pollinator protection

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Maine pollinators… who are they ?

- insects
  - bees
  - moths
  - butterflies
  - flies
  - beetles
  - ants and wasps
  - thrips, hemiptera
- hummingbird

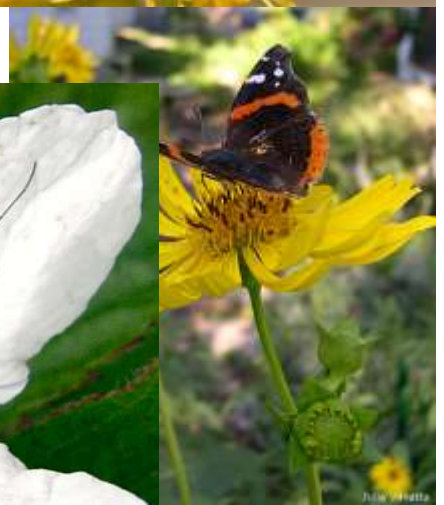








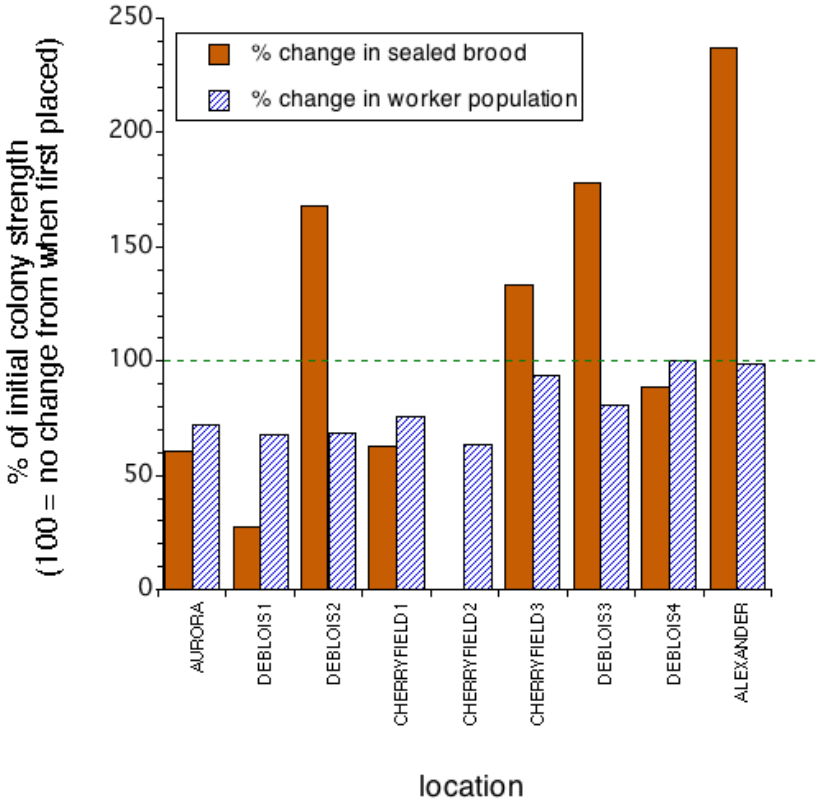


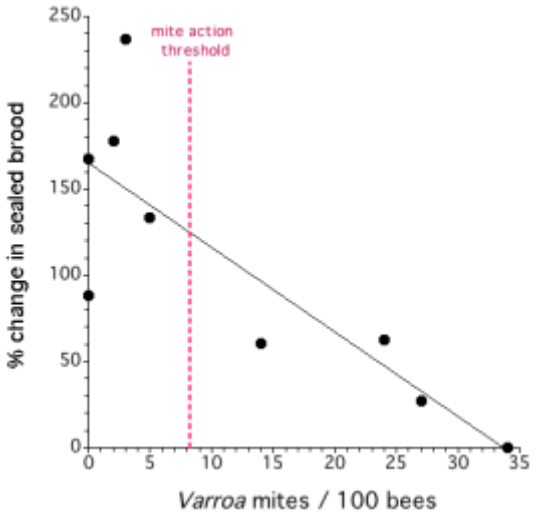



bees & pollination

perils ? …

- weather
- disease
- habitat loss
- pesticide exposure



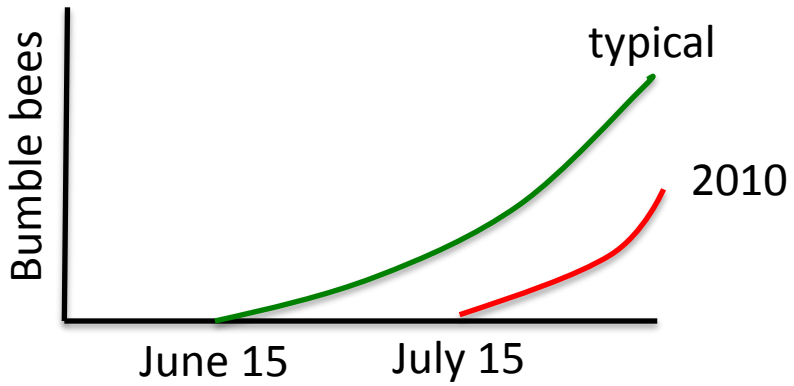


weather

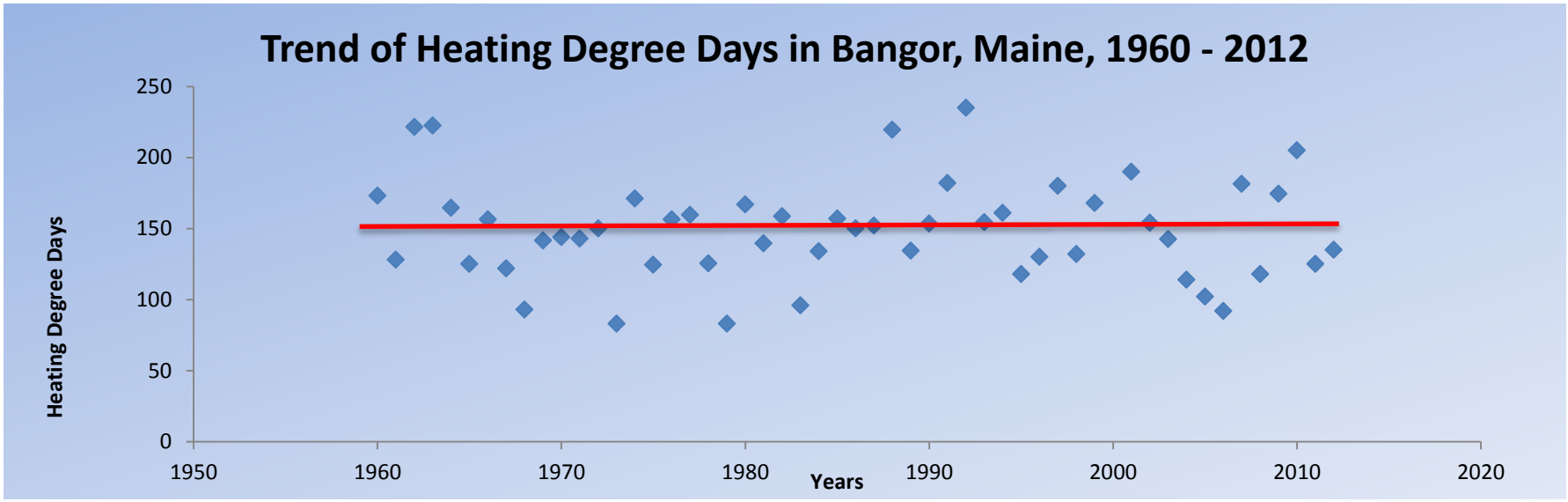
- insects are mostly cold blooded - metabolism and activity is related to air temperature
- bees do not fly in rain

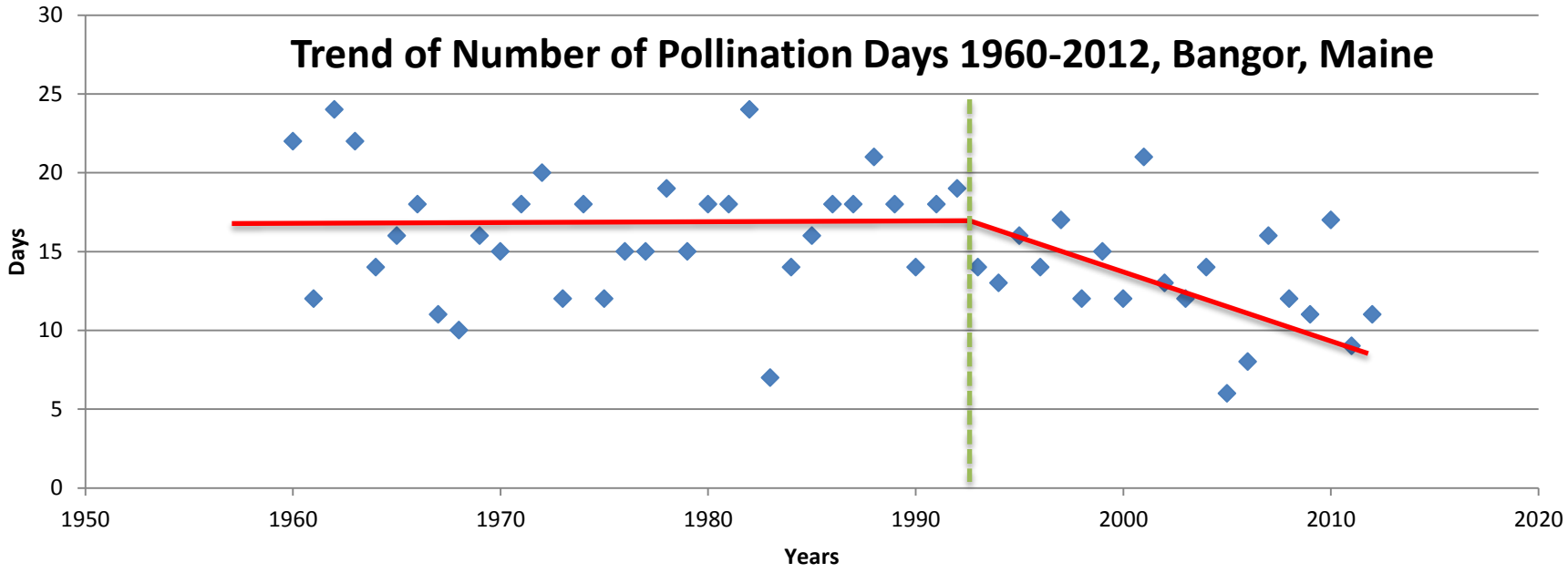
two examples of deleterious weather effects

1. in spring of 2010 had a two week period starting in mid-June that averaged 50ºF and rainy…bumble bee workers were still larvae, queens didn't go out and forage enough – mass starvation all over the state and so few bumble bees throughout summer.



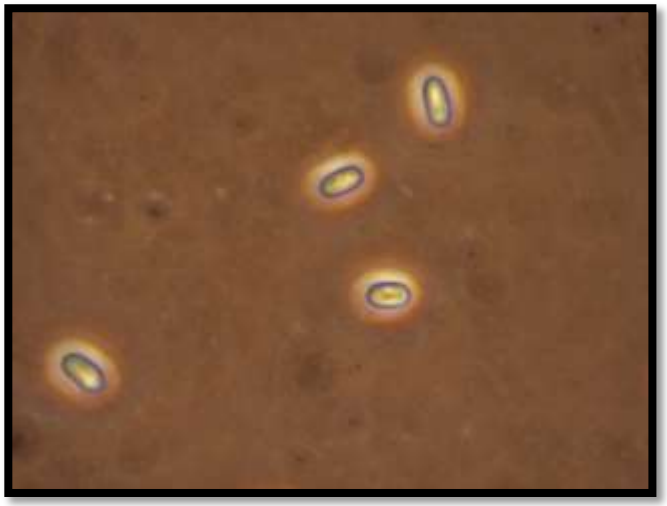
a changing climate





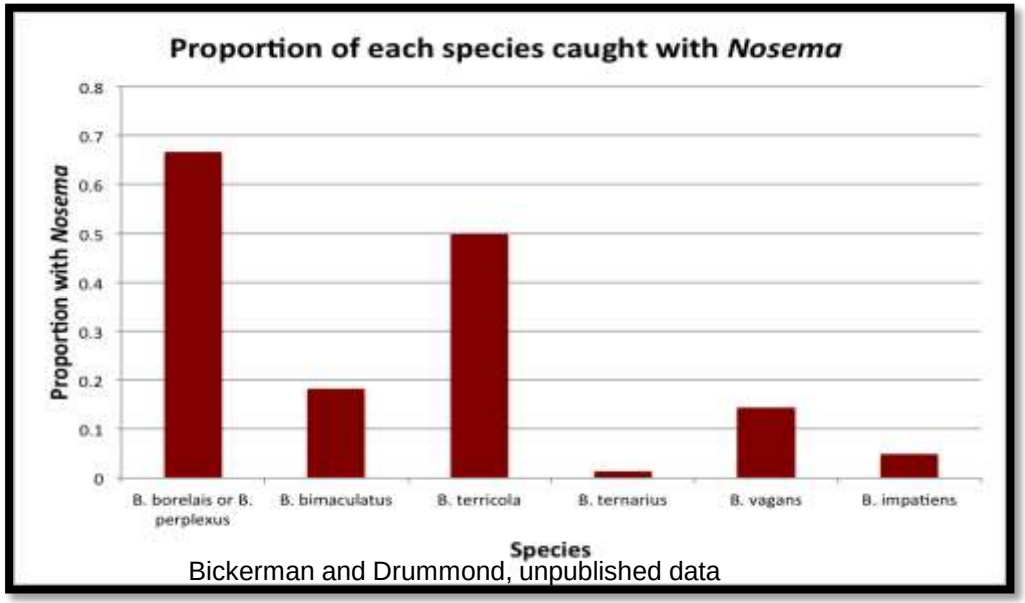
diseases…there are many

- fungal pathogen
  - *Nosema bombi*



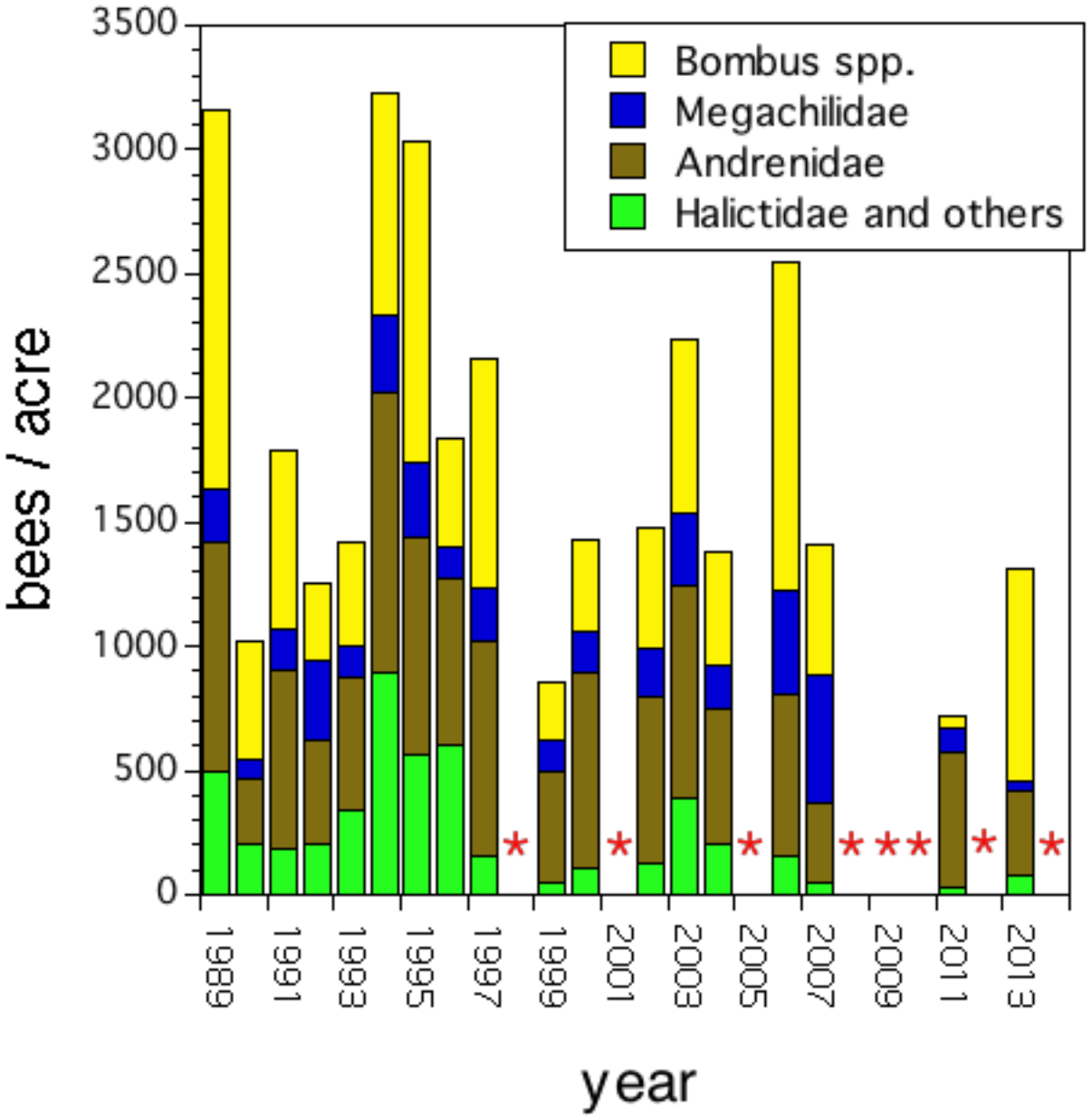
N. Bombi spores, 1000X. Bickerman, 2012

- spread through spores
- prevalence species-dependent



Bickerman and Drummond, unpublished data

natural fluctuations of bee community

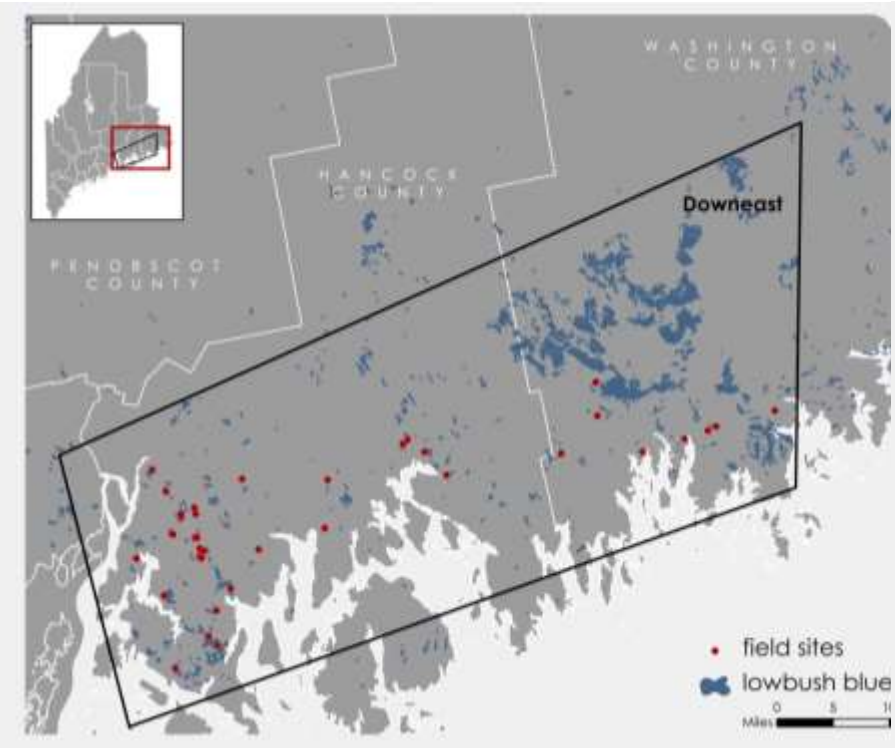


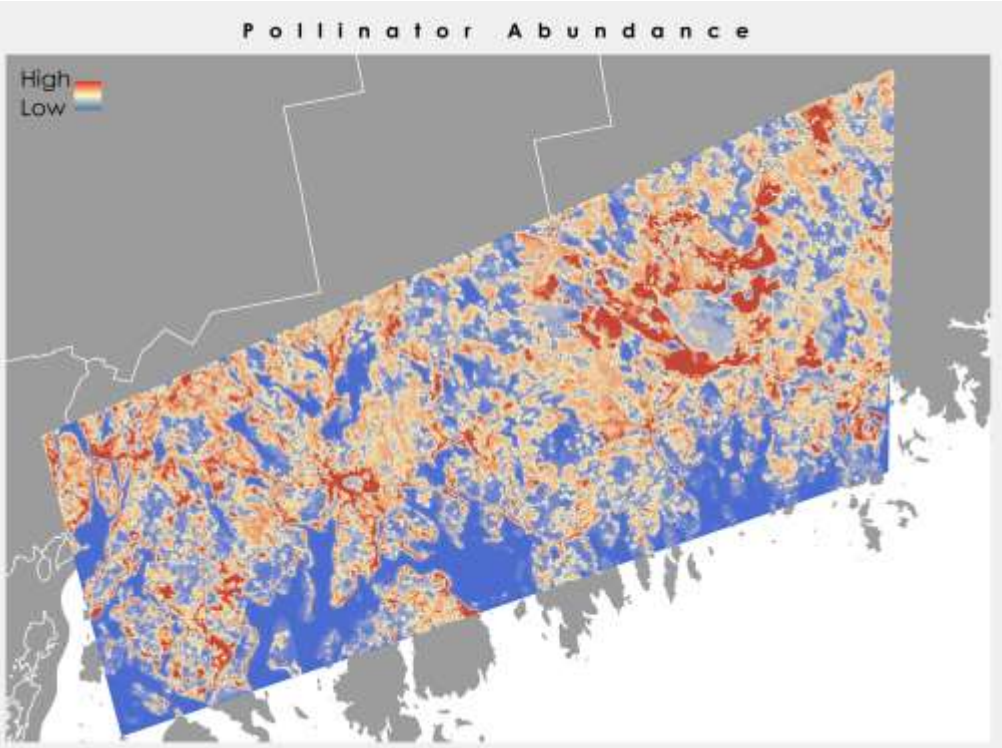
what can be done?

- create or enhance habitat
- minimize exposure to pesticides

landscape fragmentation

- 94% forested !!!!
  - Conifer forest = POOR
  - Contiguous conventional blueberry = POOR
  - Deciduous forest edge = GOOD
  - Wetland = MODERATE
  - Old field and recent clearcut = GOOD





bee pasture

- how to design?
  - season long coverage (3 flower species in each season)
    - Why ? … many bee species have different preferences, abilities, and nutritional needs
  - minimize PESTICIDE exposure

developing a seed mix

Wild bees prefer the "Wildflower Mix" treatment

Common Name	Species
Annuals	
Plains Coreopsis	*Coreopsis tinctoria*
Indian Blanket	*Gaillardia pulchella*
Sunflower	*Helianthus annuus*
Perennials	
Lavender Hyssop	*Agastache foeniculum*
Lance-Lvd. Coreoopsis	*Coreopsis lanceolata*
Canada Tick Trefoil	*Desmodium canadense*
Purple Coneflower	*Echinacea purpurea*
Common Boneset	*Eupatorium perfoliatum*
Bergamot	*Monarda fistulosa*
New-England Aster	*Symphyotrichum novae-angliae*

"Maine Blueberry Mix" sold by:

Applewood Seed Company


Natural Regeneration
Wildflower
Clover

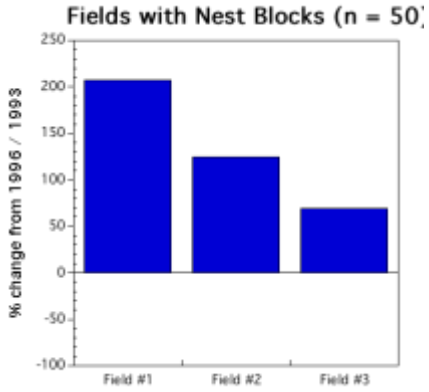
nest sites for leafcutter bees

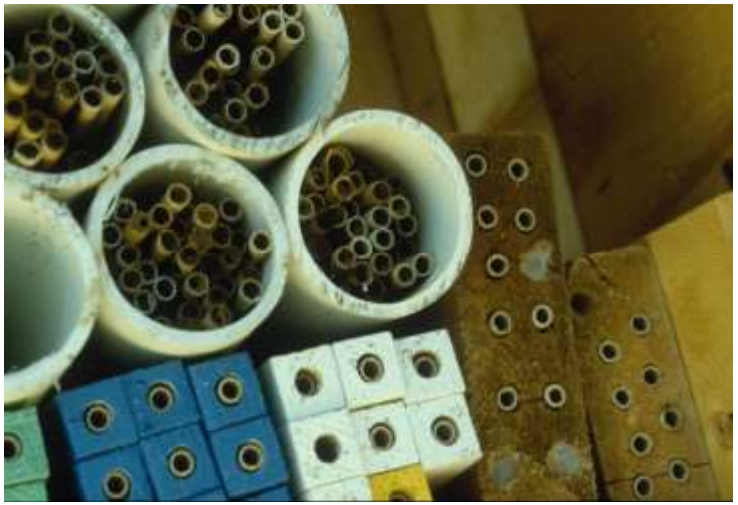
bundle of perennial stem sections

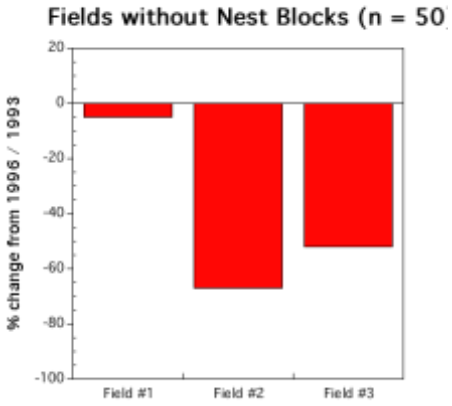
Dead wood with spruce beetle exit holes – leave a tree where it died

wooden nest block -- holes of several diameters, 6-7 inches long

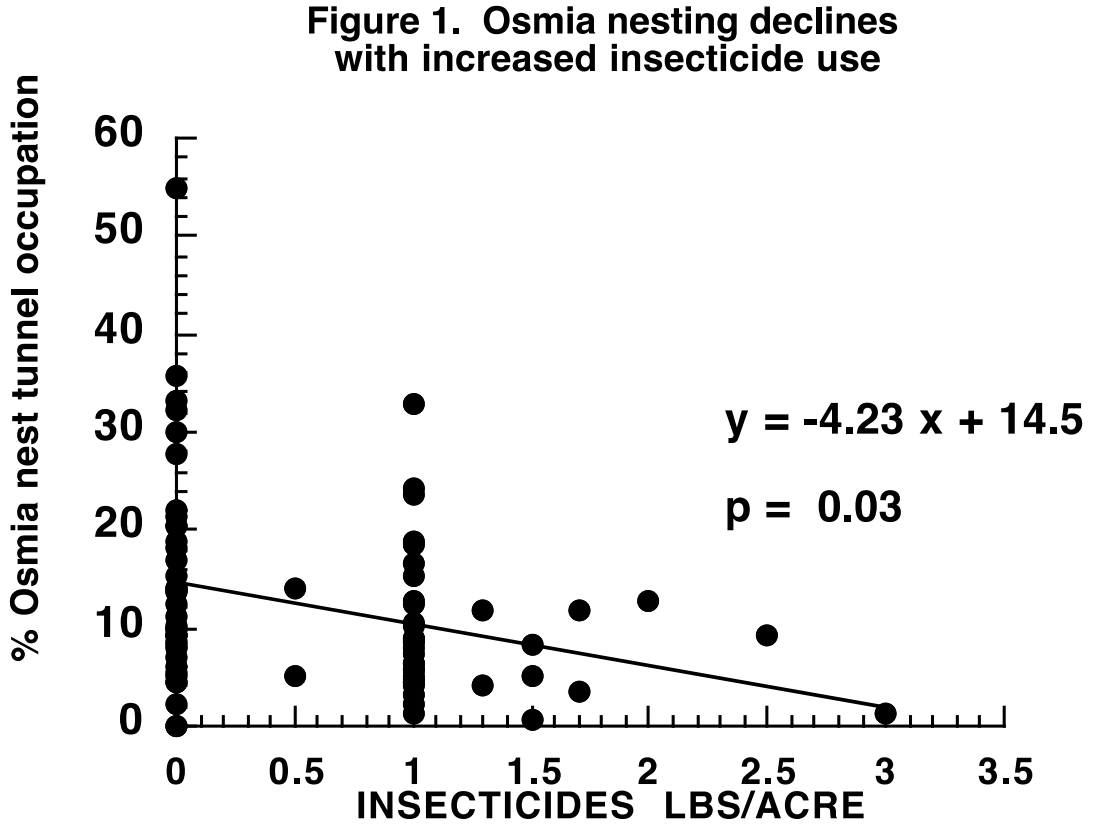
Maine blueberry bee



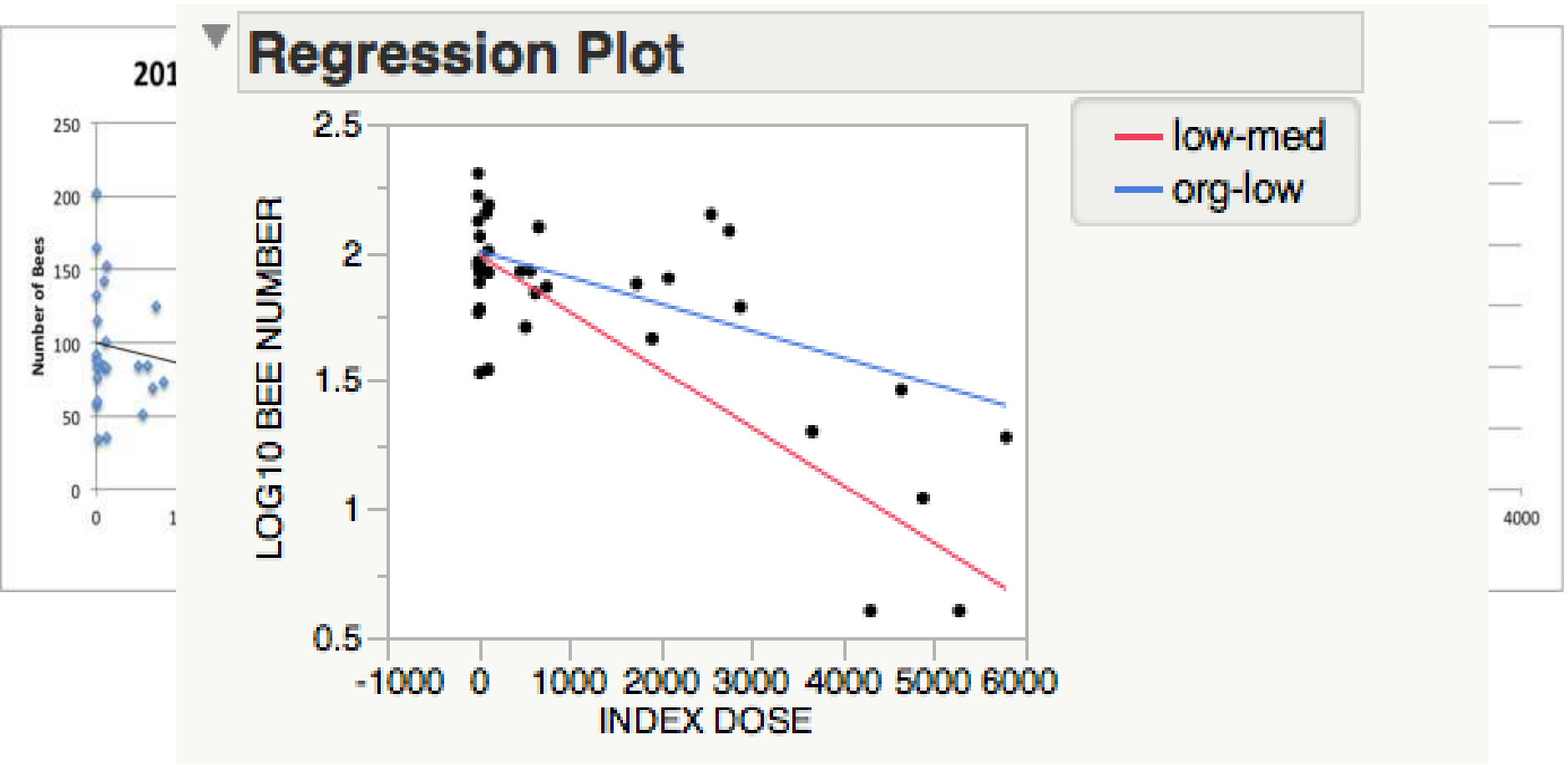




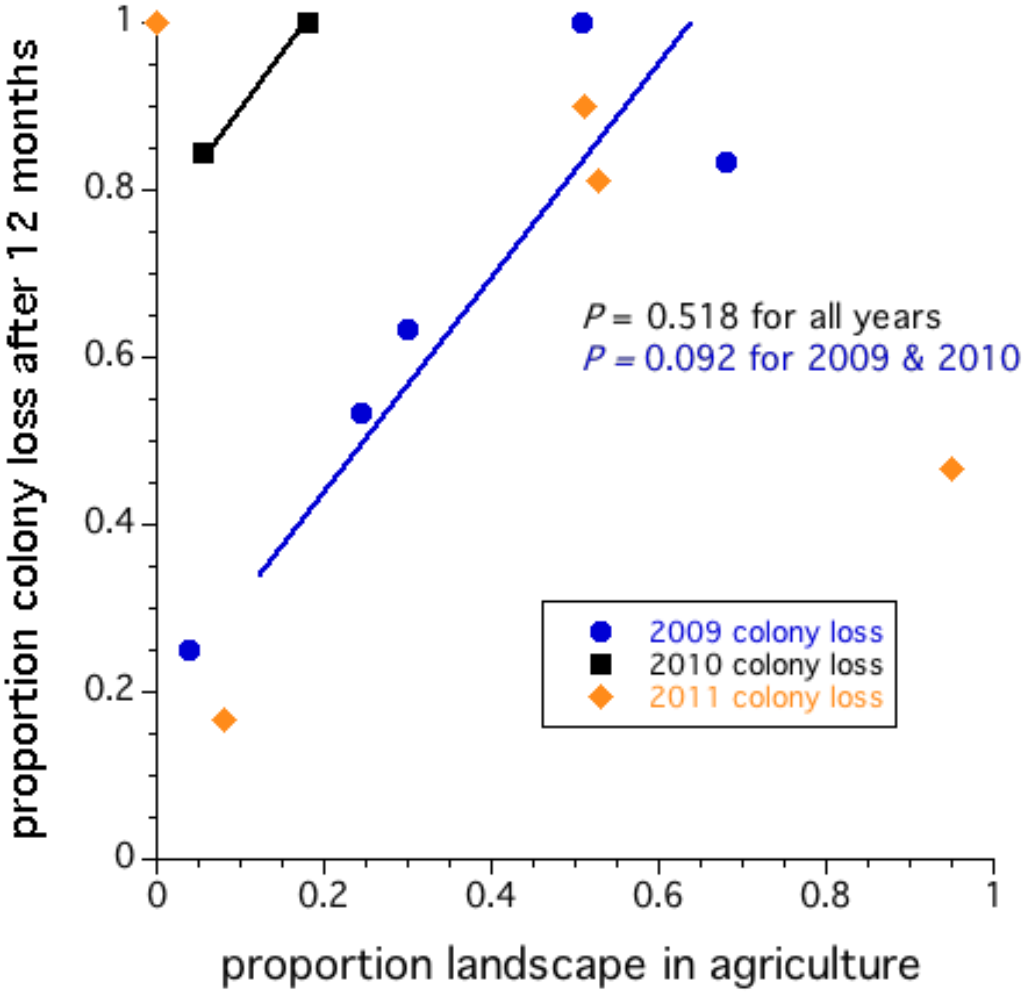
pesticide exposure

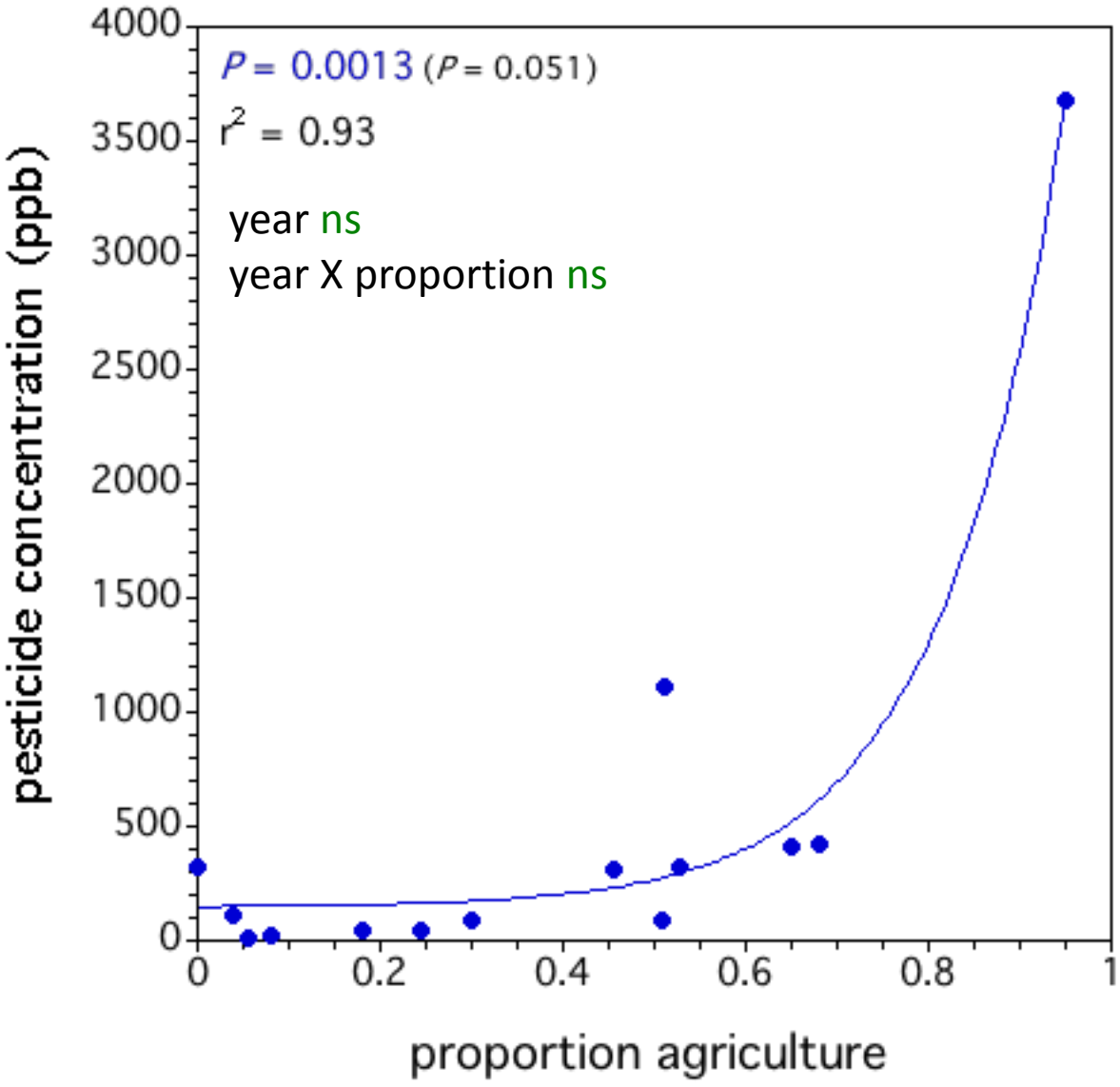


bumble bees and imidacloprid exposure



effect of intensive agriculture?




P = 0.0013 (P = 0.051)
r2 = 0.93
year ns
year X proportion ns
pesticide concentration (ppb)
4000
3500
3000
2500
2000
1500
1000
500
0
0
0.2
0.4
0.6
0.8
1
proportion agriculture

minimize exposure

Insecticide	Risk (LD_{50})	Persistence (high=10, low = 1 day)	Systemic
Imidan	**high**	**high**	no
Malathion	**high**	low	no
Bt	none	medium	no
Entrust or Success	medium	low	no
Delegate	**high**	**medium-high**	no
Assail	low	**high**	**high**
Imidacloprid	**high**	**high**	medium
Mustang Max	**high**	medium	no
Sevin	**high**	medium	no
Azadirachtin	low	low	no
B. bassiana	low	low	no
Asana XL	**high**	**high**	no
Intrepid	low	**high**	no
Pyganic	low	low	no
Exirel	**high**	**high**	no
Bifenthrin	**high**	medium	no