckland to Southland. The majority of native bee species observed are ground nesting solitary bees. Populations may be enhanced through the provision of suitable nesting sites (bare, untilled and undisturbed earth) growing suitable plant species to provide regular and predictable nectar and pollen resources and protecting nesting bees from predators (e.g. birds).



BEE POLLINATORS OF ENTOMOPHILOUS CROPS IN SW VIRGINIA

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Declines in pollinators around the globe, notably the loss of honey bees (*Apis mellifera* L.) to Colony Collapse Disorder, coupled with a dearth of quantitative data on non-*Apis* bee pollinators, led to this research, which documents the role of non-*Apis* bees in crop pollination in southwest Virginia. Major findings of this first study of its kind in the region were that non-*Apis* bees provided the majority of pollination—measured by visitation—for several economically important entomophilous crops (apple, blueberry, caneberry, and cucurbits) and diverse bee populations may be helping to stabilize pollination service (105 species on crop flowers).
Non-*Apis*, primarily native, bees in Virginia provided more than half the crop pollination service generally assumed to be provided by honey bees. Visitation to crop flowers by non-*Apis* medium and bumble bees was significantly higher than visitation by honey bees in apple, blueberry, caneberry, cucumber, and squash; and equaled honey bee visitation to melon flowers. Non-*Apis* bees made up between 68% (in caneberries) and 83% (in cucurbits) of bees observed visiting crop flowers. This service was dominated within each crop by a few bee species. At the same time, between 43 and 49 species of non-*Apis* bees visited flowers in each crop system. There was low correspondence between bee communities across or within crop systems ("within crop" Jaccard similarity indices for richness ranged from 0.12–0.28). This tremendous diversity of bees suggests that non-*Apis* bees are also providing stability to pollination services, ensuring pollination if one or more species declines over time or space.

CURRENT STATUS OF INSECT POLLINATION IN MANGO

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The importance of pollination in agriculture has been recognized for millennia. The make-up of the pollinating fauna of mangoes has been studied in a number of countries. Diptera, mostly belonging to the families Calliphoridae and Syrphidae, are the most common visitors to mango flowers in Costa Rica and India. Hymenoptera were found to be more prevalent in terms of species in Australia. *Apis florea*, syrphids and calliphorids have been reported as the major pollinators from Bangalore. Stingless bees are the most common insects visiting mango flowers in studies in Brazil, India and Australia. In Australia, Costa Rica and India, *Trigona* bees were the most efficient pollinators on the basis of the proportions of flowers pollinated after a visit. Flies are the most common visitors to mango flowers in many parts of the tropics and are probably also efficient pollinators. Thus, stingless bees and flies are the most important pollinators of this crop. Stingless bees (*Trigona* sp.), honeybees (*Apis florea*, *A. cerana*, *A.mellifera*), flies (*Syrphus* sp., *Lucilia* sp., *Sarcophaga* sp.), coccinellids (*Menochilus sexmaculatus*, *Coccinella* spp.), butterfly (*Delias* sp.) have been recorded as important pollinators of mango from Uttar pradeshThere are numerous reports concerning the insect fauna attending mango flowers and the effect on fruit set off their exclusion. It was found that on panicles that were bagged to exclude insects fruit set was zero, compared with 4.3% set on unbagged panicles that allowed insects free access. investigations in the production of 'Tommy Atkins' mangoes under greenhouse cultivation in the Canary Islands, revealed that when all insects were excluded no fruit was set but when bees were introduced and other insects had free access, there was a significant increase in fruit set. Several species of pollinators were recorded from unsprayed mango plants and the average fruit set 63.85^{-1} plant in comparison to fruit set of 15.14^{-1} plant in sprayed trees with low pollinator population in Lucknow. At CISH, average fruit set 2.5/ panicle and yield 9.0 kg/tree (5-6 years old trees) was obtained in the field in which different types of pollinators were released and average fruit set 0.5/panicle and fruit yield 2.1 kg/tree where only bee (*Apis mellifera*) boxes were kept, in Control there was no fruit set. Studies were conducted at CISH to develop in-tree rearing of flies that would assist in mango pollination. Several species, the most numerous of which were *Lucilia* sp. (Calliphoridae) and *Sarcophaga* sp. (Sarcophagidae),

were reared from natural populations infesting fish or mutton pieces that were placed in mesh bags and hung in the lower branches of mango trees. Conservation of pollinators was done in various structures and natural abodes at CISH, Lucknow. Mass production and field releases of efficient pollinators viz., *Sarcophga* sp. and *Lucilia* sp. *Coccinella septumpunctata* were mass multiplied in the laboratory and field and stingless bees, *Trigona* spp. were collected from natural abodes and utilized for pollination purpose at CISH, Lucknow.

POTENTIAL POLLINATORS: A STUDY OF THE FLORAL VISITORS OF CORIANDER *CORIANDRUM SATIVUM* L. (APIACEAE) IN MITIDJA AREA (ALGERIA)

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Coriander *Coriandrum sativum* L. (Apiaceae) is an annual, condiment and aromatic plant. It is Mediterranean. It is cultivated in several countries in North Africa, Europe and Western Asia. The insect fauna visiting crop flowers in the El Harrach area composed of Diptera (Syrphidae), Coleoptera and Hymenoptera such as Chrysisdae, Vespoidea and Apoidea (Bees). The later superfamily comprises the majority of insect pollinators. Visiting bees belong to four families: Apoidae, Andrenidae, Halictidae and Colletidae. The main pollinators are honeybee and six species of Andrenidae: *Andrena flavipes, Andrena thoracica, Andrena* sp. 1, *Andrena* sp. 2 and *Andrena* sp. 4. The three species *Andrena* sp. 1, *Andrena* sp. 2 and *Andrena* sp. 4 have 100 % pollinating visits while *Apis mellifera* has only 47 %. *Andrena* sp. 4 is the most frequent and the most abundant species.

REFINING THE ECONOMIC VALUATION OF ANIMAL POLLINATION IN AGRICULTURE AT A NATIONAL SCALE

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In 2009, Gallai et al. used a bioeconomic approach to calculate that the total economic value of the pollination service provided by animals to agriculture worldwide amounted to €153 billion in 2005 when considering solely the crops used directly for human food (Ecol. Econ. 68:810-821; guidelines and spreadsheet freely available on the FAO website http://www.internationalpollinatorsinitiative.org/uploads/POLL%20VALUE%20NATIONAL%20MANUAL.pdf). These authors also pointed to several shortcomings in their approach that could not be resolved on a worldwide basis due to a lack of data in the FAO statistics. By researching data at a national scale in France, we were able to overcome three of these shortcomings and refine substantially our estimate of the economic value of pollination. In particular, we were able to access the respective surface areas and production values for several crops produced in the open and also under enclosures, for the seeds produced for planting, and for the home gardens. By taking these figures into account, we found that for France in 2005, the total economic value of pollination went from €1.8 billion based on the approach used by Gallai et al. in 2009 to €2.8 billion (+56%). These results will be discussed as well as their significance by comparison with other means to assess the economic value of pollinators in agriculture and for society at large.

Conservation Issues in Pollination

DOES SIZE MATTER? POLLINATORS' EFFICIENCY IN CRITICALLY ENDANGERED FRITILLARY (*FRITILLARIA MELEAGRIS* L., LILIACEAE)

Marcin Zych[1], Małgorzata Stpiczynska, Katarzyna Roguz, Krystyna Jędrzejewska-Szmek & Jan Goldstein

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Fritillary (*Fritillaria meleagris* L., Liliaceae) is a critically endangered plant in the Polish flora, red-listed in most of the European countries of its range. In the literature it is described as protogynous and out-crossed species pollinated by *Bombus terrestris* L. and (perhaps) other bees. The data however is mostly historical and based solely on observations of floral visits, with no detail studies of flower visitors efficiency nor experimental tests of the plant's breeding system available. Our study conducted for four years in the largest Polish population of *F. meleagris* in SE Poland based on experimental approach showed that (1) the flowers are not truly dichogamous and their protogyny is only superficial, (2) the plant is indeed predominantly out-crossed, and (3) the diversity of floral visitors may be much higher, and apart from social and solitary bees comprise also some Dipterans. However (4) in the natural population the visitation frequency is very low and (5) field and experimental analyses of the visitors efficiency show that although there are no differences in pollen deposition between the most frequent visitors, i.e. small solitary bees, honeybes and bumblebees, the latter contribute more to pollination due to higher frequency of visits and floral constancy.

Assessing Pollination Interactions for Ecosystem Function

POLLINATION WITHIN THE LANDSCAPE CONTEXT: WHAT DO WE KNOW AND WHAT SHOULD WE KNOW?

Blandina F. Viana[1], Danilo Boscolo[2], Eduardo Mariano Neto[2], Luciano E. Lopes[3], Ariadna V. Lopes[4], Patrícia A. Ferreira[2], Camila M. Pigozzo[5] & Luis Primo[2]

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Several studies in the last decade, mostly in temperate countries, have shown that habitat loss and fragmentation cause changes in species richness, composition, abundance and behavior of pollinators. Such changes in landscape structure are considered the main causes of pollination services limitation in agricultural systems. The compilation of these studies' results can help us identify general patterns and the underlying patterns in knowledge that could subsidize the development of research and conservation guidelines, which can contribute in designing landscape level policies to counteract pollination deficit. Our objective was to review the current knowledge on the effects of changing landscape structure on pollinators and pollination services in natural and agricultural ecosystems. We searched from May to July 2010 in the Web of Science data base (http://portal.isiknowledge.com/) for the following key-words "Landscape AND Pollination" and "Friendly landscape AND Pollinator" in the "topic" field. Our search returned 178 scientific articles; 133

(75%) were directly related to the response of pollinators to landscape changes. These studies were published mainly between 2001 and 2010 in 56 journals. In general we found that most of these journals were specialized in biological conservation and ecology, with almost none with focus in agricultural sciences. The first scientific work to directly address the effects of habitat spatial distribution over pollinators was carried out in central Amazon, Brazil, but afterward research was conducted mainly in temperate regions. Within all analyzed papers, the majority approached pollination issues only at the patch level. Among these, however, most did not give any exact information on patch sizes. Few studies considered large scale landscapes and half of them used buffering zones around patches or sample sites to estimate landscape structure. Also, the inter-habitat matrix was sparingly addressed until 2005, gaining importance in publications only after 2006, indicating a general growing interest on landscape permeability and functional habitat connectivity. Our review indicates a general strong positive influence of the amount and proximity of natural areas on diversity and abundance of pollinators in natural and agricultural areas. Habitat loss and fragmentation change population viability and are therefore probably the main drivers of the pollinators decline around the world. To provide adequate conservation of pollination services, we need to find what are the critical habitat loss levels above which mass pollinator extinctions become highly probable, leading to the collapse of plant-pollinator interactions. Future studies must focus on the development of new technologies of environmental management and monitoring which can deal with multiscale approaches and integrated pollinator friendly landscape planning, with positive results for agricultural production.

PLANTS AND BEES MUTUALISTIC NETWORKS IN THREE ECOSYSTEMS IN SANTA CATARINA, SOUTHERN BRAZIL

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The network between bees and plants was studied in three different systems of the Atlantic Rainforest Domain in Santa Catarina state, southern Brasil: Atlantic Moist forest (in Blumenau), Semi-Deciduous forest (in Concórdia) and Montane moist forests or Araucaria forest (in Porto União). The first two areas belong national parks (Serra do Itajaí National Park and Fritz Plaumann State Park respectively) and the third area stays in a private property. The bees were collected in three independent surveys. Samples were carried on with hand nets directly on the flowers. The 122 bee species collected in Blumenau interacted with 110 plant species, totalizing 623 qualitative interactions and 2746 quantitave interactions. In Concórdia, 97 bee species were collected visiting 78 plant species, totalizing 434 qualitative interactions and 2659 quantitative interactions. In Porto União 95 plant species were visited by 127 bee species, totalizing 363 qualitative interaction and 1323 quantitative interactions. The resulting networks were nested, having a NODF value in Blumenau of 7.76, in Concórdia 9.66 and in Porto União5.24, all statistically significant. The connectance (C) was higher in Concórdia (C: 0.0524), followed by Blumenau (C: 0.0451) and Porto União (NS: 363). The interactions evenness (IE) and the specialization measure (H_2') of Blumenau (IE: 0.797, H_2': 0.471), Concórdia (IE: 0.744, H_2': 0.485) and Porto União (IE: 0.807, H_2': 0.459), resulted in a similar value. The most abundant bee species found in the three areas were the social species *Apis melifera* and *Trigona spinipes*, which have also the highest number of connections in all the networks. The topologies of the networks were similar to the pattern found in other studies of mutualistic interactions, including pollinator's networks: a high number of the interacting species have one or few interactions and a small number of species have a lot of interactions, showing the strong asymmetry.

MODELING POLLINATORS ACROSS AGRICULTURAL LANDSCAPES

Christina Kennedy, Eric Lonsdorf, Neal Williams, and Claire Kremen

Crop pollination by bees and other animals is an essential ecosystem service. The maintenance of pollination across landscapes requires an understanding of the contributions of landscape elements to

pollinator populations. We developed a quantitative model that predicts relative abundance of pollinators within nesting habitats throughout landscapes, based on information on the distribution of pollinator nesting resources, floral resources, and foraging distances. From these nesting source areas, the model then predicts relative abundances of pollinators on the farms or other locations requiring pollination services. The model does not explicitly capture the role of habitat configuration, which may also affect pollinator persistence and the delivery of pollination. To investigate the role of composition and configuration and explore our model generally, we applied it model across 35 studies on 21 different crops from 15 counties to predict the effects of landscape composition (i.e., the proportional areas of different habitat types within bee foraging ranges from nest sites) on pollinator (bee) abundance. Based on generalized linear mixed models in model selection framework, we then test the relative importance of habitat composition (i.e., model scores) versus habitat configuration (i.e., patch shape, inter-patch connectivity, and habitat aggregation), farming practice (i.e., organic versus conventional farming) and biome (tropical versus temperate). The greatest predictors of pollinators were habitat composition and farming practice, and to a lesser extent habitat patch aggregation. Bee abundance was estimated to increase by a factor of 15 per unit increase in habitat amount, and by over a factor of 2 in organic over conventional farms. Bee abundance was also estimated to increase slightly, by a 0.3% per unit of increase in habitat aggregation. Thus, maintaining pollinators in heterogeneous agricultural systems will depend upon not only our ability to predict and maintain sufficient amounts of habitat in landscapes, but also their inter-connectivity and compatibility with local farming practices.

POLLINATION NETWORKS ALONG A SUCCESSIONAL GRADIENT OF TROPICAL DRY FOREST

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Habitat modification often results in a matrix where forests in secondary succession are common. Pollinators, which are of crucial importance for the reproduction of most plant species, can be affected by anthropogenic disturbances. There is a shortage of information on how plant-pollinator interactions change along secondary succession. The objective of this study is to look at changes in the diversity and structure of the plant and pollinator communities, and in the pollination networks along a successional gradient of tropical dry forest. We sampled plant-pollinator interactions in early, intermediate and late successional sites of tropical dry forest in the Biosphere Reserve of Chamela-Cuixmala, Mexico, and surrounding areas. We found more plant species flowering, more plant species visited by pollinators, and a higher floral abundance at early succesional sites. As a consequence, a higher number of pollinators is attracted to these sites, which results in higher pollinator species richness. These patterns impact pollination networks: network asymmetry is higher at early successional sites, where pollinators tend to be more generalist and there is a higher number of interactions. Network specialization tends to be higher at late successional sites, nevertheless, interaction evenness remains constant along the successional gradient. Our results show that secondary forests have a diverse pollinator community, but changes in species composition results in a more generalist pollinator community.

Pollination Issues for National & International Trade

THE POTENTIAL ROLE OF THE NORTH AMERICAN FREE TRADE AGREEMENT IN POLLINATOR PROTECTION

Melanie McCavour, Peter Kevan and David Greene

Pollination, a crucial ecosystem service in agriculture, food and fiber security, environmental sustainability, international trade, and conservation, is under ever greater stress. In particular, the recent rise in parasites such as Varroa, the sudden appearance of Colony Collapse Disorder, and the increasing enlargement of agricultural fields (reducing the capacity of wild pollinators to contribute to crop reproductive success) and sophistication of broadcast pesticides make the future of this ecosystem service problematic. NAFTA (the North American Free Trade Agreement) could facilitate the maintenance of genetic diversity, integrated pest management and resilience-based management of crop and animal production to reduce this tendency toward a reduction in pollinator services. Following the 2009 Roundtable on NAFTA, Food Security and Pollination, held at the Canadian Embassy in Washington, DC, several conclusions and goals were reached: (a) Creation of a NAFTA Pollination Task within the North American Pollinator Protection Campaign (NAPPC) to advise the NAFTA Pollination Task Force; (b)Volunteer to attend CEC (NAFTA Commission on Environmental Cooperation) council sessions and other meetings to represent pollination issues; (c) Volunteer to participate as a JPAC (Joint Public Advisory Committee of the CEC) member, and (d) Overarching considerations were crafted to be presented to the CEC and the NAFTA Ministers responsible for agriculture and trade. Possible avenues for the inclusion of pollinator protection in the NAFTA will be presented, including pollinator protection as an article within Chapter 7 of NAFTA; the inclusion of pollinators within the Payment for Ecosystem Services (PES) Document of the CEC; the potential to join an existing JPAC, for example the forum on Healthy Communities and Ecosystems, or to create a new JPAC specifically focused upon pollinator protection. This proposal will draw on resources such as the Seventeenth Regular Session of the CEC Council and JPAC meeting of 2010; the Eighteenth Regular Session of the CEC Council, to be held 21–22 June 2011 (where the lead author will make a presentation) in Montreal, Canada; and the recent PES study completed by the CEC.

POLLINATING SPECIES, COMMODITY VALUES, TRADE AND POLICY CONSIDERATIONS

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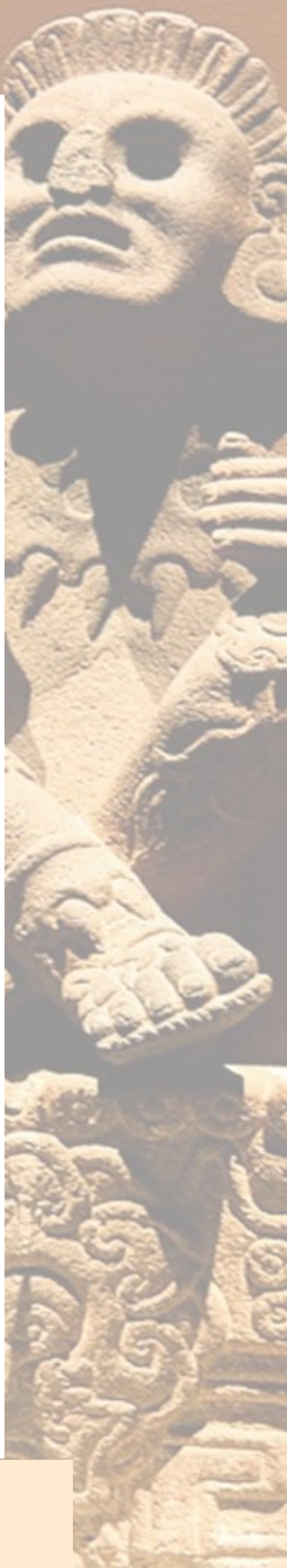
Science has successfully shown the importance of managed and wild pollinators to human food security and the conservation of biodiversity. Science has also identified the various factors causing pollinator declines and the implications of such declines for humans and the environment. However, translation of the current understanding of the importance of pollinators into current policy and regulation is weak and requires attention, both in developed and developing nations. The national and international trade of commodities generated via insect pollination is large, and trade offers a potential route for influencing policy on pollinator conservation. The international trade in certain crops (e.g. coffee, apples, and palm oil) could be potential means of influencing trade regulations in such manners as to promote the local existence of pollinating species. This is apart from their contributions to biodiversity conservation in those regions. The European Union already places legal limitations on food crops generated in certain ways (e.g. GM crops), and on commodities produced in certain manners (e.g. seal pelts and products, and paints containing lead). In North America, it is, conceivably, within the mandate the North American Free Trade Agreement (Canada, the US, and Mexico) and its International Agreement on Environmental Cooperation, to develop policies promoting the use of pollinating species in the generation of commodities traded among its Parties. This presentation explores the direct and indirect values of pollinating species and relates them to simple economics of commodity production, and how this might relate to trade and enhanced policy to promote pollinator existence.

Pollination in the Forest



POLLINATION STRATEGIES OF AMAZONIAN TREES

Márcia Motta Maués

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Bees are key pollinators at the upper strata of the Amazon forest, but there are other insects also important in pollen flow, sometimes overlooked. Canopy pollination studies at the Amazon biome are relatively scarce, although depict the diversity of strategies to attract floral visitors in a dense humid forest. Here we present data of three entomophilous hard wood trees (*Bertholletia excelsa* Bonpl., *Manilkara huberi* L. and *Vouacapoua americana* Aubl.) from Amazon humid forests. The flower visitors were assessed in the peak of the flowering season. Attraction and reward approaches in the Lecythidaceae family, specially the zygomorphic flowers of the climax tree *B. excelsa* (Brazil nut), exemplify how complex may be the pollination system in tropical plants. *B. excelsa* flowers select the legitimate pollinators mainly by means of anatomical features, therefore only robust bees such as carpenter bees, bumblebees and some orchid bees, which perfectly match the internal area of the flower hood, are capable to force the entrance and reach the floral rewards. On the other hand, open access floral rewards found in the actinomorphic flowers of the shade-tolerant trees *M. huberi* (Sapotaceae) and *V. americana* (Leg-Caesalpinioideae), increases the diversity of pollinators, allowing stingless bees, hoverflies, wasps and chrysomelids to forage and pollinate, which is worthy for effective pollination, considering the supra-annual flowering episodes in these plants. Concerning the reproductive cycles, *B. excelsa* trees flowers synchronously every year, mainly in the dry season (September to February), while *V. americana* showed supra-annual flowering episodes with biannual pattern in the rainy season (January to March) and *M. huberi* also presented a synchronous supra-annual flowering pattern, with gaps of 3-4 years, displayed on the transition from rainy to dry season (June to August). As most tropical species flowers in the dry season, we expect that species flowering in rainy season face less competition for pollinators' preference, increasing the chances of successful reproduction.

WHY DO AUSTRALIAN *ACACIAS* OFFER FREE FOOD? POLLINATORS IN AN ANT-*ACACIA* MUTUALISTIC SYSTEM WITHIN A LONGITUDINAL GRADIENT ACROSS VICTORIA

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Success of pollination may rely, among other factors, on visitor abundance, visitor diversity (related to forest health and proximity) and type of reward. It is often difficult to determine to what degree plants and pollinators are mutually dependent. Species show redundancy in traits (floral or pollinator characters) that enable interactions with multiple species, ensuring the benefits (cross pollination and reward) without obligate specificity. We examined fitness related traits in *Acacia myrtifolia* at four sites across a 600 km ecological gradient in southeastern Australia. We sampled the background ant fauna, pollinators and conducted ant- and pollinator-exclusion experiments for one year at each site. We ask whether the presence of various ant guilds explains variation in pollinator visitation rates, fruit set, seed germination and seedling establishment, but also herbivory damage and growth rate. Our aim is to understand to what extent does the combination of interactions impact the plant's fitness. Pollinator and ant communities varied among sites. The exclusion of ants had no apparent effect on pollinator visitation rates and did not alter the production of fruits. Our observations suggest that there are effects of ant-present and ant-exclusion treatments on increasing branch growth and seed set. Fruit set required pollinator visits, except at one site, where pollinator exclosures produced a fruit set similar to open pollination. Natural fruit set rates were low (4–30%). Our results on fruit set as an index of successful pollination imply that this

plant could be another example where pollination occurs by insects, wind and autonomously. The array of guilds plays a significant role in this study system. Despite that there are more than 900 species of *Acacia s.s.* in Australia most of their interactions are still a fascinating enigma.

IMPACT OF THE AFRICANIZED HONEY BEE ON POPULATION SIZE, NECTAR AND POLLEN SOURCES OF SOLITARY BEES

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This study took place in the tropical Mexican biosphere reserve of Sian ka´an, Little is known of the potential coevolution of flowers and bees in changing, biodiverse environments. Female solitary bees, megachilids and *Centris*, and their nest pollen provisions were monitored with trap-nests during 17 years. The objective of this study was to analyze the major and minor pollen species in nests of two solitary bee groups (Megachilidae and *Centris analis*). We wish to know whether a bee is using a flower for nectar, oil, for only pollen, or for a combination of these. The study was divided into what we consider 'pre' and 'post'-*Apis* periods. Sian Ka'an Biosphere Reserve was established in 1986, it is made up of 500,000 ha containing low-stature mature forest (a 20 m canopy) and some marshlands, surrounded by a Maya region buffer zone in Quintana Roo state, Yucatan peninsula, Mexico. Artificial nest domiciles were placed in the field for solitary bees, and removed before their brood emerged. Each two months, a new set of blocks was placed at the sites, and the existing blocks removed to outdoor rearing cages. Nest tunnel blocks were opened with a chisel and individual nest contents collected. All pollen samples were homogenized and acetolyzed, then mounted on microscope slides. We found that drought and heavy rain or hurricane damage had severe effects on bee populations. Honey bee competition, and ostensibly pollination of native plants, caused changes in local pollination ecology. Natural disasters made a large negative impact on native bee populations, but sustained presence of Africanized honey bees did not. Shifts in floral hosts by native bees were common and driven by plant phylogenetics, whereby plants of the same families or higher taxa were substituted for those dominated by honey bees or lost due to natural processes. Two important plant families, Anacardiaceae and Euphorbiaceae, were lost to competing honey bees, but compensated for by greater use of Fabaceae, Rubiaceae, and Sapotaceae among native bees. Over 171 plant species comprised pollen diets of the honey bees, including those most important to *Centris* and megachilids (72 and 28 species, respectively). Honey bee pollination of *Pouteria* (Sapotaceae) plausibly augmented the native bees' primary pollen resource and prevented their decline. Invasive generalist pollinators may, however, cause specialized competitors to fail, especially in less biodiverse environments. We considered as minor pollen, those with less than 50 grains in a complete nest sample, represented available but uncommon pollen, nectar and oil resources in individual nests. For *Centris analis*, Malpighiaceae, Fabaceae, Sapotaceae and Bignoniaceae were the most frequent minor families. For the Megachilidae — primarily one species, *Megachile zaptlana*— Fabaceae, Bignoniaceae and Euphorbiaceae were the main families. However, some occurred regularly and in high nest proportions. These were revealed to be sources of nectar or oil. When principal pollen sources for these perennial bees were found in nests as minor pollen resources, we interpret this to mean there was intense competition for the resource or insufficient flowering for more extensive use. Some minor species were present during at least six months, including, for *Centris*, *Bunchosia lanceolata*, *B. swartziana*, *B.* sp., *Caesalpinia* spp., *Cydista* sp., *Diphysa carthagenensis*, *Euphorbia* sp., *Heteropteris beecheyana*, *Hiraea obovata*, *Lonchocarpus rugosus*, *Malpighia emargianta*, *Metopium browneii*, and *Pouteria* spp. For megachilids, *Caesalpinia* sp., *Cydista* sp., *Euphorbia* sp. and *Malpighia emarginata* were foraged during four or more months. Such species are important because they represent a food source much of the year, but not abundant in total pollen, regardless of grain size. *Caesalpinia* spp. were important nectar sources for both *Centris* and Megachilidae. Several nest-common pollen taxa in our study do not make nectar because their flowers lack nectaries, eg. *Acacia*, *Piper*, *Mimosa, Senna*, *Peperomia*, *Bunchosia, Byrsonima*, *Hiraea* and *Heteropterys*. The last four contribute both as pollen and oil sources to the bee diet.

POLLINATION SERVICES IN MEXICO

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Animal pollination is one of the essential services provided by ecosystems to humans. In the face of a potential worldwide pollination crisis it is important to assess which countries may be more vulnerable in order to prioritize pollinator conservation efforts. The poverty level, the population density and the level of pollinator dependence for food provisioning are key aspects to identify vulnerable countries. We evaluate these aspects and determine the level of human food provisioning dependence on pollinators in Mexico, a developing and highly populated country. The diversity of crop species in Mexico is exceptionally high. Nearly 85% of fruit and/or seed consumed species depend to some degree on pollinators for productivity. Overall, pollinator-dependent crops generate larger income but cover a lower cultivated area and produce less volume compared to non-pollinator-dependent crops. Volume per unit area, however, as well as revenue per unit area, is much higher for pollinator-dependent crops. Native wild pollinators also play a key role in fruit or seed production of Mexican domesticated plant species and in the reproduction of many useful wild species. Thus, assuring free pollination services is particularly important in Mexico as the livelihood of a large proportion of the population exclusively and directly depends on ecosystem services for subsistence. Feasible conservation strategies involve the payment of environmental services to Ejidos (communal land tenure systems) making efforts to protect or restore plant resources and native pollinators, and the creation of new protected natural areas, which ensures food provision, mating and nesting sites for pollinators. Studying interaction networks including pollinators of both edible plant species and wild plant species, will allow prioritizing conservation strategies for pollinators to ensure food production.

BIRDS AND BEES ON FLOWERING TREES

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Efficiency in gathering resources is basic to optimal foraging. Throughout their lives animals must take in energy and nutrients faster than they used them. Pollinators have been models for optimal foraging, especially through energy intake from nectar. Most research has concentrated on bumblebees (*Bombus* spp.) foraging for nectar at flowers and inflorescences in meadow-like, horizontal, environments. Many flowers are presented in vertical arrays of inflorescences or on trees and bushes, or both. Climbing, especially by flight requires much energy so it can be assumed that foraging on large, vertically oriented floral arrays is more energy consumptive than foraging across a meadow: downward flight has some compensatory effect. Time and motion studies of large bees (*Bombus* spp. in Canada, Sweden and Norway; *Xylocopa* spp. in Indonesia, Malaysia, and Maldives) and hummingbirds (Streamertails and Mangos in Jamaica) document energy efficient foraging at flowers on the vertical surfaces of various flowering trees. Those foragers move in accordance with well-known vertical, ascending, movements of foragers on inflorescences and descending movements between inflorescences in horizontal environments. On vertical surfaces of flowering trees, foragers treat closely spaced inflorescences as single inflorescences and ascend between them but descend between well-separated inflorescences. Depending on the density of the inflorescences on the crown of a blooming tree, forager/pollinator movements may result in net downward movement, the reverse, or no change in altitude. Between trees, foragers mostly gain altitude. Those patterns accord with efficiency of removing resources from towers of various configurations: go to the top and load up on descent so to avoid carrying loads upwards. The botanical implications of such foraging and floral density seem not to have been studied.

POSTER ABSTRACTS—ALPHABETICAL BY FIRST AUTHOR

PESTICIDE USE IN CROPS AND POLLINATORS: PROTECTION GOALS AND RELATED REGULATORY TOOLS

Anne Alix and Mark Miles

Modern crop management practices ally the extension of cropped areas and while maintaining a proper control of pest populations and diseases. Plant Protection Products (pesticides) are part of these management practices. Many plant species are dependent on pollinators for reproduction, and pollinators have a key role in maintaining biological diversity and ecosystem functioning, as illustrated by the estimated 450 crop species that globally depend on pollination by bees and other insects. Thus a particular attention to pollinators is given in the regulations that have been implemented in many countries to accompany the placing of pesticides on the market, noticeably by requiring a preliminary demonstration of acceptable risks to human health and the environment; along with a demonstration of their protection efficacy. This risk assessment step, based on scientific knowledge characterizing exposure conditions and levels of exposure at which toxic effects may be observed, permits a consideration of whether risks can be expected in the field and the circumstances of their occurrence. Risk assessment aims at quantifying the risks related to exposure routes that cannot be avoided. Risks corresponding to exposure routes that can be avoided or reduced to levels of negligible concern are usually a trigger for the implementation of risk management measures. Finally, monitoring studies of pollinator community implemented on a post registration basis allows the ascertaining that the protection goals set by regulations are achieved and when relevant, to adjust the risk management measures implemented. This presentation aims at providing a snapshot on the regulatory tools, i.e. risk assessments performed priori to the authorization, risk management measures implemented in the field and monitoring studies that complement each other to achieve the protection of pollinators in the field.

MONITORING THE BEE FAUNA IN CROPS: A PROPOSE TO EVALUATE THE DEFICIT OF POLLINATING BEES IN BRAZIL

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Agriculture intensification, habitat destruction and fragmentation promote drastic changes in the pollinator's populations, risking the pollination service. To quantify and control the decline of pollinator's diversity and abundance is recommendable monitoring the populations systematically. Our project aims to develop a protocol to evaluate and monitor spatially and temporally the presence of the native bee fauna in crops and surrounding areas. The apifauna monitoring program was proposed to seven cultures in different regions and vegetations in Brazil. The target crops are: *Anacardium occidentale* (cashew), *Bertholletia excelsa* (Brazilian nut), *Brassica napus* (canola), *Cucumis melo* (melon), *Gossypium hirsutum* (cotton), *Lycopersicum esculentum* (tomato) and *Mallus domestica* (apple). The sampling method adopted to capture the bees was the use of color pantraps (white, blue and yellow painted with UV spray) with water and soup. The traps are displayed (24 hours) along a transect in the cultivar area and in the surrounding once a month. The captured insects are fixed in 70% ethanol. The caught bees are separated from the other insects, pinned and submit to identification. All the information on the sampled bees is stored in a data bank for analyses. The local environmental conditions and the crops characteristics needed evaluation before define the

preliminary sample design. This was done through visits to the sites, when adjustments to the various situations and scenarios of the different pollination projects have been discussed. So far, nine areas were visited, referring to four crops: canola (three areas in Rio Grande do Sul), Brazilian nut (one area in Pará, one in Amazonas and one in Acre), tomato (one area in Rio de Janeiro) and cotton (two areas in Paraíba). The preliminary results show differences between the number of bees captured in each area, each crop, and each color of the pan. In south Brazil, by the extensive canola fields, the pantraps captured more than 5,000 insects during the flowering period of this culture. In this case, the bees represented more than 15% of the sample, and *Apis mellifera* L. accounted for about the half of the bees. In the 3 studied canola fields the yellow pantraps collected about 60% of the insects. In the Brazilian nut cultivars the pantraps displayed 1.5m from the ground captured more bees than those suspended 12-15m. In this culture the blue pan was more efficient. In the tomato plantations, the number of captured bees was lower than the other cultivars, but the richness of the sampled bee species was higher, 12 species. These data are being analyzed in order to propose a monitoring protocol to be used as a reference for several crops in Brazil. (This work is supported by the Program on "Conservation and Management of Pollinators for Sustainable Agriculture, through and Ecosystem Approach" funded by GEF/FAO and the Brazilian Environment Minister.)

FLOWER ORIENTATION AND MALE REPRODUCTIVE TRAITS IN *PACHYCEREUS WEBERI* (CACTACEAE)

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Photosyntethic active radiation (PAR) is associated with CO_2 capture and therefore with photosynthetic rate. In Cactaceae, the interception of PAR differs among sides of the stem and it has been suggested that there is not translocation of resources between ribs. Therefore, PAR received on each face of the stem may determine the availability of resources for reproduction. Previous studies have shown that the production of reproductive structures and ovules are greater on the south face of the stems of columnar cacti, where PAR interception is higher. Here, we determine if flower orientation has an effect on male reproductive traits of *Pachycereus weberi*. We collected floral buds with contrasting orientations (Northeast and Southeast) and evaluated male floral traits: number of anthers per bud, anther length, anther width, length by width of anthers, number of pollen grains per anther, number of pollen grains per flower, and percentage of viable pollen grains. We applied *t* tests to determine if all of these traits were greater on flowers facing Southeast. Moreover, we applied stepwise regression analyses to determine which anther dimensions (length, width and length x width) better explained the variability on percentage of pollen viability and number of pollen grains per anther. Results showed that flowers oriented towards the Southeast had significantly greater production of pollen grains per flower. All other traits were not significantly different between flowers with different orientations. However, marginal differences were found in anther length (P=0.07), anther width (P=0.07), anther length x width (P=0.06), number of pollen grains per anther (P=0.08), and percentage of viable pollen grains (P=0.06). Anther length explained 24% of the variability in the percentage of pollen viability; whereas anther length x width explained 38% of the variability in number of pollen grains per anther. Our results suggest that flower orientation affects male floral traits.

EFFECT OF ANTROPOGENIC PERTURBATION ON THE COMMUNITY OF FLORAL VISITORS OF *BURSERA COPALLIFERA* (BURSERACEAE)

Eribel Bello Cervantes, Silvia Guzmán Jiménez, Sombra Patricia Rivas-Arancibia, Hortensia Carrillo-Ruiz, Dulce María Figueroa-Castro, and Agustina Rosa Andrés-Hernández

Benemérita Universidad Autónoma dePuebla.

Bursera copallifera is used for the extraction of copal incense, to build live fences and in the traditional medicine as well as on religious ceremonies. Moreover, *B. copallifera* is also important for other organisms. For instance, the resins produced by the tree are used as a refuge and nest by ants, spiders and weevils, whereas bees collect the resins to produce propolis. However, there is a lack of studies addressing the reproductive biology of the species. Nowadays, *B. copallifera* is threatened due to its intense extraction and the strong antropogenic perturbation suffered by the dry forests where *B. copallifera* is distributed. In this study, we evaluated the effect of antropogenic perturbation on the community of floral visitors of *B. copallifera*. We selected three nearby sites with different levels of perturbation. On each site, we choose nine inflorescences on which we conducted observations and collections of floral visitors from 900-1800 hrs during eight days. Preliminary results show that flowers of *B. copallifera* are visited by 82 species belonging to five insect orders. Hymenoptera was observed throughout all the period of observation and it was the most abundant group of visitors. Coleoptera was more abundant before midday, whereas Lepidoptera and Hemiptera were more abundant late in the afternoon. Diptera was the less abundant group. Coleoptera, Hymenoptera and Hemiptera were significantly more abundant in the most perturbed site. Diptera had similar abundances in all three sites. The diversity of insect orders was not significantly different among the three sites. Our results suggest that antropogenic perturbation does not affect the community of floral visitors at the level of insect order, probably because *B. copallifera* is tolerant to perturbation and its flowers are available for a great diversity of insects. New analyses would reveal the effect of perturbation on floral visitors at the species level.

POLLINATION AND POLLINATORS OF BRAZIL NUT (*BERTHOLLETIA EXCELSA*) IN A CROP OF THE CENTRAL RAIN FOREST

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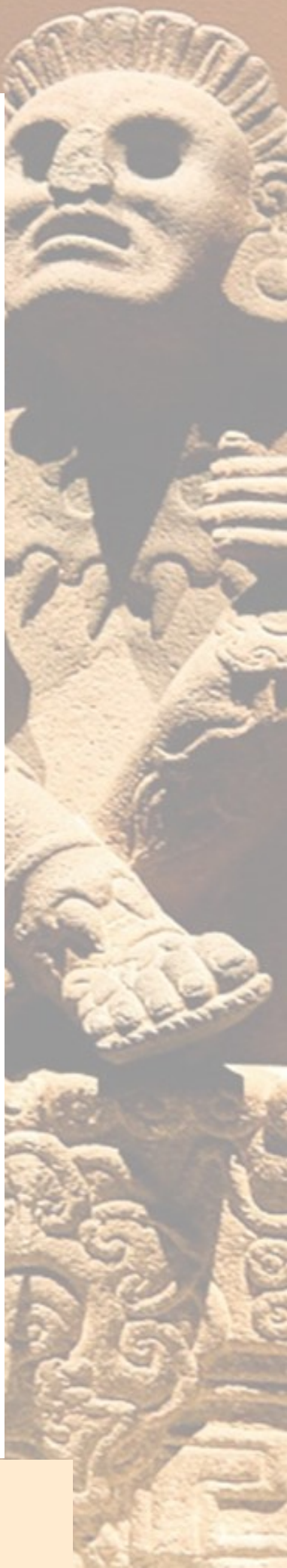
This study was carried out in Aruanã farm, municipality of Itacoatiara, in the State of Amazonas, Brazil, in an area of 3,600 ha cultivated Brazil nut tree (*Bertholletia excelsa*). Data were collected from October to December 2007, to investigate floral visitors and the pollination of grafted Brazil nut trees cultivated in Central Amazon Forest, aiming to maximize the crop productivity. Floral biology and pollination requirements of this crop were assessed, as well as richness, diversity and abundance of floral visitors in relation to the flowering phase of the trees (5, 25 and 50%); foraging behavior of bees visiting the flowers, initial fruit set and number of seeds set per fruit in hand and bagging pollination experiments (open pollination, restricted pollination, hand cross-pollination, hand self-pollination and hand geitonogamy). Results showed that 19 bee species, belonging to three Families, visited the flowers all-day long collecting nectar and pollen. The most abundant and frequent species in the area, during the whole blooming period, were *Xylocopa frontalis* (63%) and *Eulaema mocsaryi* (12%). Natural pollination rates showed to be lower than the crop's potential observed by hand pollination. The Brazil nut tree allows geitonogamy (3.85%) in initial fruit set, but its level is significantly lower ($p>0,01$) than that of hand cross-pollination (19.33%), which needs biotic pollinators, in this case large-sized bees, to accomplish successful pollination. The number of viable seeds varied significantly ($p>0.05$) among treatments showing that open pollination and hand cross-pollination produced similar results among them, but superior than geitonogamy. The foraging behavior of *E. mocsaryi* and *X. frontalis* led to the conclusion that they are the main pollinators of *Bertholletia excelsa* under cultivated conditions in that area. Richness, diversity and abundance of flora visitors and potential pollinators can be related to the surrounding forest which provides adequate environment to keep pollinators in periods of the year when the crop is not blooming.



IS FRUIT SET IN CRANBERRY CROPS LIMITED BY PLANT RESOURCE OR BY POLLINATION?

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Fruit production in cranberry crops highly depends on insect pollination. The contribution of managed pollinators (Honeybees, Bumble bees, Alfalfa leafcutter) and native bees to cranberry crop pollination in Quebec, Canada, was studied. The impact of these pollinators on the number of fertilized ovules and weight of individual fruits was analysed. Open plots and mesh exclusion cages were established in the fields before pollinators were introduced. Individual cranberry stems were labelled and the number of flowers on each stem was counted. The hierarchical position of each berry on its stem was recorded at harvest. Fruit (berry) weight and number of fertilized ovules of each fruit were noted. Honeybees were the most frequent pollinators in the open plots during the two years of the study, followed by the Alfalfa leafcutter. Fruit weight, fruit set, pollination rate and total seeds per fruit were significantly higher in the presence of introduced and native pollinators. Over 40% of the increase in fruit weight was explained by the increase in the amount of fertilized ovules. The presence of a diversity of pollinators (native and introduced) allowed a better pollination, thereby increasing the number of fertilized ovules and fruit weight. Since 25% of the analyzed stems developed three to five berries, the low average of berry per stem observed (1.9 /stem) was not due to lack of plant resource, but rather to a lack of pollination. There was no significant difference in the average weight of berries whether stems developed between one to five. The study shows that for a comparable weight, fewer developed ovules are found in fruits holding top positions on the stem, suggesting that berries in the following positions must have more fertilized ovules to reach maturity and a comparable weight.

PESTICIDE EXPOSURE ROUTES FOR BUMBLEBEES (*BOMBUS* SPP.)

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Aspects of bumblebee biology and natural history that may impact pesticide exposure are described, including body size, foraging and reproductive cycles. It is noted that thus far, most studies have been performed on managed species, which have very different life histories than wild species, and these studies have been performed under artificial conditions. Vulnerable castes such as post-overwintering spring queens and vulnerable species such as the above ground nesting and later emerging species should be tested. Species which differ in their larval feeding behaviour may be differentially impacted. Sub-lethal effects, especially those involving foraging behaviour, are likely better tests of impact on this group. Tests should be held in natural settings with environmental stressors, such as changes in food availability and weather variability.

EXPLAINING VARIATION IN POLLINATOR RESPONSES TO FLOWER DENSITY: NON-LINEAR EFFECTS AND SCALE-DEPENDENCE

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Although pollinator visitation rates often increase with plant or flower density, studies finding the opposite pattern, or failing to find a density effect, are common. Potential (and compatible) explanations for this diversity of effects are that the effect of density is nonlinear or that it is scale-dependent. Here I present data that support these possibilities. Previous theory suggests that the effect of flower density on visitation should be positive at low densities but weak or negative at higher densities. A field experiment in which I manipulated flower densities on a small scale provided partial support for this prediction. Although total visitation rates did not vary significantly with flower density, per-flower visitation by the most common group of flower visitors, halictid bees, responded to flower density in a nonlinear fashion, roughly as predicted. In an observational study using the same species, I measured effects of floral resource density on pollinator visitation rates at local (within 4m2 plots) and large (within 200m) scales. I found scale-dependent responses in the most common species I observed, the eucerine bee Melissodes lupina, whose visitation decreased with local flower density but was positively correlated with large-scale floral resource density as it changed through the season. Effects of flower density on pollinator visitation rates can have important consequences for plant ecology and are still poorly understood. The work I describe here contributes to a better understanding of these effects and should inspire further investigation of the causes of variation in this ecologically important relationship

A FLOWER-VISITATION WEB OF PAPILIONOIDEAE (LEGUMINOSAE) FROM NORTHWESTERN ARGENTINA

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We characterized the web of interactions between sympatric Papilionoideae (Leguminosae) plant species and flower visitors in Valle de Lerma, Salta, Northwestern Argentina, were plant-pollinator relationships are little known. Taking a plant-centered approach, we observed individuals of 22 native plant species belonging to five tribes of Papilionoideae that were coming into flower during the summer, and recorded all identifiable flower-visitors. Taking a visitor-centered approach, we made a network of bees, noting the plant species visited. The former approach revealed connections among the species via insects, whereas the latter confirmed these connections. Also, we studied abundance of pollinators. Our sampling yields a qualitative web that includes 25 insect species visiting 22 plant species. Flowers were visited on average by 2.76 ± 0.42 animal species, while visitor species frequented on average the flowers of 4.23 ± 0.36 plant species, for a total of 550 pair-wise species interactions. This represents a web connectance of 18.54 %. We discuss generalization of both plants and flower visitors.

SEASONALITY OF THE USE OF CARDAMOM POLLEN BY THE BEES OF LAGUNA LACHUA NATIONAL PARK ZONE OF INFLUENCE

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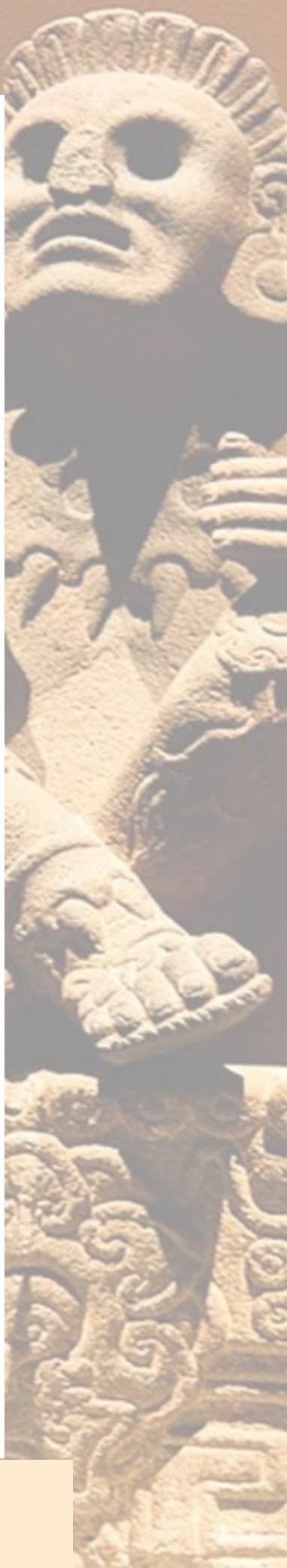

Bimestrial collections of bees visiting cardamom flowers (*Elettaria cardamomum* Maton) were made during one year, in plantations of the Laguna Lachúa National Park Zone of Influence, in order to determine the importance of pollen as a floral resource for bees. 530 specimens were collected, stored in individual vials and frozen. The pollen charges were analyzed microscopically by counting 1000 pollen grains from each slide. Proportions of cardamom pollen within the charges were obtained, and it was considered to be an important resource if appeared at 10% or higher. Twenty-one species of flower-visiting bees were identified, and the cardamom pollen was found to be an important resource for 13 bee species. Diversity and equitability (Shannon-Weaver, Pielou) comparisons were made among the bimestrial periods, finding the highest values during the June-July period. Seasonal patterns of the use of cardamom pollen and of bee communities were identified using a grouping analysis (Morisita index of similarity). It was found that cardamom is a food source for the natural pollinators of the region, as well as a crop that is compatible with its conservation policies.

POLLINATION OF *IPOMOEA CARNEA* SUBSP. *FISTULOSA* (MART. EX CHOISY) DF AUSTIN (CONVOLVULACEAE) BY BEES AND MOTHS IN THE DISTURBED AREA IN THE SEMIARID NORTHEASTERN OF BRAZIL

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The genus *Ipomoea* presents ephemeral flowers that usually open in early morning or at night, with floral longevity during less than 12 hours. The time of flower opening is often related to the habits of potential pollinators. In general, the flowers of *Ipomoea* are colorful, showy and very attractive to many groups of insects. This present work aims at studying the interactions between the flowers of *Ipomoea carnea* subsp. *fistulosa* and their potential pollinators on the Campus of Universidade Estadual de Feira de Santana, Bahia State, Brazil (lat. 12°11'S and long. 38°58'W). This area was originally composed by "caatinga" vegetation but it is very anthropically disturbed now. Monthly observations were made for a three-day period (72 hours) from October 2009 to August 2010. Individuals of *I. carnea* subsp. *fistulosa*, unlike other species of the genus *Ipomoea*, opened during three periods of the day, morning, afternoon and evening, with a longevity of 11, 20 and 16 hours respectively. These flowers exhibit morphological traits common to the melittophily and phalaenophily syndromes. The conspicuous pink color of the flowers attracts bees, and the strong sweet scent during the evenings attracts moths. The flowers were visited predominantly by bees (N = 318), from 5:00AM to 5:00PM, and by moths (N = 66) from 6:00PM to 4:00AM. Three bee species, *Apis mellifera*, *Mellitoma* aff. *segmentaria*, and *Pseudoaugchlora pandora*, were considered the potential diurnal pollinators, while the moth *Agrius cingulatus* was the potential night pollinator. Both groups of visitors showed morphology and behavior compatible to contact the flower reproductive structures. The exhibition of the flowers for 24 hours (like those of *I. carnea* subsp. *fistulosa*) to both diurnal and nocturnal visitors increases the chances of pollination, especially in ruderal plant species that occur in disturbed areas.

PESTICIDE EXPOSURE ROUTES FOR LEAF-CUTTER BEES - MEGACHILIDAE

Barbara Gemmill-Herren, Antonio Felicioli

Aspects of Leafcutter bee biology and natural history that may impact pesticide exposure are described. It is noted that Megachilid bees may be particularly exposed to pesticides through their behaviour to gather a wide range of material in agicultural environments, including mud, leaves, petals, pebbles and resin, in addition to nectar and pollen. Natural history information on seasonal

patterns is solely derived from observations in North America and Europe; although megachilid bees are abundant in tropical zones, there is little knoweldge of their seasonal cycles, reproductive rates and foraging patterns for pollen and nesting material under tropical conditions. In northern latitudes, females will intensely concentrate on gather pollen from mass flowering short-blooming species such as apple and pear, so that any pesticides applied to these crops during the bloom will be concentrated in the pollen masses.

COMMUNITY LEARNING AND INNOVATION: WILD POLLINATORS AND PESTICIDES ON APPLES IN HIMACHAL PRADESH, INDIA

Jitendar Kumar Gupta

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In the "Apple State" of India, Himachal Pradesh, farmers have learned that syrphid flies are not pests, but pollinators of apples. They have wide population variations that farmers have in the past mistaken for pest infestations. The syrphid flies are effective pollinators even at low temperatures when honeybees may not be. Understanding their role, farmers have innovated in orchard design to accommodate the short flight range of these pollinators.

A POLICY FRAMEWORK FOR CONSERVING POLLINATORS IN TRADITIONAL AGRICULTURAL PRODUCTION SYSTEM: LEARNING FROM FARMING COMMUNITIES IN UTTARAKHAND, INDIA

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Pollinators in traditional agricultural production system play a crucial role in increasing production in various food and fodder crops. In hilly regions of Uttarakhand State in India, farming communities largely depend on traditional agriculture and associated small-scale agricultural industries. In these regions, farmers grow a large number of traditional crop varieties/species for their livelihood, and follow a '*Baranaaja*' cropping system that symbolizes their tradition of conserving diversity of cropping plant species and agricultural ecosystem. As a result, in addition to strengthening production system, such dynamic traditional farming system maintains a reservoir of different flowering plant species that attracts different species of pollinators, including native bees and other pollinators across different growing seasons. This poster presentation discusses a policy framework for protecting pollinators including bee species and other alternative pollinators in traditional agricultural production system, where the use of pesticide chemicals and other modern agricultural practices is very limited, but could be deleterious (when judiciously not used) to many species of pollinators and other beneficial fauna. Besides, the poster also discusses need and importance of education and awareness programs for pollination in diversified traditional agriculture in fragile mountain farming ecosystem of these regions.

BLUEPOLL: MODELING HONEY BEE AND BUMBLE BEE POLLINATION AND SUBSEQUENT CROP YIELDS IN HIGHBUSH BLUEBERRY (*VACCINIUM CORYMBOSUM*)

Anna K. Kirk

Berry Crops Entomology Laboratory, Dept. of Entomology, Michigan State University, East Lansing, MI 48824

There is great concern over declining wild populations of honey bees and over the recent loss of managed colonies due to Colony Collapse Disorder. Recent reviews indicate that approximately 70% of plant species grown for food benefit from animal and insect-mediated pollination (Rickets et al. 2008). In commercial highbush blueberry (*Vaccinium corymbosum*) fields, managed honey bee colonies are relied upon to deliver the majority of pollination services although native bees, which are possibly more effective at performing the buzz-pollination required by blueberry flowers, are also present. It has been found that native bees provide as much as 10% of pollination services for the entire Michigan blueberry industry and are the dominant pollinators in many small blueberry fields (Isaacs & Kirk 2010). Strategies that optimize the use of increasingly scarce insect pollinators will help ensure the long-term sustainability of pollination-dependent crops that comprise 35% of global crop production (Klein et al. 2007).
A systems modeling approach was used to investigate questions surrounding the combined use of both managed honey bee and bumble bee pollinators within the environment of commercial highbush blueberry production. The BLUEPOLL model of highbush blueberry pollination was developed using the STELLA modeling program and predicts annual highbush blueberry yield for one acre of blueberry dependent upon highbush blueberry cultivar and variable weather and managed pollinator inputs. This research will assist in improving the health and stability of pollination systems and also optimize economic profits from land producing pollinator-dependent food.

MEASURING AND MODELING LONG-DISTANCE ANEMOPHILOUS POLLEN DISPERSAL: CONTAMINATION OF SEED ORCHARDS AND NON-GM AGRICULTURAL CROPS

Gail MacInnis

Data sets of long distance dispersal (LDD) of pollen by wind are almost nonexistent. The difficulty in measuring and quantifying pollen concentrations at large distances has led to almost all estimations of LDD being extrapolated from near-source data or a complete reliance on models. Without a detailed empirical understanding of LDD, assessments of the risk of gene transfer between natural stands and seed orchards, and GM and non-GM anemophilous or ambophilous agricultural crops are inadequate. For this project, pollen concentrations were measured up to 10 km over the surface of two lakes surrounded by forests of *Picea mariana, Pinus banksiana, Abies balsamea* and *Alnus rugosa.* Generalizing across species, the pollen concentration at 2 km distance averaged 40.0% of the shore concentration, and at 8 to 10 km averaged 23.2 % of the shore concentration. In a separate experiment, a steady quantity of *Lycopodium clavatum* spores were slowly released in a large field and concentrations were measured up to 2 km downwind. Here, as much as 20% of the source strength was deposited at 100 m distance from the single point source. These findings indicate that current recommendations for isolation distances between GM and non-GM varieties are being severely underestimated, thus increasing the potential for the genetic contamination of organic and conventional agriculture, and selectively bred tree species.

REPRODUCTIVE BIOLOGY *PORTULACA UMBRATICOLA* KUNTH PORTULACACEAE) IN PETROLINA, PE, BRAZIL

Carla Tatiana de Vasconcelos Dias MARTINS[1], Nerimar Barbosa GUIMARÃES[2], Magda Mangabeira de Oliveira FEITOZA[3], Tamires Almeida da SILVA[3], Amanda Pricilla Batista SANTOS[4], Lúcia Helena Piedade KIILL[5]

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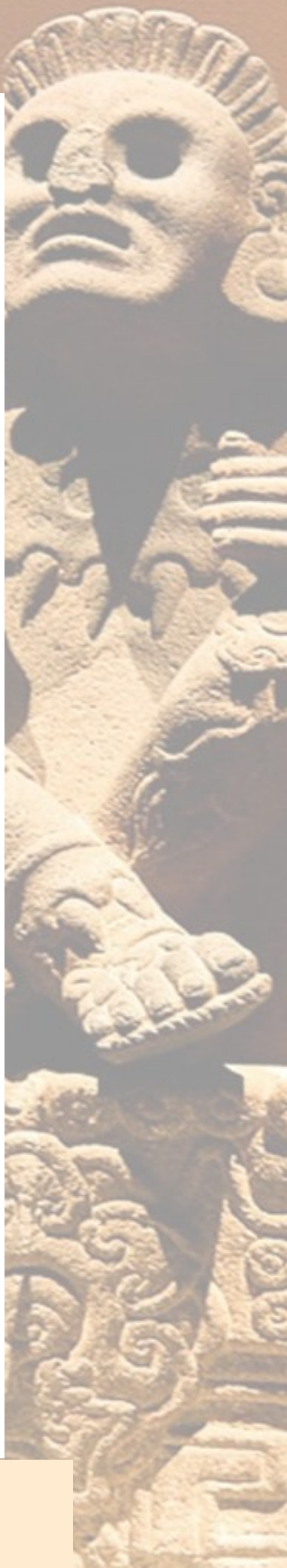
Popularly known as purslane, *Portulaca umbraticola* has ornamental and medicinal potentials. Aiming to contribute with information about pollination ecology, observations of the reproductive biology of 10 individuals of this species were made in the period from January to March 2011, in an area of Caatinga, Petrolina-PE, Brazil. For pollination experiments, buds were bagged and emasculated, if needed. Flowers were marked to estimate pollination under natural conditions (control). To check the viability of pollen grains, the anthers of buds in the pre-anthesis were collected and pollen grains stained with 1.2% carmine solution. The stigma receptivity was tested with hydrogen peroxide vol.10, in flowers collected at 1 hour intervals from anthesis to their senescence. The inflorescences are terminal type, with 3-7 buds and flowers are showy, actinomorphic, monoclin, 2-sepals, 5-petals, imbricate in pre-flowering, stamina numerous, free, bifid stigma, ovary inferior, unilocular. Anthesis is diurnal, occurring between 8:00 a.m. and 9:00 a.m., according to the temperature, prevailing the first time in warmer days. In each inflorescence 1-2 flowers open per day. The duration of the flowers is approximately 4 hours, senescence occurring at around 12:00. The stigma remained receptive throughout the duration of the flower. At the time of the anthesis the pollen grains are viable (81%). During flowering, they were observed the visits of the bees *Halictidae* sp. and *Trigona spinipes*, being the first considered effective pollinator os the species. *T. spinipes* showed two distinct behaviors for pollen visiting open flowers (sternotribic pollination) or piercing the buttons in anthesis for removal of floral resources. As for the reproductive system, *P. umbraticola* is self-fruiting producing fruits by manual self-pollination (80%), cross-pollination (100%) and in natural conditions (100%). ;
Keywords: *Portulaca*, Purslane, Pollination.

PESTICIDES AND HONEY BEES – THE RISK ASSESSMENT PROCESS IN THE EUROPEAN UNION

M. Miles

Dow AgroSciences UK Ltd., Abingdon UK and A. Alix- Ministry of Agriculture, Paris, France

Honey bees have a long standing place in pesticide regulation and there have been data requirements in the European Union (EU) and at the national for more than 40 years. The International Commission for Plant Bee Relationships (ICPBR) have been recognised as the European Expert forum for addressing the risks of pesticides to bees for 30 years. This group meets formally every 2-3 years and is an open forum including academia, government, industry, non-governmental organisations (NGOs). It publishes scientific papers from the meetings and also undertakes reviews and revisions of the European and Mediterranean Plant Protection Organisation (EPPO) honey bee testing guidelines and risk assessment when required. The EPPO scheme is used in EU pesticide regulations. Recent concerns over bees and declining insect pollinators has lead to a need for an update of the risk assessment process for pesticides for honey bees. Risk assessment follows a tiered approach and starts with laboratory data moving onto more realistic assessments using higher tier data. After initial tier I screening risk assessments further studies may be conducting for those substances for which a potential risk cannot be excluded. Higher tier studies are often performed in cages or tunnels containing colonies of honey bees which can forage on treated crops. Field tests can be conducted to establish the effects of the product under more realistic conditions. Finally, post-registration monitoring can offer additional information on specified uses of the product under commercial conditions and can be used to give feedback on the outcome of the risk assessment and the effectiveness of any risk management practices put in place to protect bees. Until recently there was a lack of formal assessment methods for soil/seed treated systemic insecticides (e.g. seed treatments such as neonicotinoid insecticides). These have been developed and validated using existing data. The ICPBR bees and pesticides group will continue to use scientific evidence to review the risk assessment and study guidelines and to ensure that the risk posed to honey bees by pesticides are fully evaluated within in a regulatory framework.



PESTICIDE EXPOSURE ROUTES FOR 'SWEAT BEES' - HALICTIDAE

Dino J. Martins

Aspects of Sweat bee biology and natural history with implications for pesticide exposure are highlighted. It is noted that Halictid exhibit variable levels of eusociality. Sociality impacts many relevant aspects of wild bee exposure including food sharing, foraging ranges and tendencies to aggregate. There has been some limited documentation of pesticide impacts on important halictid crop pollinators, notably the Alkali Bee. As ground nesters, sweat bees may be vulnerable to pesticide runoff in addition to direct exposure. Some halictids may forage at night or late in the day, outside the range of most other pollinators. The shared nest architecture of eusocial halictids merits special protection from pesticide exposure.

COHORT OF HYMENOPTERA POLLINATORS ON TWO ENDEMIC LARGE-FLOWERED *SCROPHULARIA* SPECIES IN W MEDITERRANEAN

Marisa Navarro-Pérez[1], Ana Ortega-Olivencia[1], Tomás Rodríguez-Riaño[1], José L. Pérez-Bote[2], Josefa López[1], Francisco J. Valtueña[1], and Carlos Mayo[1]

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Traditionally, wasps have been considered the main pollinators in the genus *Scrophularia*. Our study, focused in two endemic species of the W Mediterranean with similar large flowers (*S. sambucifolia* and *S. grandiflora*), shows that the cohort of Hymenoptera species visiting their flowers is wide and four main functional groups of pollinators can be differentiated: honeybees (*Apis mellifera*), wasps (*Vespula* sp, *Vespa crabro*, *Dolichovespula* sp and *Polistes* sp), bumblebees (*Bombus* sp) and small bees (*Lassioglossum interrumtum*, *Andrena* sp, *Alastor atropos* and *Symmorphus gracilis*). The analysis of different parameters as number of visits to the flowers, number of flowers and inflorescences visited per flight, shows differences among groups when they visit both species. The most frequent pollinator group in *S. sambucifolia* corresponded to honeybees, whereas bumblebees were most important in *S. grandiflora*.

SPECIALIZED ON GENERALISTS – ATTRACTION CHARACTERISTICS OF EARLY SPRING FLOWERING *TRILLIUM CUNEATUM*

Ha N. Nguyen[1], Amy Boyd[2], Michelle Zjhra[1], Robert Raguso[3], Peter Palmiotto[1]

Sweet Betsy (*Trillium cuneatum* Small.) is one of the earliest plants to flower in the spring and combines a fruity odor with unusually colored wine-red petals. We conducted field studies of *Trillium cuneatum* from 2009 to 2011. Using direct observation and various trapping methods to we determined: 1) the identity of insect visitors to *Trillium cuneatum*; 2) the characteristics of floral attraction (color, scent); and 3) temporal variation of insect visitors relative to floral display, including flower duration and year-to-year. Our results suggest that *Trillium cuneatum* is among a floral guild that exhibit a floral syndrome that is functionally specialized and ecologically generalized, attracting a range of non-typical floral visitors.

PESTICIDE EXPOSURE ROUTES FOR BRAZILIAN STINGLESS BEES

Roberta C. F. Nocelli, Thaisa C. Roat, Andrigo M. Pereira, Stephan M. Carvalho, Elaine C. M. Silva-Zacarin, Osmar Malapsina

The state of knowledge of Meliponinae – stingless bee - biology and natural history in Brazil that may impact pesticide exposure are described. It is noted that these bees can be found in all Brazilian states and have an important role in the maintenance of native forests and in the pollination of a wide variety of crops. information on foraging time, amounts collected, flight activity, food intake and nesting sites are scarce and for few species; available information is reviewed and points of possible exposure highlighted. Noting that Brazil is presently the world's largest consumer of pesticides, the need to document the actual effect of pesticides (insecticides, herbicides, fungicides, etc.) on bees, assessing both direct effects (death) and the indirect (physiological, behavioral, morphological, etc.) is imperative for developing new public policies and rational management plans.

POLLINATION NEEDS AND THE ROLE OF SOLITARY BEES ON SEED SET AND QUALITY OF *CROTALARIA BREVIDENS* BENTH IN KAKAMEGA, WESTERN KENYA

MaryLucy Oronje

Slender leaf (*Crotalaria brevidens* Benth) is an important African Indigenous Leafy Vegetable in Sub-Saharan Africa and forms a major component of household diets both in the rural and urban populations. Lack of seed and poor quality are some of the bottlenecks in the production of this vegetable. A study was carried out in Kakamega Forest farmland, Western Kenya focusing on the pollination biology, pollinator diversity and their effectiveness on seed set and quality. Effect of different pollination treatment (open pollination -control, pollinator exclusion, pollen augmentation, hand self and hand cross pollination) on the fruit/seed set, weight of dry seed and % germination were investigated. Pollinator diversity was recorded and their effectiveness evaluated using the corresponding seed set from single visits. *C. brevidens* can self-pollinate but relies heavily on pollinators for fruit and seed set (0.98). Seed set per pod increased in the flowers that had unrestricted pollinator visit and hand cross pollination treatments compared to pollinator exclusion and hand selfed treatments. Pollinators not only increased the seed set but also the seed quality. Percent seed germination was low in seeds from pollinator exclusion treatments (30%) but higher in hand cross pollination (76%) and open pollination with unrestricted pollinator visit (72%). Solitary bees: *Megachile* spp and *Xylocopa* spp. were the most frequent and important pollinators of this crop. *Megachile rufipes* is the most promising due to its high pollinator effectiveness (0.91) and the ability to nest in aggregations. Domestication and evaluation of the use of *M. rufipes* for managed pollination in *C. brevidens* seed production system is recommended.

ALONE BUT NOT APART? THE POLLINATION ECOLOGY OF DIOECIOUS SHRUBS IN A FRAGMENTED FOREST

Colin Phifer and Elizabeth Stacy

Universtity of Hawai'i at Hilo

Habitat fragmentation is a leading threat to biodiversity that can impact existing populations as well as future recruitment. For plants, habitat fragmentation can affect pollinator community structure and pollination rates with consequent reductions in seed production. Previous research suggests that breeding system may be an important predictor of a plant species' response to fragmentation, with self-incompatible plant species more susceptible to fragmentation. To better understand the relationship between habitat fragmentation and pollinator-mediated reproductive success, I am studying the pollination ecology of two common dioecious species, *Broussaisia arguta* (Hydrangeaceae)

and *Astelia menziesiana* (Asteliaceae), which represent the most extreme form of self-incompatibility in plants. For each species, I am examining the pollinator identities and visitation rates, fruit set and seed germination of open-pollinated flowers, and degree of pollen limitation in a naturally fragmented forest and a nearby continuous forest on the Island of Hawai'i. Preliminary results from 80 hours of observation for *B. arguata* during peak flowering suggests different pollinator assemblages and visitation rates between the continuous and fragmented forests. In total, 187 visits were observed in the continuous forest compared with 53 visits in the forest fragments. Pollinator assemblages are diverse and unequal with 70% of the pollinator visits in the continuous forest coming from honeybees (*Apis melifera*). In contrast, only one honeybee visited the plants in the forest fragment where moth species accounted for 66% of the visitors. These results will be further refined temporally and spatially across the forest fragments using GIS at multiple, hierarchical scales at both the individual plant perspective and forest fragment level. Germination trials of seed viability will be compared with pollination results to relate pollinator assemblages and visitation with seed success. Results from this study will provide important baseline information for the pollination ecology of these native species and contribute to the growing body of literature on the effects of fragmentation on pollination and plant population persistence in the face of habitat fragmentation.

BEES OF THE GENUS *XYLOCOPA* (HYMENOPTERA: APIDAE) IN STATE OF NUEVO LEON, MEXICO

Liliana Ramírez-Freire[1], Glafiro José Alanís Flores[1], Ricardo Ayala Barajas[2], Humberto Quiroz Martínez[1] y Carlos Gerardo Velazco Macías[3]

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Wild native bees have very low representation on Mexican collections, this may be explained because he state is located in one of Mexico's less studied zones on this subject; for this reason a study about *Xylocopa* genus was carried out to know its distribution and relationships among native flora and vegetation types in Nuevo Leon state. Filed work using net and bowl trap collecting was done in 35 sites in 20 municipalities; a species list was built using literature and filed work, species were collected only at 7 sites, 38 individuals were collected (25 females and 13 males). Four species were identified: *Xylocopa californica*, *X. mexicanorum*, *X. tabaniformis* and *X. micans* (this being a new state record). Two individual bees were not able to be identified (one male and one female); also *X. lateralis* and *X. fimbriata* are reported to the state in literature, giving a total of six species found in Nuevo Leon. Bees were collected in plants belonging to Fabaceae family and only one specimen at bowl traps. Bees were found in shrub land and disturbed vegetation. Specific range extensions and bee specimens are obtained for the state.

POTENTIAL BEE FLORA OF CENTRAL NEPAL

Nar B. Ranabhat

Beekeeping is one of the promising ventures for economically poor families in Nepal. Owing to massive geographical variations enriched with biodiversity, several species of bees have been noticed. Similarly, the quality of the honey produced depends on the seasons and timing of the bees visiting diverse plant species. Many of the farmers engaged in beekeeping enterprise since long times have enriched indigenous knowledge on plant species and quality of honey. A study was conducted in Central part of Nepal in 2008-09 to monitor the common plant species visited by bees along with their visiting time and seasons. Observations were made on the bees' activities on flowers of different plant species. Relevant information was captured through informal key informant

interviews. The plant species visited by the bees and the bee species themselves were collected, preserved and identified. They were categorized as major, medium and minor sources of pollen and/or nectar. The pollen and nectar statuses in different plants were also determined. Data verification was done through published literatures and some melissopalynological studies. From the field survey, 162 plant species were identified as important bee flora. They were categorized in different groups depending upon their resource potentials. Out of which, 35, 39 and 35 species were recognized as the major, medium and minor sources for both nectar and pollen. Similarly, 49, 53 and 51 species were identified as major, medium and minor sources for nectar and 51, 54 and 49 were noticed to be major, medium and minor sources of pollen. Plants like *Zea mays*, *Eclipta prostrata*, *Ageratum conyzoides*, and *Alnus nepalensis* were visited by bee mainly for pollen, whereas *Mentha spicata* and *Bombax* sp. were visited for nectar only. Months from February to April and August to October were found as the honey flow seasons. *Brassica*, *Citrus*, *Pyrus*, *Berberis*, *Rubus*, *Callistemon*, *Bombax* and *Artemisia* are some of the important plants which bloom during this season. Winter season (mid Nov to Jan) and rainy season (June and July) were identified as the dearth periods for bees to collect honey. Some of the plants that bloom during winter are *Pisum sativum*, *Ipomoea batata* and *Eupatorium* sp. Similarly, *Lagerstroemia* sp, *Impatiens balsamina*, *Sesamum indicum*, *Zea mays* and many cucurbits bloomed during rainy season. Based on available flora, food sources and flowering duration could be developed.

POLLINATION ECOLOGY OF *ARROJADOA RHODANTHA* (GURK) BRITTON & ROSE (CACTACEAE) IN PETROLINA – PE, BRAZIL

Amanda Pricilla Batista SANTOS[1], Tamires Almeida da SILVA[2], Daniela Pionório Vilaronga CASTRO[3], Magda Oliveira Mangabeira FEITOSA[4], Carla Tatiana de Vasconcelos Dias MARTINS[5], Lúcia Helena Piedade KIILL[6]

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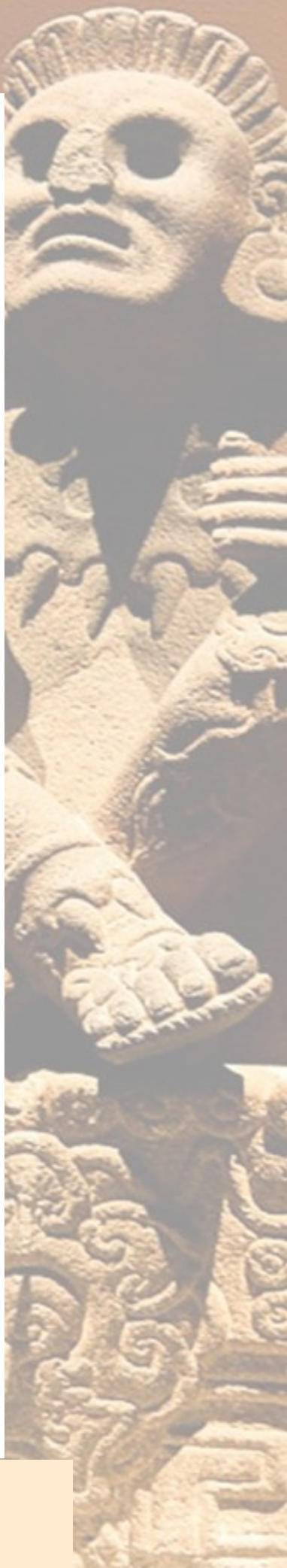
Arrojadoa rhodantha is native to Caatinga, occurring in the states of Minas Gerais, Bahia, Piauí and Pernambuco in Brazil. This work aimed to study the biology and floral visitors of this cactus in Petrolina, PE. The study was conducted in a hyperxerophilous caatinga area at Embrapa Semiarid, in 20 individuals of *A. rhodantha* where analyzed the morphology, anthesis and flower senescence, floral visitors and pollination system. Flower visitors were observed at intervals of one hour on non-consecutive days, totaling 35 hours of sampling effort. *A. rhodantha* has pink flowers, asepal, gamopetal, tubular, free stamina, with about 340 stamina, anthers with longitudinal dehiscence and stigma included, branched into nine parts. The anthesis occurs before 4:00 a.m. and the stigma is receptive from the button. The floral senescence begins at 10:30 and ends around 11:00. The lifespan of the flowers is approximately seven hours, which are visited by hummingbirds (*Clorostilbon aureoventris*, *Eupetomena macroura*, *Chrysolampis mosquitus*), bees (*Trigona spinipes*, *Friseomelitta doederleini*, Halictidae unidentified, *Plebeia* sp.), flies (Diptera not identified) and butterflies (*Agraulis vanillae*). The peak visitation occurred in the period from 07:00 a.m. to 08h00 a.m., however, the visits were not recorded between 4:00 a.m. and 05:00 a.m. According to the visiting behavior, *C. aureoventris*, *E. macroura* and *C. mosquitus* were considered effective pollinators because they tap the reproductive structures. *A. vanillae* was classified as occasional pollinator, since their visits are rare and the bees *T. spinipes*, *F. doederleini* and Halictidae were considered pollen thieves. As for the reproductive system, it was found that occurred the formation of fruits per pollination (40%) and in natural conditions (35%), demonstrating that *A. rhodantha* is a self-incompatible species, pollinated primarily by hummingbirds.



THE BIODIVERSITY OF THE GENUS *ANDRENA* AND THEIR FLORAL ASSOCIATION COLLECTED FROM KAZAKHSTAN AND KYRGYZSTAN

Mohamed Shebl Abd Elfattah

Dept. of Plant Protection, Faculty of Agriculture, Suez Canal University, Ismailia 41522, EGYPT

Desertification has rapidly progressed in arid areas of Asia. Various practices aimed at combating desertification have been implemented in many countries. Although planting campaigns have been tried and continue to be used, basic information on wild bees which pollinate plants in desert and semi-desert areas is insufficient. Among the arid temperate zones in the world, Central Asia has the least information on bees because of the fewer number of expeditions conducted in this region. The Kyushu University Expedition team collected and kept specimens of wild bees at Entomological Lab., Kyushu University. The bee fauna of Kazakhstan and Kyrgyzstan has not been well studied until now. In this study 62 species had been recognized of the genus *Andrena* from this area. The *Andrena* fauna of Central Asia is mainly composed of the Turkemnian species, with some Europe-Siberian and Mediterranean species. Very few species are distributed in other parts of western Palaeractic area about 12 species in China, 4 species in Japan and 2 species 1n Korea. Some *Andrena* species are recorded as polylectic visiting different plant genera *A. laterlais*; A. labialis; *A. fuscosa*; *A. albopunctat*; *A. cussariensis*; *A. limata*; *A. bimaculata*; A. eversmanni; *A. pilipes*; *A. combinata*; A. ovatula and A. flavipes. Other species are strictly oligolectic *A. humilis* and *A. taraxaci* visiting Asteraceae; *A. proxima* visiting Apiaceae; *A. wilkella* visiting Fabaceae and *A. lapponica* and *A. praecox* visiting *Salix* (Salicaceae).

METHOD TO DETERMINE THE ACUTE CONTACT LD50 OF PESTICIDES TO NON-STANDARD SOCIAL AND SOLITARY BEES

J. van der Steen, I. Roessink, R. Nocelli, O. Malaspina, M. Kasina, M. Gikungu

The risk assessment of pesticides to insect pollinators, is mainly based on studies with the European honeybee (Apis mellifera L.). However e.g., in Brasil and Kenya insect pollination does not depends on the European honeybee but on the Africanised honey bee (Brasil) and Apis mellifera scullellata (Kenya) and on many species of social and solitary bees. This raises the question whether these pollinators are protected by European honeybee driven risk assessment. The risk assessment is based on the toxicity (LD50) and exposure in the field. Here the contact LD50 test is the first step. For honey bees this first tier study is described in the EPPO guideline 170. For other social and solitary insect pollinators guidance is lacking. This poster presents the alterations and additions to EPPO guideline 170 made, to determine the contact LD50 for both solitary bees and social bees having small colonies (e.g. bumble bees).

ASPECTS DETERMINING RISK OF PESTICIDES TO WILD BEES: STRUCTURED ASSESSMENT FOR FOCAL CROPS

Harold van der Valk, Irene Koomen, Barbara Gemmill-Herren, Tjeerd Blacquière

To be able to carry out an appropriate risk assessment of pesticides to wild bees, or to non-*Apis* managed bees, information is needed on the probability of exposure of the bee to the pesticide, and the toxicity of the pesticide. The probability and degree of exposure to pesticides depends on cropping and pesticide application practices, certain pesticide properties, attractiveness of the crop to bees, and bee biology (in particular phenology and behaviour). Through an initiative funded by the Dutch Ministry of Economic Affairs, Agriculture & Innovation, Wageningen University has been working with the Food and Agriculture Organization of the United Nations (FAO)'s Global Pollination Project and its national partners in Brazil and in Kenya on improving knowledge man-

agement of pesticide risks to wild bees. In this context the initiative has outlined the detailed data on these aspects of exposure, for a given crop in a given country or region needed to carry out a structured assessment of the risk of pesticides to wild bees. This poster describes the scope of the information identified for the assessment. While not all information is readily available, the exercise will help to better identify gaps in our present knowledge on risk factors that may require further research.

BEHAVIOUR OF BUMBLEBEES AND WASPS VISITING TWO LARGE-FLOWERED *SCROPHULARIA* SPECIES IN THE IBERIAN PENINSULA

Francisco J. Valtueña[1], Ana Ortega-Olivencia[1], Tomás Rodríguez-Riaño[1], José L. Pérez-Bote[2], Josefa López[1], Carlos Mayo[1], and Marisa Navarro-Pérez[1]

[1]Área de Botánica, Facultad de Ciencias, Universidad de Extremadura, Avda. de Elvas s.n., 06006-Badajoz, Spain; [2]Área de Zoología, Facultad de Ciencias, Universidad de Extremadura, Avda. de Elvas s.n., 06006-Badajoz, Spain

Traditionally, wasps were considered the main pollinators in the genus *Scrophularia* and their pattern of visit on vertical inflorescences followed downward movements. By contrast, in vertical inflorescences of different genera, bumblebees are considered to follow an opposite pattern, i.e., from the bottom up, something that prevent geitonogamy in protandrous species due to the existence of basal female flowers and apical male flowers. The study of the behaviour of wasps and bumblebees visiting vertical inflorescences of two *Scrophularia* species (*S. sambucifolia* and *S. grandiflora*), which possess protogynous flowers, indicated that although both pollinators groups showed a similar pattern of visits, from the bottom up, they used to visit more frequently the different flowers of each whorl. This behaviour is due to the fact that *Scrophularia* inflorescence is not a raceme, but a racemose inflorescence of dichasial whorls, with flowers in different sexual stages along the inflorescence.

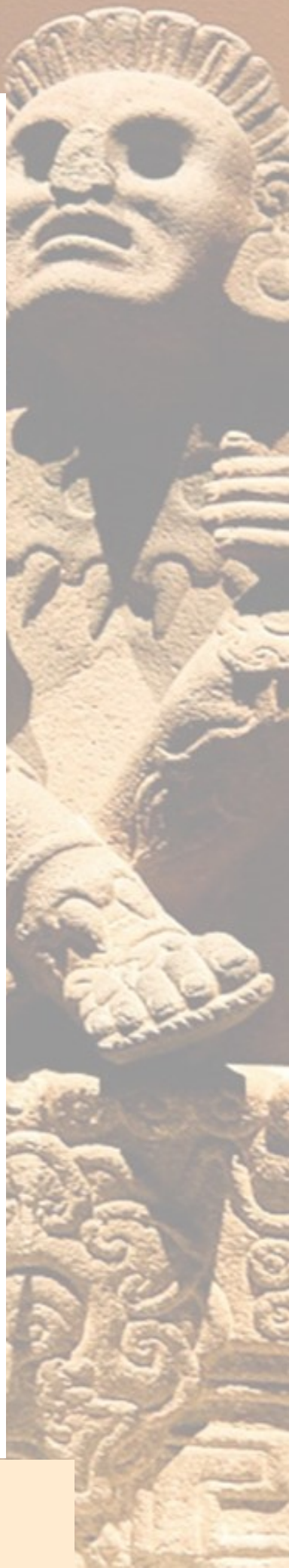
OPPORTUNITIES FOR NON-*APIS* BEES TO INFORM POLLINATOR RISK ASSESSMENT

Mace Vaughn

Some life history characteristics of non-*Apis* bees lend themselves to providing very useful information for risk assessors. For example, when tiered assessment protocols lead to field testing of a pesticide, it is usually most feasible to apply the product to a small area (e.g. 2 hectares or less) of a bee-attractive crop, and then place honey bee colonies within or adjacent to that crop. Those colonies will forage over hundreds of hectares, where it is hard to control where and what foraging honey bees visit. Solitary non-*Apis* bees, such as *Osmia* and *Megachile* species can be brought into such small application areas and scientists can have a much greater degree of certainty that they are actually foraging within the treated crop. As such, it is possible to gather much more precise data on pesticide effects in the field, and extrapolate to potential impacts on bees when tens or hundreds of contiguous acres are treated in real-world situations.

LARGE-SCALE FIRE EFFECTS ON WILD BEE DIVERSITY IN NORTHEASTERN ARGENTINA

Natalia Veiga
York University, Toronto, ON, Canada



Little research has been done on the effect of fires on essential pollinators, such as bees. Studies have shown that bees do respond to fire but it is unknown how bees will respond to a large-scale fire or how re-colonization occurs immediately after a large burn. Bees captured using malaise traps in Mburucuya National Park, Corrientes, Argentina are categorized into guilds based on bee behaviour, size and nesting requirements in order to explain community composition pre and post-burn. It is expected that recolonization by bees into newly cleared areas will occur with directional movement away from unburned areas gradually into the post-burn site based. Guild traits such as cavity nesters, ground nesters, social bees and larger bees will be positively affected post-post burn and thus be the first to re-colonize burn sites.

BUSINESS MEETING ICPBR

General update, progress and relations with the International Union of Biological Sciences (IUBS) and other pollinator/pollination organizations around the world

Name change

- Whereas pollination is now of global concern and extends to many groups of pollinators other than just bees be it resolved that the International Commission on Plant -Bee Relations change its name to the International Commission on Plant-Pollinator Relations
- Mover and a second
- Discussion
- Minutes to be prepared
- Online vote to be arranged within one month

Nominations:

- According to the ICPBR Statutes and Internal Regulations there will be X vacancies to serve on the Council. The following nominations have been received so far:
- Blande Viana
- Carolyn Mayer
- Massimo Nepi
- Siveran Venkatarame Gowda
- Nominations from the floor
- Discussion
- Minutes to be prepared
- Online vote to be arranged within one month

Working Groups:

- There have been suggestions for additional working groups, notably in the areas of a.) education, outreach and organization; and b.) International policy and trade
- Discussion
- Motions if any
- Minutes to be prepared
- Online vote to be arranged within one month

Memberships for organizations

- At present ICPBR has no provision for corporate or institutional memberships
- Discussion
- Motion if any
- Minutes to be prepared

- Online voting if necessary

Logo:
- Announcement and dissemination of entries by email
- Online vote to be arranged within one month

Pollinator Protection Group:
- General update
- Concerns regarding pesticide usage
- Discussion
- Motion if any
- Minutes to be prepared
- Online vote to be arranged within one month if necessary

Next venue:
- Call for hosting XI International Symposium on Pollination 2015
- List of possible venues and attributes to be circulated
- Online vote to be arranged within 6 months

Other Motions from the Floor

LATINS AMERICAN AND CANADIAN CROP POLLINATION WORKSHOP/EXPERT CONSULTATION

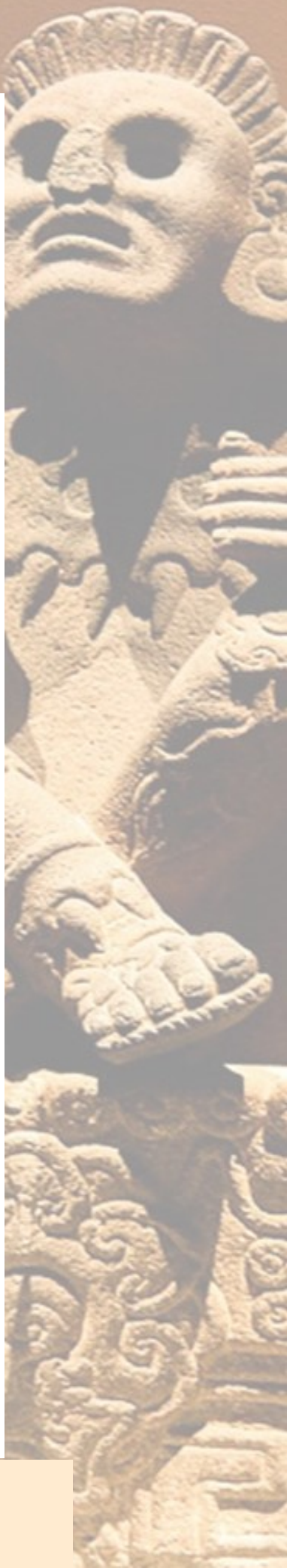
Location: Cholula Ethnobotanical Gardens

Rationale: Crop pollination is of increasing concern internationally because of problems confronting beekeeping, pollinator shortages, new crops and cultivars, poor understanding of crop pollination requirements, breeding and mating systems in both temperate and tropical agricultural systems. Moreover, the husbandry of new species of pollinators and novel uses for managed pollinators in crop protection have huge economic potential. Therefore the Canadian Pollination Initiative (NSERC-CANPOLIN) is pleased to provide support for this workshop to explore how international collaborations can be fostered.

Primary Aim: Explore, identify and evaluation of pollinations/pollinator contributions to agricultural production systems of mutual concerns with a view to optimize pollinator utility for food and fiber security

Secondary aim: Publication of the outcome of this workshop/expert consultation as an expanded and formal document for international and national organizations (government, academic, and corporate) to promote the role of pollination in food security

Tertiary aim: Establish an ongoing expert consultation through NSERC-CANPOLIN (electronic) and conducting meetings with national experts, corporate organizational representatives, governments, and intergovernmental organizations.



Crops and issues to be addressed:

- Canola
- Apples
- Sunflowers
- Cucurbits
- Greenhouse crops
- Coffee
- Corn and cereals
- Pollination biovectoring for crop protection and pollination
- Binational and multinational (including corporate) funding opportunities for joint R&D
- Biodiversity issues & spin-offs
- Others as time and need requires

ICPBR IMPORTANT DOCUMENTS

ICPBR COUNCIL 2011

(Name, Country, Position, Expected End of Term)

Amots Dafni Israel, Council Member, 2014

Arnon Dag Israel, Council Member, 2014

Art Davis Canada, Nectar Working Group Chair, 2011

Connal Eardley South Africa, Vice Chair, Executive 2013

Angela Etcheverry Argentina, Council Member 2011

Breno Freitas Brazil, Council Member 2014

Caroline Gross Australia, Council Member 2012

Rufus Isaacs USA, Council Member 2014

Osman Kaftanoglu Turkey/USA, Council Member 2012

Peter Kevan Canada Chair, Executive 2012

Kenna MacKenzie Canada, Council Member 2012

Pieter A. Oomen Netherlands, Bee Protection Working Group Chair 2011

Juliet Osborne UK, Council Member, 2011

Theodora Petanidou Greece, Council Member, 2014

Simon Potts UK, Pollination Working Group Chair, 2013

Job van Praagh Germany, Secretary and Treasurer Executive, 2013

W. Punchihewa Sri Lanka, Council Member, 2014

Bernard Vaissiere France, Council Member, 2013

Carlos Vergara Mexico, Council Member, 2013

Prepared July 30, 2009

International Commission for Plant-Bee Relationships Statutes

Article 1. The Organisation shall be called the "International Commission for Plant-Bee Relationships", hereafter to be referred to as "ICPBR".

Article 2. ICPBR is a Scientific Member of the International Union of Biological Sciences (IUBS).

Article 3. The objectives of ICPBR are as follows:

(a) To promote and co-ordinate research in the area of relationships between plants and insects of the superfamily Apoidea, Apiformes (as defined by Michener 2007, The Bees of the World, John Hopkins University Press, Baltimore, pp953), hereafter referred to as bees. This research shall be concerned with in particular physiological, ecological, ethological, and agronomic aspects of these relationships, with reference to:

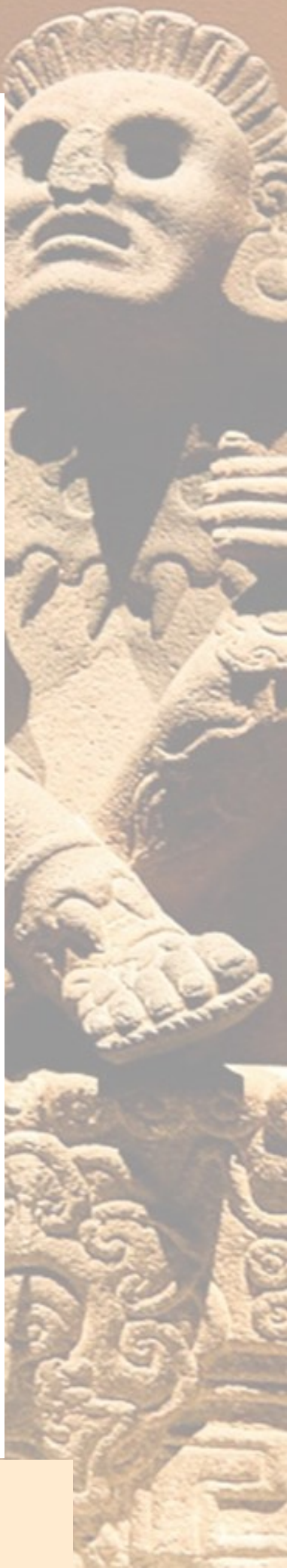
* Insect-pollinated plants
* Foraging behaviour of bees
* Effects of pollinators' visits on plants
* Management and protection of pollinating bees
* Materials collected by bees on plants
* Products derived from plants and elaborated by bees

(b) To organize meetings, colloquia or symposia related to the above matter and to publish and disperse their proceedings.

(c) To collaborate closely with national and international institutions interested in the relationships between plants and bees, particularly those whose objectives are to expand scientific knowledge of animal and plant ecology and flora and fauna protection.

Article 4. The headquarters of ICPBR can be contacted through its web site (http://www.uoguelph.ca/icpbr) and through the IUBS Secretariat (http://www.iubs.org/)

Article 5. Members of ICPBR shall be either active or associate.



Members may be individuals, or national, private, technical, or scientific institutes or organizations interested in the relationships between plants and bees. Each institute or organization may appoint a delegate as a representative to ICPBR.

Active members are institutes, organizations, or individuals whose social statutes or professional activities enable them to participate scientifically or materially in the objectives and programmes of ICPBR.

Associate members are individuals, institutes or organizations who support the objectives and activities of ICPBR, but who are not able to participate directly scientifically or materially in the objectives and programmes of ICPBR.

Article 6. The statutory structure of ICPBR shall be:
(a) The General Assembly is composed of the all members.
(b) The Council
(c) The Working Groups
(d) Executive

Article 7. The General Assembly shall consist of all members.

It shall meet in ordinary session at least every five years. The place and date of the meeting will be fixed by the Council. At least two months notice of a meeting will be given to all members.

The General Assembly hears of and decides upon the recommendations of the Council and approves the treasurer's report. It decides upon:

The recommendations in the Chairman's contained report
The creation or suppression of Working Groups
The approval of the internal regulations
Amendments to the statutes

No quorum shall be fixed for the meetings of the General Assembly, nor for votes by correspondence, which must be cast within three weeks of the ballot being circulated. Decisions instituted by voting at meetings shall be by simple majority.

When needed, a special meeting of the General Assembly may be called by the Council.

Article 8. The Council shall consist of between 15 and 20 members. It shall conduct the business affairs of ICPBR. It shall report annually and make recommendations to the General Assembly. The report and recommendations shall be published on the ICPBR website. The Council shall produce and be governed by its own internal regulations.

The Council shall elect the Executive officers from within the membership and they shall consist of a Chair, 2 Vice-Chairs, and a Secretary-Treasurer who shall comprise the Executive. The Chair shall preside at meetings of the Council and represent ICPBR on all matters including any business dealings with institutes or organizations. The Vice-Chairs shall assume the office and duties of the Chair when needed. The Secretary-Treasurer

shall have responsibility for the correspondence (including the annual questionnaire required for continuation of membership (see Internal Regulations)), records, and financial affairs of the Council and shall ensure permanent relations with the IUBS, according to the rules set by IUBS.

The Council shall be responsible for asking the membership (General Assembly) to nominate qualified members to serve on Council as and when necessary.

When Council meets in person or by electronic means, the quorum shall consist of one-third of the members. Decisions instituted by voting at Council meetings shall be by simple majority, but in cases of equally divided opinion, the Chair shall have the casting, even a second.

Council members shall be elected for a term of 5 years, but can be re-elected for additional terms.

The Council shall encourage proposals from within Council and from the active membership for the appointment of active members and associate members. Council reserves the right to accept membership in ICPBR.

Article 9. The Working Groups shall be recommended on the initiative of the Council or of a member, with the agreement of the Council, to realize definite programmes according to the objectives reported in Article 3 of these Statutes.

The Working Groups shall conduct themselves freely. Each Working Group is to be represented on Council by an active member who shall also act as group leader. The group leaders shall report the activities of their respective Working Groups to Council who shall include such reports in the annual report (Article 8).

Article 10. The resources of ICPBR shall ensure its administrative functioning and assist the Working Groups to realize their objectives.

These resources shall come from:

- subscriptions, gifts, and various grants from public or private institutions
- sale of publications by ICPBR or Working Groups
- symposia and colloquia fees
- membership subscriptions, if necessary

The Working Groups select their own means of financing their activities.

Article 11. Amendments to the internal regulations of ICPBR shall be drafted by Council and approved by the General Assembly. The internal regulations must be in accordance with these Statutes and with those of the IUBS.

The internal regulations define the activities of the General Assembly, the Council, and the Working Groups and which activities are eligible and worth reporting to the IUBS by the Council.

Article 12. Amendments of the Statutes may be recommended to the General Assembly by the Council or by any member of ICPBR. In the latter instance, the proposal shall be made in writing to the Chairman of the Council, and supported by at least two other members. The Council shall be entitled to inform all members of ICPBR of its opinion as to the proposed amendment. All Commission members should be informed of proposals for the amendment of the Statutes at last two months before they are to be decided upon by the General Assembly.

Article 13. ICPBR can be dissolved by a two-thirds majority of the votes registered at the General Assembly.

In the instance of dissolution, ICPBR's assets shall be conveyed to the IUBS.

Prepared July 30, 2009

Prepared July 30, 2009

International Commission for Plant-Bee Relationships Internal Regulations

GENERAL ASSEMBLY

Election of Council members. Notice of the General Assembly shall be sent to all members at least two months in advance (Article 7 of the Constitution) by email. The exact indication of the place, day and hour of this Assembly shall be stated, as well as the Agenda. It shall include a reminder that all candidatures for the Council should be submitted to the President at least one month in advance in writing.

The Council, meeting before the General Assembly, shall establish a list of candidatures received. The voting forms with a list of candidates shall be distributed to members of the General Assembly two weeks before the election.

The candidates who receive the highest number of votes shall be elected to the Council. When more than 5 persons holding the same nationality are elected, those obtaining the fewest votes shall be eliminated. In the event of equality a new election shall be held in

order to decide the outcome of the vote.

In the case of vacancies on Council, Council may also solicit nominations electronically at any time from the membership (General Assembly) to allow for the constitution of a full Council. Nominations shall be circulated to the membership for election by electronic voting.

Election of Officers. The members of Council elected by the General Assembly shall meet as soon as practically possible in person or by email to elect their Executive, under the Chairmanship of the most senior member present. The Chair shall be elected by majority vote. In the event of equality, the casting vote shall be that of the most senior member of Council who is not on the ballot for an executive position. The elected Chair shall then have the Council elect 2 Vice-Chairs and a Secretary-Treasurer.

MEMBERSHIP

The affiliation to ICPBR as associate or active member (Article 5 of the Constitution) may require the payment of an annual subscription if deemed necessary by Council.

Membership of ICPBR is by agreement between the applicant and Council (Statute Article 8). Yearly continuation of membership requires members to complete a short questionnaire to update email addresses and interests in serving on working groups.

WORKING GROUPS

The Council recognises or rejects the freely formed working groups. To be recognised, a working group must be introduced by its Head, who will present its members and their programme. The Council shall judge the interest of the programme on the strength of a report by the President.

The Heads of the working groups must submit a yearly report of activities.

When a working group does not submit an activities report for two consecutive years, the Council shall proceed to reorganise or dissolve it.

A Working group's programme may be on the basis of one year or several. The following activities shall be considered as eligible:

- the common realisation of a research programme in the field covered by ICPBR
- the comparison of results obtained in various countries or under various experimental conditions
- publication of bibliographical notes which involve team work
- publication of collective studies within the field covered by ICPBR
- organisation of international scientific meetings (colloquia, symposiums, conferences)
- international fact-finding studies
- collective work on analysis methods or experimental procedure

statistical analysis of data gathered in various countries by computer
international cartographical work, concerning the relationship between bees and plants.

This list is not limited and may be extended according to needs.

AMENDMENTS TO THE INTERNAL REGULATIONS

The internal regulations may be amended by the Council and ratified by the General Assembly.

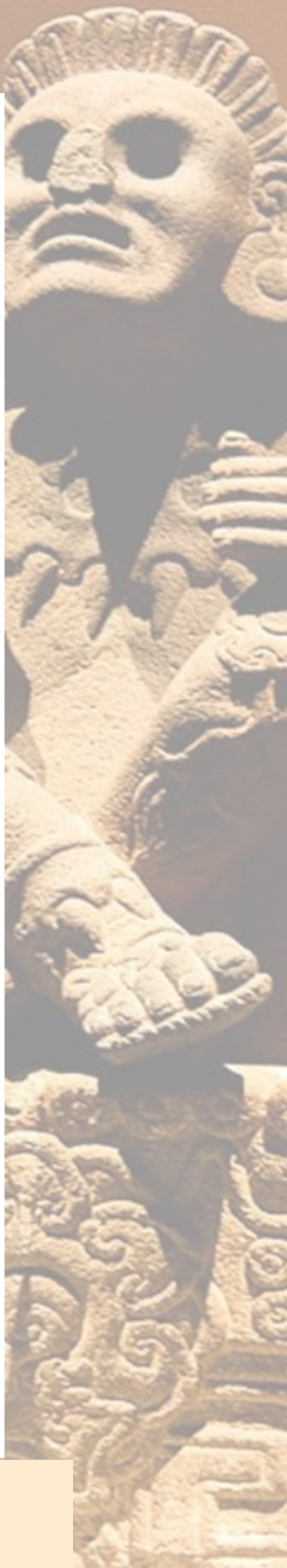
Prepared July 30, 2009

MEMBERSHIP INFORMATION

If you are not currently a member of ICPBR and would like to join, or if you would like to change the information we have on file for you, please fill out the form on following page and submit to Andrea McGraw-Alcock or Peter Kevan by the end of the Symposium or by hard copy to:

Dr. Peter Kevan,
School of Environmental Sciences,
University of Guelph,
Guelph, Ontario, Canada, N1G2W1

An electronic version is available at the ICPBR website: *http://www.uoguelph.ca/icpbr/membership.html*



International Commission for Plant-Bee Relationships (ICPBR)
Membership Form 2011

Founded in 1950 by Anna Maurizio 1900-1993

Please submit this membership form in electronic format to the ICPBR email address, icpbr@uoguelph.ca, or by hard copy to:

Dr. Peter Kevan,

School of Environmental Sciences,

University of Guelph,

Guelph, Ontario, Canada, N1G2W1

This membership form is also available on the ICPBR website: http://www.uoguelph.ca/icpbr/membership.html

Membership is free and you can be removed at any time

If you do not wish to be affiliated, please keep us informed

The information that you provide will not be shared with any other parties without your consent

First/Given Name(s) (e.g. Jane Joanne):	**Family name (e.g. Doe):**
Email (e.g. j.j.doe@inc.com) – this will be the main method of contact between you and the Commission:	
Address:	
Phone (Country code + city code + number):	
Fax:	
Website:	
Research Interests:	
ICPBR Working Group(s):	
Languages:	