

Assessing sensitivity of Quino checkerspot butterfly larvae to two common herbicides used for habitat management

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2014 Cal-IPC Symposium
Oct. 8, 2014.



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Overview

Background and introduction to the
Quino checkerspot butterfly,
Euphydryas editha quino



Maroon Valley Field Study:
Improving Habitat for Host Plants

Lab Study:
Effects of Herbicide on Larvae



Next Steps: Discussion



Quino Checkerspot Butterfly

Euhydryas editha quino - Federally listed 1997

Host plants *Plantago*, *Collinsia*, *Anterrhinum*,

Mostly coastal sage scrub, native grasslands, open chaparral

Life cycle

Adults fly February – April

Females lay ~ 400-800 eggs

Pre-diapause larvae molt 2-3 times, then diapause until winter rains promote plant growth

Post-diapause larvae feed through 3 instars & pupate

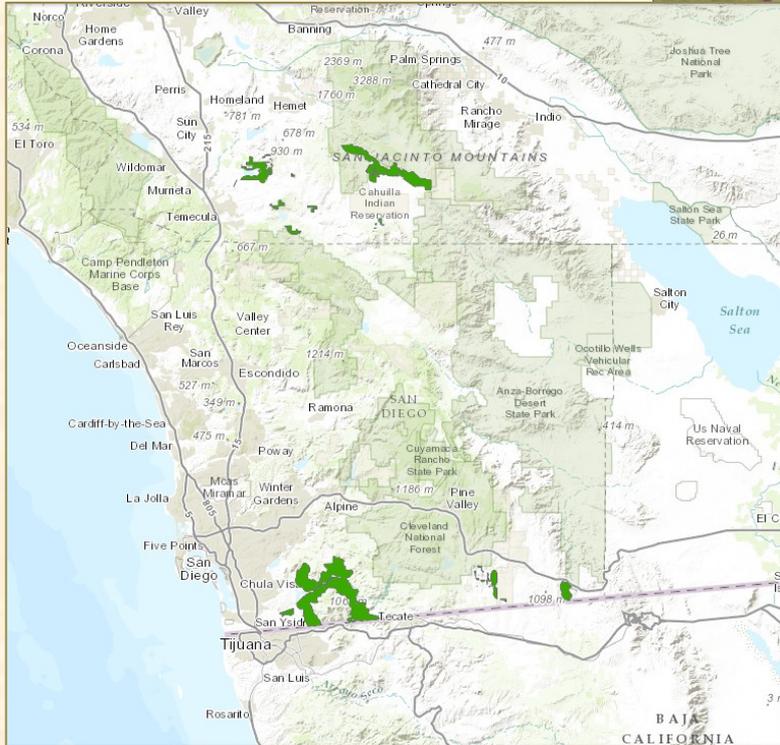
Distribution

Historical: Los Angeles, San Bernardino, Orange, Riverside, San Diego Counties (Baja California)

Now: maybe 30 locations in Riverside & San Diego Counties (Baja California)



Distribution



 Final Critical Habitat for the Quino Checkerspot Butterfly (*Euphydryas Editha Quino*) within Jurisdiction of the Carlsbad Fish and Wildlife Office (CFWO) [not visible in current extent]

Quino Checkerspot Butterfly *Euphydryas editha quino* Recorded Presence

Larval Host Plants

- 2005–2012
- 1987–2004
- 1946–1986
- 1881–1945

Butterfly

- 2005–2011
- 2000–2004
- 1992–1999
- 1968–1986
- 1946–1963
- 1890–1940

- *Plantago erecta*
- *Castilleja exerta*
- *Antirrhinum coulterianum*

Butterfly Habitat

- Recent (1992–2012)
- Inferred Historic
- Recovery Units
- Counties & States

0 50 100 km

Data: Butterfly, USFWS Carlsbad 2011, USFWS 2003, Mattoni et al. 1997; Plants, CalFlora 2012, Consortium of CA Herbaria 2012; Terrain, USGS, ESRI, BMacD12.

Problems? Habitat loss, grazing, invasive plants

Many types of habitat restoration/enhancement tried:

- **Weed Control**

- Herbicide application (Fucilade)
- Burning (Dethatching) in Fall 2005

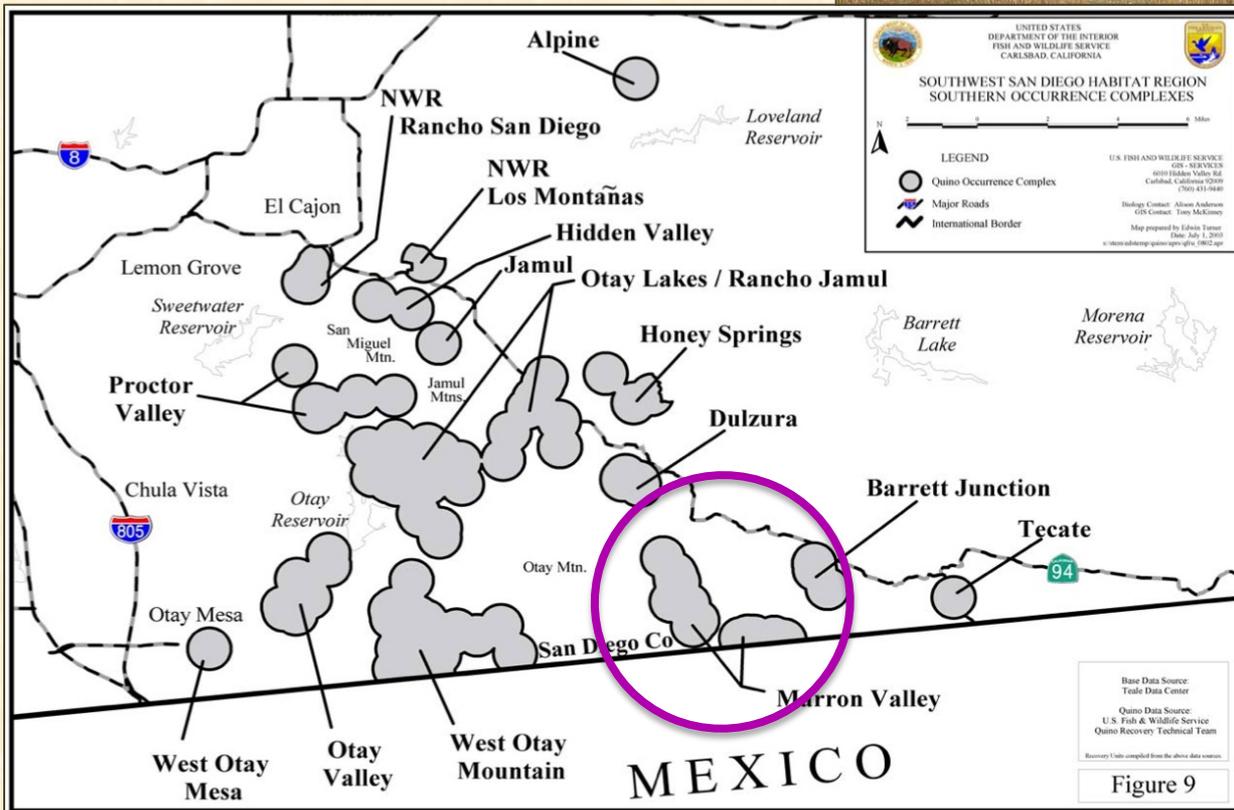
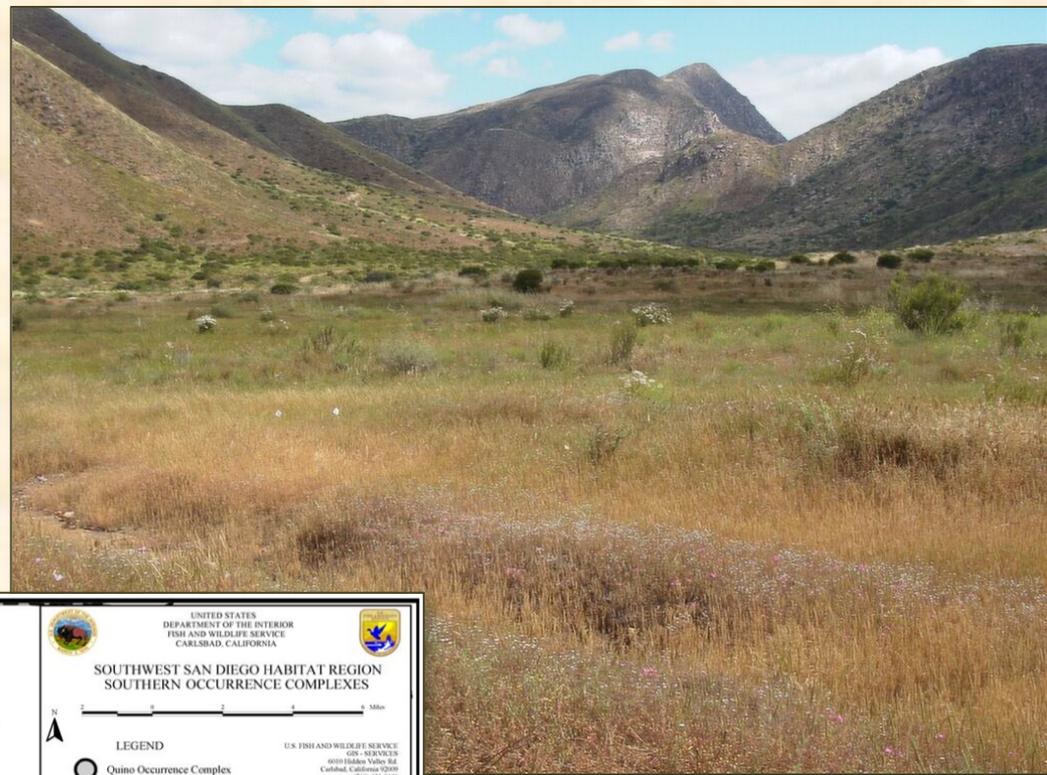
- **Seeding**

- **Field studies** were conducted in Marron Valley, CA (2005-2006)

- Plots randomly assigned to

- with and without **SEEDING** and
- with and without **HERBICIDE** application

Marron Valley

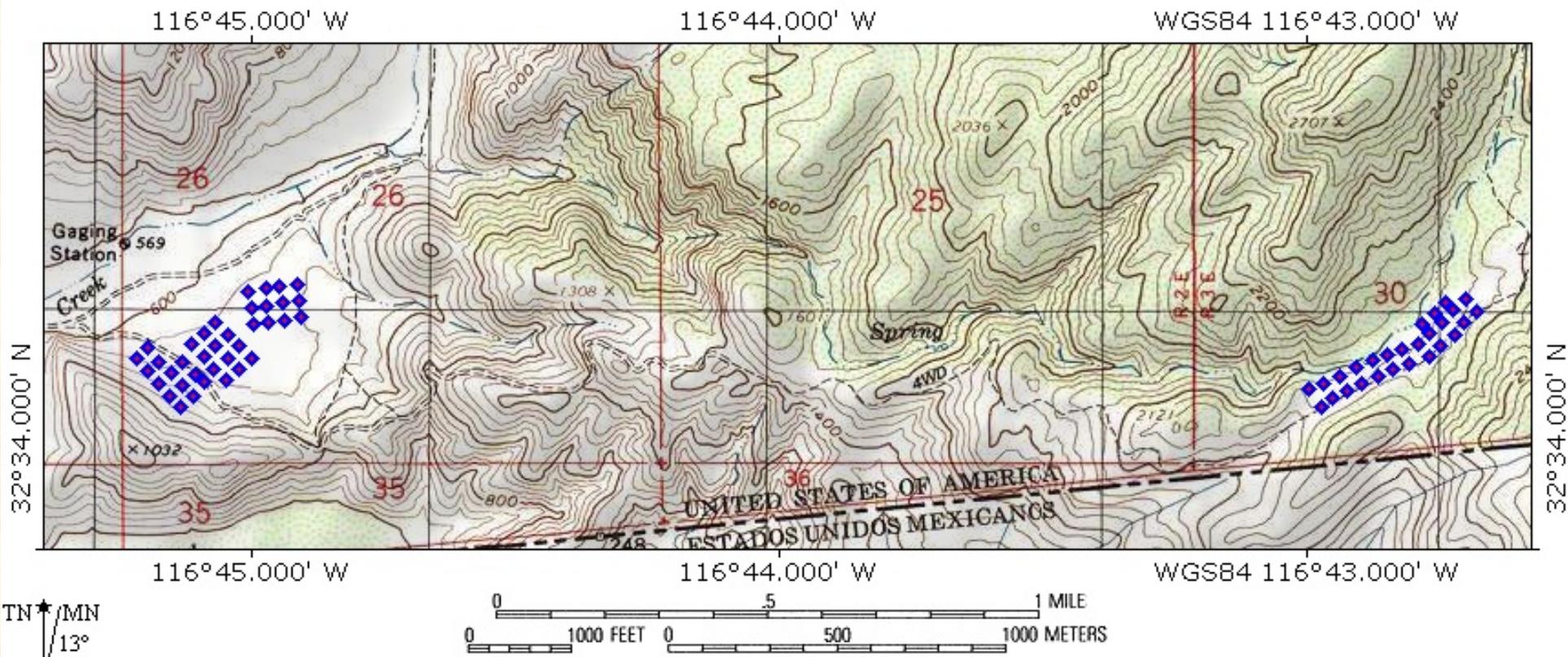


Southwest San Diego
Habitat Region Southern
Occurrence Complexes
(2005)

Marron Valley Study

- **Weed Control**
 - Herbicide (Fusilade II®) application (spring 2004)
 - Burning (Dethatching) for Fall 2005
- **Seeding** - application (spring 2004)

TOPO! map printed on 12/31/06 from "MarronVyPlotsAll.tpo"



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

Marron Valley Study

Herbicide application was most effective in first year.



Effects of herbicides on Quino larvae?

Study designed to evaluate effects of Fusilade II[®] & Transline[®] (+ ProSpreader[®] surfactant) on Quino checkerspot butterfly (2011)

- larval growth
- proportions of larvae pupating
- pupal weights

Assess both direct & indirect effects of herbicide exposure

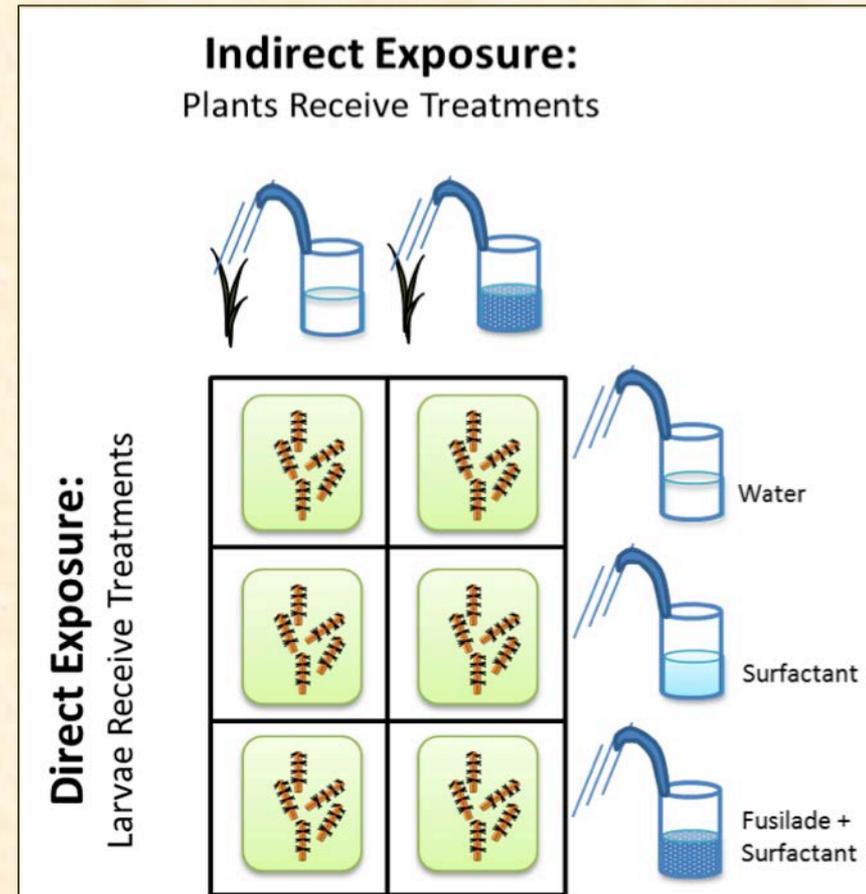


Methods - initially

Larvae experienced **direct** contact with water, surfactant (S), or Fusliade+S, - and were **fed food plants** that were exposed to water, surfactant, or Fusliade+S.

Compared ...

- larval growth
- proportions of larvae pupating
- pupal weights

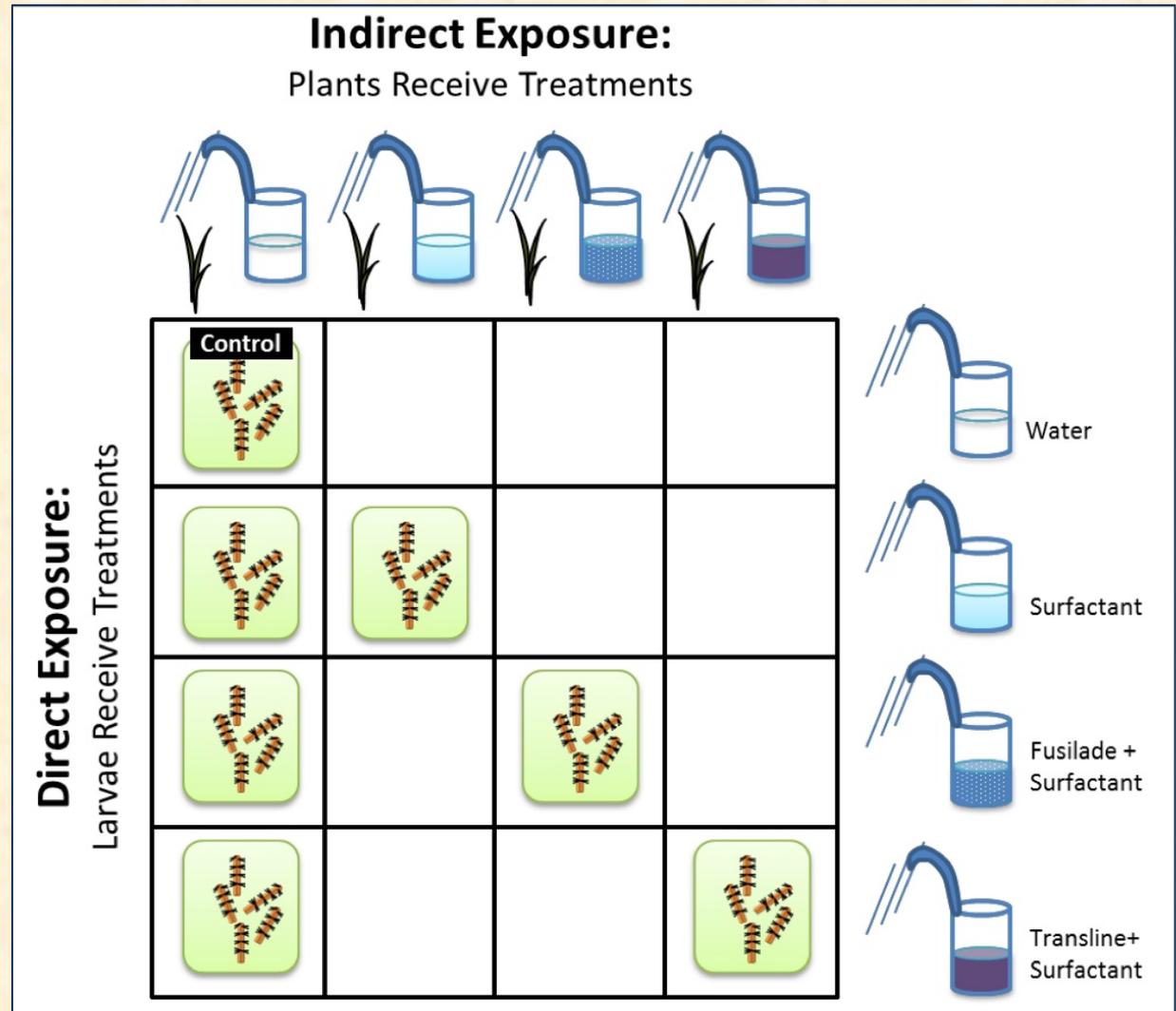


Methods – finally: Fusilade and Transline

Larvae experienced **direct** contact with water, surfactant (S), or herbicides+S, - and were **fed food plants** that were exposed to water, surfactant (S), or herbicides+S.

Compared ...

- larval growth
- proportions of larvae pupating
- pupal weights



Methods

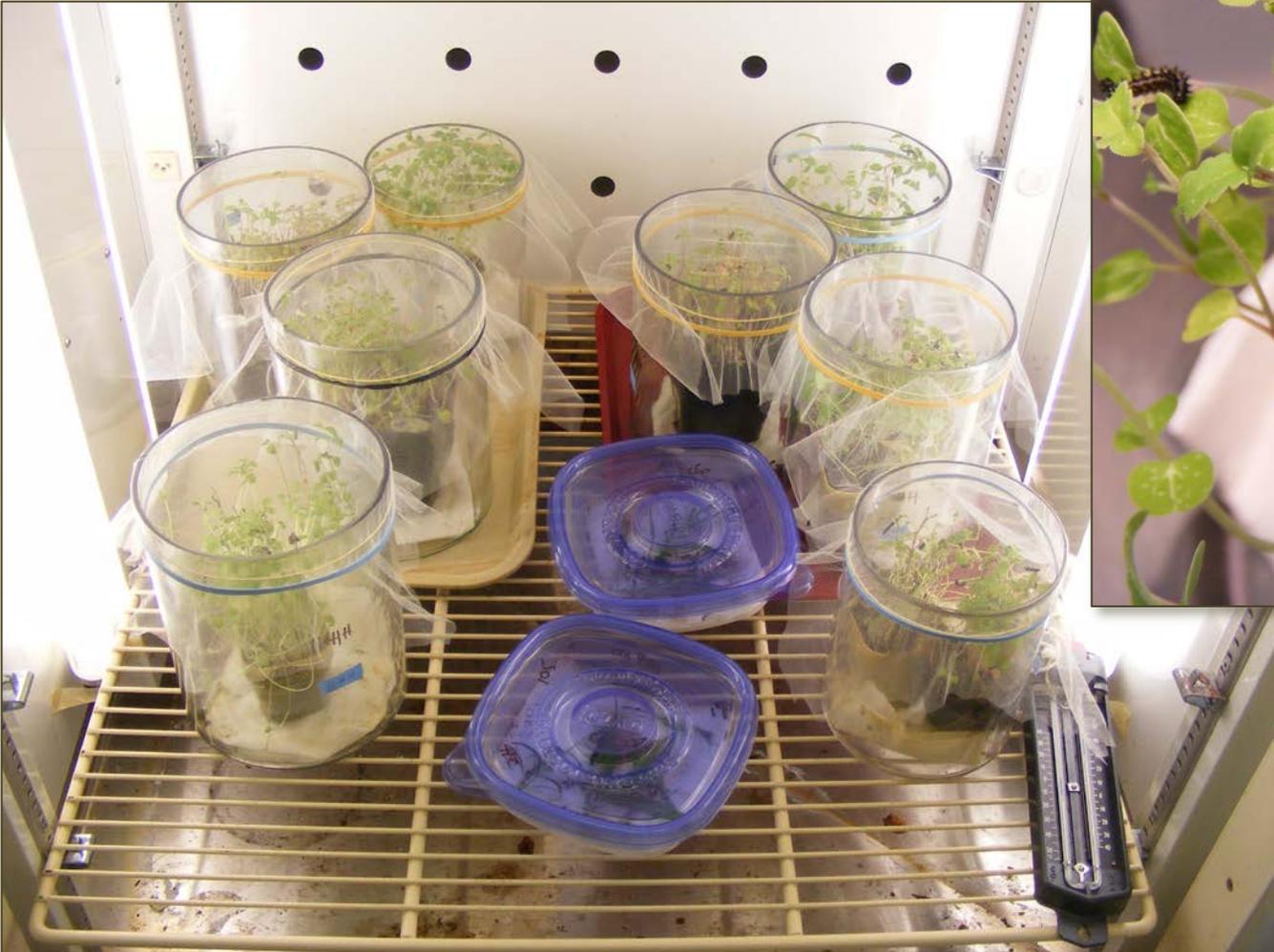
~ 600 diapausing larvae obtained from captive rearing facility

Brought them out of diapause



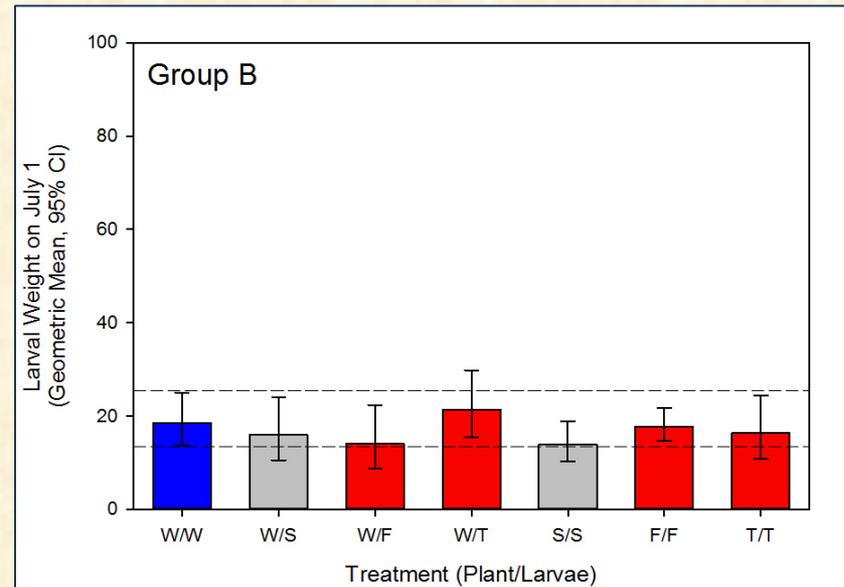
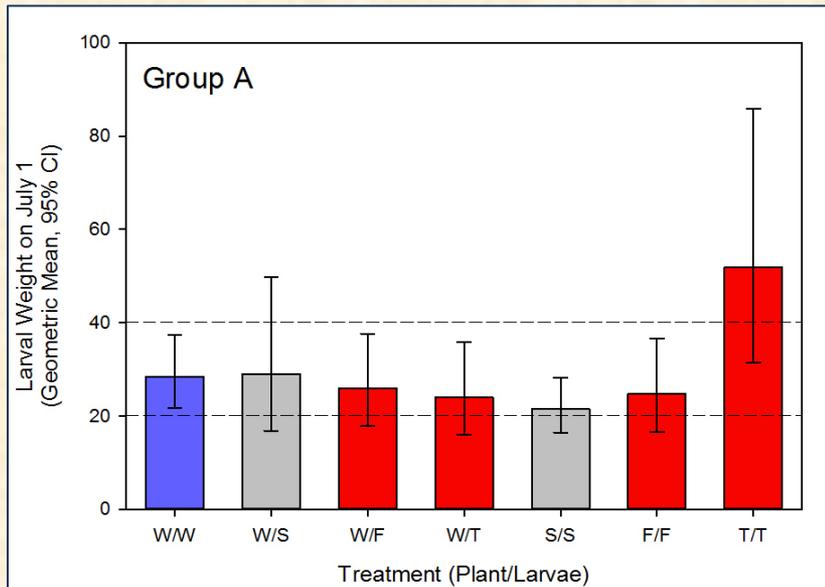
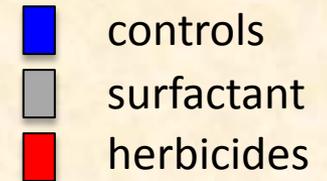
Methods

Post-diapause larvae were treated; and development & weights recorded, May-July 2011



Results

Weights on July 1 (~5 weeks after breaking diapause)



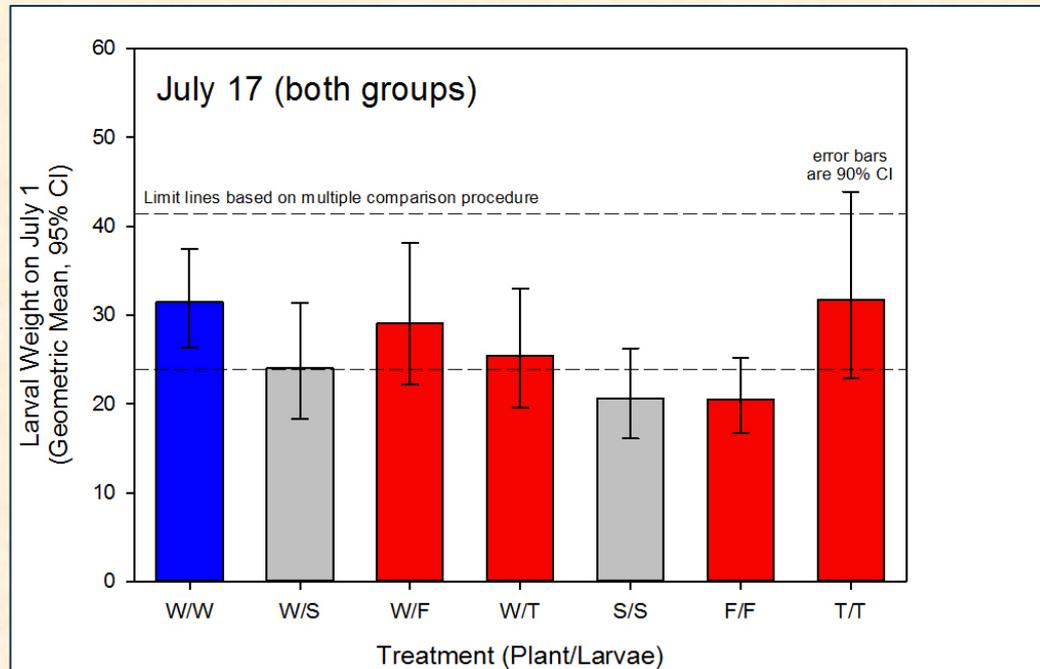
Analysis of Variance

| Source | Type III SS | df | Mean Squares | F-ratio | p-value |
|----------------------------|-------------|-----|--------------|---------|---------|
| GROUP\$ | 24.408 | 1 | 24.408 | 31.85 | <.001 |
| TREATMENT\$ | 7.804 | 6 | 1.301 | 1.697 | 0.121 |
| GROUP\$*TREATMENT\$ | 6.641 | 6 | 1.107 | 1.444 | 0.197 |
| Error | 254.421 | 332 | 0.766 | | |

n = 346, R² = 12.1%

Results

Weights on July 17 (~7 weeks after breaking diapause)



- controls
- surfactant
- herbicides

| Source | SS | df | MS | F | p |
|-----------|-------|-----|-------|-------|-------|
| TREATMENT | 8.534 | 6 | 1.422 | 1.822 | 0.095 |
| Error | 199.9 | 256 | 0.781 | | |

Results

Had **logistical problems** starting the study.

Larvae were not "tricked" into behaving like it was early spring (even with efforts to control day length), so the majority of larvae went back into diapause before pupating (also happens in nature).

Since most larvae didn't pupate, **couldn't assess effects of herbicide treatments on pupal weights.**

* However, results showed **NO direct or indirect effects on growth** of post-diapause Quino checkerspot larvae from exposure to Fusilade or Transline and/or surfactant.



Discussion

That we saw no indication of gross toxicity from Fusilade or Transline and/or surfactant exposure – and no apparent reduction in growth of post-diapause larval growth – was encouraging.

Further studies, when larvae are available, will provide a more complete assessment of potential herbicide effects on this species' developmental and reproductive biology – and ultimately effects on population dynamics.

Summary and Conclusions

- *Restoration of Quino habitat is challenging*
- *Many questions remain about requirements of the butterfly*
- *Future may depend on reintroduction programs*
- *Continued management will likely be required*



Acknowledgements

California Department of Fish and Game
Cooperative Endangered Species Conservation
Fund (Section 6) Grant #P1082033.



Thanks to David Mayer, DFW South Coast Region.

USFWS, Carlsbad Office – Dr. Alison Anderson

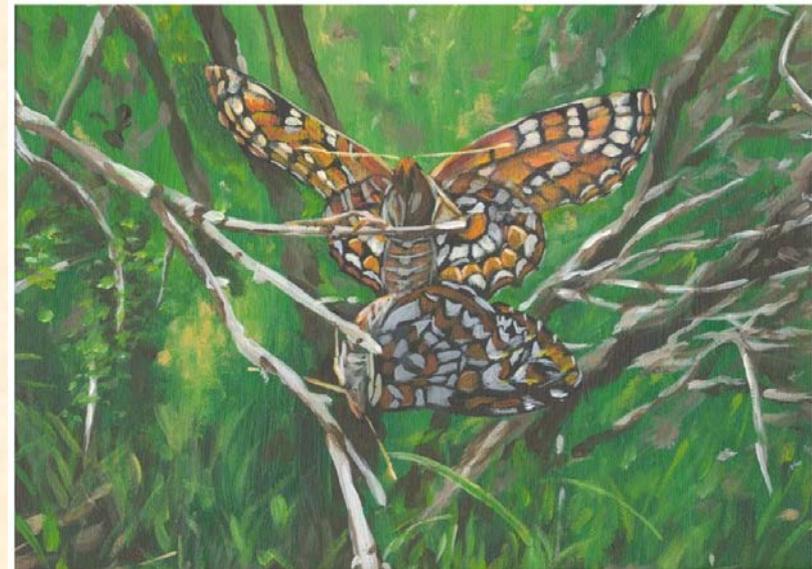


Dr. Gordon Pratt, QCB Wrangler Extraordinaire

Dr. Douglas Deutschman (Co-PI),
Biology, San Diego State Univ.

MS students Dave Bailey &
Patrick McConnell

Many undergraduates !



Painting by Alison Anderson after photo by Frank Ohrmund