

# Creating, Monitoring, and Protecting a Bee Resource Garden in Costa Rican Dry Forest

G.W. Frankie

S.B. Vinson

J.L. Hernandez

University of California Berkeley

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



## General Outline

- Introduction
- Costa Rican Case Study
- Considerations for Restoration
- Concepts and Implementation
- Implications for Future Work
- Conclusions



## Introduction

- Several national initiatives to conserve and protect pollinators
- Many recommendations have emerged
- *One is to restore pollinators*



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- The case for restoring bee pollinators in Costa Rican dry forest: lessons learned and applications

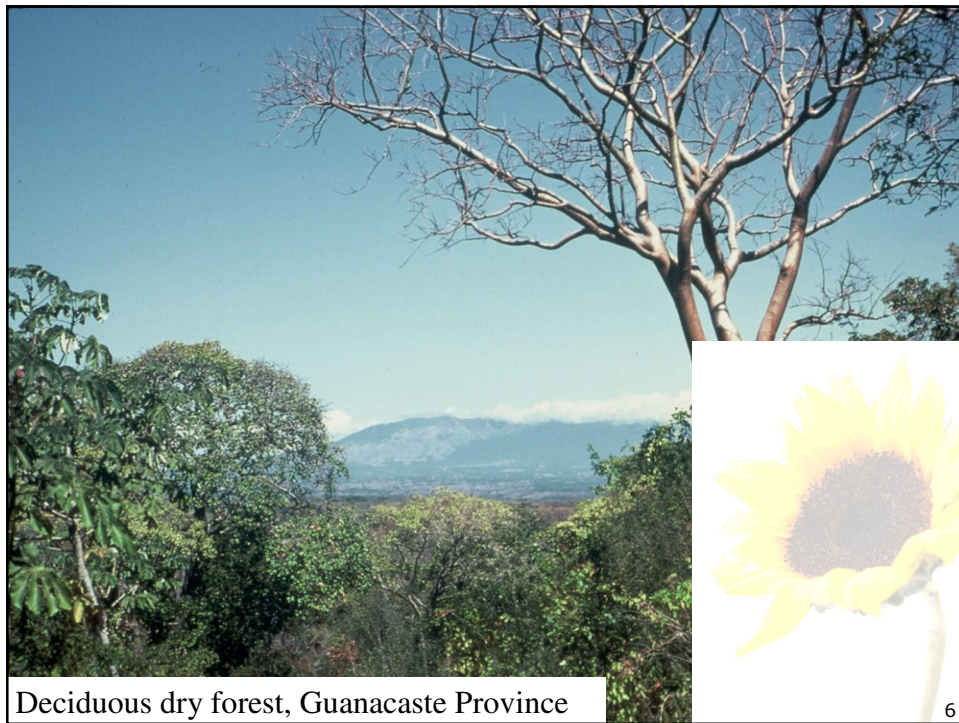


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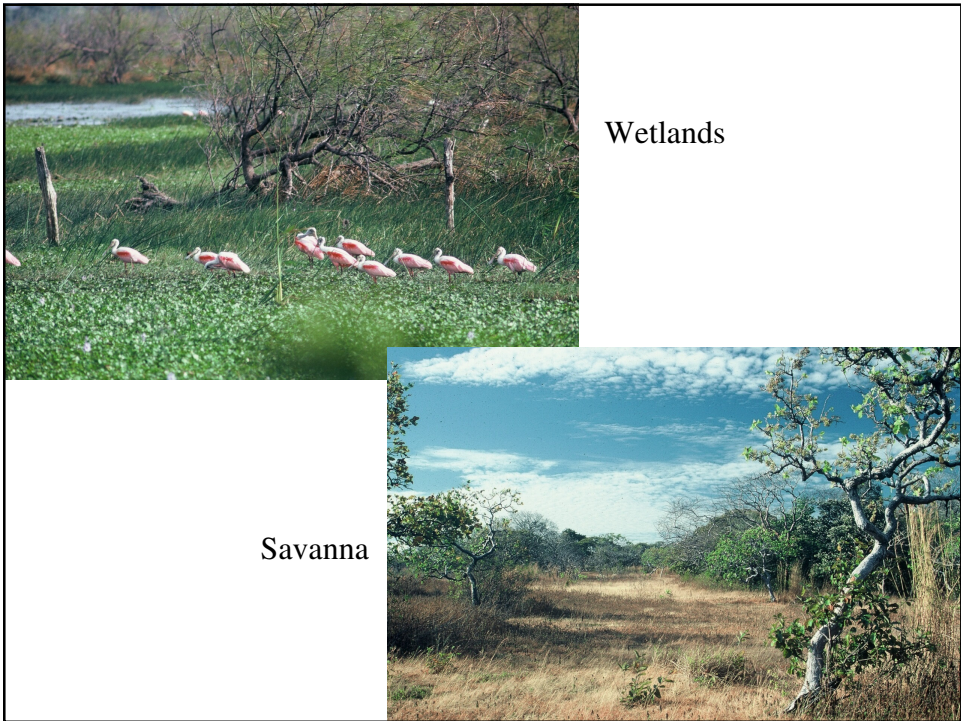
Map of Costa Rica

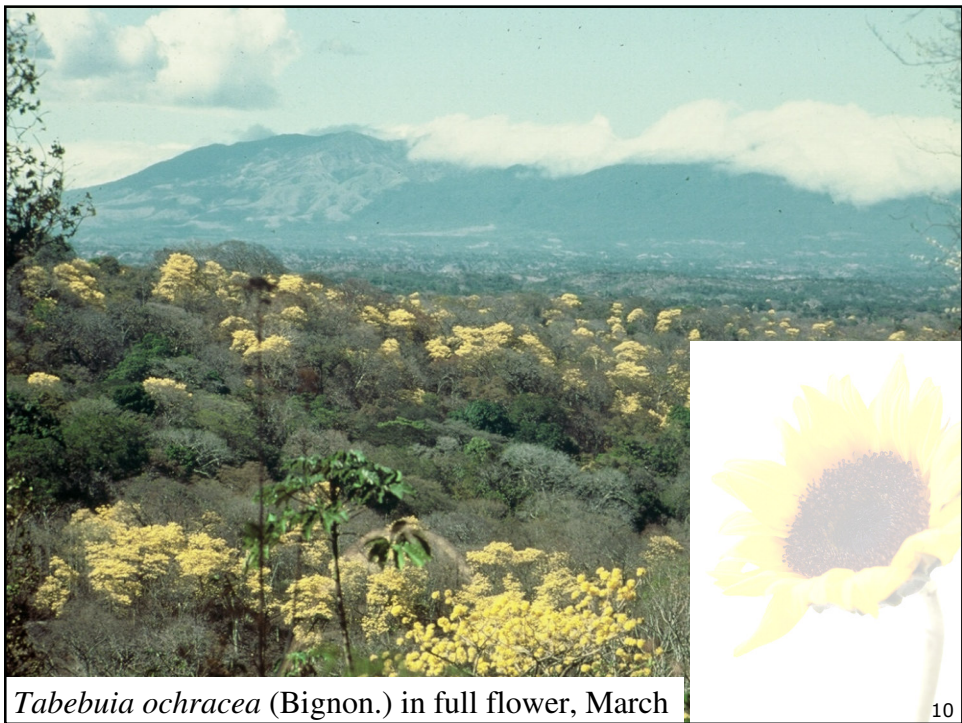
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Deciduous dry forest, Guanacaste Province

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## Case Study

- Long-term monitoring was conducted on *Andira inermis* trees in Liberia
- Standard samples were taken on 8 trees in 1972, 1996, 1999, 2004
- Decline in Costa Rican bees was obvious

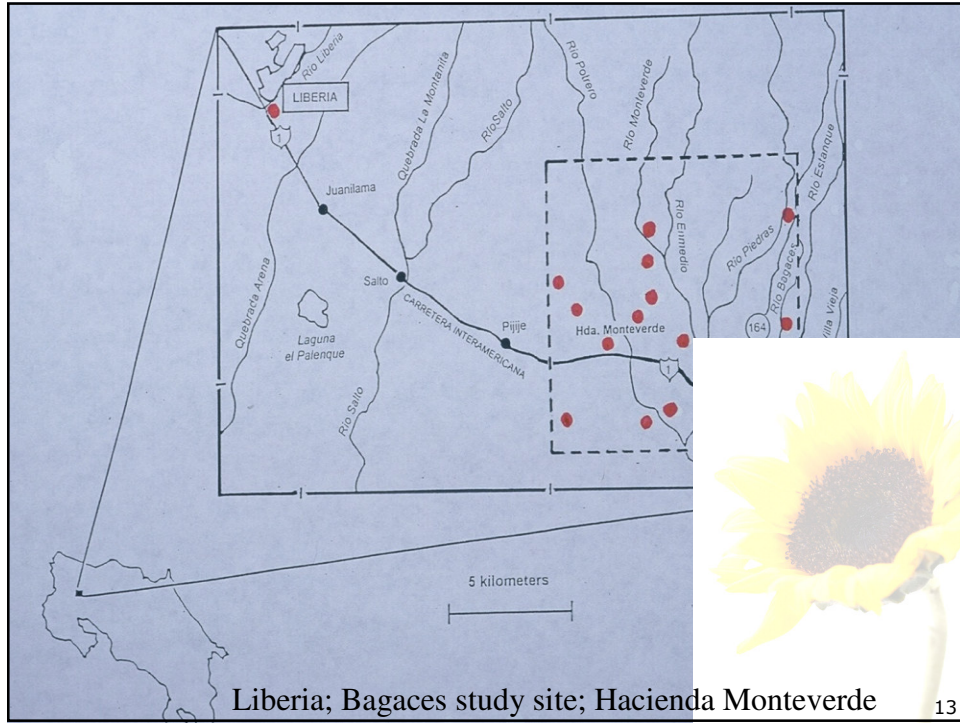


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*Andira inermis* (Fabac.) in full flower in Liberia

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### Outline for Standard Sampling Protocol

- 48 top crown sweeps
- 48 lower crown sweeps

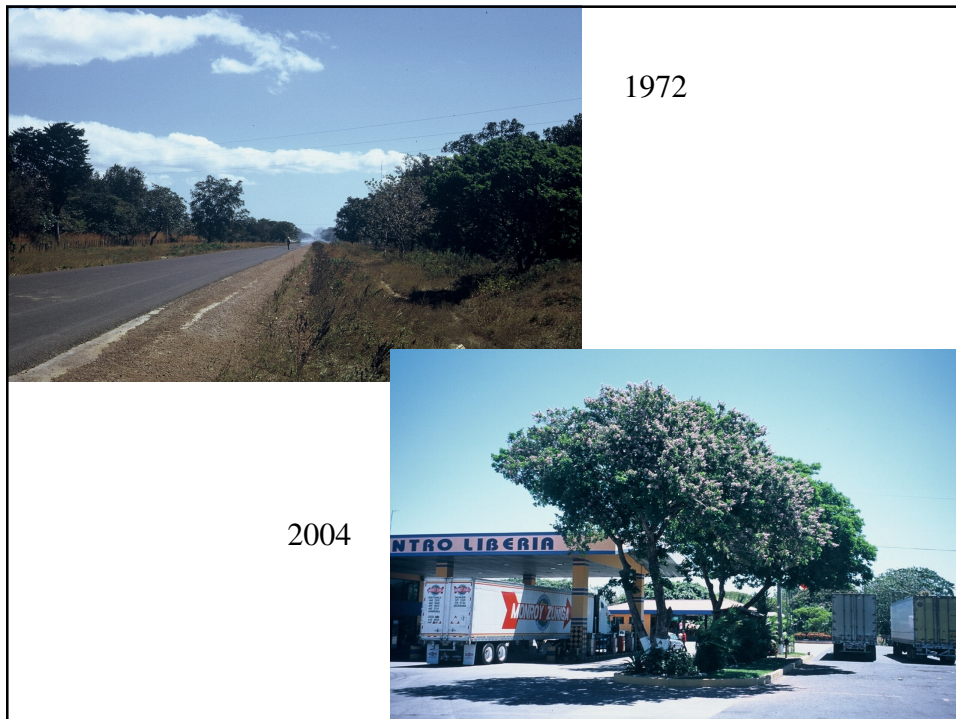


## Bee diversity and Abundance on *A. inermis* at Liberia: 1972-2004

Year	No. bee species	Ave. sample/tree <sup>1</sup> ± SD
1972	70	824±210
1996	28	92±59
1999	30	79±33
2004	ca 25	131±62

<sup>1</sup> N=8 trees per year

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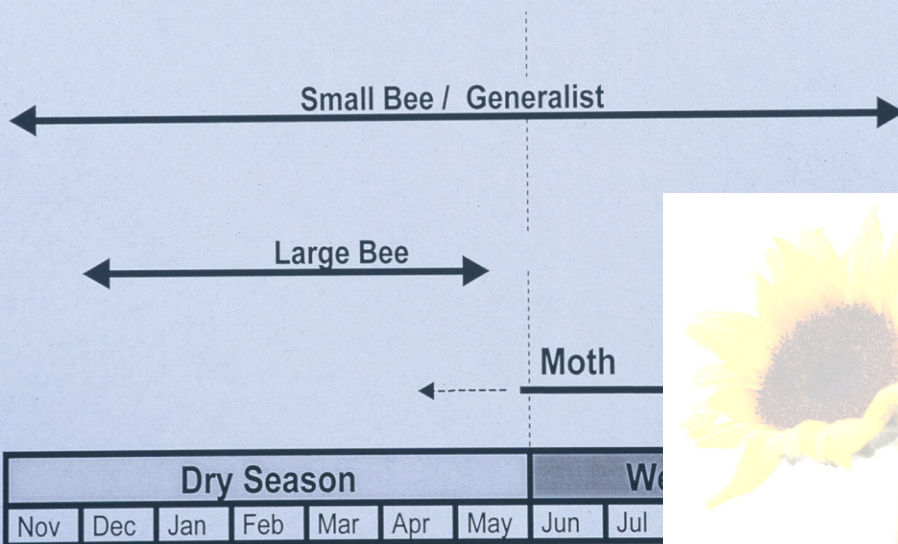
## Main Pollination Systems in Bagaces Study Site

Type	Nos. plant spp.	% total
1. Large Bee	78	<u>16.8</u>
2. Small Bee (general)	245	<u>52.7</u>
3. Moth	34	7.3
4. Bat	11	2.4
5. Hummer	10	2.2
Totals:	378	81.4



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## Main Dry Forest Pollination Systems



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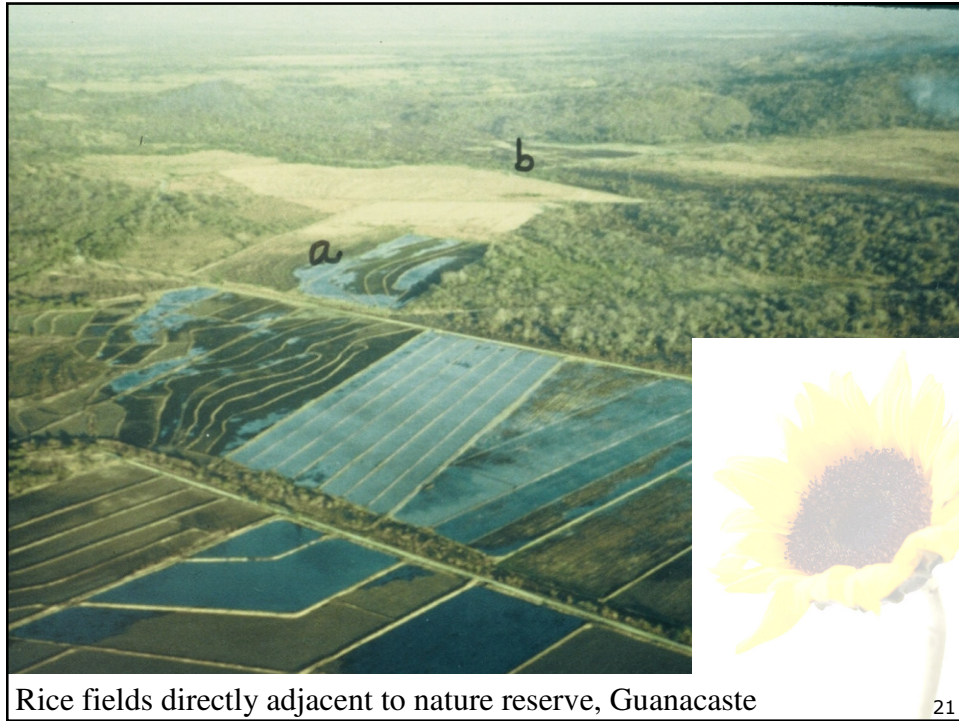
## Probable Causes of Bee Decline

1. Deforestation; removal of preferred floral resources
2. Agricultural development
3. Wildfires



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Rice fields directly adjacent to nature reserve, Guanacaste

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## General Considerations for Restoration

- How is restoration defined?
- Challenges, Reality!
- Feasibility?



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## Concepts and Implementation

1. Planning (1999)
2. Plan Implementation (2000)
3. Ongoing Evaluation
4. Monitoring
5. Long-term Outlook (2010)



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## Planning

- Site Selection
- Baseline information on flora, bee fauna, vegetation type(s)
- Bee nesting habitat



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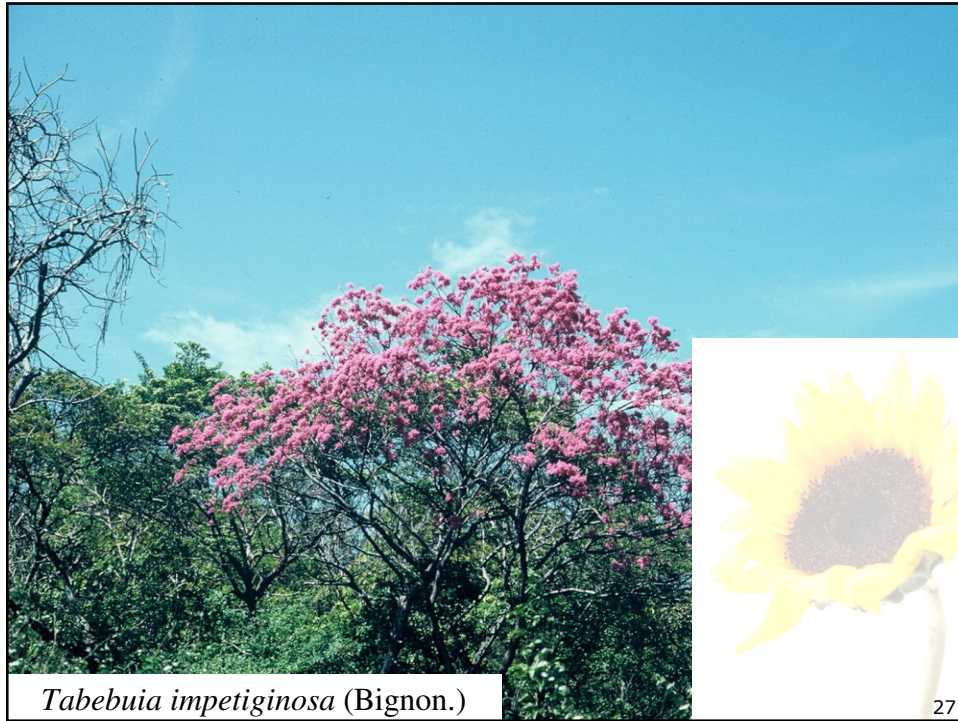


Aerial view of restoration site and surrounding environment

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## Nos. Dry Forest Plant Species in C.R.

- Est. total in lowland forests: 1,000+
- Est. total in Bagaces study area: 550+
- No. spp. With flowering info: 480 (87%)
- No. spp. With pollination info: (465) (85%)

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## Implementation

- Plant selection
- Seasonality: plants, bees
- Nursery stock
- Planting water
- Site protection, security



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## Restoration Planting in Garden

- Trees\*, shrubs, vines, lianas, herbs

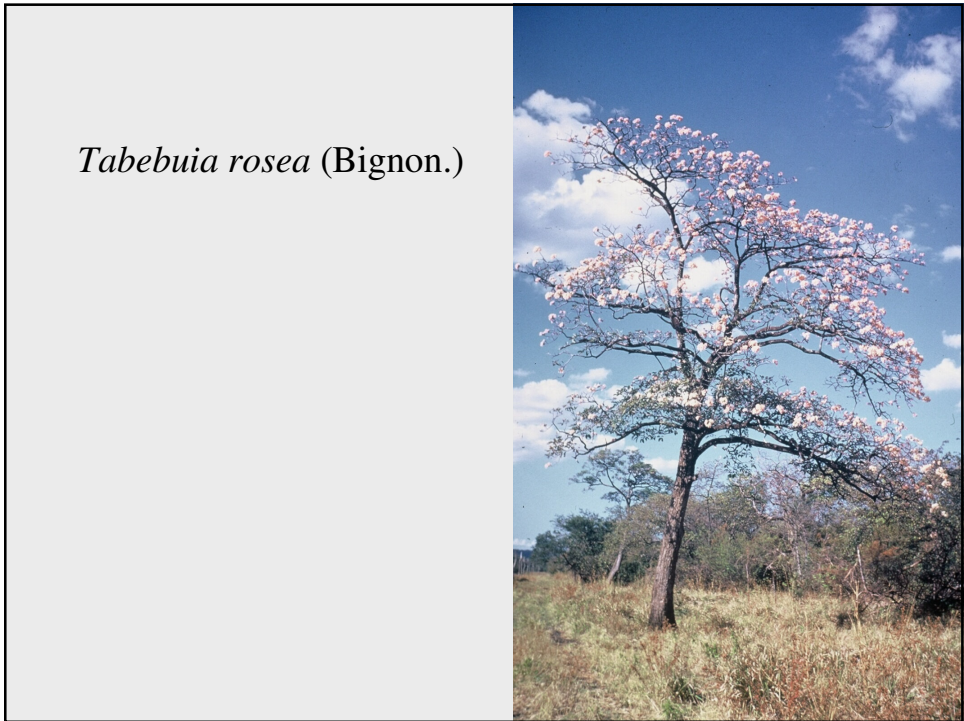
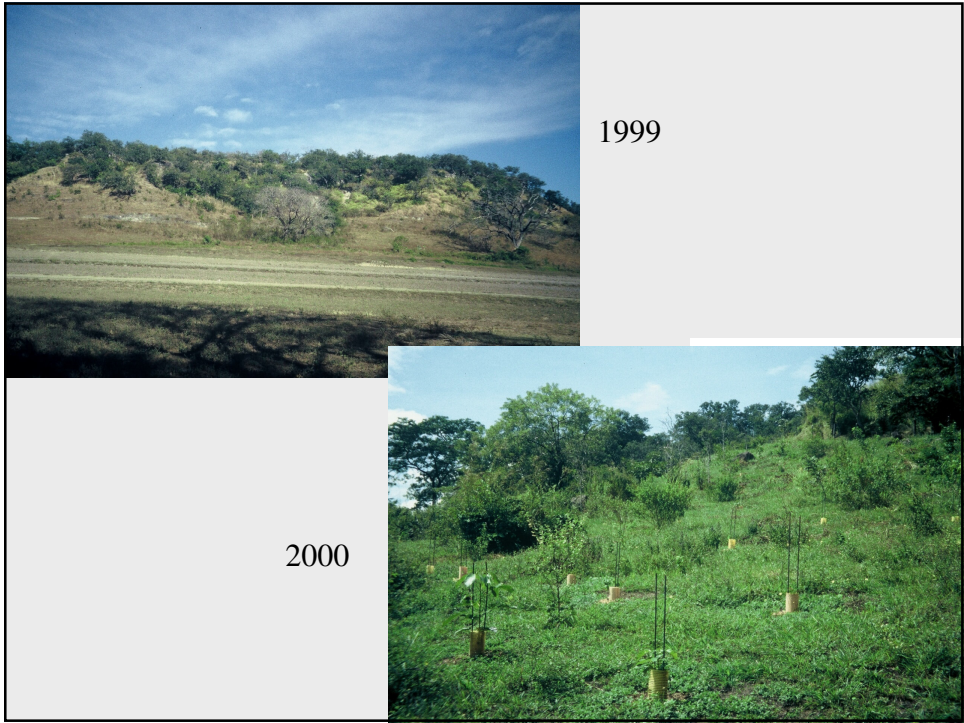
Total planted: 60 spp. (N=800 indiv.)

Total volunteers: ca 30 spp.

Total of 90 preferred bee flowers



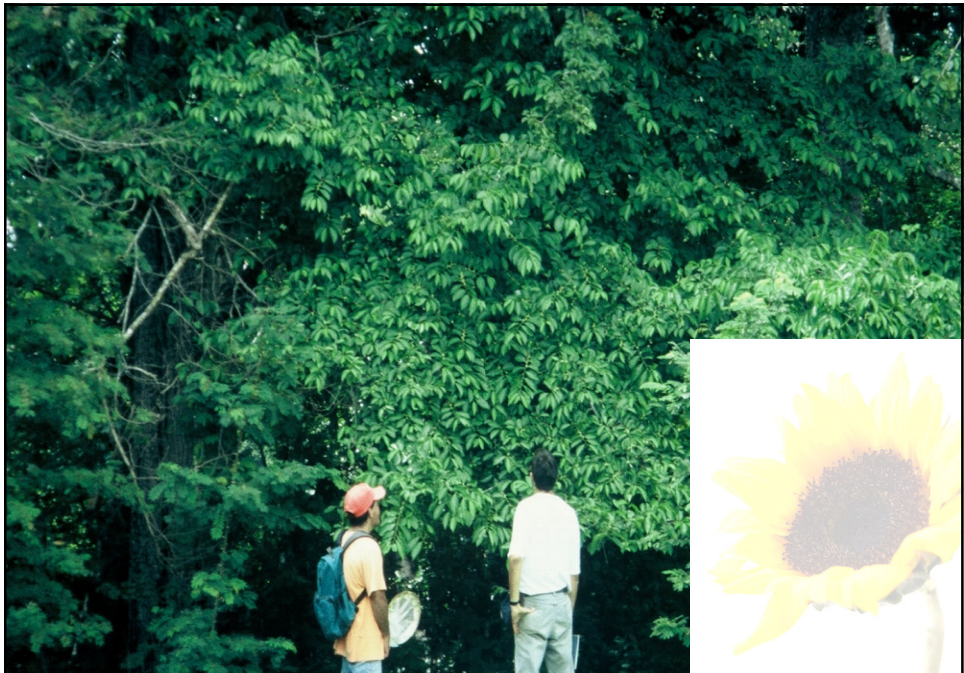
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Protective fence line



Conducting visitation counts to establish bee host preferences

## Ongoing Evaluation

- Site maintenance; fire
- New bee plants
- Successional plant development
- Regular contact with land steward



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Exotic grass invading restoration site

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## Monitoring

- Flowering phenology
- Human disturbances
- First bee monitoring: mid 2002-  
mid 2003, using pan traps and aerial  
netting



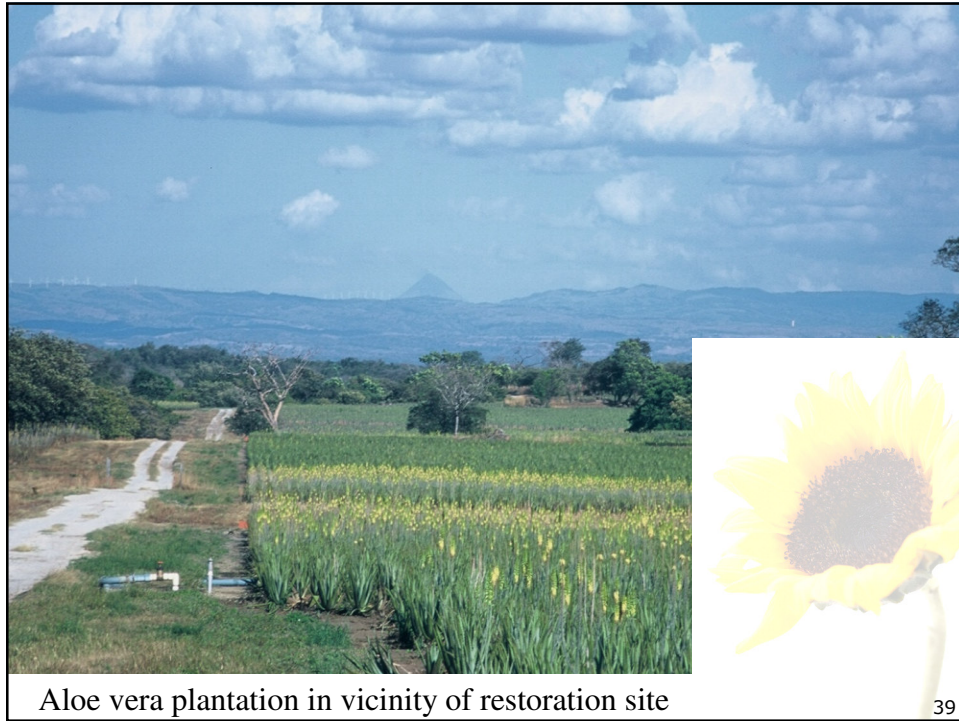
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*Cochlospermum vitifolium*  
(Cochlospermaceae)



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Aloe vera plantation in vicinity of restoration site

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## Monitoring

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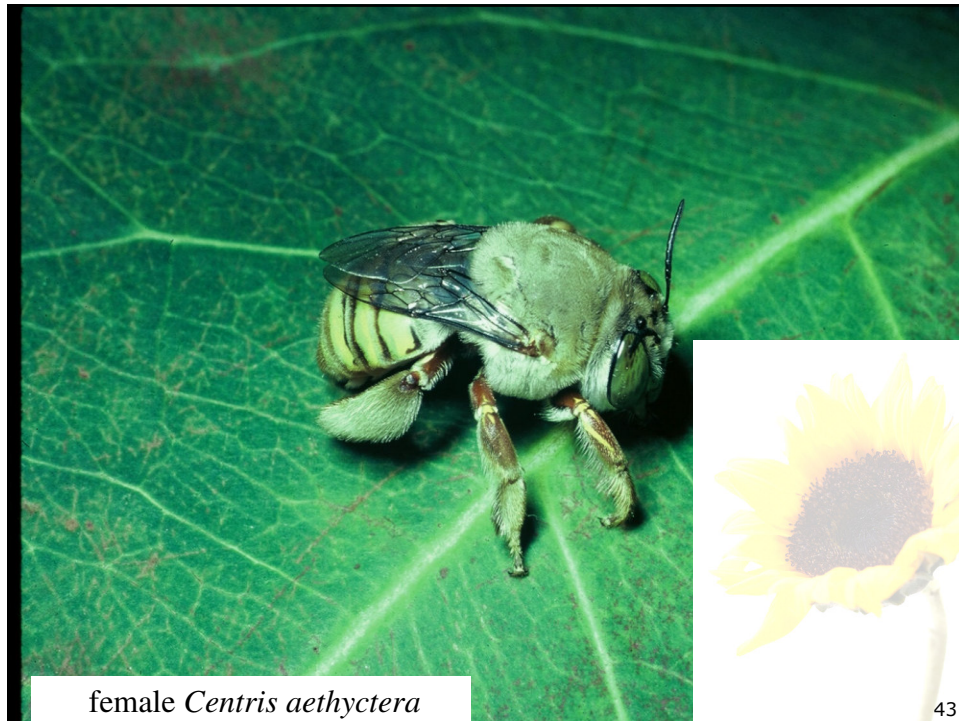
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Pan trap



Restoration site, July 2003



female *Centris aethytera*

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## Long-term Outlook: 10yr

- Commitment of biologist
  - Second bee monitor, 2007
- Fatigue factor
- Relationship to land steward
- Environmental education



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# Implications from other projects

## Urban bee connection *Berkeley, California*



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San Francisco  
Bay Area, California

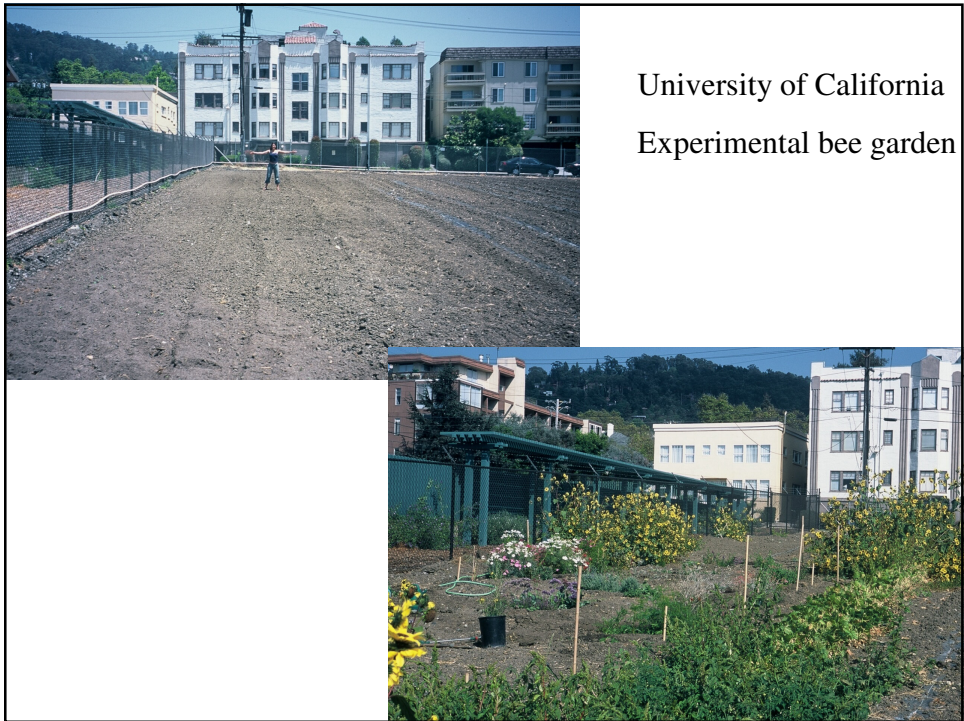


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Peralta community garden in Berkeley, California

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University of California  
Experimental bee garden



## Urban bees in diverse plant gardens

- Bee diversity higher on attractive plants
- Bee abundance higher on attractive plants
- Bees visit relatively unattractive plants
- Bees visits may be longer
- Nesting resources



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## Implications for other projects

- Urban bee connection
  - *Phenological succession of preferred host plants and bees*
  - *Social synergy among solitary bees?*
- Possible applications to croplands and agro-ecology
  - *Design-built hedgerows and vegetation plots adjacent to crops*



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## Conclusions

- Restoring bees to an are requires:
  - Planning
  - Realistic goals and time frames
  - Baseline info
  - Monitoring
  - Ongoing evaluation
  - Collaboration
  - Patience
  - Finances



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It is DOABLE!

