Life on Earth

9940 species

9939 birds

1 bird food

Toxic Effects to Terrestrial Fauna

Toxicity

Exposure

Toxicity

Exposure

Toxicity

- Standardized laboratory testing
- Generates indices
- Compare different chemicals and different species
- Lower the indices, greater the toxicity/sensitivity

Endpoints and their Indices

Endpoint	Indices
Mortality	LD50 and LC50
Reproductive, Physiological, Behavioral	NOEC, LOEC, and MATC

Mortality Indices

LD50- the estimated dose where 50% of the test animals died. Generated from single dose exposure . Units: mg/kg (mg chemical/kg body weight)

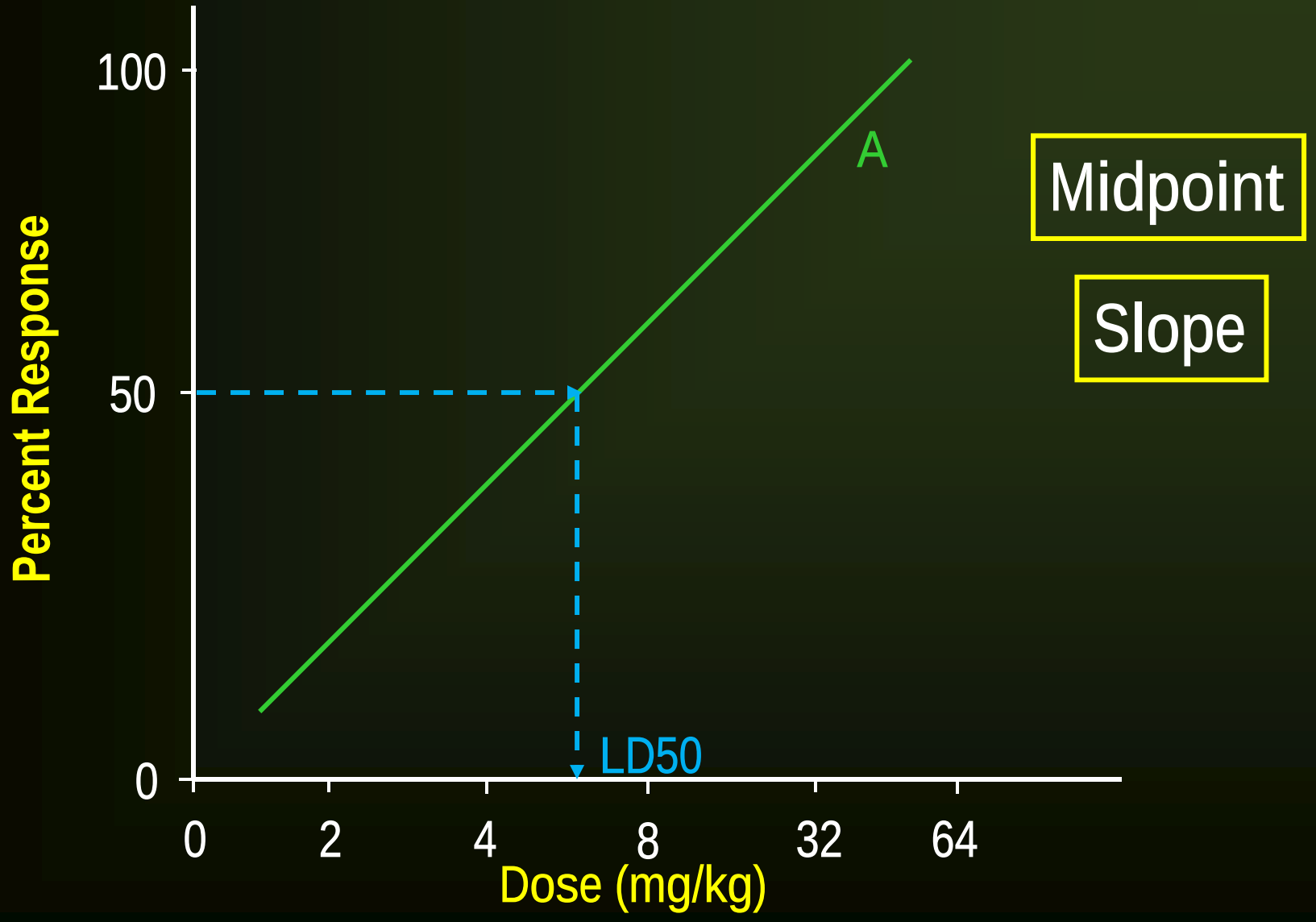
LC50- the estimated concentration where 50% of the test animals died generated from 5 d feeding exposure. Units: ppm (mg chemical/kg feed)

Mortality Tests

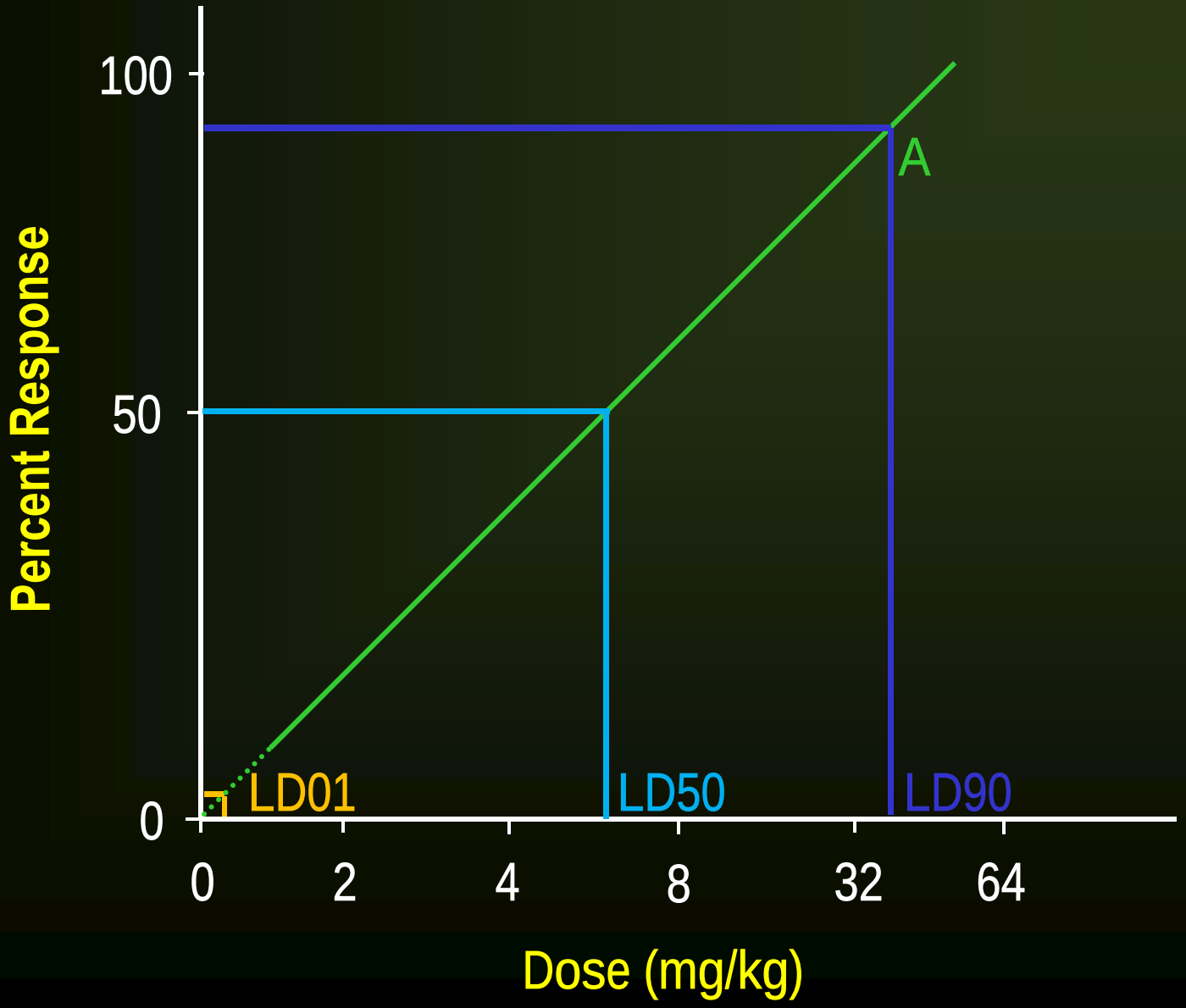
Objective is to determine the slope and midpoint of the dose-response curve.

The LD50 or LC50 value does not mean 50% mortality in the field.

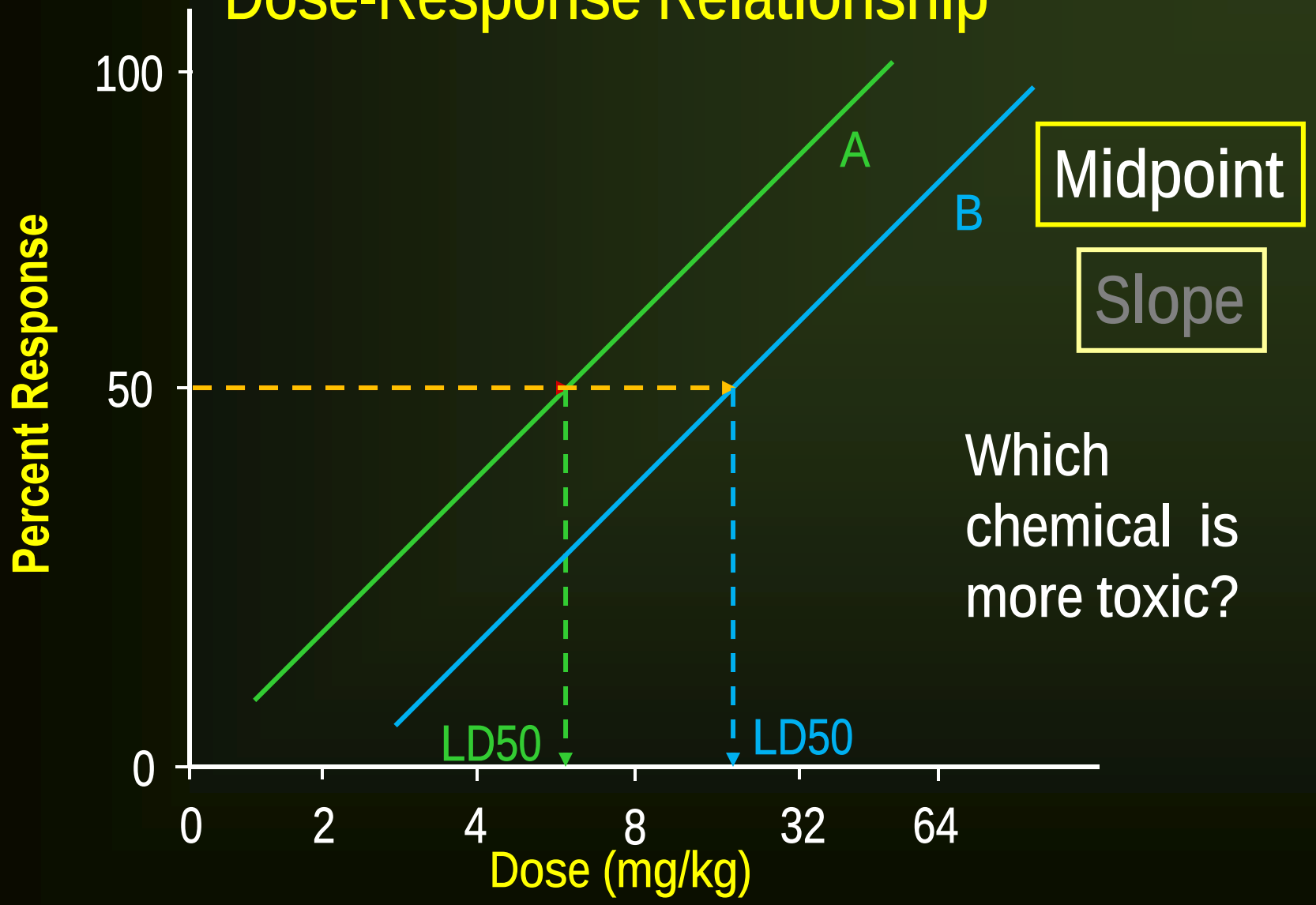
Dose-Response Relationship



Dose-Response Relationship



Dose-Response Relationship

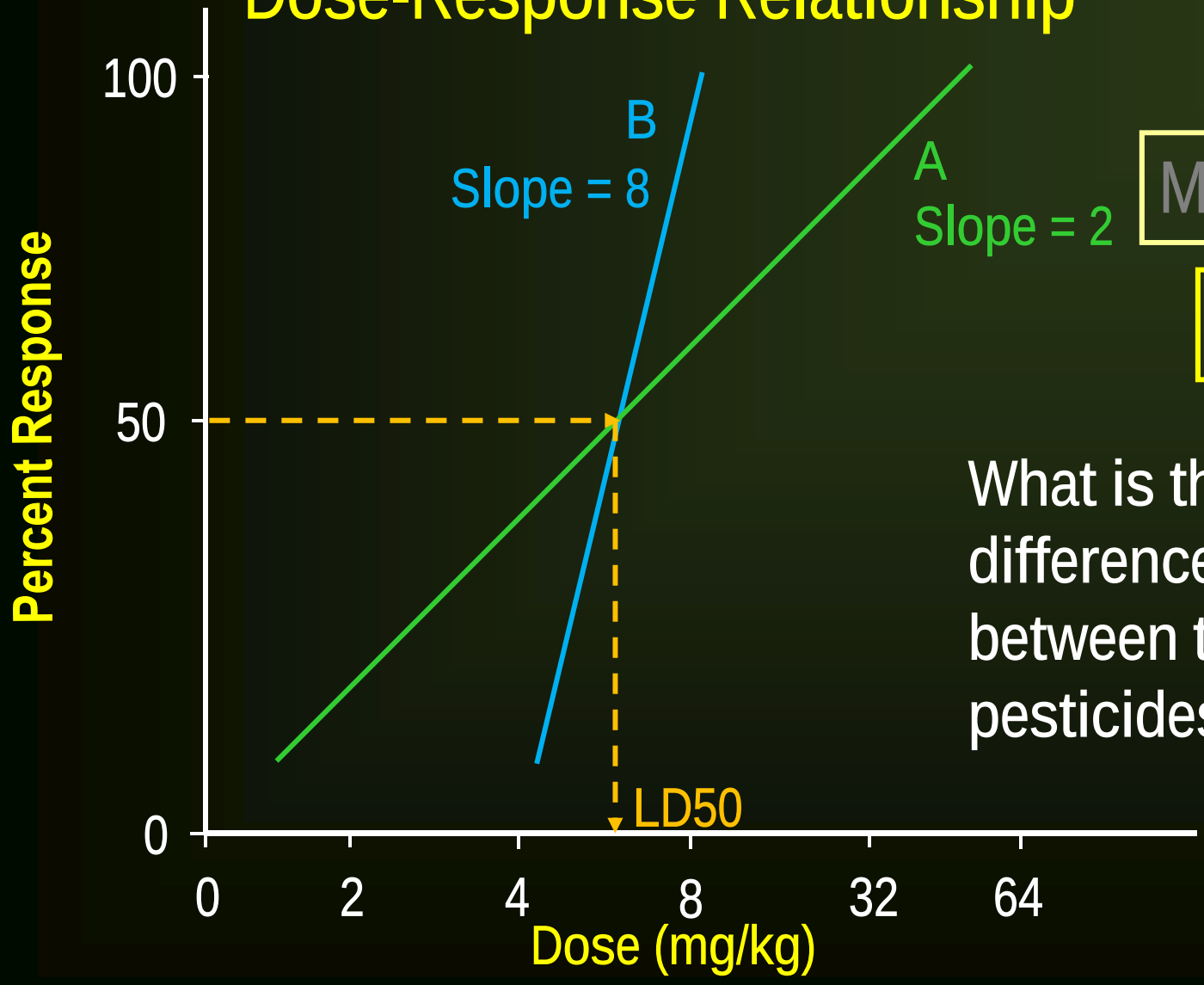


Midpoint

Slope

Which chemical is more toxic?

Dose-Response Relationship



Midpoint

Slope

What is the difference between the two pesticides ?

NOEC, LOEC, and MATC

Treatment (ppm)	Number eggs hatched/50	
0	48	
2	46	
4	38	NOEC
8	20*	LOEC
16	19*	
32	2**	

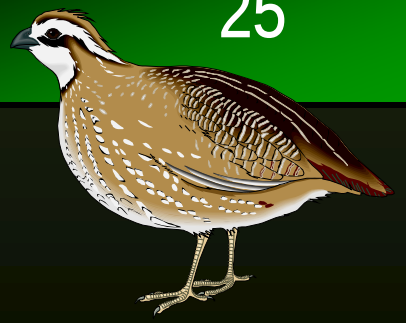
MATC

*p<0.05; **p<0.01

Endpoint example

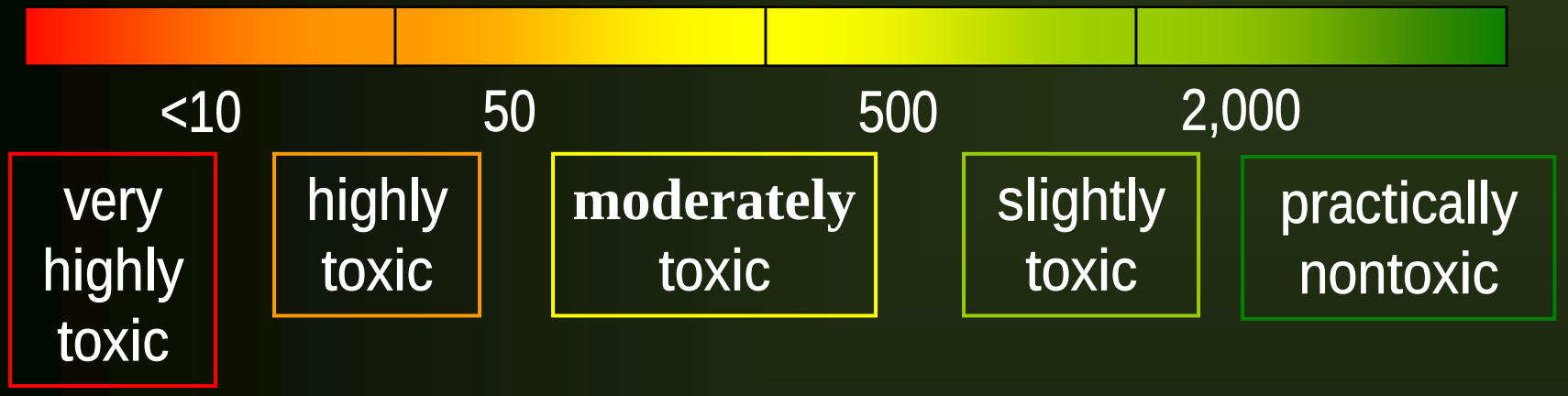
Northern Bobwhite

Insecticide	LD50 (mg/kg)	LC50 (ppm)	Reproduction LOEC (ppm)
Fenvalerate	>2,000	10,000	25

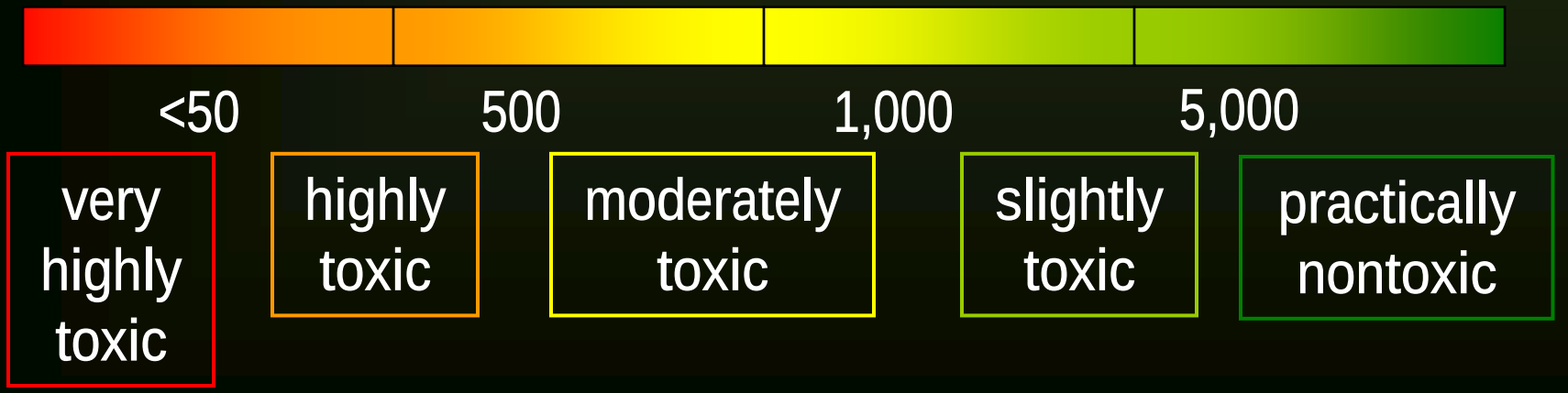


EPA's Criteria for Categorizing Acute Toxicity to Birds

LD50 mg a.i./kg



LC50 ppm a.i.



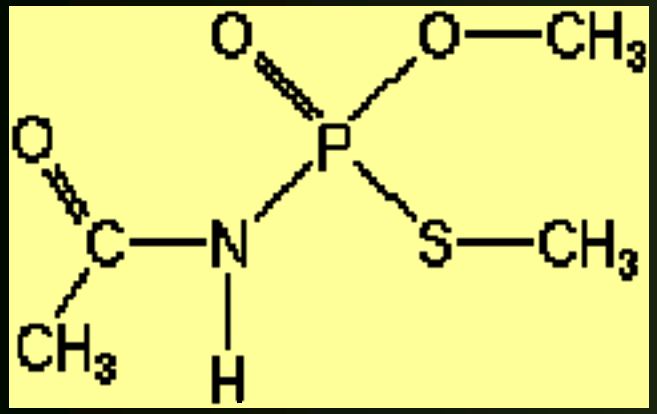
Factors that affect Toxicity

- Chemical
- Metabolites
- Formulation
- Species
- Sex
- Age
- Stressors

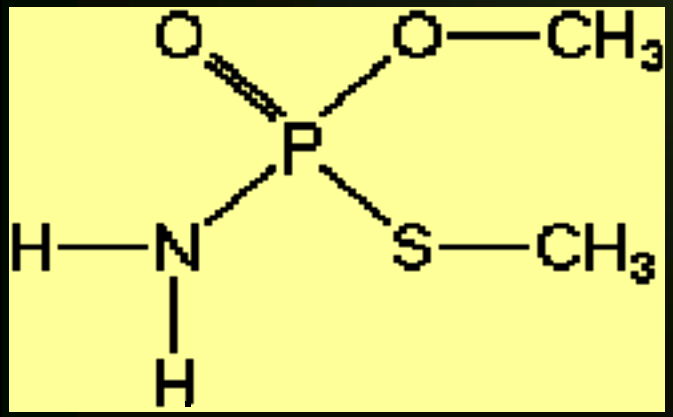
Chemical

Insecticide	Ring-necked Pheasant LD50 (mg/kg)
Carbofuran	4
Aldicarb	5
Disulfoton	12
Temephos	35
Malathion	167
Carbaryl	707
Ethion	1297

Metabolites

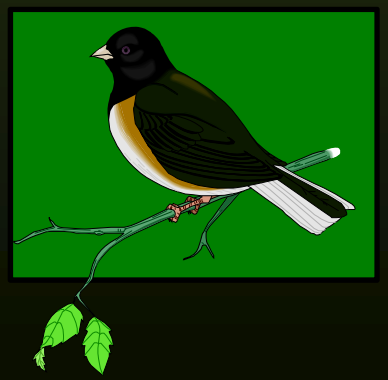


Acephate



Methamidophos

Dark-eyed Junco LD50 (mg/kg)	
Acephate	106
Methamidophos	8



Formulation

Insecticide	Relative LD50s (mg/kg) by formulations for Northern bobwhite
Diazinon	Emulsifiable concentrate > Granular > Technical grade > Technical grade (C)
Carbofuran	Emulsifiable concentrate > Technical grade (C) > Technical grade > Granular

Species

Species	Chlorpyrifos LD50 (mg/kg)
Ring-necked pheasant	8
Northern bobwhite	32
Chukar	61
Common grackle	6
Red-winged blackbird	13
Starling	75

Age

Mallard LD50 (mg/kg)				
Insecticide	36 ± 3 hrs	7 ± 1 d	30 ± 3 d	6 mo ± 3 d
Chlorpyrifos	145	29	50	83

Starling LD50 (mg/kg)			
Insecticide	5 d	15 d	1 yr
Dicrotophos	5	10	8.4

Physiological condition, nutrition, other stressors

Common grackle LC50 (ppm)		
Insecticide	mid-May	mid-August
Dicrotophos	125	17

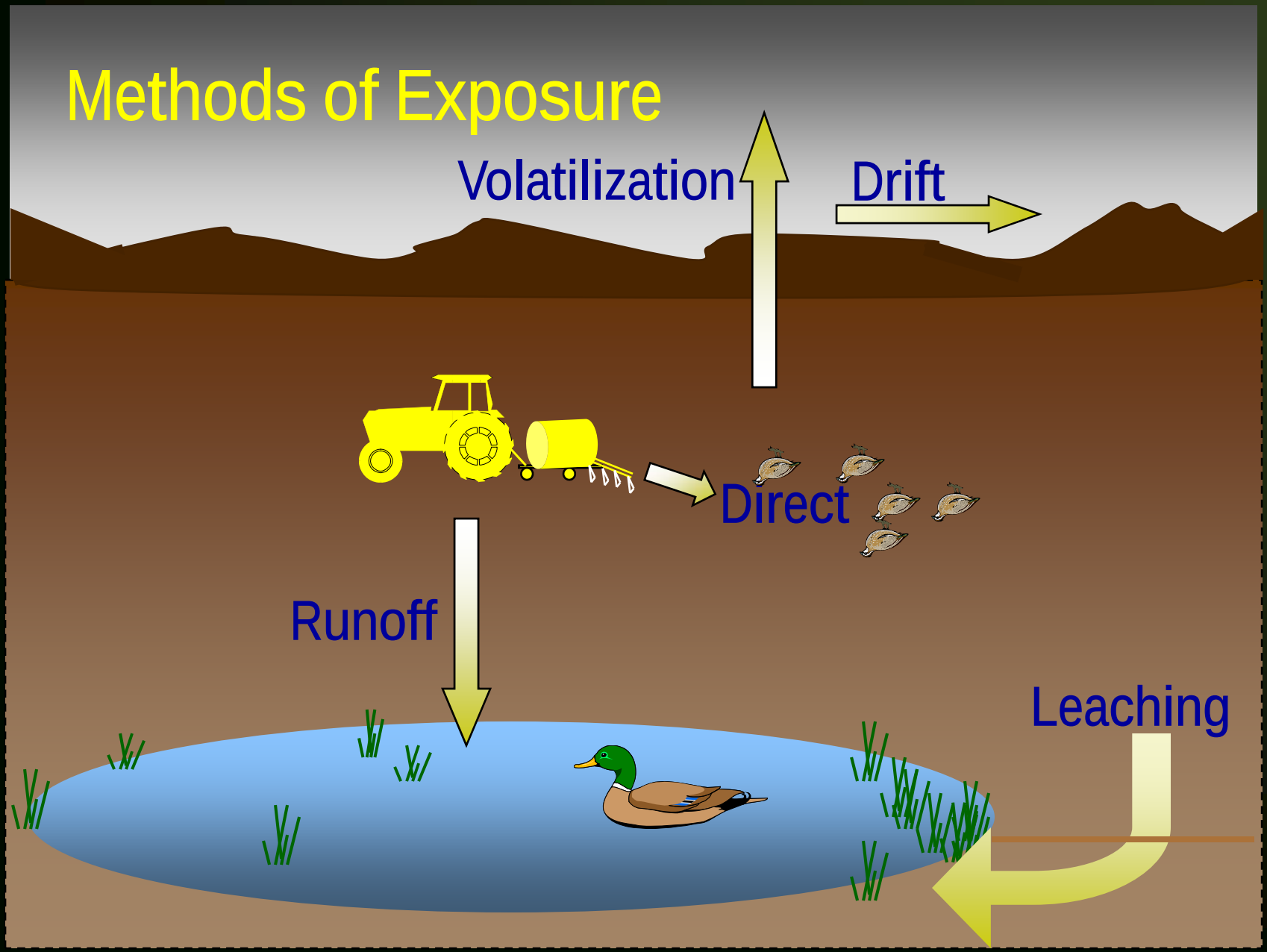
Sex

LD50 (mg/kg) of Northern bobwhites in breeding condition		
Insecticide	Males	Females
Fenthion	7	3

Toxicity

Exposure

Methods of Exposure



Example of runoff

Photo by Tonie Rocke

How birds are exposed to pesticides

Bill Horn

Gary Robertshaw

Dave Cagnolatti

Mike McDowell

Arthur Morris

Bill Horn

Factors that affect Exposure

Anthropogenic

Abiotic

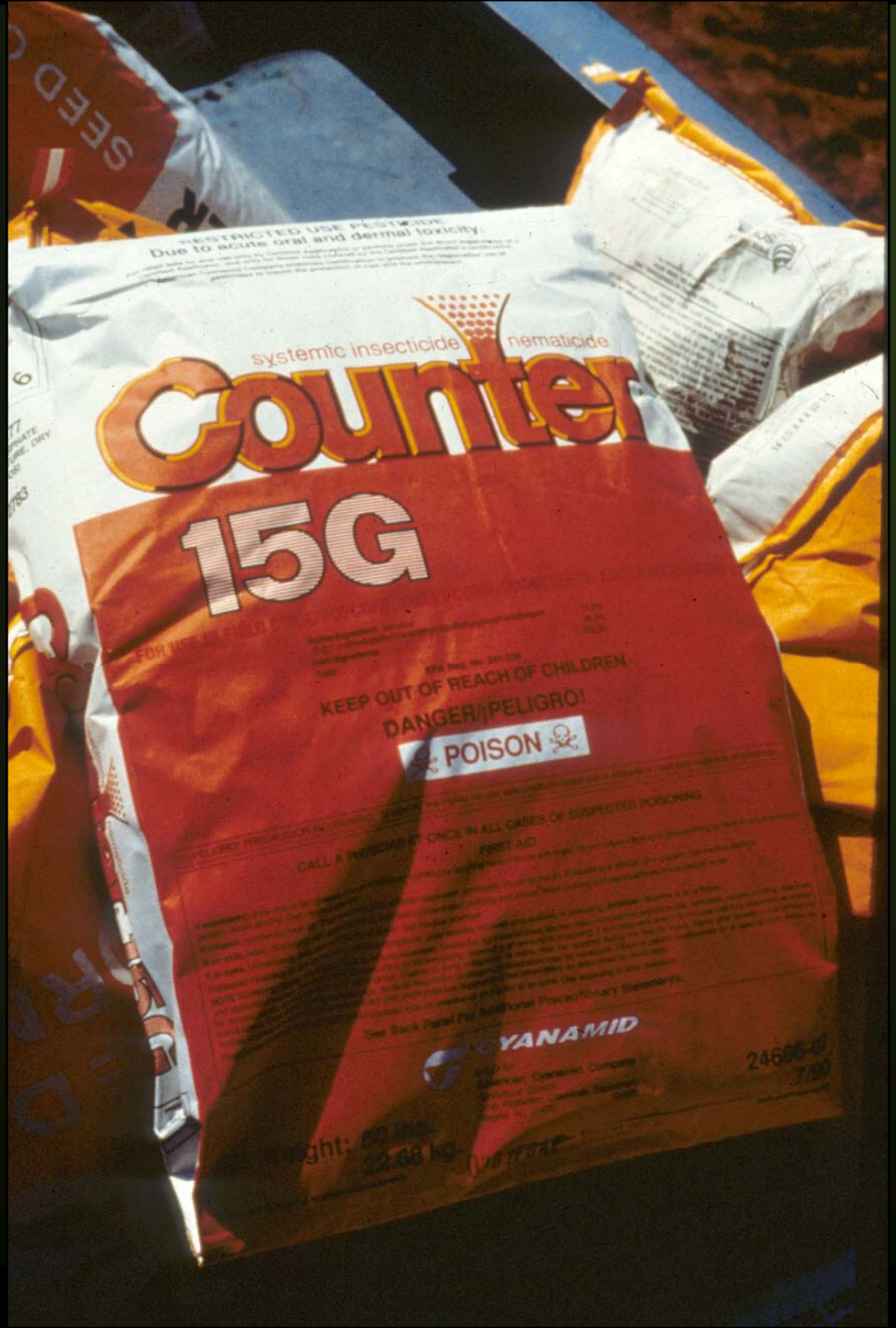
Biotic

Factors that affect Exposure

Anthropogenic

Abiotic

Biotic


RESTRICTED USE PESTICIDE
Due to acute oral and dermal toxicity
systemic insecticide nematicide
Counter
15G
KEEP OUT OF REACH OF CHILDREN
DANGER/PELIGRO!
POISON
CALL A PHYSICIAN AT ONCE IN ALL CASES OF SUSPECTED POISONING
FIRST AID
See Back Panel For Additional Precautionary Statements
CYANAMID

MGM

Incorporation Method	Depth (inches)
BROADCAST	0.0
DISKED IN AFTER BROADCAST	4.0
CHISEL PLOWED AFTER BROADCAST	6.0
SURFACE BANDED	0.0
BANDED - INCORPORATED	1.2
T - BANDED	1.5
IN FURROW	2.0
AERIAL or AIRBLAST SPRAY	0.0
GROUND SPRAY	Depends on method

From GENEEC Version 2.0

Glyphosate Application

broadcast

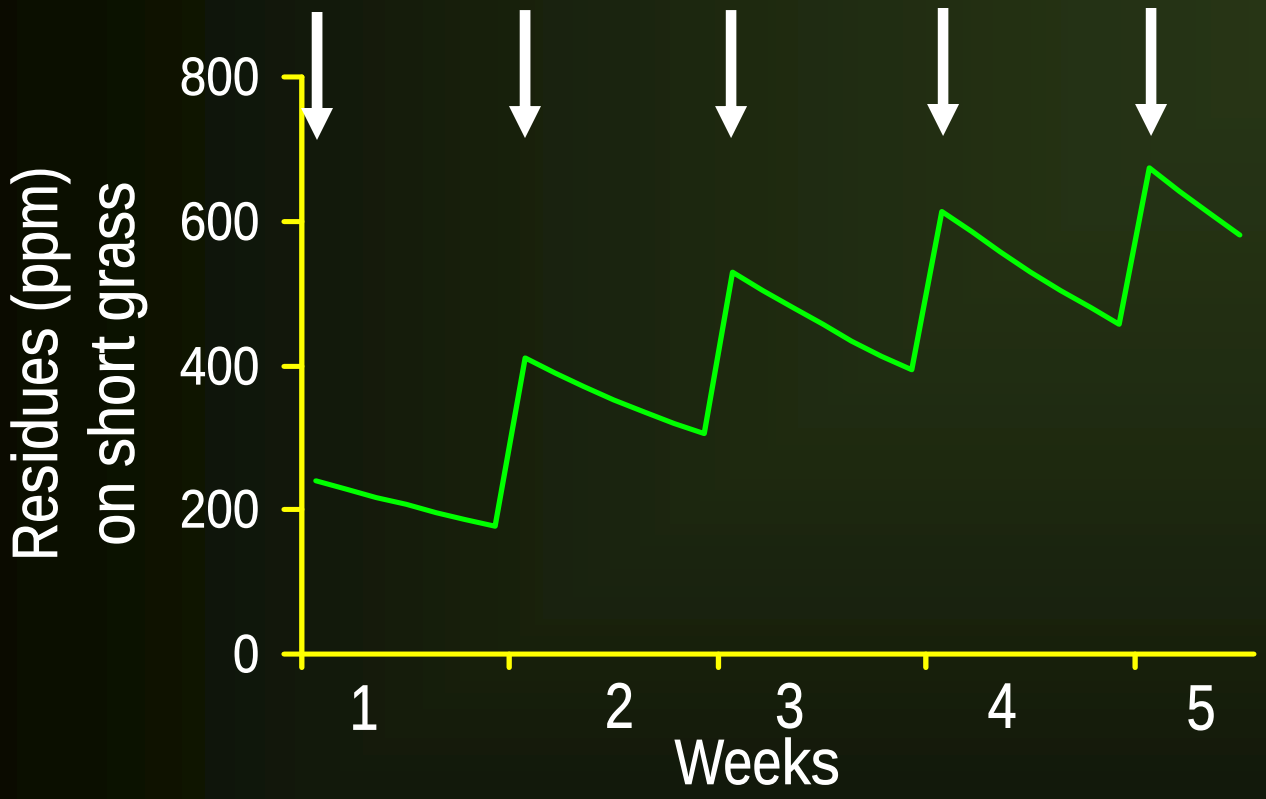
banded

Ron Hoover

Application Rate

Crop/Nematodes	Temik® 15G
Cotton	3.5 - 10 lbs/A
Sugar Beets	27 - 33 lbs/A
Soybeans	5 - 10 lbs/A

Number of Applications



pesticide half-life: 14 days

application (↓) frequency: 7 days

T-REX, EPA

Don Patterson

Pesticidereform.org

Ohio State University

Factors that affect Exposure

Anthropogenic

Abiotic

Biotic

Factors that affect Exposure

Anthropogenic

Abiotic

Biotic

Gerhard Hofmann

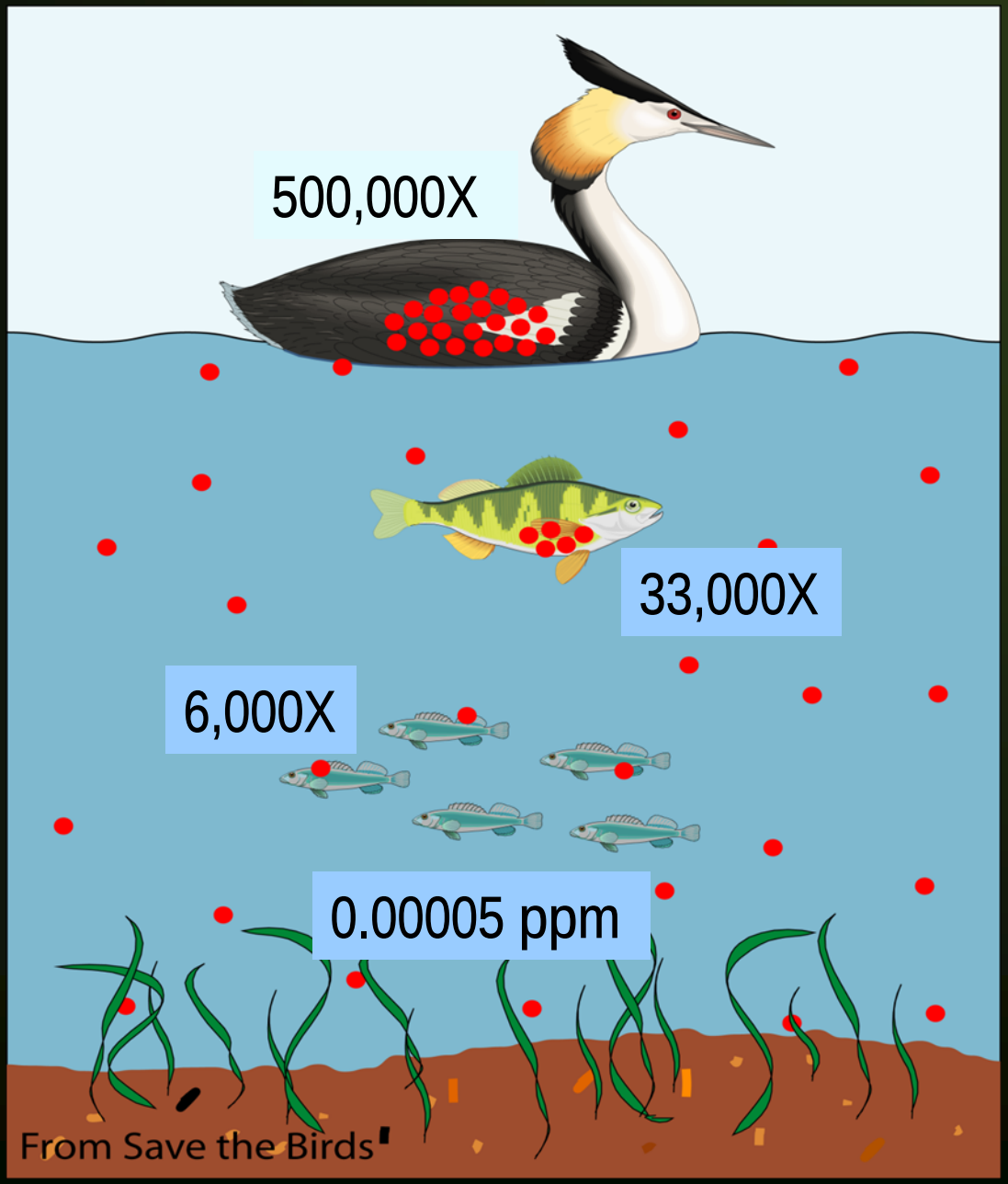
Arthur Morris

Niels Bohr

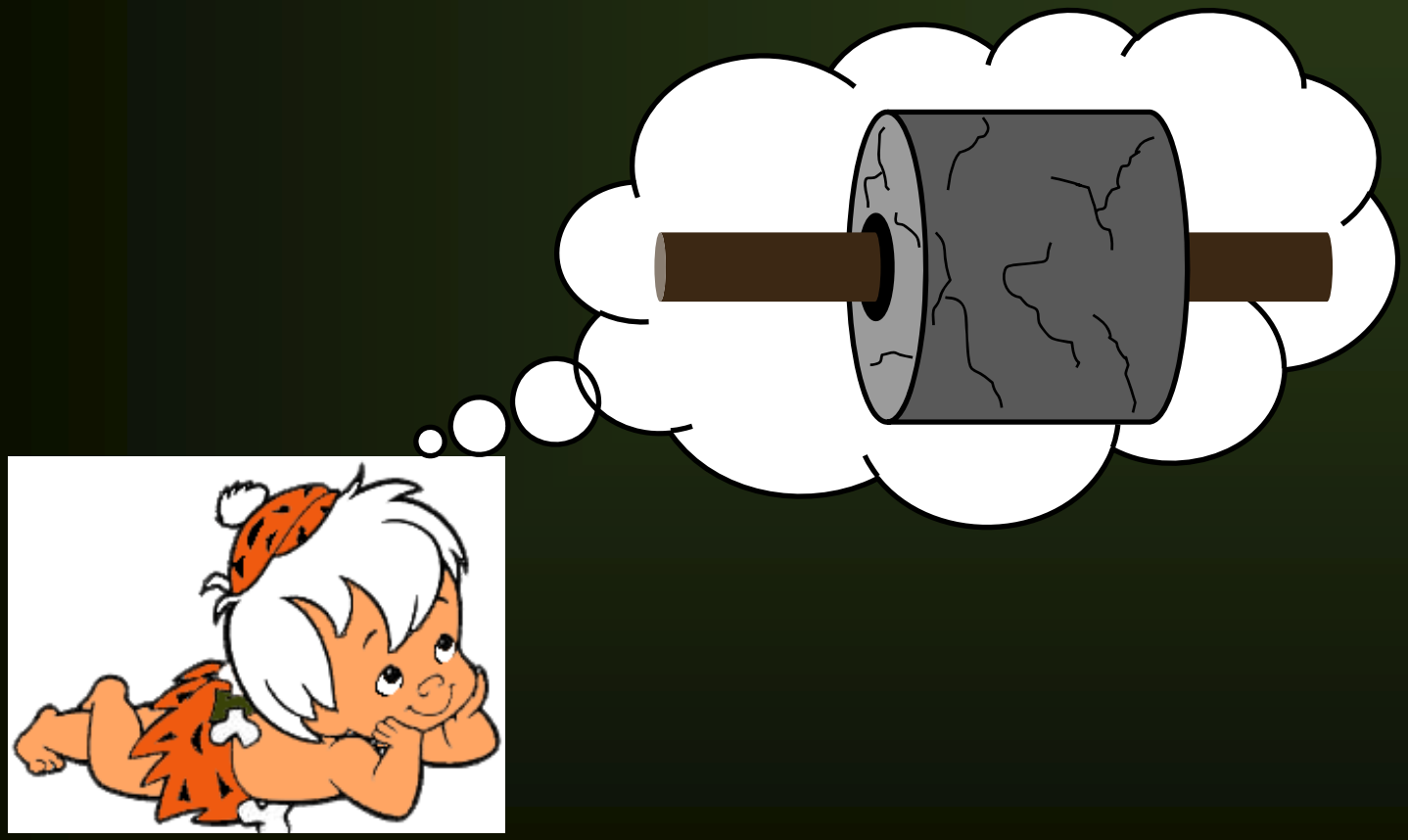
Enrico Fermi

Arthur Morris

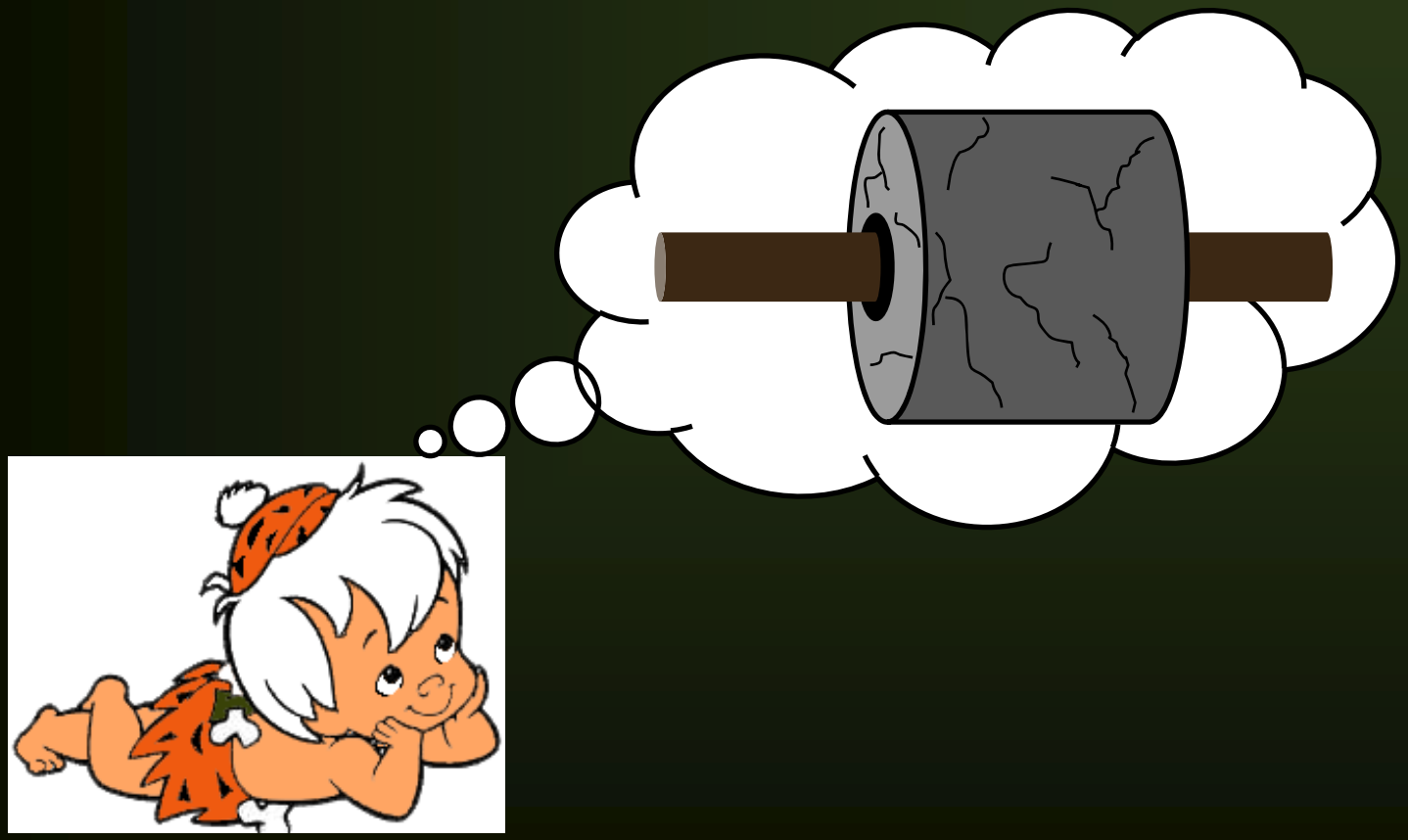
Diane Fries


500,000X
33,000X
6,000X
0.00005 ppm
From Save the Birds


Behavior
Exposure




PANGEA
SHORE



Callie de Wet

National Wildlife Federation

Gerhard Hofmann

How birds get exposed: Abuse

Diane Fries

How birds get exposed: Grazing

Imalda P.

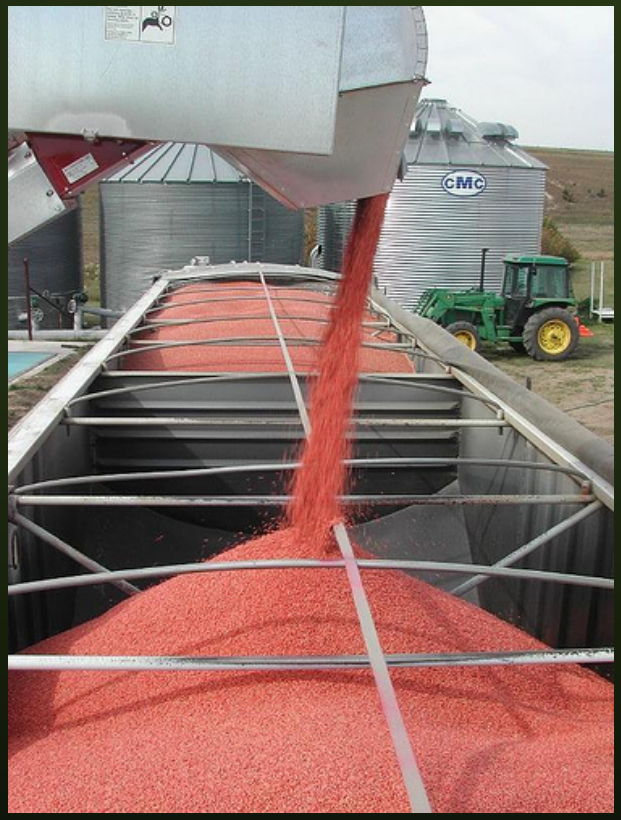
How birds get exposed: Prey

Gerhard Hofmann

How birds get exposed: Granules

Linda Lyon

How birds get exposed: Treated seeds



How birds get exposed: Vertebrate control agents

Aristide Economopoulos

How birds get exposed: Veterinary products

How birds get exposed: Irrigation

University of Alabama

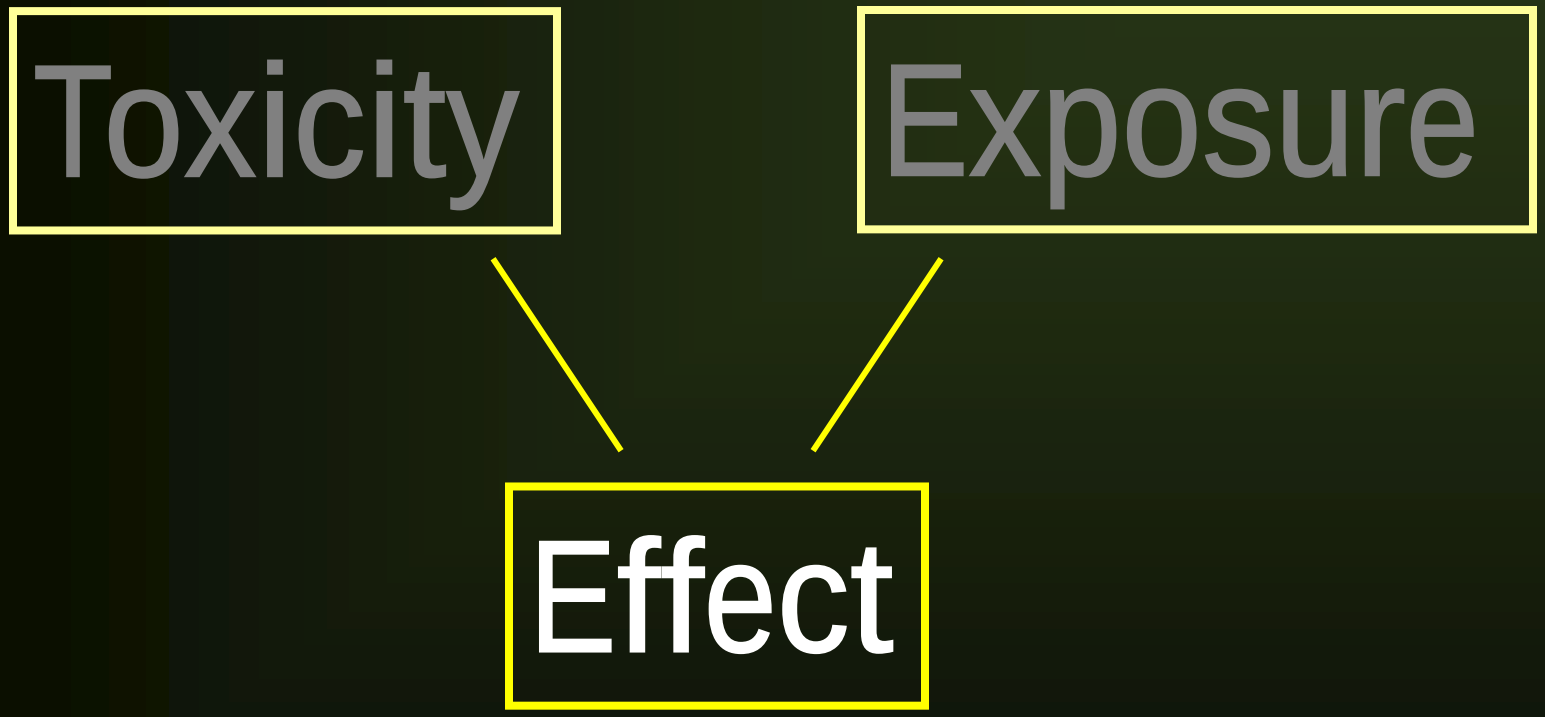
University of Alabama

Calfed Bay Delta Program

Toxicity

Exposure

Break


Toxicity
Exposure
Effect

Linda Lyon

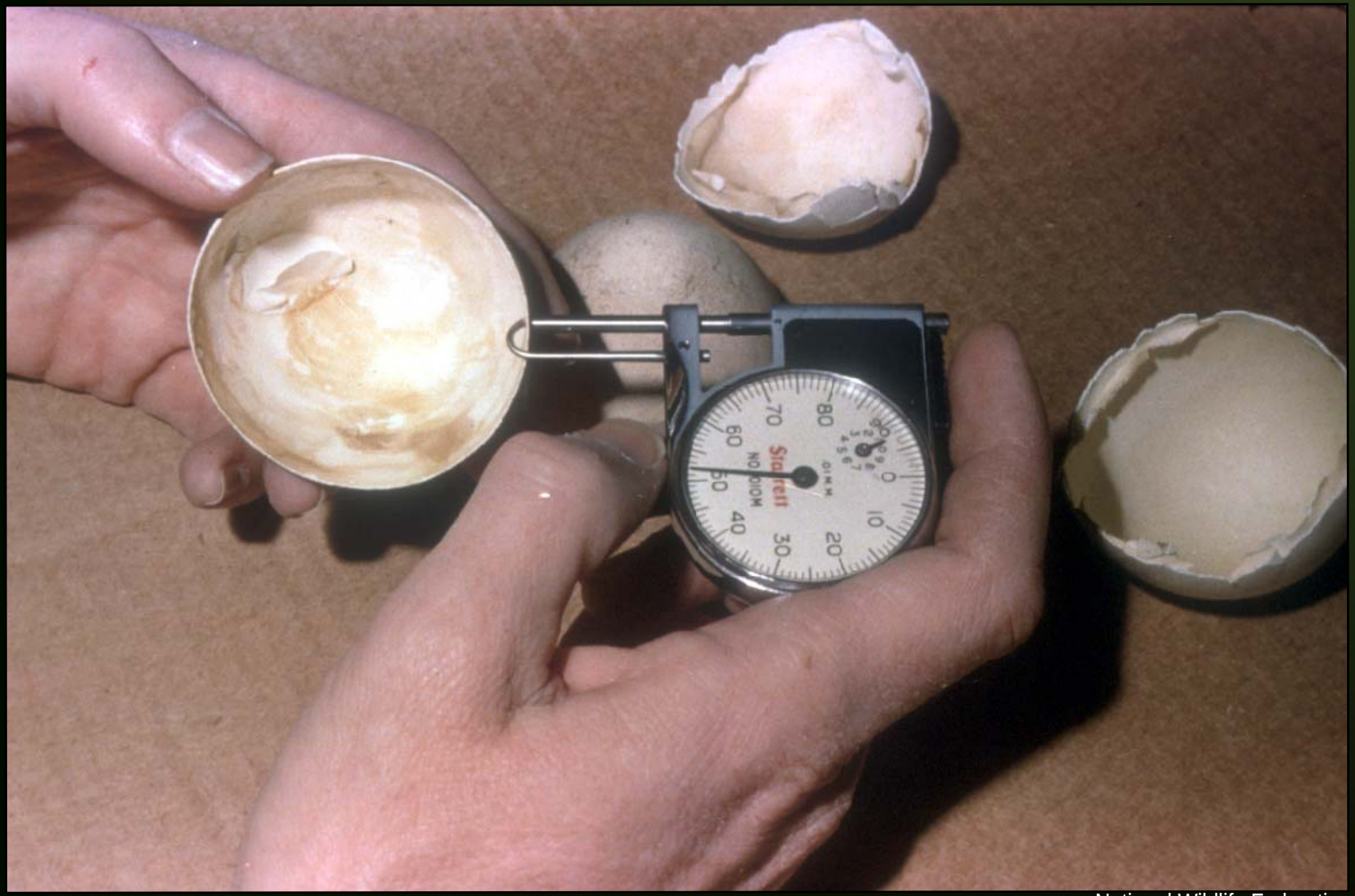
C. Sowards

Linda Lyon

Linda Lyon

Ed Clark

Don Patterson



National Wildlife Federation

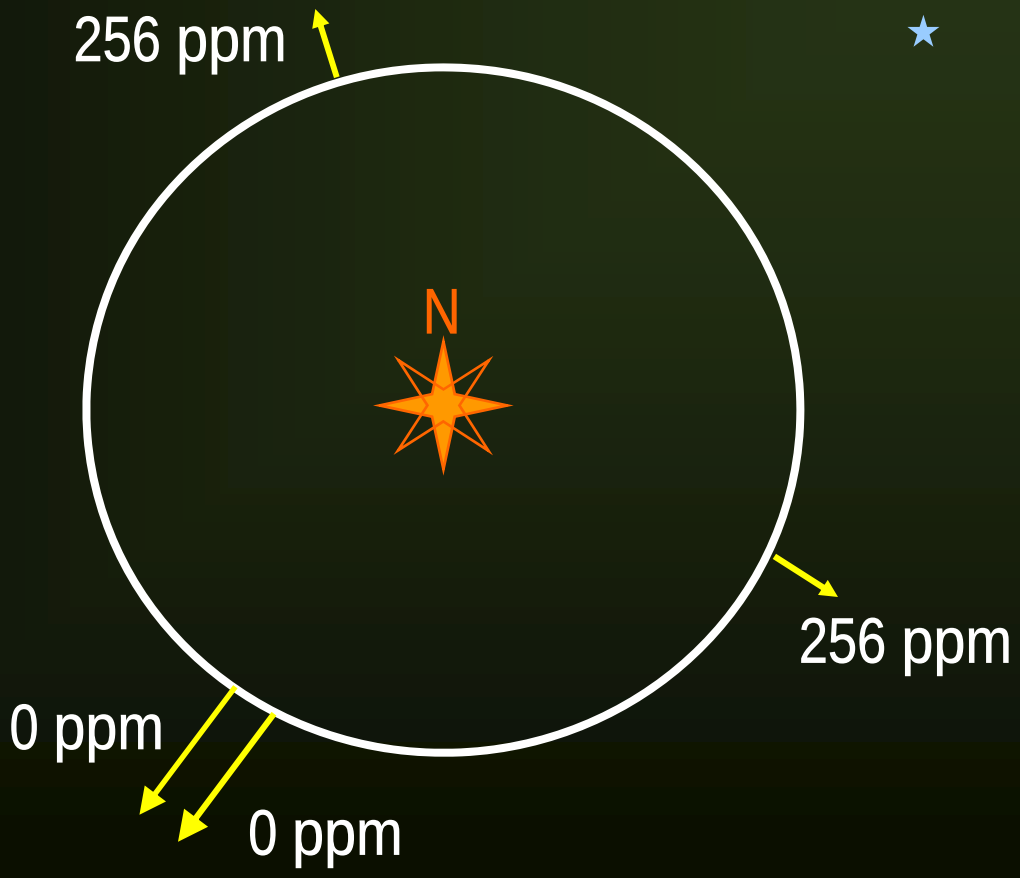
David Hoffman


Behavior
Exposure

Gerhard Hofmann

Tom Murray

Fall nocturnal migratory orientation of adult white-throated sparrows exposed to acephate



Royal Alberta Museum

Gerhard Hofmann

Charley Eiseman

Charley Eiseman

Charley Eiseman

Brian E. Small


Gerhard Hofmann


Gerhard Hofmann


Robert Royse


River Bend Nature Center


Gerhard Hofmann


Gerhard Hofmann


Arthur Morris


Matt Studebaker


Gerhard Hofmann

Robert Shantz

Case studies

J. Huddle

Lawrence Blus

Lawrence Blus

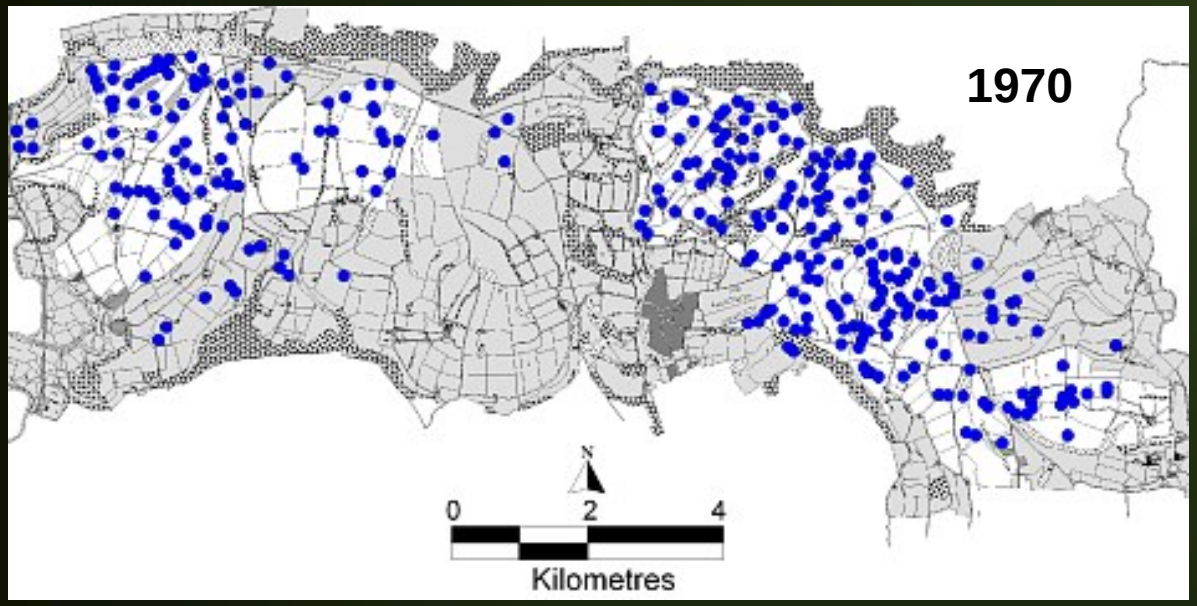
Anza Borrego Desert State Park

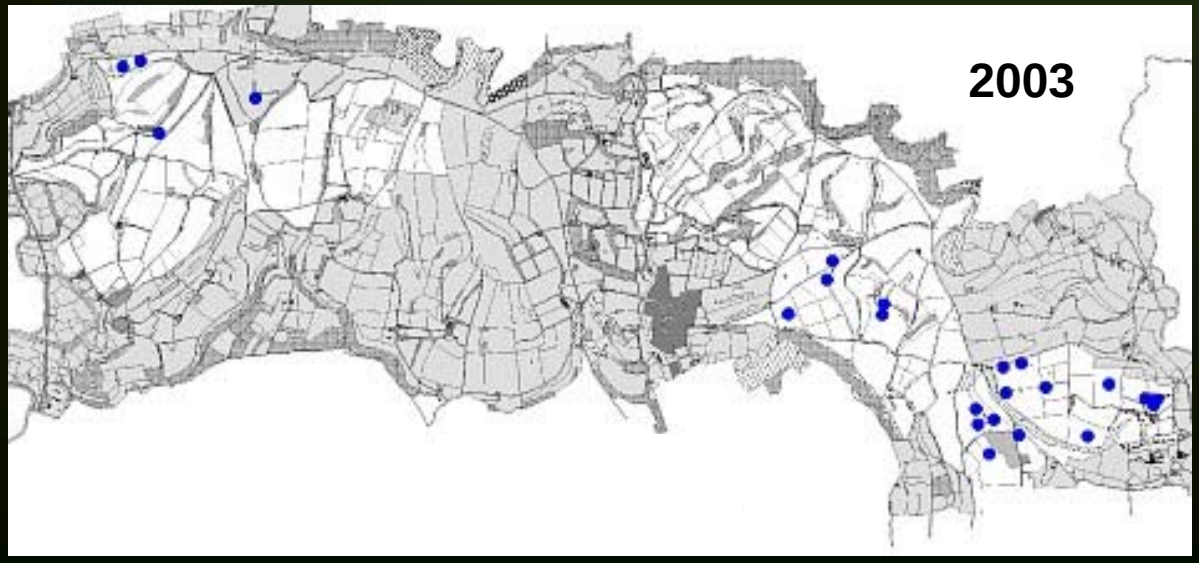
Gerhard Hofmann

Steve Bird

Distribution of grey partridge coveys – Sussex study

RSVP





Source: The Game Conservancy Trust - http://www.gct.org.uk/

USGS
science for a changing world

Birds found dead or debilitated on 10 farms treated with Furadan 15G

American kestrel	Mourning Dove	American Crow
Carolina wren	Eastern bluebird	American robin
Water pipit	Cedar waxwing	European starling
Summer tanager	Northern cardinal	Northern mockingbird
Chipping sparrow	Savannah sparrow	Grasshopper sparrow
Swamp sparrow	Eastern meadowlark	Rusty blackbird
Boat-tailed grackle	Common grackle	Brown-headed cowbird
House sparrow	Blue grosbeak	Red-winged blackbird
	White-throated sparrow	

From Stinson et al. 1994. Wildl. Soc. Bull. 22:566-575

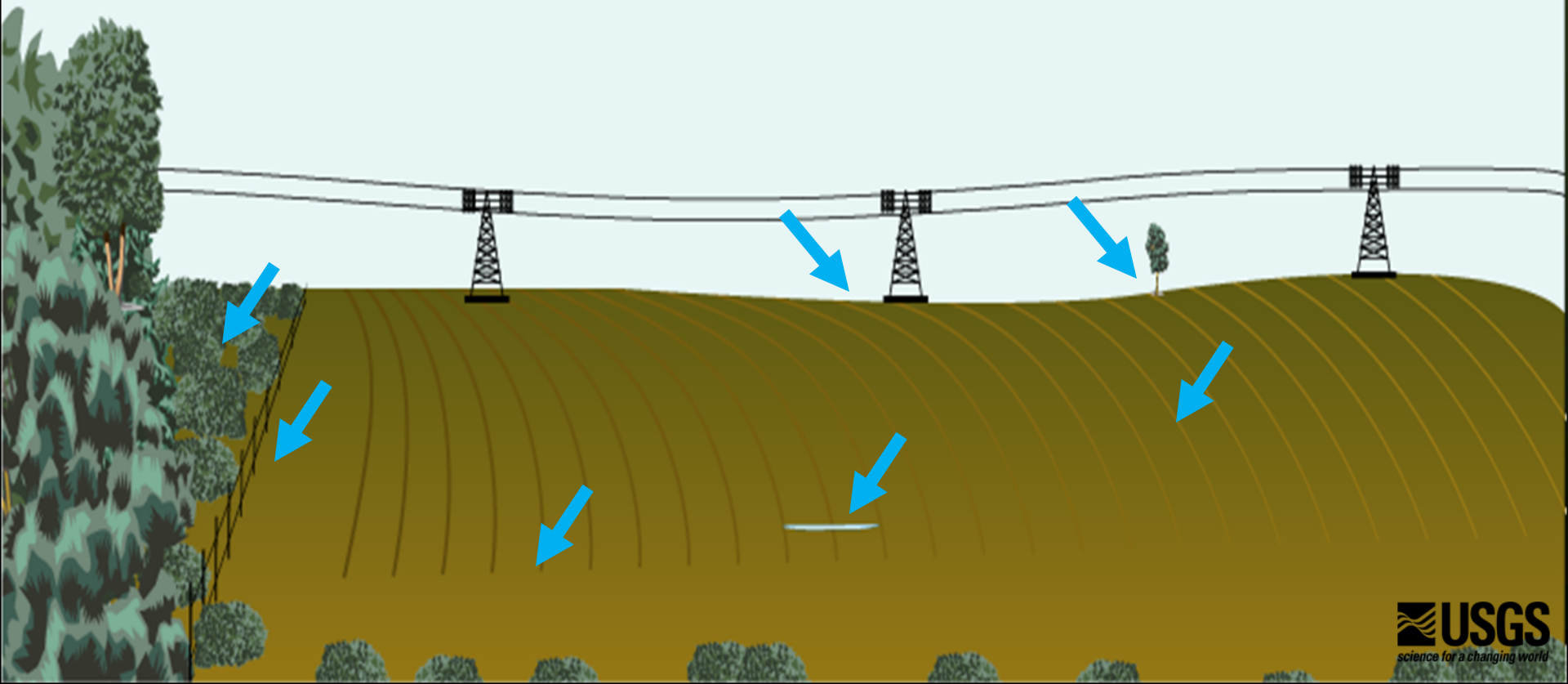
Brian E. Small

Before and After of Protecting Wildlife

- **Documenting Hazard**
- **Predicting Risk**

Documenting Hazard

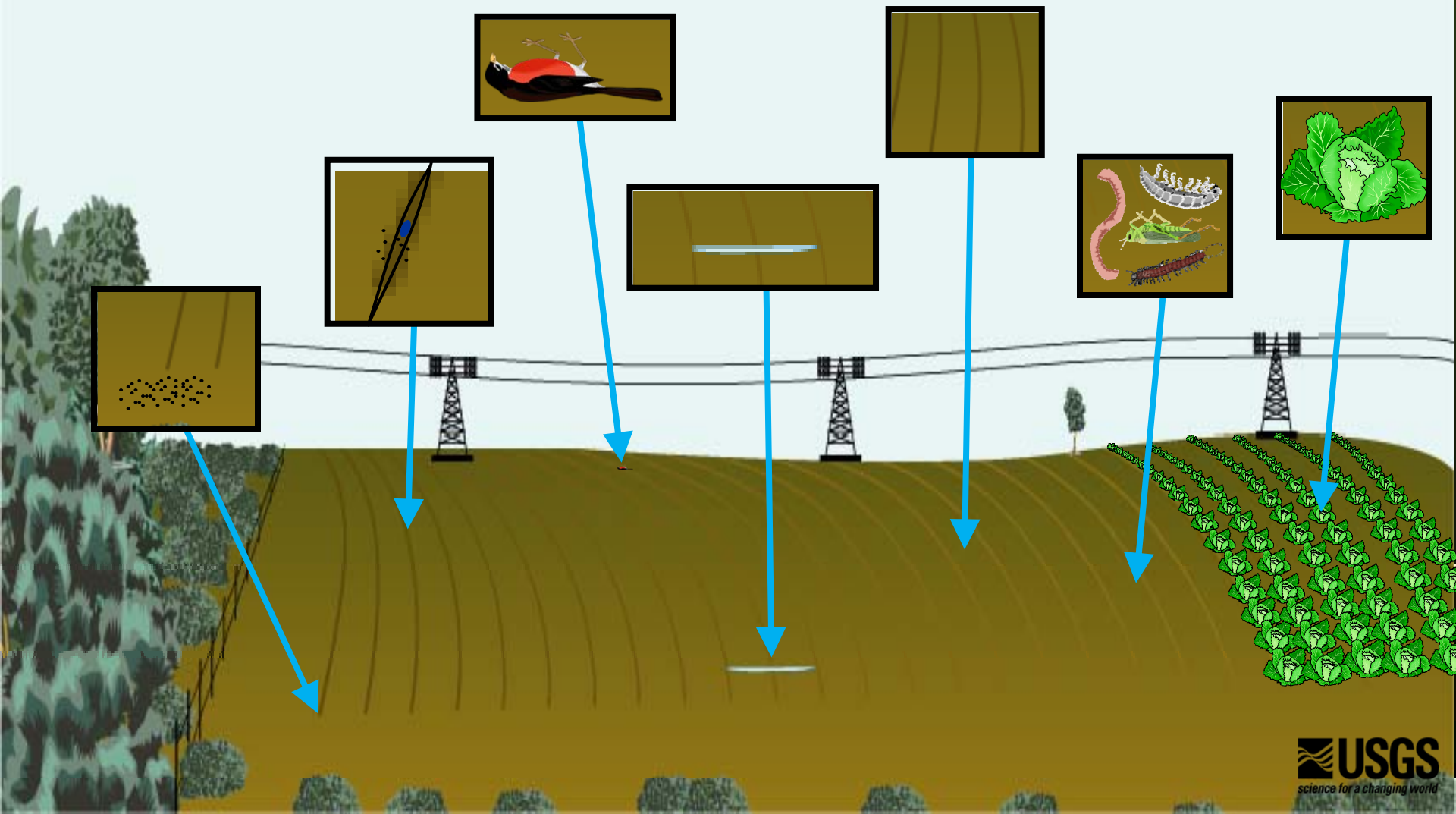
Where to sample



USGS
science for a changing world

Diane Fries

What to sample



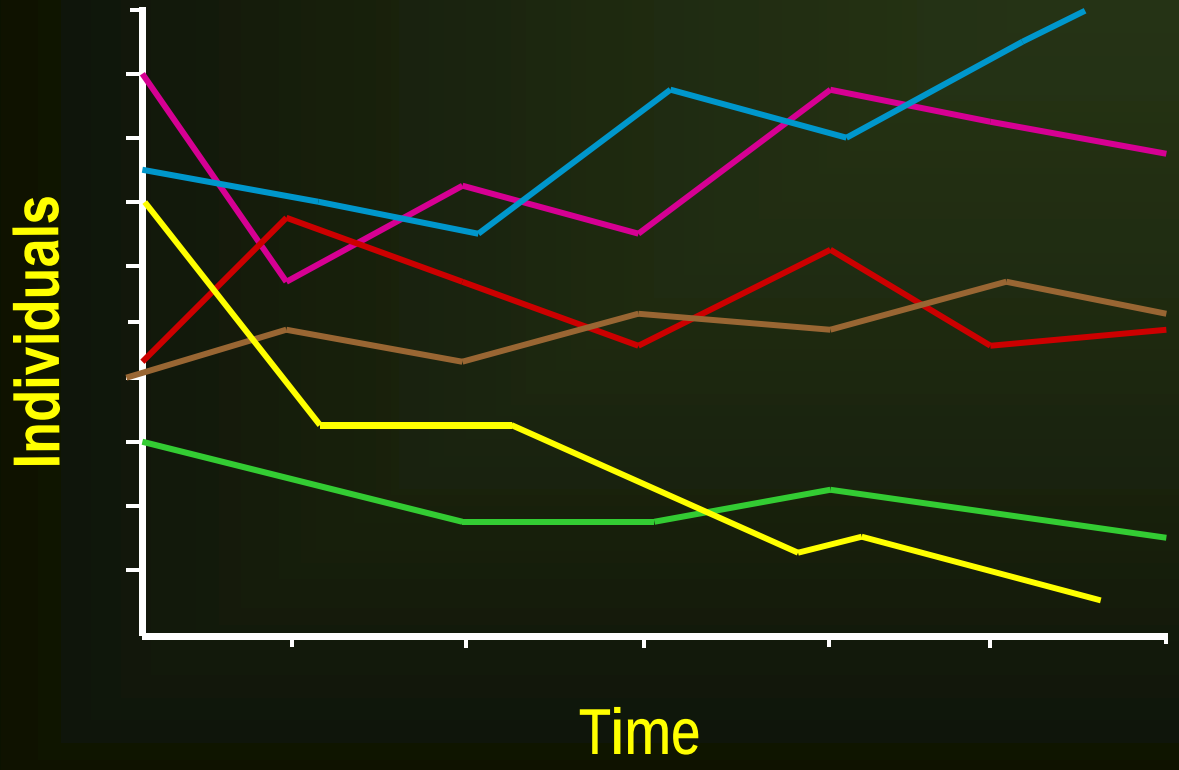
USGS
science for a changing world

Predicting Risk

Risk Assessment

Laboratory → Field

Population- level effects and pesticides



Defining a population correctly

Garrett Lau

Scaling population-level pesticide effects

Purpose

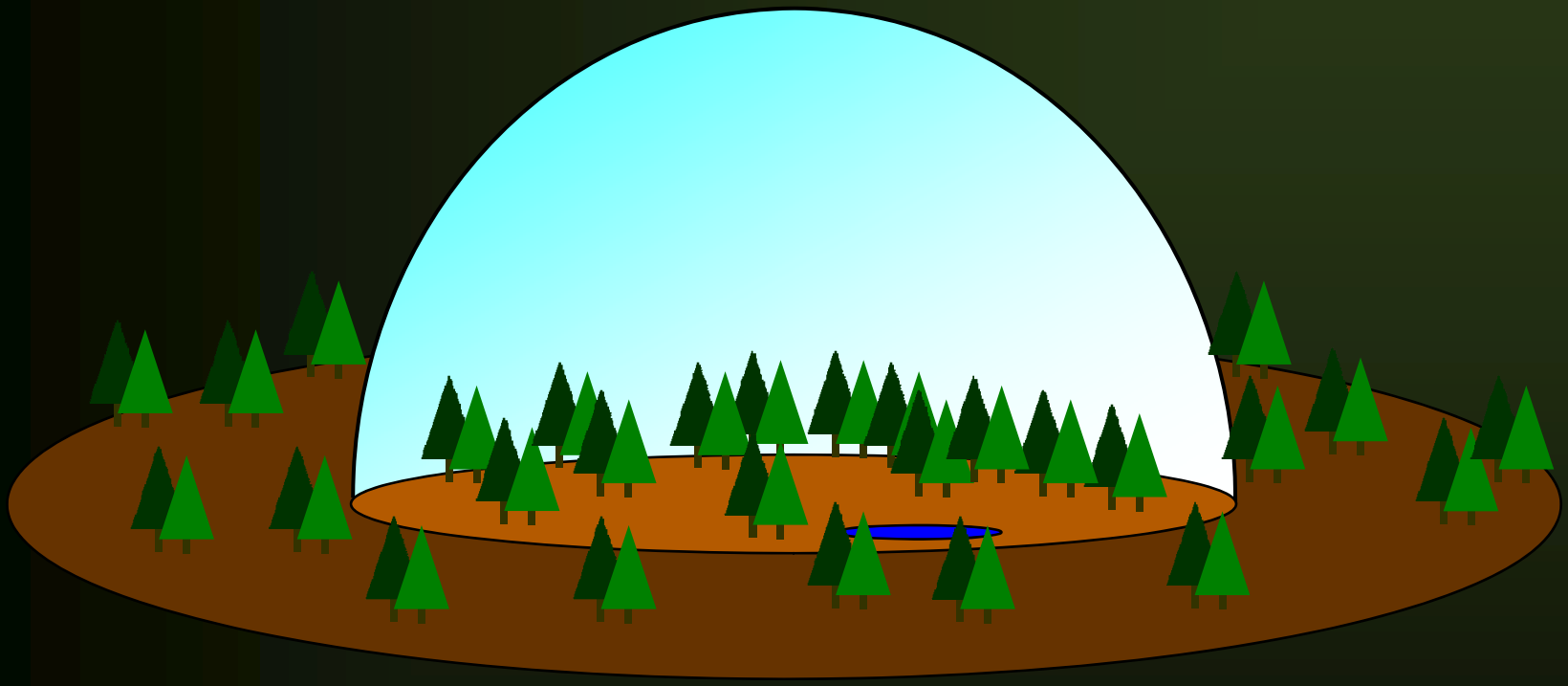
- Species management
- Pesticide regulation

Spatial considerations

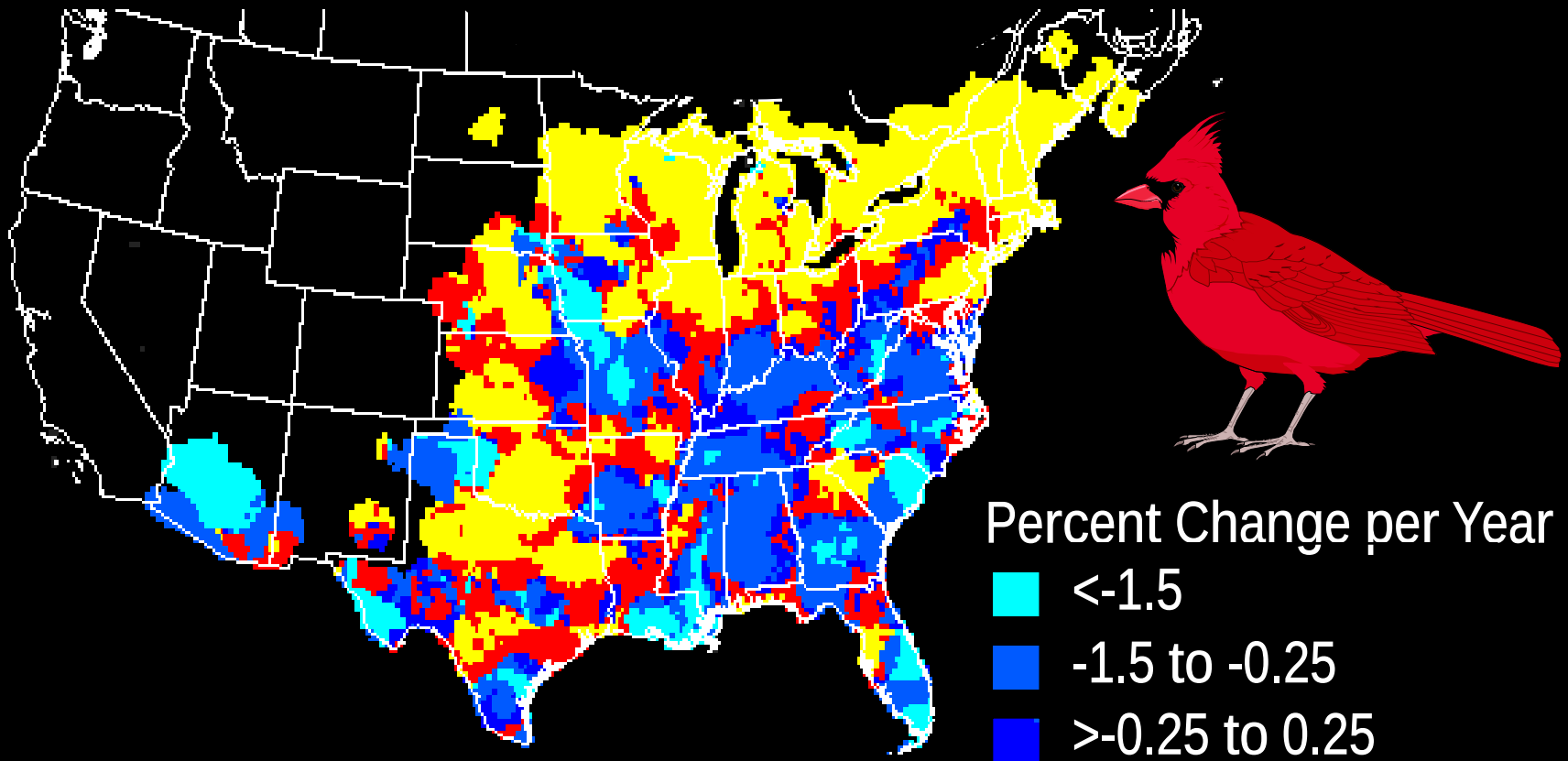
- Local effects
- Regional and National effects

Temporal considerations

- Short term effects
- Long term effects

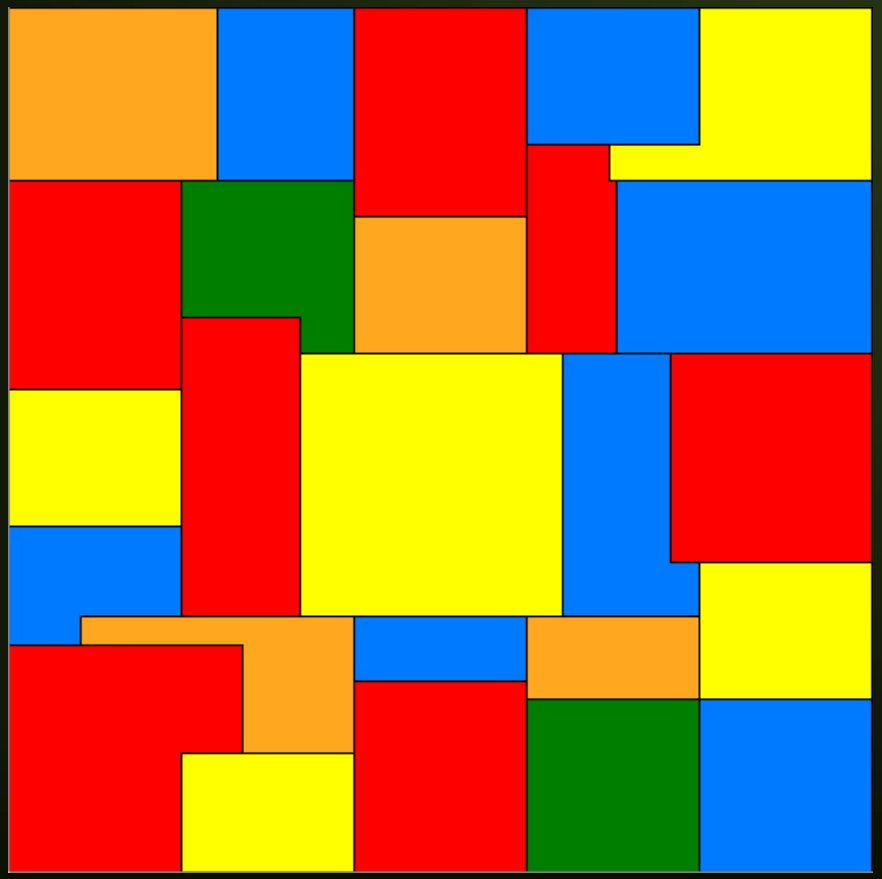


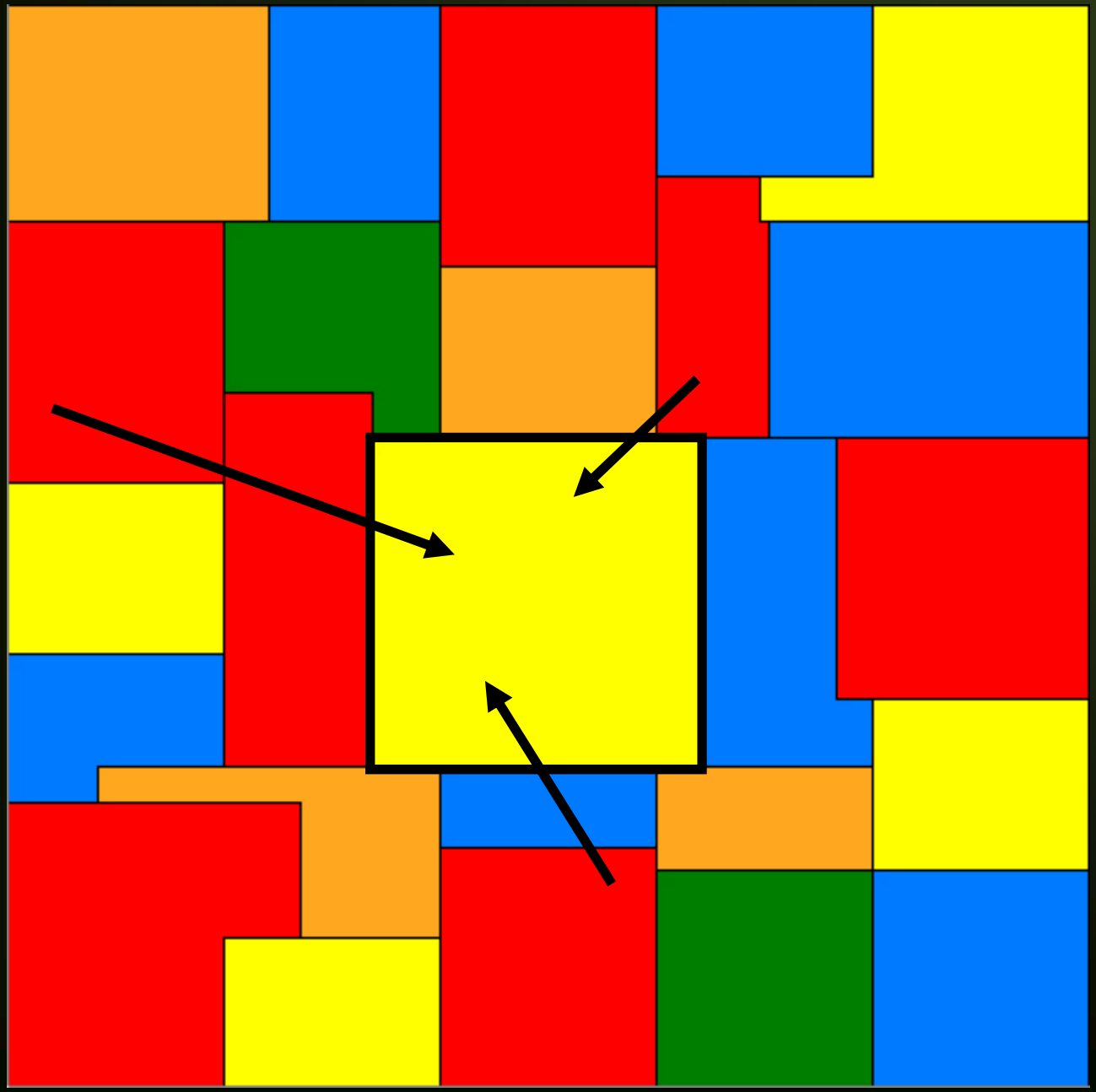
Spacio-temporal population fluctuations

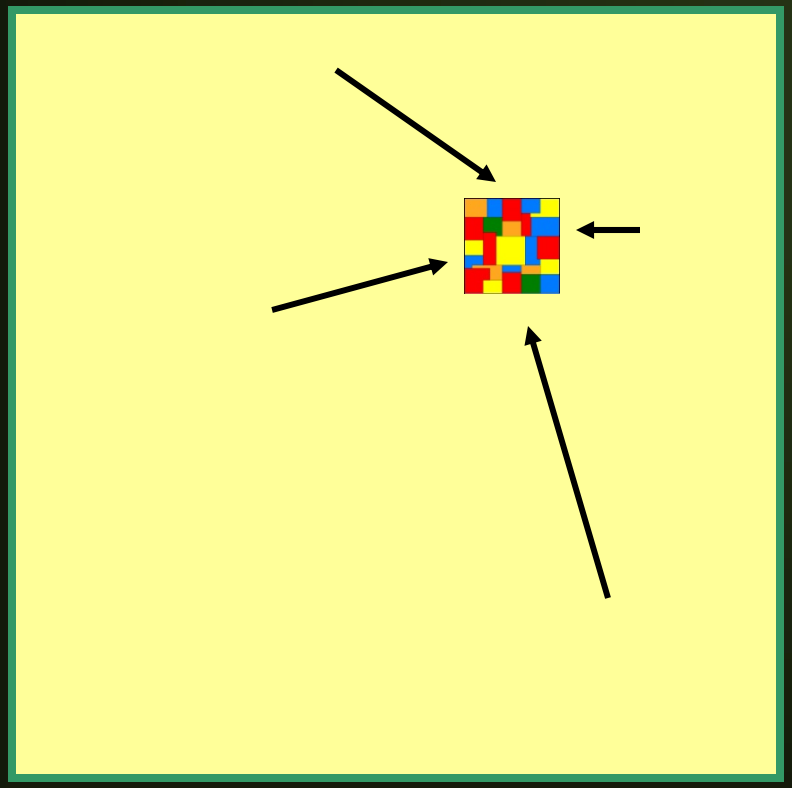


Breeding Bird Survey Trend Map
1966-2003

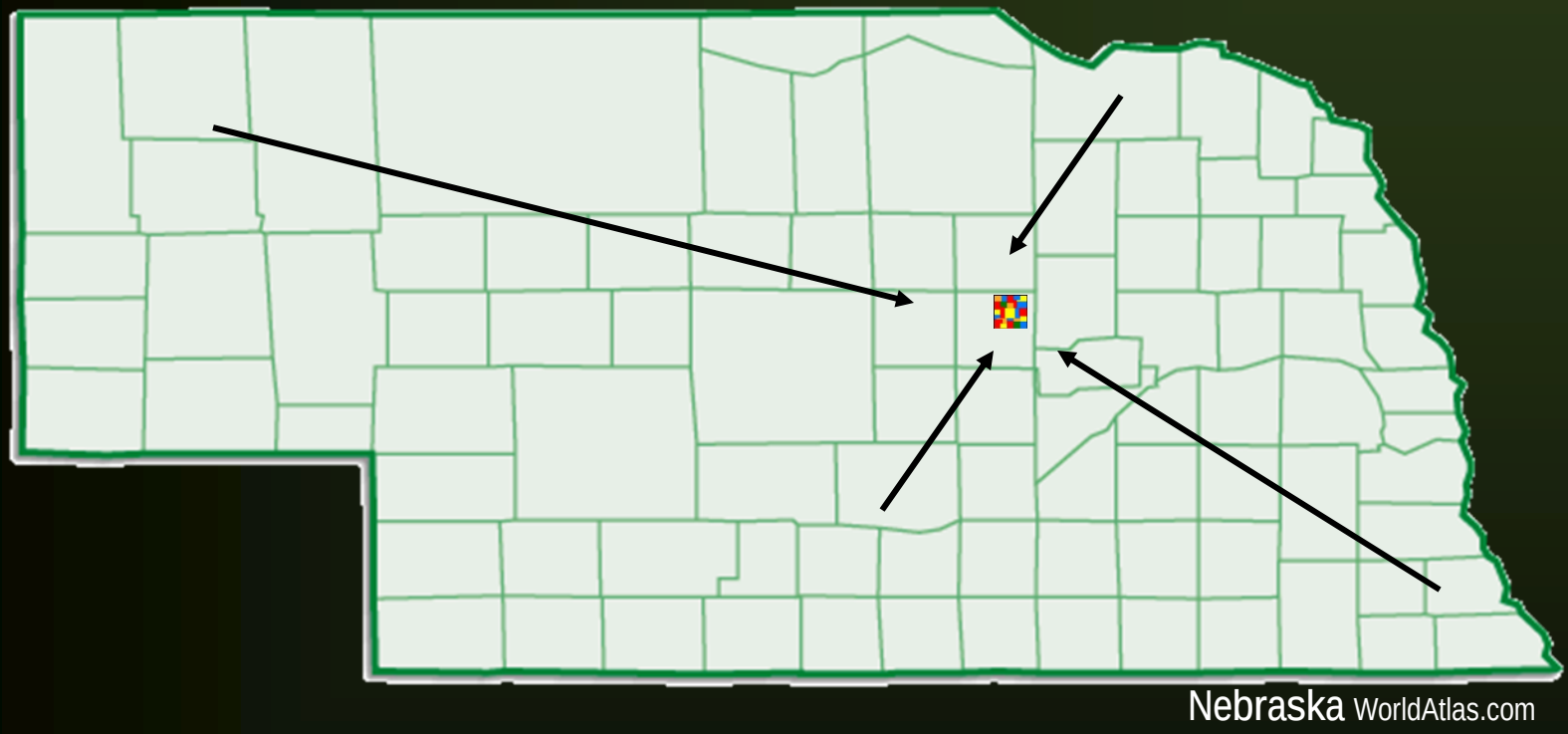
Spacio-temporal pesticide variations

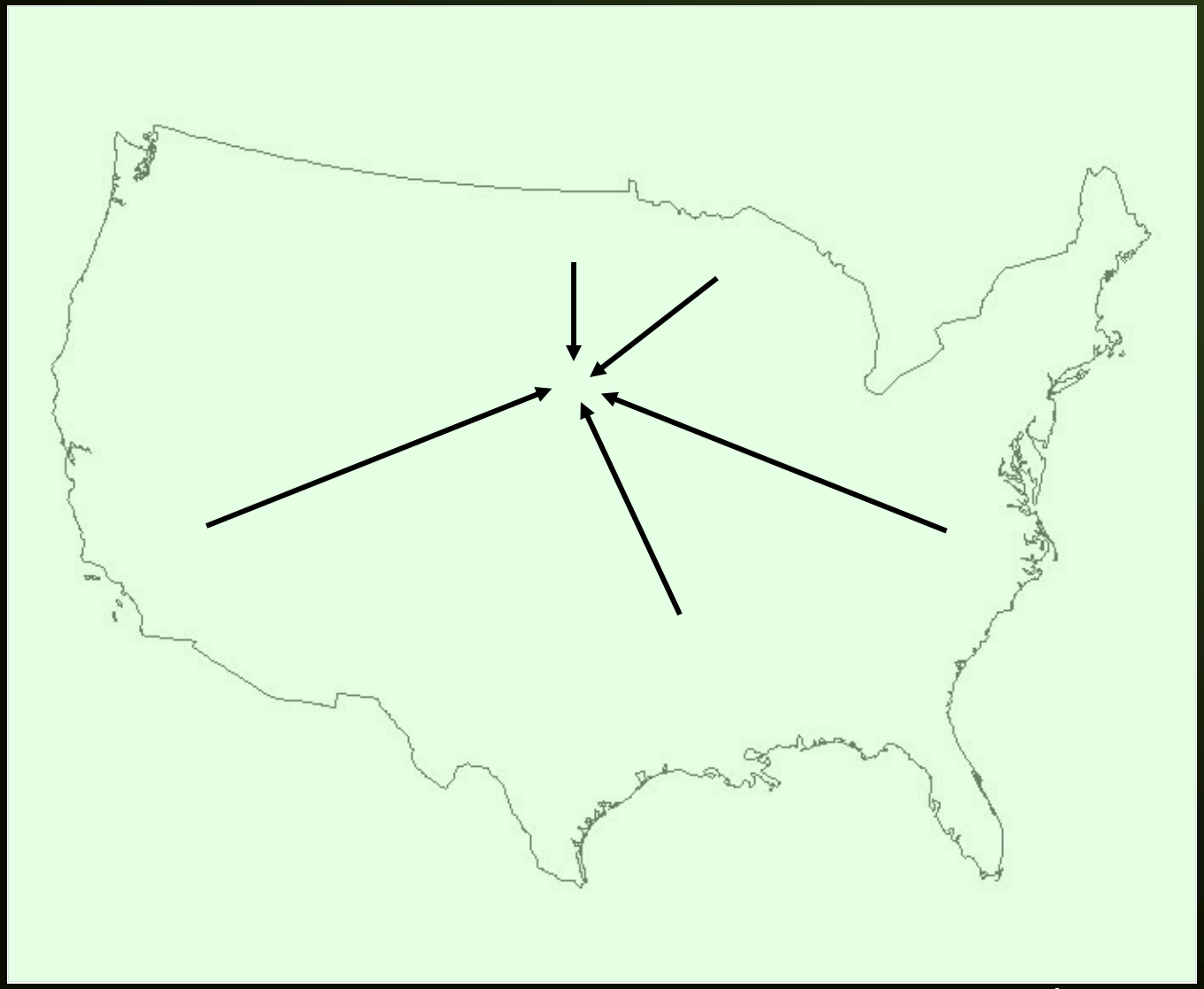


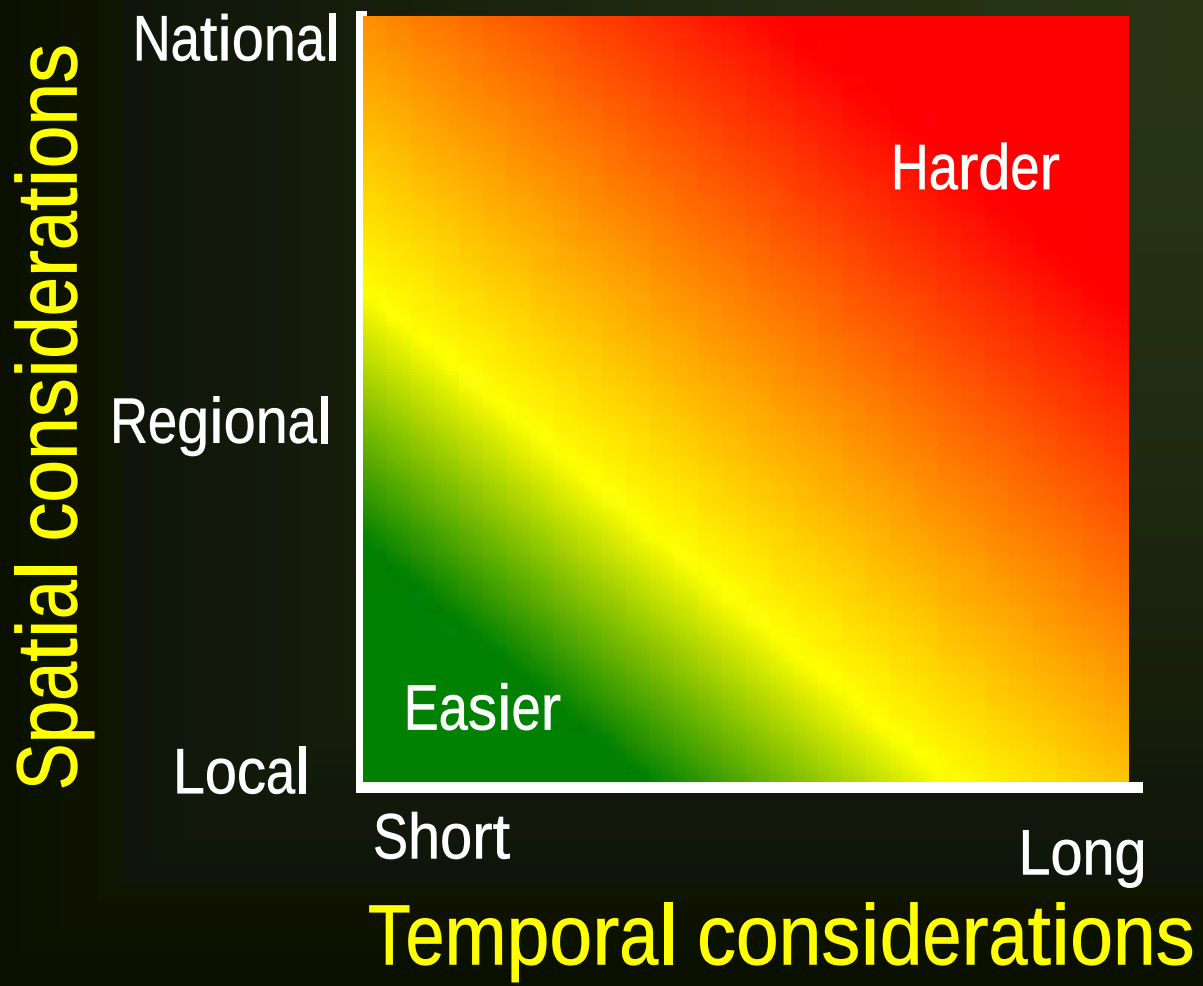




Greenley County,
Nebraska

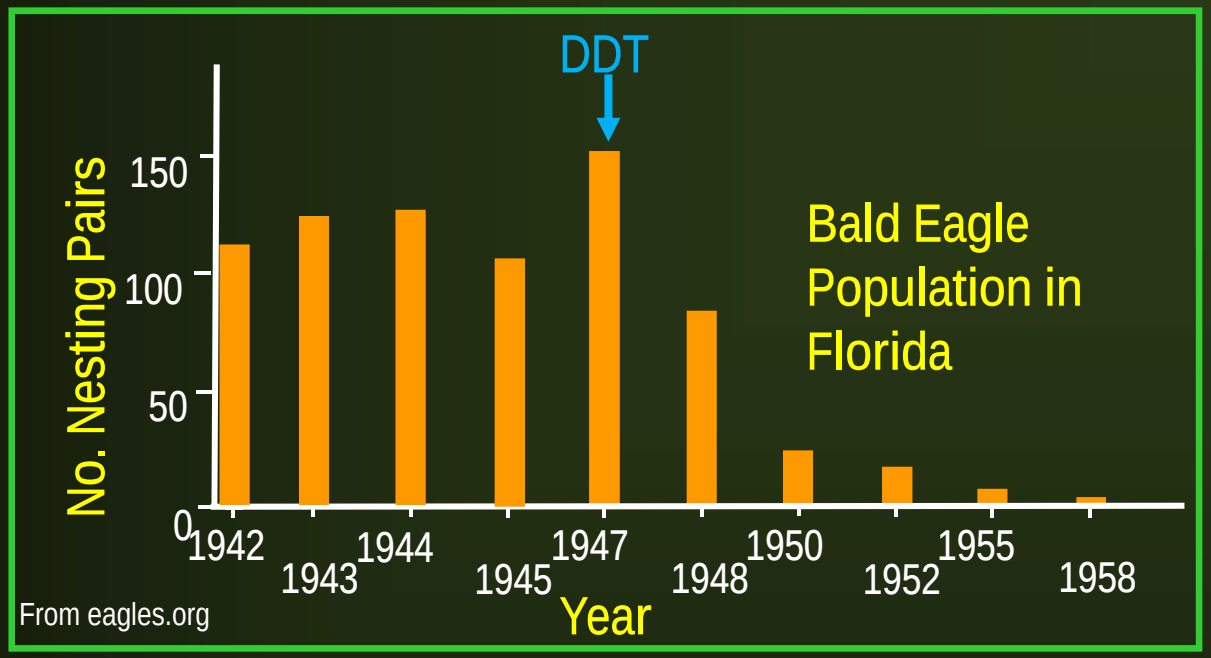

Nebraska WorldAtlas.com




National
Regional
Local
Spatial considerations
Harder
Easier
Short
Long
Temporal considerations

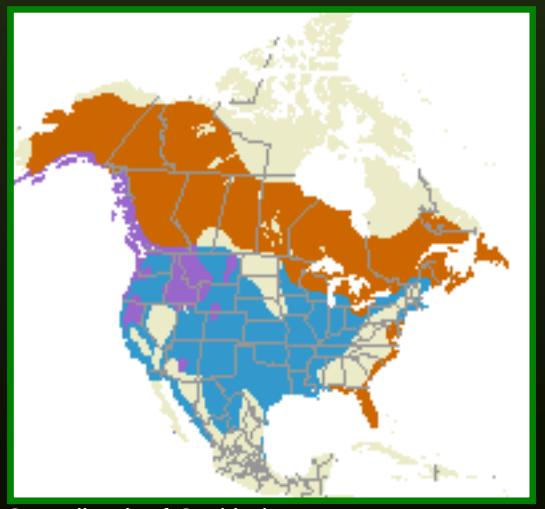
Errol Taskin

Geraint Smith



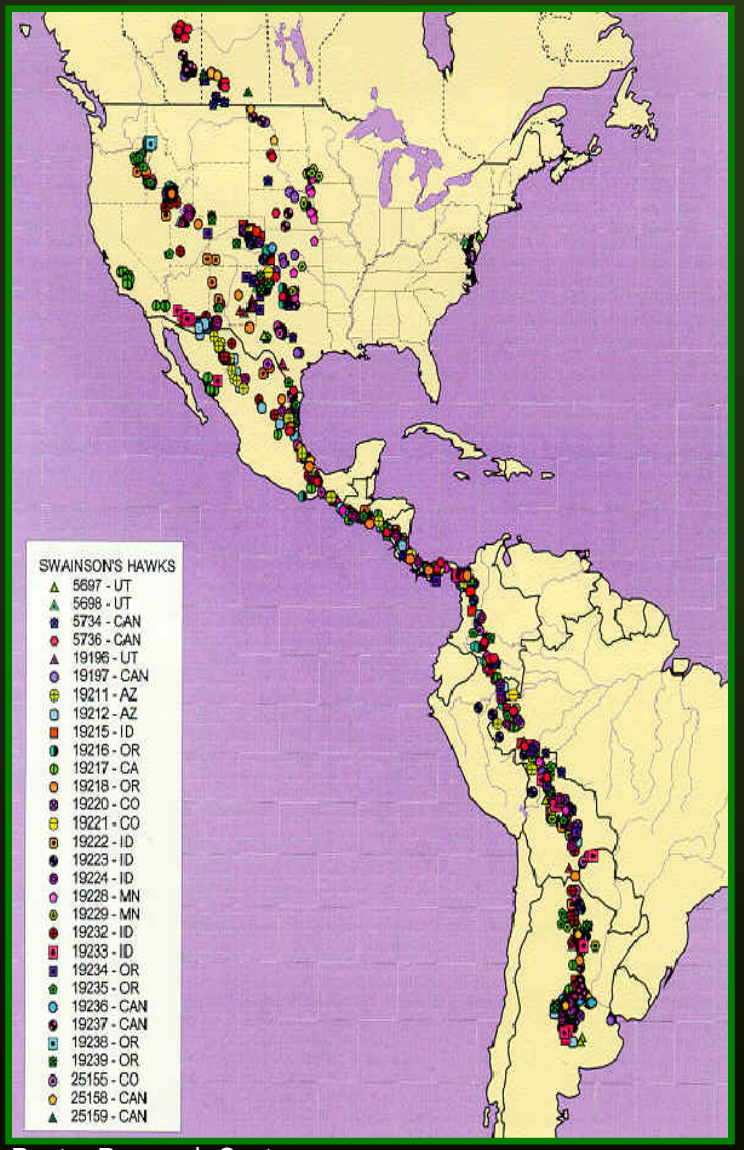
DDT

- bioaccumulation
- persistence
- soil: 2 – 15 yrs
- water: 150 yrs
- animal: 8 yrs



Cornell Lab of Ornithology

J. Huddle



Raptor Research Center

Monocrotophos

no bioaccumulation

low persistence

soil: < 7 d

plant: ≤ 3.4 d

animal excretion: 60-65% w/in 24 hrs

Questions to consider before jumping onto the population bandwagon.

www.philip graham.net

Brian E. Small

An incorrect focus on population-level effects undermines:

- Migratory Bird Treaty Act
- Endangered Species Act
- FIFRA

Pesticide Regulation and Populations

(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

- 1988- EPA issued the cancellation notice for granular diazinon on golf courses and sod farms based on actual bird kill reports.
- The EPA Administrative Law Judge said benefits > risks, so cannot cancel diazinon.

Pesticide Regulation and Populations

(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

- EPA Administrator overrulled the Administrative Law Judge.
- This was appealed by Ciba Geigy to the 5th Circuit Court.

FIFRA section 3 (c)(5)

"when used in accordance with widespread and commonly recognized practice, the product will not generally cause unreasonable adverse effects on the environment"

Pesticide Regulation and Populations
(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

"Generally cause unreasonable adverse effects"

- Ciba Geigy argued that "generally" means "more often than not".
- Court said "generally" means "commonly" or with "considerable frequency" though not 51% of the time.

Pesticide Regulation and Populations
(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

"Generally cause unreasonable adverse effects"

- Ciba Geigy argued that a risk is unreasonable only if it endangers bird populations (ex. DDT).

Pesticide Regulation and Populations
(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

Because FIFRA defines "unreasonable adverse effects" as harmful consequences (Hazard) and the unreasonable potential for harm (Risk), the Court recognized that diazinon use need not generally cause actual bird kills to warrant cancellation, but that cancellation could be justified if it generally causes an unacceptable risk of bird kills.

Pesticide Regulation and Populations
(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

- The Court rejected the EPA's and Ciba Geigy's arguments but stated that the EPA Administrator can "determine that recurring bird kills, even if they do not significantly reduce bird populations, are themselves an unreasonable environmental effect".

Pesticide Regulation and Populations
(Ciba Geigy Corp. v. EPA, 874 F.2d 277, 1989)

- The Court basically reaffirmed FIFRA and threw the decision process back to the EPA Administrator.
- In 1990 the use of granular diazinon on golf courses and sod farms was cancelled.