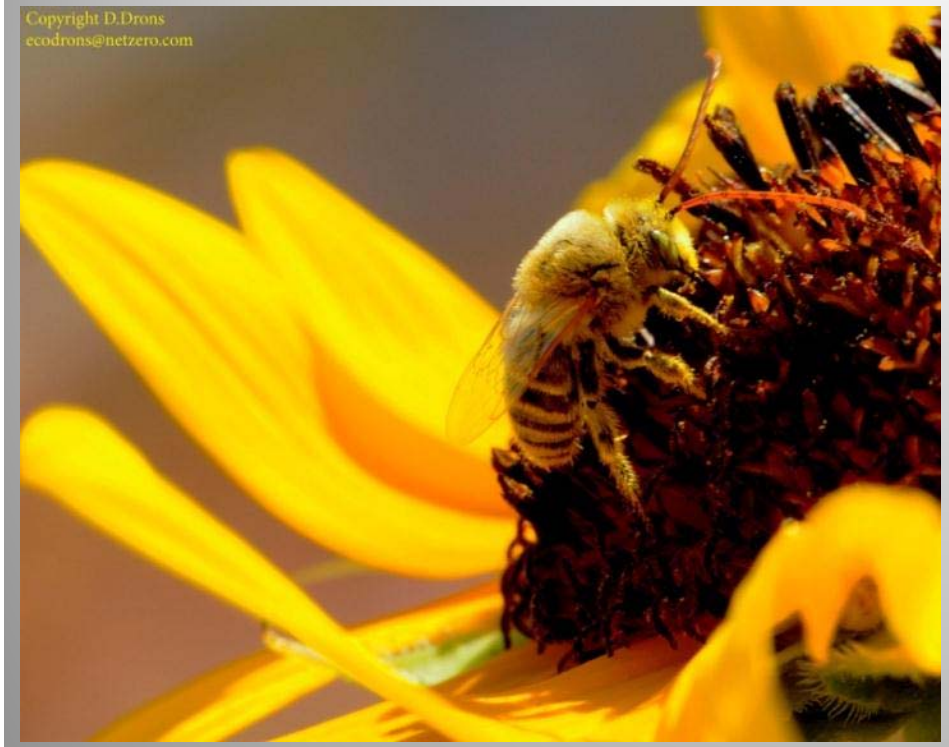
Cute, Fuzzy and Understudied: Native Bees of the Black Hills



David Drons and Dr. Paul Johnson
Severin-McDaniel Insect Research Collection
South Dakota State University
Brookings, South Dakota

Outline

- Pollination & Pollinator decline
- Bee background
- Bee decline
- Black Hills Inventory

Insect Pollination

- 70 % of worlds flowering plants rely on insect pollination (Kearns et al., 1998)
- Seed set, fruit size
- Bees, Beetles, Flies
- Genetic diversity
- Ecosystem services
  - $112 billion worldwide (Kearns et al., 1998)
  - $57 billion in U.S. (Losey &Vaughn 2005)

Pollinator Decline

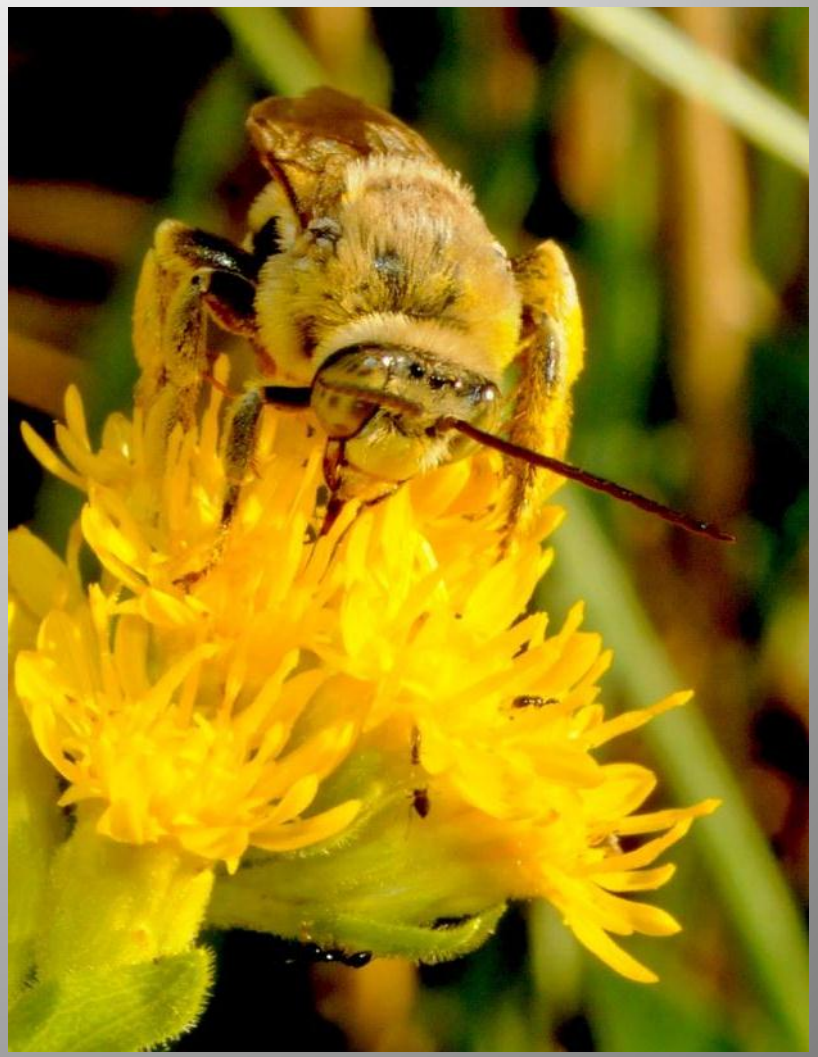
- Status of Pollinators in North America

  (National Research Council, 2007.; Buchmann and Naban, 1996.)

  – Pollinator Crisis
    - Species extinction
    - Crop system failure
  – Taxa specific studies
    - Inventory – Baseline
    - Monitor – Long term
    - Lack of abundance records

Causes of Pollinator Decline

- Anthropogenic changes
  - Habitat loss
  - Habitat degradation
  - Habitat fragmentation
  - Pesticide use
  - Agriculture practices



Results of Pollinator Decline

- Reduced reproduction success
- Genetic diversity decreased
- Reduced fruit size
- Reduced seed set
- Reduction of forage

Bees

Native Bees Are Not:

- Honey Bee- *Apis mellifera*
- Affected by Colony Collapse Disorder (CCD)
- Wasps, hornets, yellow jackets
- Covered by media
- Well known in the Western U.S.

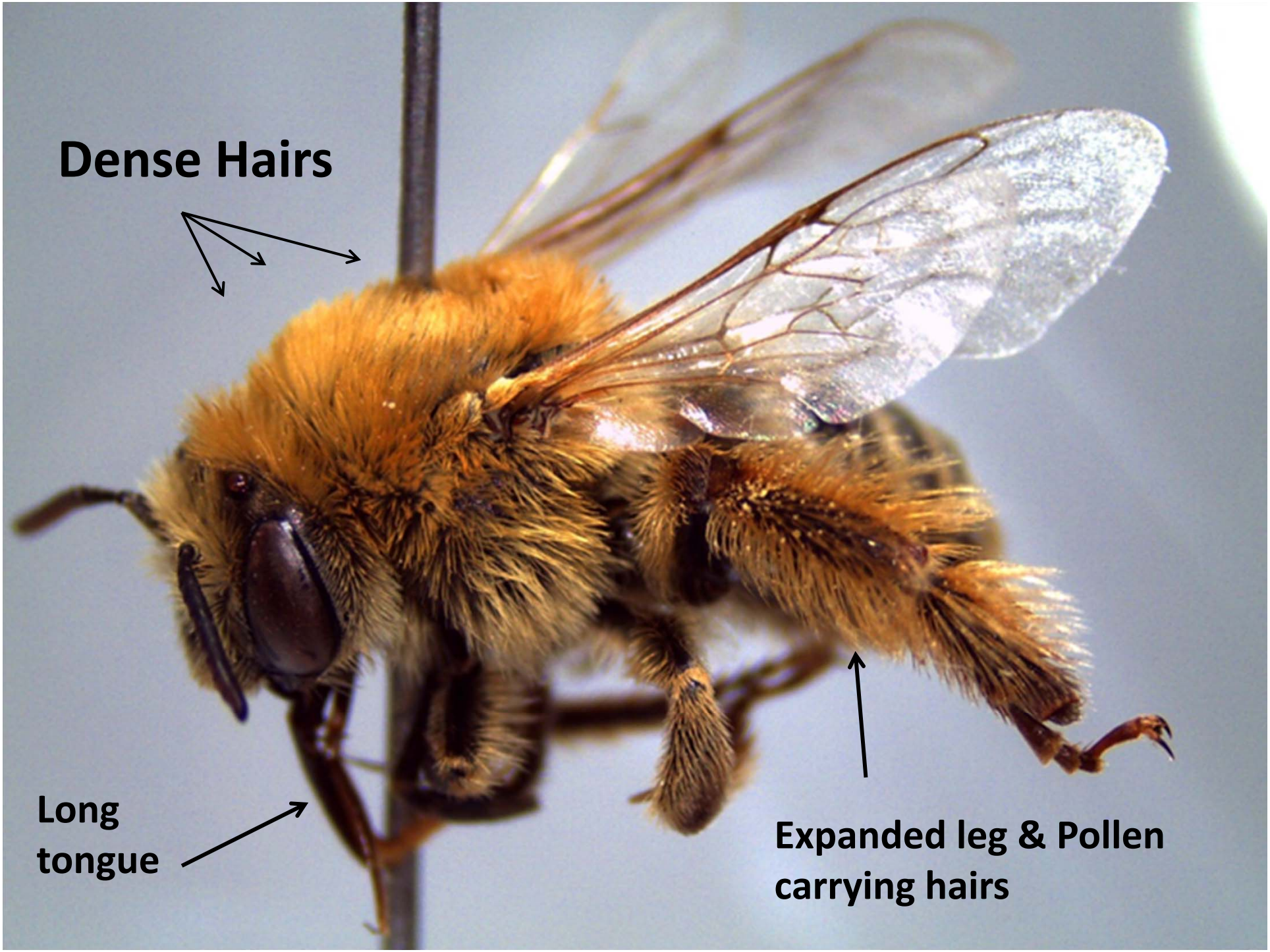
Photo: Eran Finkle

Bees

- 20,000 spp. In world
  - 75% Solitary-no “hive”
  - 10% Social
  - < 4% make honey
- 4,000 spp. In N. America
- Rarely sting (females only)
- Diet of pollen and nectar

Bee Background

- Adult expectancy
- Female
  - Fertilized for life
  - Pollen provision for young
- Morphology
  - Pollen collecting
  - Long tongue & Short tongue


Dense Hairs
Long tongue
Expanded leg & Pollen carrying hairs

Nesting

Ground

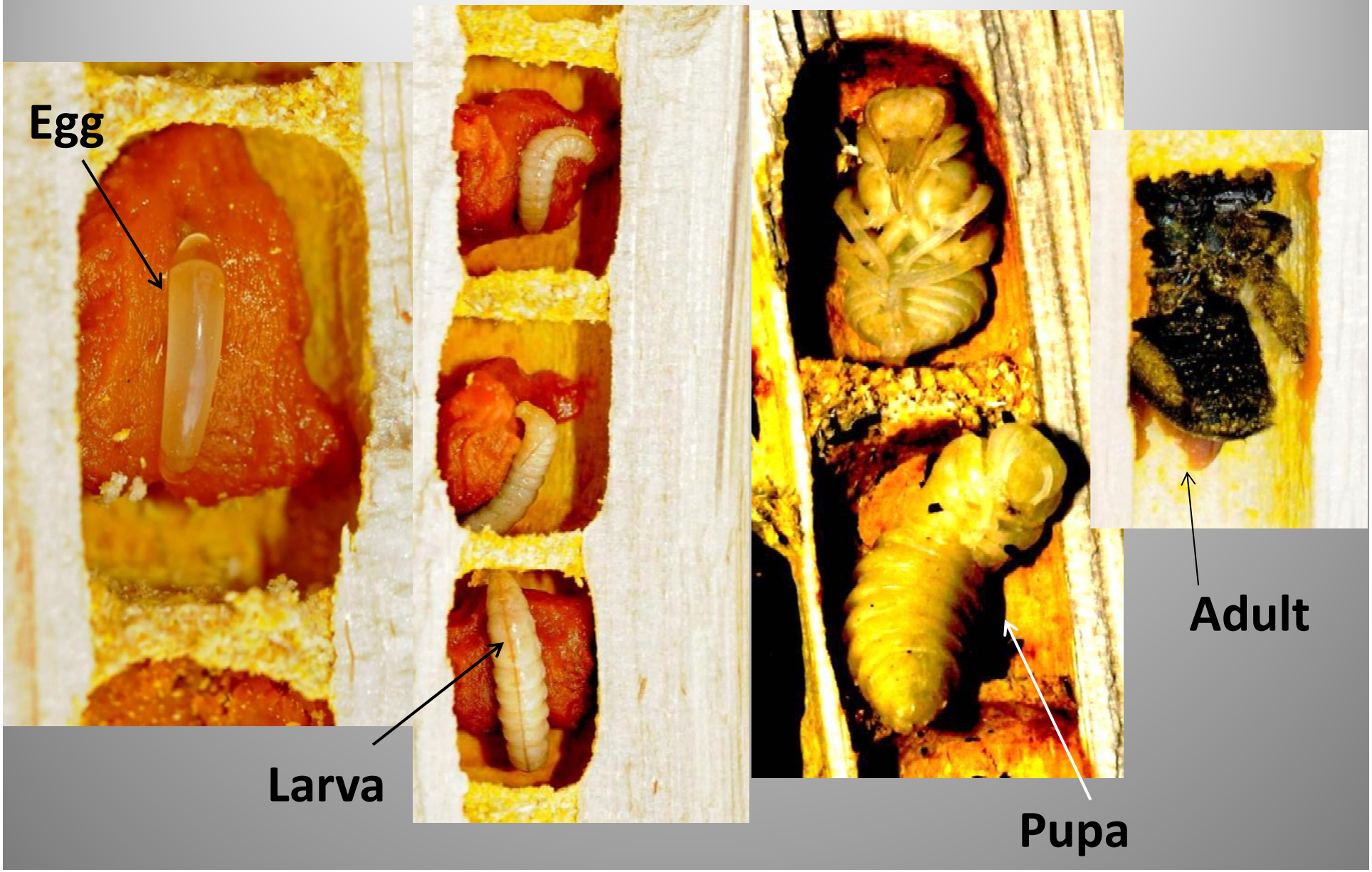
- Branching tunnels
- Soil type
- Moisture
- Grazing

Cavity

- Plant stems
- Root collars, rock piles, & coarse woody debris
- Unoccupied insect galleries
- Nest block

Ground Nesting

Nesting & Development

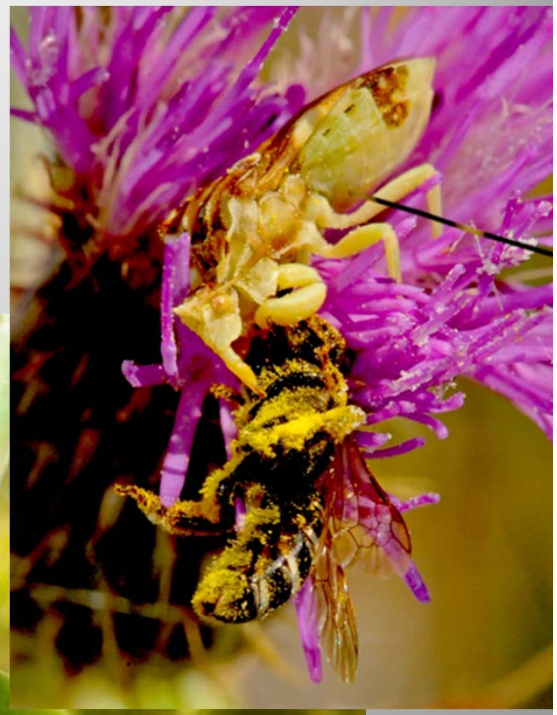


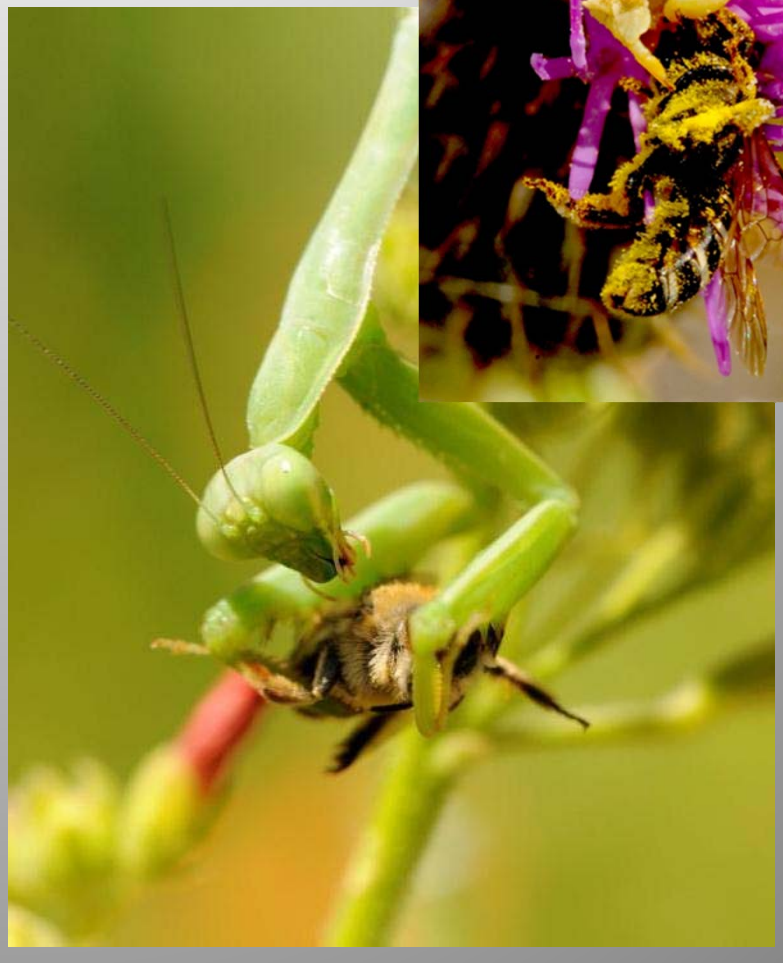
Importance of Bees

- Top pollinator
- Floral relationship
  - Oligolectic
- Keystone component
  - Negative feedback loop
- Flight distance proportional to size of bee (Greenleaf et al., 2007)
- Habitat diversity = bee diversity

Bees

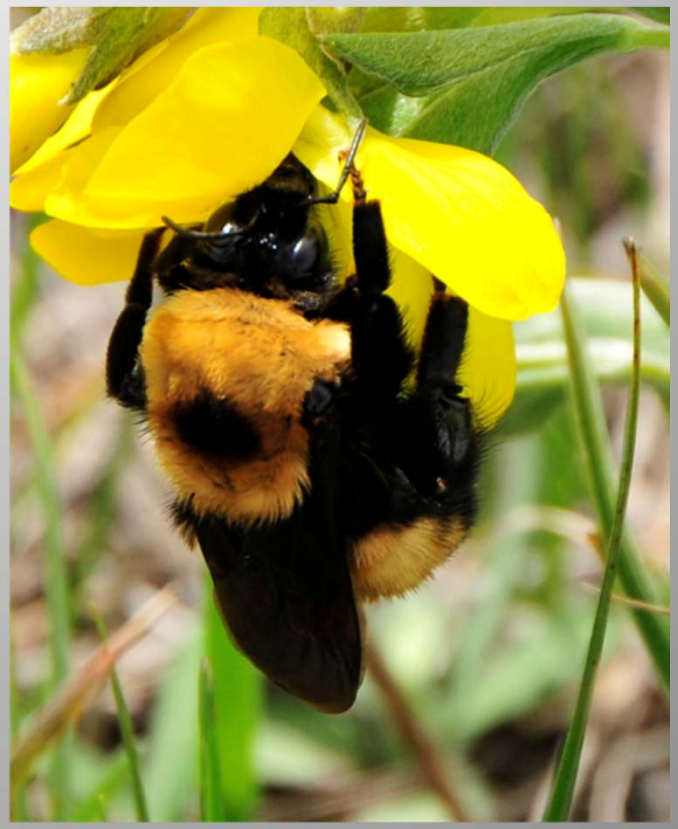
- Food source
- Increase efficiency of managed pollinators
- Buzz pollination
  - 45% increase in fruit set
  - 200% increase in weight





Bee Decline

- Overall lack of studies
- *Bombus* Declines (Cameron et al., 2010.; Grixti et al., 2009.)
  - Decreased abundance and occurrence (95%)
  - Contraction of ranges (20-85%)
  - Loss of habitat and fragmentation
- Unknown threshold



Bombus nevadensis

Understudied- Black Hills

- No formal inventory
- Literature review
- Over ~250 species from South Dakota
  (Musebeck, 1951, American Museum of Natural History, 2010)
- ~160 species from Black Hills AMNH database
- ~200 species expected in the Black Hills

Black Hills

- Convergent zone
- Elevation 3,000- 7,000ft
- Regional biodiversity hot spot
- Forest
  - Tree diversity
  - Disturbance levels
  - Disturbance types
- Public land

Study Objectives

- Inventory
  - Sample entire Black Hills
    - Spatially
    - Ecologically
  - List of species
    - Locality data
    - Checklist of Black Hills bees

Secondary objectives

- Host plant data
- Species and site attribute association
- Maps using ArcGIS

Sampling

- May - August 2010
- May - September 2011
- Weather dependent
- Pan trap
- Net collection

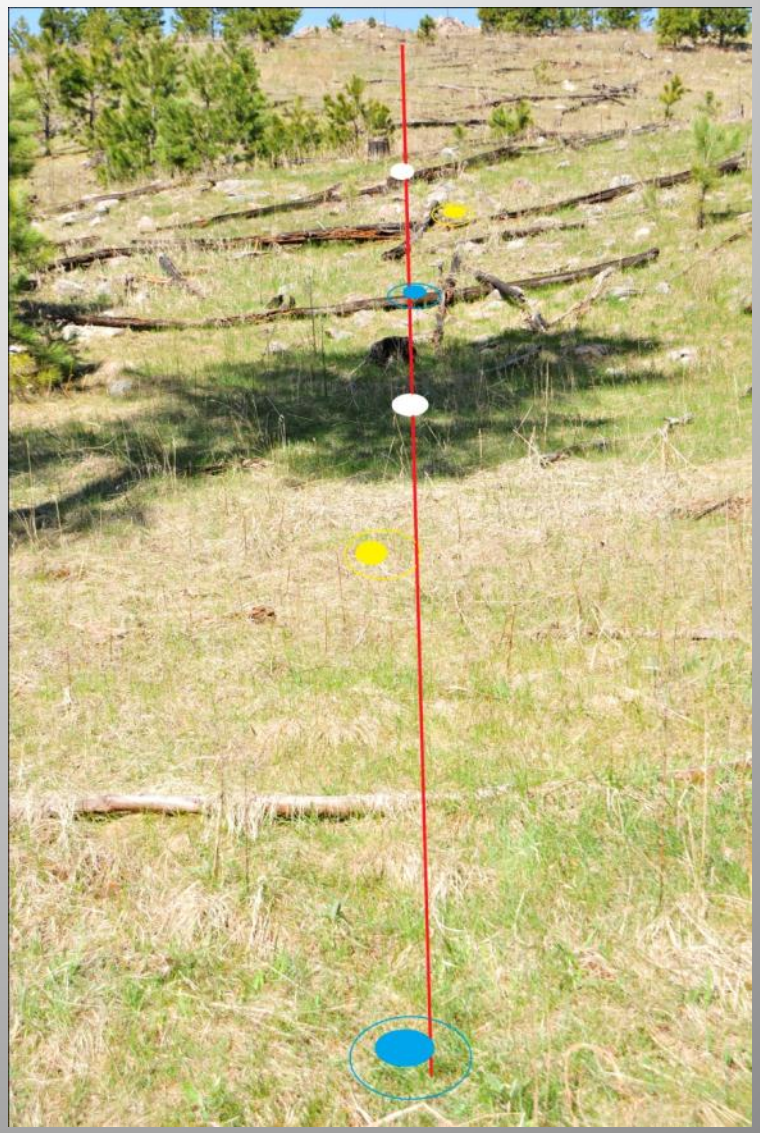
Methods-Pan trap

- 5oz and 3.25oz bowls
- Fluorescent yellow, fluorescent blue, and white
  - Color bias by species
- Filled ¾ with soapy water

*all Pan Trap Methodology from Cane, J.H.et al. 2003; Droege, S. 2010, 2011.

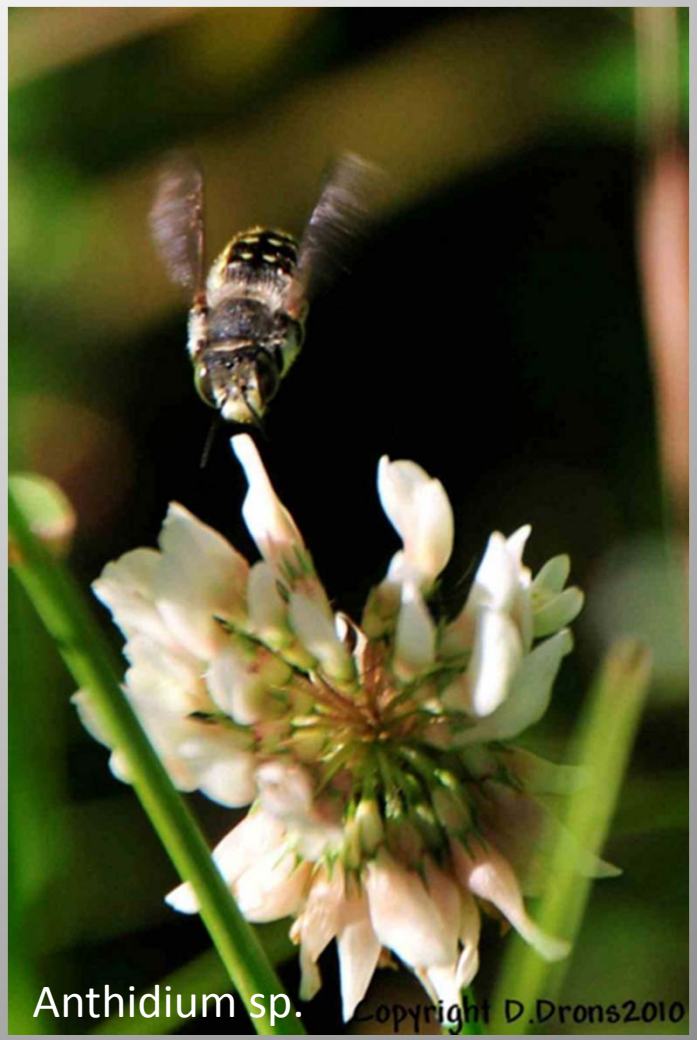
Pan Traps

- 30 bowls
- 5m apart
- Alternating colors
- Left for 24 hours
- Strained
- Placed in whirlpac
- Stored in alcohol



Net collection

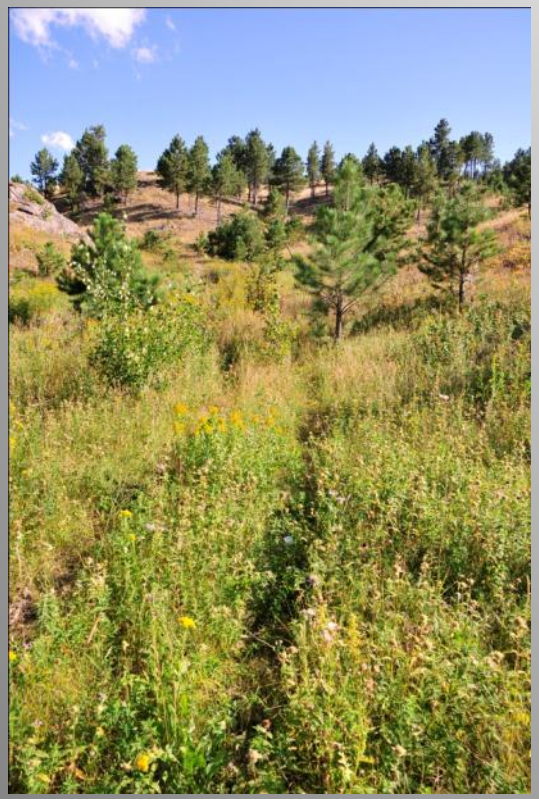
- Collected for 1 hour at bowl sites
- 15 min intervals at opportunistic locations
- Concentrated on abundant flowering plants
- Bees from each plant kept separate
- Collector bias



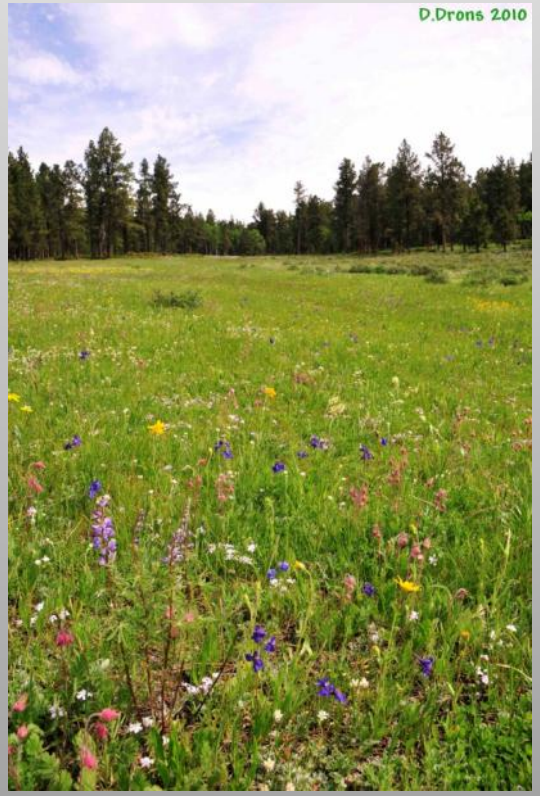
Anthidium sp.

Site Selection

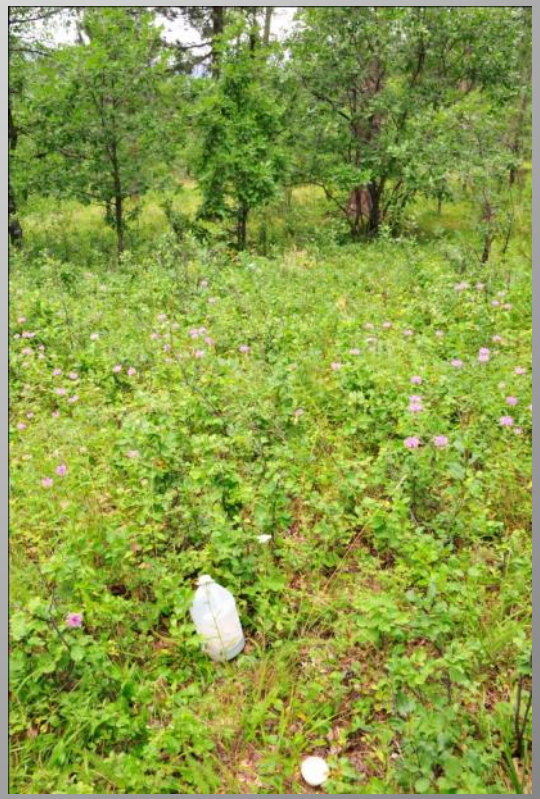
- Spatial distribution
- Habitat type
- Continuous habitat
- Ease of access



Undisturbed low density ponderosa –Custer State Park



Large meadow, light grazing

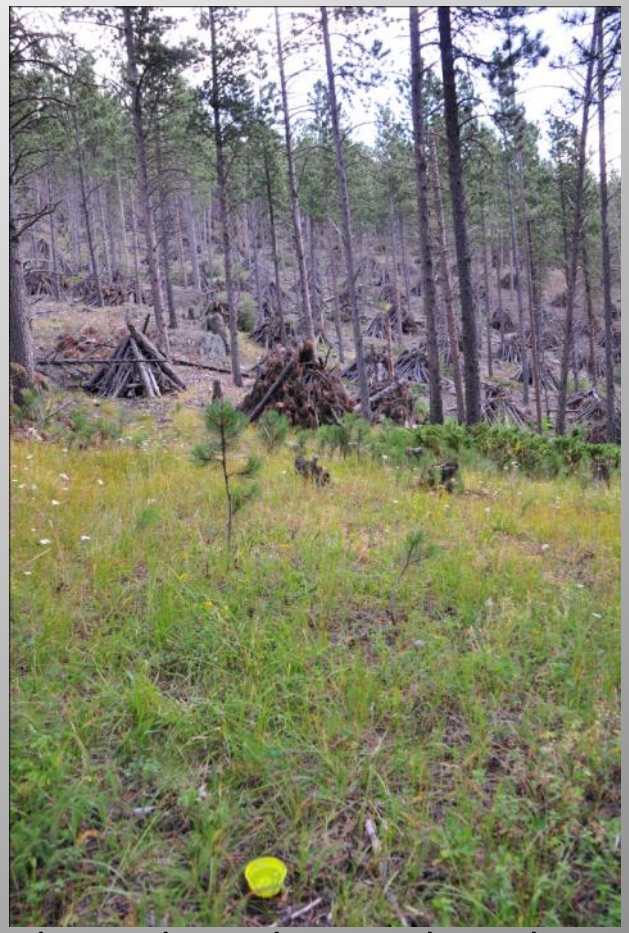


Mixed deciduous near thinned Ponderosa

Data Collected

- Latitude & Longitude
- Site description
- Flowering plants
- Weather

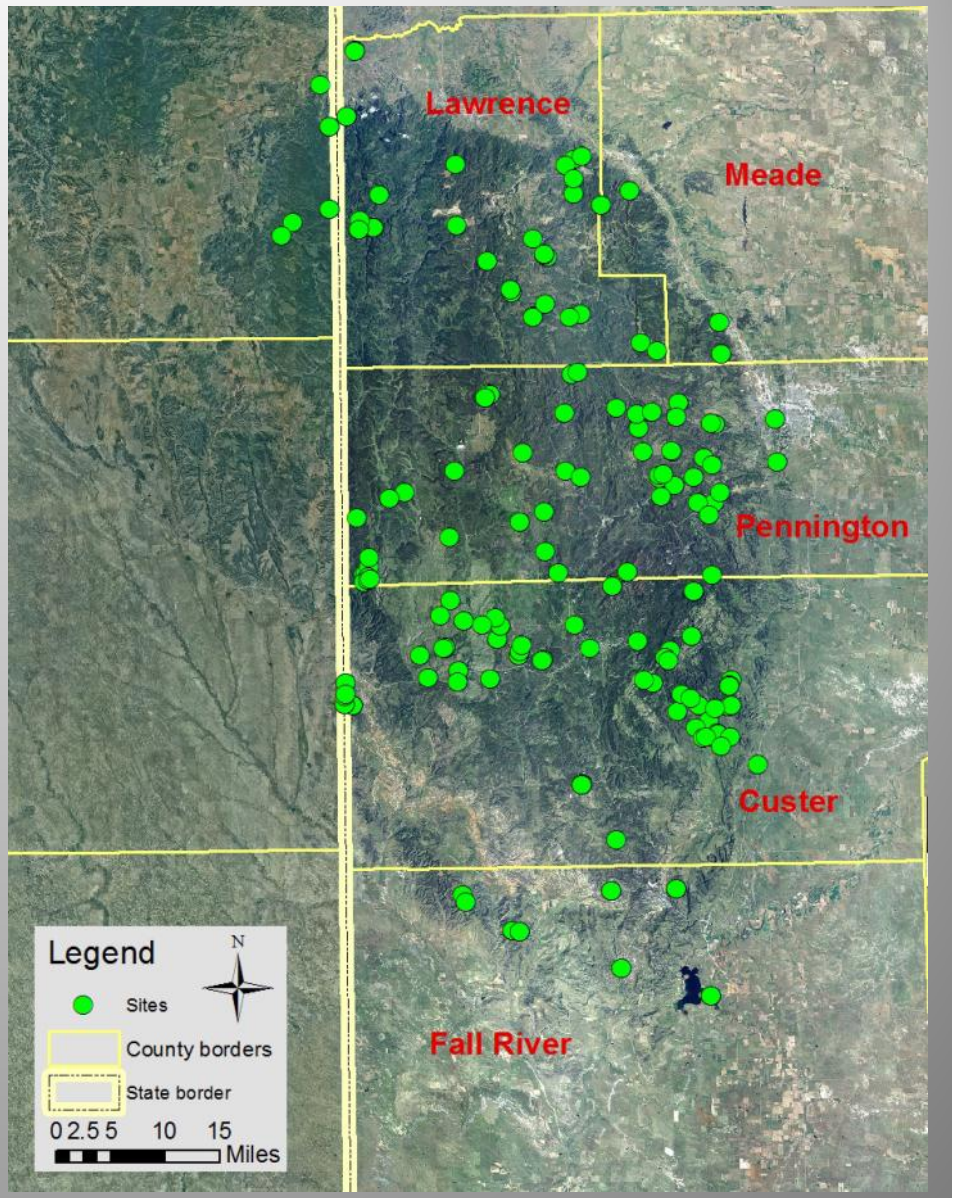
Low elevation deciduous forest, grazed



Thinned Ponderosa –heavily disturbed, abundant woody debris

Results

- Pan trapped at 102 sites
  - Repeated @ 52 sites
  - 106,000 trap-hours
- Net collected
  - Floral records
- 22,000 bees
- Database completed
- Identification
  - Genera ~90% complete
  - Species (ongoing)



Results cont.

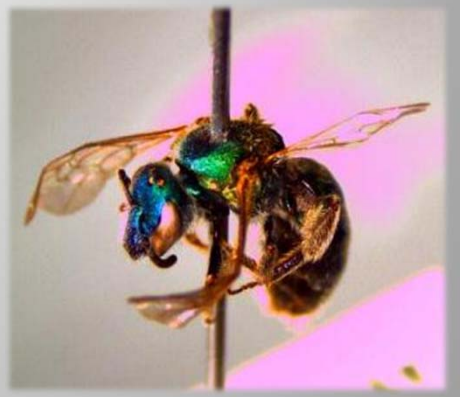
- 155 species
  - 35 morpho-species
- 41 New State Records
- Over 60 New county records
- Range extensions
- 241 species with SMIRC
- Most common
  - Halictidae
    - Lasioglossum (approx. half of all collected)
  - Megachilidae

Analysis

- Species richness
- Species frequency
- Diversity indices
  - Shannon-Weiner
  - Simpsons
- Site comparisons
  - Ordination
  - Chi squared
- Bowl size

Future…..

- Identification
- Maps using ArcGIS
  - Sites, species, species diversity
- Publication
  - Checklist of Black Hills bees
  - Cooperative with Badlands N.P. and database program of J.S. Ascher
- Expand initial inventory into monitoring protocol
  - Based on sites with high species richness
  - Unique species composition or habitat



Conclusion

- There are no fewer than 250 spp. of native bees in the Black Hills
- Additional sampling will yield additional species occurrence records
- Bees are “friendly” and diverse

Acknowledgements

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- Custer State Park
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References

- Buchmann, S.L. and G.P. Naban. 1996. *The Forgotten Pollinators*. Island Press, Washington, D.C. 292 p.
- Cameron, S.A. et al. 2010. Patterns of widespread decline in North American bumble bees. Proceedings of the National Academy of Sciences 108(2): 662-667.
- Cane, J. H. 2001. Habitat Fragmentation and Native Bees: a Premature Verdict? Conservation Ecology, http://www.consecol.org/vol5/iss1/art3/. [Accessed 14 March 2012].
- Cane, J. H., R.L. Minckley, and L.J. Kervin. 2000. Sampling Bees (Hymenoptera: Apiformes) for Pollinator Community Studies: Pitfalls of Pan-trapping. Journal of the Kansas Entomological Society 73(4): 225-231.
- Cane, J.H. and V.J. Tepedino. 2001. Causes and extent of declines among native North American invertebrate pollinators: detection, evidence, and consequences. Conservation Ecology, http:www.consecol.org/vol/iss1/art1 [Accessed: 14 FEB 2011].
- Cane, J.H. et al. 2003. A Standardized Method for Monitoring Bee Populations the Bee (BI) Inventory Plot. Unpublished Draft.
- Droege, S. 2010 and 2011. Personal Communications. U.S. Department of the Interior, U.S. Geological Survey, Patuxent Wildlife Research Center, Beltsville, MD.
- Grixti, J.C., L.T. Wong, S.A. Cameron, and C. Favret. 2009. Decline of Bumble Bees (*Bombus*) in the North American Midwest. Biological Conservation 142: 75-84.
- Kearnes, C. A., D.W. Inouye and N.M. Waser. 1998. Endangered Mutualisms: The Conservation of Plant-Pollinator Interactions. Annual Review of Ecology and Systematics 29: 83-112.
- Kluser, S. et al. 2010. UNEP Emerging Issues: Global Honey Bee Colony Disorders and Other Threats to Insect Pollinators. http://www.unep.org/dewa/Portals/67/pdf/ [Accessed: 14 FEB 2011].
- Losey, J.E, and M. Vaughan. 2006. The Economic Value of Ecological Services Provided by Insects. Bioscience 56(4): 311-323.
- Michener, C.D. 2000. *The Bees of the World* 2nd Edition. The Johns Hopkins University Press, Baltimore. 953 p.
- Muesebeck, C.F.W., K.V. Krombein, and H.K. Townes. 1951. Hymenoptera of America North of Mexico Synoptic Catalog. United States Government Printing Office, Washington D.C. 1420 p.
- National Research Council. 2007. *Status of Pollinators in North America*. The National Academies Press, Washington, D. C. 307 p.
- Taki, H., P.G. Kevan, and J.S. Ascher. 2007. Landscape effects of forest loss in a pollination system. Landscape Ecology 22:1575-1587.
- Winfree, R., T. Griswold, and C. Kremen. 2007. Effect of Human Disturbance on Bee Communities in a Forested Ecosystem. Conservation Biology. 21(1): 213-223.