Session V

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31. Raw, A.; Boaventura, M.C. and Freitas, G.S. “The diversity of a bee fauna: the species of the cerrados of Central Brazil”

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HABITAT FRAGMENTATION, POLLINATOR DECLINE, AND PLANT POLLINATION

Marcelo A. Aizen

Many insect pollinators are vagile animals that can fly relatively long distances during single foraging bouts. This trait alone would imply that pollinator faunas as a whole should not be particularly susceptible to habitat fragmentation and other forms of habitat degradation. Evidence from regions as disparate as the Argentine Chaco, Sweden, Florida and Amazon, however, indicates that pollinator faunas are strongly affected by habitat disruption, becoming markedly depaupurate with increasing fragmentation. Pollinator assemblages show great variation at scales of a few meters because of their responsiveness to microscale changes in environmental conditions and to plant-plant differences in availability of nectar or pollen. Presence or absence of pollinator species may also be determined by exploitative competition among "weedy" and "habitat-restricted" flower visitors, and abundance of specific plant resources.

In addition, habitat degradation, which usually accompanies fragmentation, can greatly decrease the availability of nesting sites for ground- and tree-dwelling pollinators. Because all these effects are likely to be most intense near borders of habitat fragments, changes in species diversity and composition with fragmentation might be a classic expression of "edge effects". In the Chaco, for instance, small fragments (~1ha) sustain not only poorer pollinator communities than larger fragments but also faunas that converge on those thriving in the surrounding agricultural matrix. In general, habitat alteration in the Americas favors the invasion of opportunistic flower visitors such as exotic honeybees *(Apis mellifera*). Likewise, in the south Andean temperate forests the only native bumblebee (*Bombus dahlbomii)* appears to be replaced by a recent European immigrant (*Bombus ruderatus*) with increasing habitat disturbance.

Although the actual mechanisms underlying all these patterns are poorly understood, I suggest that, because of pollinators' fine-grained perception of their resource landscape, processes occurring at a local scale are important to understanding large-scale patterns in the diversity and composition of pollinator assemblages. Because of redundancy characterizing plant-pollinator interactions in general, habitat fragmentation does not necessarily lead to the total disruption of this mutualism. Nevertheless, simplification may have subtle but important consequences on the quality of the interaction, hindering the capacity of plants to adapt further to a changing environment.

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BEE DIVERSITY IN MEXICO

Ricardo Ayala

The known bee fauna of Mexico is the result of 240 years of taxonomic work during which 95 authors have contributed to the description of species. The known apifauna de Mexico is composed of seven families, 144 genera, and 1,800 species and subspecies. The bee fauna of Mexico appears intermediate between those of the United Stated and Central America. The northern Mexican states with xeric vegetation are the richest in species, specially Chihuahua (396) and Sonora (359). The peninsula of Baja California (states of Baja California and Baja California Sur), with 445 species, is the area of greatest richness. The poorest regions of Mexico are the Yucatan Peninsula and montane regions above 3,000 m.

Other vegetation types have not been analyzed, but it is possible that pines, pine-oak, and tropical evergreen forests have relatively low diversity. In 1985 a group of scientists from Mexico and the U.S. met at the “Estacion de Biologia Chamela”, to discuss and organize long-term cooperative studies that they called “Programa Cooperativo sobre la Apifauna Mexicana (PCAM)”. The objective o the PCAM is 1) investigation of the taxonomic diversity and distribution of the bees in Mexico, 2) establishment and enhancement of permanent collections of bees in Mexico. The principal accomplishments of this project are 1) a computerized relational database, 2) a collection of approximately 22,500 specimens. The specimens represent 950 species from 120 genera, 169 species not previously recorded from Mexico, and approximately 178 species that are apparently undescribed.

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ESTIMATION, CONSERVATION AND SUSTAINABLE USES OF NATIVE BEES FOR POLLINATION OF AGRICULTURAL AND WILDLAND PLANTS IN THE UNITED STATES, WITH IMPLICATIONS FOR THE TROPICS.

Stephen Buchmann,

Worldwide, taxonomists have described 25,000 species of bees. If they were known completely, it is likely that 35,000 or 40,000 species are actually extant. With a few exceptions (portions of Europe, Mexico and several U.S. sites) we have a poor understanding of our local, regional and national bee faunas. This lacuna is especially troubling as habitat fragmentation, pesticides and competition with honeybees have depressed some local populations and likely caused undocumented extinctions of native bees. Several *Bombus* spp. In Britain are likely already extinct. Sampling bees is not difficult (sweep samples at flowers, trap-nesting for stem-nesters, light traps, Malaise traps, and floral volatiles for euglossine bees). Several new types of bee-sampling techniques (yellow pan traps, PVC pipes, and attractants) are also discussed. Once captured and prepared as museum voucher specimens, however, most ecologists or land managers cannot find the expertise to get authenticated generic and specific level determinations. This will continue to be an ever-worsening problem.

Conservationists, ecologists and land managers charged with the responsibility of protecting biological diversity, including bees, on various lands do not have a coherent set of guidelines for the protection/conservation of existing bee populations, nor specific recommendations for habitat restoration for bees and other pollinators. Often, these can be as simple as allowing dead trees and branches (containing beetle emergence holes) to remain, or the creation of stable banks or attractive bare ground patches where other species may nest. Often, supplemental "drilled boards" may be placed and used to attract and rapidly build up populations of native bees especially in habitat restoration studies, or for pollination of agricultural crops. Land managers are often unaware that prescribed burns to control invasive weedy plants may have profound deleterious effects on native stem and shallow ground-nesting bees. These and other methods are reviewed along with comparison of their utility for temperate and tropical habitats.

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FIRE, *BOMBUS TERRESTRIS* INVASION AND THE THREAT TO SOLITARY BEE DIVERSITY IN A MEDITERRANEAN ECOSYSTEM

Amots Dafni

Bombus terrestris , which is native to the northern region of Israel, invaded massively at the last two decades, into natural habitats. It is a an integrated result of intensive gardening, escape from greenhouses and the availability of postfire open habitats. The main points are as follows:

1.Pollen analyses of the *Bombus* ' loads indicate that the foraging range of an individual bee may be at least 5km. The nectariferous ornamental plants subsidise the maintenance of the *Bombus*' wild population along the dry season, in which resources are scarce.

2. There is a massive escape of queens from greenhouses (commercial hives were introduced to Israel as late as 1991) and the establishment of feral colonies even in a distance of 30km. from the closest introduction site.

3.Under conditions of limited resources *Bombus* bees exploit almost every available nectar source and are more efficient than solitary as well as hones bees. There are indications that *Bombus* limit the other bees by competitive exclusion.

4. Nine years after the fire (at Mt. Carmel) the solitary bees diversity is very low and 95% of all the bee's visits (on several key plant species) is performed by *Bombus* . In conclusion, the alarming , man made as well as man-promoted , invasion of *B. terrestris* in Israel , combined with high frequency of fires , posed a threat on one of the world richest bee's fauna – the *Mediterranea phrygana*. The Israeli lesson may serve as warning light against any attempt of introduction of *B. terrestris* or commercial pollination in areas in which solitary bees are common e.g. as South Africa -solitary bees are less vulnerable than valuable.

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THE DIVERSITY OF A BEE FAUNA: THE SPECIES OF THE CERRADOS OF CENTRAL BRAZIL

Anthony Raw
Marcelino C. Boaventura
Geusa Simone de Freitas
Jardim Botanico de Brasilia Brasilia DF, Brazil

The vegetation of some two million km^2 in central Brazil is Cerrado. This type of savanna ranges from herbaceous to tree savanna with ribbons of evergreen gallery forest lining the courses of rivers and streams. Some areas bear semideciduous forest. The annual rainfall of much of the region is high, though there is a severe winter drought. Cerrados are very rich in species of flowering plants and small animals. For example, in the Federal District of Brasília an area of 5,822 km13,500 species of flowering plants, 8,000 of moths, 1,250 of butterflies and 503 of bees have been recorded. Brasília lies at an altitude of 1,000 m and a latitude of 15^oS and its vegetation is solely cerrado. To date, 821 species (121 genera) of bees have been recorded from the Cerrado region. Apparently, 420 species (51 %) are restricted to the region and various of them seem to be endemic to small areas. Species richness is high at a local level, for example, 206 species of bees have been collected in an area of $2km^2$ in Brasília. About 60 % of the 821 species are solitary and many of them are ground nesters. Up to 29% are social or semisocial of which 17 % are Halictidae and 7 % are Meliponini. Some 10% (86 species) are predatory species. To date, 18% of the species are apparently confined to open cerrado, 37 % to gallery forest, and 38 % to semideciduous forest. There are two difficulties in assessing the numbers of species of bees in the Cerrado region; surveying and taxonomy. To date, bees have been surveyed in only 6.4 % (60) of the region's 921 municipalities - and only 11 of them at what can be claimed a satisfactory intensity. Species vary considerably from place to place which indicates that additional collecting in different areas will reveal substantial additional numbers. The level of taxonomic knowledge of the region's bees is insufficient. Of the total of 821 species, 58 (7 %) are new to science and 81 (10 %) may be new.