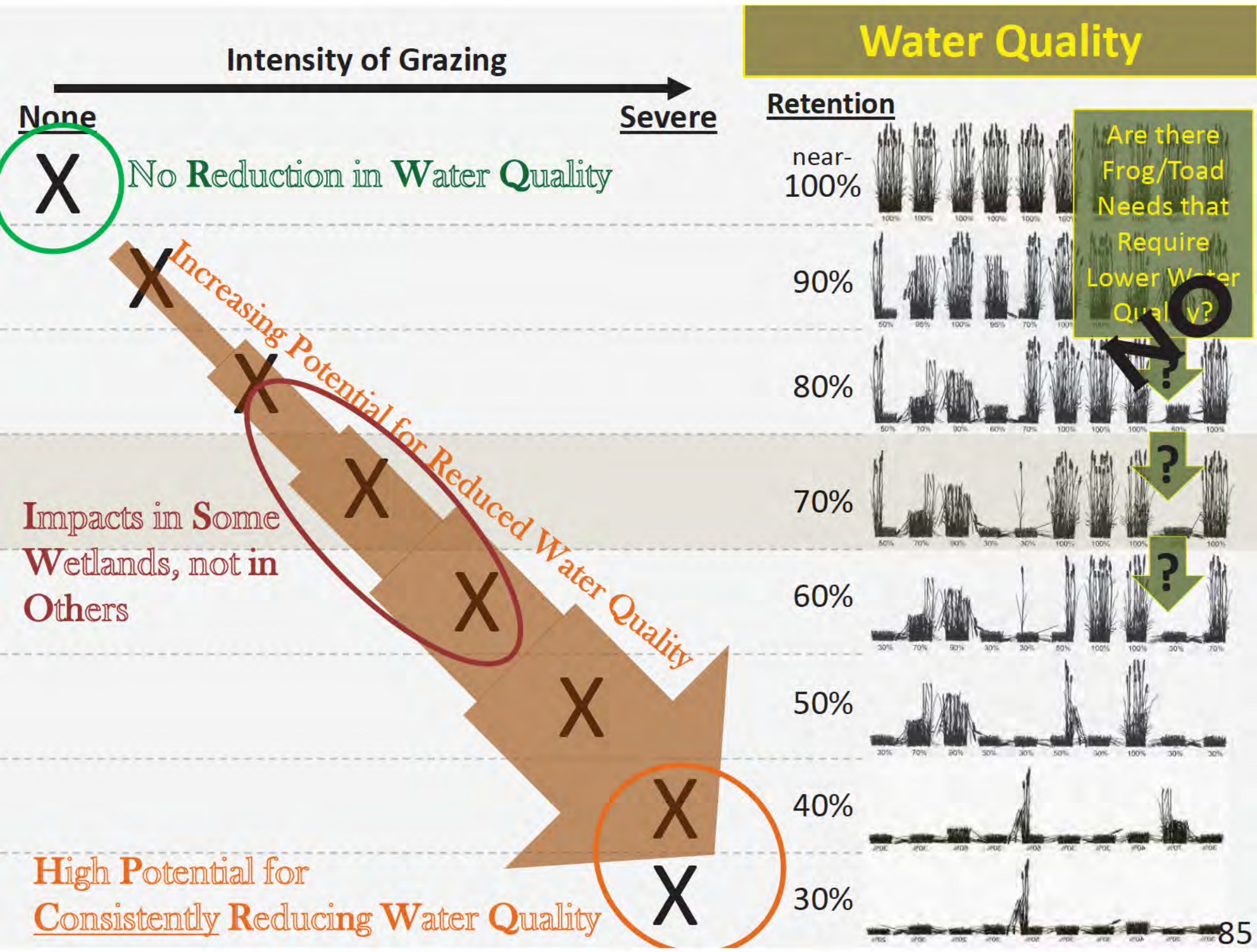
Water Quality



B.2 — Surface-water Retention in Small Wetlands

- Drying out of breeding wetlands before metamorphosis can be a major source of mortality in local populations.

  (Shoop 1974, Smith 1983, Newman 1989, Tejedo and Reques 1994, Reques and Tejedo 1997, Carey et al. 2005, Patla and Keinath 2005, Bull 2009)

- Declining water levels is a natural wetland process, and wetlands can naturally dry before metamorphosis.

  (Carey et al. 2005, Bull 2009, Laubhan et al. 2012)

- Several experts have expressed concern about drinking by livestock accelerating the decline in water levels in breeding wetlands.

  (Patla and Keinath 2005, Bull 2009)

B.2 — Surface-water Retention in Small Wetlands (cont'd)

Drinking by livestock unquestionably causes drying of some breeding wetlands before metamorphosis is complete, especially in small pools, which can result in major loss of tadpoles.

Example:

Pool Characteristics

- 30 ft. diameter pool (700 ft^2)
- 3,500 gallons of water
- Ave. depth of 8" and max depth of 18"

Evapotranspiration

- Water declines at rate of 30-50 inches / year *(Wyo. Joint Venture 2010)*
- Pool loses an estimated 3,500 gallons June – August or Sept.

Drinking by Cattle

- Can drink 10-15 gallons / day during summer *(Gadberry 2010)*
- Pool would lose 3,500 gallons June – Sept. w/o cattle
- 8-12 cow-calf pairs can drink 3,500 gallons in 2 weeks

Another Example:

Pool Characteristics

- 200 ft^2 pool *remaining in late August*
- 500 gallons of water (30 ft. diameter)
- Ave. depth of 4”

Water could last >2 weeks

Drinking by Cattle

- 8-12 cow-calf pairs can drink 500 gallons in 3 days

Therefore, drinking by livestock has potential to result in large die offs.

→ Potential for major implications for some frog/toad populations on the BTNF.

Water Retention

Intensity of Grazing

None — Severe

No Depletion of Water

Increasing Potential for Drying before Metamorph.

Retention

near-100%

90%

80%

70%

60%

50%

40%

30%

Are there Frog/Toad Needs that Require Faster Water Declines?

NO

B.3 — Survival as Affected by Livestock Trampling

- Trampling by livestock can increase mortality of frogs and toads, considerably in some situations.

  (Bartelt 1998, Maxell 2000, Patla 2001, Wind and Dupuis 2002, Keinath and McGee 2005, Hogrefe et al. 2005, Pierce 2006, Bull 2009)

- "In some instances trampling can result in severe population-level impacts."
  (Maxell 2000:15)

- Trampling of frogs and toads has been documented in many areas, including several hundred boreal toad metamorphs on Caribou-Targhee NF.

  (Bartelt 1998, Maxell 2000, Bull 2009)

- Trampling mortality is of such concern that *Keinath and McGee (2005:44)* and others recommended excluding livestock from key boreal toad areas.

- Trampled amphibians are very difficult to find. *(Bull 2009)*

- Of most concern is trampling of metamorphs, given large congregations.

  (Bartelt 1998, Maxell 2000, Keinath and McGee 2005, Bull 2009)

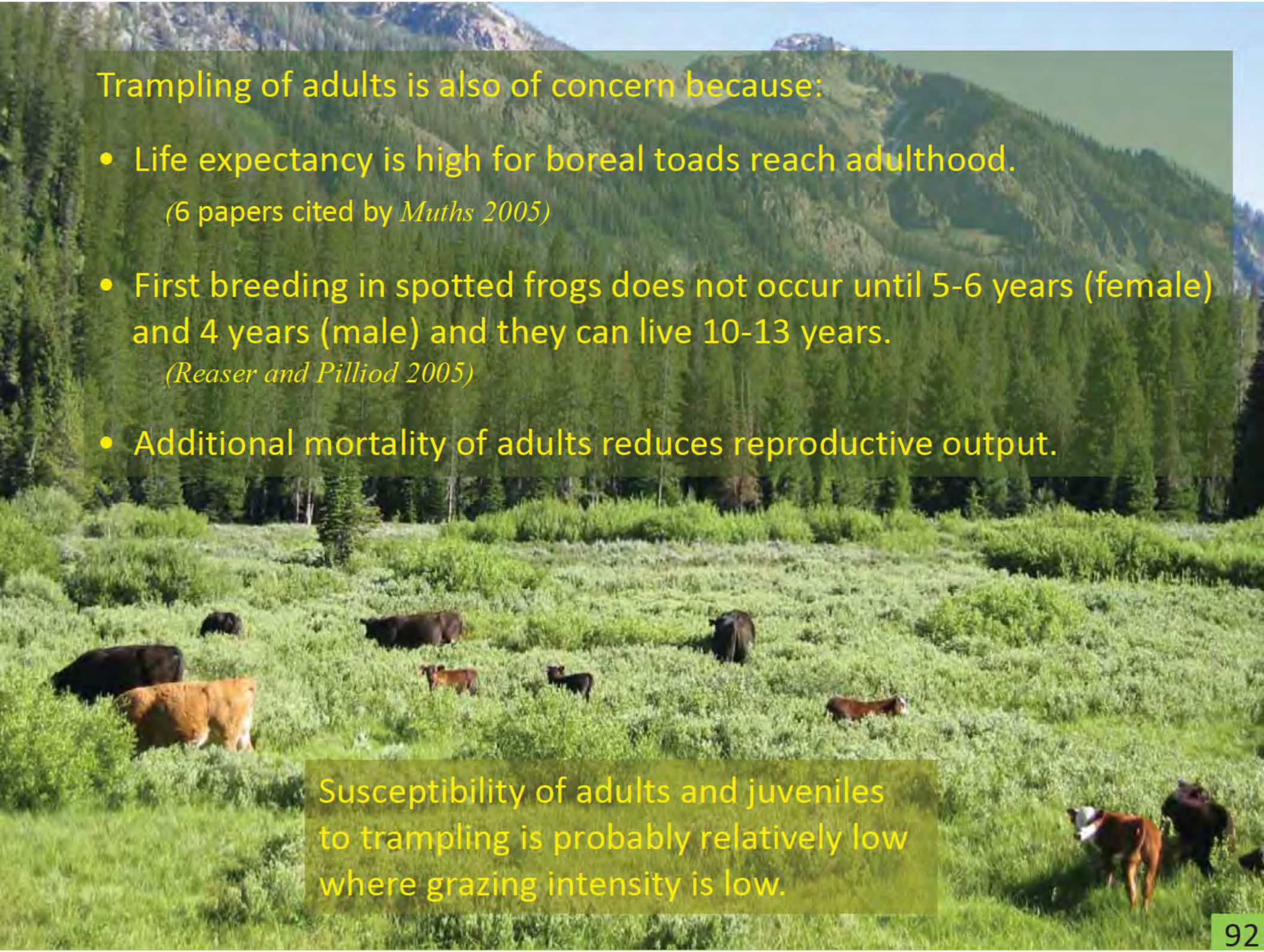
- Densities of metamorphs can be >1/10 ft^2 or even >5/ft^2.

- Aggregations can "…sometimes be two or more individuals deep."

  (Wassersug 1974, as cited in Muths 2005).

  → It can be very difficult to avoid stepping on them.

  → It is possible for nearly an entire cohort to be killed by trampling.



Trampling of adults is also of concern because:

- Life expectancy is high for boreal toads reach adulthood.

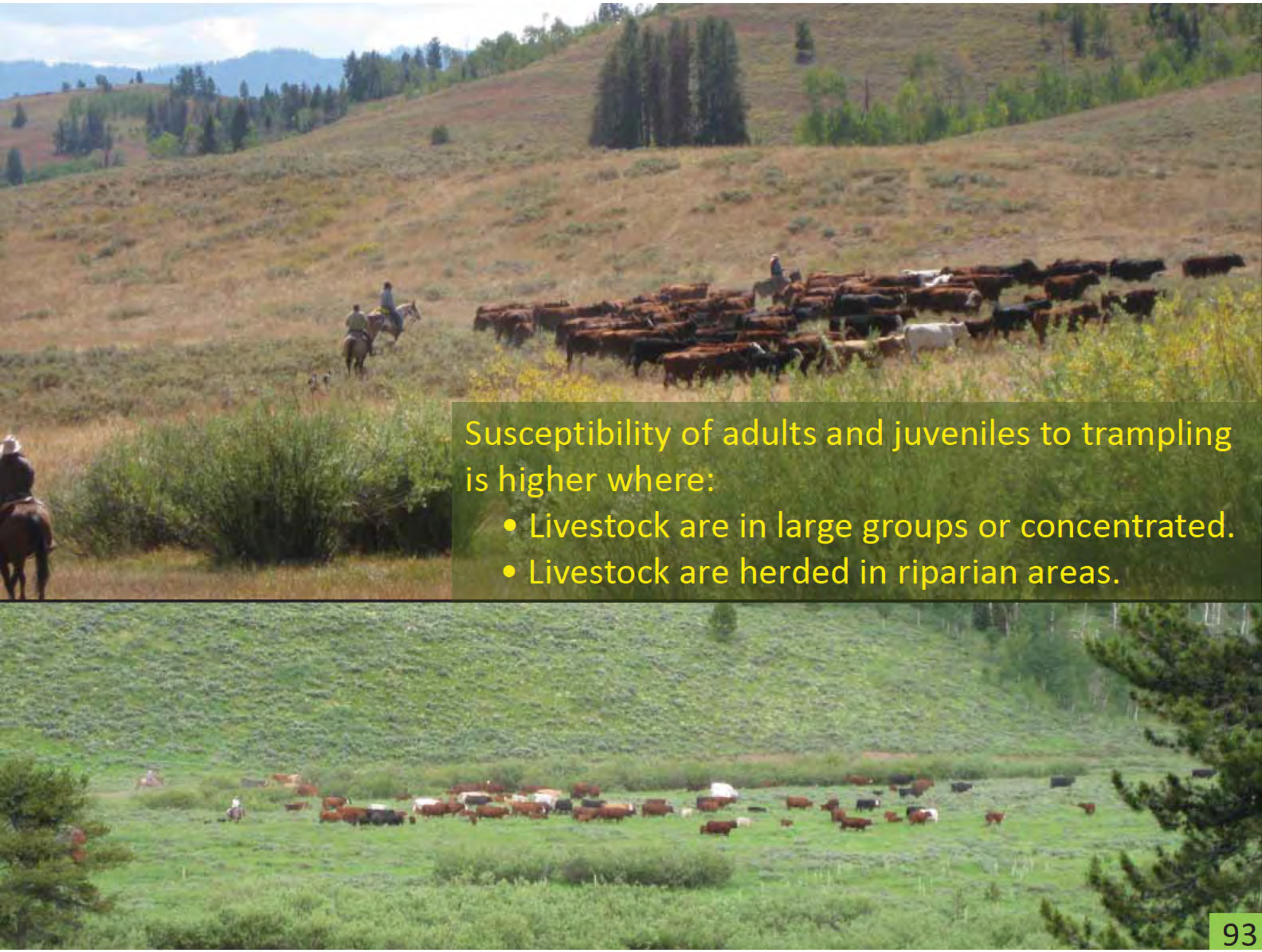
  *(*6 papers cited by *Muths 2005)*

- First breeding in spotted frogs does not occur until 5-6 years (female) and 4 years (male) and they can live 10-13 years.

  (Reaser and Pilliod 2005)

- Additional mortality of adults reduces reproductive output.

Susceptibility of adults and juveniles to trampling is probably relatively low where grazing intensity is low.


Susceptibility of adults and juveniles to trampling is higher where:
• Livestock are in large groups or concentrated.
• Livestock are herded in riparian areas.

Use of Clay Pigeons

- Clay pigeons placed in livestock pastures are used to experimentally simulate the rate that livestock step on certain things, including bird nests and sensitive animals like desert tortoises.

  (Koerth et al. 1983, Beintema and Müskens 1987, Jensen et al. 1990, Guthery and Bingham 1996, Paine et al. 1996, Mandema et al. 2013)

- Results of these studies provide an upper bounds to the impacts on frogs and toads.

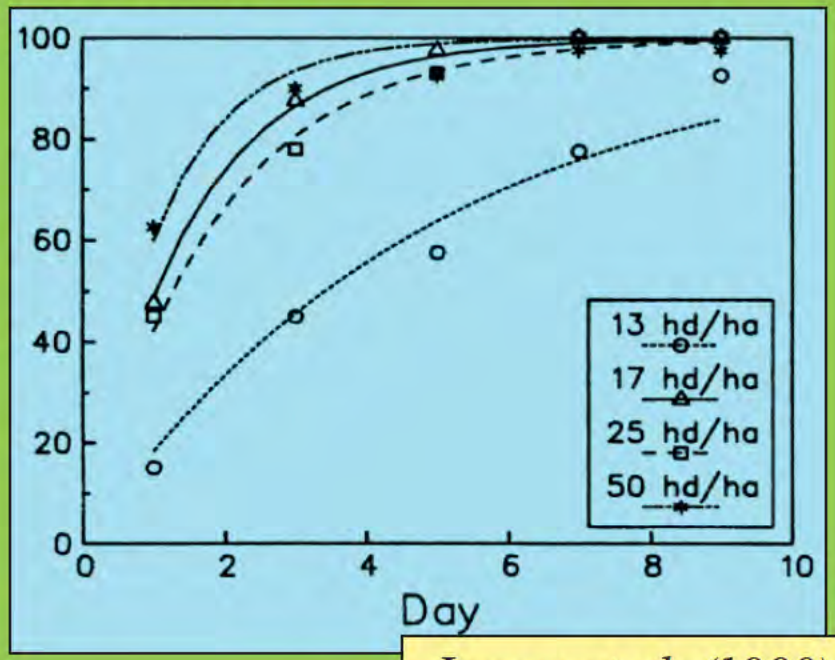
- While results likely overestimate the magnitude of trampling impacts in many situations, they

  (1) likely approximate effects under some situations, and

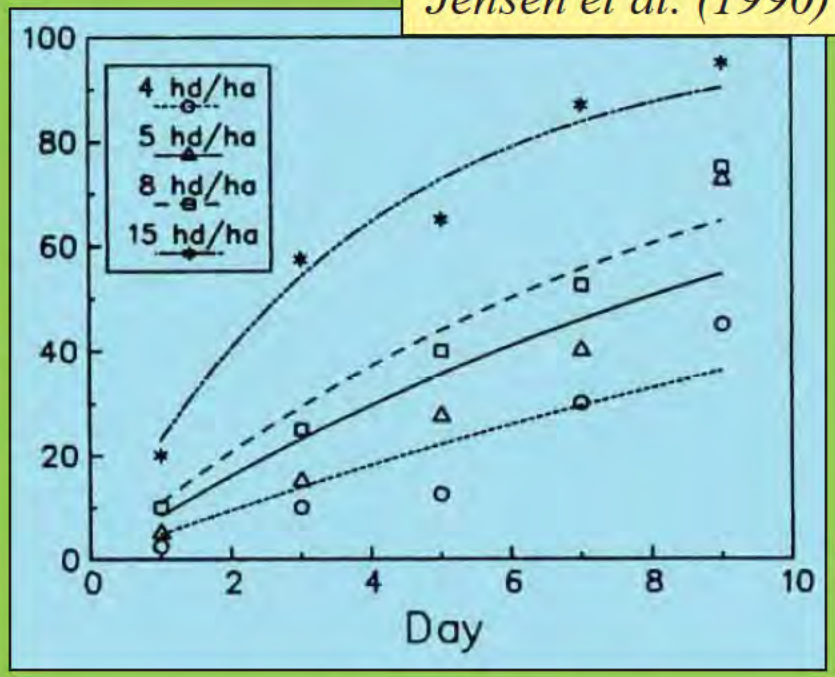
  (2) provide an indication of the rate of increase in potential impacts.

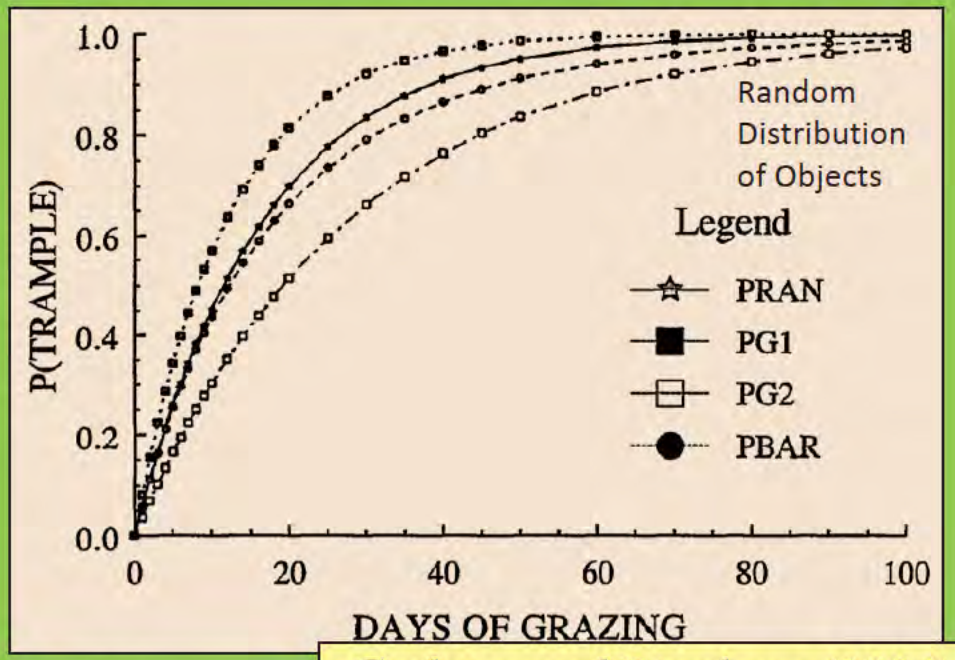
Two examples:

Percent of Clay Pigeons Trampled

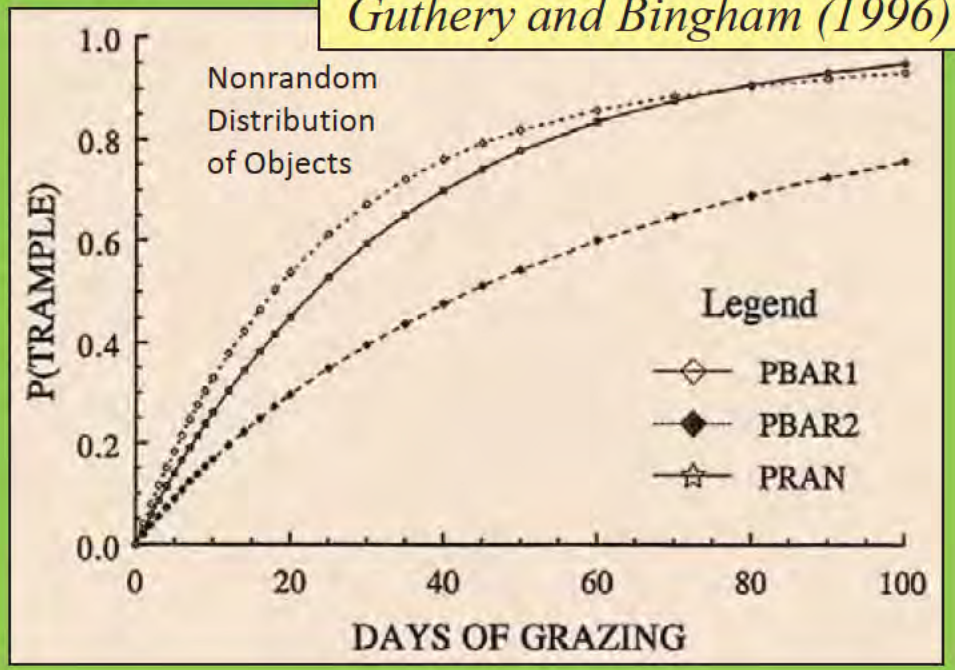


Jensen et al. (1990)





Guthery and Bingham (1996)



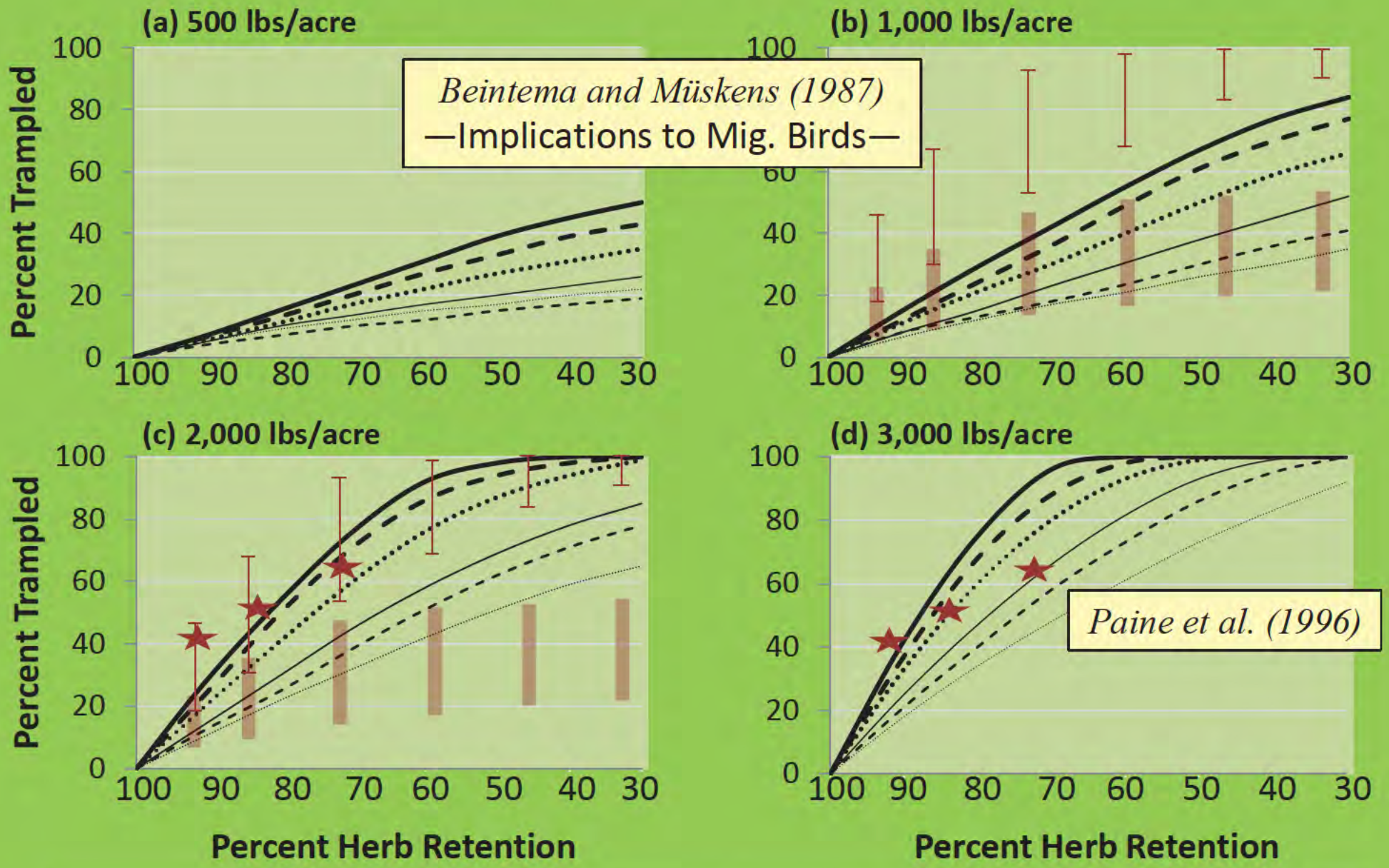
Livestock Grazing Intensity →

NEXT STEPS:

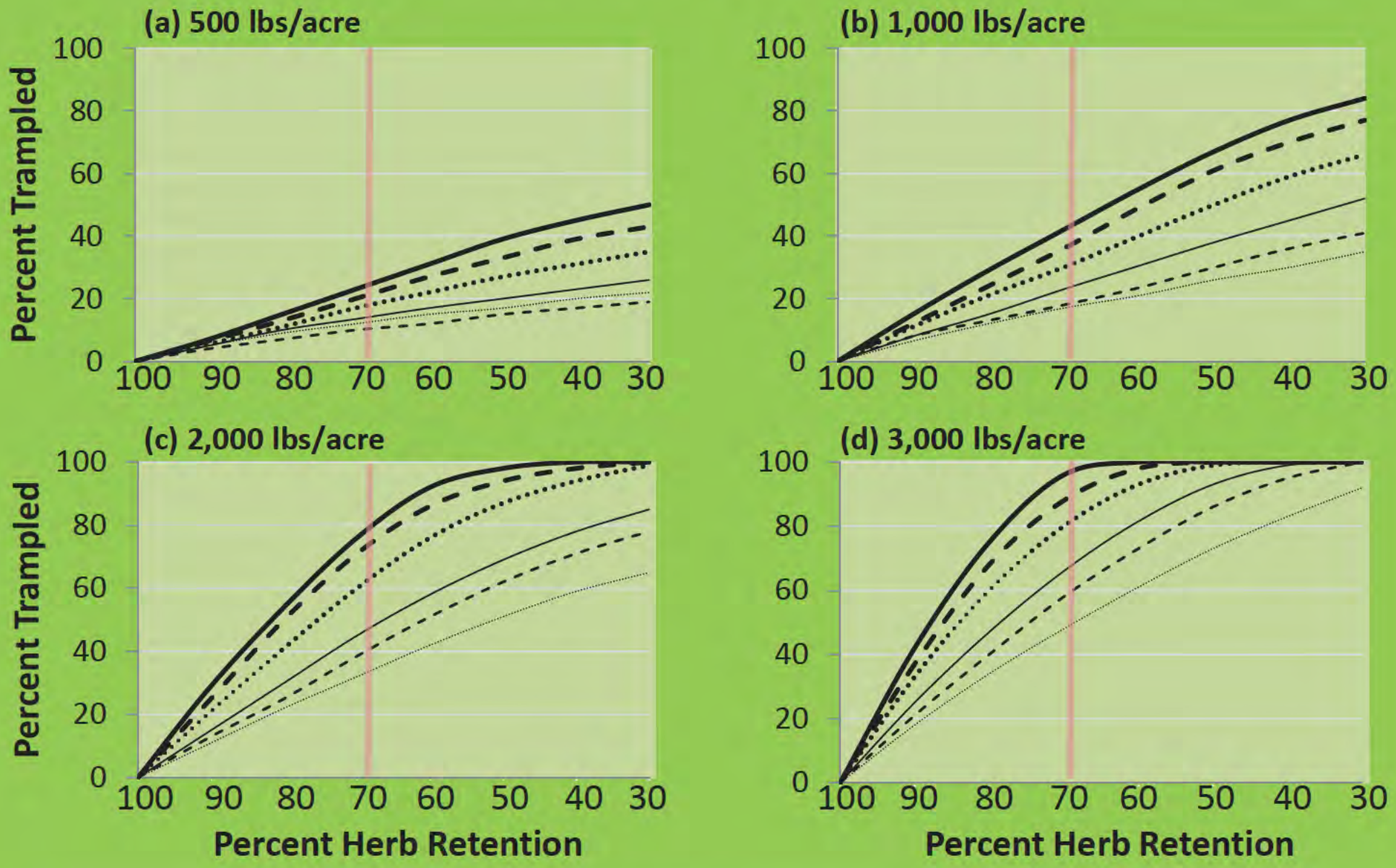
Livestock density was converted to percent retention by accounting for:

- Forage consumption rate of cow/calf pairs *(Lyons et al. 1999, Pratt and Rasmussen 2001)*
- Different production levels of meadows *(Youngblood et al. 1985, Kovalchik 1987, Padget et al. 1987)*
  - 500 lbs/acre
  - 1,000 lbs/acre
  - 2,000 lbs/acre
  - 3,000 lbs/acre
- Percent of production that is retained (100%, 90%, 80%, etc.)
- Different durations of grazing (1 week, 2 weeks, 4 weeks)

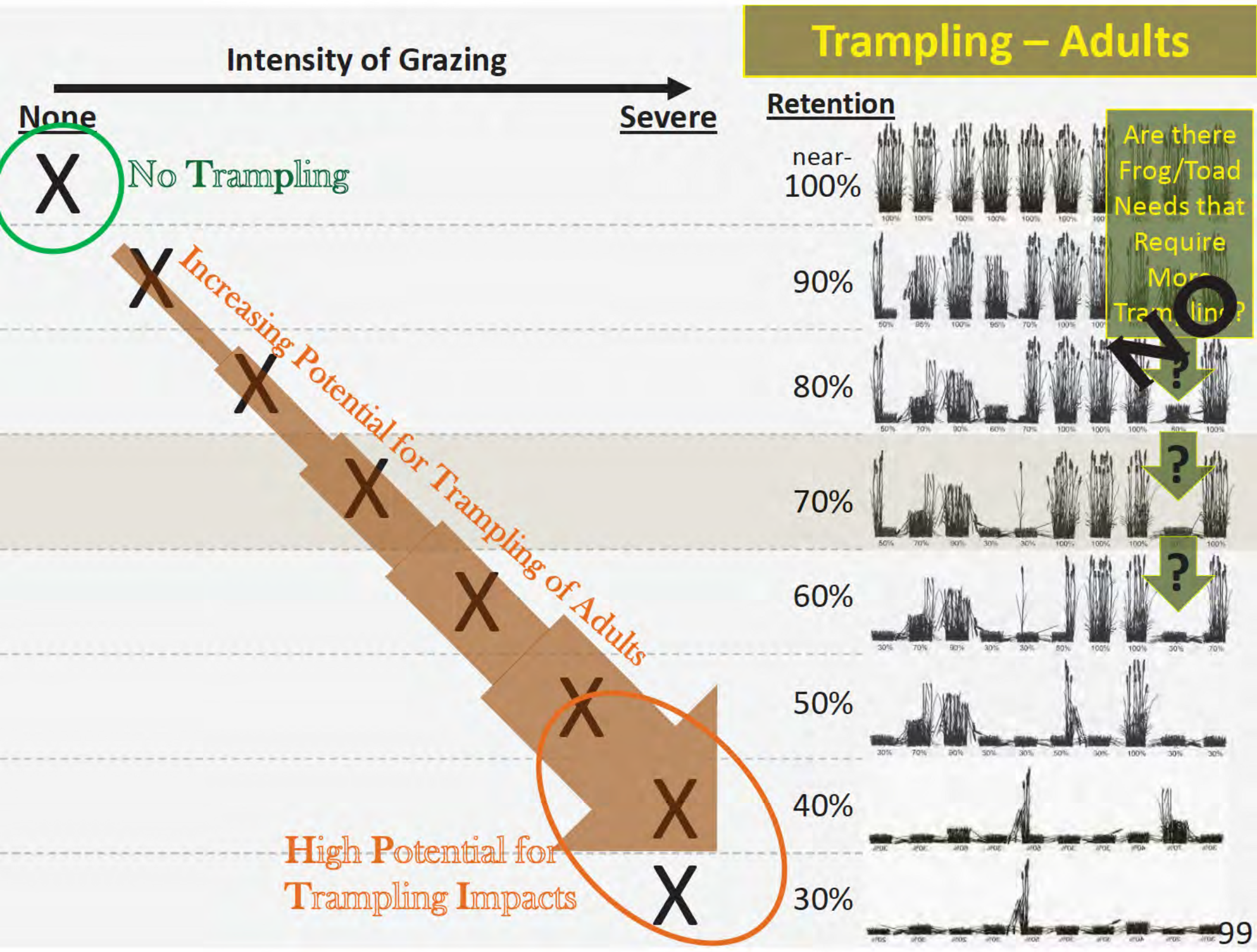
Trampling Rate of Small Stationary Objects by Percent Retention



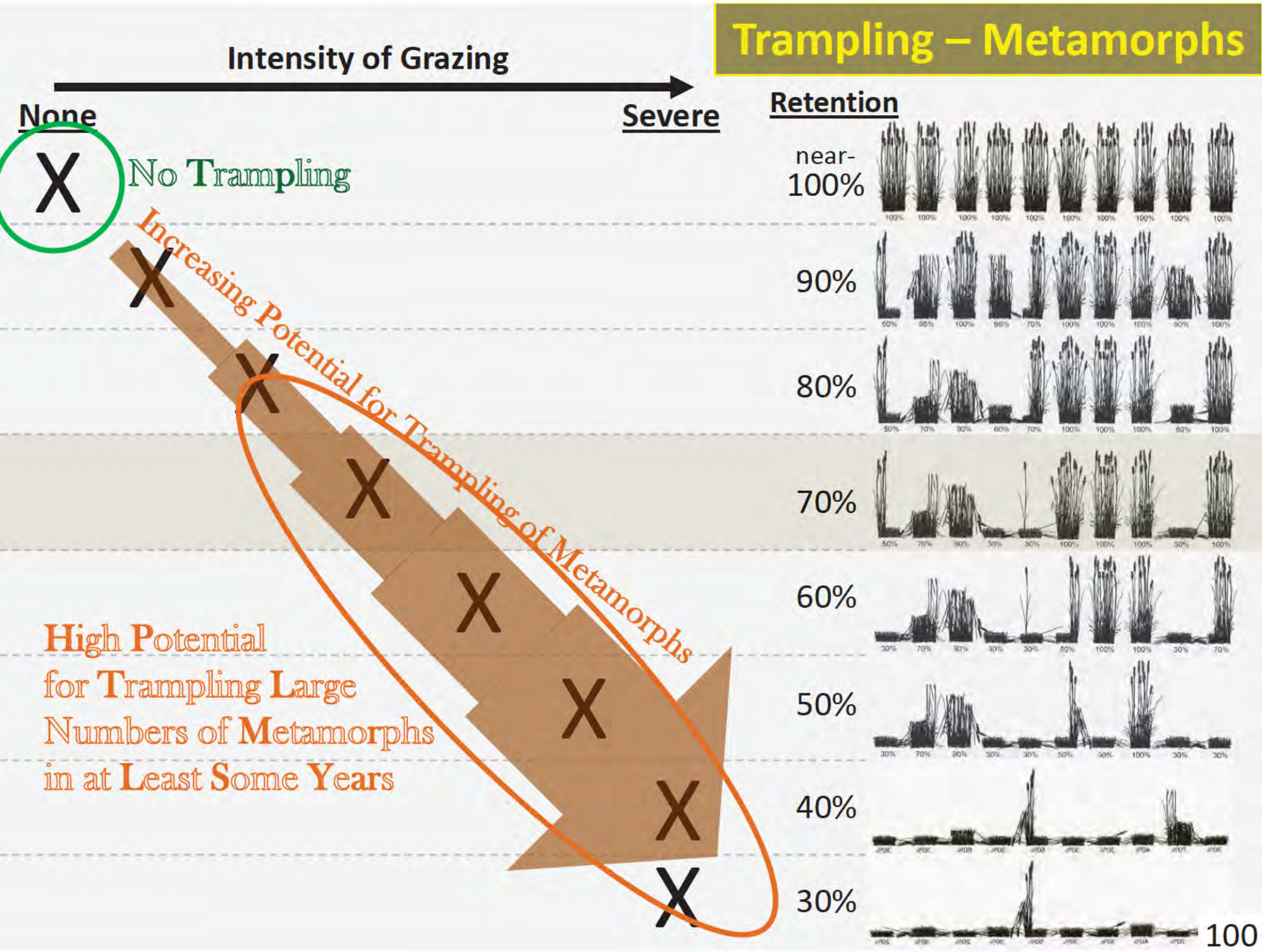
Trampling Rate of Small Stationary Objects by Percent Retention



Trampling – Adults



Trampling – Metamorphs



B.4 — Soil Looseness & Porosity

- Soil looseness and porosity is important to spotted frogs and boreal toads for several reasons, including:

  - They "self excavate," which requires loose soil and is facilitated by a duff layer. *(Keinath and McGee 2005, Patla and Keinath 2005, Bull 2006)*

  - Maintenance of plant species composition requires a relatively natural soil structure. *(Thurow 1991, Holechek et al. 2004)*

- Livestock use compacts soils.

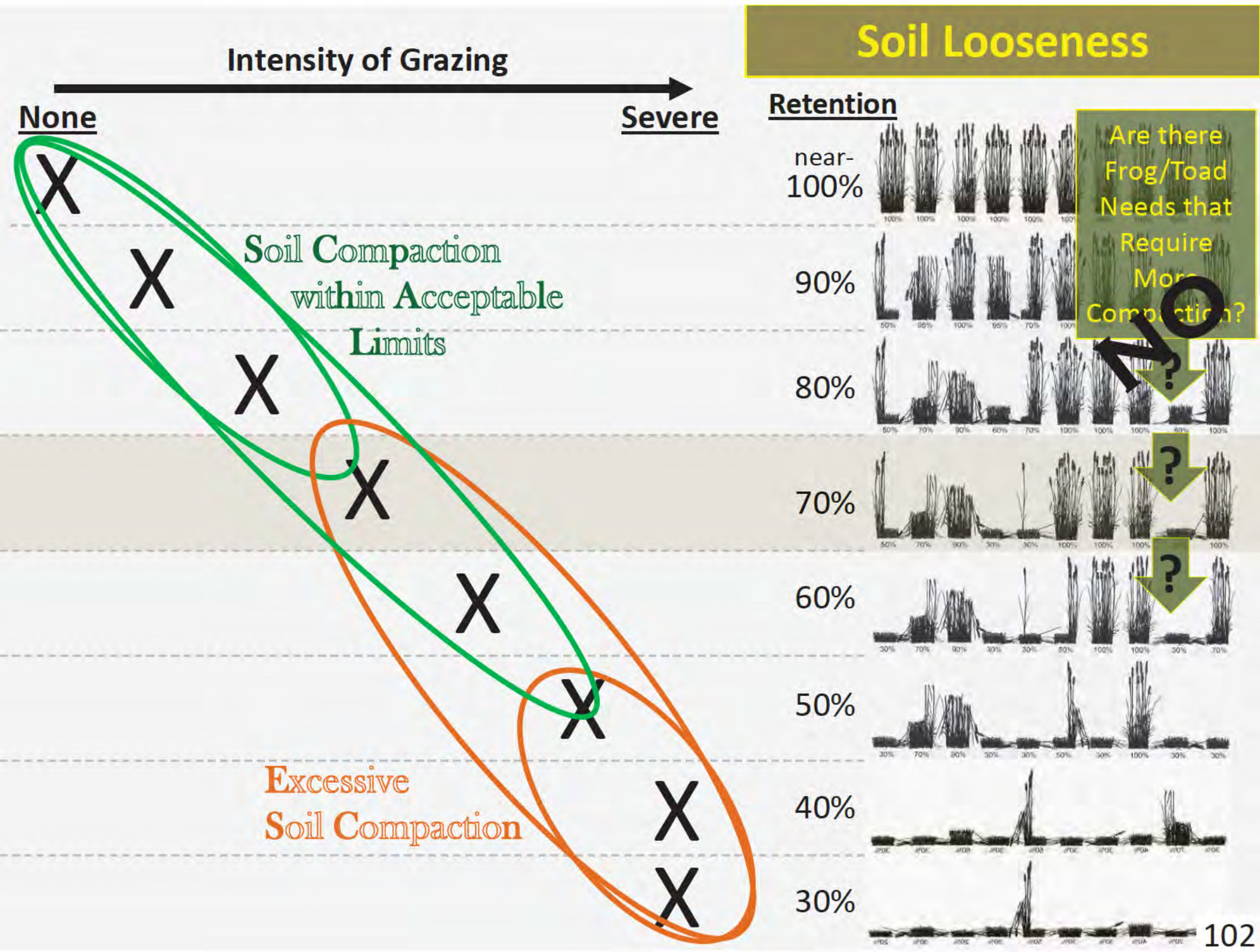
  (Moore et al. 1979, Kaufman and Krueger 1984, Pluhar et al 1987, Leffert 2002:24-25, Hubbard et al. 2004)

- Soil compaction from livestock grazing can prevent frogs and toads from burrowing to prevent desiccation or freezing. *(Douglass et al. 1999, Maxell 2000, Keinath and McGee 2005, Patla and Keinath 2005, Bull 2006)*

- Water infiltration rates decline by small degrees at 31-50% use of key forage species (55-80% use of total herbaceous vegetation).

  (Thurow 1988, Thurow 1991, Holechek et al. 2004)

Soil Looseness



B.5 — Integrity of Small Mammal Burrows

- Boreal toads and spotted frogs use small mammal burrows.

  (Jones 2000, Bartelt 2000, Patla 2001, Wind and Dupuis 2002, Keinath and McGee 2005, Patla and Keinath 2005, Bull 2006, Browne and Paszkowski 2010)

  → 26% of boreal toads used burrows in Bartelt (2000).

  → 20% of boreal toads used burrows in Bull (2006).

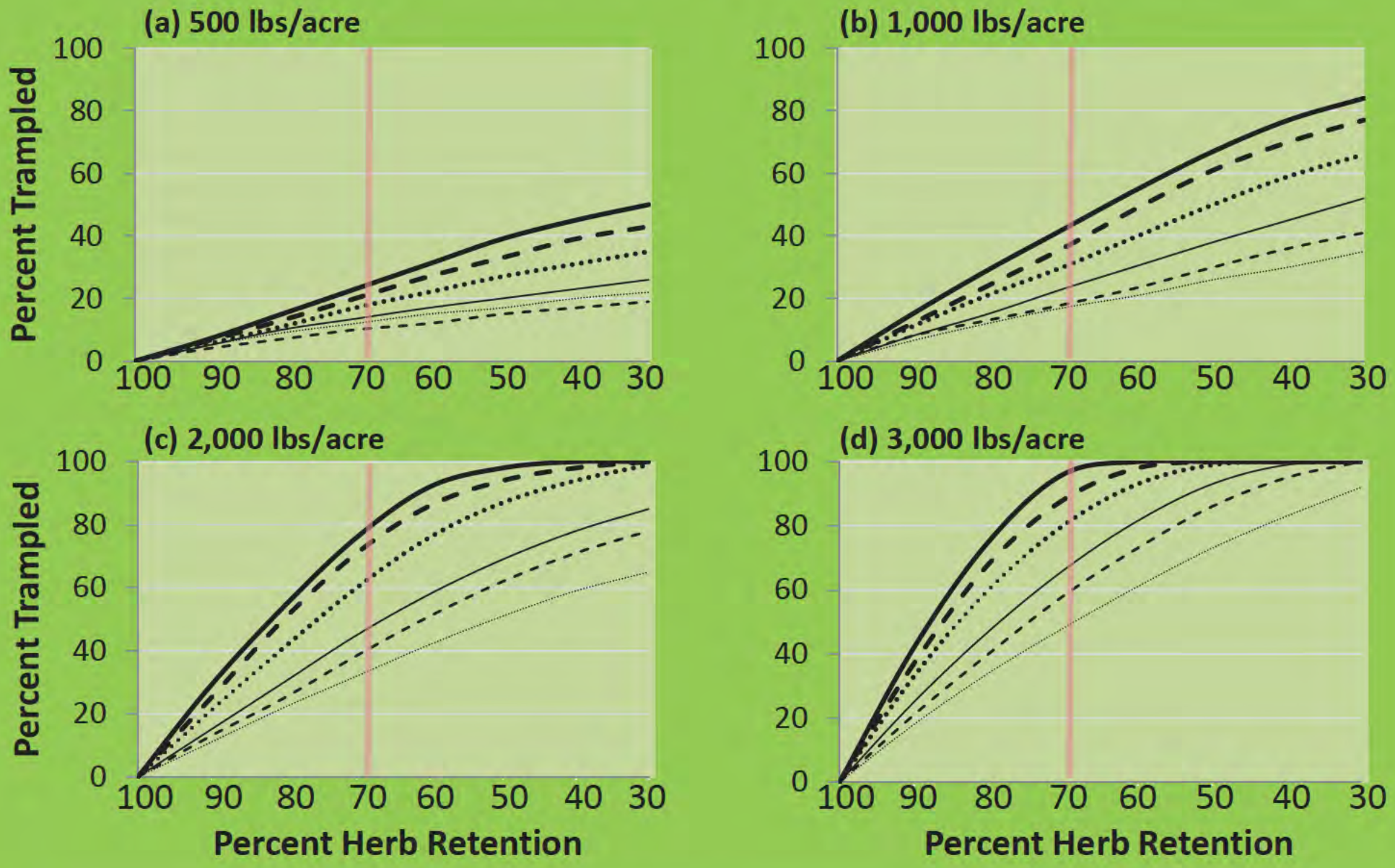
- Livestock can crush burrows (making them unavailable) and can crush toads within burrows.

  (Maxell 2000, Keinath and McGee 2005)

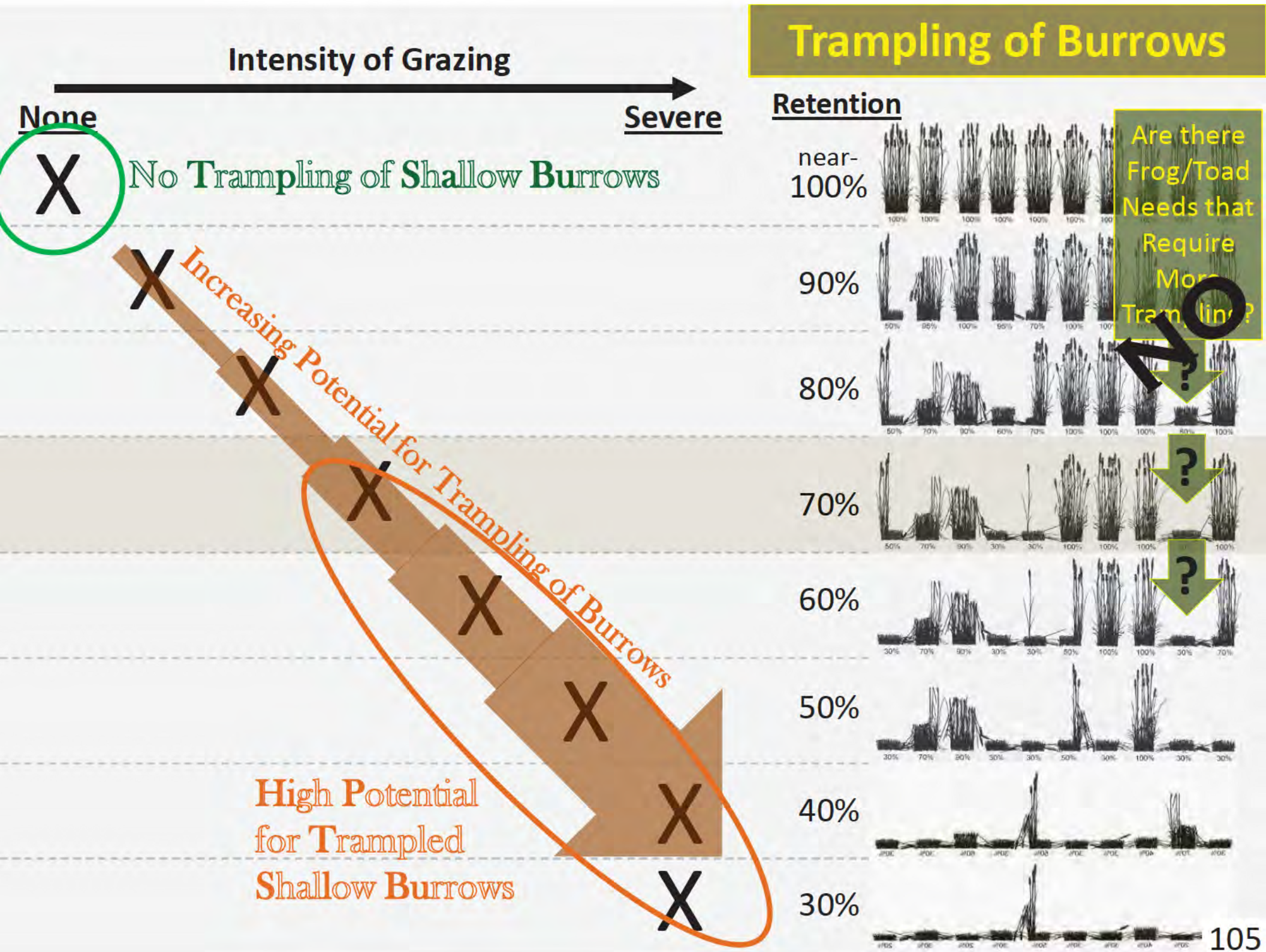
- The potential for crushing burrows is directly related to the depth of burrows and livestock grazing intensity.

  → Trampling of clay pigeons provides a good estimate of the potential rate that shallow burrows are crushed.

Trampling Rate of Small Stationary Objects by Percent Retention



Trampling of Burrows



Summary of 11 Habitat & Survival Elements

Humidity Retention
Shading
Hiding & Escape Cover
Forage for Tadpoles
Invertebrate Habitat
Small Open Patches
Water Quality
Water Retention
Survival (Trampling)
Soil Looseness
Burrow Retention

= Relatively Strong Support

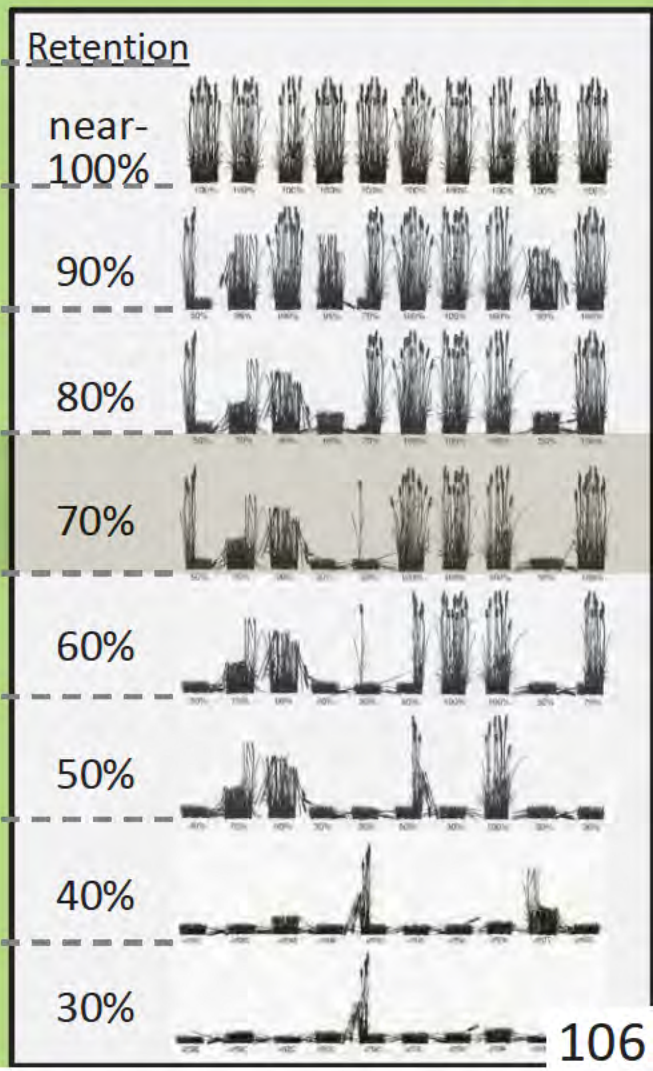
Known Suitable Conditions

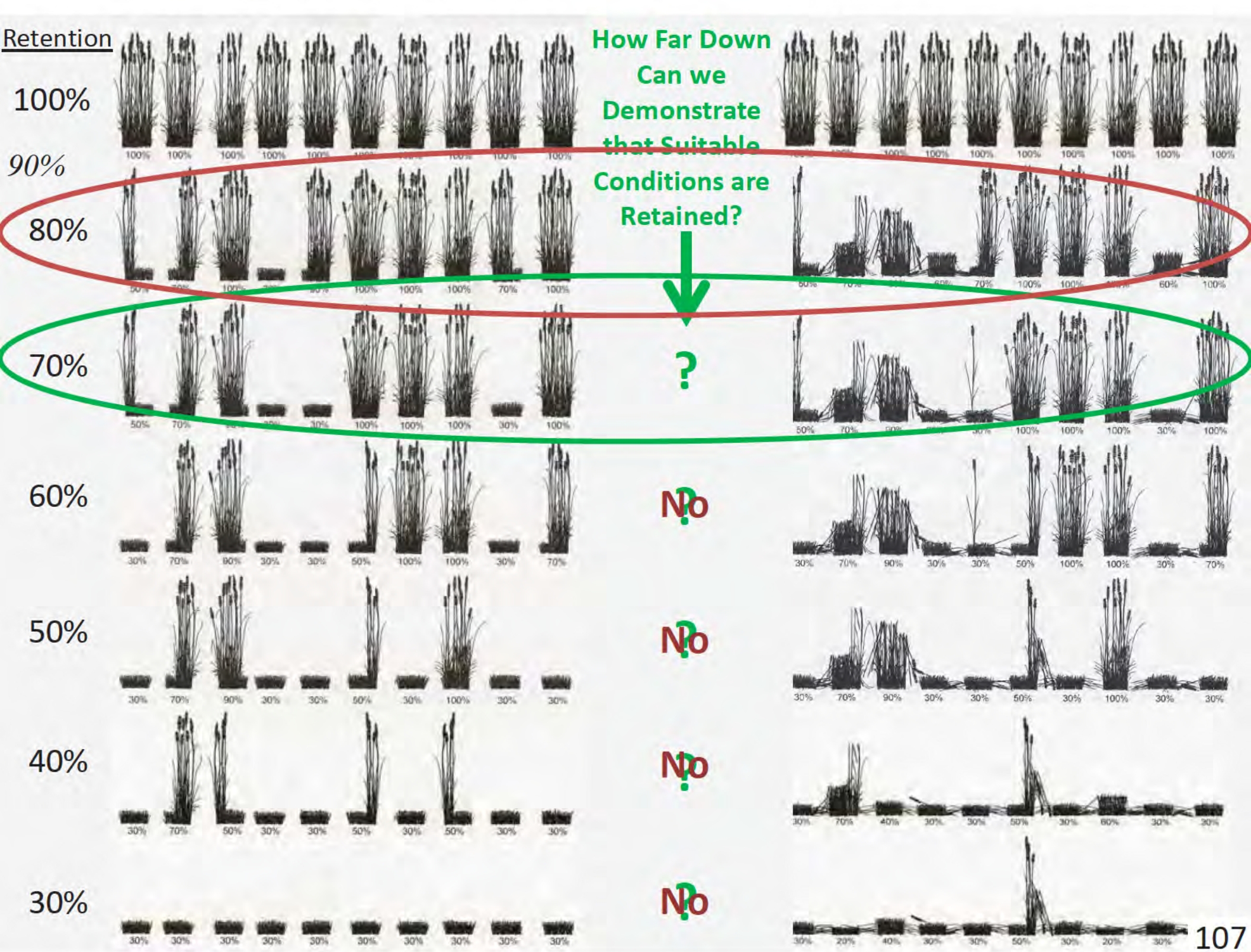
Relatively Strong Support

Moderate Support

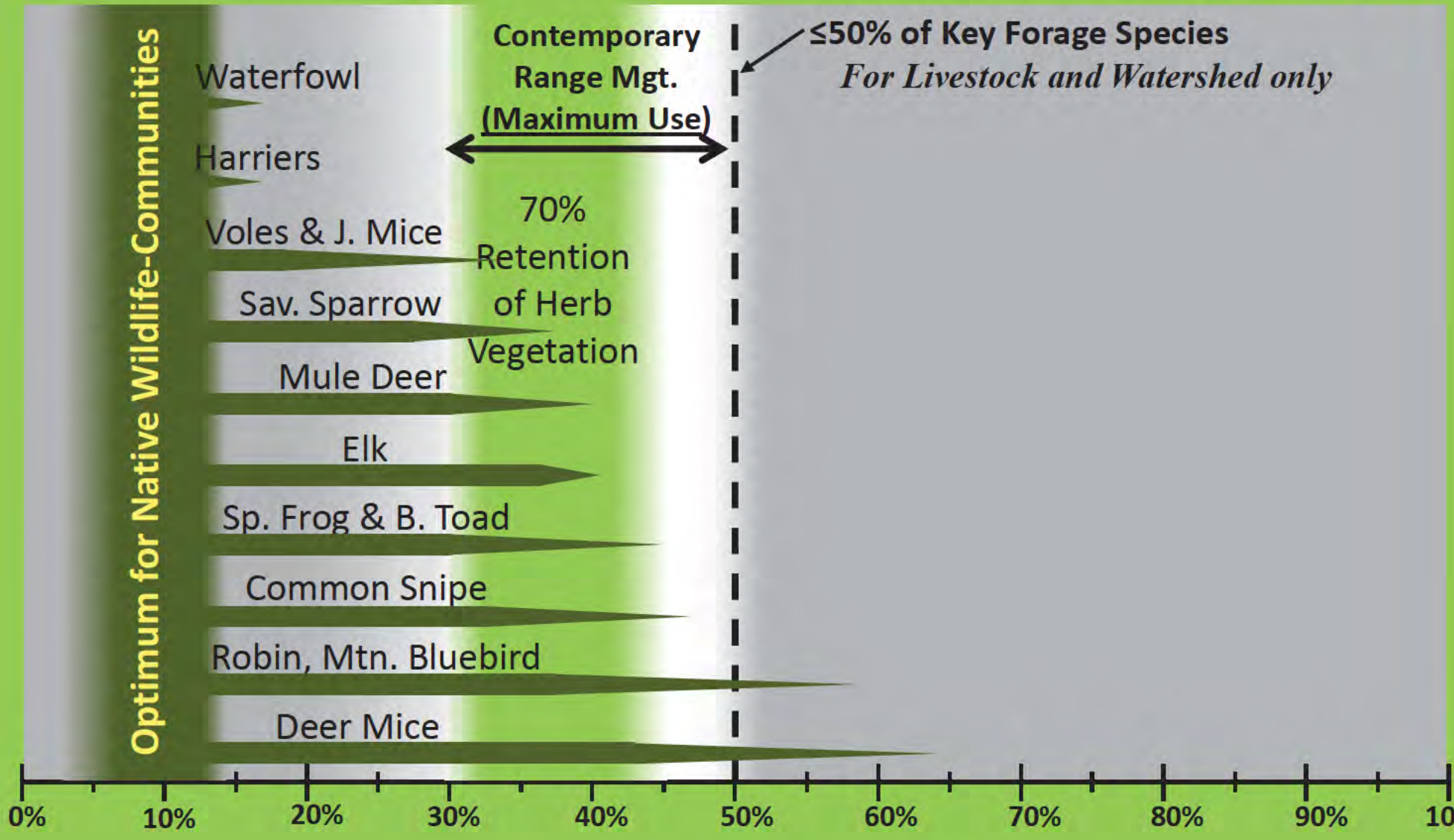
Weak Support

No Support




Retention
100%
90%
80%
70%
60%
50%
40%
30%
How Far Down Can we Demonstrate that Suitable Conditions are Retained?
?
No
No
No
No

Relationship to Native Wildlife-Community



Purpose of Presentation

To outline the scientific basis of 70% retention* as a habitat threshold and indicator to meet Forest Plan and regulatory requirements for:

- Providing an adequate amount of suitable habitat for SFs & BTs.
- Retaining an adequate amount of forage and cover for SFs & BTs.
- Protecting spotted frogs and boreal toads.

→ Ultimately, to prevent any further reductions in habitat and populations that may be caused by livestock grazing use, and to minimize the extent to which this activity compounds the effects of disease, climate change, and other factors.

In other words, to meet requirements of:
- *FSM 2670.22.1*
- *Forest Plan Objectives 3.3(a) and 4.7(d)*
- *Sensitive Species Mgt. Standard*

Ultimately → NFMA

* 70% retention of total herbaceous vegetation.

End of Regular Presentation

Outline

I. Status & Habitat Use

II. Some Basic Concepts

III. Forest Plan & Other Direction

IV. Suitable Herbaceous Retention and Relationship to Range Management & Wildlife Community as a Whole

V. Suitable Meadow Habitat Characteristics: conditions under which native wildlife-communities formed

VI. Scientific Basis for 70% Threshold

VII. 4" Stubble Height

VIII. Risk Factors — Multiple Stressors

IX. Metapopulation Concept

X. Objectives vs. Standards

4" Stubble Height of Frog/Toad Habitat (NOT on green-line) = 30-50% retention for 12-28" sedge community

- Keinath and McGee (2005:44) did not recommend min. 4-6" stubble height to provide for boreal toad habitat.

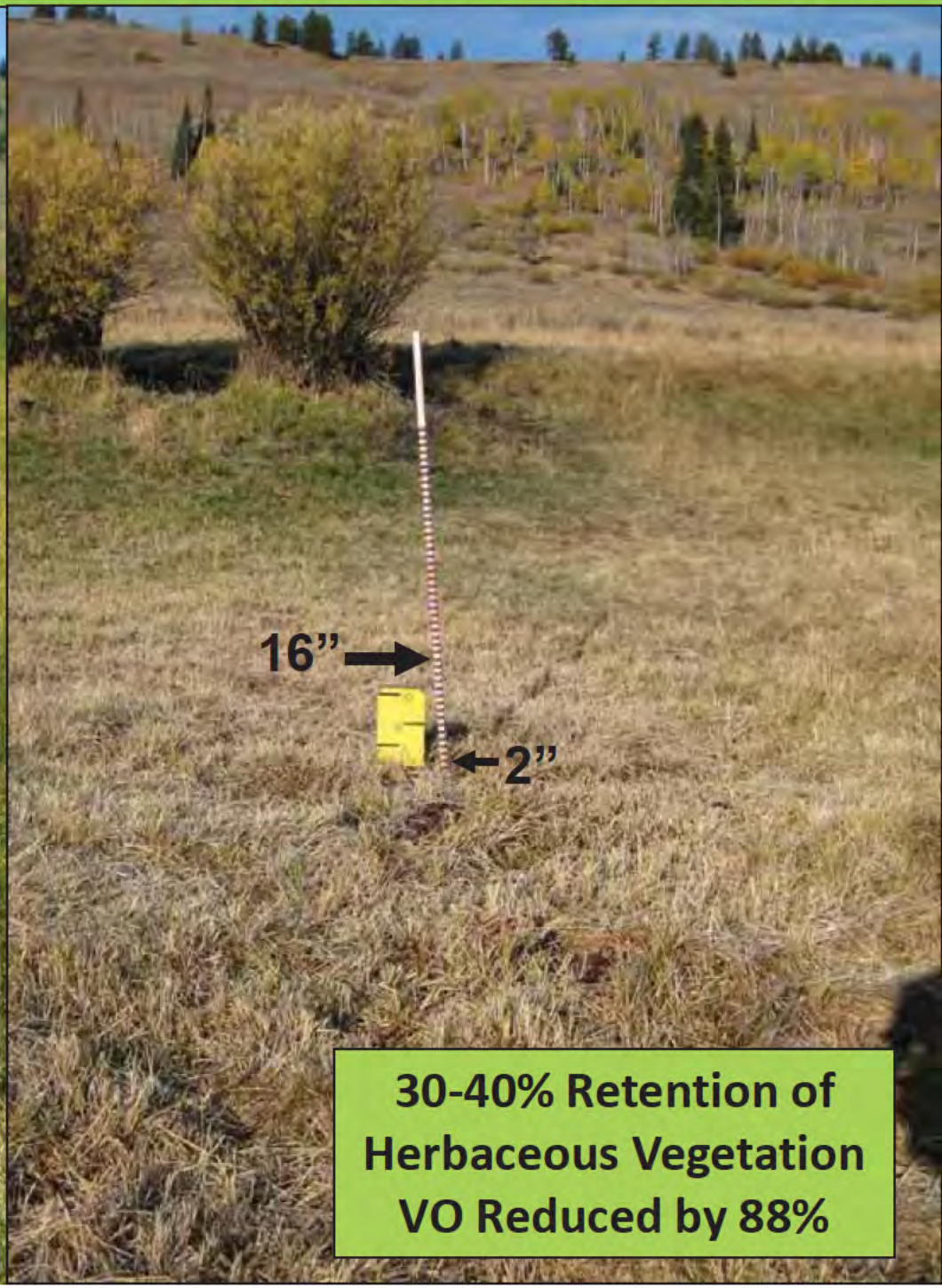
  → They recommended this as a "Standard practice intended to maintain healthy riparian areas."

  (well established in the scientific literature)

  → No supporting science was cited with respect to retaining suitable boreal toad habitat.

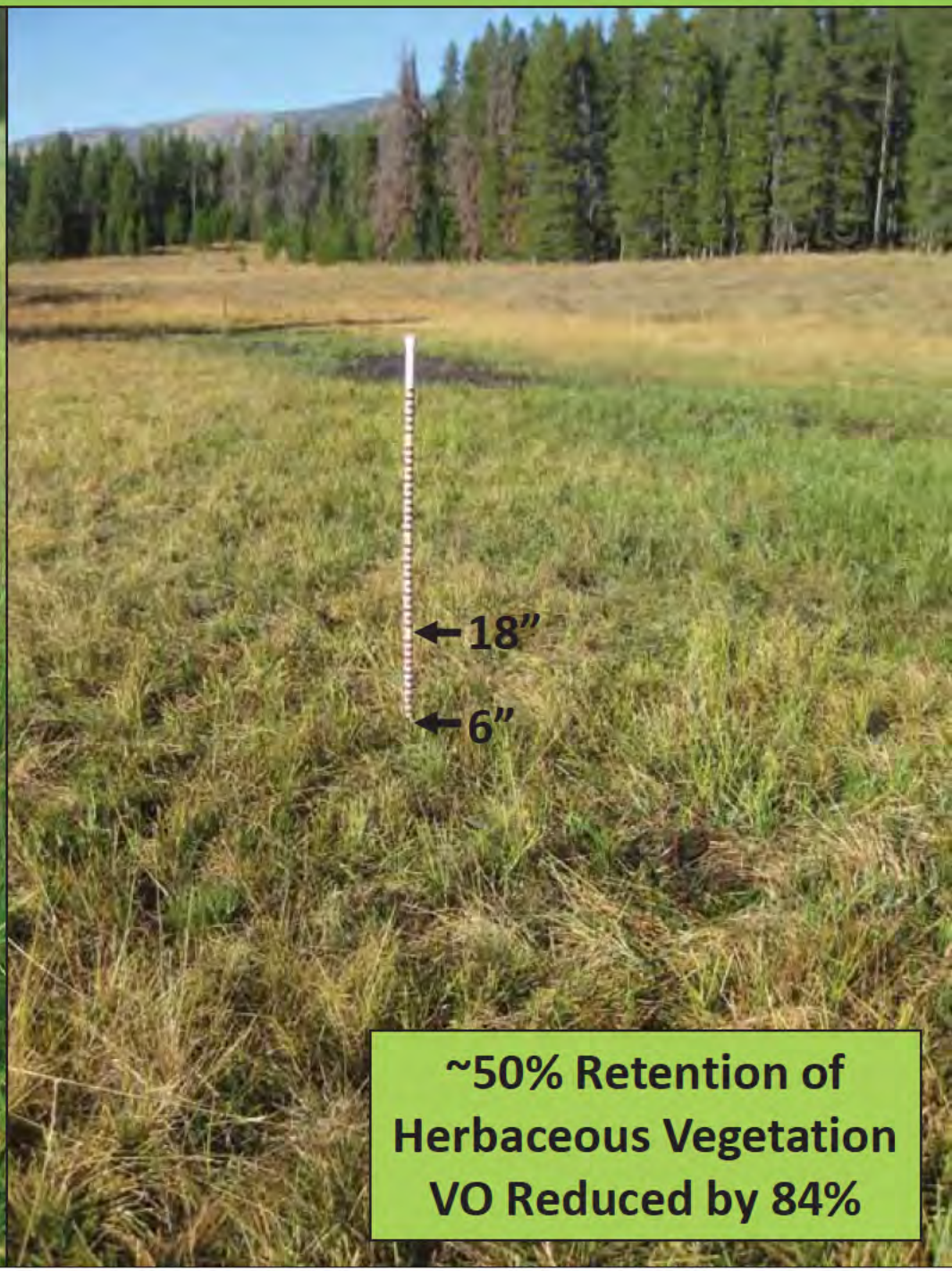
Plant Species Comp. is Satisfactory, and Habitat is Suitable for Dependent Wildlife

Plant Species Comp. is Satisfactory, but Habitat is **not** Suitable for Dependent Wildlife



Plant Species Comp. is Satisfactory, and
Habitat is Suitable for Dependent Wildlife

Plant Species Comp. is Satisfactory, but
Habitat is **not** Suitable for Dependent Wildlife



4” Stubble Height of Frog/Toad Habitat = 30-50% retention for 12-28” sedge community

- No humidity retention or temperature moderation.
- Negligible shading.
- Negligible hiding and escape cover.
- Minimal forage base for tadpoles.
- Poor invertebrate habitat.
- Very far beyond “small, open” sunlit patches.
- High potential for reduced water quality.
- High potential for accelerated declines in water level in small pools.
- High potential for trampling effects.
- High potential for compacted soils.
- High potential for shallow burrows being crushed.

What is the Best Way to Express Min. Retention?

- % of Annual Production, or
- Absolute Measure — Robel Pole or Stubble Height?

<u>Some Downsides to Using Percent of Annual Production</u>:

- Where plant-community height is relatively short (e.g., 8-10") — low end of suitability — a decline to 70% retention can result in less-than-suitable habitat.
- Where open-water and mud-flats comprise a large proportion of the acreage of a wetland, a decline to 70% retention can result in less-than-suitable habitat.

<u>Some Downsides to Using Absolute Measures</u>:

- Where plant-community height is relatively tall (e.g., ≥24"), a decline to the minimum height can result in water quality issues, trampling, water loss, etc.
- Studies:
  - Reductions from 29" & 34" to 17" & 24" significantly reduced WQ & tadpole div.
  - Reductions from 20" & 24" to 7", 8", 9, & 11" significantly reduced dragonflies.

Conflicting/Unresolved Science or Variable Effects?

Hypothetical Situation: a company is considering building a plant in your community.

Three studies are available for 3 different plants in other areas:

- In one study, a plant discharged a moderate amount of contaminants, but no effects on cancer rates were detected.
- In two studies, plants discharged relatively small amounts of contaminants, but there were significant increases in the rate of cancer.

Would you have any concerns about a plant being built in your community?

A few Considerations:

"Absence of evidence is not evidence of absence."

(Carl Sagan, Astronomer)

1. Failing to detect effects in a study only provides weak evidence that the activity does not cause effects:
   - Statistical analyses are designed to greatly minimize the potential of concluding there was an effect when there actually was not.

     → i.e., minimization of Type II error.

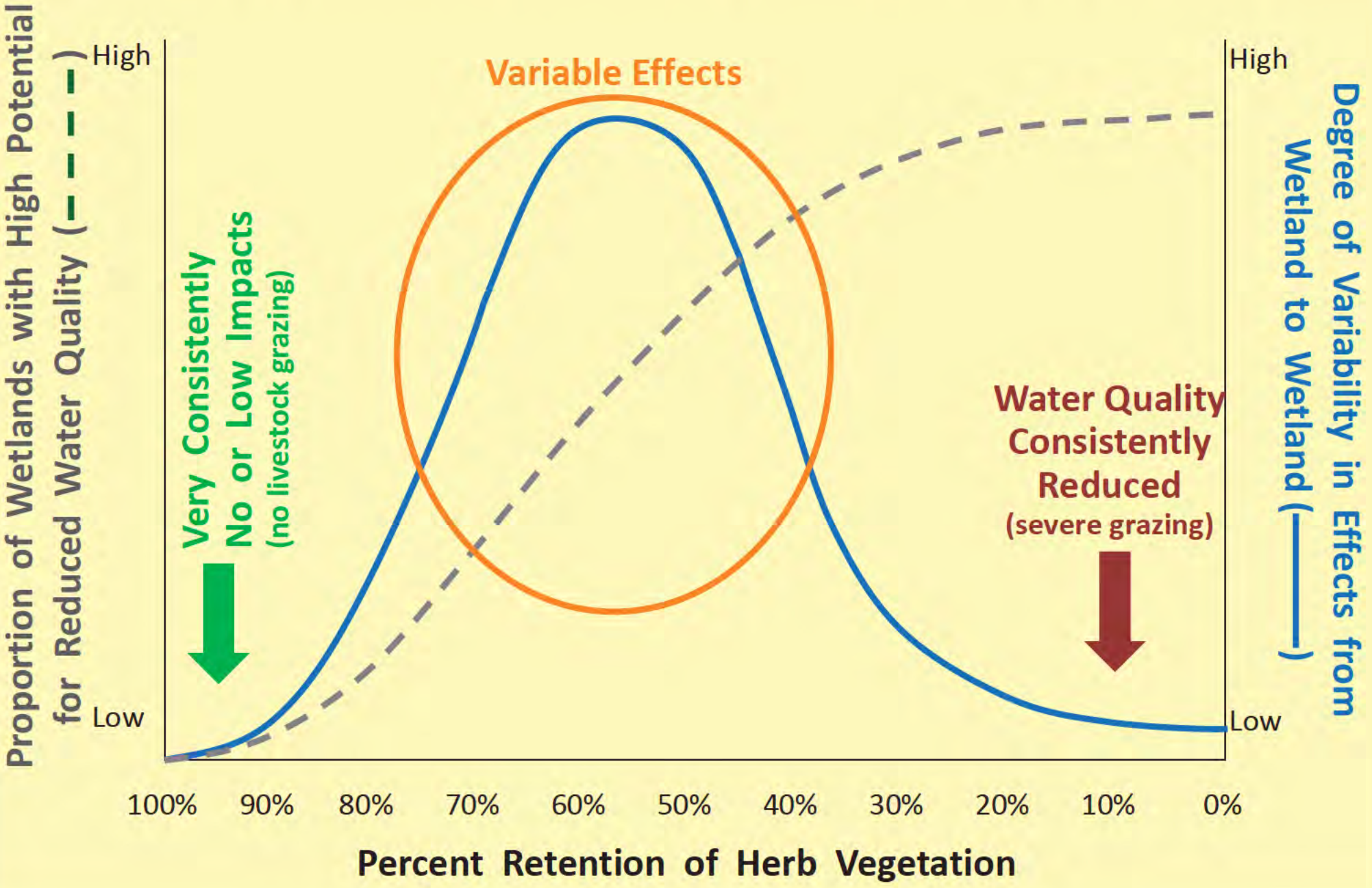
   - Minimizing Type II error comes at the expense of a higher probability of concluding "no effect" when there actually was an effect.

     → i.e., Type I error.

Snedecor & Cochran 1967, Zar 1974, Kleinbaum and Kupper 1978, Barrett & Raffensperger 1999, Fisher et al. 2006, Walshe et al. 2007

2. Also, lack of information due to lack of monitoring and lack of research obviously provides no evidence of the absence of negative effects.

Effects of Livestock Grazing on Water Quality & Tadpoles



Other Considerations

- Where plant-community height is relatively short (e.g., 8-10”) — low end of suitability — a decline to 70% retention can result in less-than-suitable habitat.
- Where open-water and mud-flats comprise a large proportion of the acreage of a wetland, a decline to 70% retention can result in less-than-suitable habitat.
- On the other hand, trampling & water quality impacts — in both scenarios — would be less since there would be fewer cows for a lesser amount of time.

VIII. Risk Factors — Multiple Stressors

Stressor = Anything that negatively affects individuals and/or populations, naturally and artificially.

Multiple Stressors and Population Viability

Viable Population — Persists over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments (2012 Planning Rule).

Amphibians are impacted by multiple stressors, not just 1 or 2; and effects of some stressor are increased by other stressors.

(*Collins and Storfor 2003, Corn 2003, Rohr 2004, Sih et al. 2004, Green 2005, Halliday 2005, Keinath and McGee 2005, Patla and Keinath 2005, Boone et al. 2007, Davidson and Knapp 2007, Gray 2009, Chen et al. 2008, Groner 2012, Adams et al. 2013, Gallana et al. 2013, Holden 2013, Reeve et al. 2013*)

Amphibians populations already affected by other stressors are more susceptible to being impacted by disease.

(*Cleaveland et al. 2002, Corn 2003, Forson and Storfer 2006, Gray et al. 2007, Gray et al. 2009, Gahl and Calhoun 2010, Groner 2012, Adams et al. 2013, Gallana et al. 2013, Reeve et al. 2013*)

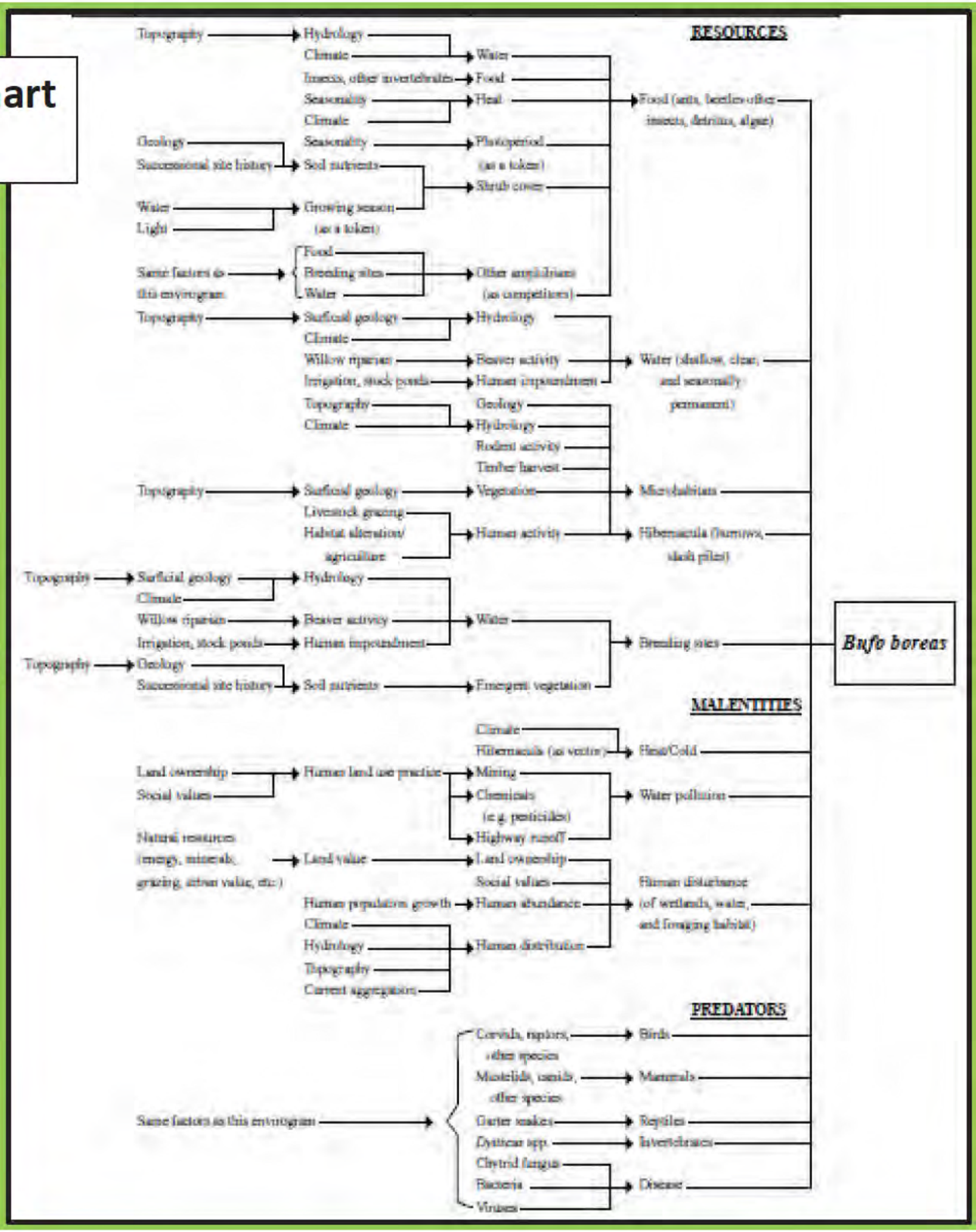
Simplified **cause-and-effect flowchart**
(From Patla and Keinath 2005)

Inhabit a Wide Range of Habitats

- Wetlands
- Riparian Areas and Streams
- Meadows
- Rangelands
- Forests

Numerous Activities Affect Them

- Roads & Driving
- ✓ Livestock Grazing
- Camping & Motorized Use
- Reservoirs
- Stocked Fish
- Water Diversions
- Skidders, Other Heavy Equip.
- Fire Suppression
- Loss of Large Woody Mat.



Roads, Livestock Grazing, and Altered Vegetation

- Roads and motorized vehicles commonly have negative impacts on amphibian populations (numerous studies in several literature reviews.
  (deMaynadier and Hunter 1995, Maxell and Hokit 1999, Maxell 2000, Forman et al. 2003, Patla and Keinath 2005, Andrew et al. 2008, PARC 2008, Beebee 2013)

- Thousands boreal toad metamorphs were killed by vehicles on forest roads near 2 of 3 breeding sites studied in Oregon *(Bull 2009)*.

- A spotted frog population in YNP declined by 80% after a road was constructed near a spotted frog breeding pond *(Patla 2001)*.

Roads, Livestock Grazing, and Altered Vegetation

- Livestock grazing has been identified as a threat in all conservation assessments, plans, etc. that address spotted frogs and boreal toads

  (Gomez 1994, Perkins and Lentsch 1998, Maxell 2000, Patla 2001, USFWS 2002, Munger et al. 2002, Keinath and McGee 2005, Muths 2005, Patla and Keinath 2005, Reaser and Pilliod 2005, PARC 2008)

- Of all strategies identified to minimize or avoid impacts of livestock grazing, excluding livestock is by far the most common recommended strategy.

  (Bartelt 2000, Maxell 2000, Engle 2001, Patla 2001, Keinath and McGee 2005, Patla and Keinath 2005, Shovlain et al. 2006, Schmutzer et al. 2008)

- No recommendations were found for retention limits below that which is achieved through complete exclusion (approx. ≥90-95%).

Roads, Livestock Grazing, and Altered Vegetation

The two largest veg. impacts on the BTNF that affect wildlife are:

1. Overrepresentation of woody vegetation

   Implications:

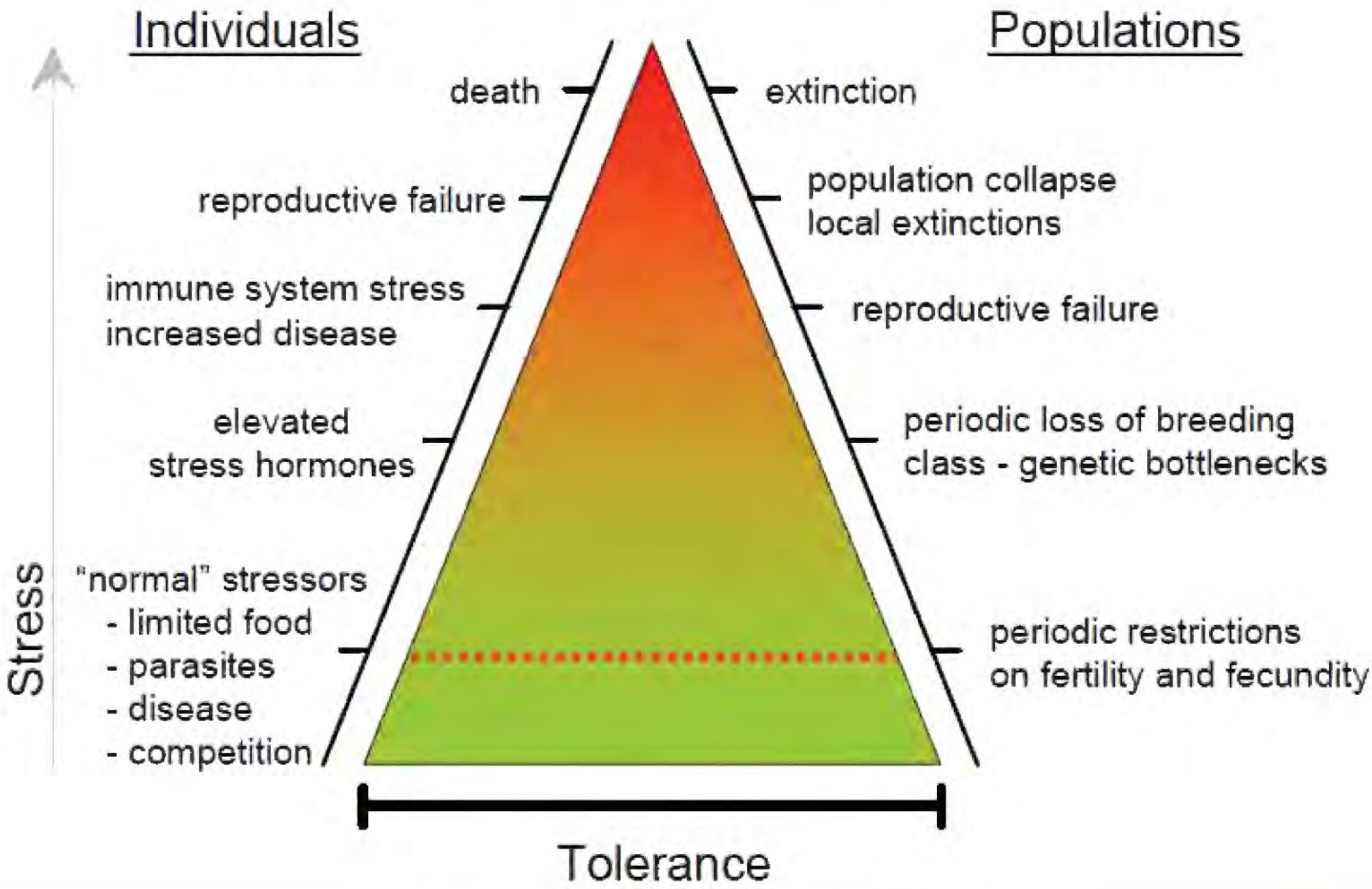
   - Reduced spring flow & accelerated wetland water declines
   - Reduced distribution of beaver pond complexes
   - Reduced acres of moist meadow habitat
   - More acres of high forest canopy cover
   - Increased shading of breeding ponds
   - Improved water quality (due to reduced fire)
   - Reduced burned habitat (neg. impacts to boreal toads)

2. Underrepresentation of herbaceous vegetation

   Implications:

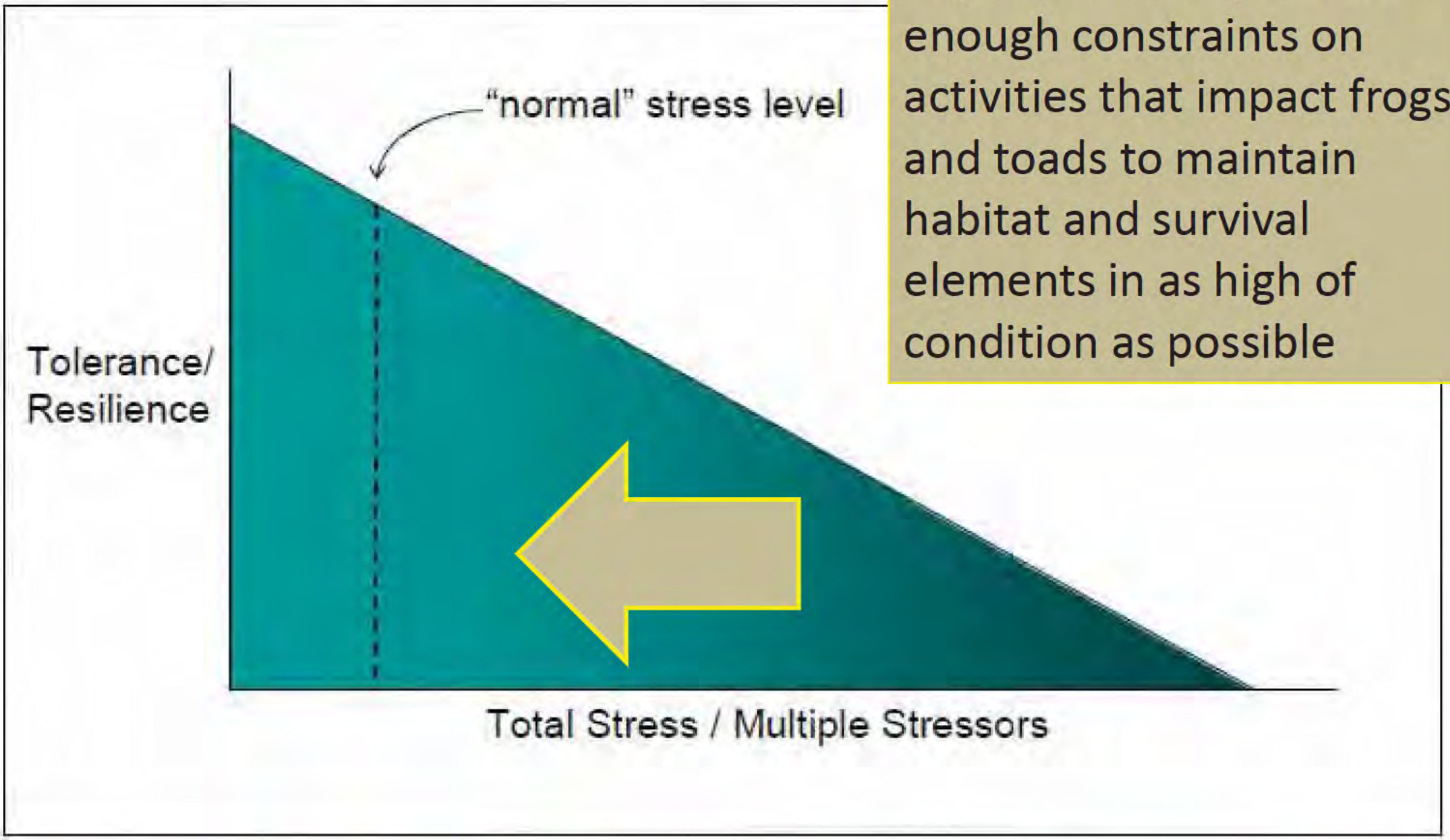
   - Reduced acres of frog & toad habitat
   - Reduced quality of cover (hiding, moist) & insect habitat

Stress Pyramid



Response to Multiple Stressors

Important to implement enough constraints on activities that impact frogs and toads to maintain habitat and survival elements in as high of condition as possible



From

Roads, Livestock Grazing, and Altered Vegetation

Scientific info. demonstrates:

- A high probability that SF and BT pop's on the BTNF have been impacted by these factors.

  → A large majority of impacts have occurred without us knowing they happened.

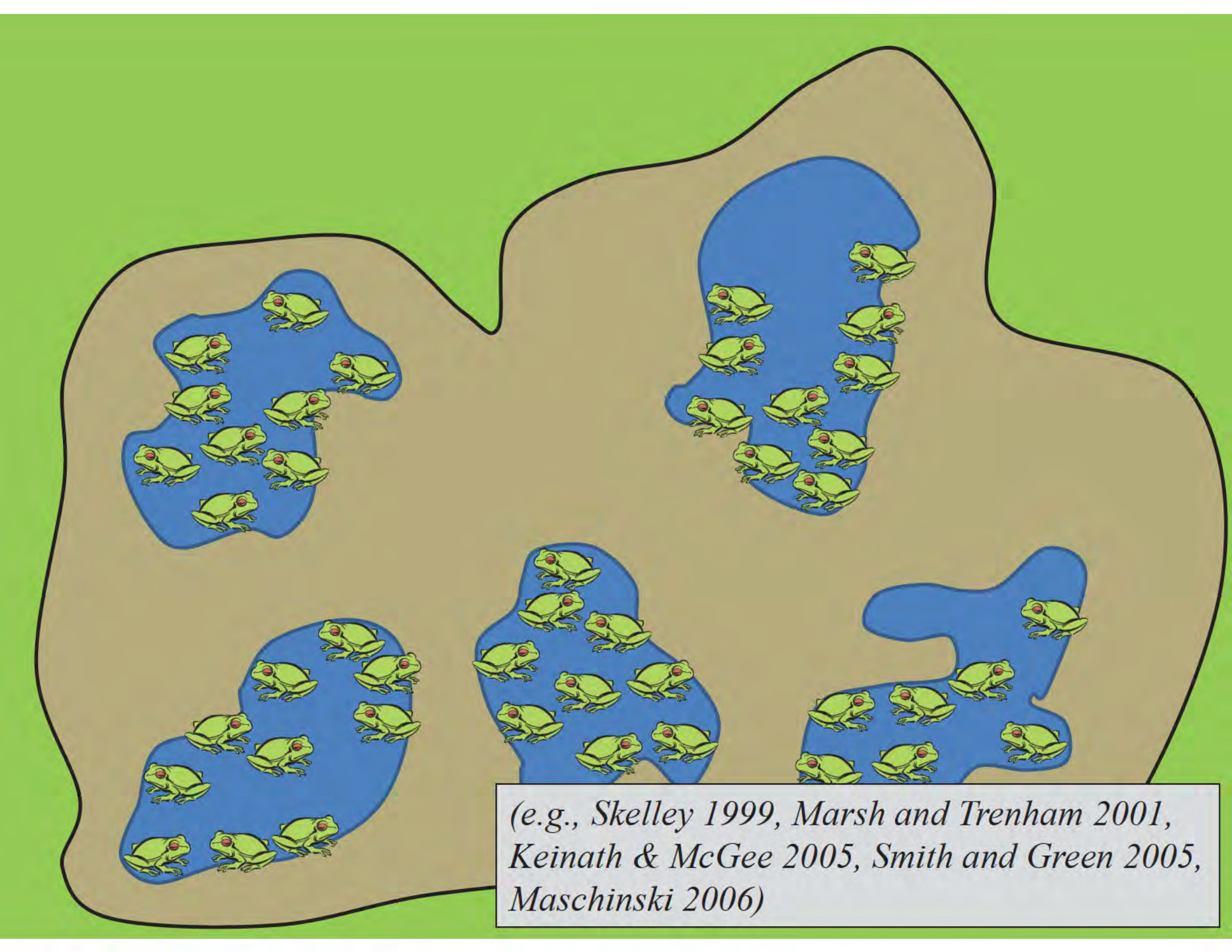
"Absence of evidence is not evidence of absence"

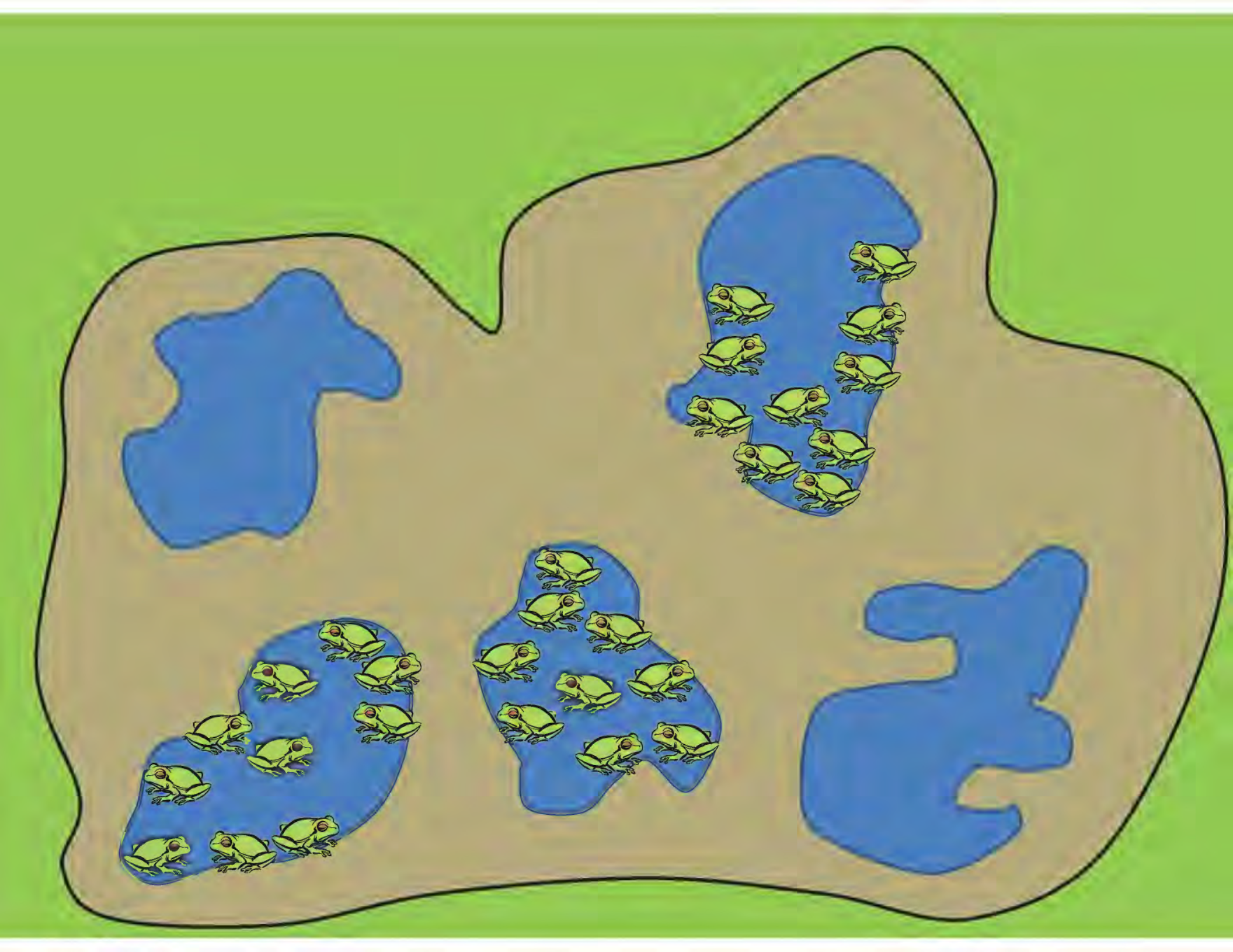
(Carl Sagan, Astronomer).

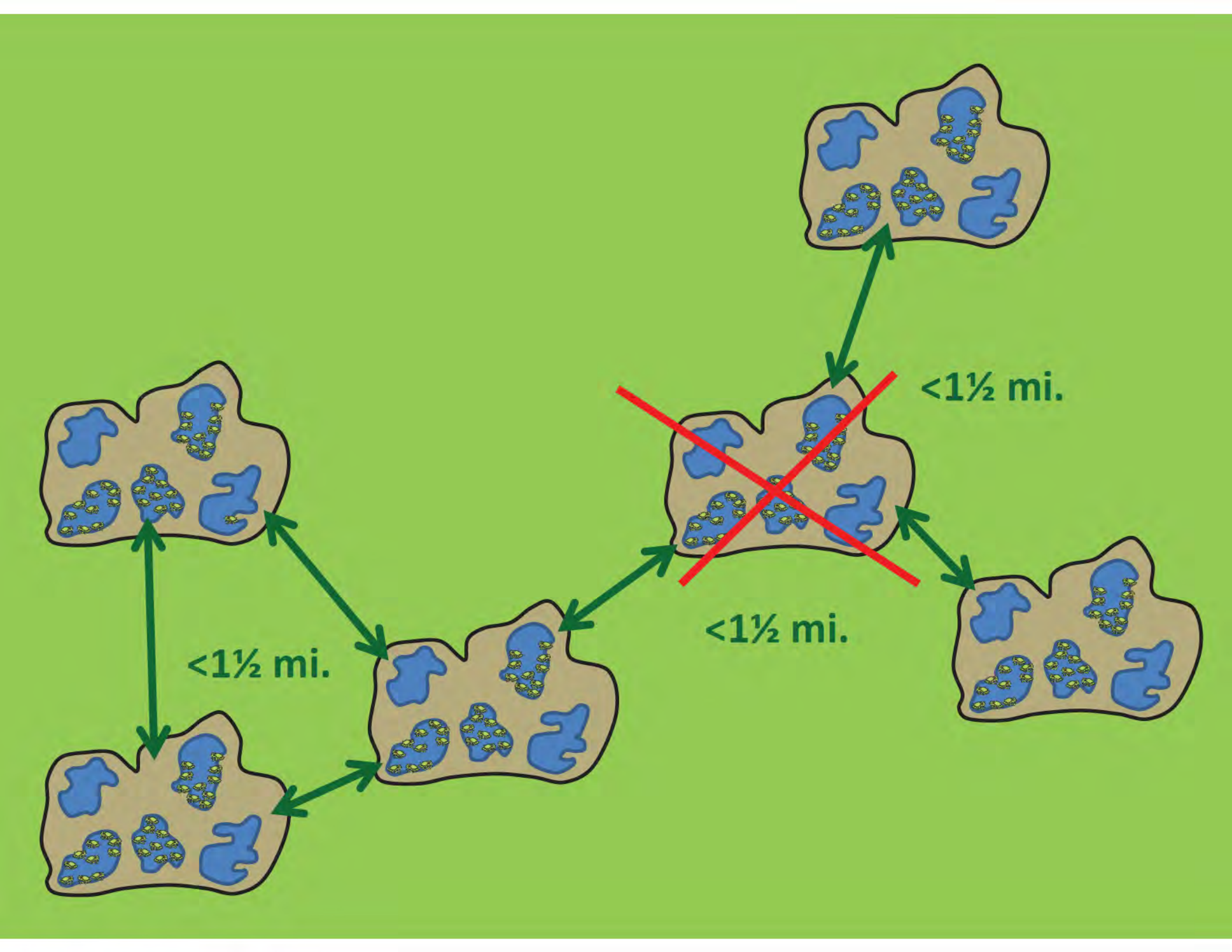
- A high probability that roads, livestock grazing, and altered veg. have compounded impacts of chitrid fungus, climate change, etc.

- A reality → with our level of monitoring, we won't be able to distinguish between effects of roads, motorized use, livestock grazing, water developments, disease, and climate change, etc.

IX. Metapopulation Concept


(e.g., Skelley 1999, Marsh and Trenham 2001,
Keinath & McGee 2005, Smith and Green 2005,
Maschinski 2006)

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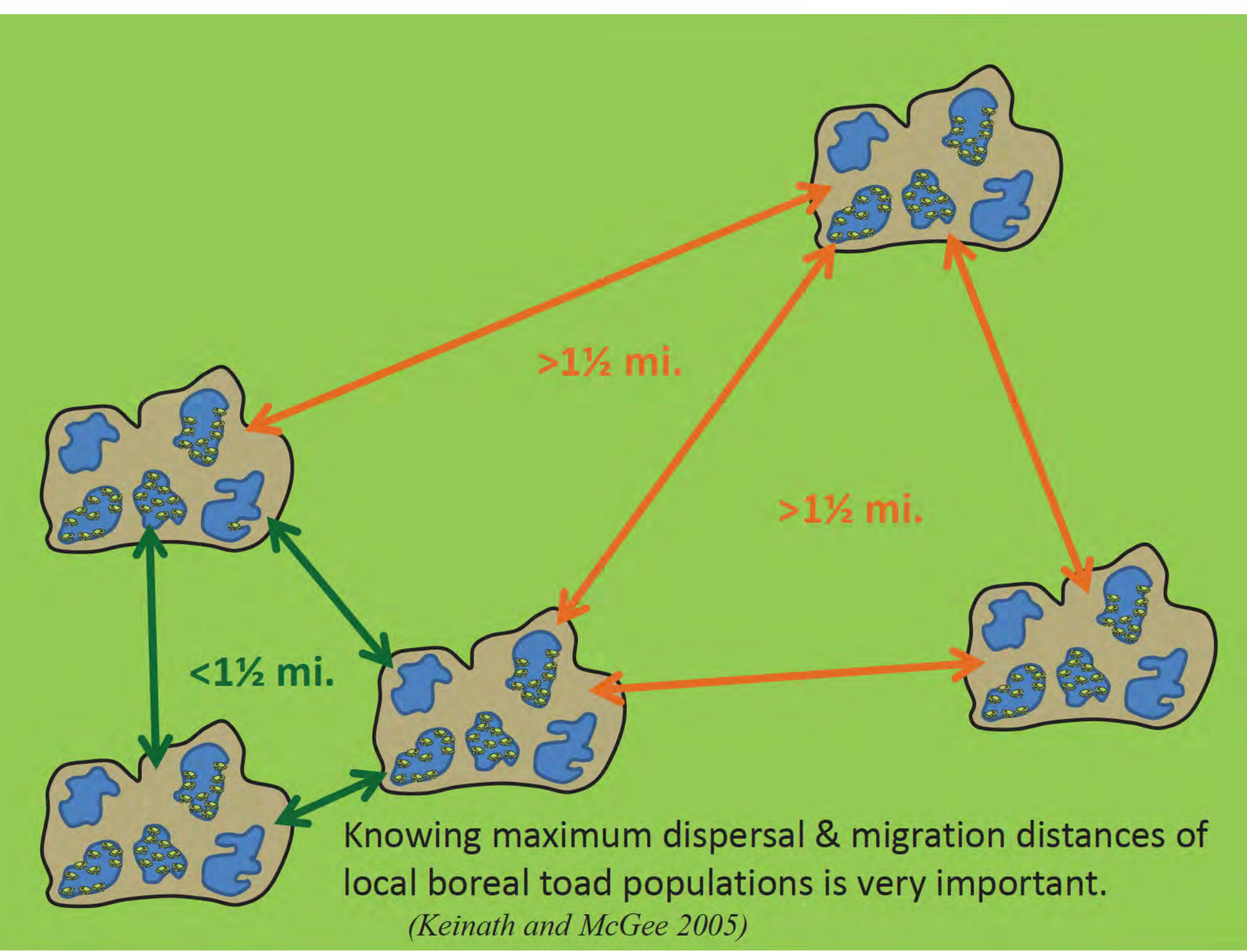

Knowing maximum dispersal & migration distances of local boreal toad populations is very important.

(Keinath and McGee 2005)

X. Objectives vs. Standards

Stubble Height

Streambank Stability & Channel Integrity

Time (Years)

Ecological Processes

Time (Years)

Ecological Processes

Retention

No Time Delay
(what is measured… is habitat at that point in time)

Herbaceous Wildlife Habitat

Retention

Instantaneous

Herbaceous Wildlife Habitat

HERBACEOUS RETENTION IN THE UPPER GREEN RIVER ALLOTMENT: IMPLICATIONS FOR THE UPPER GREEN GRAZING DECISION

By

Kerry Murphy & Dave Cottle

(field assistance from D. Booth, A. Roberts, A. DeLong, D. Cottle, P. Archual, M. Rogers-Gardner, G. Hayward, and T. Johnson)

Upper Green Retention Measurement – summer 2013

Objective: Increase our understanding …

1) How to practically measure retention in a breeding zone.

2) Do results square with the "70%" guidance?

3) Does 50% key herbaceous use indicate that total herbaceous retention is 70%?

Cage deployment and conditions

Results—Retention and key species use

			Total Herb.	Key Species	Robel Pole Ht. (cm)	Robel Pole Ht. (cm)
Location	**Site ID**	**Site type**	**Retention (%)**	**Use (%)**	**Ungrazed Plots**	**Grazed Plots**
Upper Teppee	UTMM13-1	Mesic Meadow	48.8	46.7	2.8	1.8
Lower Gypsum	LGMM13-1	Mesic Meadow	67.5	38.5	3.3	1.7
Upper Gypsum	UGMM13-1	Mesic Meadow	54.6	36.8		
Upper Gypsum	UGMM13-3	Mesic Meadow	72.7	-6.9	1.8	0.6
Lower Teppee	LTMM13-1	Mesic Meadow	82	41.7		
Upper Teppee	UTSS13-2	Silver Sage	45.1	15.1	2.1	0.8
Lower Teppee	LTSS13-2	Silver Sage	53.9	68.3		
Upper Gypsum	UGSC13-2	Shrubby Cinquefoil	97	-57.8		
Average			**65.2**	**22.8**	**2.5**	**1.2**
	Confidence interval (retention)					
		Lower bound	47.1			
		Higher bound	83.3			

What we learned

- **Cover provided by woody species likely increases herbaceous retention (or other metrics of cover), and should be accounted for if feasible.**

What we learned

- Herbaceous retention is not necessarily the best measure of cover and humidity conditions for amphibians-- high retention does not necessarily imply tall & dense cover.

- In our case, 65% retention did not equate to 50% key species use.

Upper Green - 65% total herbaceous; 23 % key species utilization ➔ Dave

What we learned

- **Measuring retention using grazing exclosures is labor intensive, and visual estimates may be inaccurate.**

Alternative: measure cover using a Robel pole; establish a standard.

Improve the "standard" through amphibian research by partners.

Implications for Upper Green?

- **Cope with the uncertainty by maintaining flexibility in management and field methods.**

- **Keep learning -- identify what aspects of cover (and other habitat components) are important to amphibians and what can be feasibly measured in the field.**

[Thanks for listening]