

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

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# Overview

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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

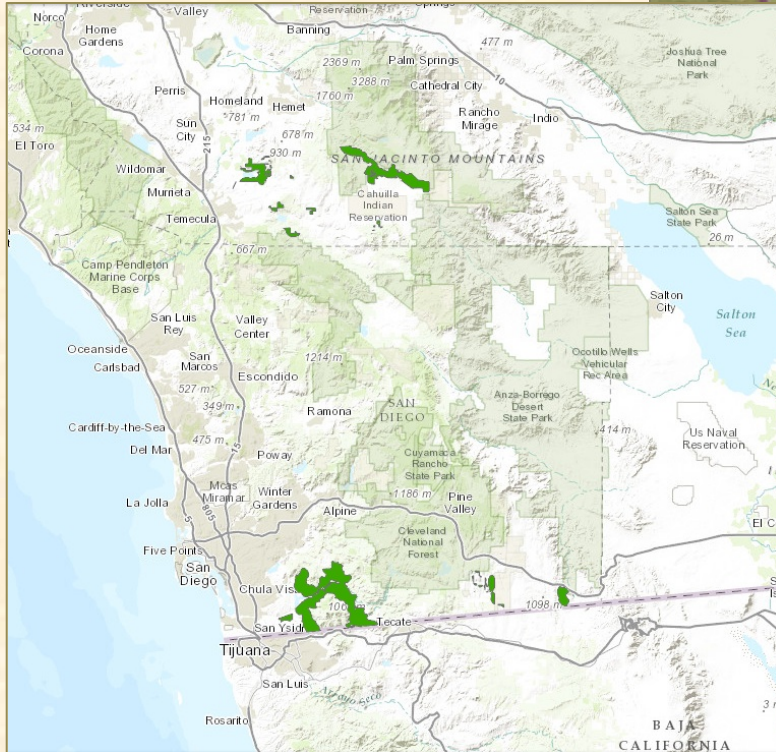
## Distribution


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

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



# Distribution

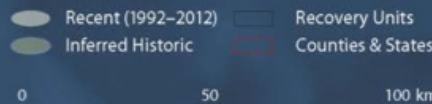


 Final Critical Habitat for the Quino Checkerspot Butterfly (*Euphydryas Editha Quino*) within Jurisdiction of the Carlsbad Fish and Wildlife Office (CFWO) [not visible in current extent]

## Quino Checkerspot Butterfly *Euphydryas editha quino* Recorded Presence



## Butterfly Habitat



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

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Many types of habitat restoration/enhancement tried:

- **Weed Control**

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

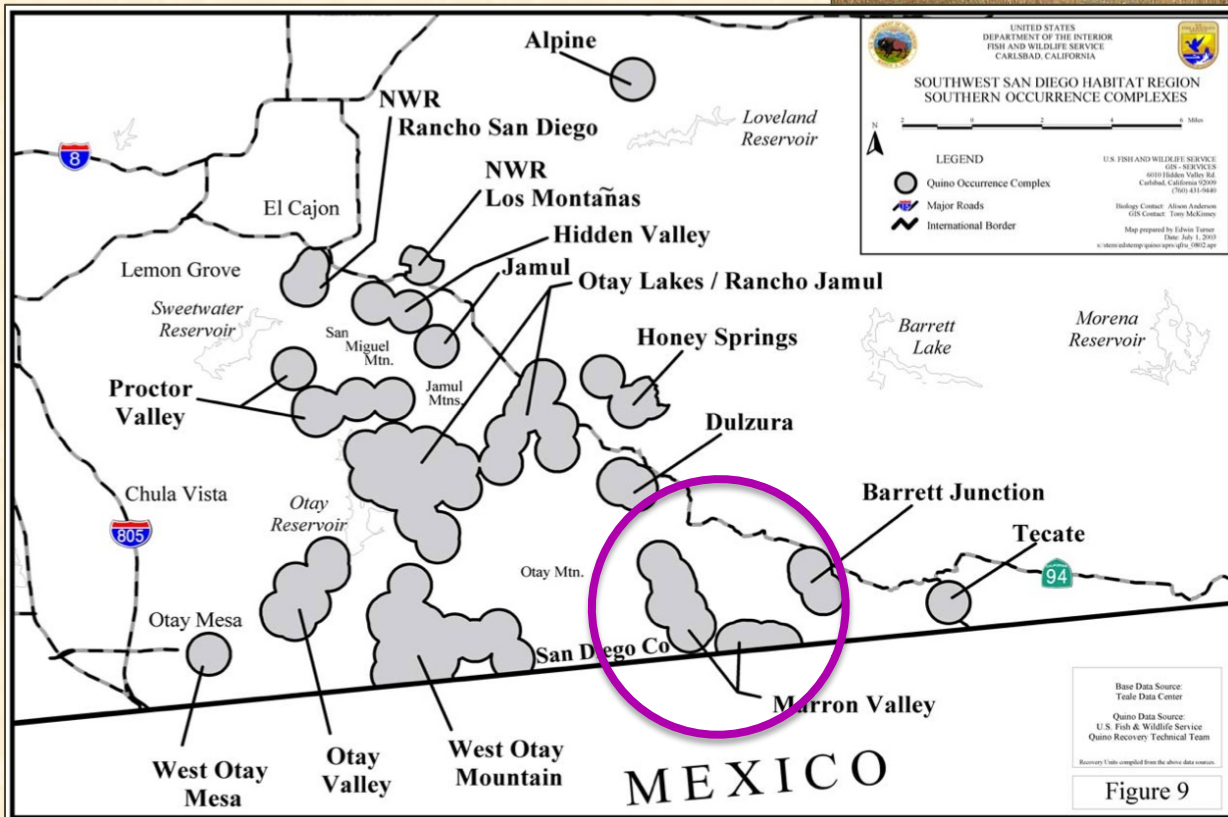
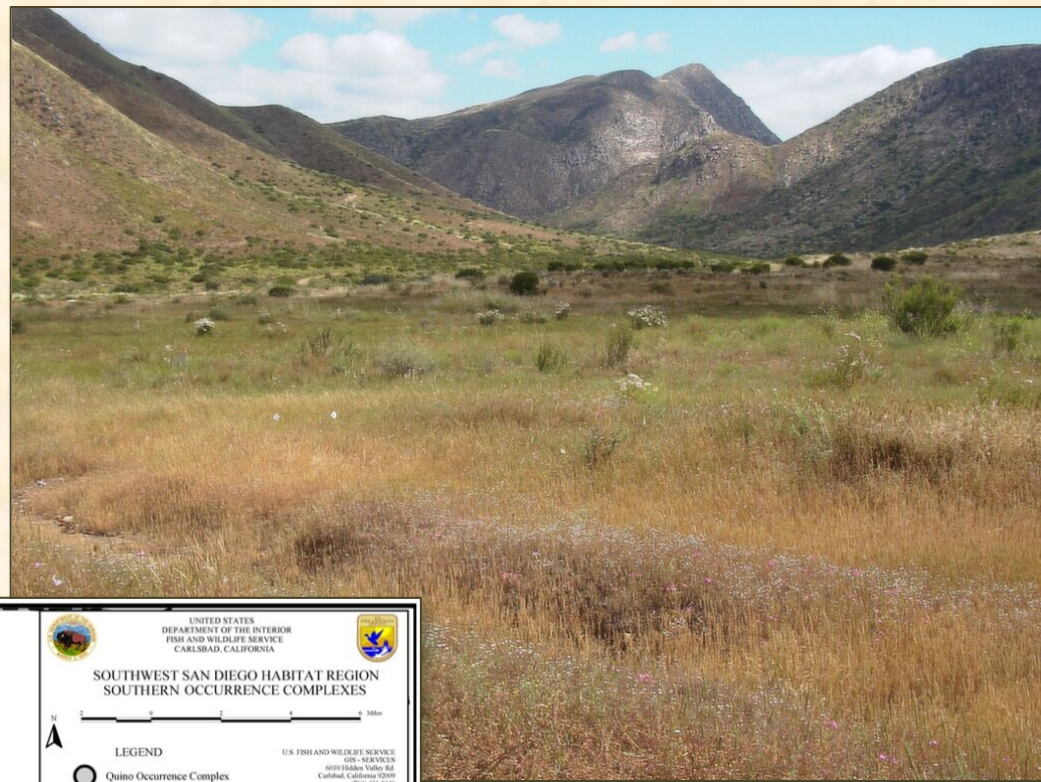
- **Seeding**

- **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

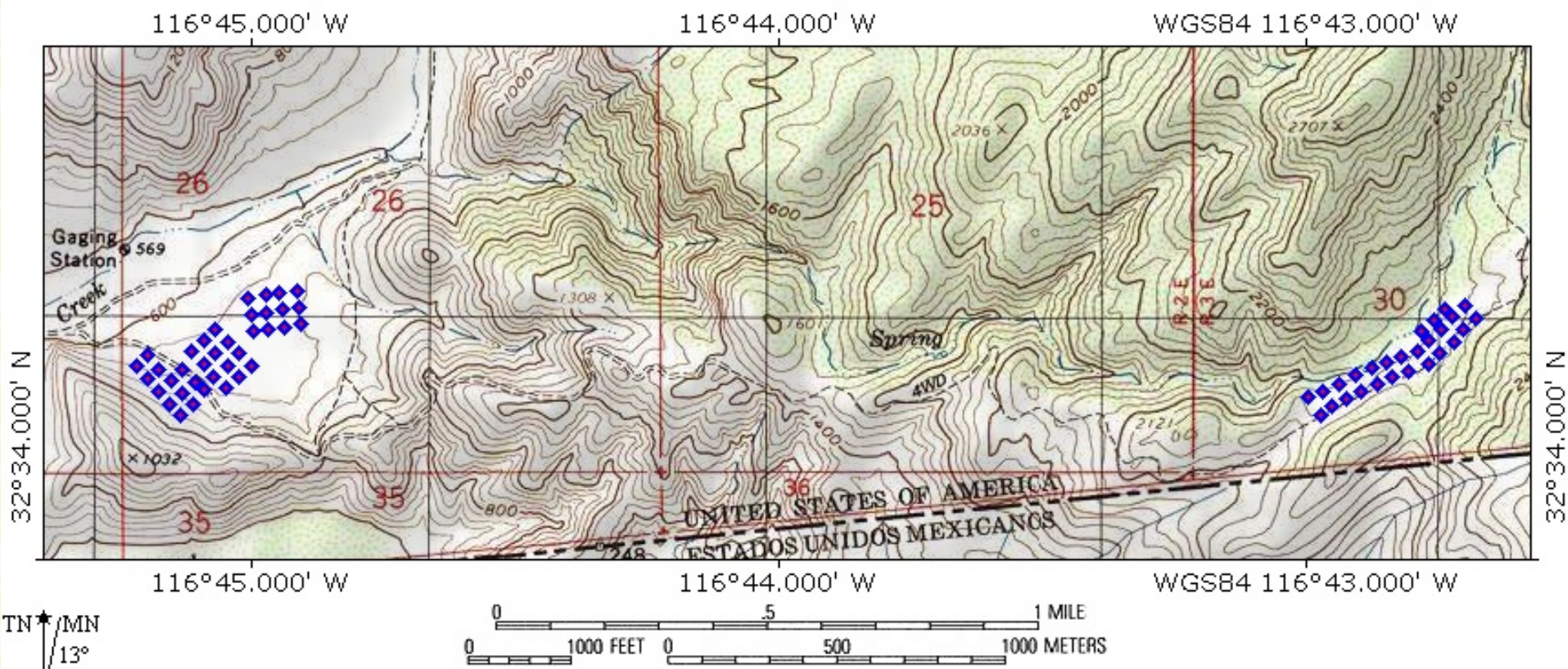


Southwest San Diego  
Habitat Region Southern  
Occurrence Complexes  
(2005)

# 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](http://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

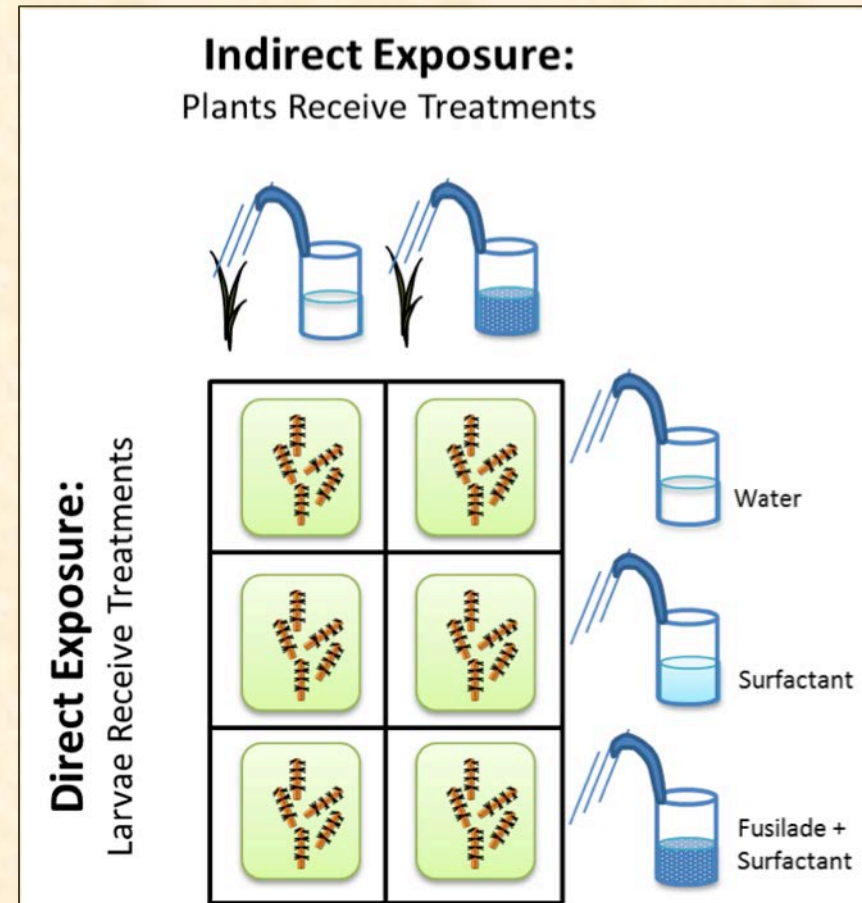


# Methods - initially

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

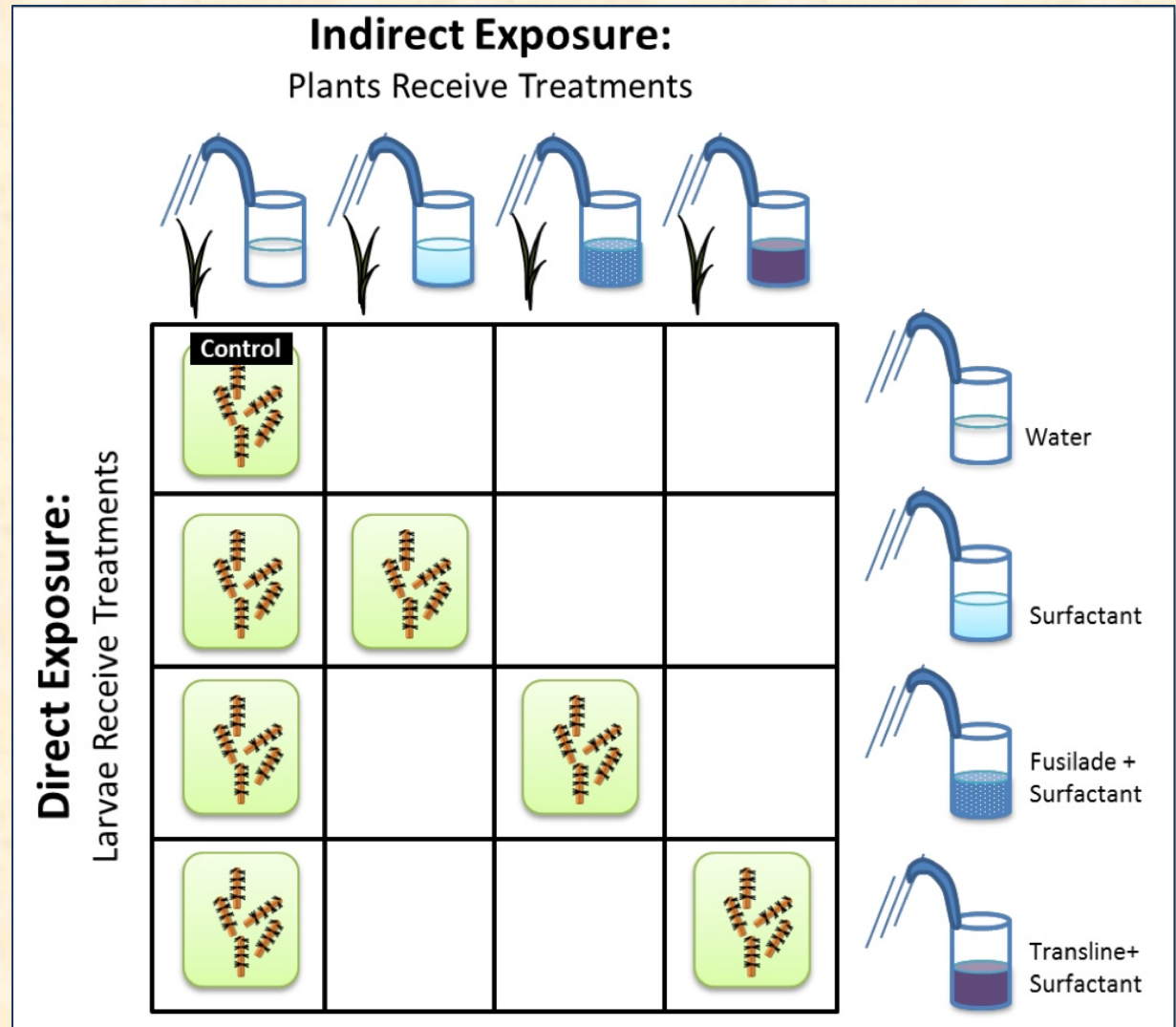


# Methods – finally: Fusilade and Transline

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

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~ 600 diapausing larvae obtained from captive rearing facility

Brought them out of diapause



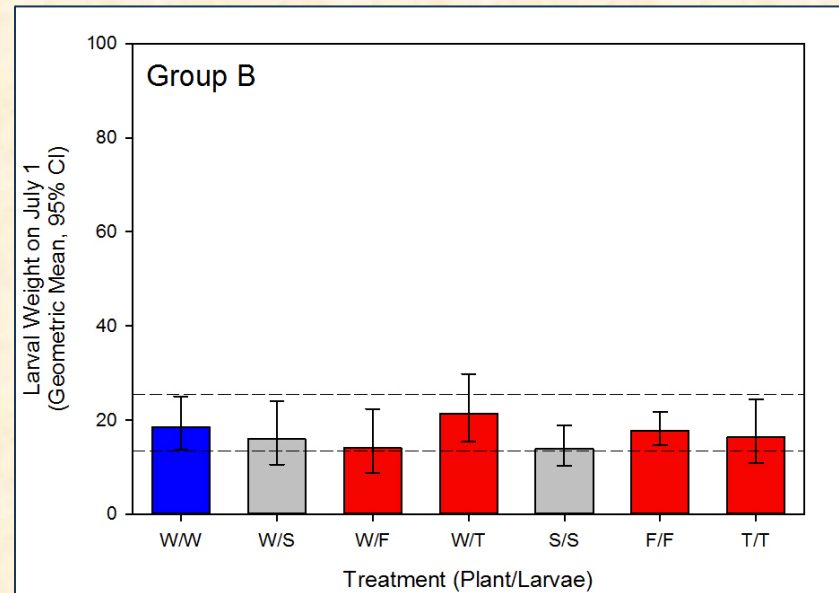
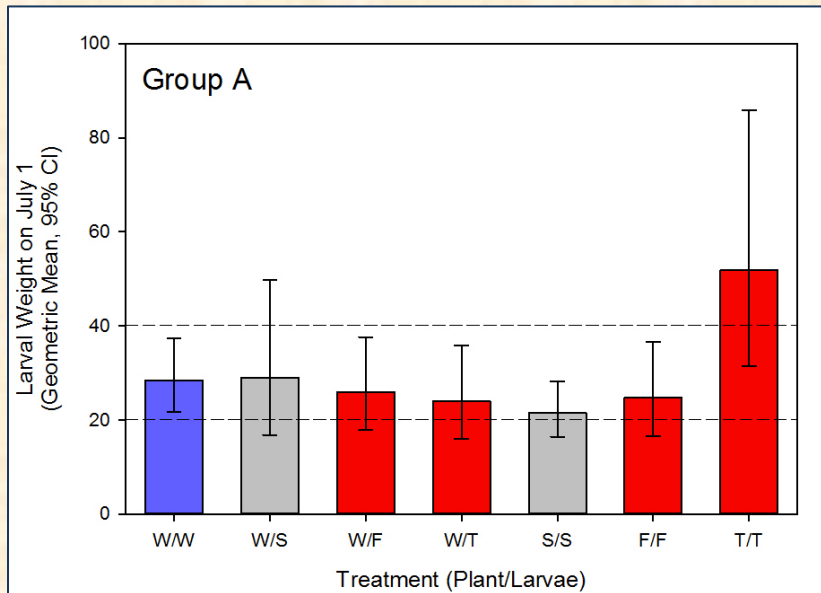
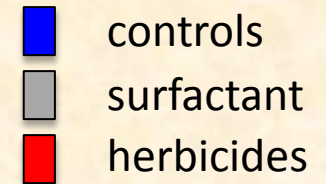
# Methods

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



# Results

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



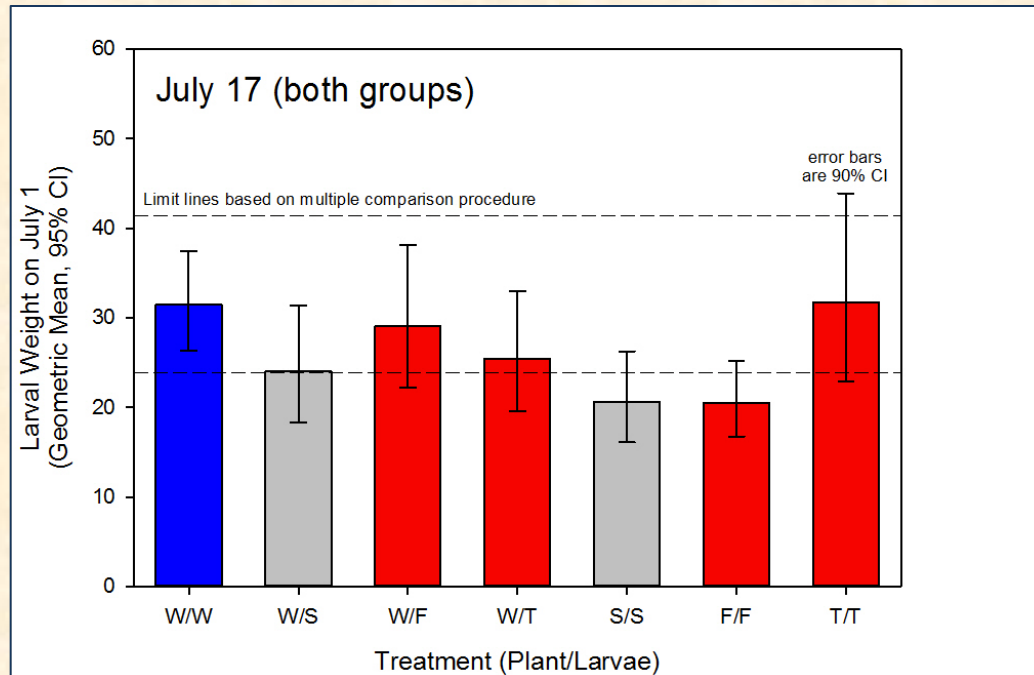
Analysis of Variance

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

n = 346, R<sup>2</sup> = 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

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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

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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

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Patrick McConnell

Many undergraduates !



Painting by Alison Anderson after photo by Frank Ohrmund