Anticoagulant Rodenticides and Wildlife

Stella McMillin
California Department of Fish and Wildlife
Wildlife Investigations Laboratory
Pesticide Investigations

- CDFW Wildlife Investigations Laboratory
- Investigate morality incidents
- Report findings to the USEPA, Department of Pesticide Regulation, County Agricultural Commissioners
What are Anticoagulant Rodenticides?

- Cause death by interfering with blood clotting mechanism
- Several days from exposure to death
- Persistent in body tissue
- High potential for secondary exposure
Two different kinds of ARs.

1\textsuperscript{st} Generation (FGAR)
- Multiple feedings
- Less persistent in tissues
- Commensal and outdoor use
- Chlorophacinone, diphacinone, warfarin

2\textsuperscript{nd} Generation (SGAR)
- Intended for single feeding (more toxic)
- More persistent in tissue
- Registered only for commensal use
- Brodifacoum, bromadiolone, difethialone, difenacoum
Two different kinds of ARs.

2nd Generation (SGAR)

- Intended for single feeding (more toxic)
- More persistent in tissue
- Registered only for commensal use
- Brodifacoum, bromadiolone, difethialone
First the SGARs
In the early 1990’s, DFW began receiving animals with signs of anticoagulant toxicosis. Symptoms include unexplained bleeding in the body cavities and subcutaneously and lack of clotting in blood.

Mostly result of secondary exposure.

In 1999, DFW requested that DPR place products with brodifacoum in re-evaluation based on 58 cases of exposure.

USEPA was also considering issue so no action by DPR.

- Brodifacoum (66%)
- Bromadiolone (19%)
- Diphacinone (8%)
- Chlorophacinone (7%)
- Difethialalone (1%)
Persistence of anticoagulants in liver tissue (USEPA)

- **Brodifacoum**: 217 days
- **Bromadiolone**: 248 days
- **Difethialone**: 118 days
- **Diphacinone**: 90 days
- **Warfarin**: 35 days
Acute Oral Toxicity of Anticoagulants to Dogs (LD50 values in mg ai/kg)

Brodifacoum: 0.25 - 1
Bromadiolone: 8.1
Difethialone: 4
Chlorophacinone: 50 - 100
Diphacinone: 3 - 15
Warfarin: 20 - 50
Acute Oral Toxicity of Anticoagulants to Birds (LD50 values in mg ai/kg)

- Brodifacoum: 0.26 - 10
- Difethialone: 0.26
- Bromadiolone: 138-170
- Chlorophacinone: 100-430
- Diphacinone: 400-3158
- Warfarin: 620-2150
Acute Oral Toxicity of Anticoagulants to Cats (LD50 values in mg ai/kg)

- Brodifacoum: 25
- Difethialone: 16
- Bromadiolone: 25
- Diphacinone: 5-15
- Warfarin: 2.5-20
Necropsies of Anticoagulant Cases
How do we diagnose AR toxicosis?

- Signs of coagulopathy (abnormal bleeding) without signs of trauma.
- Concentration of AR in liver.
Interpretation can be difficult

- Often more than 1 kind of AR.
- Persistent in liver – don’t know when exposure(s) occurred.
- Each AR has its own toxicological profile for different species.
- Gross necropsy doesn’t tell the whole story.
- Other stressors (disease, trauma, starvation)
Species Impacted

- Golden Eagle
- Great-horned Owl
- Barn Owl
- Red-tailed Hawk
- Red-shouldered Hawk
- Cooper’s Hawk
- American Kestrel
- Turkey Vulture
- Canada Goose
- Black bear
- Fisher

- Red Fox
- Gray Fox
- SJ Kit Fox
- Coyote
- Mountain Lion
- Bobcat
- Kangaroo Rat
- Raccoon
- Badger
- Wild Pig
Summary of Mortality Data

- Current list contains over 350 mortality incidents.
- Mortality database under-represents number of wildlife impacted.
Monitoring Studies Confirm Widespread Exposure

- 79% of San Joaquin Kit Foxes in Bakersfield had been exposed to ARs.
- Mountain Lions and Bobcats: 90% of bobcats, all of mt lions tested in Southern California (Riley, 2007).
- Fishers (Mourad Gabriel, UCDavis): 79% had AR detections.
Conclusions from Mortality and Monitoring Data

- Widespread AR exposure to predators and scavengers
- Mortalities caused by exposure
- Sublethal impacts?
- Multiple exposure scenarios: Urban, Rural, Wilderness
- Illegal/Legal Use?
Illegal Sources

(Gabriel 2012)
ARs at 1 site (Gabriel 2012)

- 1.5 lbs found and removed
- 6.5 lbs empty containers
- Enough to kill 9000 mice
- Enough to kill 4-21 fishers
The Regulatory Battlefield: USEPA

- 2008: USEPA Risk Mitigation Decision: SGARs not available to general consumer.
- 3 companies sued USEPA – USEPA moved to cancel noncompliant products.
- D-con sued. Still available over the counter while USEPA holds cancellation hearing.
- First time in 20 years a company has not complied!
The Regulatory Battlefield: California
Rural Exposure Risks

- Loophole: SGAR availability at farm stores in large packages (>8 lbs) for use inside and around ag buildings.
- FGARs restricted use for field applications: easier to obtain SGARs
- Rural exposure likely route for bobcats, mtn lions
CDFW Recommendation

- CDFW recommended in 2011 that Department of Pesticide Regulation make SGARs Restricted Use Materials (need a license to buy or use).
- The goal of this recommendation is to prevent the public from buying these products at farm stores (and other retail outlets).
- Available only to certified applicators.
Regulation Change

- CDPR agreed with our recommendation
- Restricted use materials
- Decrease allowable distance from structures
- Regulation change: July 2014
- D-con lawsuit
Contra Costa County 2013

- 6 investigations of wildlife losses
- All raptors
# 2013 Contra Costa losses

<table>
<thead>
<tr>
<th>Species</th>
<th>Cause of Death</th>
<th>Pesticides Detected</th>
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<tbody>
<tr>
<td>Red-tailed hawk</td>
<td>Probable AR</td>
<td>Brodifacoum 0.32 ppm</td>
</tr>
<tr>
<td>Red-tailed hawk (7)</td>
<td>Not determined</td>
<td>None</td>
</tr>
<tr>
<td>Red-shouldered hawk</td>
<td>AR</td>
<td>Brodifacoum 0.39 ppm</td>
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<tr>
<td>Barn owl</td>
<td>AR</td>
<td>Brodifacoum 0.017 ppm</td>
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<tr>
<td>Red-shouldered hawk</td>
<td>AR</td>
<td>Brodifacoum 0.52 ppm</td>
</tr>
<tr>
<td>Red-shouldered hawk</td>
<td>AR</td>
<td>Brodifacoum 0.4 ppm</td>
</tr>
</tbody>
</table>
Now FGARs
The Question of FGARs

- SGARs clearly a threat to non-target wildlife.
- FGARs less clear.
- Greater toxicity than mammals to birds.
- Mortalities not common.
- Exposure more common in felids and canids than raptors.
- Sub-lethal impacts?
Detections of FGARs: 2013 (DFW only)

- 42/43 animals tested contained ARs
- 40/43 brodifacoum
- 10/43 diphacinone (mt lions, bobcats, gray fox, DKF, coyote, CSO). All had other ARs as well.
- 1/43 warfarin (mt lion)
UCLA’s Study

- Bobcats in Orange and LA County
- Sampled blood in ~200 bobcats
- ~30% had diphenacpine exposure
- Liver samples were more likely to show SGARs.
- Possible connection to mange.
Monitoring for First Generation ARs

- SJKF: 10%
- Raptor: 0-2%
- Bobcats: 31%
- Fishers: Diphacinone: 15 - 18%
  Chlorophacinone: 8 - 12%
Use Trends: FGARs

- Chlorophacinone
- Diphacinone
Other Rodenticides

- Other rodenticides are also toxic to vertebrates
- Burrow fumigants may kill everything in burrow.
- Acute toxicants can kill non-target wildlife (strychnine, bromethalin).
What's in that burrow?
USEPA’s Comparative Analysis

- Mortality (secondary hazard to birds and mammals)
- Blood retention
- Liver retention
USEPA’s Risk Model

High Risk
- Brodifacoum
- Zinc Phosphide
- Difethialone
- Diphacinone
- Bromadiolone
- Chlorophacinone
- Cholecalciferol
- Warfarin

Lower Risk
- Bromethalin
What can we do?

- Monitoring.
- Careful use practices.
- Reporting and investigating.
- Tinkering with old tools and developing new ones.
- Increased regulation when necessary.
Working together, we can protect wildlife!