The Butterfly Effect:
Herbicides & Invertebrates

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Quotable Quotes
Mark Twain

“He has been a doctor a year now and has had two patients, no, three, I think -- yes, it was three; I attended their funerals.”
“It's like calling a doctor that you expect can cure your disease but since he doesn't know much about your body he prescribes a medicine that cures the disease but ends up killing you.”
The control strategies we use to reduce the ecological impacts caused by invasive weeds also pose some level of ecological risk.

- Fire
- Disking
- Mowing
- Hand-removal
- Biocontrol
- Herbicides
The Problem

- But our solutions to this problem are often...
  - Biased
  - Non-scientific
  - Silly
Weeds, Herbicides & Butterflies

- Winter 2012 Cal IPC newsletter article
- Antioch Dunes NWR
- Lange’s metalmark butterfly *Apodemia mormo langei*
- The host plant... naked stem buckwheat *Eriogonum nudum psychicola*
- The villains...
  - winter vetch *Vicia villosa*
  - yellow starthistle *Centaurea solstitialis*
  - ripgut brome *Bromus diandrus*
Herbicides & Butterflies

- J.D. Stark University of Washington; Environmental Pollution 164 (2012) 24-27
- evaluated potential toxic effects on Behr’s metalmark, a close relative of Lange’s metalmark.
- First instars caterpillars were used
- “Field level” rates of...
  - Triclopyr ester (Garlon 4)
  - Sethoxydim (Poast)
  - Imazapyr emulsifiable conc (Stalker)
- Sprayed directly on caterpillars and their food plants
Herbicides & Butterflies

- Herbicide exposure thru direct spray and dietary routes reduced the number of adults that emerged from pupation (24-36%).

- The authors speculated that...
  - Because each herbicide has a different mode of action, the effects are due to inert ingredients or indirect effects on food plant quality.
  - Continued use of these herbicides at the site.. “may contribute to the decline of this species.”
It’s not the data... it’s the interpretation.

- Well-collected data is always good, but we have to be careful about our conclusions.

- Stark’s study brings up several important points.
  - Let’s be cautious about assuming that herbicides are safe *solely because they’re herbicides*.
  - Few studies have studied the effects of herbicides on butterflies or any other invertebrates.
Insects & Herbicides

EPA only requires one terrestrial invertebrate toxicity study for pesticide registration...an acute contact honeybee test.

- Are honeybees a suitable surrogate for assessing herbicide risks to other invertebrates?

- A review of the available bee contact test data for the three herbicides is less than convincing.
  - sethoxydim? “no significant impact.”
  - triclopyr ester? “no impact”
  - imazapyr? “no impact”
What’s going on here?

- Maybe the honeybee test isn’t adequate for other invertebrates.
- These studies all used the active ingredients and not the formulation.
What’s going on here?

- With mammals and birds, the formulated products* are not much more toxic than the active ingredients alone.

- The results from fish tests, however, indicate a greater toxicological risk

* Poast, Garlon 4 and Stalker
Some Conclusions

- Avoid using herbicides that have toxicity “red flags” for fish when invertebrates are involved.

- Use less “fish-toxic” formulations
  - Use Garlon 3A (amine) instead of Garlon 4 (ester)
  - Use Habitat (aqueous) instead of Stalker? (an EC)
  - Poast (80% naphthalene) can be replaced with another grass-specific herbicide with low fish toxicity
    Envoy (A.I. is clethodim)
Low Exposure = Low Risk

- avoid direct application or significant drift to sensitive invertebrate host plants.
  - Poast is harmless to naked stem buckwheat
  - Garlon 4 or Stalker? Lethal to broadleaf plants.

- make herbicide applications when the most sensitive life stage isn’t present.
  - Caterpillar feeding exposure
What's clear is that other at-risk and endangered butterflies may also be in danger in places where weed killers are applied.”
Take Home Messages

- Assess herbicide product risk based on chemical-specific data (not lumping)

- Consider both toxicity and exposure when assessing non-target risk

- Read lots of studies but think about them critically

- Know what herbicide tools are available