



Ecological Effects of Transgenic Crops: Non-target Effects in *Bt* Cotton

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Pest Complex - Western U.S. Cotton

Key Pests



*Pectinophora
gossypiella*



Bemisia tabaci



Lygus hesperus

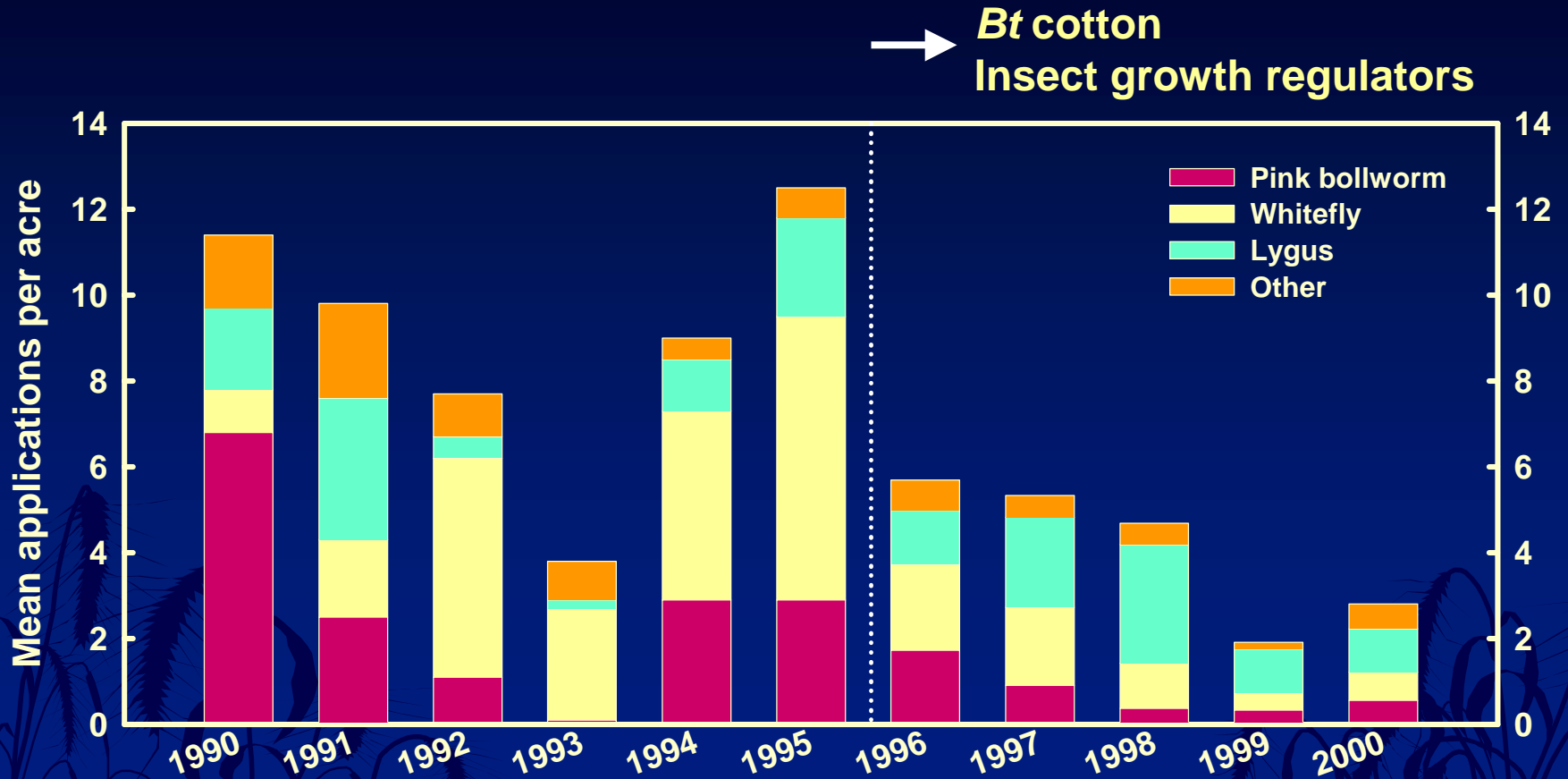
Sporadic and Minor Pests

Cotton bollworm
Tobacco budworm
Armyworms
Loopers
Cotton leafperforator
Saltmarsh caterpillar
Cutworms

Fleahoppers
Plant bugs
Stink bugs
Cotton aphid
Thrips
Spider mites

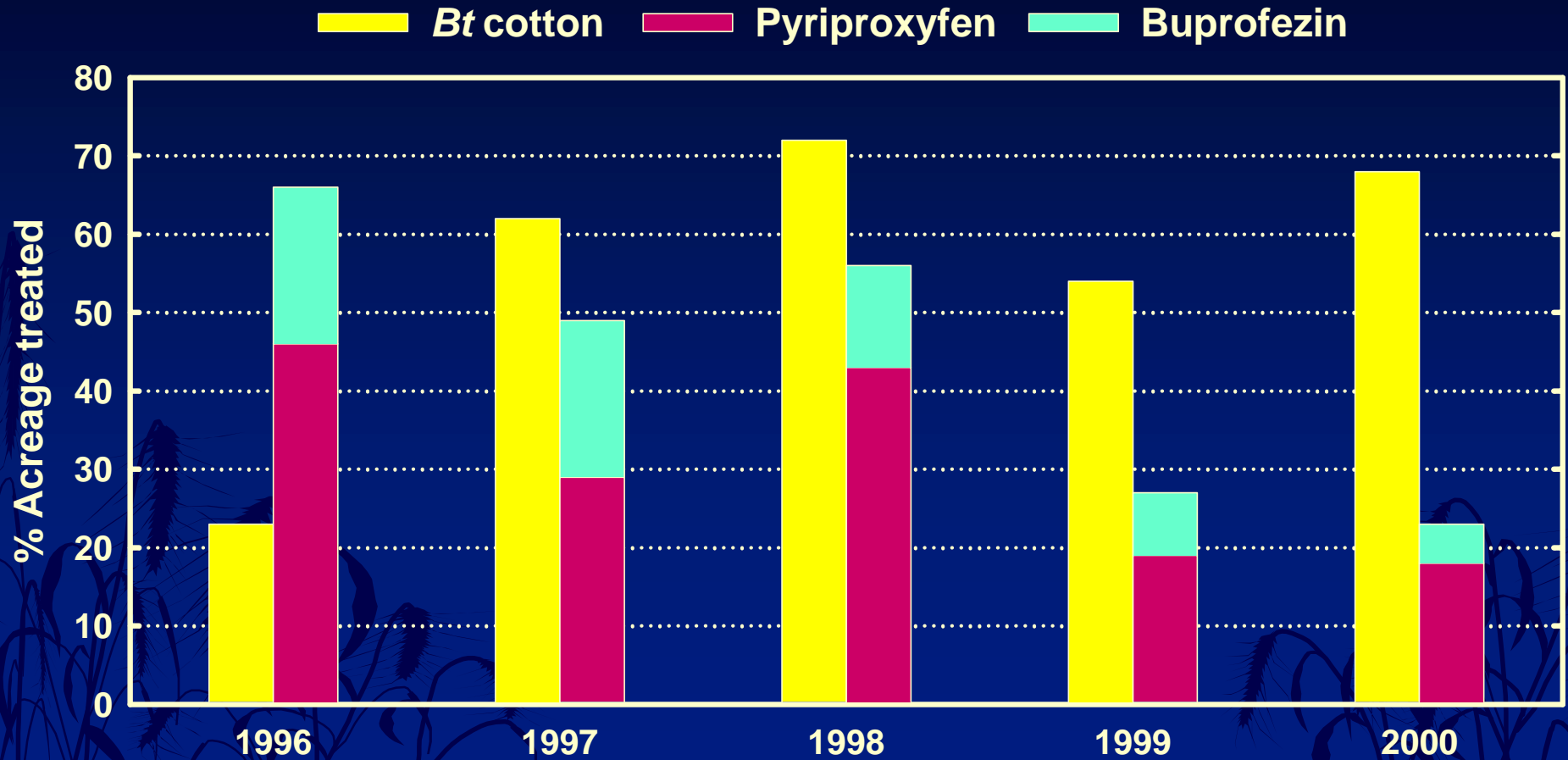
Insecticide Use Patterns

Arizona Cotton



Selective Insecticide Use

Arizona Cotton



Natural Enemy Complex - Western U.S.

Parasitoids

30+ species

Hyposter

Copidosoma

Microplitis

Lysiphlebus

Chelonus

Lespesia

Eretmocerus

Encarsia

Anaphes

Leiophron



Predators

50+ species

Geocoris

Orius

Nabis

Zelus

Collops

Hippodamia

Drapetis

Chrysoperla

Labidura

Misumenops



Natural Enemies – Pectinophora gossypiella



Predators

≈23 species described
9 species (immunological ID)

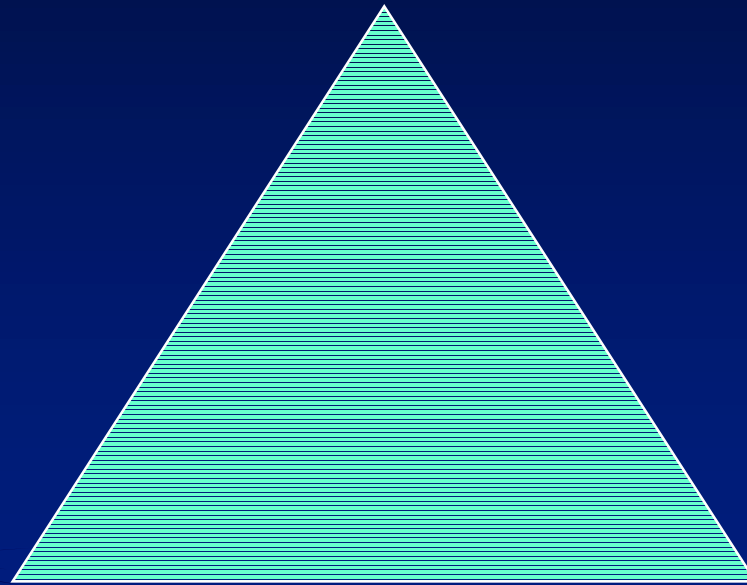


Parasitoids

4 native species described (rare)
16 exotic species introduced
(0 established)

Non-Target Effects ***(Arthropods)***

Function



Abundance

Diversity

General Methods

Non-target abundance/diversity

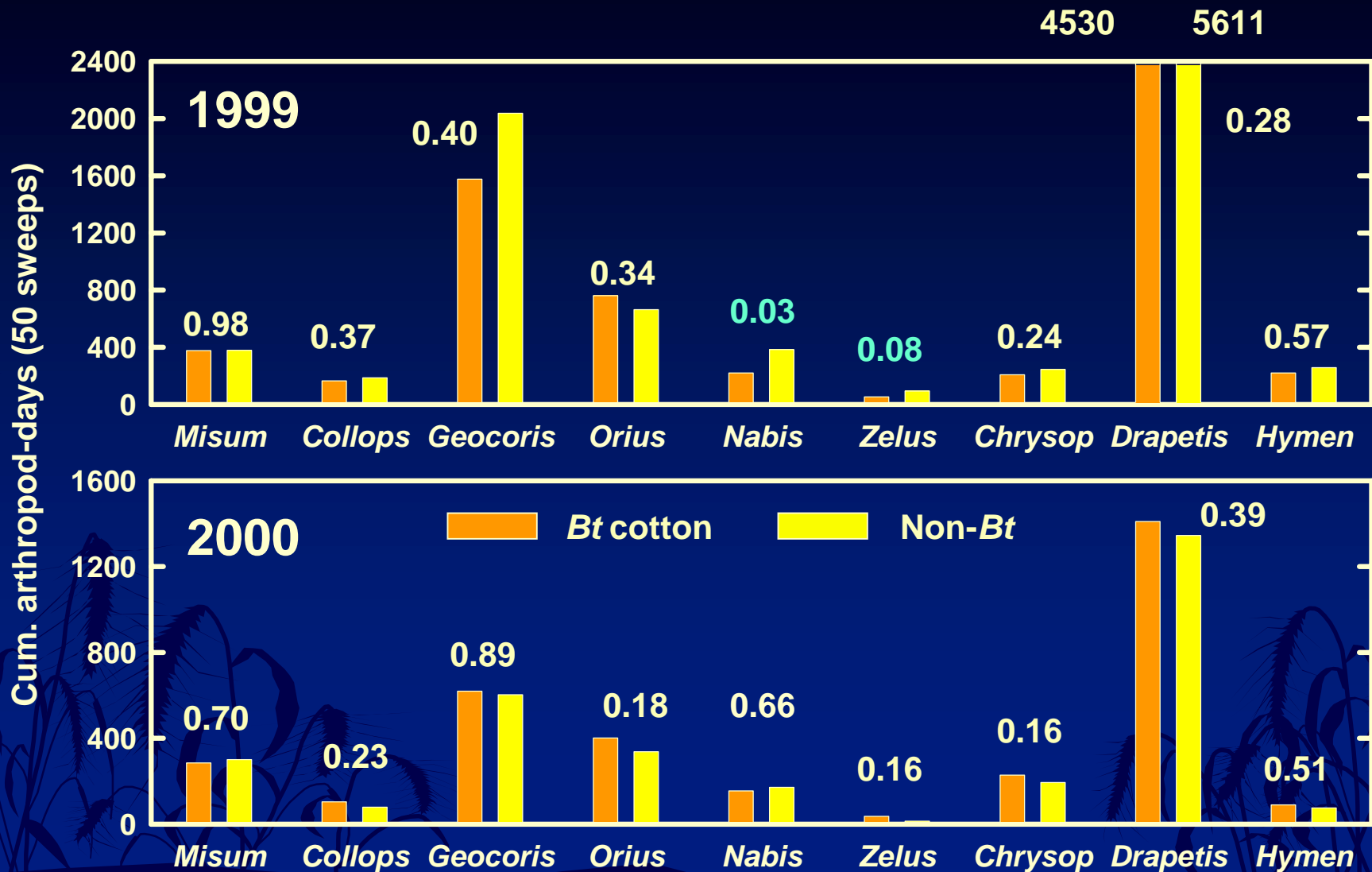
- Replicated experimental studies at MAC
- Treatments:
 - ◆ Bt cotton / conventional cotton
 - ◆ Unsprayed for any pest
 - ◆ Insecticides for all pests as needed
- Sampling by **sweep nets**, beat buckets, whole plants, **pitfall traps**
- ANOVA, EstimatorS V. 5 (Colwell) for diversity analyses

Natural Enemy Abundance



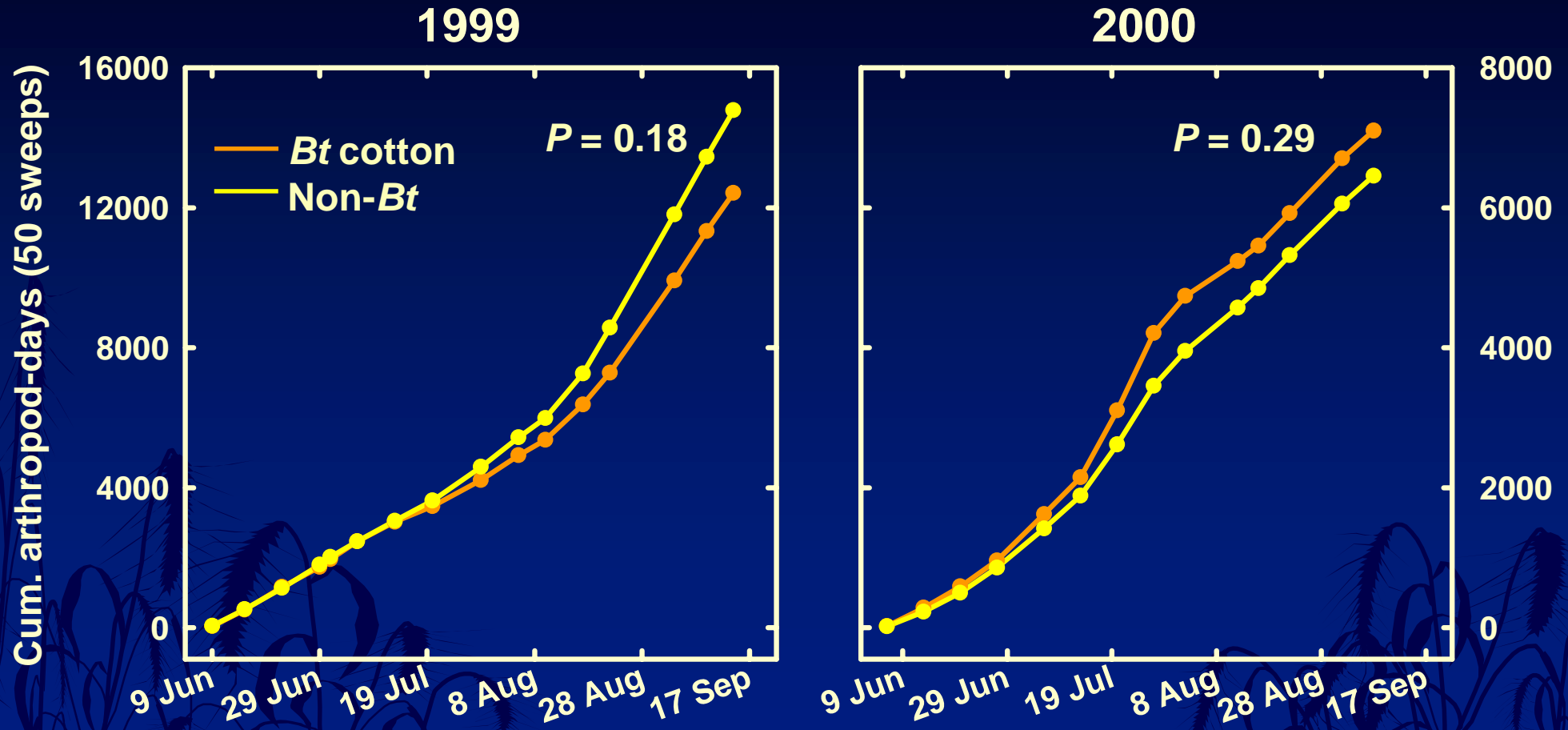
Natural Enemy Abundance

No Insecticides



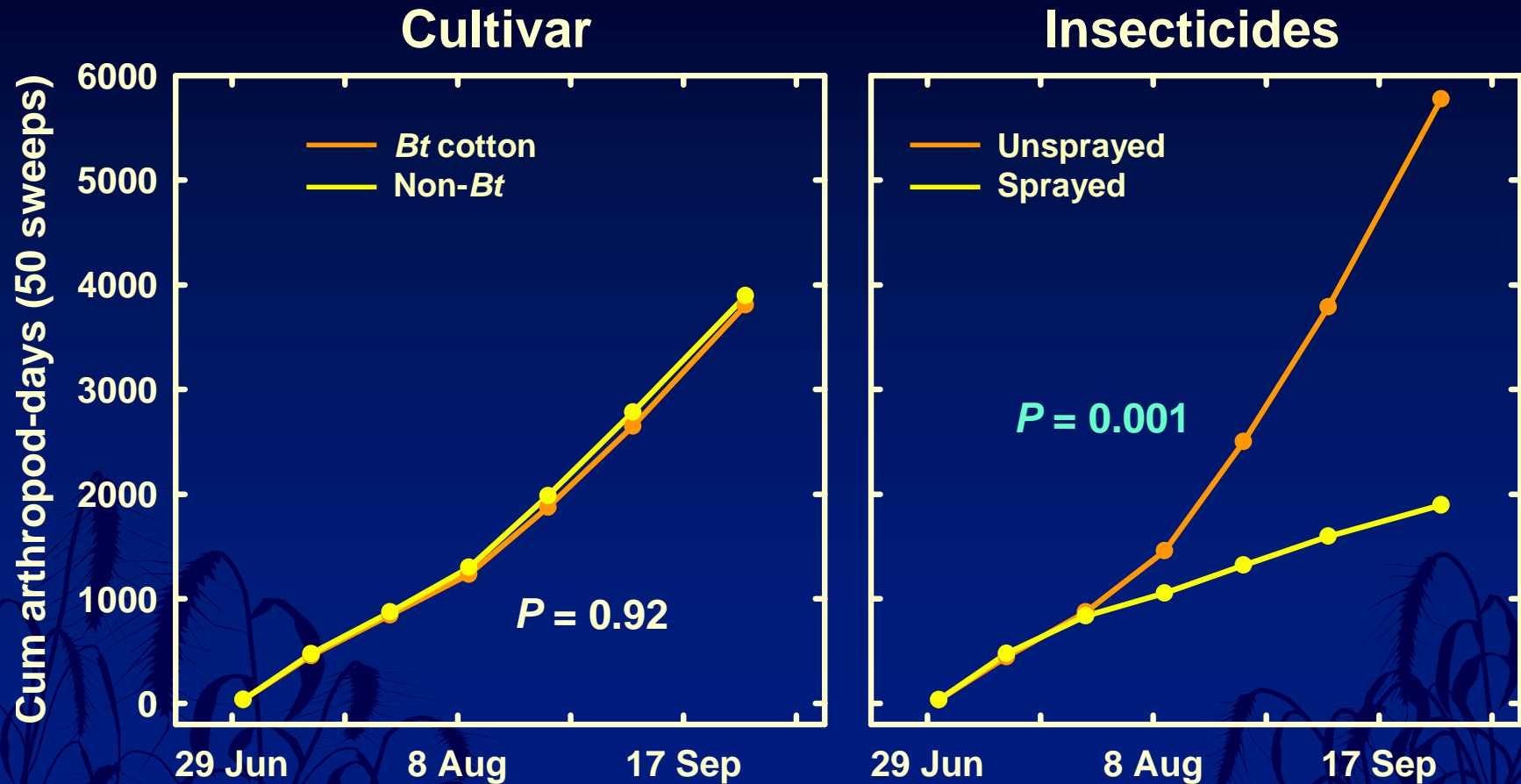
Natural Enemy Abundance

No Insecticides



Natural Enemy Abundance

Insecticides as Needed (e.g. 1999)



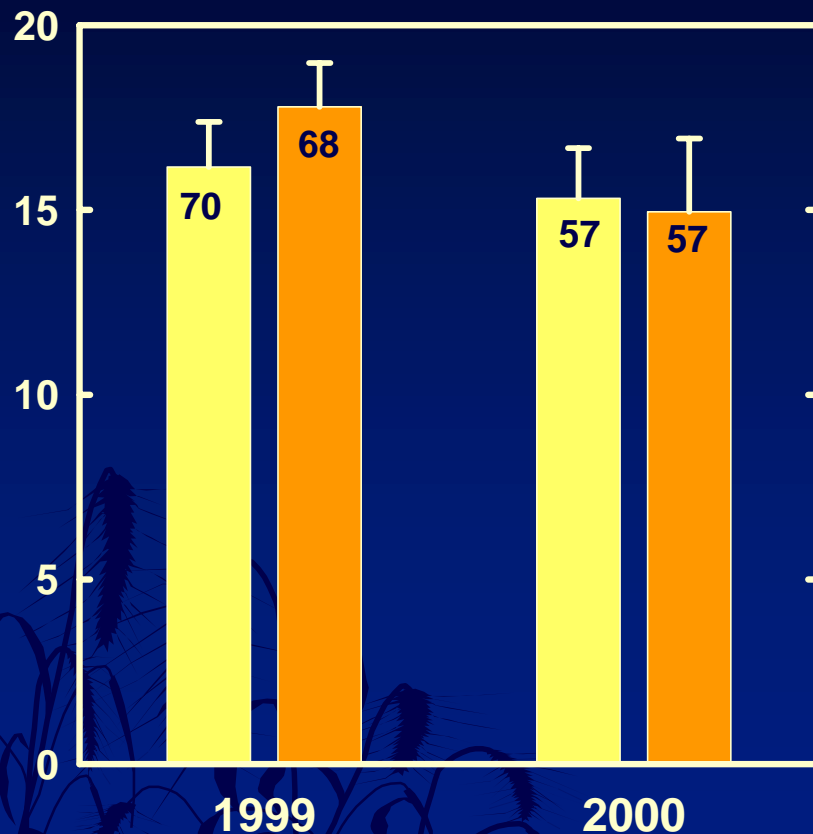
Arthropod Community Structure



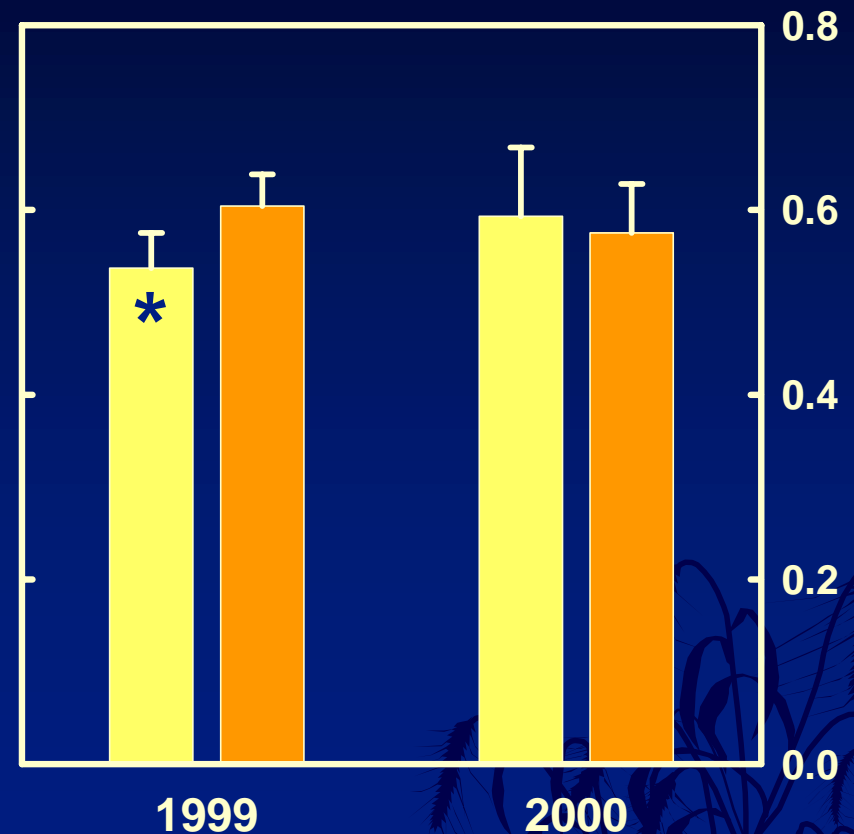
Community Structure – Pitfall Traps

(*Bt* vs. *Non-Bt*)

Diversity
(Fisher's alpha)



Evenness
(Shannon)

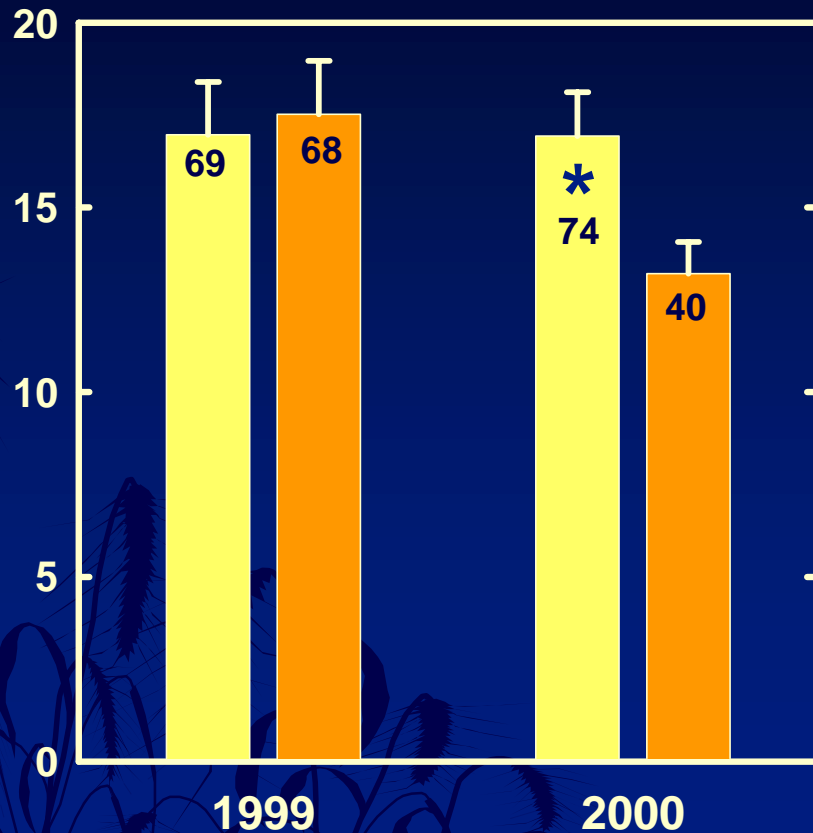


■ Non-Bt ■ Bt cotton

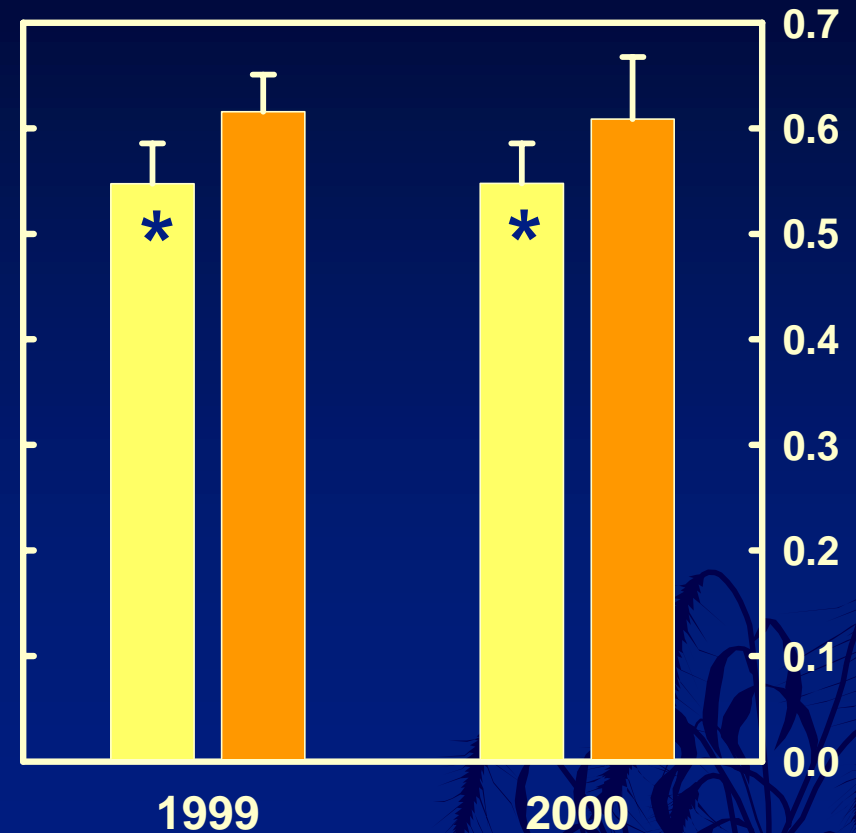
Community Structure – Pitfall Traps

(Sprayed vs. Unsprayed)

Diversity
(Fisher's alpha)



Evenness
(Shannon)



Unspray Spray

Natural Enemy Function



Methods

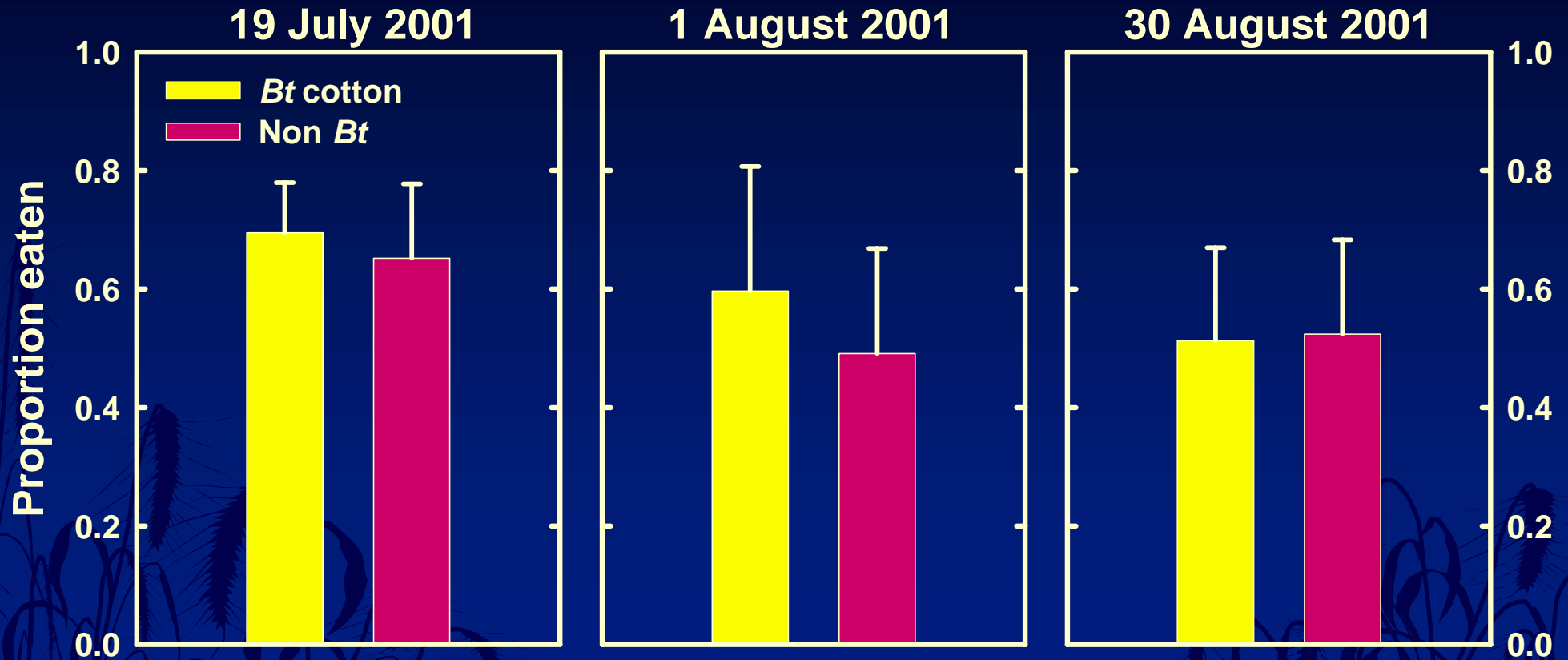
Natural Enemy Function

- Replicated experimental studies at MAC
- No insecticides
- Estimate rates of predation and parasitism
- Sentinel pink bollworm egg masses (20 per plot)
- Life tables for whitefly nymphs (50 per plot)



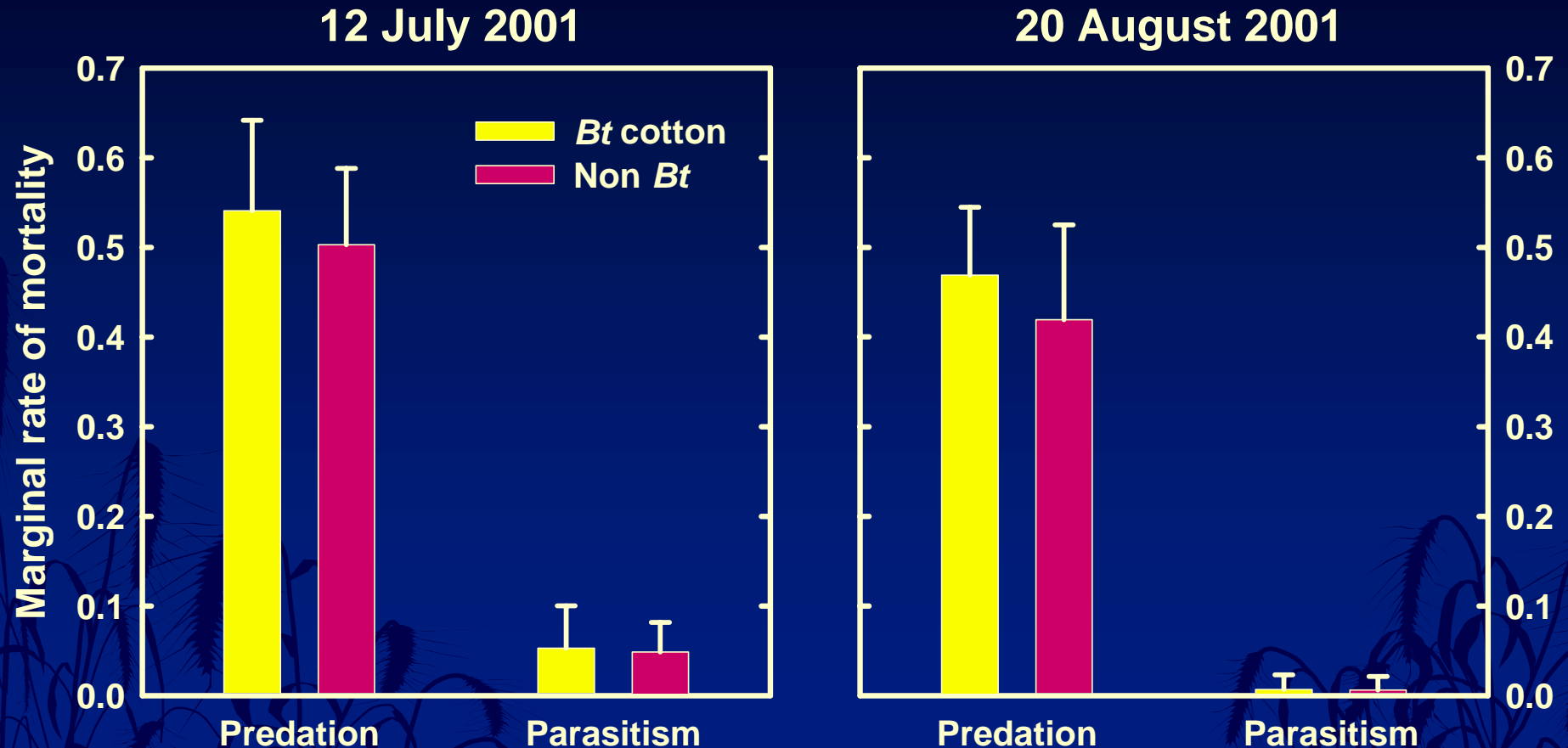
Natural Enemy Function

Predation on Pink Bollworm Eggs



Natural Enemy Function

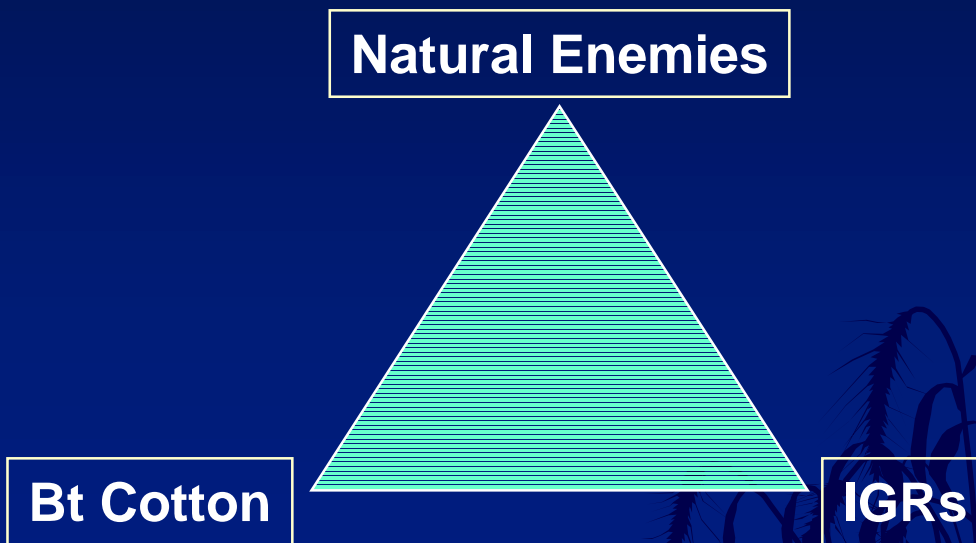
Mortality of Whitefly Nymphs



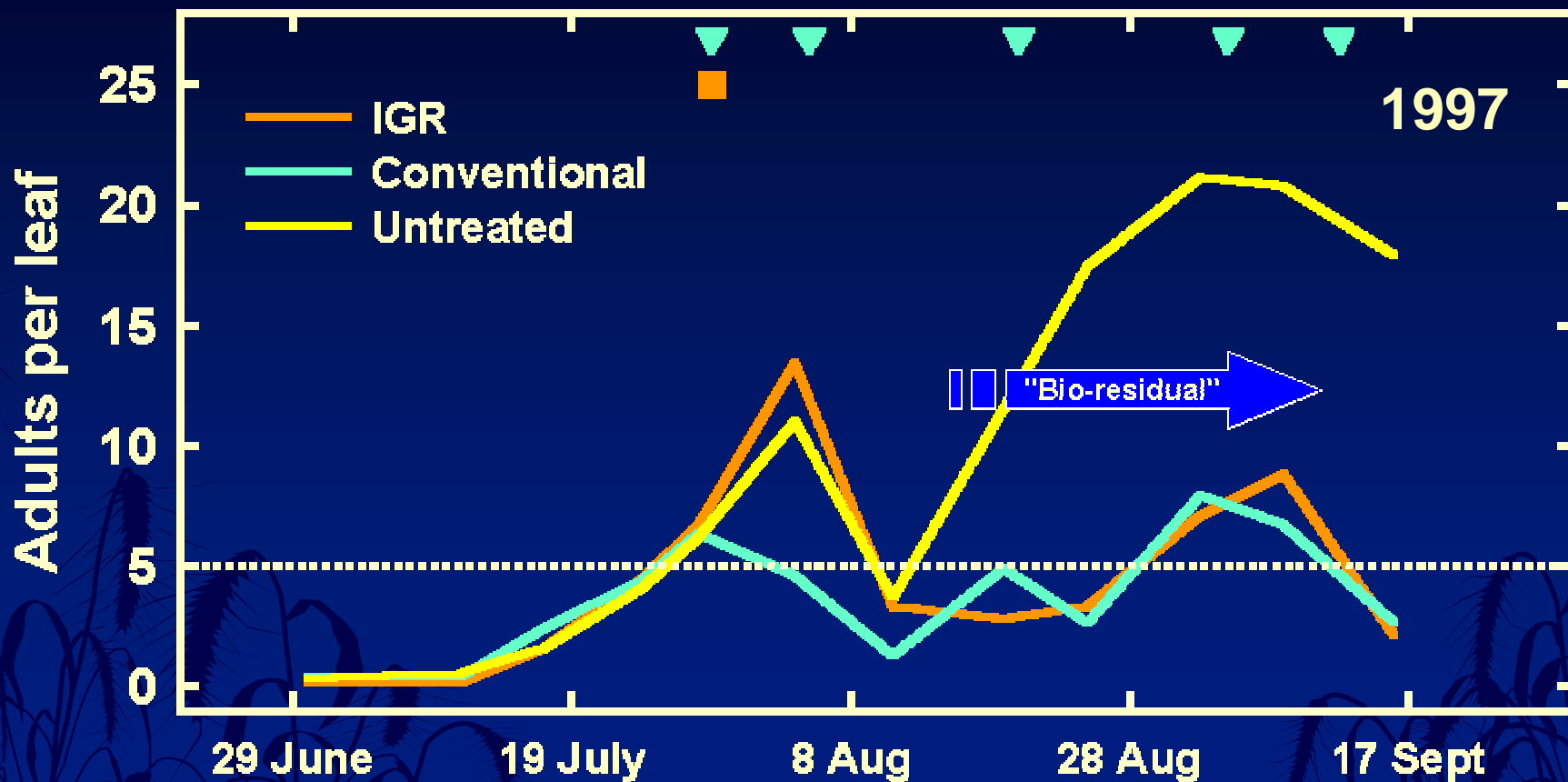
Conservation Biological Control

An Example

Whitefly IPM in Cotton



Impact of Conservation



Thanks to

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Melanie Charney

Scott Davis

Ghislaine Majeau

Ruben Marchosky

Greg Owens

Jeffrey Rivas

Doug Sieglaff

