Light Brown Apple Moth: Enhancing Natural Biological Control

Nick Mills - UC Berkeley

LBAM: Background and Seasonal Cycle

Background:

1 of 40+ species of *Epiphyas* in Australia, specialists on Asteraceae, Fabaceae

1 of 3 more generalist species of *Epiphyas*

Invasive in western Australia, New Zealand, New Caledonia, Hawaii and the British Isles

Common cassinia, *Cassinia* sp.

E. xylodes

LBAM: Management Options in California

- Eradication
  - Is its feasible?
  - Are there tools available?
  - 33 months since first detection
  - No diapause → flights not discrete

- Likelihood of establishment and spread
  - High due to v. broad host plant range

- Long-term management options
  - Standard IPM programs for crops
  - Biological control for non-crop habitat

LBAM: Arthropod Predators in Australia

Spiders: *Achaearanea veruculata* (Theridiidae)

Diaea spp. (Thomisidae)

Earwigs: *Forficula auricularia*

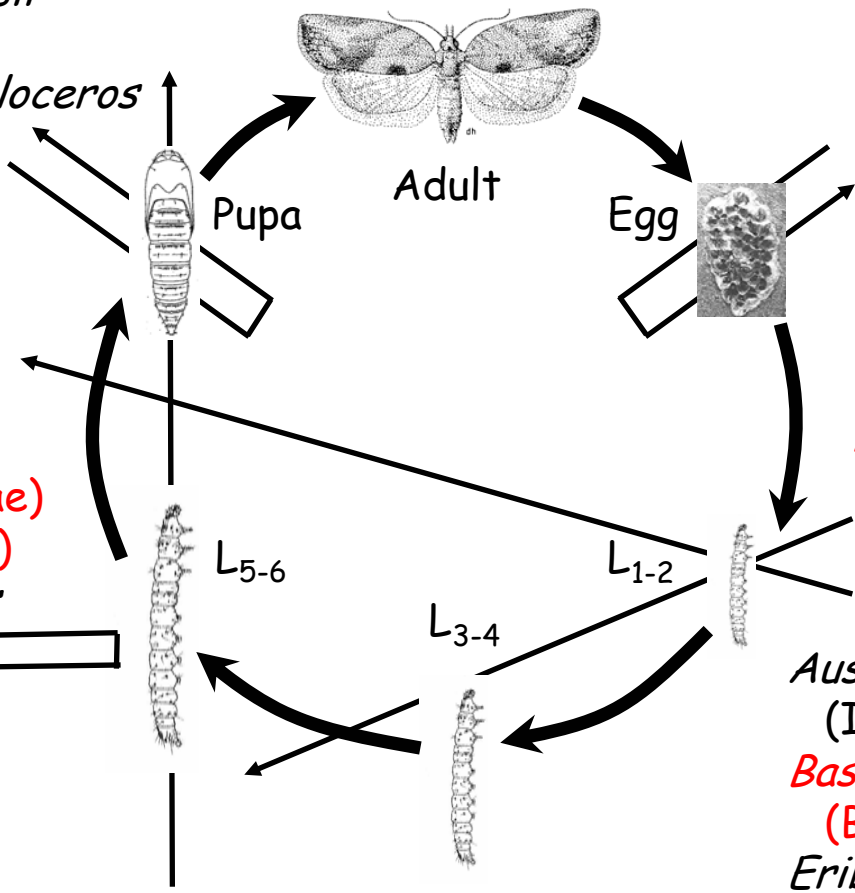
Lacewings: *Chrysopa* sp. (Chrysopidae)

True bugs: *Melanotrichus australianus* (Miridae)

LBAM: Insect Parasitoids in Australia

Brachymeria teuta
Brachymeria phya
(Chalcididae)
Glabridorsum stokesii
(Ichneumonidae)
Xanthopimpla rhopaloceros
(Ichneumonidae)

Dominant species
Other species



Trichogramma carverae
T. funiculatum
(Trichogrammatidae)

Bracon sp. (Braconidae)
Eupsenella sp. (Bethylidae)
Goniozus jacintae (Beth.)
Oedemopsis hobartensis
(Ichneumonidae)
Phytodietus celsissimus
(Ichneumonidae)

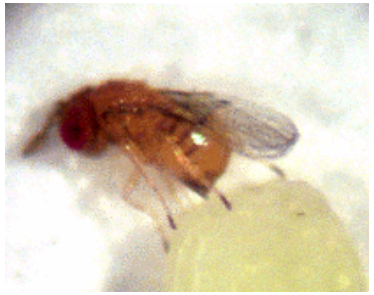
Dolichogenidea tasmanica
(Braconidae)

Australoglypta latrobei
(Ichneumonidae)
Bassus unimaculata
(Braconidae)
Eriborus epiphyas
(Ichneumonidae)
Temelucha minuta
(Ichneumonidae)

Exochus sp. (Ichneumonidae)
Trigonospila brevifacies (Tachinidae)
Voriella uniseta (Tachinidae)

LBAM: Insect Parasitoids in Australia

Egg Parasitoid



Trichogramma carverae

Larval Parasitoids

Dolichogenidea tasmanica

Goniozus jacintae

Larval-Pupal and Pupal Parasitoids

Voriella uniseta

Brachymeria teuta

Enhancing Natural Biological Control of LBAM in California

- Monitoring LBAM in California to assess the seasonality, abundance and impact of indigenous parasitoids

- Importation and screening of specialized parasitoids from Australia for potential introduction to CA

Monitoring: LBAM Populations and Indigenous Parasitoids

- Two sites in each of San Francisco and Santa Cruz

  - sampled every 2 weeks since May 2008

  - abundance, stage structure and parasitism

Monitoring: Seasonal Stage Structure of LBAM

- All larval stages present throughout the season

- Pupae less frequently found than larvae, peaks in June and September, also Feb

- Adult flights continuous with peaks in June, October/ November and March/April

Monitoring: LBAM Populations and Indigenous Parasitoids

- Notable indigenous parasitoids include:

Trichogramma platneri and *T. fasciatum* – egg parasitoids

Meteorus trachynotus – larval parasitoid

Enytus eureka – larval parasitoid

Importation Biological Control: Previous Experience New Zealand (1922,1967-69)

Stage of light brown apple moth affected	Parasitoid family	Parasitoid species imported and released
LARVA	Hymenoptera: Ichneumonidae	*Australoglypta latrobei* *Diadegma* sp.
	Hymenoptera: Braconidae	*Dolichogenidea tasmanica*
	Hymenoptera: Bethylidae	*Goniozus jacintae*
LARVA/PUPA	Diptera: Tachinidae	*Trigonospila brevifacies* *Voriella uniseta*
PUPA	Hymenoptera: Chalcididae	*Brachymeria phya* *Brachymeria teuta*
	Hymenoptera: Ichneumonidae	*Glabridorsum stokesii* *Xanthopimpla rhopaloceros*

Established from introductions
Failed to establish

Importation Biological Control: Previous Outcome in New Zealand

Dolichogenidea tasmanica, contributes 10-51% parasitism

Goniozus jacintae, extent of parasitism believed to contribute to control

Xanthopimpla rhopaloceros, Glabridorsum stokesii, Trigonospila brevifacies are believed to contribute to control, but have non-target impacts on other indigenous tortricids and Microlepidoptera

Importation: Host Specificity Tests

Procedures currently in use for *D. tasmanica* and *G. jacintae*

- Hosts to be tested
  - tortricids from CA crops
  - non-crop leafrollers in CA

- Physiological host range
  - no-choice oviposition tests
  - developmental success tests

- Behavioral compatibility
  - olfactometer tests for attraction to volatile cues from host and host plant

Conclusions

- LBAM flights peak in Mar, Jun and Oct, but all stages present through season with poorly defined generations
- Impact of indigenous parasitoids is much greater than expected for an invader, due to broad age structure
- Standard IPM programs likely to be effective for crops
- Importation of exotic specialist parasitoids has good potential for long term management in non-crop habitats