# Canary in the Cannabis Field:

## How the Fisher Illuminated the Conservation Concerns from Cannabis Cultivation on California's Forest Lands.

Integral Ecology Research Center

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This PDF was converted from a PowerPoint presentation given for the California Department of Fish and Wildlife Conservation Lecture Series on June 23rd, 2017 in Sacramento, California.

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The Fisher (Pekania pennanti)
photo: Morgan Heim

# 2009

"We urgently need an end to the sugar coating of unpalatable facts. The public must decide whether it wishes to continue on the present road, and it can do so only when in full possession of the facts."

— Rachel Carson *Silent Spring*

## 2009-2012

PLOS | ONE

Gabriel M. W., L. W. Woods, R. Poppenga, R. A. Sweitzer, C. Thompson, S. M Matthews, J Mark Higley, S. M. Keller, K. Purcell, R.H Barrett, G.M Wengert, B. N Sacks, and D.L Clifford (2012). Anticoagulant rodenticides on our public and community lands: spatial distribution of exposure and poisoning of a rare forest carnivore. PLoS ONE 7(7):e40163

Anticoagulant Rodenticides on our Public and Community Lands: Spatial Distribution of Exposure and Poisoning of a Rare Forest Carnivore

- Four fisher deaths
- 79% exposed
- 1.61 rodenticides
- Kit exposed

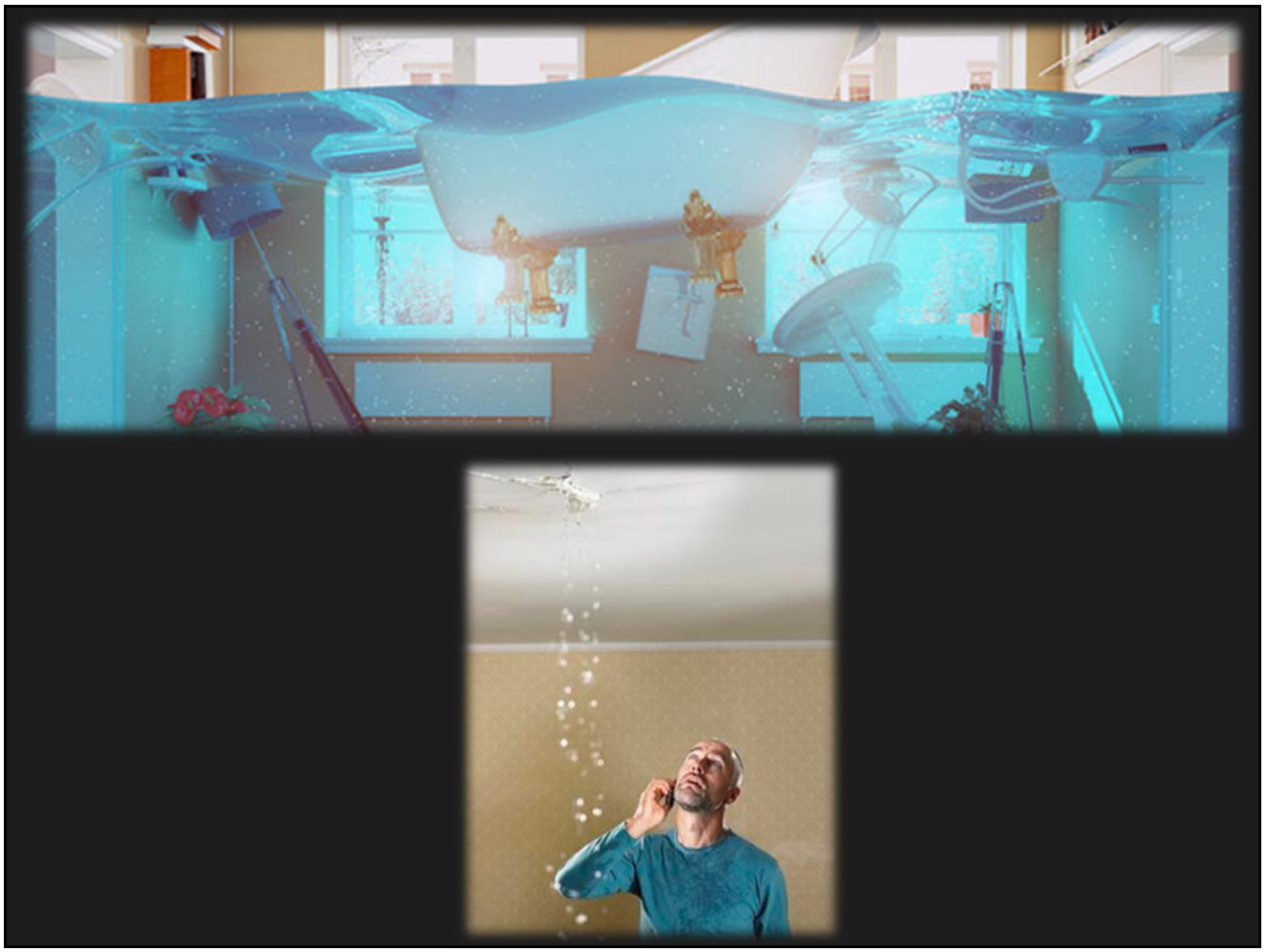
Conservation Letters

**Impacts of rodenticide and insecticide toxicants from marijuana cultivation sites on fisher survival rates in the Sierra National Forest, California**

Thompson, C., R. Sweitzer,, M.W. Gabriel, K. Purcell, R. Barrett, and R. Poppenga. (2013). Impacts of rodenticide and insecticide toxicants from marijuana cultivation sites on fisher survival rates in the Sierra National Forest, California. Conservation Letters. doi: 10.1111/conl.12038

- Fisher: Average of **5.3 sites**
- Exposed to Rodenticide: **4.0 sites**; not exposed **0.6 sites**
- One fisher had **16 sites**

"When we try to pick out anything by itself… we find it hitched to everything else…"
John Muir



# The Fisher Became the Canary in the Coal Mine

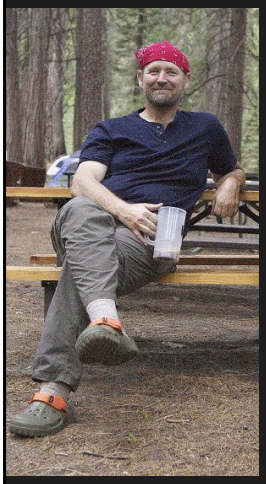
- Other Species?
- The Environment?
  - Water, Soil, Plants…..
- Humans?
  - Community Members
  - Law Enforcement

## Next Steps

- Section 6 Grant
- USFWS Funds Administered by CDFW.
- An interdisciplinary team of experts for field of work was created.

## Science with Solutions: Documentation, Reclamation and Monitoring of the Ecological Impacts of Marijuana Cultivation

Shane Krogen



Mark Higley
Stella McMillian
Deana Clifford
Greta Wengert

Leslie Woods

Bob Poppenga

Gabriel, M.W.(1), G.M., Wengert(1), J.M., Higley(2), D.L. Clifford(3), R.H., Poppenga(4),L.W. Woods(4), S. McMillian(3), S. Torres(3), (2017) Science with Solutions: Documentation, Reclamation and Monitoring of the Ecological Impacts of Marijuana Cultivation on Endangered Species, Final Performance Report, Grant #F14AP00021, USFWS: Endangered Species Act (Section-6) Grant-in-Aid.

## Science with Solutions: Documentation, Reclamation and Monitoring of the Ecological Impacts of Marijuana Cultivation

1. Continue to monitor exposure and mortality rates in fisher and other sensitive wildlife species from grow site toxicants.
2. Document and quantify the types of toxicants found. In addition, to wildlife mortality and poaching.
3. Sample abiotic and biotic material to determine if site material is contaminated.
4. Remove grow site material and monitor sites post-cleanup.
5. Extrapolate data to project annual toxicant and fertilizer loading, plus annual poisoning and poaching statewide at grow sites.

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## What does Trespass Marijuana Cultivation look like?

Small sites: ≤ 1,000 plants

Large sites: 1,000 - 80,000 plants

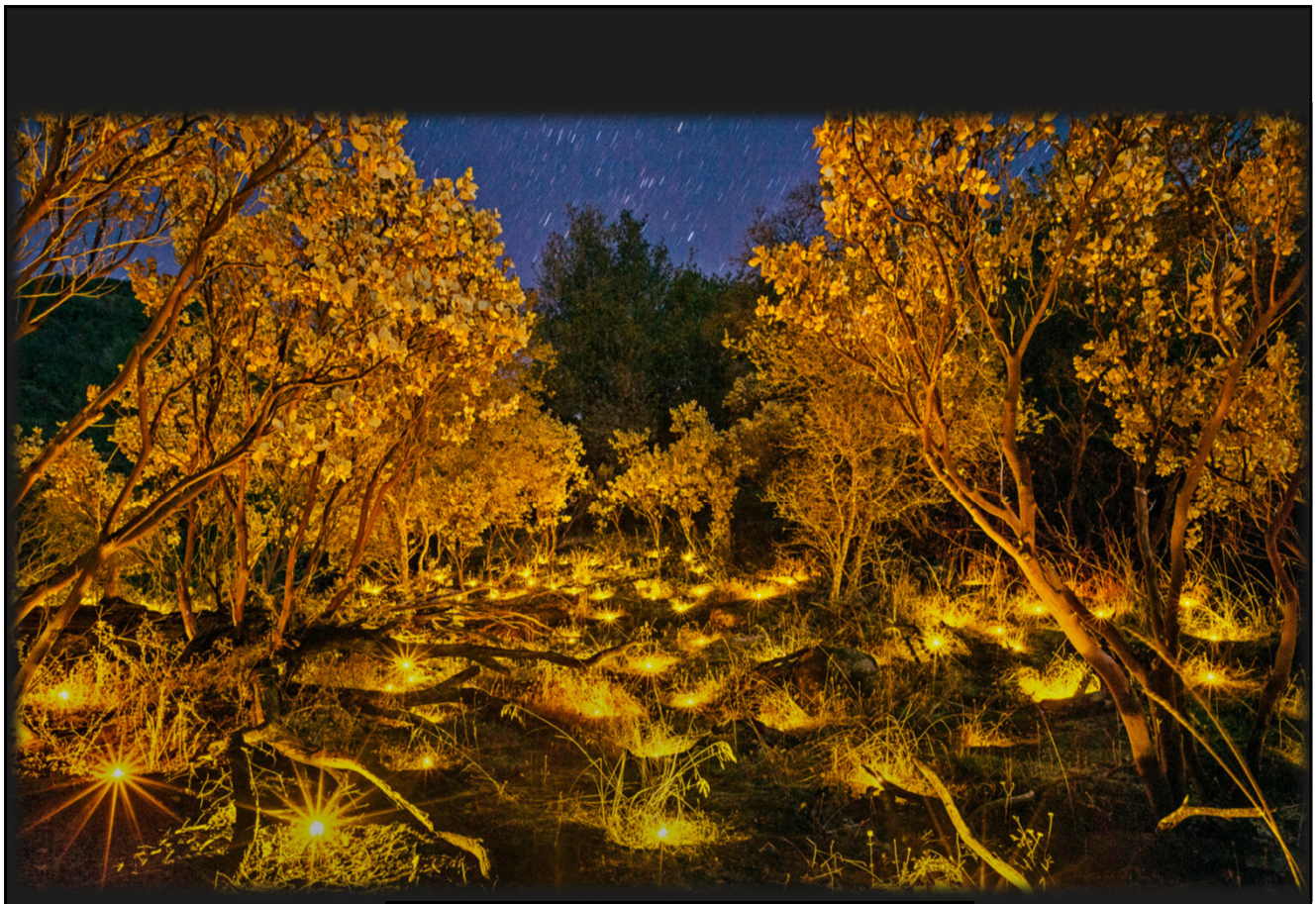

Photo: Morgan Heim

## What Does a Camp Site Look Like?

## What Does a Trash Dump Look Like?

## What Does Source and Plot Line Look Like?

# Is it Getting Better?

## Are exposures and deaths from grow site contaminants decreasing?

PLOS ONE

2012 Paper

Exposure

Mortality

| N.CA | Sierras | All CA |
|---|---|---|
| 72% | 83% | 79% |
| 2 | 2 | 4 |

PLOS | ONE

RESEARCH ARTICLE

Patterns of Natural and Human-Caused Mortality Factors of a Rare Forest Carnivore, the Fisher (*Pekania pennanti*) in California

Gabriel M.W., L. Woods, G.M., Wengert, N. Stephenson, J.M. Higley, C. Thompson, S.M. Matthews, R.A. Sweitzer, K. Purcell, R.H. Barrett, and S.M. Keller, (2015). Patterns of Natural and Human-Caused Mortality Factors of a Rare Forest Carnivore, the Fisher (Pekania pennanti) in California. PLoS ONE, 10(11), p.e0140640

- **9 additional poisonings**
- **85% exposed, up from 79%**
- **1.73 rodenticides per fisher**
- **Poisoning per year up from 5.6% to 18.7%**

**233% Increase**

| | | N.CA | Sierras | All CA |
|---|---|---|---|---|
| PLOS ONE 2012 Paper | Exposure | 72% | 83% | 79% |
| | Mortality | 2 | 2 | 4 |
| PLOS ONE 2015 Paper | Exposure | 84% | 86% | 85% |
| | Mortality | 5 | 4 | 9 |
| Nov 2015- Jan 2017 14 months of data | Exposure | 100% (n= 9) | 100% (n= 17) | 100% (n= 26) |
| | Mortality | 2 | 2 | 4 |

Gabriel M.W., 2017, Unpublished Data

We know that fishers are exposed, what route?

By secondary or primary poisoning?

**Objective:** Document fishers visiting grow sites with known AR available.

Science teams placed remote cameras out at sites.

d-CON

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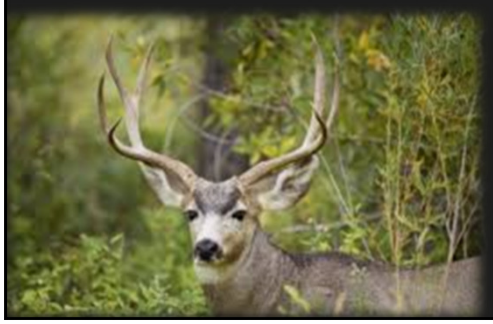
Are Game Species Contaminated?

# Hunter Killed Game

- Tested 22 hunter harvested deer in remote N. CA.
  - One deer tested positive for rodenticide
  - Tested one mountain quail, tested positive.
- Tested one black bear, tested positive.

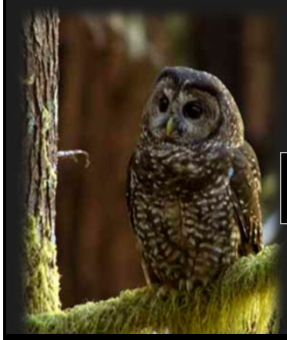
**Is this now a Human Health Concern?**

Gabriel, M.W., G.M. Wengert, K. Schlick, R. Poppenga, and J.M. Higley. (In Submittal) Exposure to Contaminants in Game Species Harvested by Hunters in California Forest Lands.



## Are Northern Spotted Owls at Risk?

**Barred Owls (Green-Diamond): 88 of 158 Positive, 56%**



N. Spotted Owls: 7 of 10 (70%)

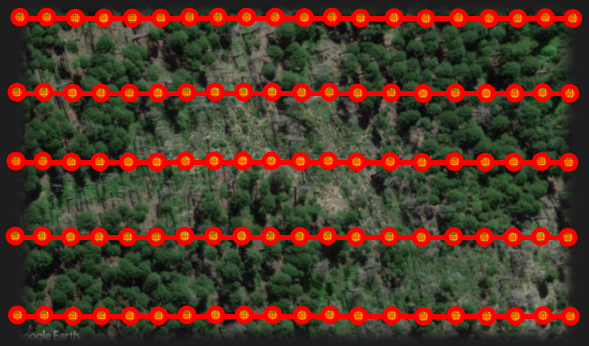
Gabriel M.W., L. Diller, J. Dumbacher, J.M. Higley, G. M. Wengert, S. Mendia, and R. Poppenga. (In Review). Avian Conservation & Ecology, Exposure to Pesticides in Northern Spotted and Barred Owls on Remote Forest Lands in Northwestern California: Evidence of Food Web Contamination.

**We have top predators exposed, what about their prey? Diversity, abundance, exposure?**

Rodent Trapping: Grow Sites and Control Sites

1. Diversity & Abundance
2. Any exposure to ARs in trap mortalities

- Trapped six grow and control site pairs
  - 5 transects with 20 traps, 4 nights = ~400 trap nights (per site)



Grow Site Vs. Control Sites

- Grow Sites had lower species diversity.
- Grow sites had only young or smaller bodied individuals.
- Control sites had greater diversity and age structure.

Wengert, G.M., Higley, J.M., Gabriel, M.W., and D. Clifford, 2017, Unpublished Data

Trap Mortalities

15 at Grow Site

**6 of 15: 40% positive for AR**

0 of 6 at Control Site

## Data are demonstrating ongoing and escalating exposure and mortality along with food web contamination.

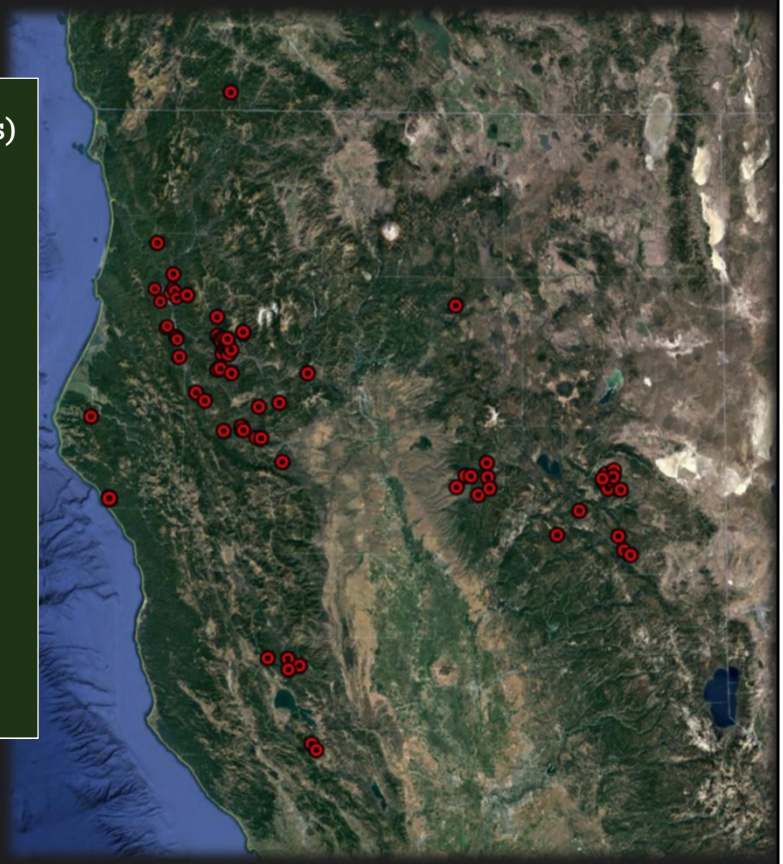
### What We Still Don't Know

- What specific types of toxicants and fertilizers are used?
- In what quantities?
- What might be the annual loading of these chemicals on the landscape?
- Are regulations altering the use of selected toxicants?

## Number of Locations Science Team Visited

- Total of 108 geographically independent locations visited in Northern California.
- 31 locations did not allow safe access.
- **Data**: **77** geographically independent locations in California

- Locations included (77 Sites)
  - 9 Public Lands
    - 6 USFS
    - 2 Wildernesses
    - 1 BLM
  - 4 Private timberlands
  - 1 Tribal



## Mean Amount of Fertilizer and Toxicants **per** Cultivation Location (n=77)

| | |
|---|---|
| Soluble Fertilizer kgs (lbs) | 1,268 lb |
| Liquid Fertilizer L (oz) | 1,353 oz |
| Carbamates | 48 oz |
| Organophosphates | 82 oz |
| Pyrethroids | 205 oz |
| Neonicotinoids | 21 oz |
| Avermectins | 90 oz |
| 1st Gen ARs kgs (lbs) | 17 lb |
| 2nd Gen ARs | 9 lb |
| Neurotoxicant Rodenticides | 8.7 lb |
| Phosphides | 4.4 lb |
| Molluscicides | 21 lb |

Gabriel M.W.,, G.M. Wengert, J.M. Higley, D.Clifford, S.Frick, R. Gaske, D. Little, P.Jordan, B.Lynch, R.Poppenga, C.Holland, M.Filigenzi, S.McMillin, and D.Clayton (In Review) Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands.

## Amount of Fertilizer and Toxicants used State-wide Annually (projected)

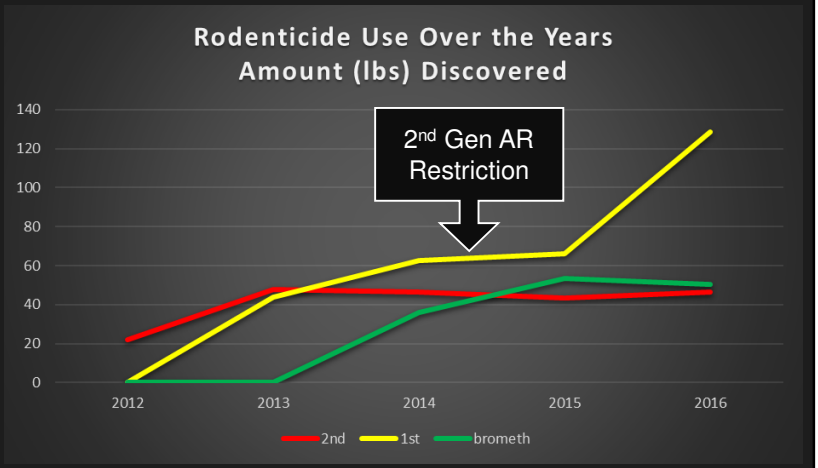
Average per year: 356 locations discovered in CA

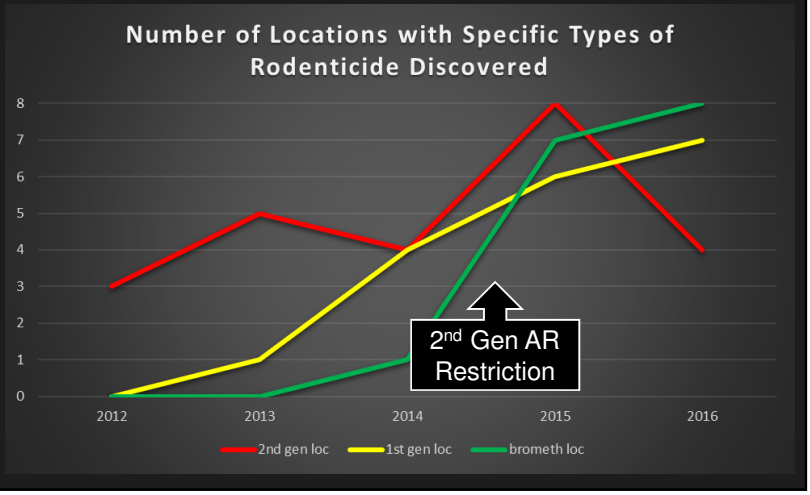
| | |
|---|---|
| Soluble Fertilizer | 731,224 lbs |
| Liquid Fertilizer L (oz) | 491,280 oz |
| Carbamates | 20,612 oz |
| Organophosphates | 41,296 oz |
| Pyrethroids | 125,312 oz |
| Neonicotinoids | 7,582 oz |
| 1st Gen ARs kgs (lbs) | 6,444 lbs |
| 2nd Gen ARs | 3,916 lbs |
| Neurotoxicant Rodenticides | 3,560 lbs |
| Phosphides | 819 lbs |

Gabriel M.W.,, G.M. Wengert, J.M. Higley, D.Clifford, S.Frick, R. Gaske, D. Little, P.Jordan, B.Lynch, R.Poppenga, C.Holland, M.Filigenzi, S.McMillin, and D.Clayton (In Review) Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands.

## Rodenticide Use Pre- and Post-regulation.

- July 1, 2014, 2nd Gen ARs Restricted for Use.
- Only licensed applicators.
- No longer available at your local hardware stores.



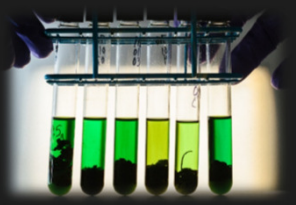



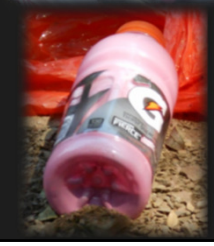

Gabriel M.W.,, G.M. Wengert, J.M. Higley, D.Clifford, S.Frick, R. Gaske, D. Little, P.Jordan, B.Lynch, R.Poppenga, C.Holland, M.Filigenzi, S.McMillin, and D.Clayton (In Review) Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands.

## Detection of Banned or Restricted Use Pesticides

- Out of 77 locations, 35% had banned/restricted pesticides.
- Numerous detections needed laboratory confirmation.
  - Unknown substances in…
    - Repurposed containers

Gabriel M.W.,, G.M. Wengert, J.M. Higley, D.Clifford, S.Frick, R. Gaske, D. Little, P.Jordan, B.Lynch, R.Poppenga, C.Holland, M.Filigenzi, S.McMillin, and D.Clayton (In Review) Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands.





## Collection of Data: Three Types of Efforts

1) Day 0 (Discovery/ Eradication) = 28 locations
2) Post Day 0 = 25 locations
3) Day 0 and Post Day 0 = 24 location

## Day 0 Visit vs. Complete Analysis (Day 0 & Post Visit)

For the 24 locations, significant differences in detection and amounts discovered between Day 0 and Post Day 0.

- All Fertilizers ($p < 0.05$)
- All Insecticides ($p < 0.05$)
- All Rodenticides ($p < 0.05$)

We were significantly less likely to detect banned or restricted use pesticides on a Day 0 visit. ($p<0.05$)

Mean amount of time spent at locations (Per Person)

| | |
|---|---|
| Day 0: | 2.7 hrs |
| Complete Analysis: | 10.46 hrs |

Gabriel M.W.,, G.M. Wengert, J.M. Higley, D.Clifford, S.Frick, R. Gaske, D. Little, P.Jordan, B.Lynch, R.Poppenga, C.Holland, M.Filigenzi, S.McMillin, and D.Clayton (In Review) Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands.

## Data demonstrating large amounts of toxicants used per site.

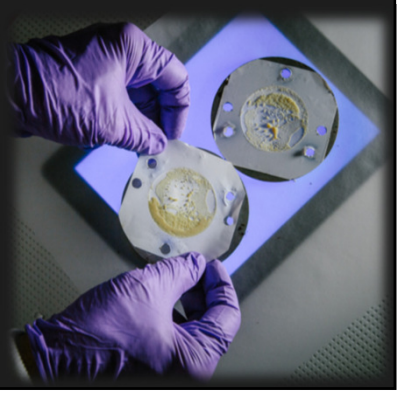
### What We Still Don't Know

- Is water below grow sites contaminated?
  - If so, with what and for how long?
- Is soil within cultivation plots contaminated?
  - If so, with what and for how long?

## Detecting Water Contaminants

### POCIS (Polar Organic Chemical Integrative Samplers)

- Device used to detect hydrophilic contaminants
  - Pesticides like Carbamates, Organophosphates, Pyrethrins, Rodenticides
  - Placed in-stream, below grow sites
  - Leave in place for 30-60 days



- Monitored 14 grow site complexes
- Nine sites were monitored for two years (seasons)
- Site monitoring intervals varied from 4-6 months only each year.
  - Safety concerns

**Detected pesticides in 7 of the 14 (50%) water samples.**

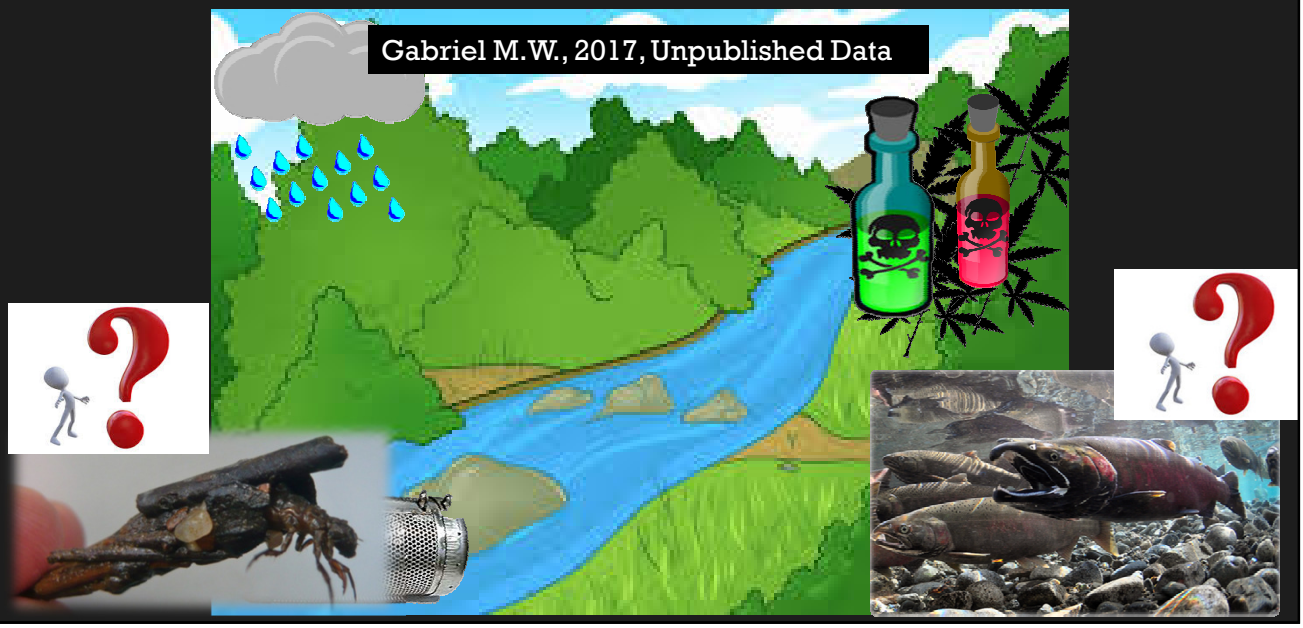
**Detections included restricted and banned pesticides.**

Gabriel M.W., 2017, Unpublished Data

- Five sites were in Headwater areas.
  - Two of these were in Wilderness Areas.
- One site Mid-slope
- One site below private inholding, growing marijuana.
  - Contamination could have originated from private grow

# Interesting Data on the Detection of Contaminants

- Detected different toxicants in the same headwater streams.
  - Each detection at a different time point (~1 year apart).
- Detected some toxicants for entirety of sampling (+8 months).



## We Have Water Contamination At Sites, What About the Soil?

- Sampled planting holes in cultivation plots.
  - Total of 13 sites samples, some sites…
- Sampled on day of eradication (Day 0)
- Sampled on post eradication

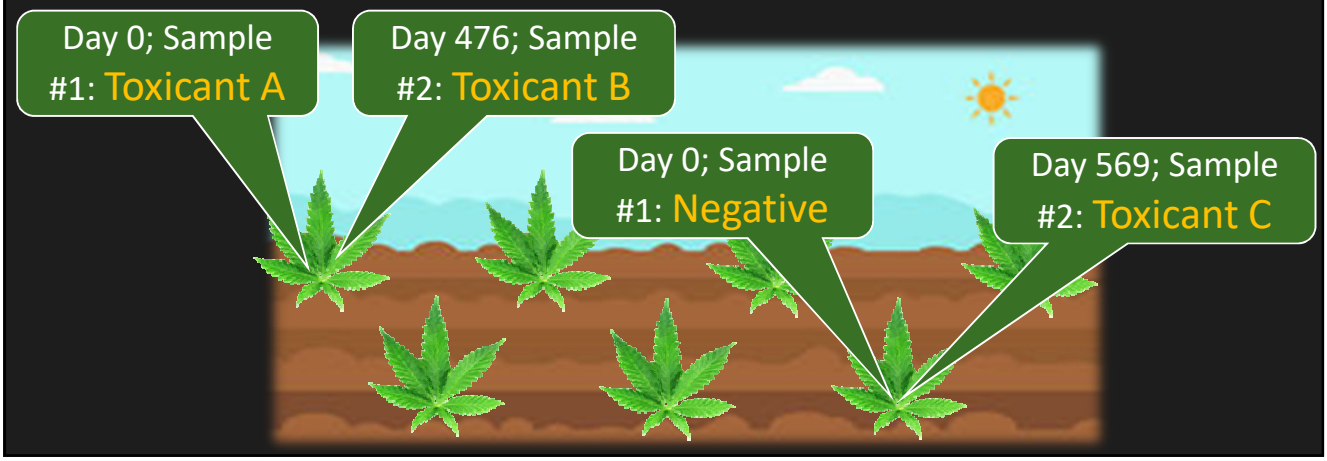
**Detected pesticides in 6 of the 13 (46%) soil samples.**

**Detections included restricted and banned pesticides.**

**Different toxicants at different time points**

Gabriel M.W., 2017, Unpublished Data

Current data demonstrate grow site toxicants are not degrading based off EPA or other published accounts. Why?



# Are Grow Sites and Cultivators Poisoning and Poaching Wildlife?

# Dead Wildlife Discovered at Grow Sites have been Reported in Newspaper, TV, Blogs and Magazines

**Illicit marijuana grows decimate western wildlife**

Benjamin Spillman , bspillman@rgj.com Published 3:53 p.m. PT Nov. 30, 2016 | Updated 6:00 a.m. PT Dec. 5, 2016

USA TODAY

*Research shows illicit grows harmful to everything from owls to deer*

capital public radio

**California Illegal Marijuana Grows Killing Wildlife, Damaging Environment**

Amy Quinton

ember 15, 2016 | Permalink

NBC BAY AREA

Poisoned Parks: Illegal Marijuana Growers Leave National Parks Trashed, Animals Dead

**Going to Pot**

Humboldt County's marijuana boom is destroying a unique redwood forest ecosystem and killing some of California's rarest wildlife. Now veteran pot farmers are fighting the 'green rush' to make cannabis cultivation truly sustainable.

Law Enforcement Discovers and Reports Dead Wildlife Discovered at Grow Sites

## Growers also Record the Wildlife they Poison or Poach

## Growers also Record the Wildlife they Poison or Poach

However, collection and retention of a robust data set for this issue is lacking but is much needed.

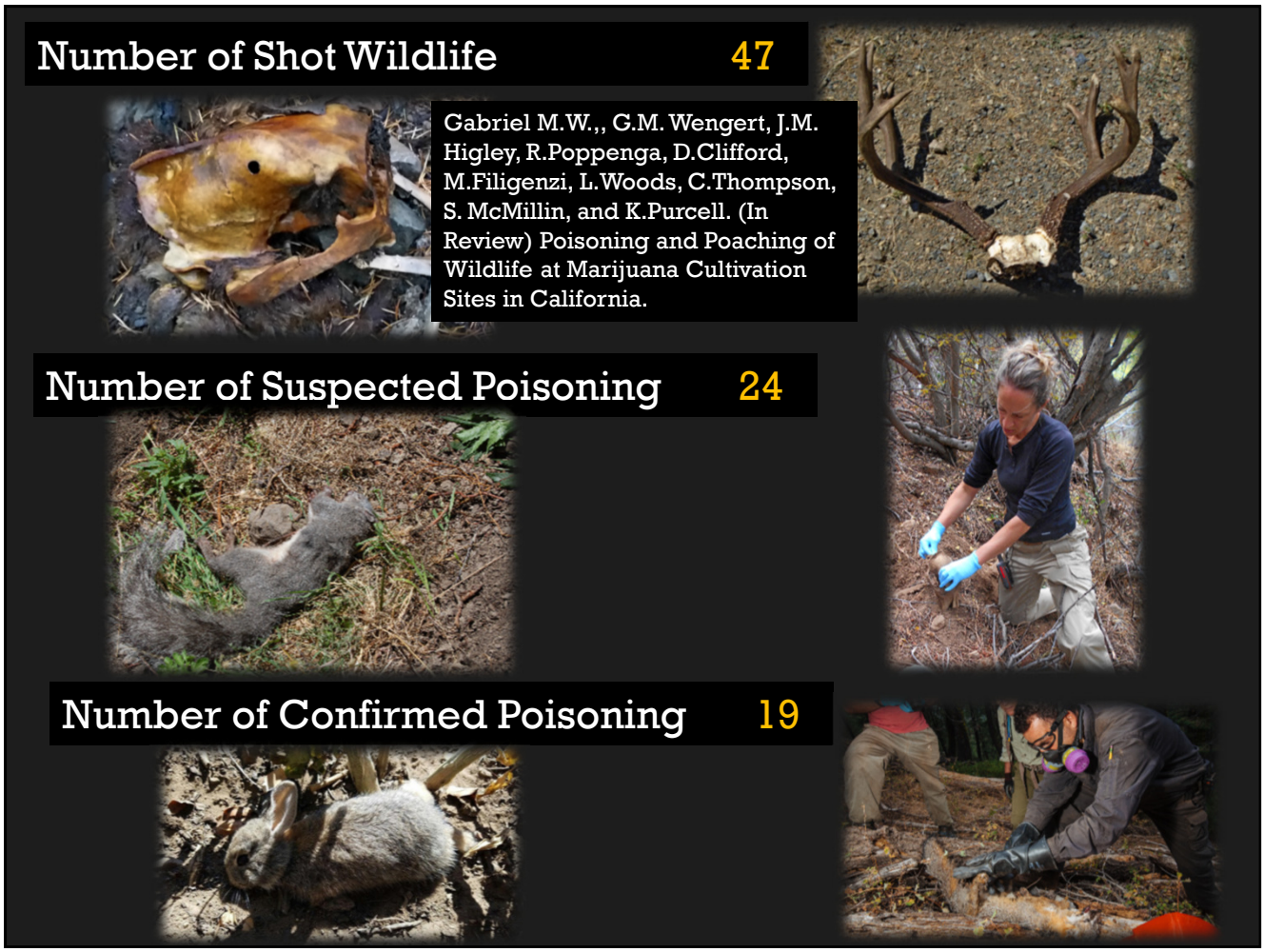
Our Science Team Set off to Answer

- What species are being killed?
- What toxicants are being used to poison wildlife?
- What is the potential motive?
- What are the methods growers are using?
- What is the potential state-wide mortality from these sites?

## Number of Dead Wildlife Discovered

- Total of **90** dead animals discovered out of 85 sites.
- 46 of 85 (**54%**) locations we detected dead wildlife.

Gabriel M.W.,, G.M. Wengert, J.M. Higley, R.Poppenga, D.Clifford, M.Filigenzi, L.Woods, C.Thompson, S. McMillin, and K.Purcell. (In Review) Poisoning and Poaching of Wildlife at Marijuana Cultivation Sites in California.


Number of Shot Wildlife 47
Gabriel M.W.,, G.M. Wengert, J.M. Higley, R.Poppenga, D.Clifford, M.Filigenzi, L.Woods, C.Thompson, S. McMillin, and K.Purcell. (In Review) Poisoning and Poaching of Wildlife at Marijuana Cultivation Sites in California.
Number of Suspected Poisoning 24
Number of Confirmed Poisoning 19

## Notable Observed Data: Deer

16 deer were males (bucks)

- Many males taken from X zones (coveted draw hunt zones)

- Many of the deer were killed with air rifles.

- 13 Does and 2 Fawns killed
  - During fawning/rearing season
  - Additive mortality due to orphaning.

Gabriel M.W.,, G.M. Wengert, J.M. Higley, R.Poppenga, D.Clifford, M.Filigenzi, L.Woods, C.Thompson, S. McMillin, and K.Purcell. (In Review) Poisoning and Poaching of Wildlife at Marijuana Cultivation Sites in California.

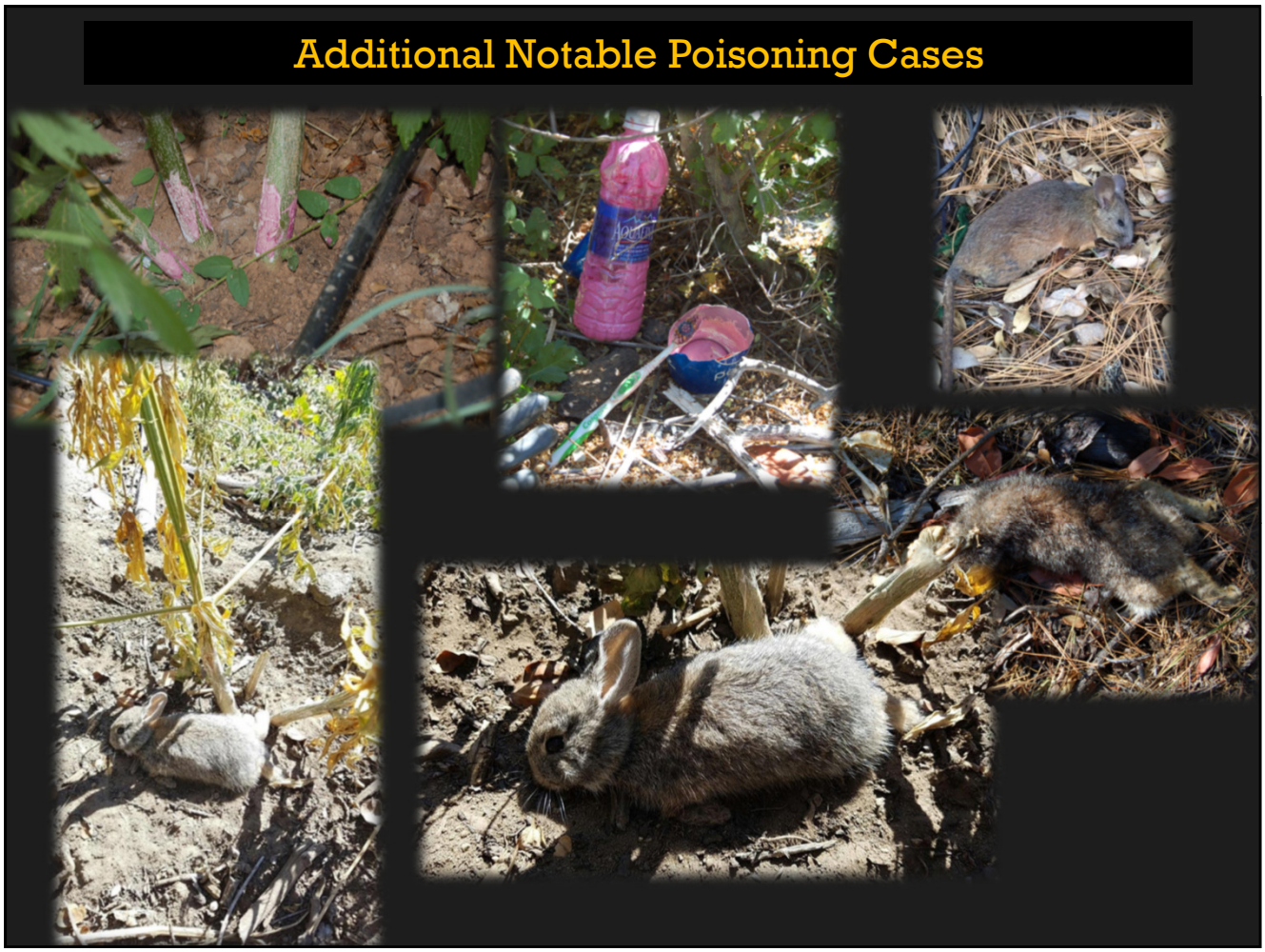
# Additional Notable Poisoning Cases

Gabriel M.W.,, G.M. Wengert, J.M. Higley, R.Poppenga, D.Clifford, M.Filigenzi, L.Woods, C.Thompson, S. McMillin, and K.Purcell. (In Review) Poisoning and Poaching of Wildlife at Marijuana Cultivation Sites in California.

## Two Separate Locations

- Location 1: One dead gray fox with nearby food items.
  - Nestled in the fox is a dead vulture.
- Location 2: One dead bear with nearby food items.
  - ≤ 2meters is a dead vulture.

NOTE: Many dead and dying flies. Positive for Carbofuran


Additional Notable Poisoning Cases

## How they viewed Wildlife

- Wildlife as nuisance, pest or food items.
- Shot wildlife because they were "bored".

## How they Approached Nuisance Wildlife

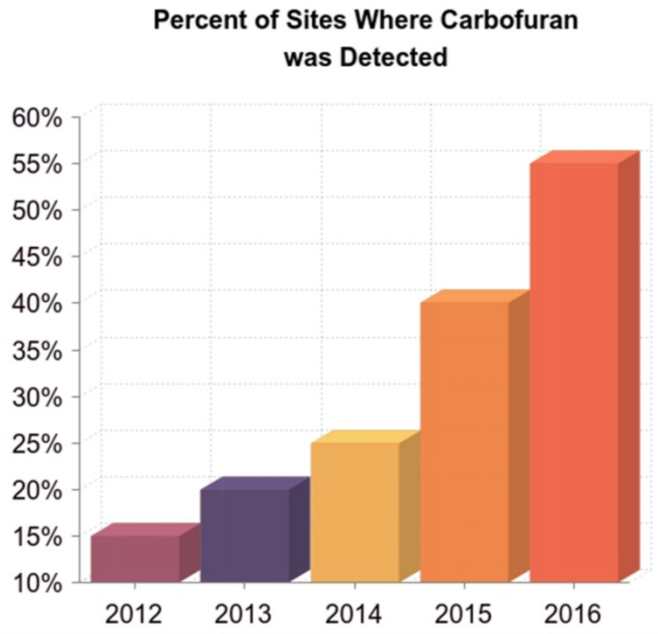
- Just shot at them.
- Placed poisons on MJ or native plants to discourage plant damage.
- Placed poisons on raw food.

Gabriel M.W.,, G.M. Wengert, J.M. Higley, R.Poppenga, D.Clifford, M.Filigenzi, L.Woods, C.Thompson, S. McMillin, and K.Purcell. (In Review) Poisoning and Poaching of Wildlife at Marijuana Cultivation Sites in California.

## Carbofuran, a Carbamate

- Banned for ALL legal uses in the United States, Canada and the European Union.
- Banned for its high toxicity to humans and the environment.
- ¼ Teaspoon can kill an African Lion

# Trend of Carbofuran Use at Cultivation Sites in California




Gabriel M.W.,, G.M. Wengert, J.M. Higley, D.Clifford, S.Frick, R. Gaske, D. Little, P.Jordan, B.Lynch, R.Poppenga, C.Holland, M.Filigenzi, S.McMillin, and D.Clayton (In Review) Current and Projected Toxicant and Fertilizer Use at Marijuana Cultivation Sites on Public Lands in California and Southern Oregon: Four Year Trends of Landscape Impacts to Watersheds and Forest Lands.

## What About Water Use Rates for Sites?

Humboldt County Outdoor Medical Cannabis Ordinance Draft (2010)

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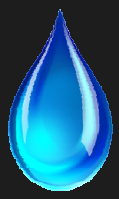

6 gallons a day

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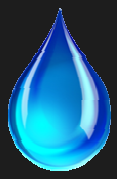
150 days



**900 gallons per plant/season**

**Is 6 gallons a day realistic for outdoor- trespass cultivation?**

- Evapotranspiration
- Local climate
- Plant health

Gabriel M.W., 2017, Unpublished Data

**Not Likely**

Current water use data for trespass sites

**Avg: of 9.5 gallons per plant, per day**

**1,425 gallons per plant/season**

## Estimation of Public Land Water Use: California

**1,425 gallons per plant, full season**

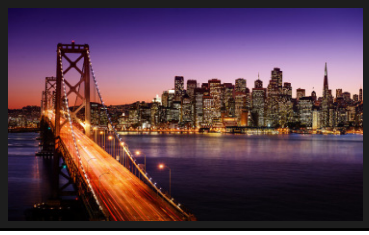
2012: ~870,000 plants = **1.24 Billion gallons**

2013: ~500,000 plants = **712 million gallons**

2014: 500,000+ plants = **712 million gallons**

2015: 640,000 plants = **912 million gallons**

2016: 1,000,000+ plants = **1.43 Billion gallons**



Each Year: Amount of San Francisco households uses: **+ 1- 2 months**

7 lines at 8 gallons per min. =
3,360 gallons per hour or
80,640 gallons per day
29.4 million gallons per year
IERC
Integral Ecology Research Center

## Is Marijuana Cultivation On Public and Tribal Lands Decreasing?

- Caveat: Law Enforcement detects 20-50% of all sites
- Eradicated sites: Of those found, only 10-20% are reclaimed

SUCCESS
SOLUTION
PROBLEM

## Focus Areas to Offset Environmental Impacts

**Enforcement**
Disrupting sites

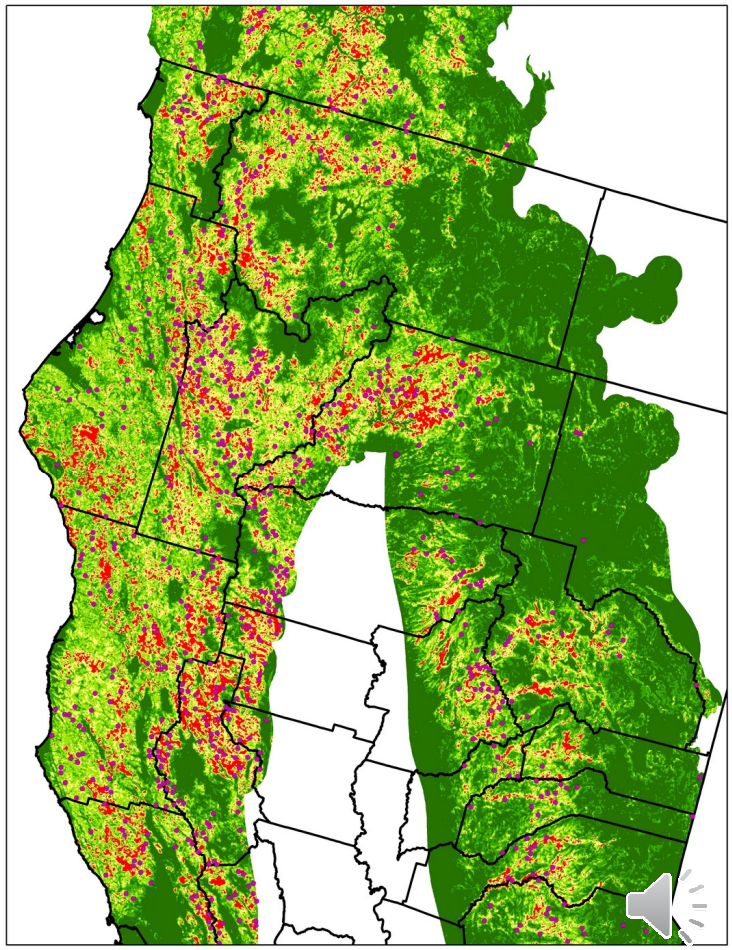
**Interdiction**
- Preventing establishment of sites.

**Removal**
- Removing sites

Wengert, G.M., 2017, Unpublished Data

## MaxEnt Modeling

- Using an exclusive LE database to model and predict risks for grows.
- Conservation and LE use.
- Ground Truthing to refine models.



- Randomly chose 13 streams.
- Surveyed for grow sites, only **0.5%** of N.W. CA.
- Detected **11** new grow sites.
- 78% fell within moderate or high risk areas.

Success?

- Allow us to focus time/efforts in selected areas.
- Develop realistic budgets to curtail impacts.

Wengert, G.M., 2017, Unpublished Data

# Reclamation
# Improving Towards Successful Outcomes

Historical Approaches

- Reclamation conducted on the day of eradication.
- Little to no time for site assessment.
  - Increases pesticide exposure risks to personnel.
  - Partial reclamation of sites, rarely full reclamation.

## "Reclaimed" site visits

Gabriel, M.W., 2017, Unpublished Data

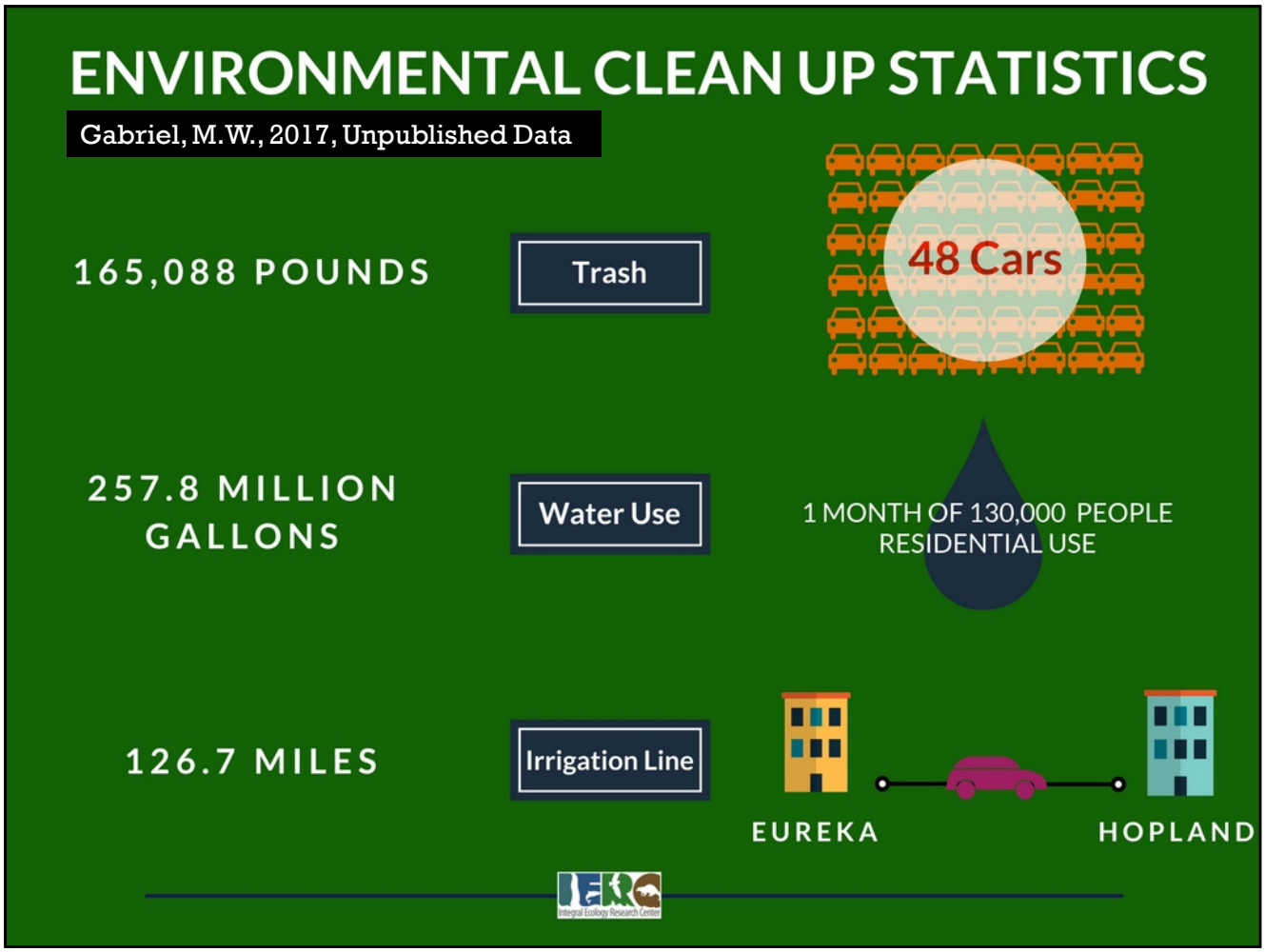
- Visited several historical sites considered "reclaimed".
- All sites had either trash, food, infrastructure, toxicants or dams.
  - 50-70% reclaimed success.
- New Protocol: IERC and USFS-LEI and Plumas National Forest
  - New techniques and procedures.
  - Safe approach for human safety.
  - 97-99% FULL reclamation success.

## Reclamation: Improving towards Successful Outcomes

- Use experienced and qualified groups.
  - NGOs, state or federal partners.
  - **Always** partnered with LE

Gabriel, M.W., 2017, Unpublished Data

- 2014-2017: Reclaimed 139 grow sites
  - 44 major cultivation complexes
  - 0% injuries, 0% documented exposure to toxicants.


ENVIRONMENTAL CLEAN UP STATISTICS
Gabriel, M.W., 2017, Unpublished Data
165,088 POUNDS
Trash
48 Cars
257.8 MILLION GALLONS
Water Use
1 MONTH OF 130,000 PEOPLE RESIDENTIAL USE
126.7 MILES
Irrigation Line
EUREKA
HOPLAND

# Thank You & Questions?

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UCDAVIS VETERINARY MEDICINE
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