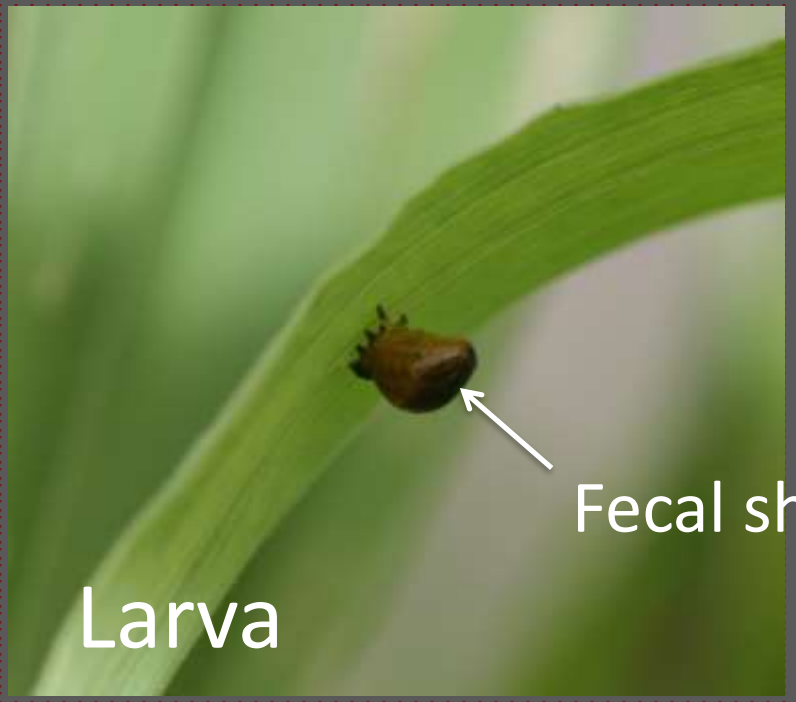
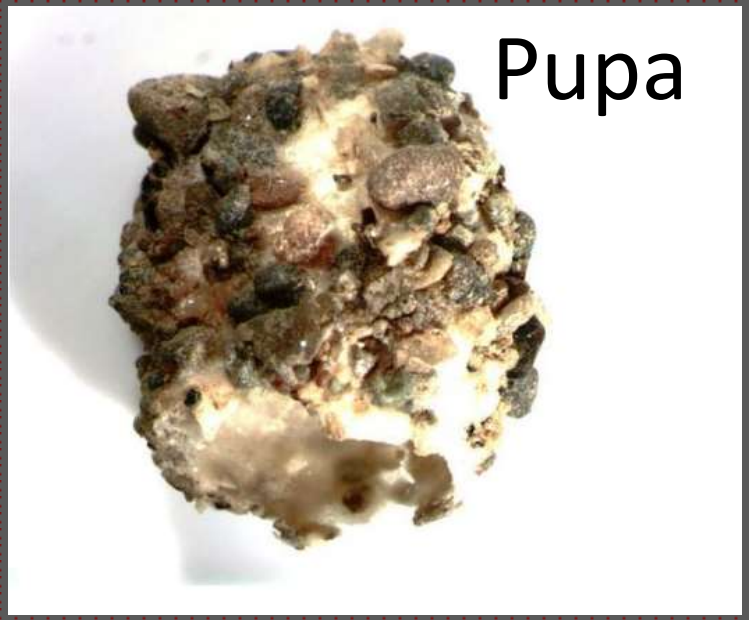
Sebastian Mortimer

REACCH 2013

Cereal Leaf Beetle

- A pest of Wheat, Barley, Corn, Rye; also feeds on numerous wild grasses
- Univoltine (One generation per)
- Life Cycle
  - Eggs – Larvae –Pupa – Adults
  - Adults overwinter in protective foliage, perennial grassy stands, tree bark, and hay bales





Pictures: Nate Foote

US CLB History

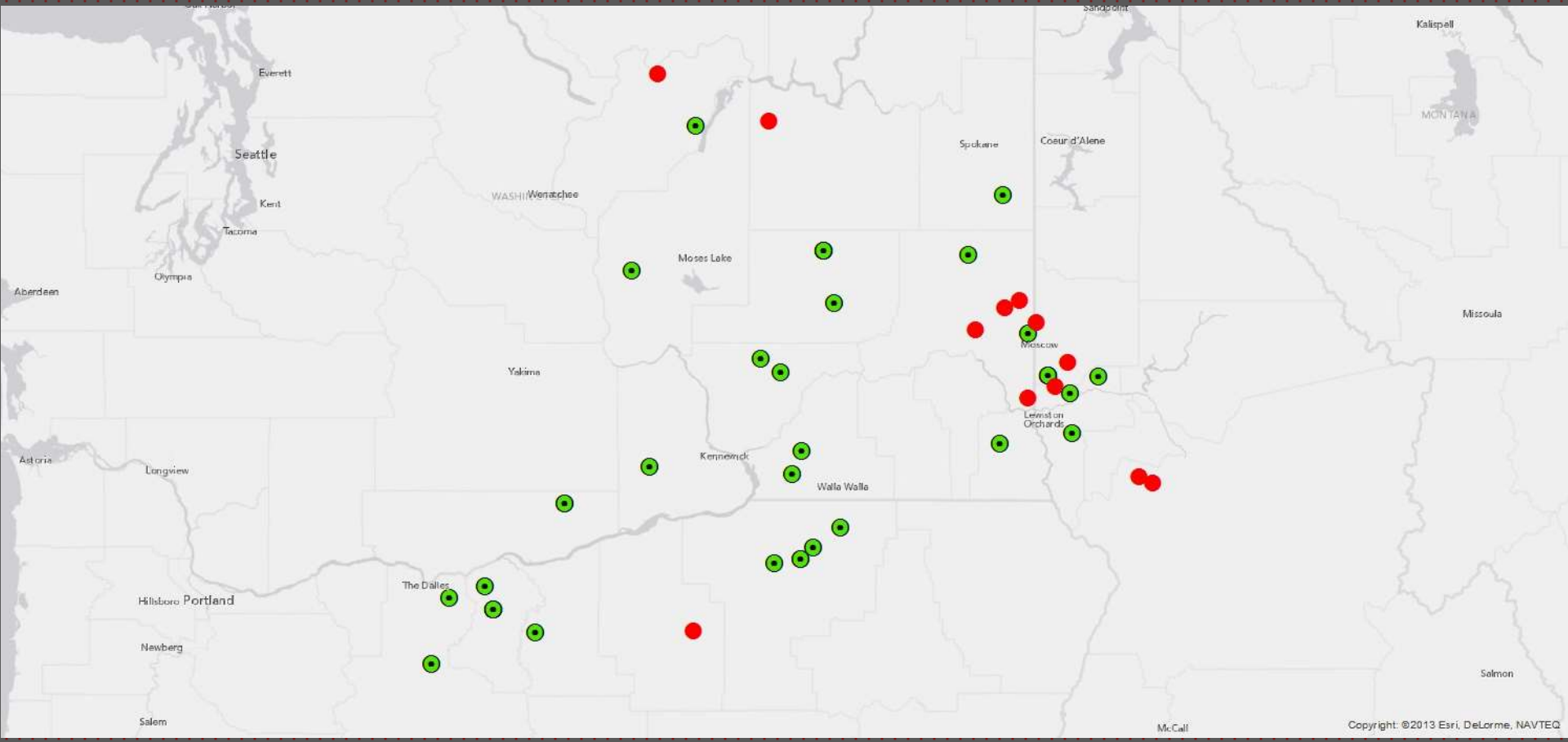
- First detection 1962 - Michigan
- Attempts of control: Pesticides & quarantine
- Utah, Montana, Idaho, and Washington by 2003
- Biological control success story

CLB in the PNW

CLB Feeding 2013

Green = Positive (27/39)

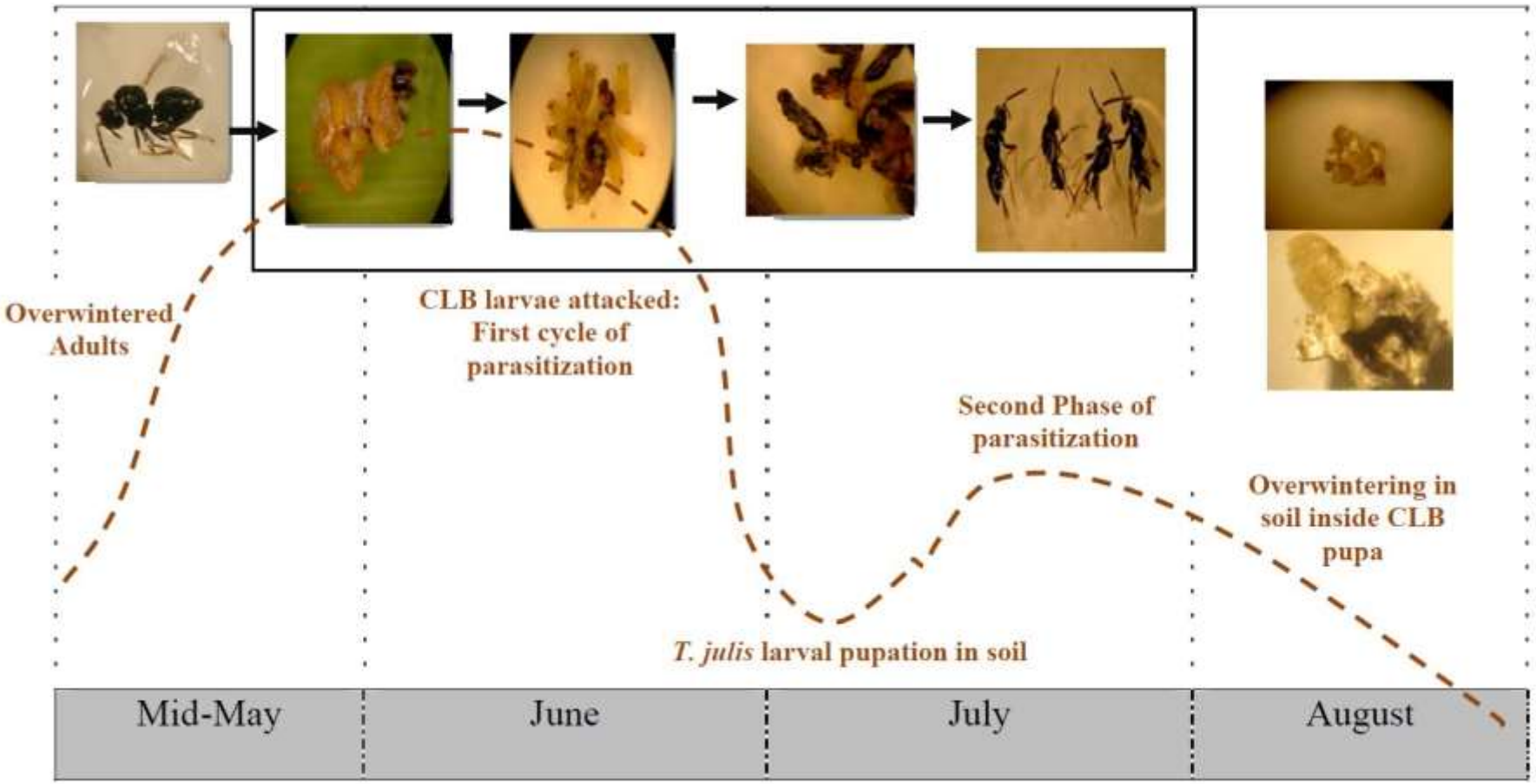
Red = Negative (12/39)



Key Biological Control Agent: Tetrastichus julis

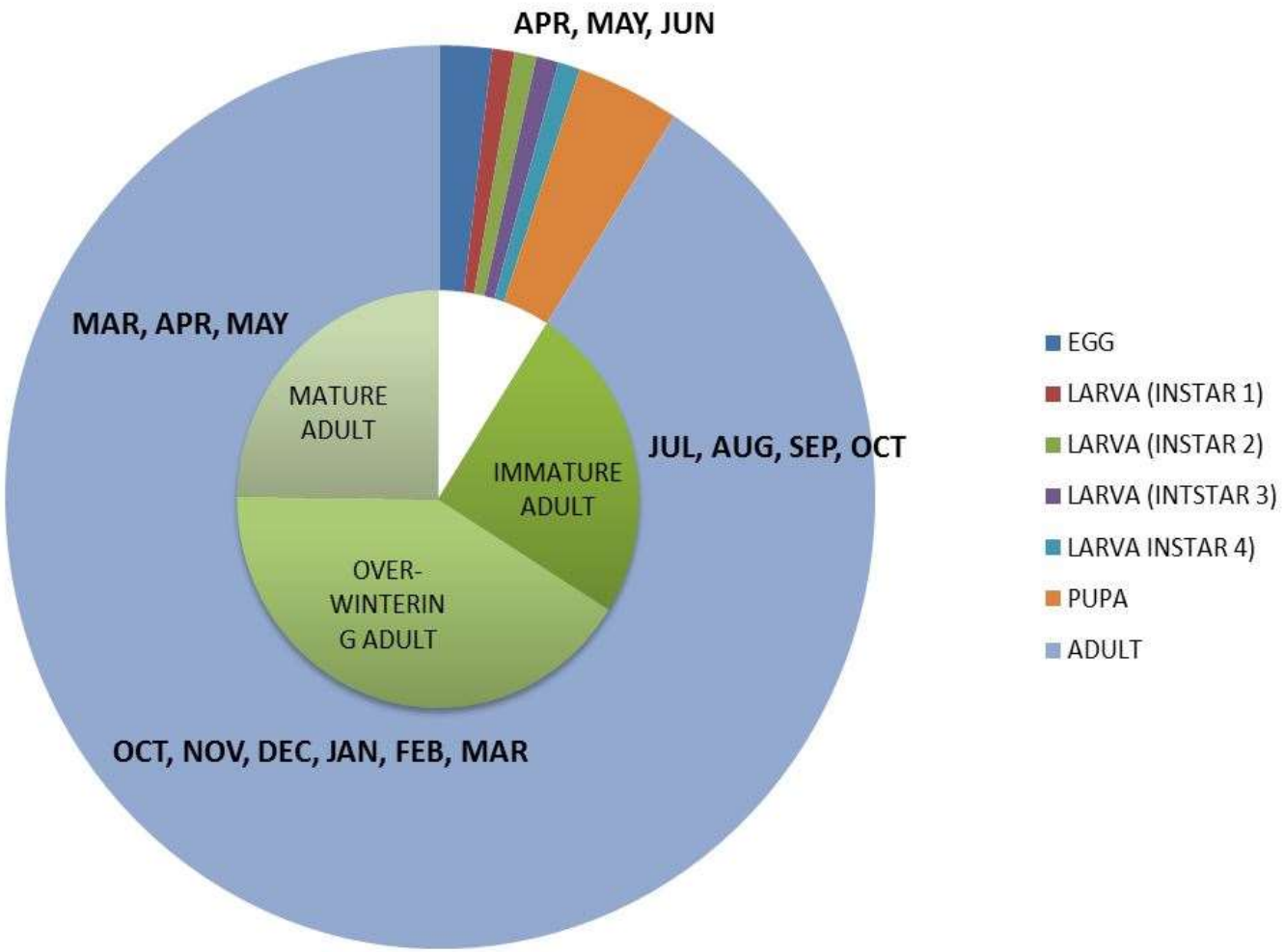
- Specialist parasitoid wasp
- Emerges from CLB pupal cases
- (Bivoltine) two generations per year

Fig. 3. Phenology of *T. julis* in southern Alberta and Saskatchewan

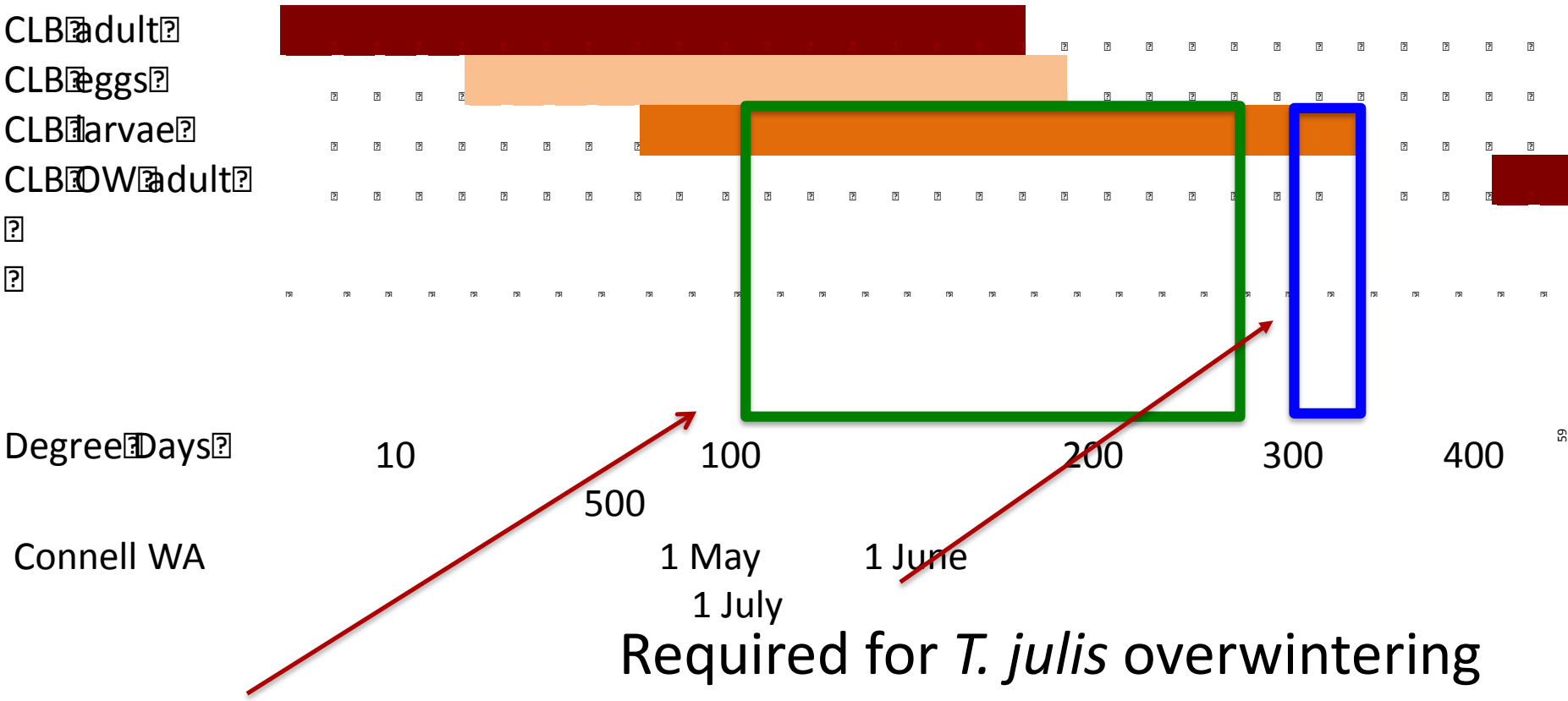


SOURCE?

CLB and Phenology



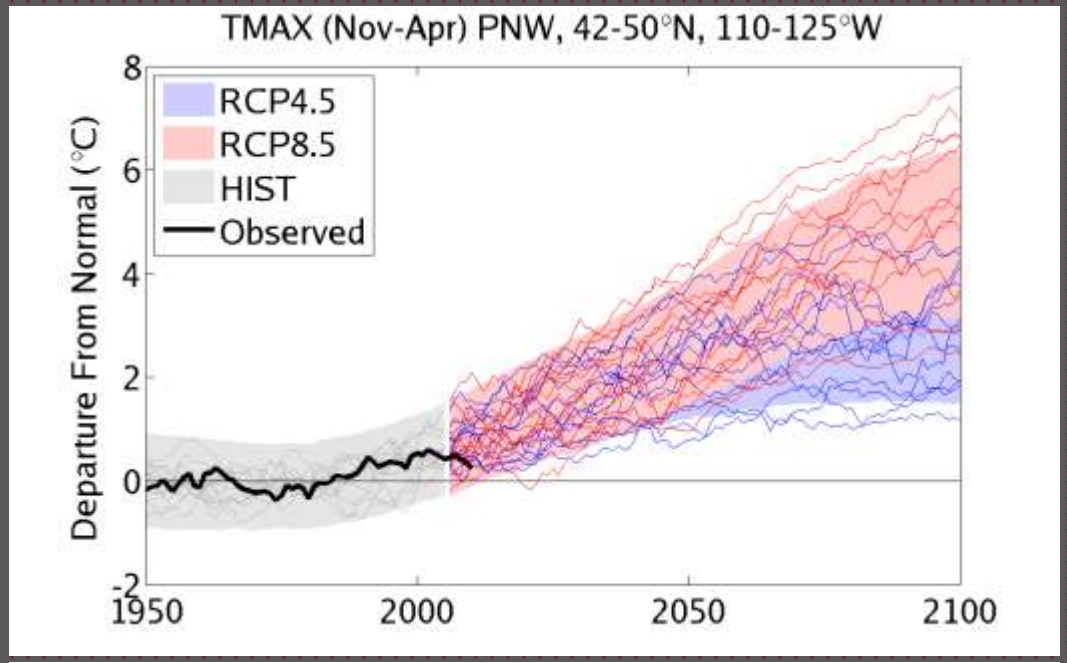
Overlapping phenology of CLB and *T. julis*



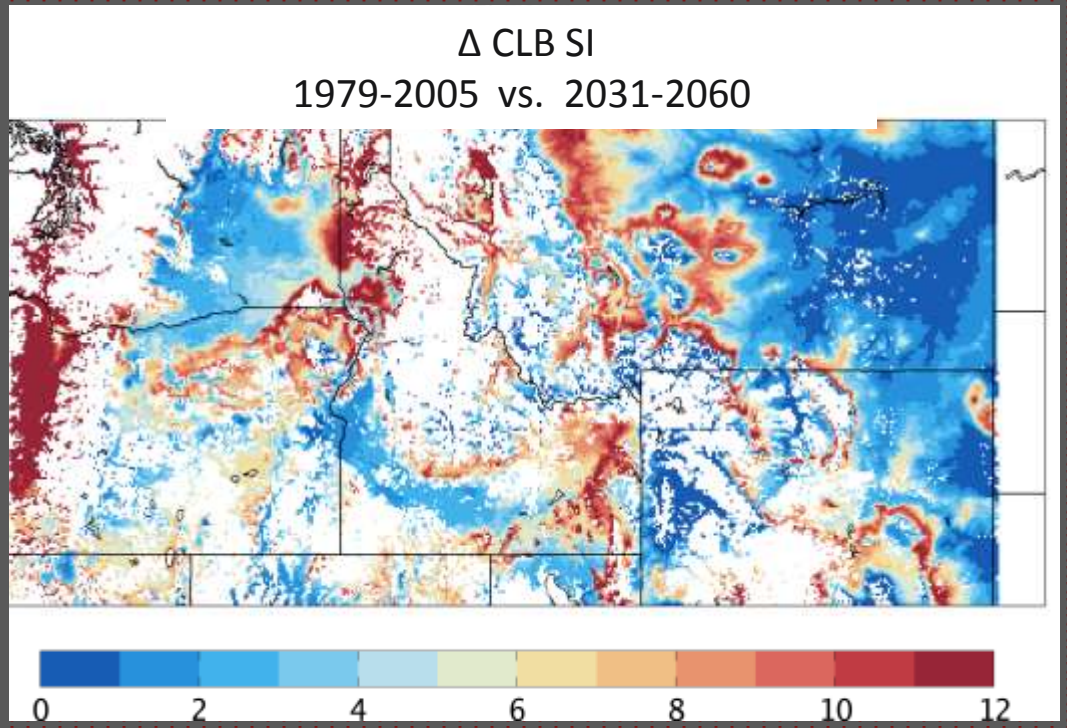
Required for *T. julis* overwintering

Days of overlap ≈ Relative potential biocontrol impact

WHAT ARE THE POTENTIAL EFFECTS OF PROJECTED CLIMATE CHANGE ON CLB BIOLOGY AND BIOLOGICAL CONTROL?



- Projections show increased temperatures



- Increased CLB suitability in the next 50 years

John Abatzoglou, UI

What does this mean for Bio-control?

Complex system – Each interaction affected by climate

- Cereal Crops
- Cereal Leaf Beetle
- T. julis

HYPOTHESES

Direct

1. Increased temperatures negatively effect the survivorship of CLB adults

Fecal Shield

1. Removal of the CLB fecal shield negatively effects the survivorship of larvae before reaching pupation
2. The volume, generation and regeneration of the fecal shield differs for CLB larvae fed on host plants under water-stressed and unstressed conditions
3. The composition of the fecal shield differs for CLB larvae fed on unstressed and water-stressed host plants

Predation and Bio-control

1. The CLB fecal shield provides protection against attack by generalist predators
2. The CLB fecal shield is a means of host localization by *T. julis.*
3. Natural enemies of CLB react differently to isolated fecal shield from CLB fed on unstressed and water-stressed host plants.

Expected Results

- Increased daytime temperatures would increase mortality
- Differences in shield mass and composition
- Slower regeneration time on drought stressed plants
- Organic compounds picked up by SPME

Method development

- Establish working colony of CLB and parasitoid
- Develop methods for handling and measuring fecal shields
- Controlled temperature regime treatments

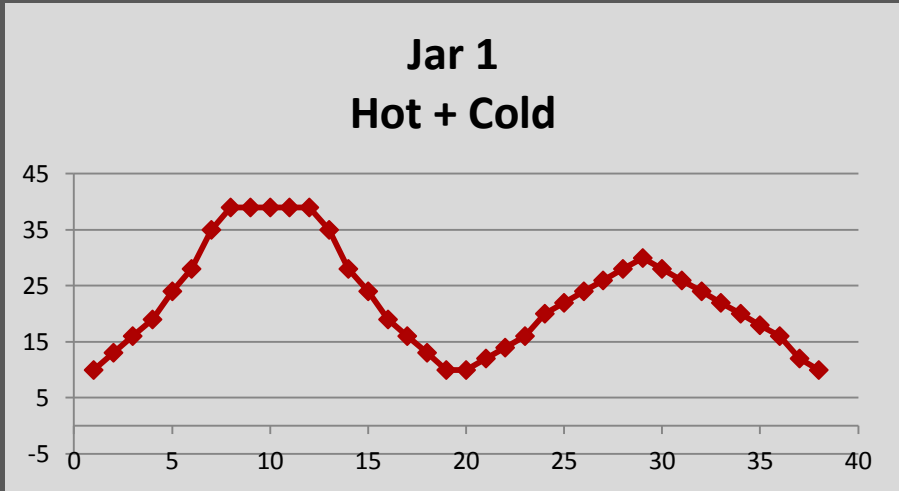
Hypothesis 1 - Heat Stress – Direct

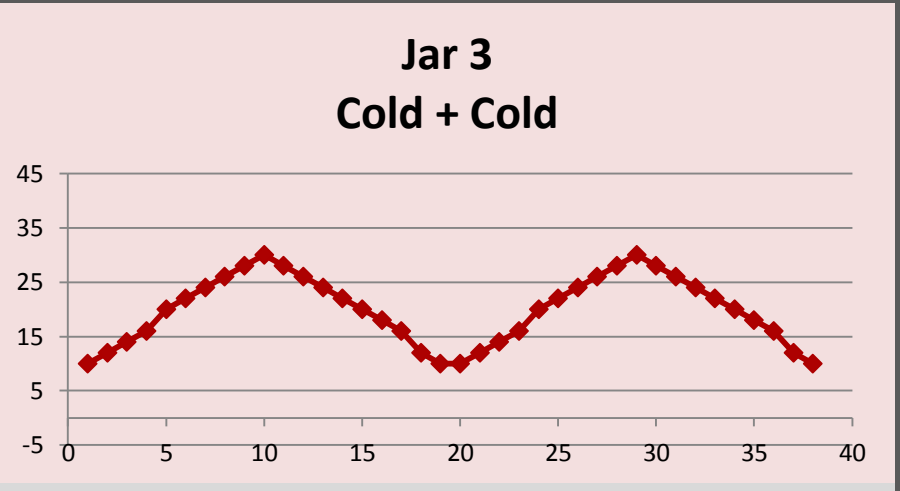
- Newly emerged Adults in July and August
  - Subject to warmest temperatures of the year
- Effects of extreme heat on Adults going into diapause

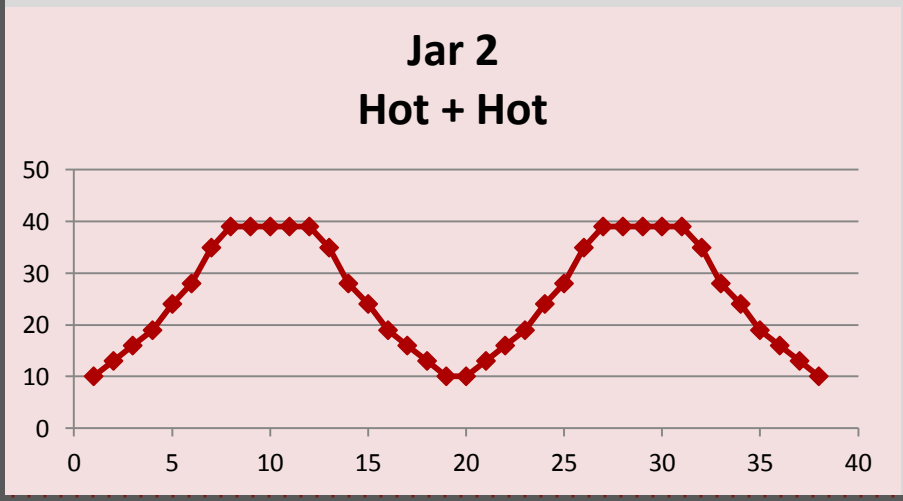
Hypothesis 1 - Heat Stress – Pilot Test Methods

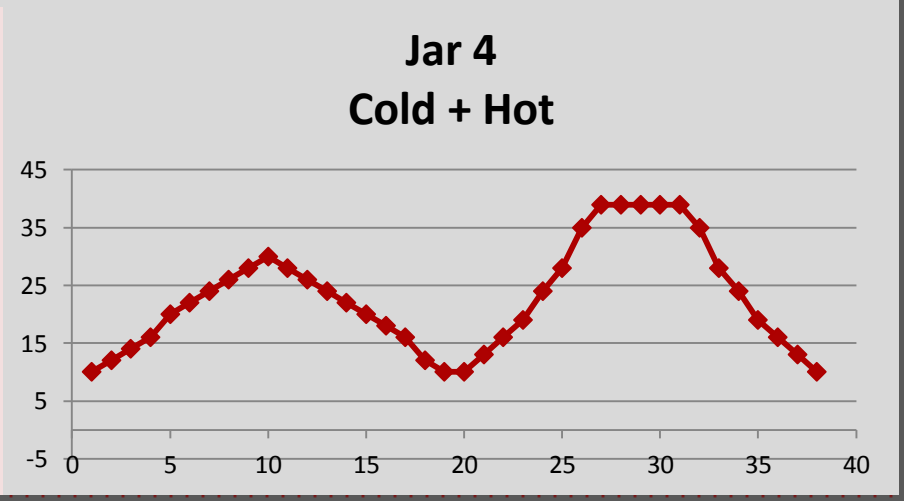
Subject CLB adults to four temperature regimes

Assess survival

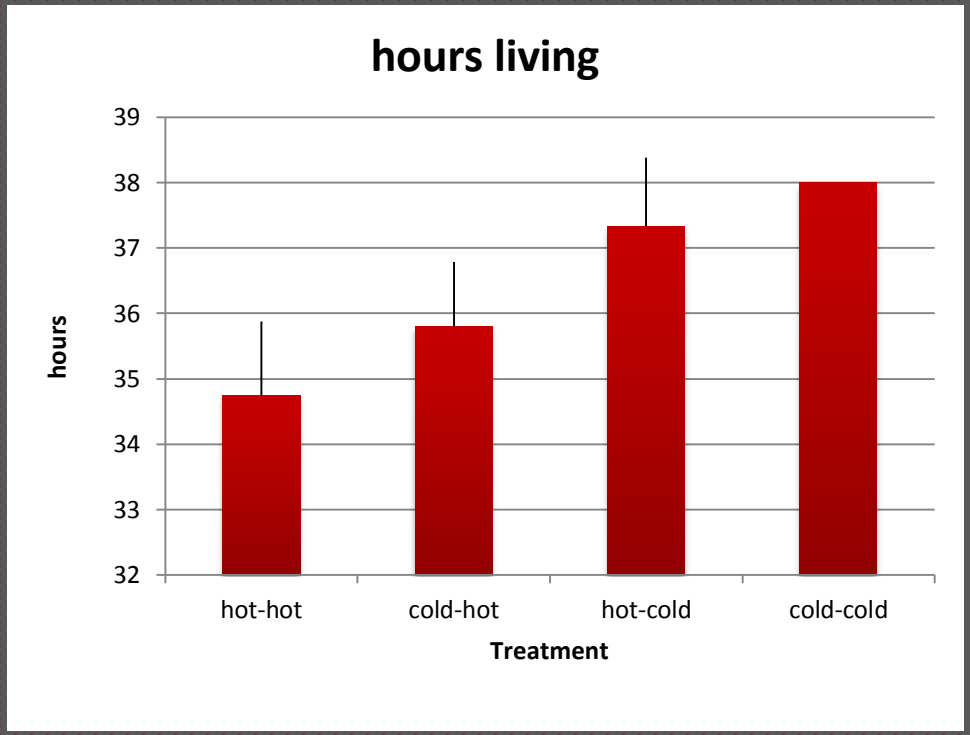








Hypothesis 1 - Heat Stress – Pilot Test Results



Survivorship

Hot-Hot: 14/20

Cold-Hot: 15/19

Hot-Cold: 17/18

Cold-Cold: 17/17

Hypothesis 2. Fecal Shield Removal

What exactly is it?

- Chrysomelidae

Chrysomelidae Fecal Shield

- Physical or chemical defense?
- Insulator for temperature and humidity?
- Localization for specialist parasitoid *T. julis?*

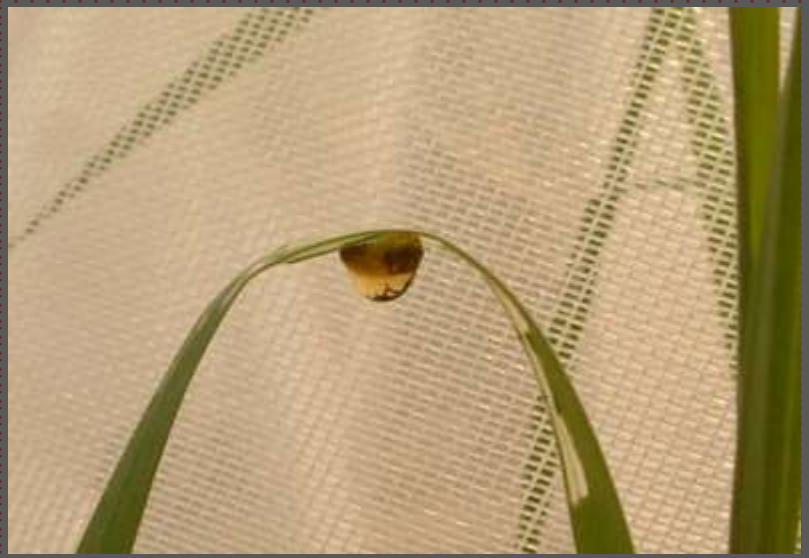
Foote 2013

Hypothesis 2. Fecal Shield Removal

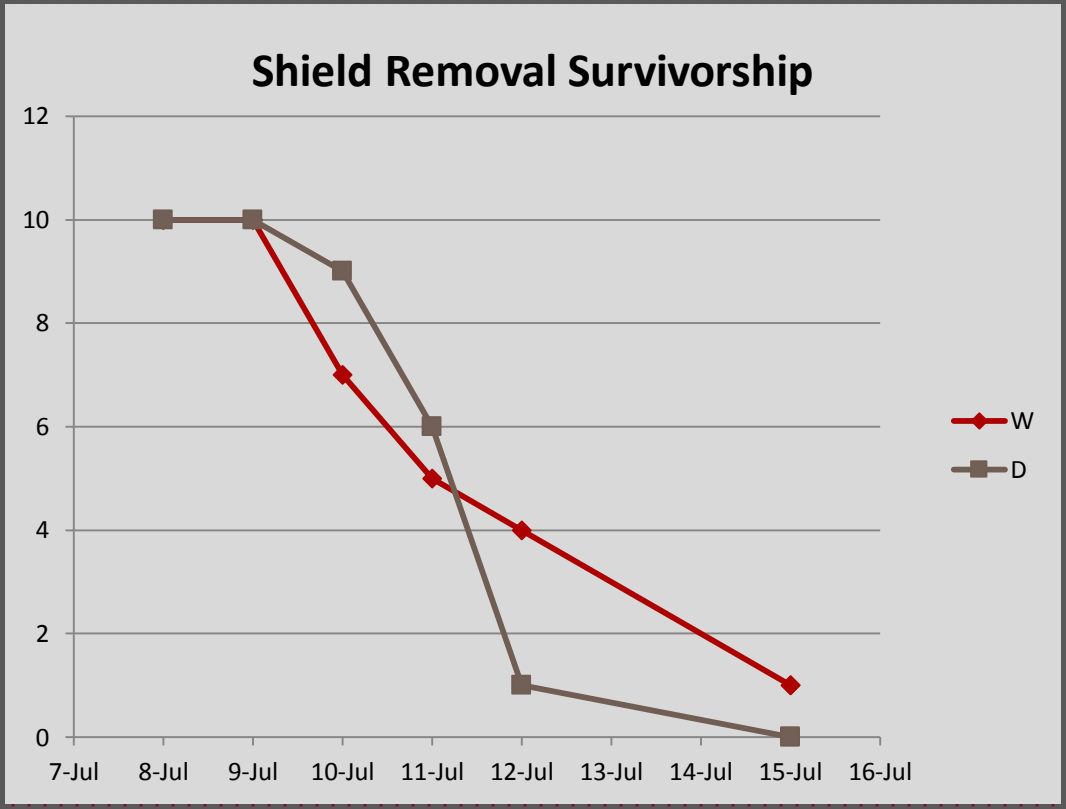
- The fecal shield provides physical or chemical protection against generalist predators.
- Its composition changes under differing water treatments.
- Regeneration time or mass change under differing water treatments.

Hypothesis 2 – Pilot Test - Fecal Shield Removal - Methods

- 1st instar larvae
  - Drought and Replete
- At 3rd instar shields were collected
  - Shield mass differences
  - Survivorship (an afterthought)



Hypothesis 2 – Pilot Test - Fecal Shield Removal - Results



Shield Mass
Drought vs. Replete

Std Dev	1.469
Av.	1.266
Std Dev W/o 5	0.495

Std. Dev	1.638
Av.	2.666
Std. Dev W/o 5	1.427

No adults emerged after pupating

Other tests and activities

- Assessing % parasitism by dissection
  - Cutler farm (Nine Mile Falls, WA)
- Collecting beetles for colony establishment
- Bio-assay design
- Exploratory: SPME samples of fecal shield

Method development challenges

- Collecting large numbers
- Keeping steady numbers of larvae alive
  - Life span
  - Fragility
- *Tetrastichus julis*
  - Lab conditions for emergence
  - Total < 10

Conclusion slides…

- For hypotheses addressed with pilot studies
- 1. Heat stress – evidence for heat stress related mortality at a regime that can occur in our region
- 2. Fecal shield there may be differences in regeneration mass of Fecal shield
- 3. Analyzable compounds in fecal shield include…
- 4. Parasitism is identifiable in fresh or frozen samples

- Based on the pilot results, full experiments a to be conducted with improved methods include:
- Heat stress simulations
  - Increase temp in growth chambers and extend time
  - Thermal limit - Isolation chambers in water bath
- Fecal Shield removal
  - Control treatments
  - Higher repetition

Thanks to:

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