Weeds, Wildlife & Herbicides:
BMPS for protecting special-status species when using herbicides for invasive plant management

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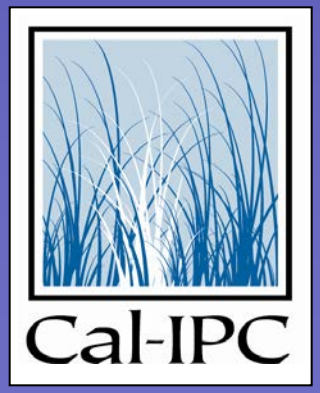


IPM

Cal-IPC policy to support:

- **Integration of program approaches (prevention, surveillance, EDRR, mapping, control, revegetation, monitoring)**
- **Integration of control methods (mechanical, chemical, biological and cultural), with…**
- **Consideration of safety, ecological impact, effectiveness, efficiency, and practicality**
- **Site-specific choices**

Balancing act

- **Mitigate one stressor:** Invasive weed control can assist in the recovery of special status (i.e. threatened or endangered) plant and animal species by removing exotic competitors and improving habitat quality.

- **Avoid creating others:** In some cases, however, invasive weed control efforts can pose risks to these species through disturbance or contact with herbicide residues.

Herbicide use

Potential benefits:

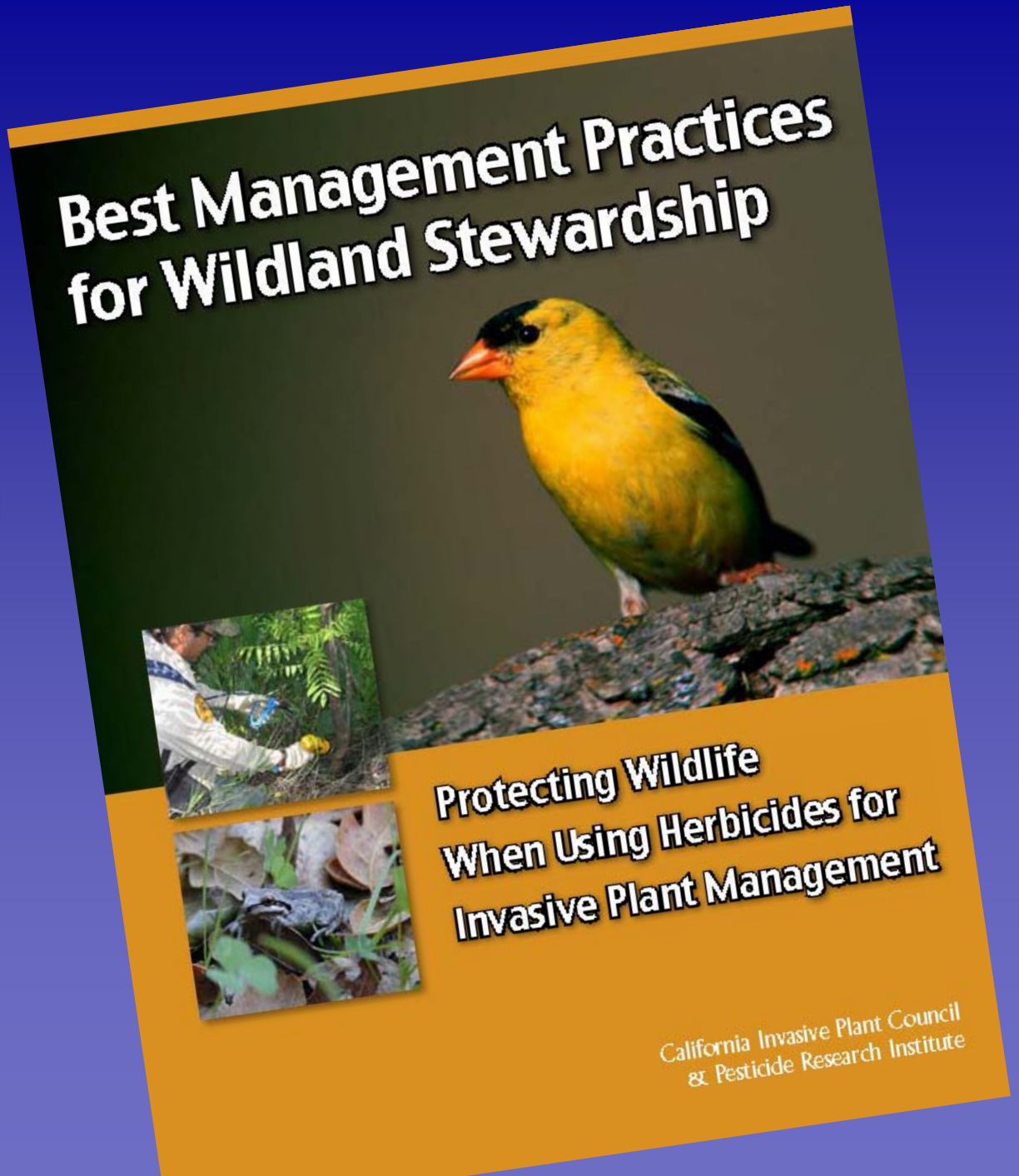
- Less physical disturbance of habitat
- More effective and efficient
- Safer for worker

Grant to:

- Research and promote BMPs
- Leverage better collaboration among stakeholders

Worked with:

- Dr. Susan Kegley, Pesticide Research Institute
- Technical advisory team



BMPs

Two key sources:

- **Expert knowledge from longtime land managers**
- **Latest findings from wildlife toxicology**

Survey of land managers

How many years have you worked in the field of invasive plant management?

0-2 years

3-5 years

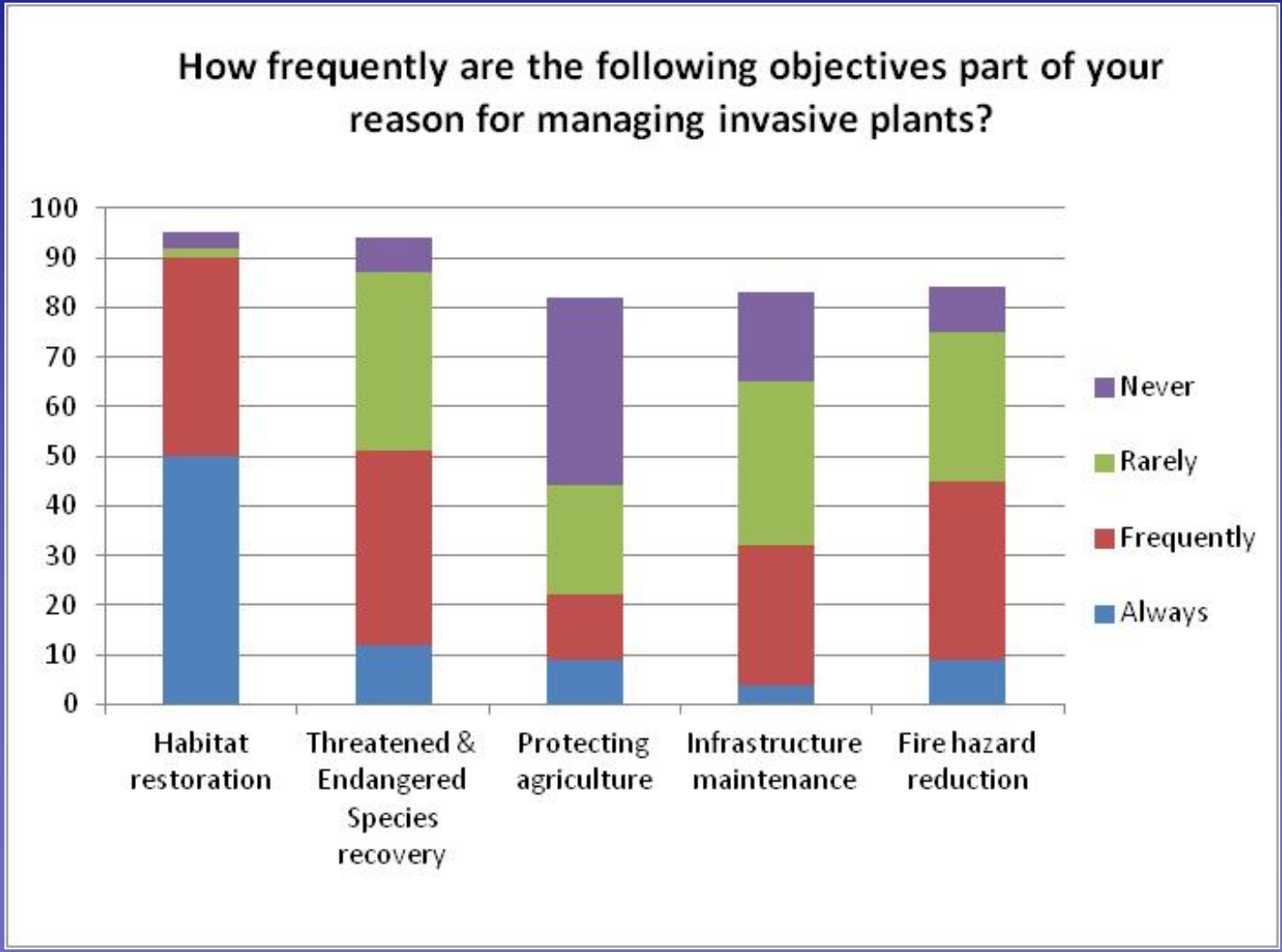
6-10 years

over 10 years

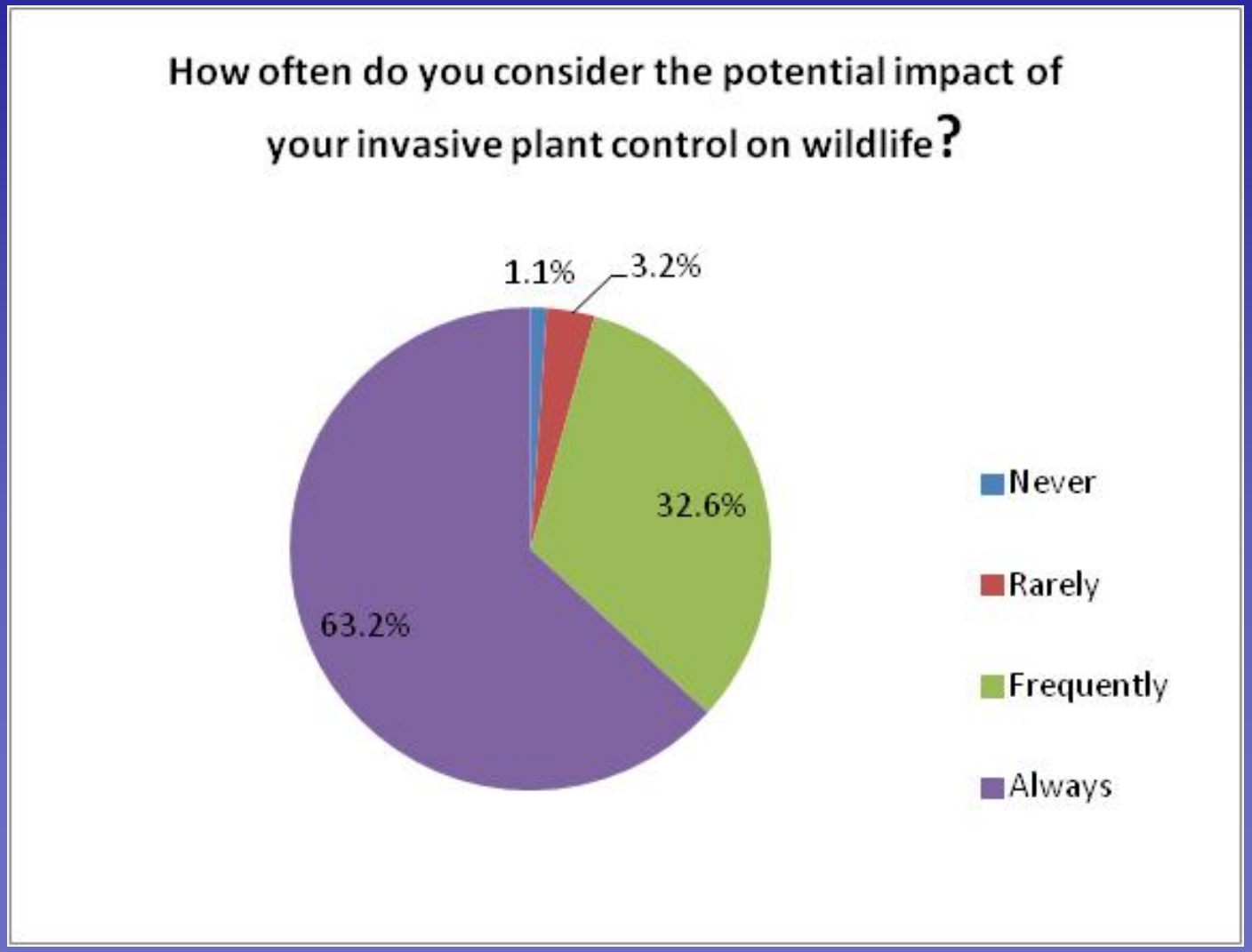
Survey of land managers

Organization	Response
Local agency	54%
Federal agency	53%
State agency	48%
Land trust or other private landowner	40%
Private consultant	26%
Other (including nonprofit organization, forestry company, utility, regional parks district, Resource Conservation District)	27%

Survey of land managers



Survey of land managers

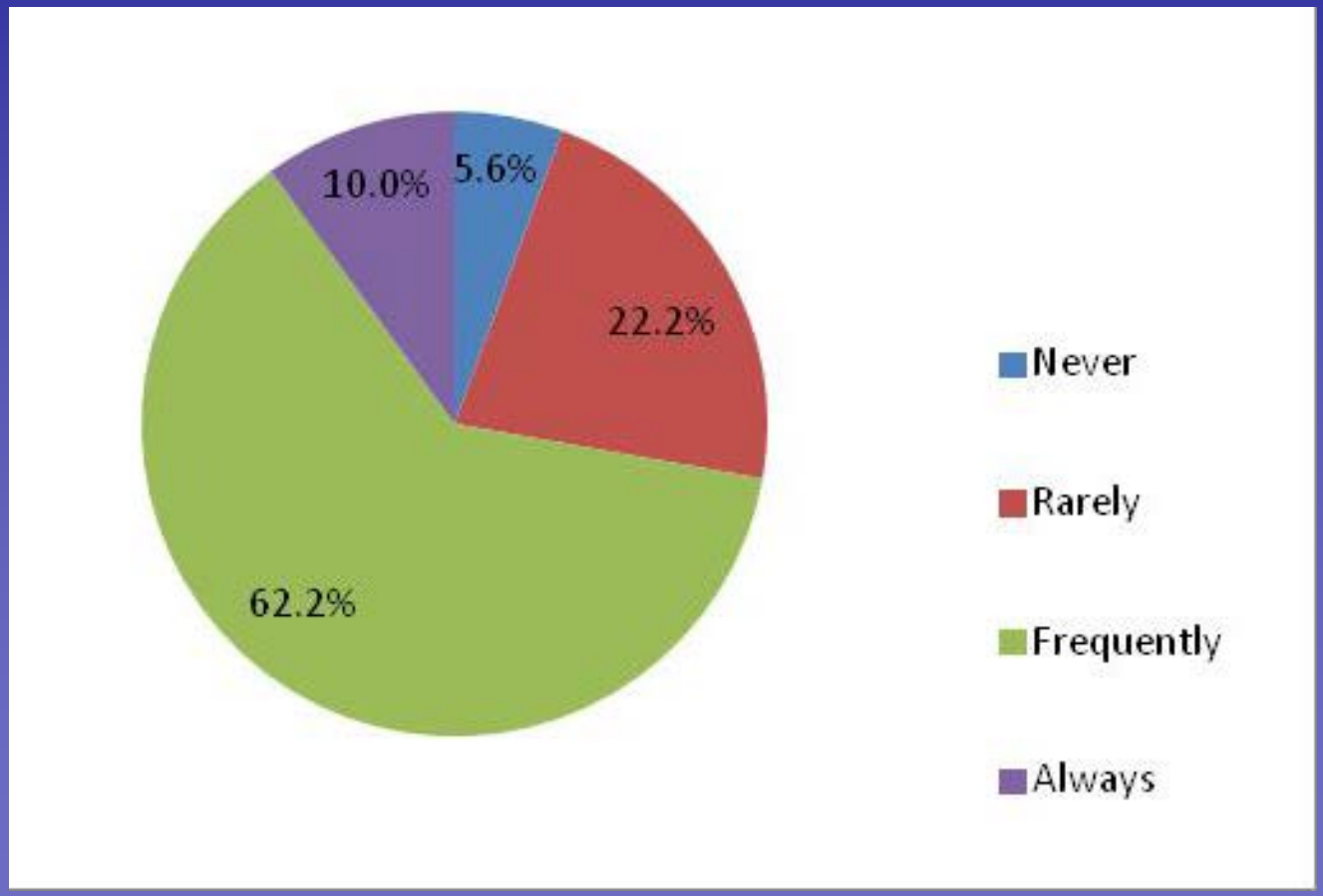


Survey of land managers

Method	Always	Frequently	Rarely	Never
Pulling with hand tools	9%	76%	14%	1%
Digging with hand tools	8%	64%	24%	4%
Cutting with pruners or loppers	7%	59%	27%	7%
Weed whacking with a string or plastic blade	7%	52%	27%	14%
Cutting with a hand saw or chainsaw	3%	52%	34%	10%
Mowing with large equipment	3%	44%	26%	27%
Brushcutting with a metal blade	2%	30%	37%	30%
Grazing	0	29%	23%	47%

Survey of land managers

How often do you use herbicides for invasive plant control?



Survey of land managers

Method	Always	Frequently	Rarely	Never
Foliar spray - spray to wet	8%	69%	19%	4%
Foliar spray - thin line	1%	13%	30%	55%
Foliar spray - low volume/high concentration	1%	22%	35%	42%
Basal bark application	2%	17%	44%	37%
Cut stump application	4%	49%	35%	13%
Drill and inject application	1%	11%	30%	58%
Girdling or frilling application	1%	5%	43%	51%
Broadcast application	1%	23%	45%	31%
Wick application	2%	6%	44%	48%
Aerial application	0%	4%	13%	83%

Survey of land managers

Active Ingredient	Response Percent
Glyphosate (e.g. RoundUp®, Aquamaster®)	99%
Triclopyr (e.g. Garlon 3A®, Garlon 4®)	74%
Aminopyralid (e.g Milestone VM®)	50%
Clopyralid (e.g. Transline®, Reclaim®)	45%
Imazapyr (e.g. Chopper®, Stalker®, Habitat®, Arsenal®)	42%
Chlorsulfuron (e.g. Telar®)	31%
Fluazifop (e.g. Fusilade®)	20%
2,4-D (e.g. Amine 4®, Weedar®)	12%
Acetic acid	6%
Clove oil (e.g. Matran®)	5%
Pelargonic acid (e.g. Scythe®)	2%

Survey of land managers

Method	Response
Adjusting the timing of field work to minimize impacts on species reproduction (for example: not cutting vegetation during bird nesting season).	87%
Avoiding application of herbicides near water.	83%
Using targeted herbicide application methods (like cut-stump techniques or spot spraying) instead of broadcast spraying.	81%
Using mechanical methods instead of herbicides to avoid wildlife exposure to herbicide.	73%
Adjusting the timing of field work to occur during the dry season to avoid herbicide runoff to waterways.	65%
Using herbicides instead of mechanical methods to avoid physical damage to habitat.	56%
Setting limits on the amount of herbicide to be used and/or the number of acres to be treated.	47%
Leaving untreated "reserves" in the treatment area to maintain wildlife habitat.	18%

BMPs

General wildlife:

- Know your site
- Record wildlife observations
- Create separation between wildlife and treatment areas

BMPs

General herbicide:

- Consider the full range of control tools
- Consider timing of herbicide application
- Consider herbicide formulations
- Follow safe procedures for transporting, mixing, and loading herbicides
- Plan for what happens after treatment

BMPs

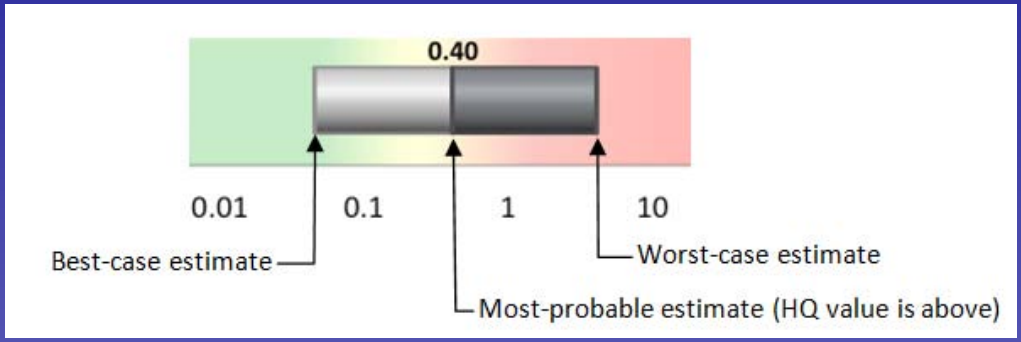
Foliar applications:

- Choose appropriate equipment
- Protect non-target vegetation

Cut-stump applications:

- Make an effective cut
- Use a suitable application tool
- Plan for biomass management after treatment

Risk Charts



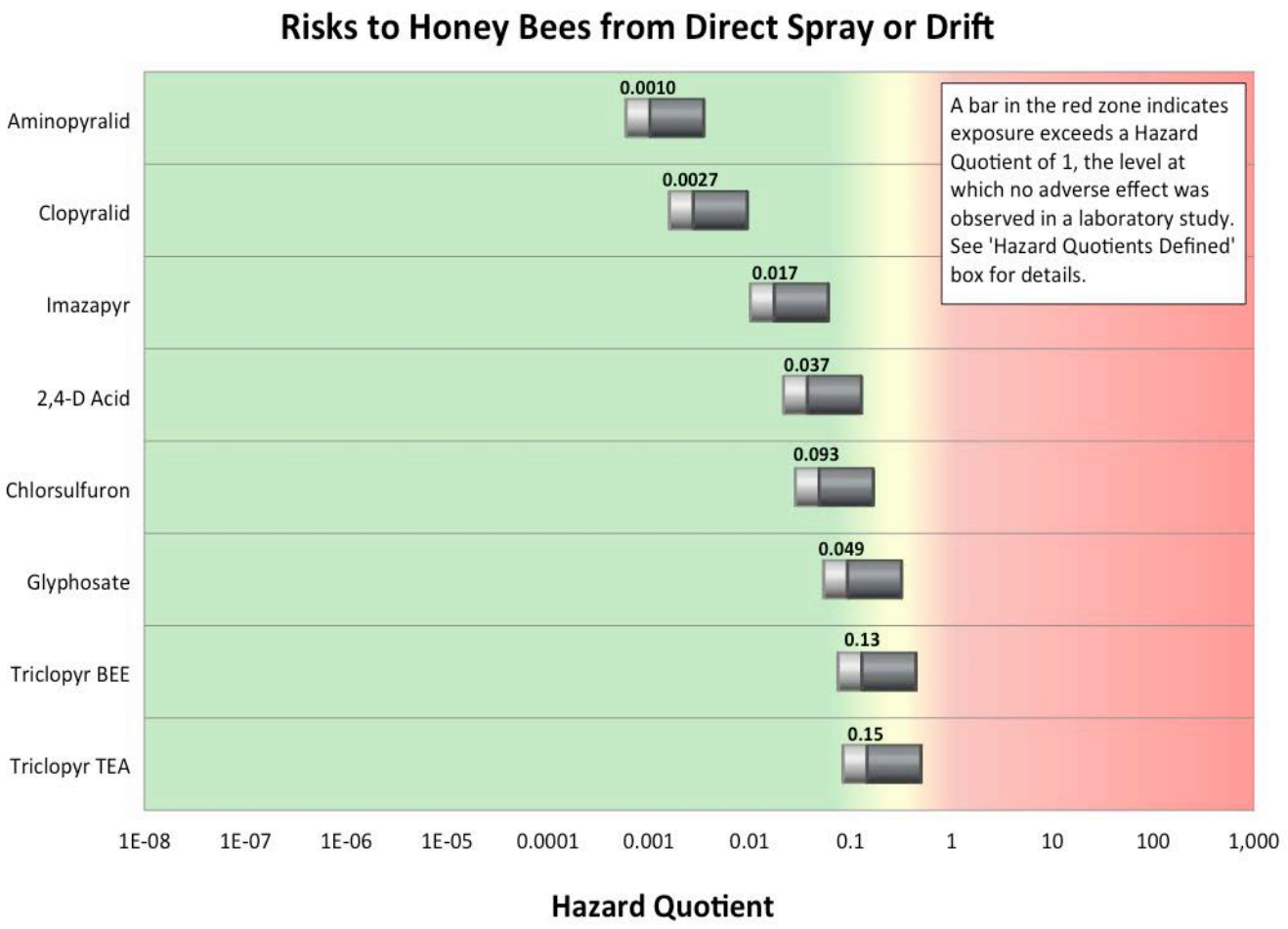
For each chart:

- Taxa
- Assumptions
- Likelihood
- Mitigation
- Risk calculated from…
- Methodology and sources

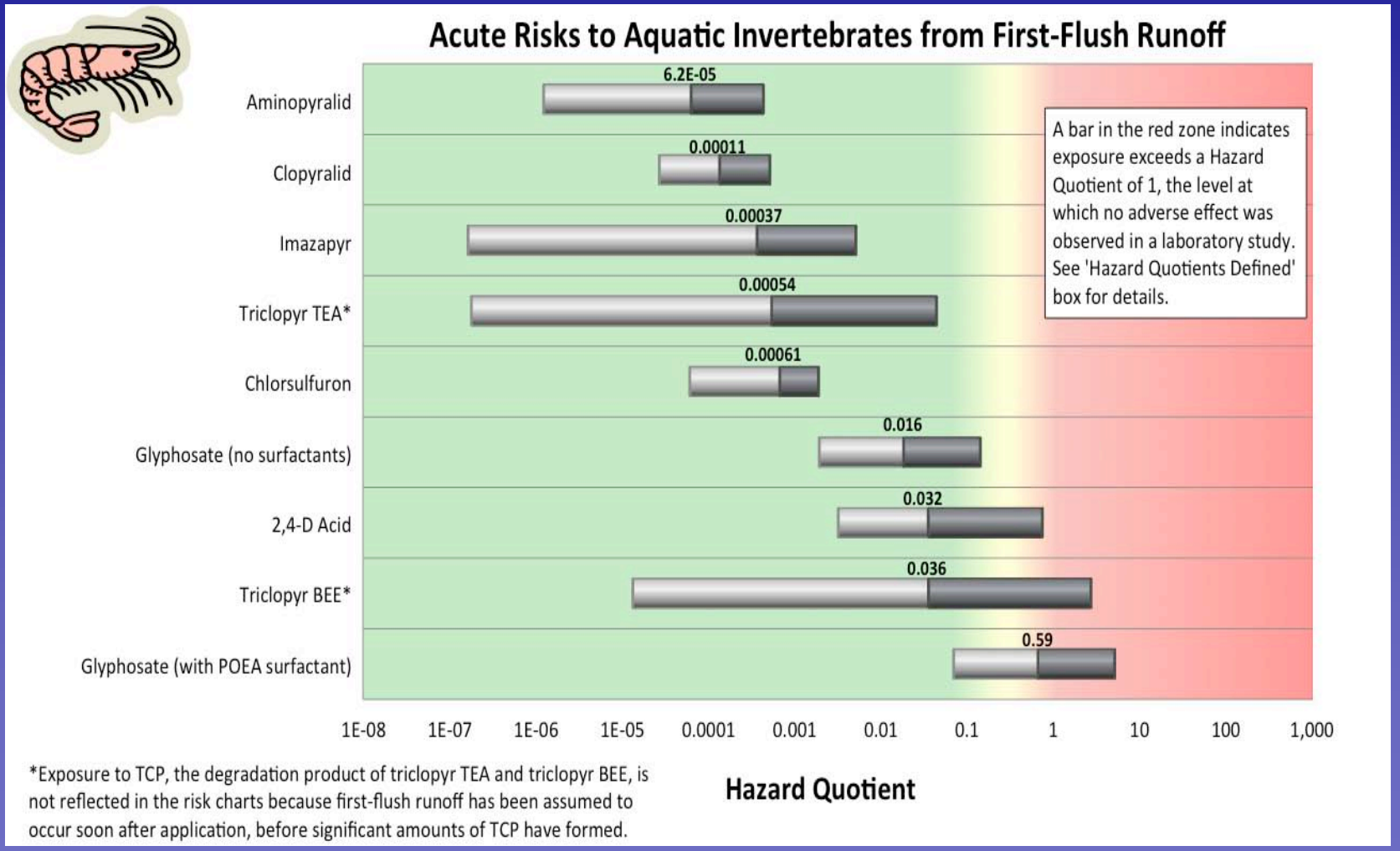
Hazard Quotients Defined

The Hazard Quotient (HQ) is a measure of risk and is defined as the ratio of the predicted exposure to a Toxicity Reference Value (TRV) for the particular type of wildlife being assessed. Hazard quotients above one indicate that exposure exceeds the level of concern, and humans or wildlife may be at risk of adverse effects. For these exposure scenarios, action should be taken by the land manager to reduce impacts. Hazard quotients between 0.1 and 1.0 suggest that there may be particularly sensitive individuals or species that may be affected. Hazard quotients below 0.1 indicate low levels of risk for the effects that have been studied and are represented by the TRVs.

Risk Charts


Risks to Honey Bees from Direct Spray or Drift
Aminopyralid
Clopyralid
Imazapyr
2,4-D Acid
Chlorsulfuron
Glyphosate
Triclopyr BEE
Triclopyr TEA
0.0010
0.0027
0.017
0.037
0.093
0.049
0.13
0.15
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which no adverse effect was observed in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
Hazard Quotient

Risk Charts

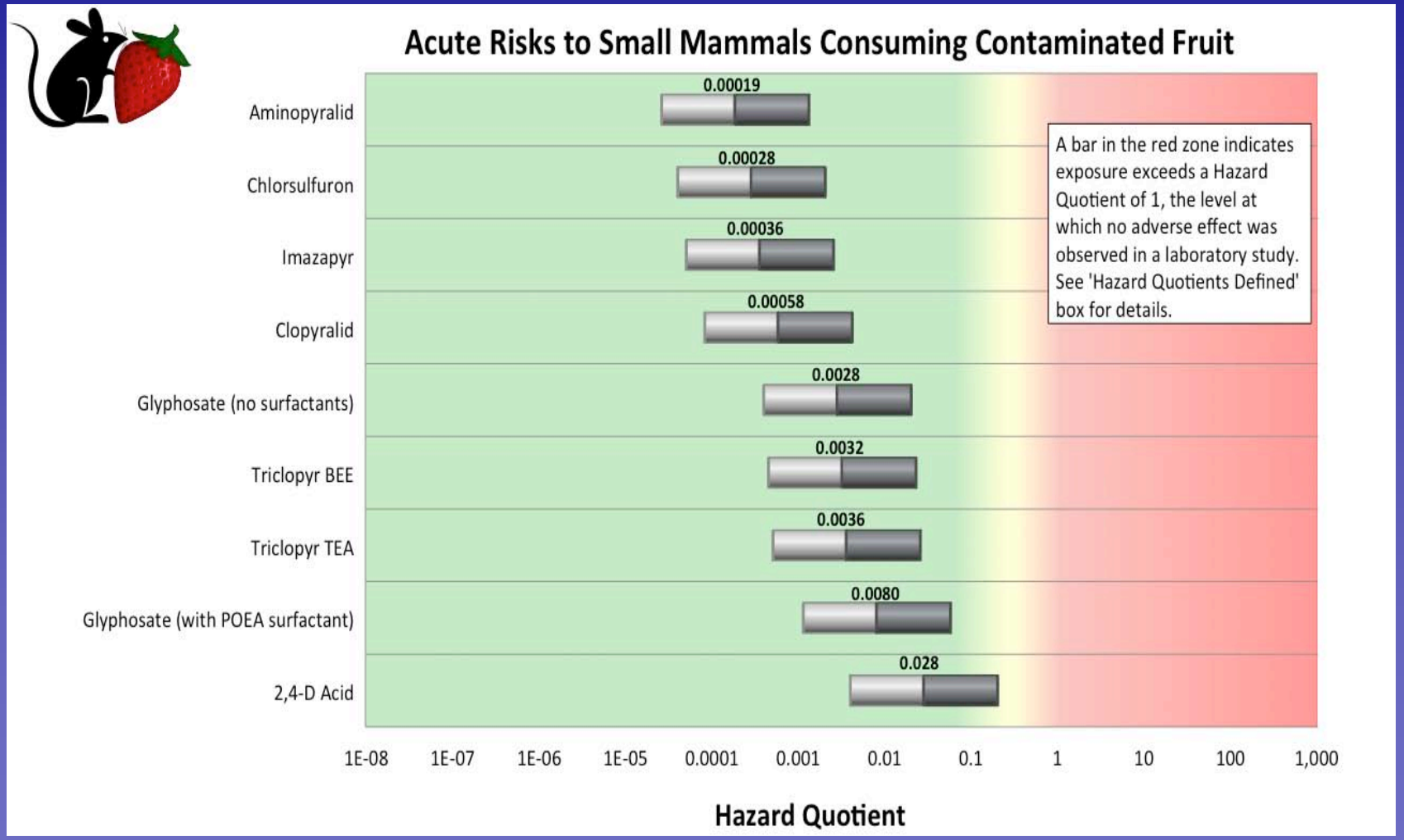


*Exposure to TCP, the degradation product of triclopyr TEA and triclopyr BEE, is not reflected in the risk charts because first-flush runoff has been assumed to occur soon after application, before significant amounts of TCP have formed.

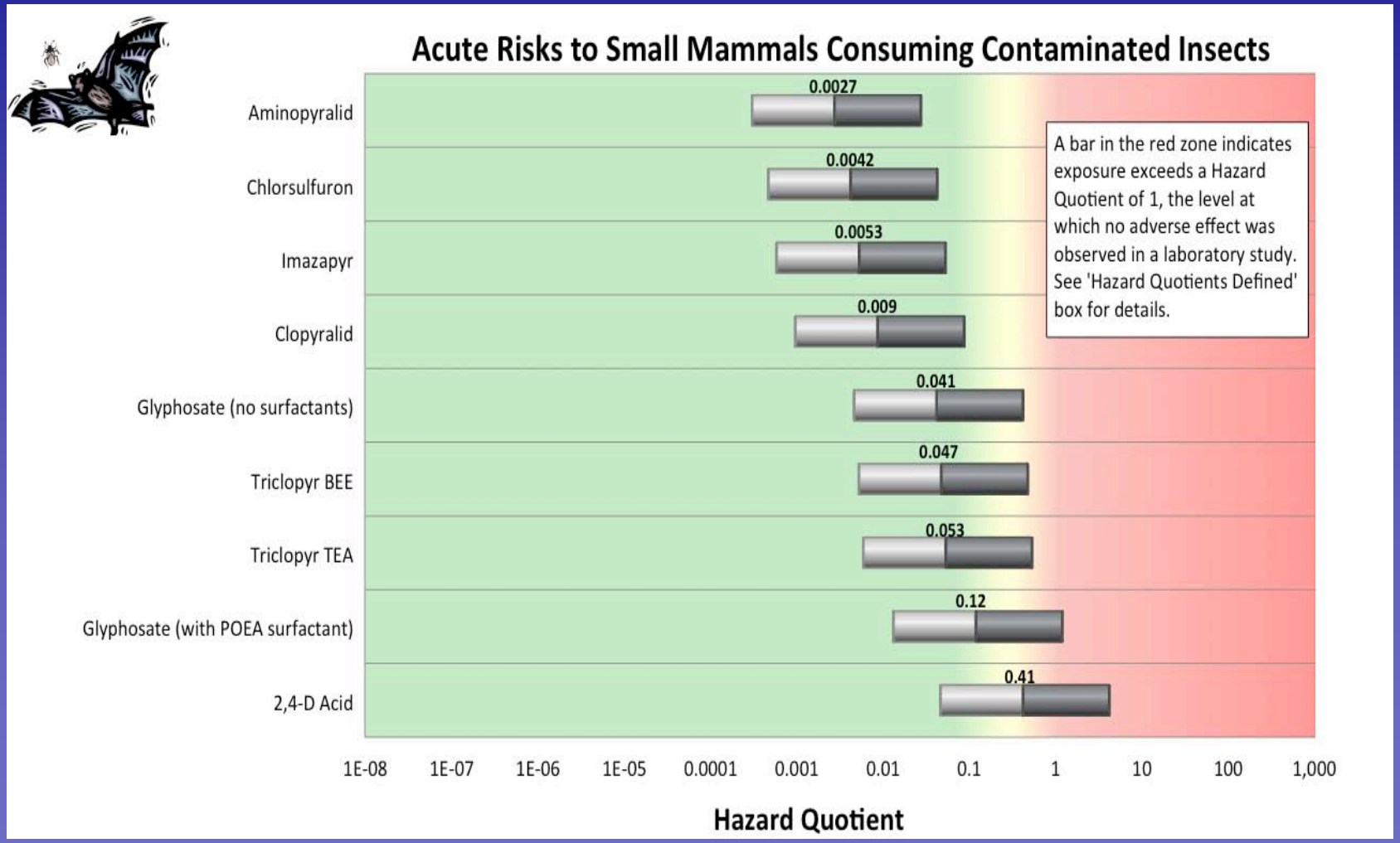
Risk Charts

*Exposure to TCP, the degradation product of triclopyr TEA and triclopyr BEE, is not reflected in the risk charts because first-flush runoff has been assumed to occur soon after application, before significant amounts of TCP have formed.

Risk Charts


Acute Risks to Small Mammals Consuming Contaminated Fruit
Aminopyralid
0.00019
Chlorsulfuron
0.00028
Imazapyr
0.00036
Clopyralid
0.00058
Glyphosate (no surfactants)
0.0028
Triclopyr BEE
0.0032
Triclopyr TEA
0.0036
Glyphosate (with POEA surfactant)
0.0080
2,4-D Acid
0.028
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which no adverse effect was observed in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
Hazard Quotient

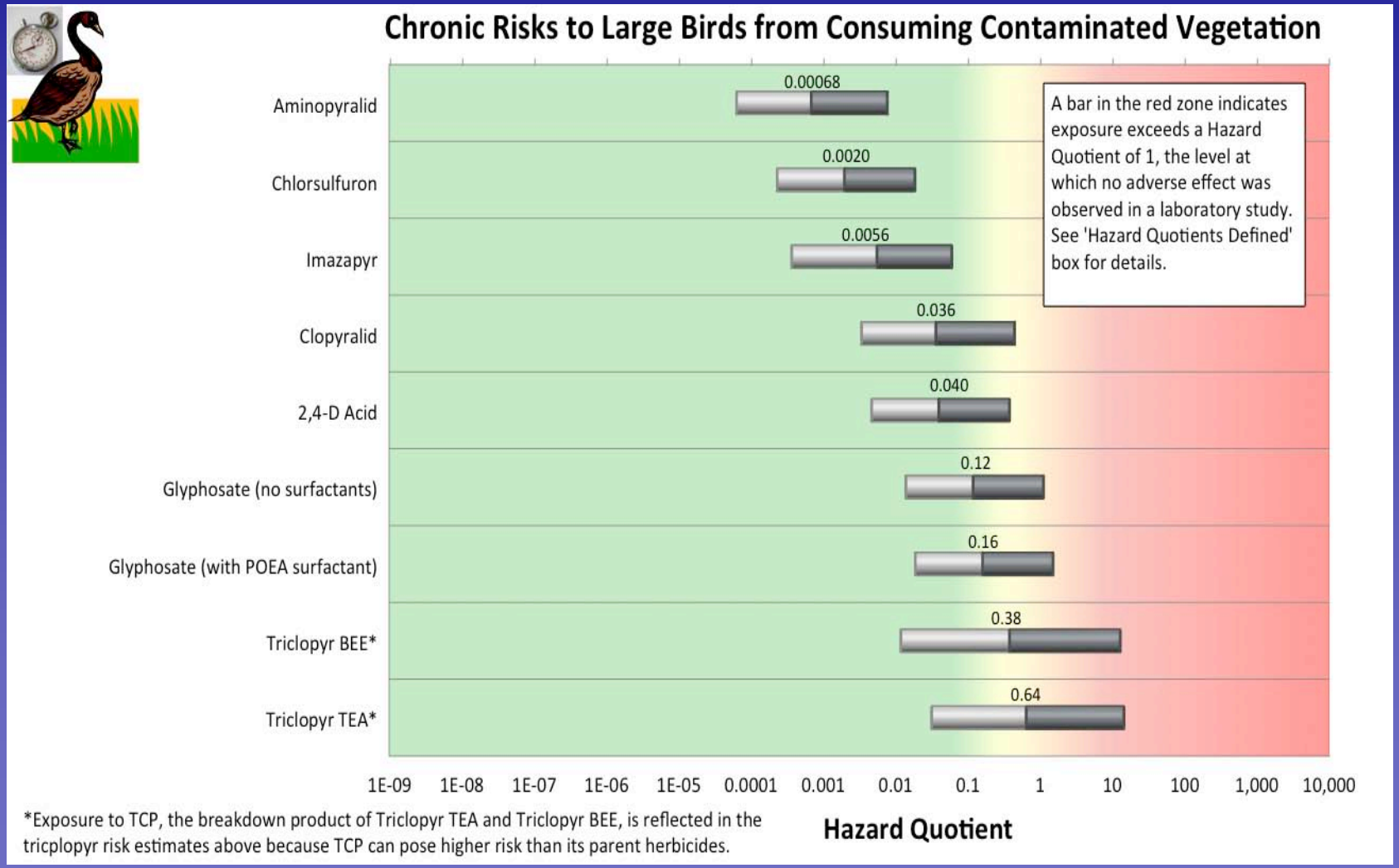
Risk Charts


Acute Risks to Small Mammals Consuming Contaminated Insects
Aminopyralid
Chlorsulfuron
Imazapyr
Clopyralid
Glyphosate (no surfactants)
Triclopyr BEE
Triclopyr TEA
Glyphosate (with POEA surfactant)
2,4-D Acid
0.0027
0.0042
0.0053
0.009
0.041
0.047
0.053
0.12
0.41
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which no adverse effect was observed in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
Hazard Quotient

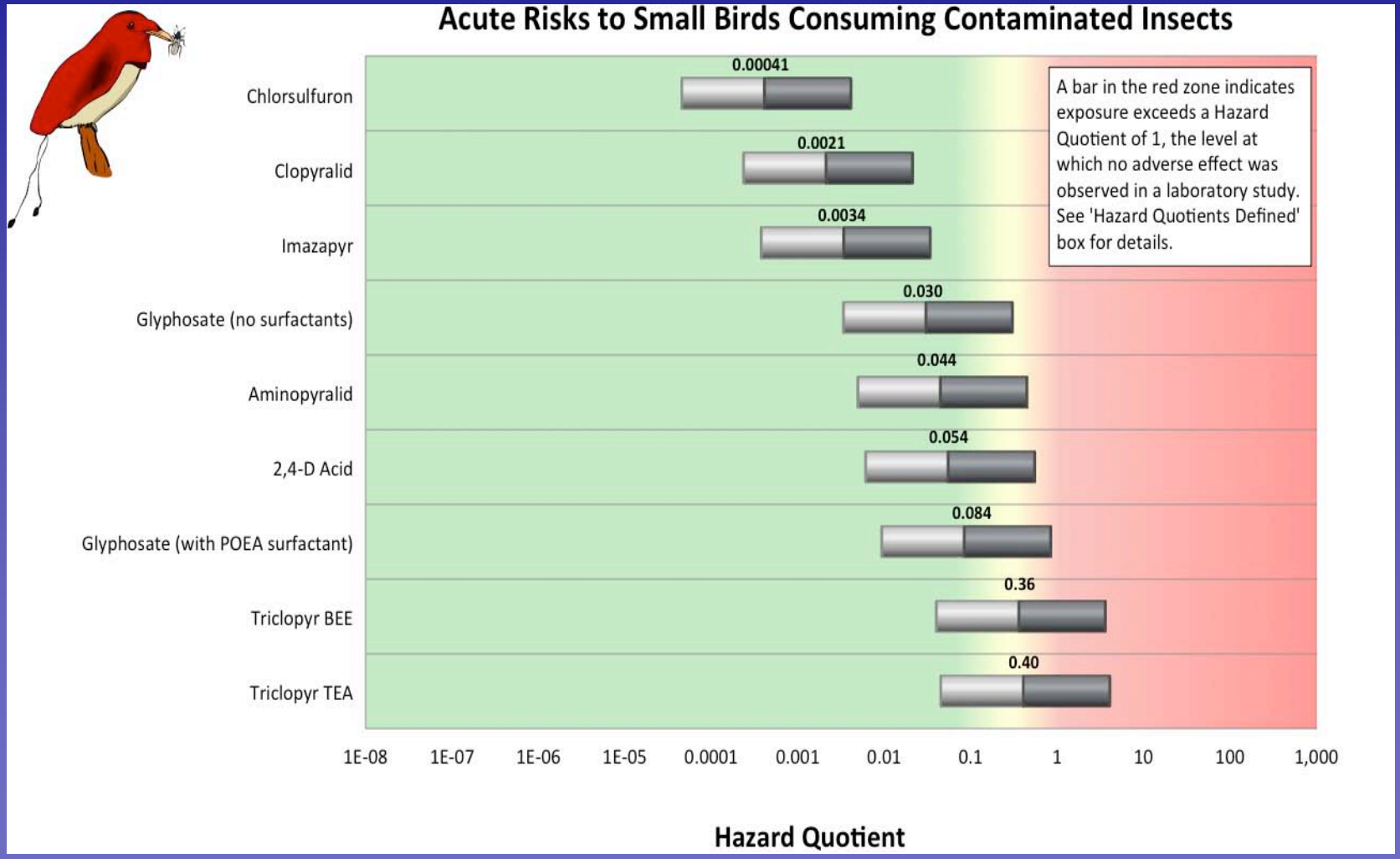
Risk Charts

Chronic Risks to Large Mammals From Consuming Contaminated Vegetation
Aminopyralid
Imazapyr
Glyphosate (no surfactants)
Clopyralid
Glyphosate (with POEA surfactant)
Chlorsulfuron
2,4-D Acid
Triclopyr BEE*
Triclopyr TEA*
0.0013
0.0024
0.0072
0.019
0.021
0.029
0.32
3.7
6.3
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which no adverse effect was observed in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
Hazard Quotient
*Exposure to TCP, the breakdown product of Triclopyr TEA and Triclopyr BEE, is reflected in the tricplopyr risk estimates above because TCP can pose higher risk than its parent herbicides.

Risk Charts


Chronic Risks to Large Birds from Consuming Contaminated Vegetation
Aminopyralid
Chlorsulfuron
Imazapyr
Clopyralid
2,4-D Acid
Glyphosate (no surfactants)
Glyphosate (with POEA surfactant)
Triclopyr BEE*
Triclopyr TEA*
0.00068
0.0020
0.0056
0.036
0.040
0.12
0.16
0.38
0.64
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which no adverse effect was observed in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-09
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
10,000
Hazard Quotient
*Exposure to TCP, the breakdown product of Triclopyr TEA and Triclopyr BEE, is reflected in the tricplopyr risk estimates above because TCP can pose higher risk than its parent herbicides.

Risk Charts


Acute Risks to Small Birds Consuming Contaminated Insects
Chlorsulfuron
Clopyralid
Imazapyr
Glyphosate (no surfactants)
Aminopyralid
2,4-D Acid
Glyphosate (with POEA surfactant)
Triclopyr BEE
Triclopyr TEA
0.00041
0.0021
0.0034
0.030
0.044
0.054
0.084
0.36
0.40
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which no adverse effect was observed in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
Hazard Quotient

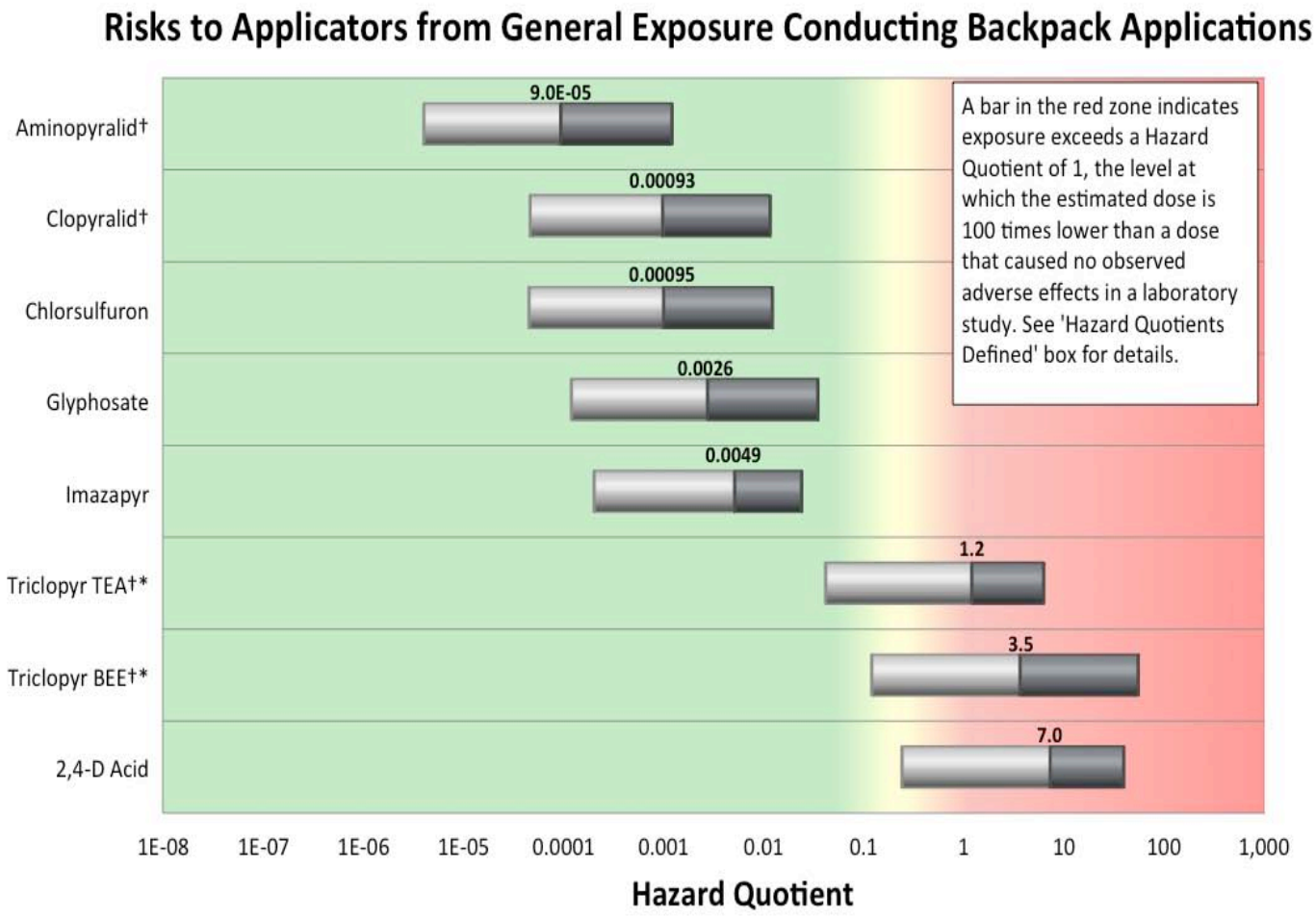
Risk Charts

Acute Risks to Applicators from Wearing Herbicide-Contaminated Gloves for 1 Hour
Aminopyralid
Clopyralid
Chlorsulfuron
Glyphosate
Imazapyr
Triclopyr TEA*
2,4-D Acid
Triclopyr BEE*
3.0E-06
1.6E-05
3.3E-05
0.00018
0.0010
0.13
24
60
A bar in the red zone indicates exposure exceeds a Hazard Quotient of 1, the level at which the estimated dose is 100 times lower than a dose that caused no observed adverse effects in a laboratory study. See 'Hazard Quotients Defined' box for details.
1E-08
1E-07
1E-06
1E-05
0.0001
0.001
0.01
0.1
1
10
100
1,000
Hazard Quotient
*The triclopyr risk estimates account for reproductive and developmental risks of triclopyr to females. For male workers, risk estimates would be lower by a factor of 20, according to USFS methods.

Risk Charts

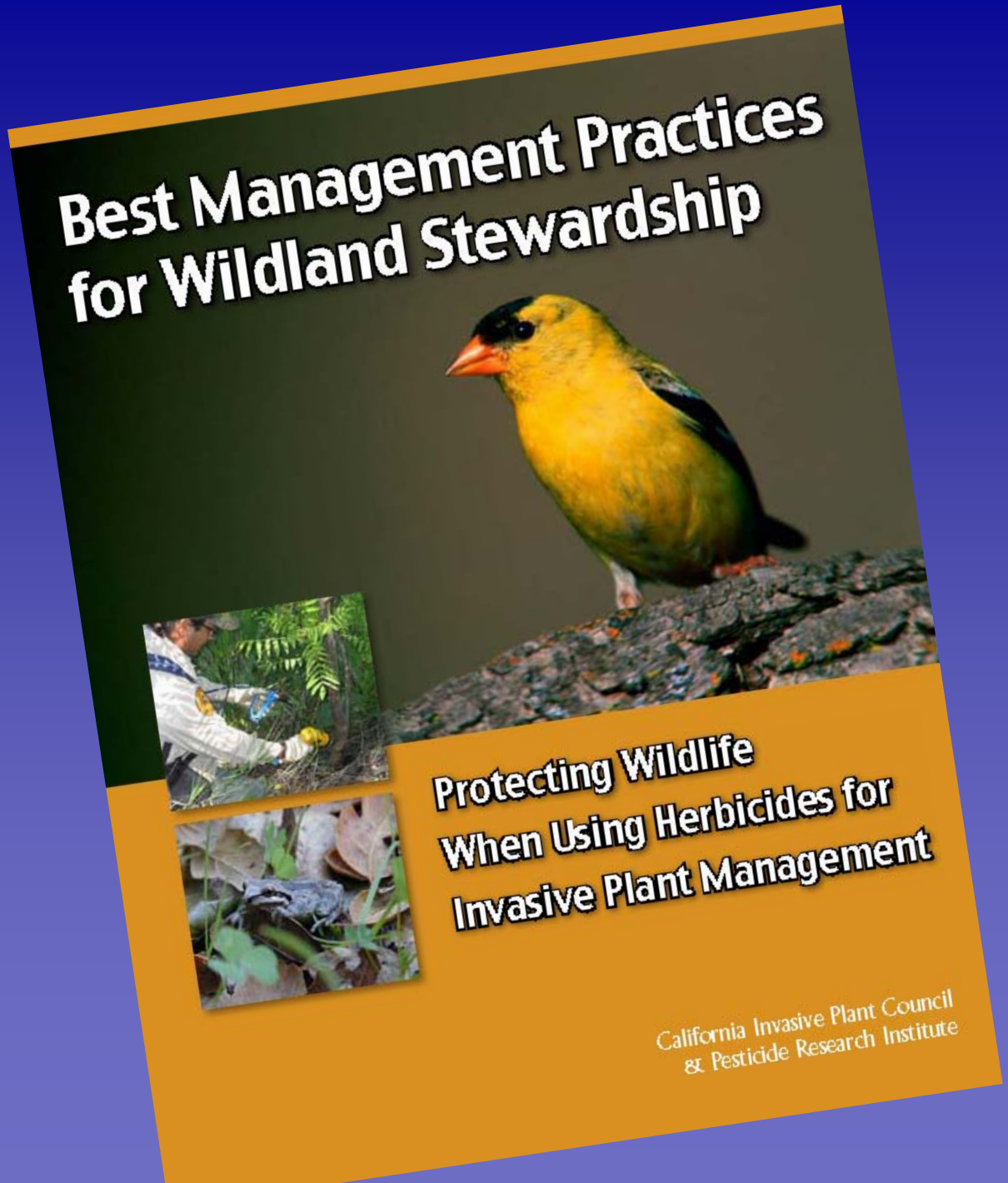
†Empirical absorbed dose rates (ADRs) were unavailable for these herbicides, so ADRs were extrapolated from a similar herbicide with known ADRs using the method described in USFS/SERA 2012 (Table 14 and Equation 22).

*The triclopyr risk estimates account for reproductive and developmental risks of triclopyr to females. For male workers, risk estimates would be lower by a factor of 20, according to USFS methods.



In review

Early 2015



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