Forest Plan Direction & Other Wildlife

Two purposes for identifying herb retention threshold:

1. Suitable conditions… to feed into desired conditions
2. To feed into prescribing utilization limits

Management Direction

Applicable Forest Plan Objectives:

Objective 2.1(a) — Provide suitable habitat for big game species.

Objective 3.3(a) — Protect sensitive spp and provide suitable habitat to ensure activities do not cause declines in habitat or populations or trends toward federal listing.

Objective 4.7(d) — Retain an adequate amount of suitable forage and cover for wildlife.

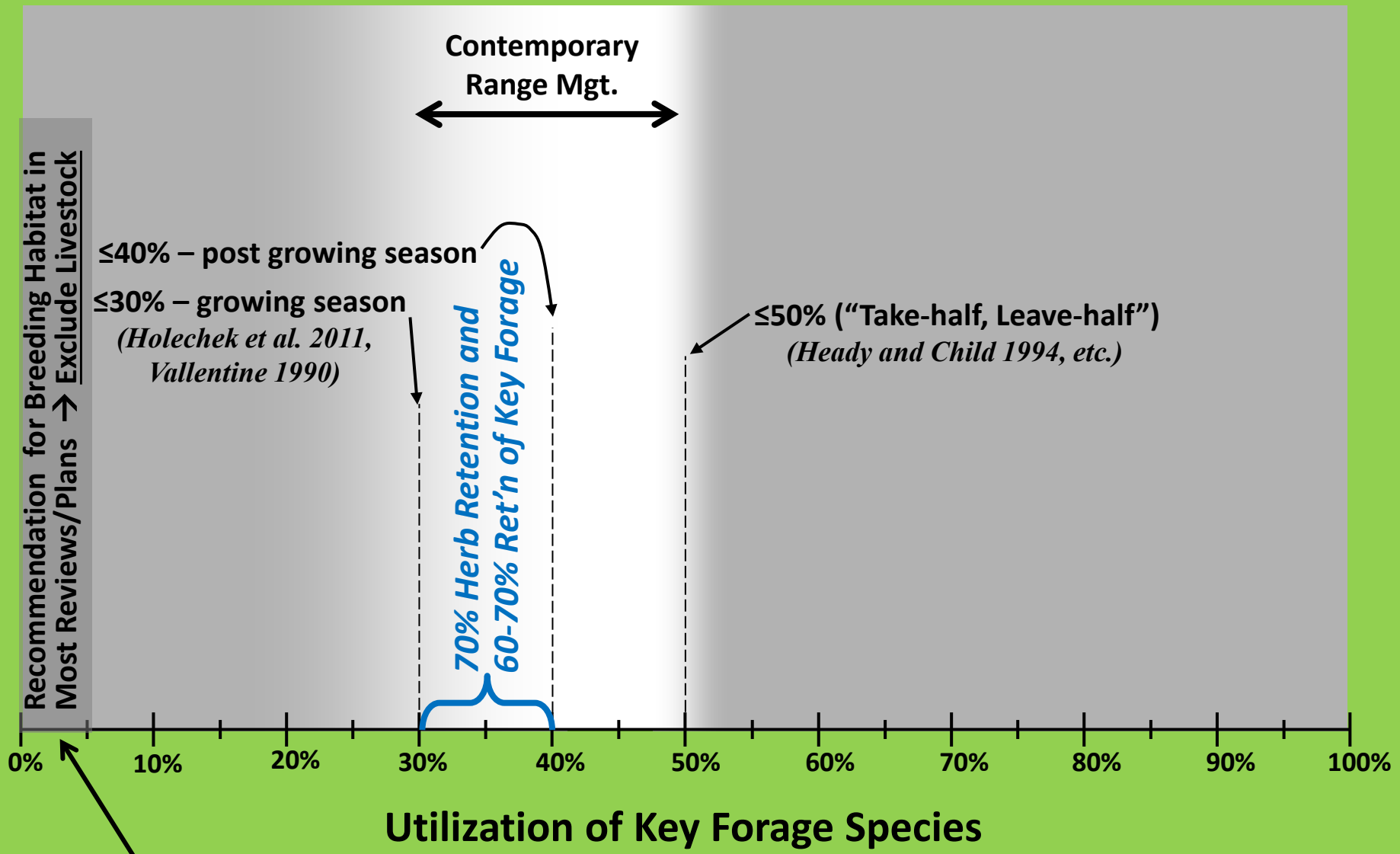
Forage Utilization Standard Requirements:

During AMP revision, prescribe site-specific utilization levels needed to meet Forest Plan objectives.

Site-specific utilization levels on key wildlife ranges will be established by IDT.

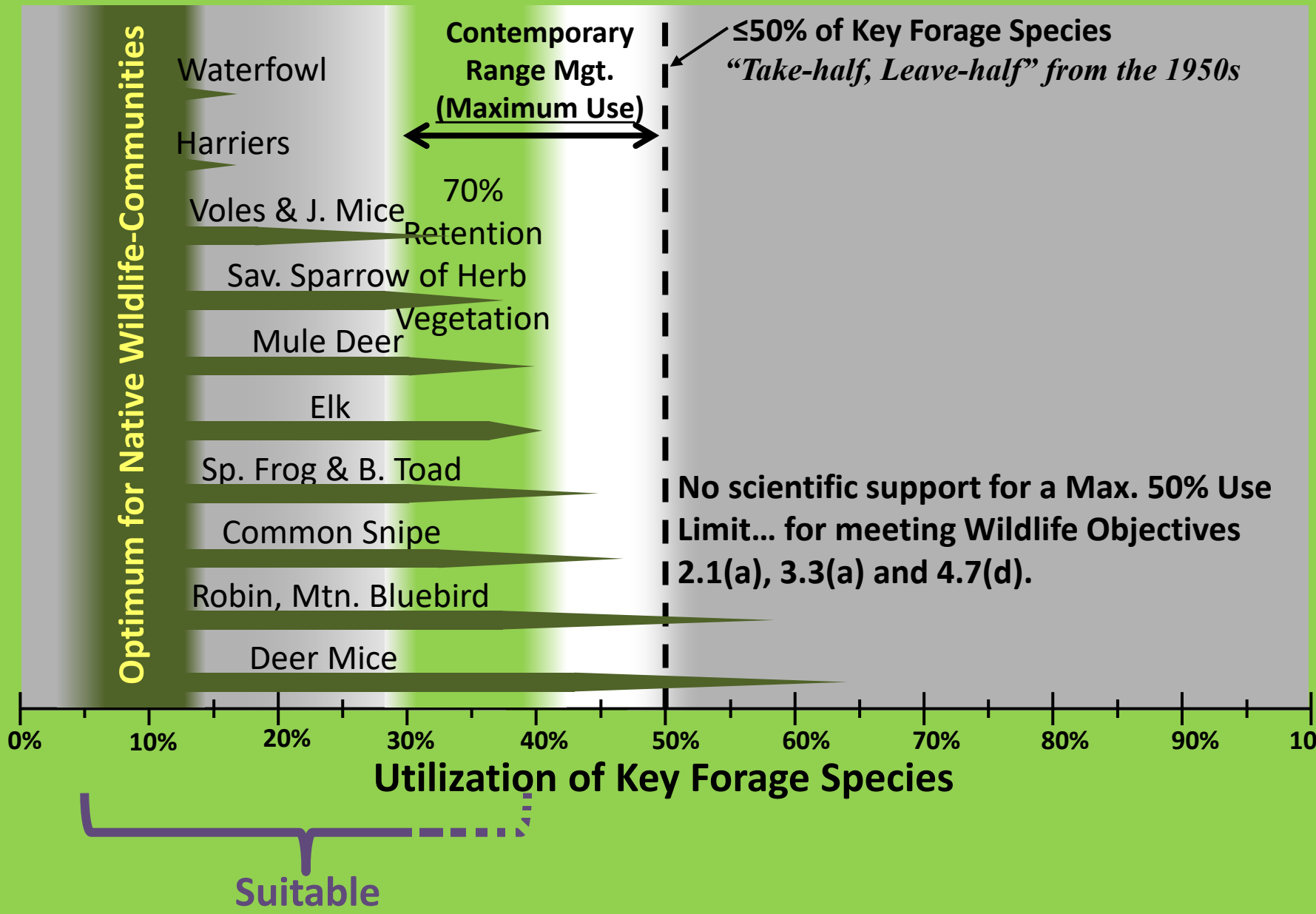
"Chapter 90" (FSH) calls for developing allowable-use limits to achieve Forest Plan objectives.

Relationship to Range Management



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

Relationship to Native Wildlife-Community



Large Amt. of Science Showing:

Mod. Amt. of Science Showing:

Limited Science Showing:

No Science Showing:

Retention

near-100%

90%

80%

70%

60%

50%

40%

30%

Suitable Conditions Retained

Suitable Conditions Not Retained

Suit. Cond's Not Ret.

Suit. Cond's Ret.

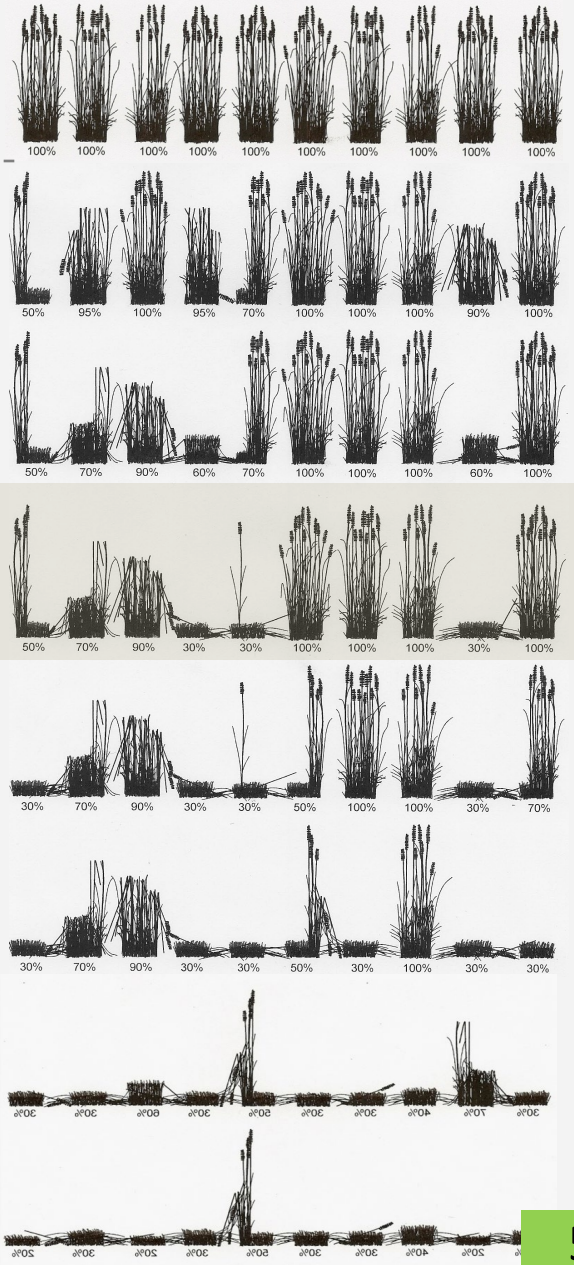
Suit. Cond's Ret.

Suit. Cond's Not Ret.

Suitable Conditions Not Retained

Suitable Conditions Retained

100s of papers & books were reviewed



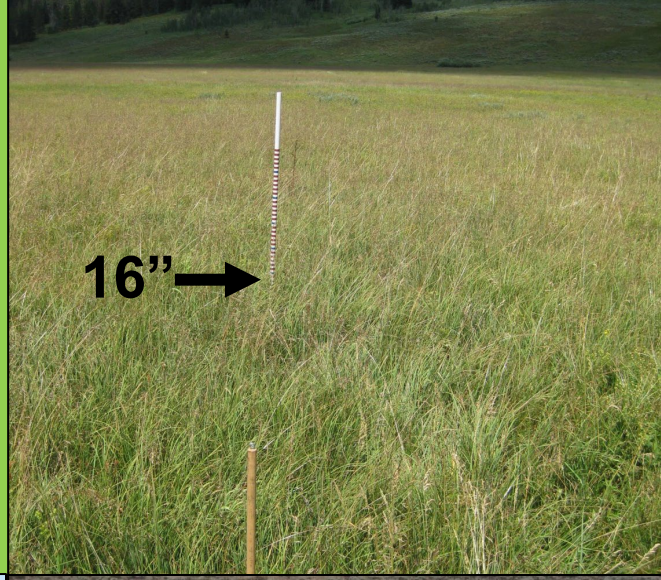
Meadow Habitat Characteristics

Conditions under which Native Wildlife-Communities Formed

Wet and Moist Meadows, Greys River RD

— June through November —

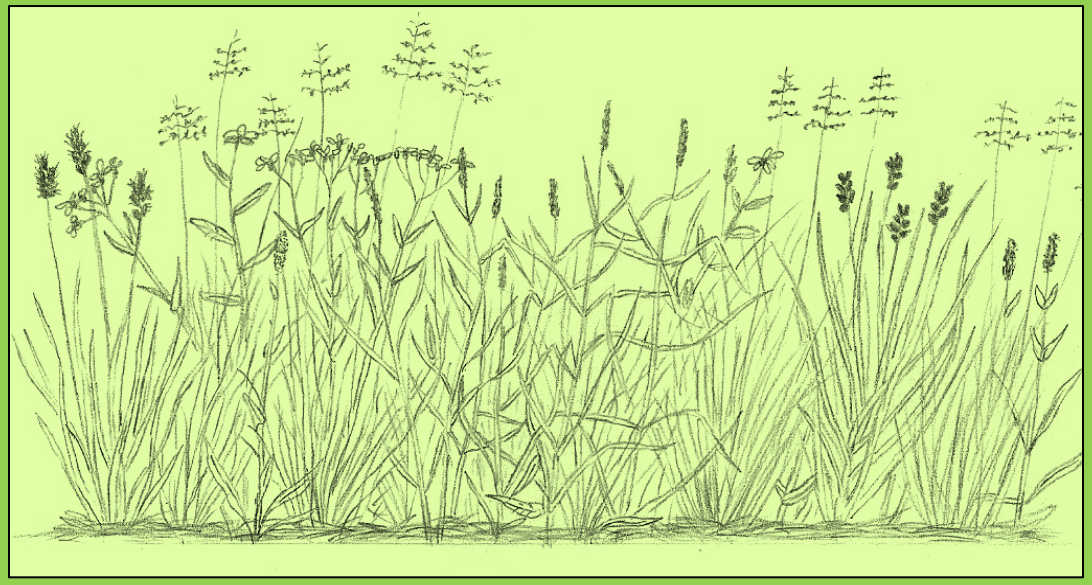
Grazing is a natural process, but...



<u>Note</u>: Herbaceous vegetation naturally does not cover 100% of wetlands & other habitats.

But, where this vegetation occurs it has characteristics that native wildlife-communities became dependent upon…

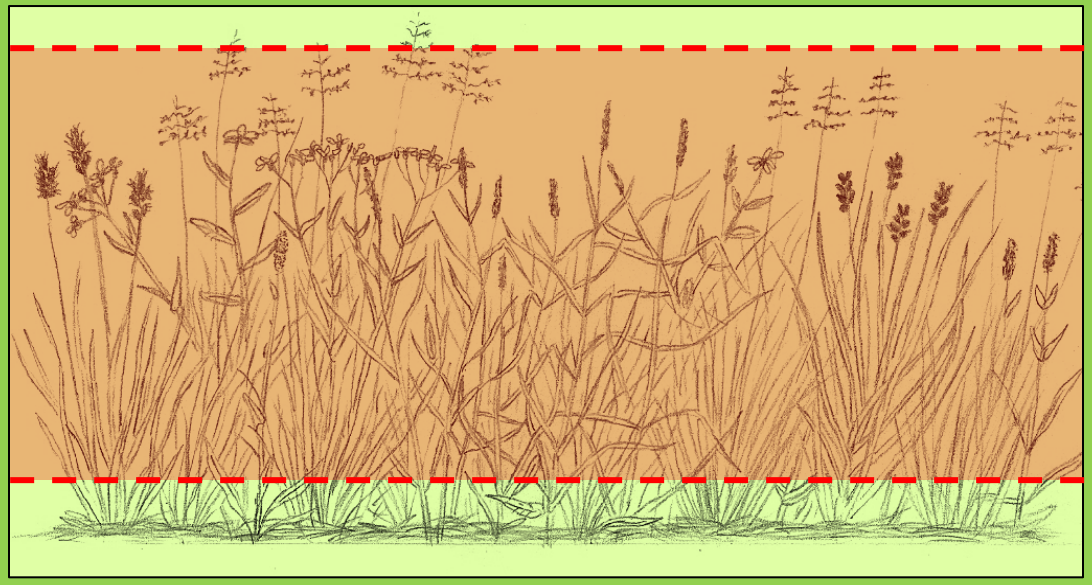
Near-100% Ret.



50% Ret.

30% Ret.

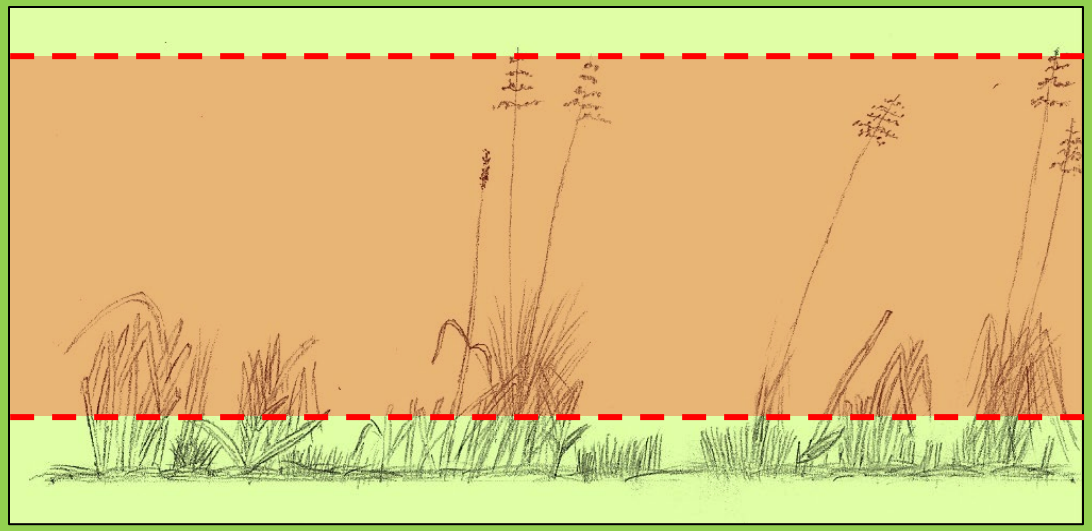
Near-100% Ret.



Upper & Middle Layers

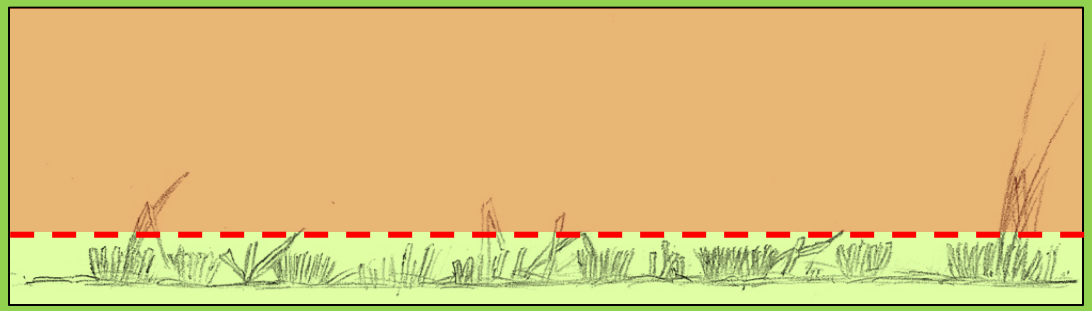
- Mod. humidity retention
- Mod. temp. moderation
- Mod. wind reduction
- Mod. shade
- Mod. to high hiding cover
- Large Invertebrate diversity

50% Ret.



- Ambient humidity
- Ambient temp. (or higher)
- Ambient wind
- Negligible shade
- Negligible hiding cover
- Low Invertebrate diversity

30% Ret.

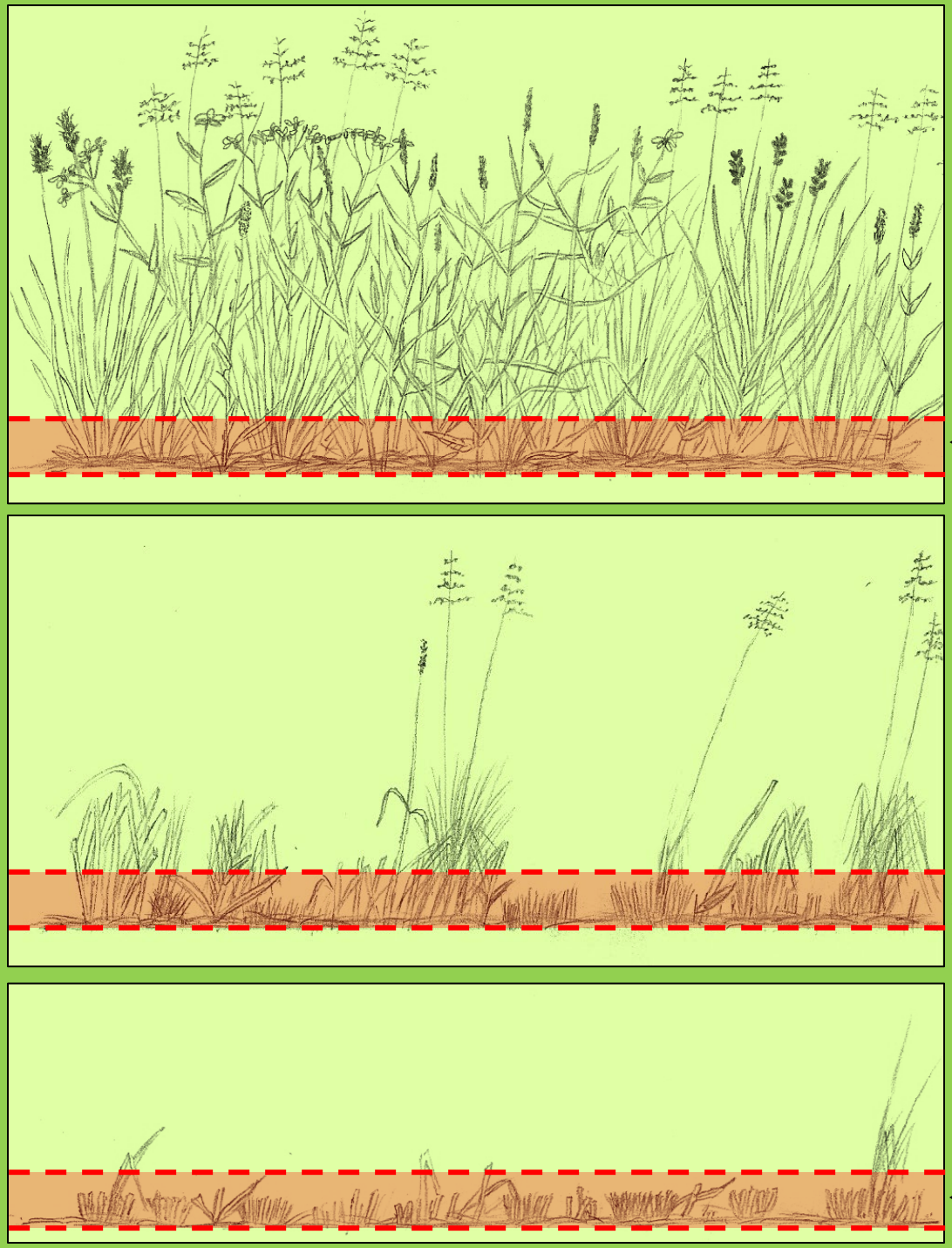


- Ambient humidity
- Ambient temp. (or higher)
- Ambient wind
- No shade
- No hiding cover
- Negl. Invertebrate diversity

Near-100% Ret.

50% Ret.

30% Ret.

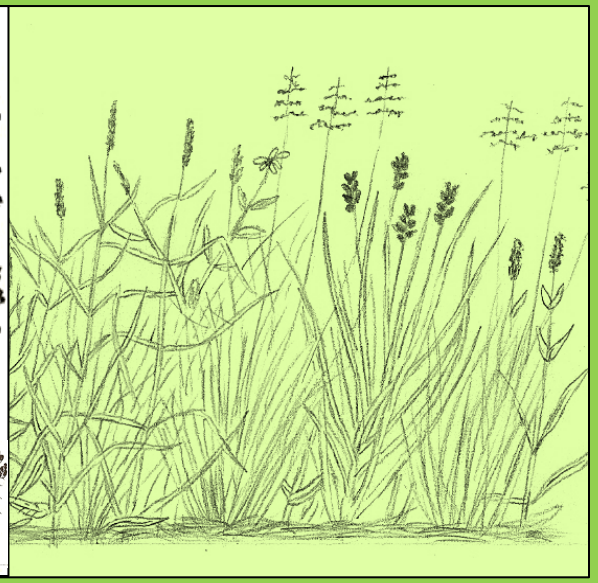


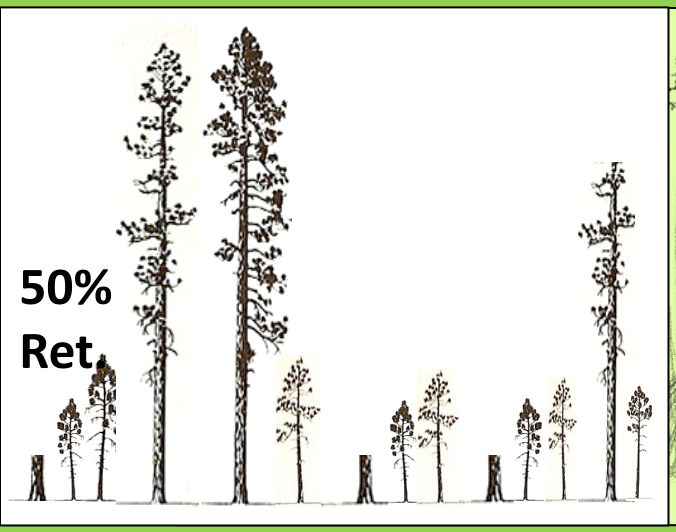
Bottom Layer (≤2”)

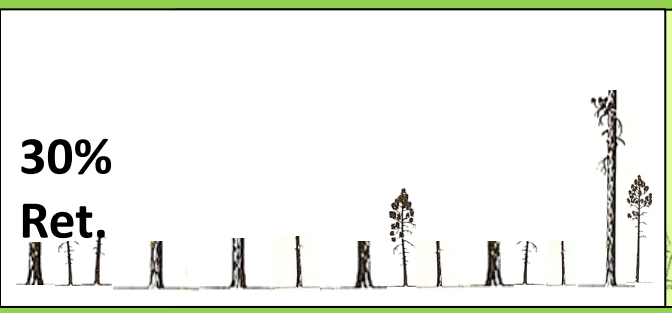
- High humidity retention
- Temperature moderated
- No wind
- Deep shade
- Major hiding cover
- Well dev. litter layer

- Near ambient humidity
- Near ambient temp.
- Near ambient wind
- Low - Moderate shade
- Low hiding cover
- Moderate litter layer

- Ambient humidity
- Ambient temp. or higher
- Ambient wind
- Negligible shade
- Negligible hiding cover
- Low litter layer







Implications to Wildlife

- Wildlife diversity is representative of native meadow-communities

- Few of meadow habitat attributes remain
- Greatly diminished number of wildlife species & abund.

- Virtually no meadow habitat attributes remain
- No semblance of meadow wildlife diversity

What parts of plants contribute to wildlife forage & cover?

Seeds — food, substrate, some cover
(ungulates & many small mammals, birds, insects)

"Flowers" — food (e.g., nectar, seeds), substrate, cover
(ungulates, small mammals, birds, insects)

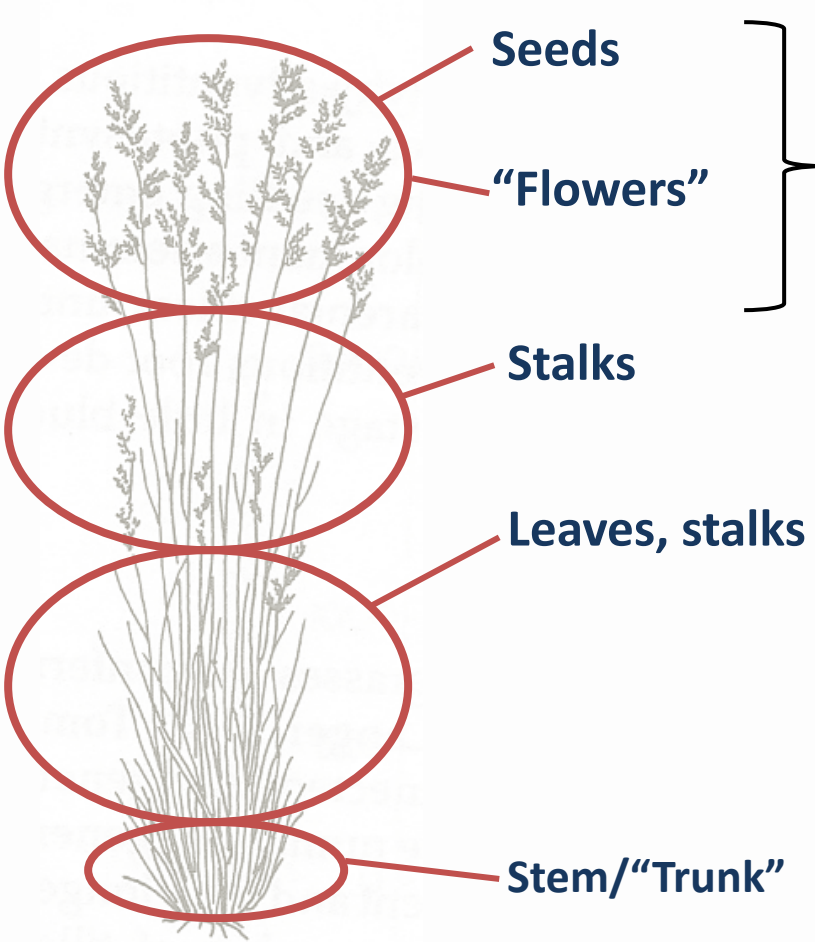
Stalks — food, substrate, some cover
(ungulates, rodents, birds, insects)

Leaves, stalks — food, substrate, hiding cover, thermal protection, humidity
(ungulates & many small mammals, birds, amphibians, insects)

Lowest ~30-50% of Biomass

Stem/"Trunk" — holds up food, cover, etc. (no direct contributions to habitat)

What parts of plants contribute to wildlife forage & cover?



- Some wildlife only use this part of plants
- Some wildlife only use this part of *specific species / genera*, incl. key spp.

- Many wildlife species need upper parts of leaf "tuft" for food or cover
- Some wildlife favor certain plant species / genera, incl. key species

Development of Desired Retention Levels for Amphibians on Livestock Allotments, Bridger-Teton National Forest

by: Don DeLong, Greys River & Kemmerer RDs

June 25, 2014

Purpose of Presentation

To outline the scientific basis of 70% herb retention to meet Forest Plan requirements for:

- Providing an adequate amt of suitable hbtt for sensitive amphibs.
- Protecting sensitive amphibs from the activity of livestock grazing.

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

Outline

I. Status & Habitat Use

II. Some Basic Concepts

III. Basic Approach

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

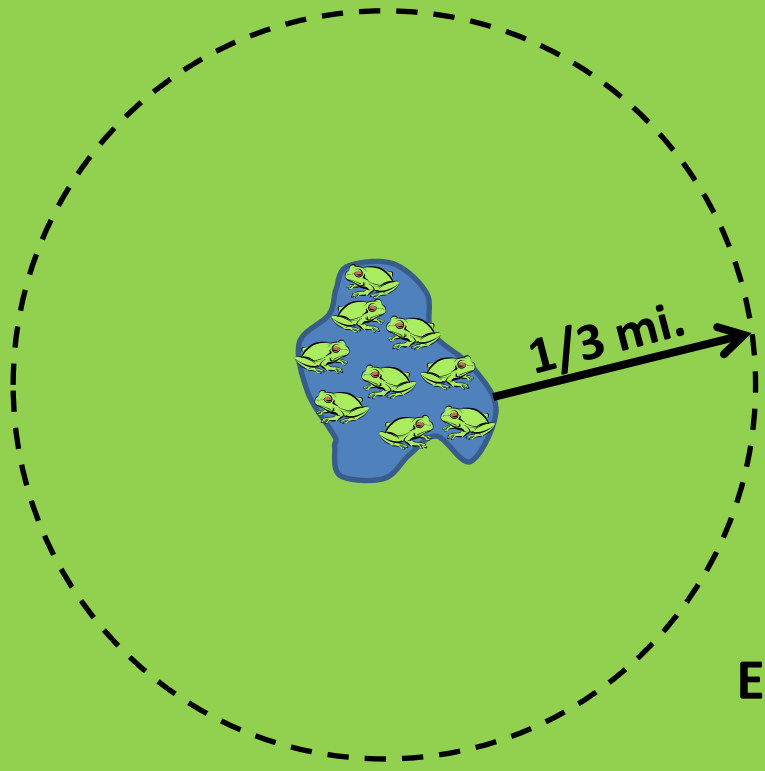
VI. Scientific Basis for 70% Threshold

→ **Scientific Citations**

→ **Animations**

I. Status and Habitat Use

Movement Distances



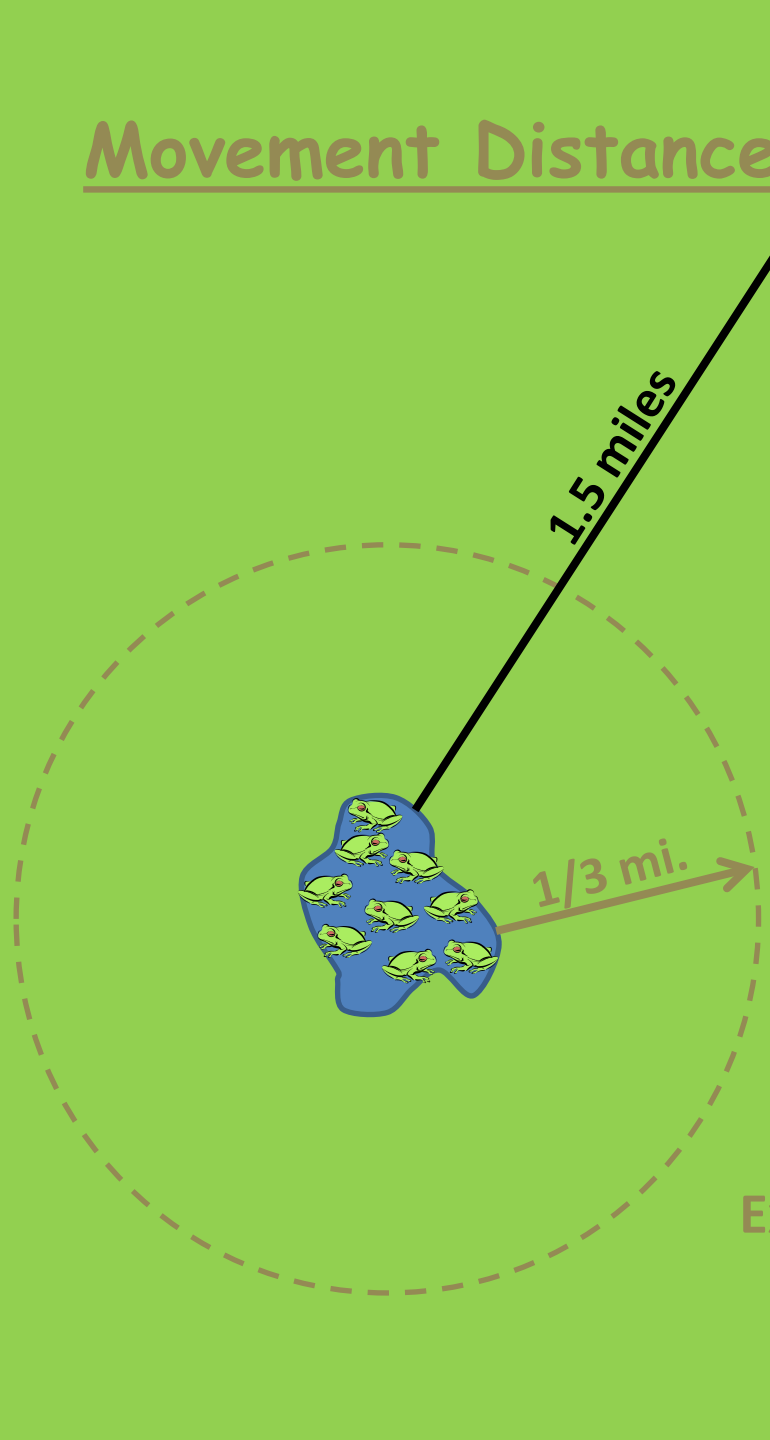
75 – 100% of SF's & BT's stay within 1/3 mile:

(Turner 1960, Hollenbeck 1974, Bull and Hayes 2001, Pilliod et al. 2002, Muths 2003, Bartelt et al. 2004)

Except >50% BT's move >1/3 mi. in many areas:

(Bull 2006, Schmetterling & Young 2008, Bull 2009 Browne and Paszkowski 2010)

Movement Distances



Nearly 100% of SF's & BT's stay within 1½ mi.

(Turner 1960, Hollenbeck 1974, Bull & Hayes 2001, Pilliod et al. 2002, Muths 2003, Bartelt et al. 2004, Schmetterling & Young 2008, Browne & Paszkowski 2010)

- Some studies: small % moved 1/3 to 1½ mi.
- Some studies: large % moved 1/3 to 1½ mi.

Up to 25% of BT's move >1½ mi.

(Bull 2006, Schmetterling & Young 2008, Bull 2009)

75 – 100% of SF's & BT's stay within 1/3 mile:

(Turner 1960, Hollenbeck 1974, Bull and Hayes 2001, Pilliod et al. 2002, Muths 2003, Bartelt et al. 2004)

Except >50% BT's move >1/3 mi. in many areas:

(Bull 2006, Schmetterling & Young 2008, Bull 2009 Browne and Paszkowski 2010)

Terrestrial Habitat

- Historically, biologists focused on aquatic breeding sites.
- Increasing recognition is being given to the importance of terrestrial habitat and conservation of terrestrial habitat.

  (Marsh and Trenham 2001, Pilliod et al. 2002, Wind and Dupuis 2002, Bull 2006, Bull 2009, Moore et al. 2011, Keinath and McGee 2005, Patla and Keinath 2005, Pierce 2006, Smith and Green 2005, Browne et al. 2009, Browne and Paszkowski 2010, Bishop et al. 2014)

- "Exclusively pond-based studies generally lead to pond-based explanations for patterns of abundance and persistence."

  (Marsh and Trenham 2001)

- Boreal toads are terrestrial, but they reproduce in aquatic habitat.

  (Hammerson 1982, Bartelt 2000, Wind and Dupuis 2002, Bartelt et al. 2004, Brazier and Whelan 2004, Keinath and McGee 2005, Bull 2006, Pierce 2006, Schmetterling and Young 2008, Bull 2009, Browne and Paszkowski 2010)

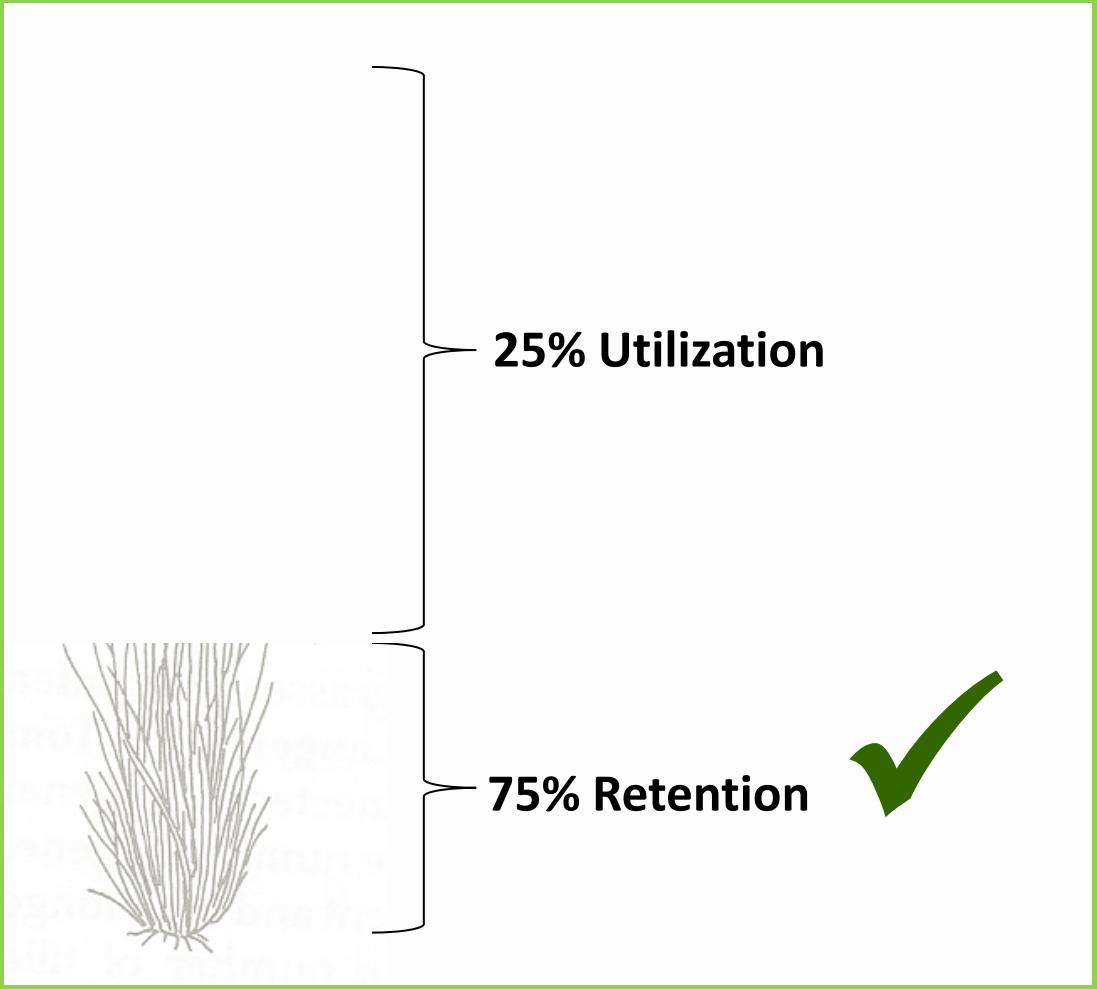
- Spotted frogs are semi-aquatic, but feed on many terrestrial invertebrates and regularly travel across terrestrial habitat.

  (Turner 1960, Hollenbeck 1974, Bull and Hayes 2001, Pilliod et al. 2002, Patla and Keinath 2005, Reaser and Pilliod 2005)

II. Some Basic Concepts

Retention vs. Utilization (by WEIGHT)

Retention vs. Utilization (by WEIGHT)



Plant Height vs. Plant Weight

Note: the lowest 10% of height contributes little or nothing to cover for many species, but it constitutes substantial weight.

III. Basic Approach

Forest Plan Objectives

& reqt's of Forage Utilization Standard

are paramount

Coarse-filter / Fine-filter Approach

(2012 Planning Rule)

1. Coarse-filter — Approximation of conditions under which native wildlife-communities formed. *(a key premise of Planning Rule)*

2. Fine-filter — Adjustments to meet the needs of species of conservation concern.

Supporting literature: *Diamond (1981), Reid and Miller (1989), Keystone (1991), Noss and Cooperider (1994), Hunter (1996), Aplet and Keeton (1999), Everett and Lehmkuhl (1999), Haufler (1999), Hughes et al. (2000), Cooperrider (2002), Samways (2005)*

Coarse-filter Conditions

~90-100% herb retention

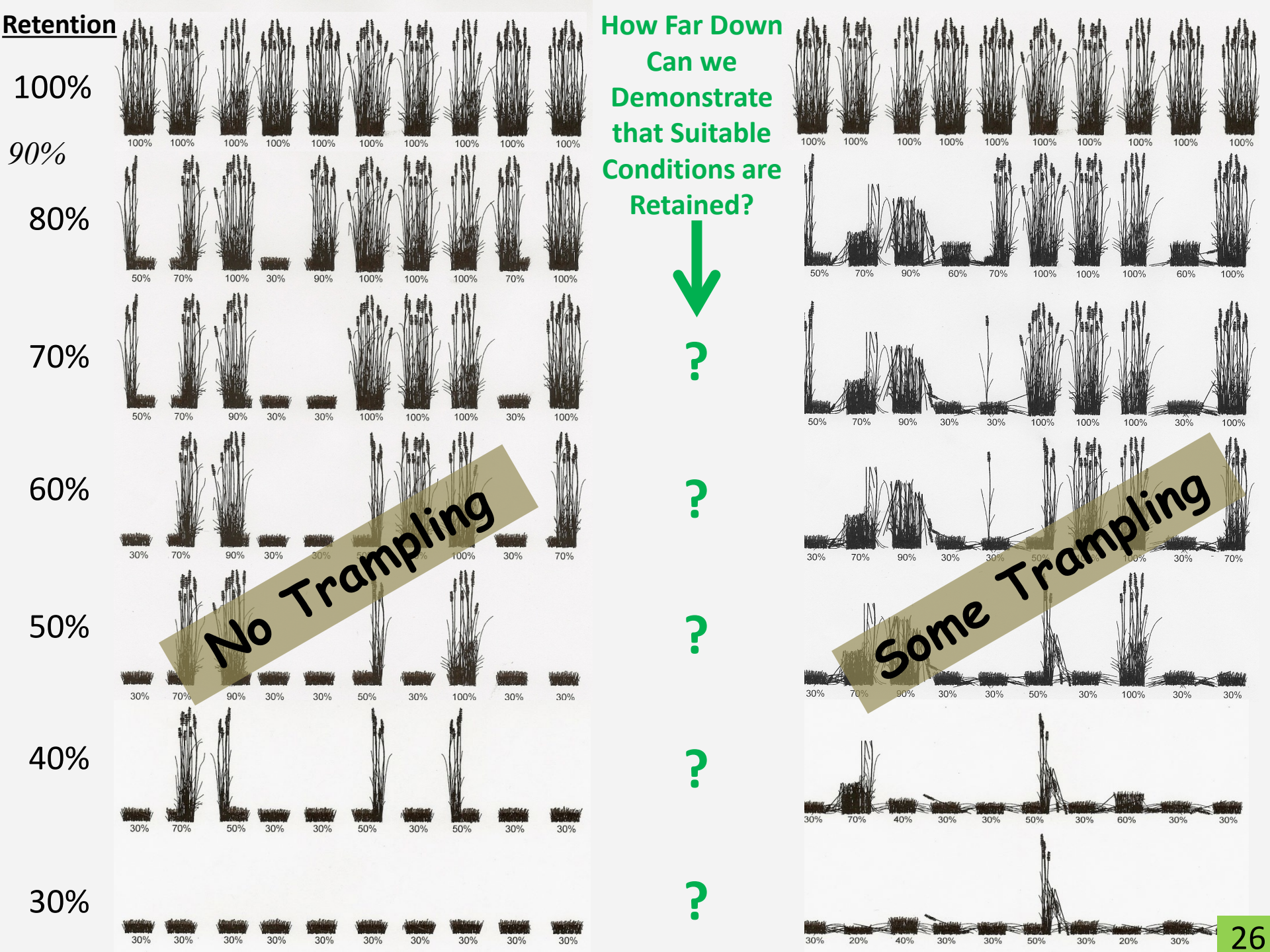
Any Fine-filter Adjustments Needed to Meet the Needs of Frogs & Toads?

- No science was found showing need for fine-filter adjustments.

Any Adjustments Needed to Accommodate Livestock Grazing?

- Yes, based on Forest Plan, NFMA.
- Scientific info. shows coarse-filter conditions can be adjusted downward as far as 70% retention.

If it weren't for livestock grazing, there wouldn't be a need to assess <90% herb retention


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

Why start with near 100% retention?

- Complete exclusion is a widely recognized way to protect amphibians from livestock grazing use and to provide suitable conditions.

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

- Coarse-filter conditions equate to conditions without livestock use.

  (*2012 Planning Rule* and large volume of supporting literature)

- We have an affirmative requirement to protect sensitive species and to provide suitable conditions for them.

  Requirements are not stated in the negative

  → *There are no requirements to prove that suitable conditions are not met before changing management to protect sensitive species.*
  (Obj's 3.3(a) & 4.7(d), Sens. Species Mgt. Standard, USFS 1990b, FSM 2670.22)

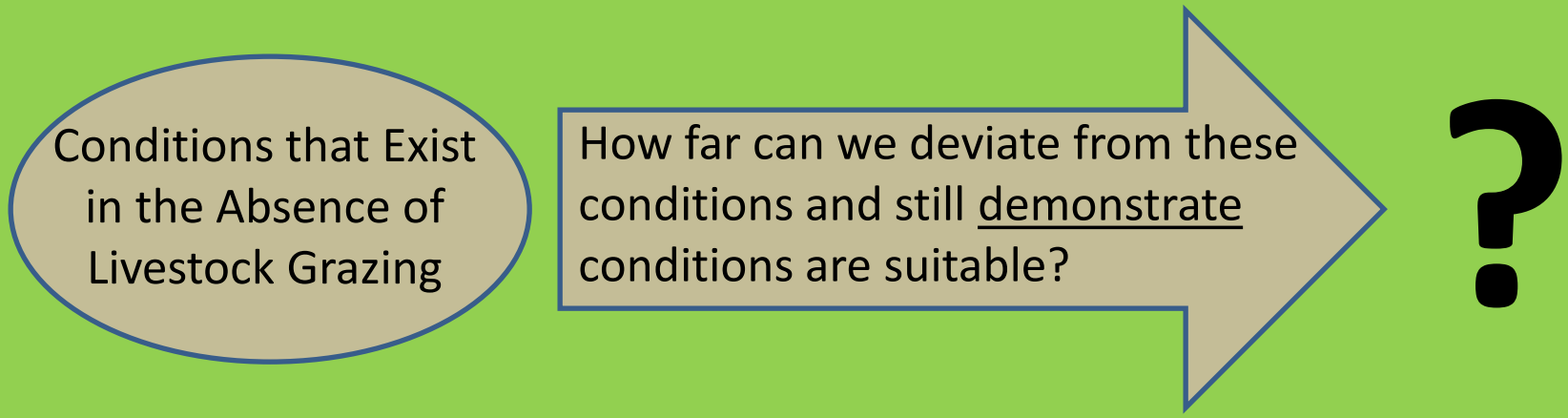
In defining suitable conditions for habitat elements affected by a given activity (e.g., livestock grazing):

The burden of proof is on demonstrating that deviations

from conditions without livestock grazing

to conditions with x-level of livestock grazing

….will still be suitable.



This approach is consistent with a growing body of ecological literature.

(Barrett and Raffensperger 1999, Fisher et al. 2006, Walshe et al. 2007)

Research --- Effects of different use levels on amphibian biology

Biology of Amphibians, esp. tied to **vegetation structure**

Research --- Effects of different vegetation conditions on **humidity, hiding cover, insect habitat,** etc.

Research --- Grazing effects on **vegetation structure**

Biology of Amphibians, re: **water quality, surface-water retention, trampling**, etc.

Information --- Grazing effects on vegetation structure

Research --- Grazing effects on **water quality, trampling, etc.**

Synthesis of Info

Effects of Grazing on Amphibians

IV. Suitable Herbaceous Retention

Suitable Herbaceous Vegetation Conditions for Spotted Frogs and Boreal Toads

1. 70% of the weight of herb veg is retained in the area encompassed w/in a perimeter 10 ft. beyond high-water mark of known breeding wetlands.

2. 70% of the weight of herb veg is retained on ≥80% of the acreage of each major veg type used by sensitive amphibs w/in 1/3 mile of known breeding sites, except:

    - Retention can be as low as 50% in nonnative bluegrass and smooth brome communities where they do not dominate large areas.

- These apply to rangelands & riparian areas in functioning condition.
- Assumes canopy cover of relatively-intact herb veg. remains above about 60%.

IV. Scientific Basis for 70% Threshold for Sensitive Amphibians

11 Factors Considered in Process of Determining Retention Level

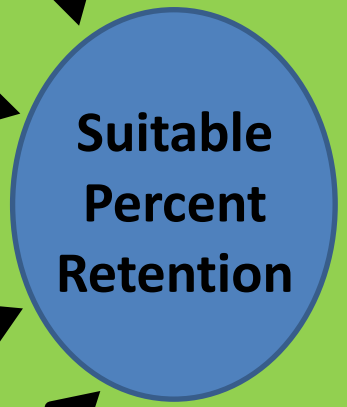
Why were the 11 Factors Examined in Detail?

- Livestock grazing use affects amphibians in many different ways.
- There are no amphibian–livestock studies that identify thresholds for livestock grazing.
- Many amphibian–livestock studies examined individual factors.
- A large volume of info. from a wide range of disciplines addresses individual aspects of frog & toad ecology affected by livestock.

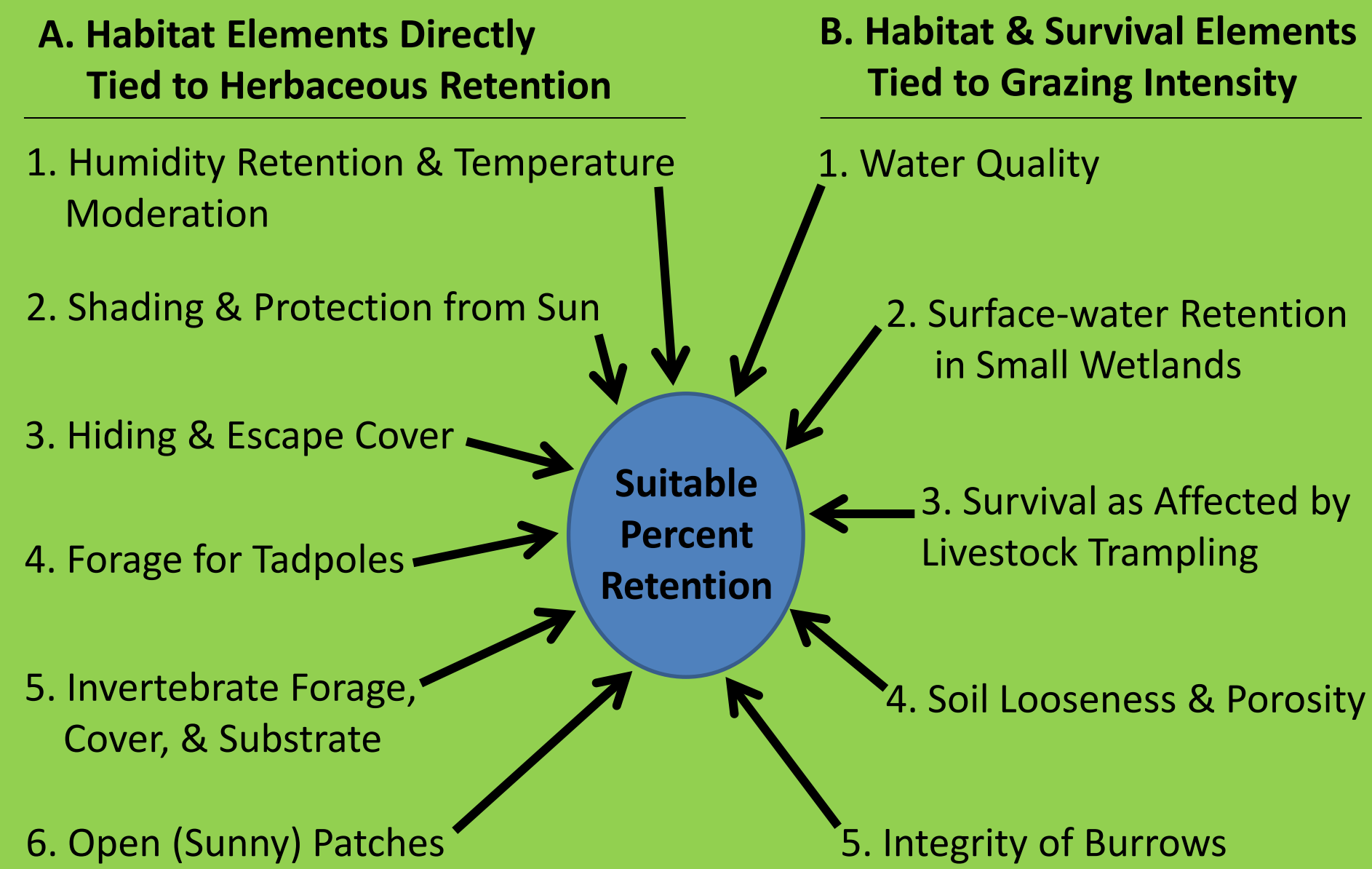
Factors Considered in Determining Suitable Retention Level

A. Habitat Elements Directly Tied to Herbaceous Retention

1. Humidity Retention & Temperature Moderation
2. Shading & Protection from Sun
3. Hiding & Escape Cover
4. Forage for Tadpoles
5. Invertebrate Forage, Cover, & Substrate
6. Open (Sunny) Patches



Factors Considered in Determining Suitable Retention Level



A.1 — Humidity Retention & Temperature Moderation

Moist / Humid Habitat & Micro-sites are ***A Must***

- Wetland habitat
- ✓ Sedge and Grass Canopy Cover
- ✓ Litter
- Willow Canopy Cover
- Logs
- Burrows

A.1 — Humidity Retention & Temperature Moderation

- Frogs & toads seek out and require moist to wet habitat & microsites.

  (Dumas 1964, Schwarzkopf & Alford 1996, Sjogren and Ray 1996, Engle 2001, Patla & Keinath 2005, Rittenhouse et al. 2008, Bull 2009, Burton et al. 2009)

- Moderated temperatures are also important to frogs & toads.

  (Dumas 1964, Sjogren and Ray 1996, Engle 2001, Semlitsch et al. 2008/2009)

- In herbaceous plant communities → herb. veg. is central to retaining near-ground humidity and moderating temperature.

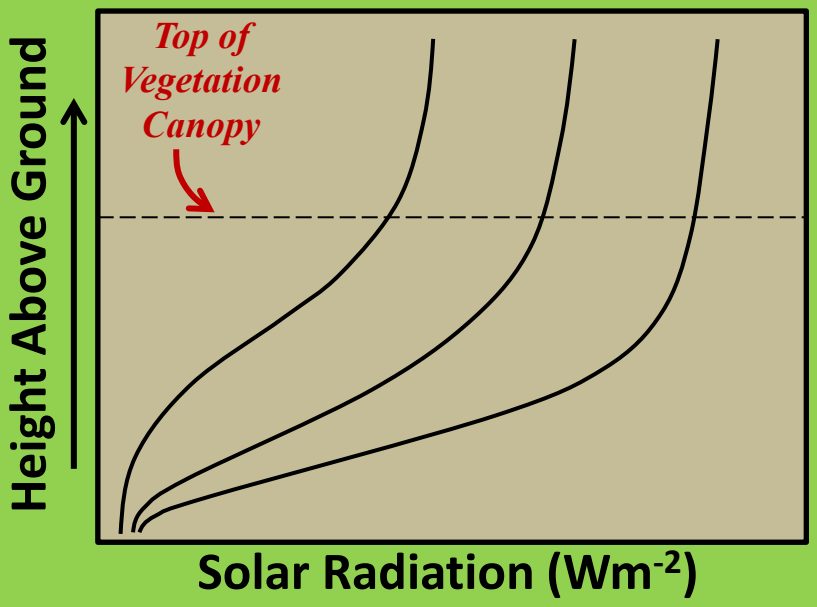
  (*Marlatt 1961, Thom 1971, Cionco 1972, Goudriaan 1977, Oke 1978, Baldocchi et al. 1983*)

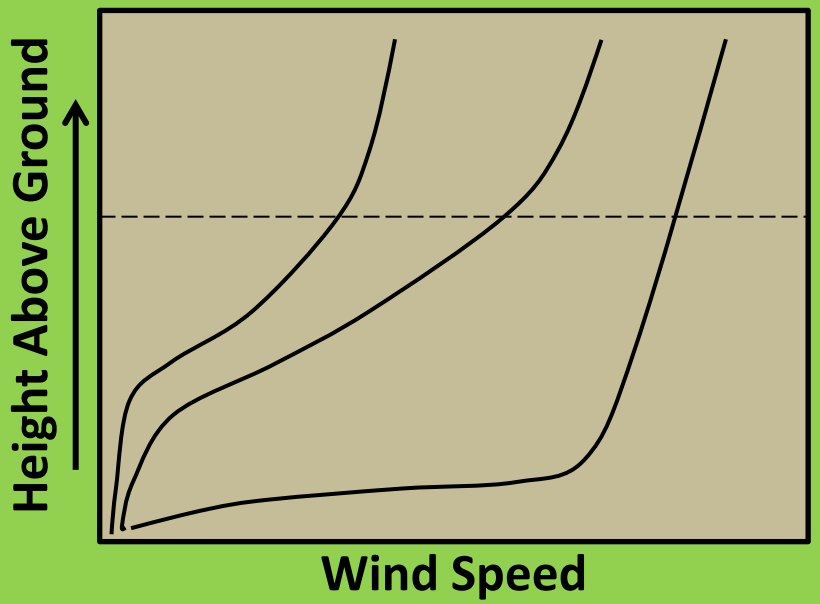
- Relative humidity of 65% at about 80 °F is lethal to adult spotted frogs in about two hours. (*Dumas 1964*)

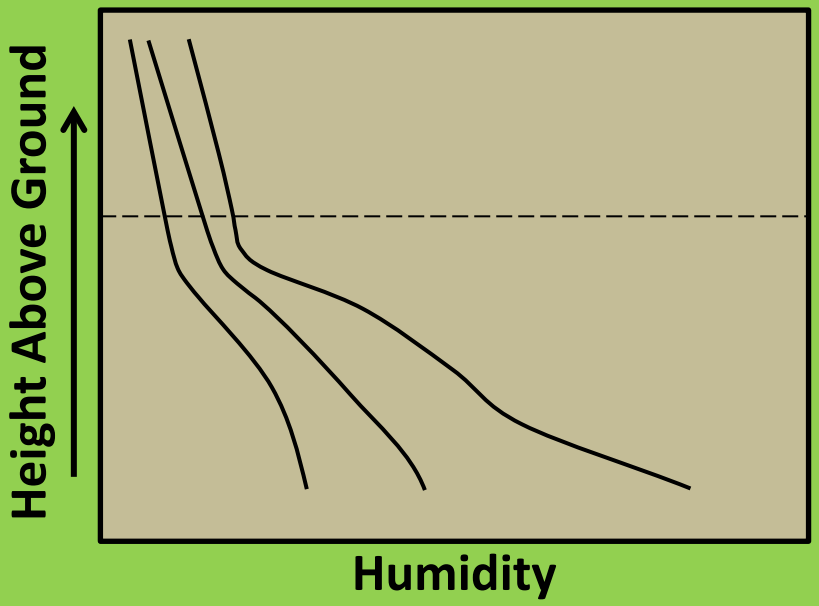
- While toads do not desiccate as easily as frogs, moist habitat and microsites are important to boreal toads

  (Thorson 1955, Schmid 1965, Duellman and Trueb 1986, Schwarzkopf & Alford 1996, Keinath and McGee 2005, Rittenhouse et al. 2008, Bull 2009)

A.1 — Humidity Retention & Temperature Moderation





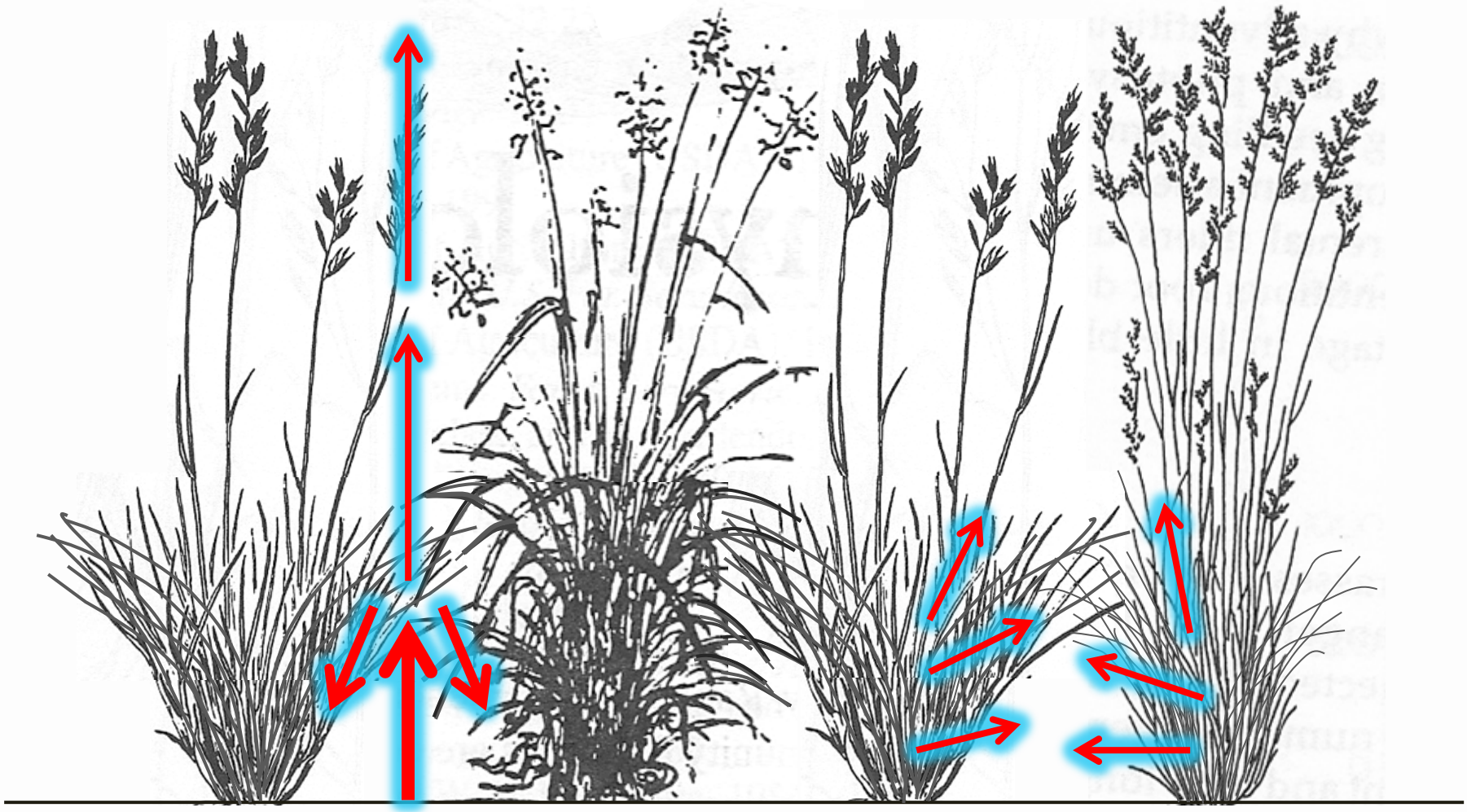


These results are for agricultural crops.

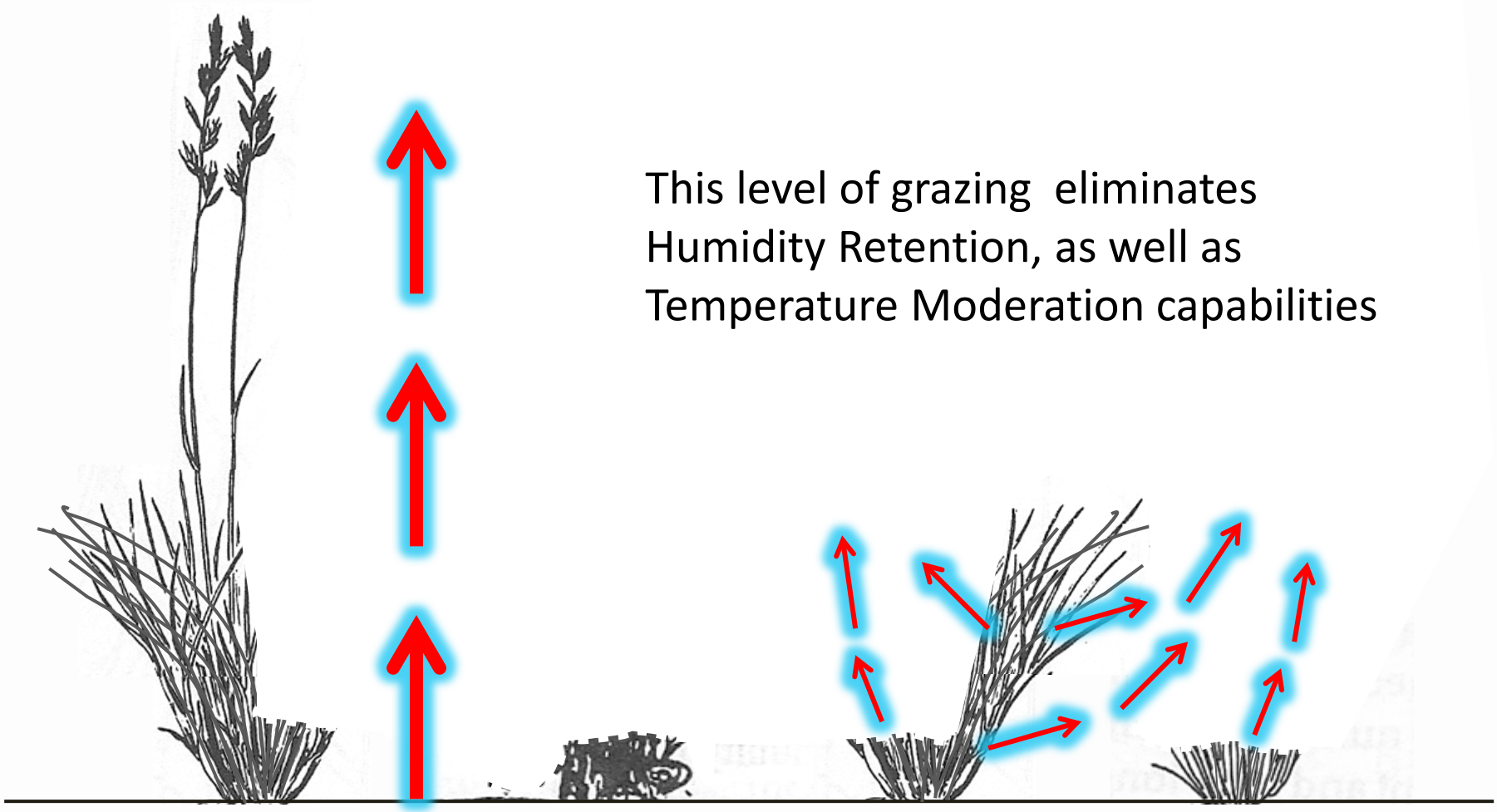
Native meadow veg. is more dense, so differences are greater.

Marlatt (1961), Thom (1971), Cionco (1972), Goudriaan (1977), Oke (1978), Baldocchi et al. (1983)

Canopy Cover Effects on Humidity



Canopy Cover Effects on Humidity



This level of grazing eliminates Humidity Retention, as well as Temperature Moderation capabilities

Evaporation

Transpiration

Humidity Retention

Percent Canopy Cover of Relatively-Intact Veg.

100% 80% 60% 40% 20% 0%

100%

85-100%

70-85%

Well Supported by Science

50-65%

35-50%

20-35%

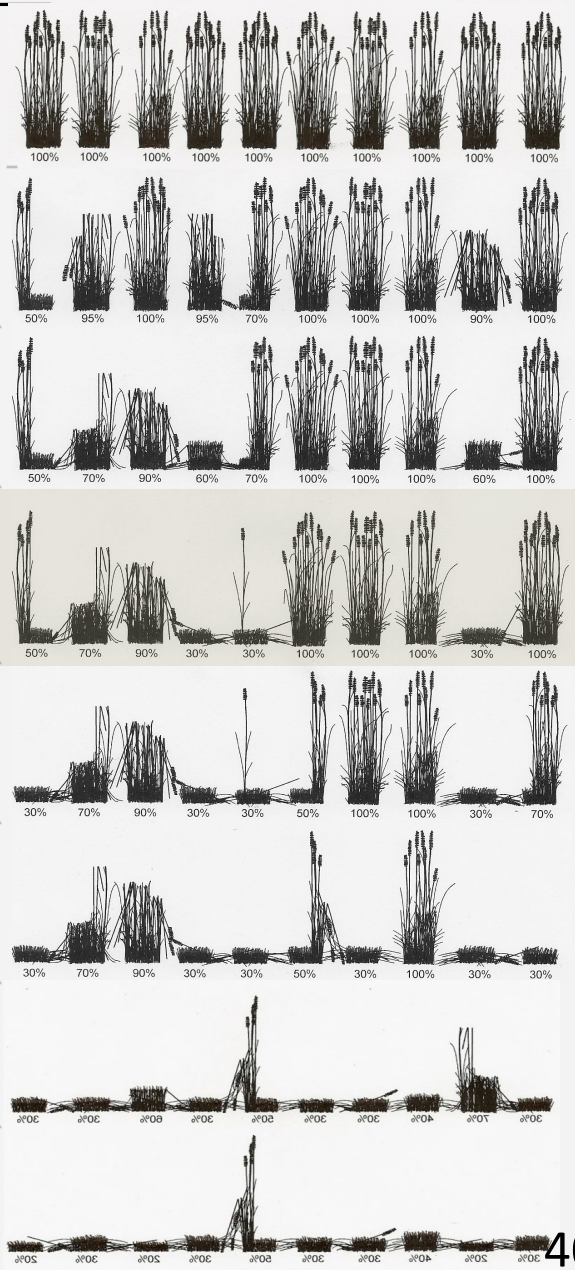
≤15%

≤5%

Not Supported by Science

This Assumes Starting Canopy Cover near 100%

Retention



A.2 — Shade & Protection from the Sun

- Related to humidity retention and temperature moderation, but this element involves direct exposure to sun.

- Shade and protection from the sun is important to frogs & toads.

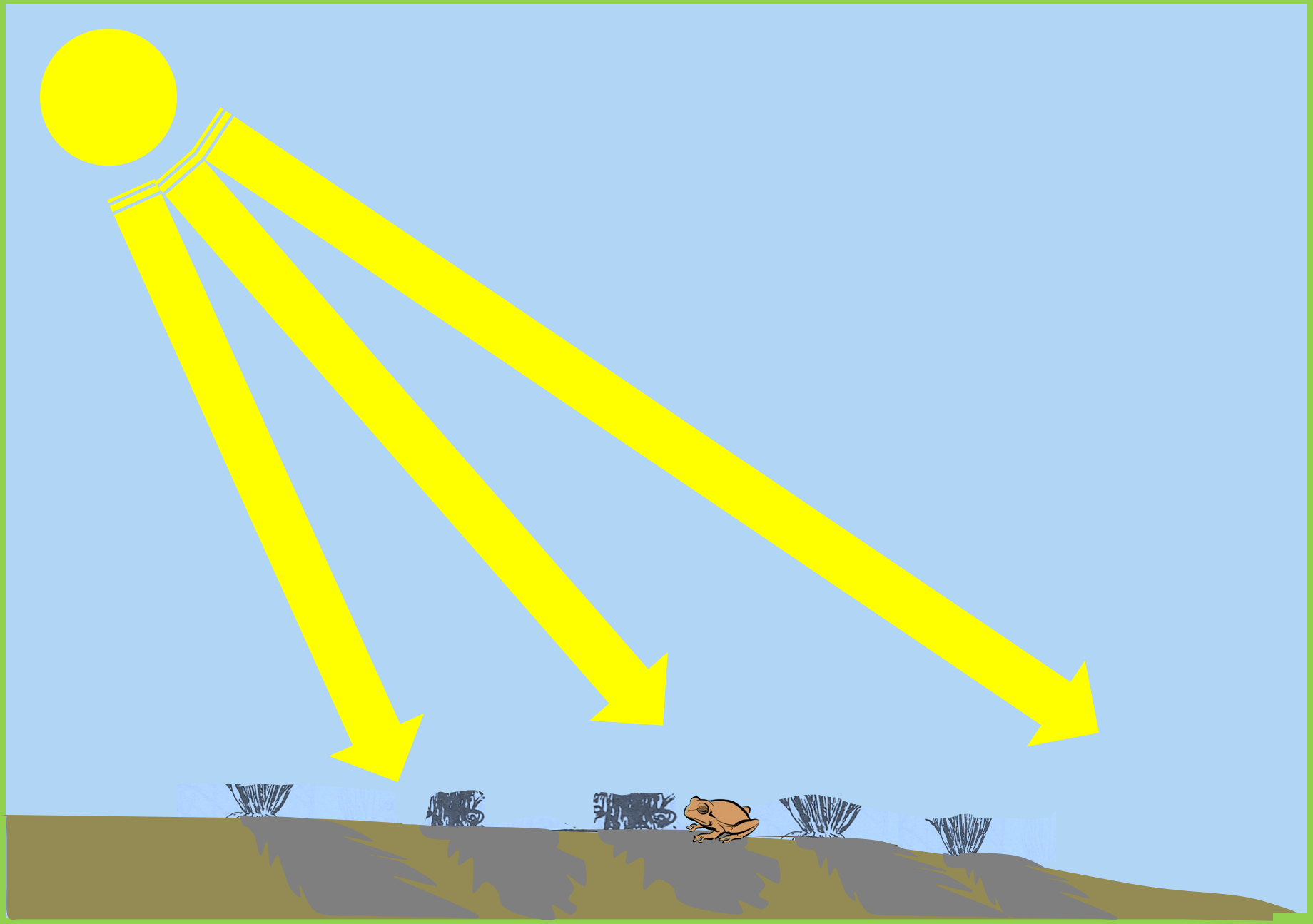
  (Schwarzkopf & Alford 1996 , Engle 2001, Bartelt et al. 2004, Semlitsch et al. 2008, Semlitsch et al. 2009)

- Access to sunlit ground and sunlit shallow water also important.

  → addressed in "6. Open (Sunny) Patches"


Herbaceous Veg. Contributes to:
• Protection from Sunlight
• Litter in Future Years

A.2 — Shade & Protection from the Sun



Shade & Sun Protection

Percent Canopy Cover of Relatively-Intact Veg.

100% 80% 60% 40% 20% 0%

100%

85-100%

70-85%

Large Amount of Shade Provided

50-65%

35-50%

Moderate Amount of Shade Provided

20-35%

≤15%

≤5%

Negligible or No Shade Provided

This Assumes Starting Canopy Cover near 100%

Retention

near-100%

90%

80%

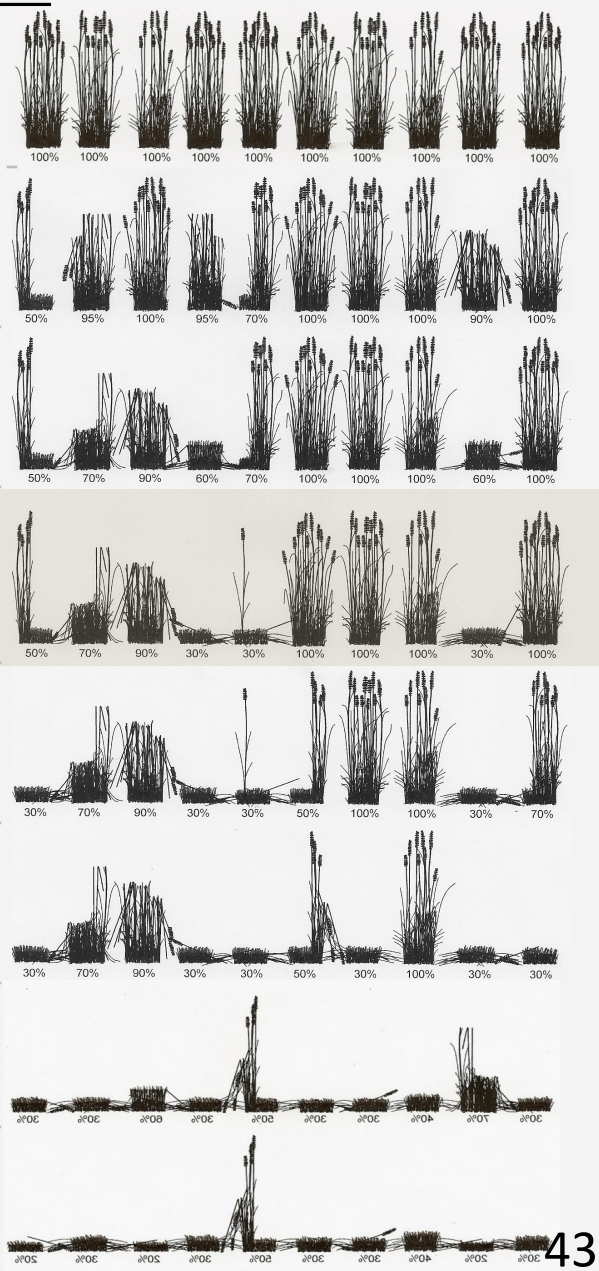
70%

60%

50%

40%

30%



A.3 — Hiding & Escape Cover

- Hiding & escape cover is important to tadpoles in wetlands.

  (Warkentin 1992, Healey 1998, Jansen and Healey 2002, Schmutzer et al. 2008)

- Hiding & escape cover is important to metamorphs on shorelines.

  (Jansen and Healey 2002, Bartelt et al. 2004, Burton et al. 2009)

- Hiding & escape cover is important to adults, juveniles, & metamorphs in aquatic and terrestrial habitats.

  (Healey 1998, Jansen and Healey 2002, Bull 2006, Shovlain et al. 2006, Bull 2009)

- Predators of boreal toads include:

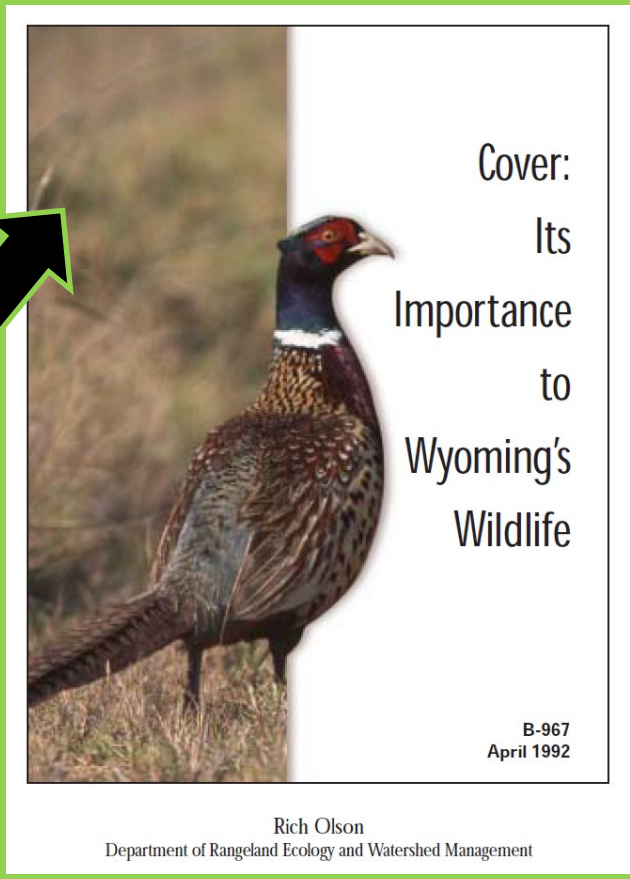
coyotes	badgers	gray jays	sp. sandpipers	garter snakes
foxes	ravens	robins	mallards	salamanders
raccoons	magpies	killdeer	r-tailed hawks	

*(*12 references in *Wind and Dubois 2002, Keinath and McGee 2005, Muths 2005, Bull 2009)*

Fundamental Principle of Wildlife Ecology:

As Hiding Cover
(Herbaceous Veg.)

Predation

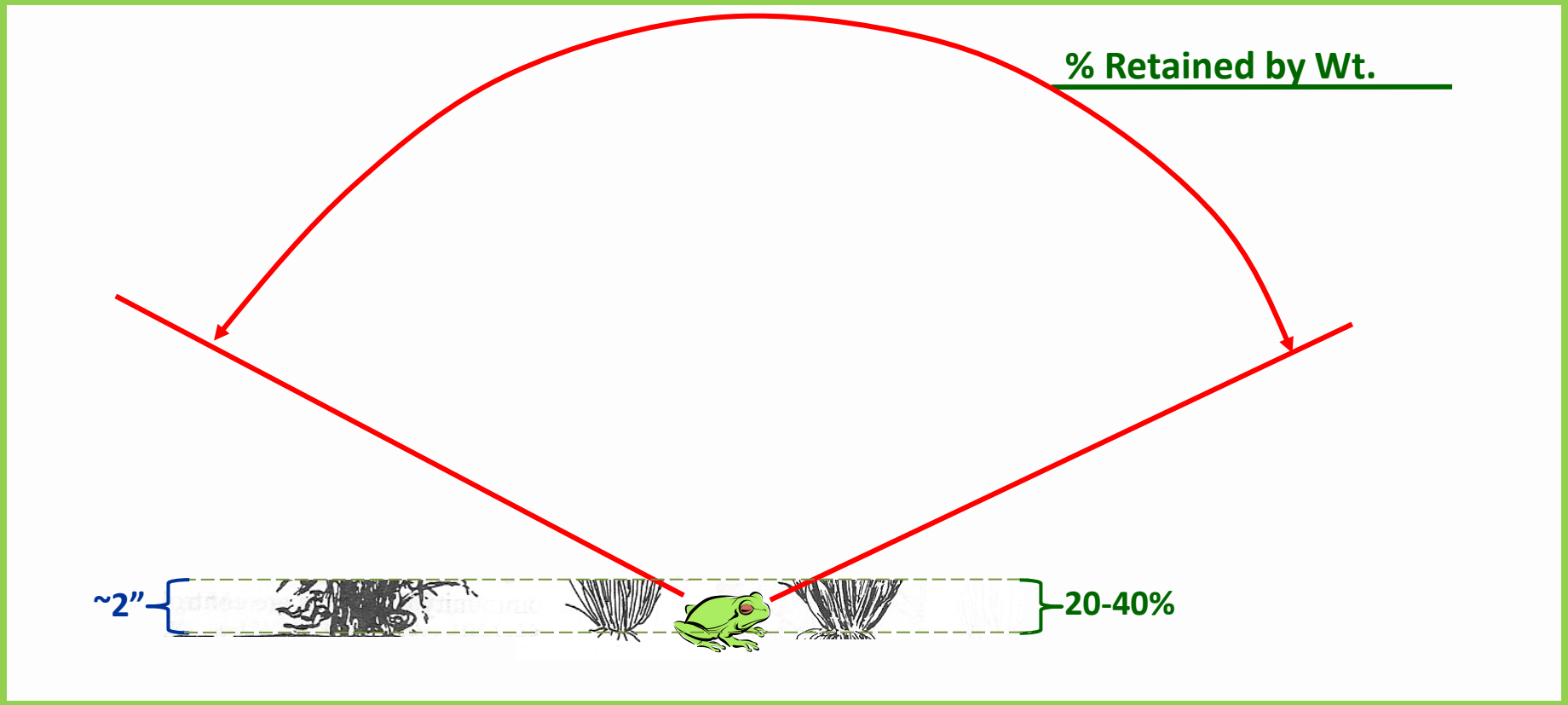


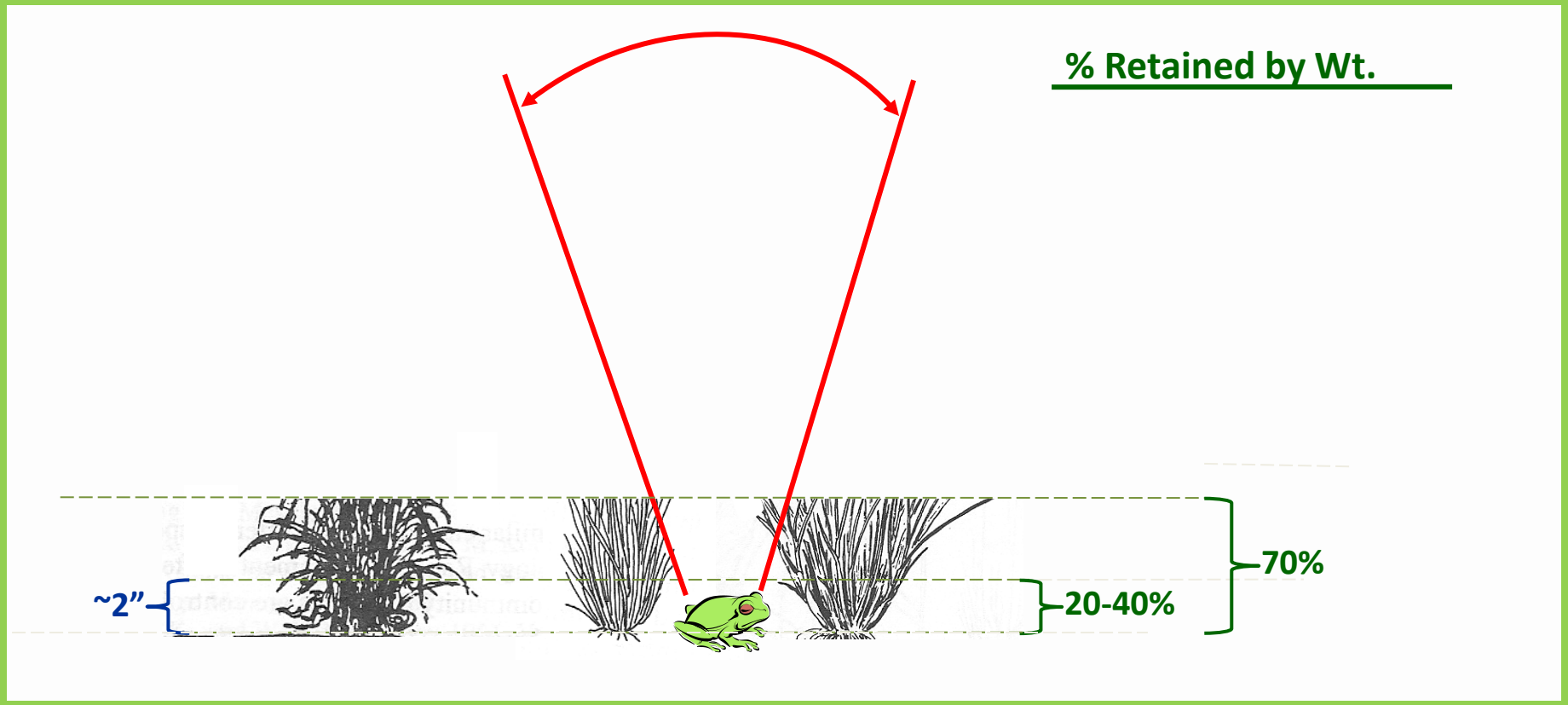
(Leopold 1933, Braun et al. 1978, Dasmann 1981, Bailey 1984, Peek 1986, Beintema and Müskens 1987, Warkentin 1992, Olson 1992, Fagerstone and Ramey 1996, Gilbert et al. 1996, Choate 2007)

In herb. plant communities → herb. veg. **IS** hiding & escape cover.

(Robel 1970, Birney et al. 1976, Peek 1986, Beintema and Müskens 1987, Ohmart 1996, Dwire et al. 2004, Patla and Keinath 2005, Shovlain et al. 2006)


% Retained by Wt.
100%


% Retained by Wt.
~2”
20-40%


% Retained by Wt.
~2”
70%
20-40%

Studies on Livestock Grazing & Amphibians

(Studies did not Specifically Assess Effects on Hiding Cover)

No effects on adult and tadpole occurrence, abundance, and/or survival were detected* where retention averaged:

- **~75-85%** *(Roche et al. 2012a, Roche et al. 2012b, McIlroy et al. 2013)*
- **~80%** *(Bull & Hayes 2000)*
- **High levels** *(Shovlain 2006)*
- **~50-60%** *(Adams et al. 2009)*

32-41% lower survival of tadpoles in grazed wetlands

40% reduction in survival in grazed wetlands vs. 14% reduction in ungrazed

Adult and tadpole occurrence and/or abundance were statistically lower where retention averaged:

- **~80%** *(Munger et al. 1994)* → Sim. Results by *Munger et al. (1996)*
- **~70-85%** *(Schmutzer et al. 2008, Burton et al. 2009)*
- **Low levels** *(Shovlain 2006)*

* This does not mean there were no effects.

Studies on Livestock Grazing & Amphibians

(Studies did not Specifically Assess Effects on Hiding Cover)

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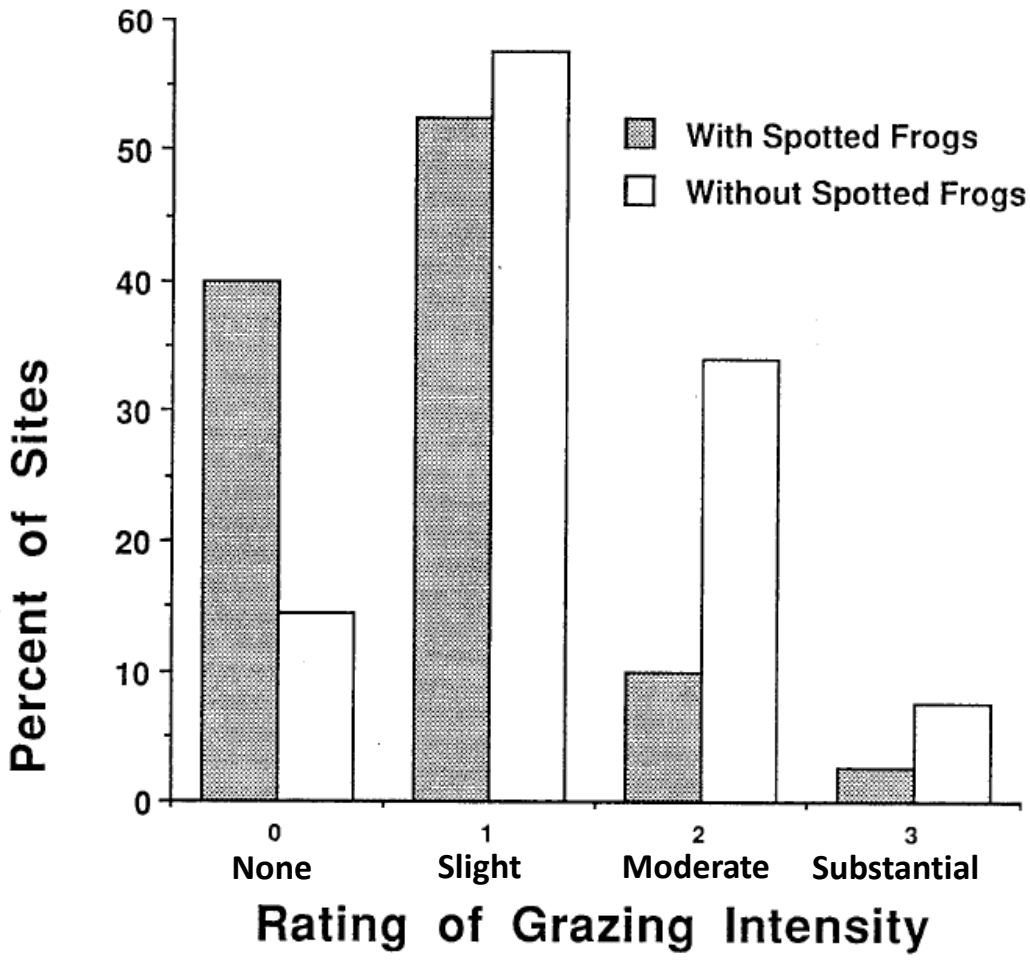
- **~50-60%** *(Adams e*

Adult and tadpole occurrence where retention averaged:

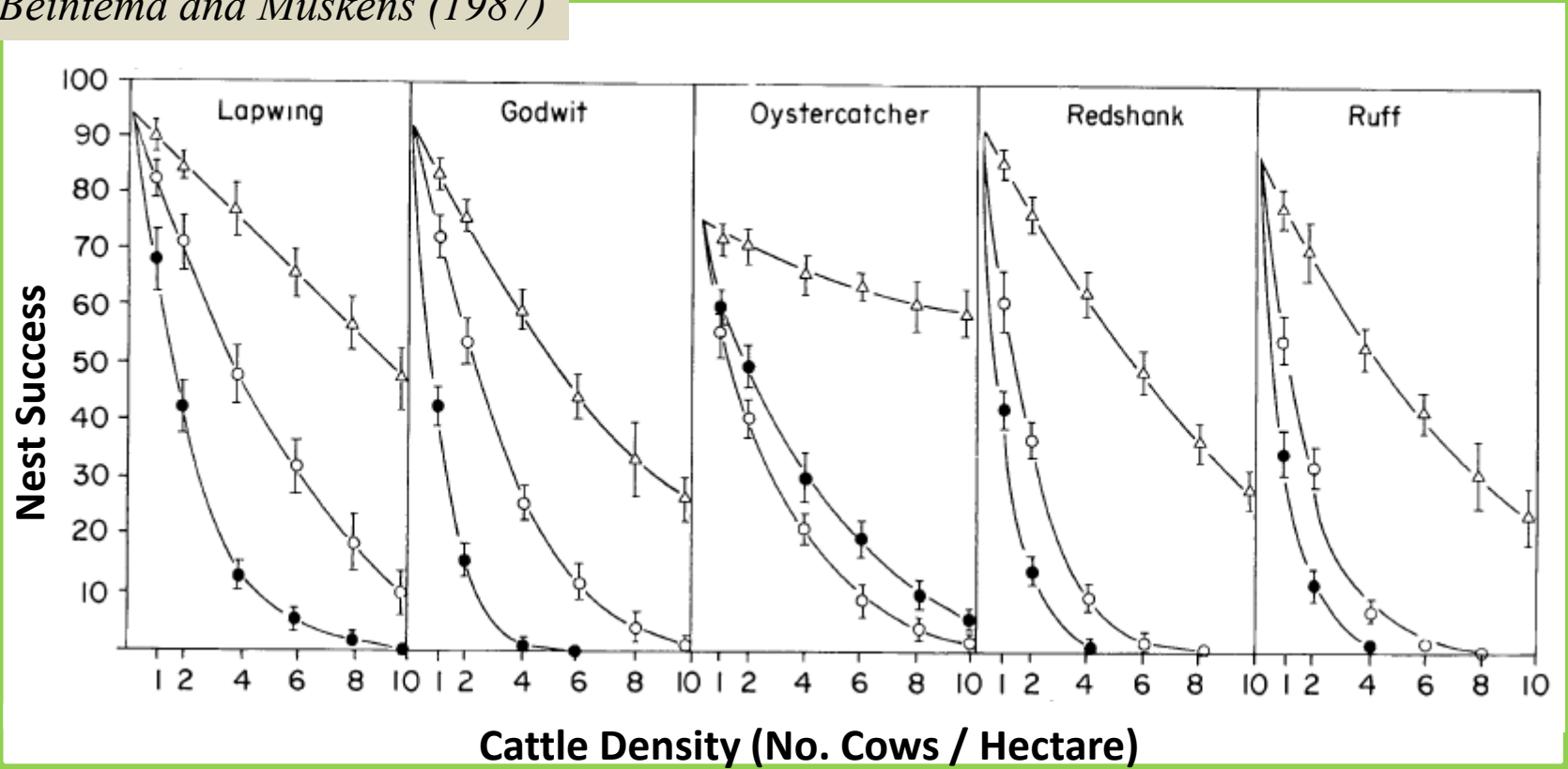
- **~80%** *(Munger et a*
- **~70-85%** *(Schmutzer e*
- **Low levels** *(Shovlain 20*



Munger et al. (1994:Fig. 3)

Waterbirds

Beintema and Müskens (1987)

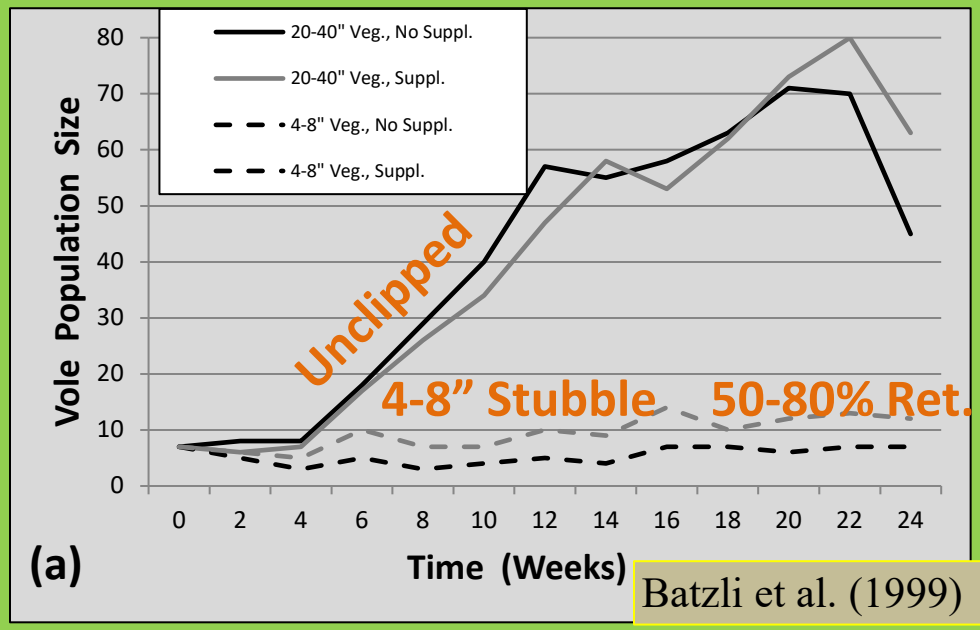


- About 18,000 nests in meadows were tracked during 1974 – 1983.
- Major declines in nest success was driven by reductions in cover and increased trampling.

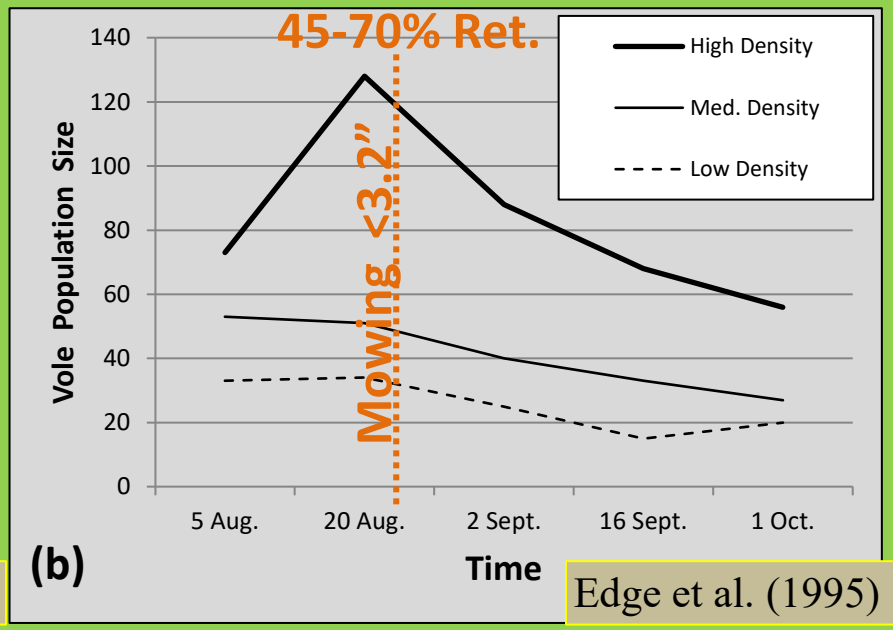
- *Kirsch (1969), Braun et al. (1978), & Gilbert et al. (1996)* reviewed >50 studies on effects of livestock grazing on waterfowl:

  → anything above light grazing generally is detrimental (predation).

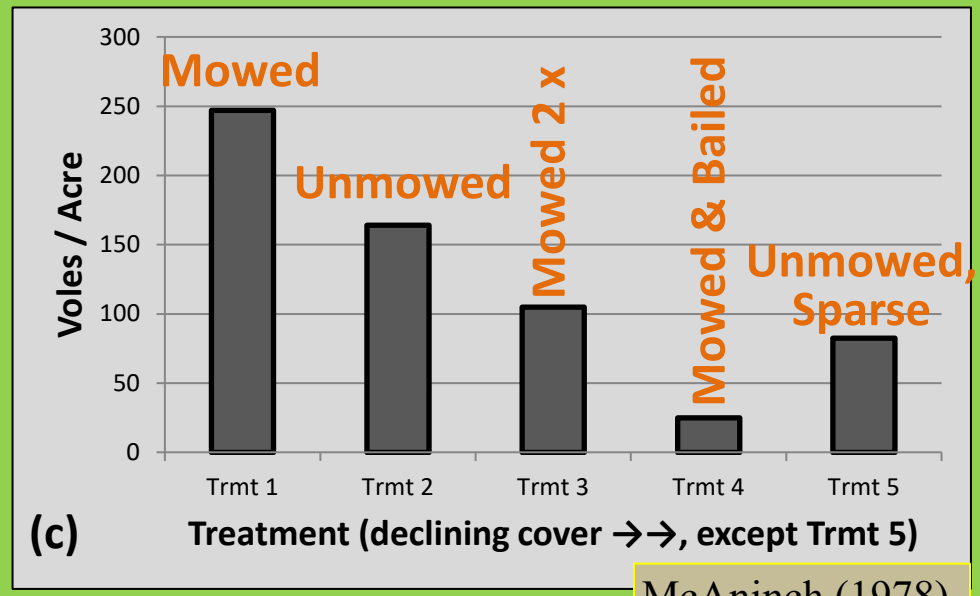
Voles



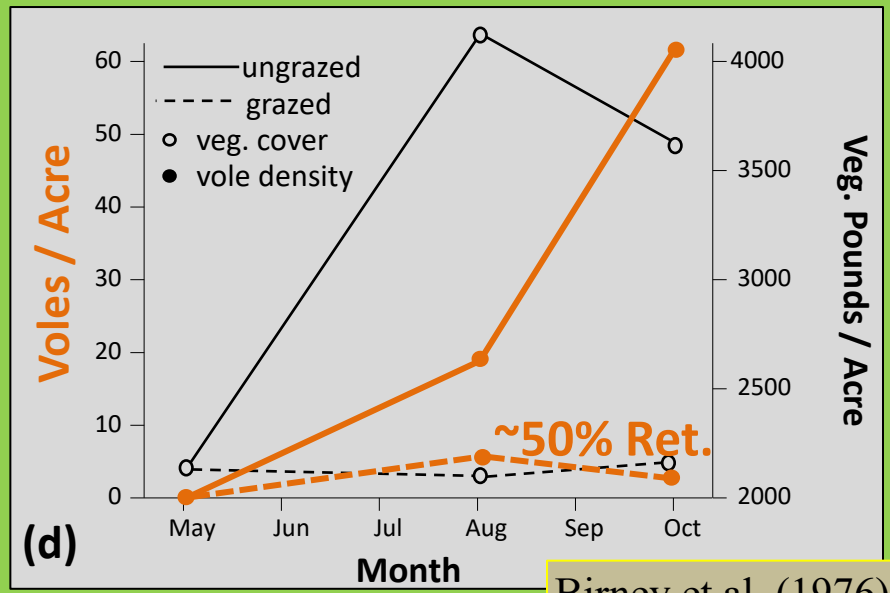
Batzli et al. (1999)



Edge et al. (1995)



McAninch (1978)



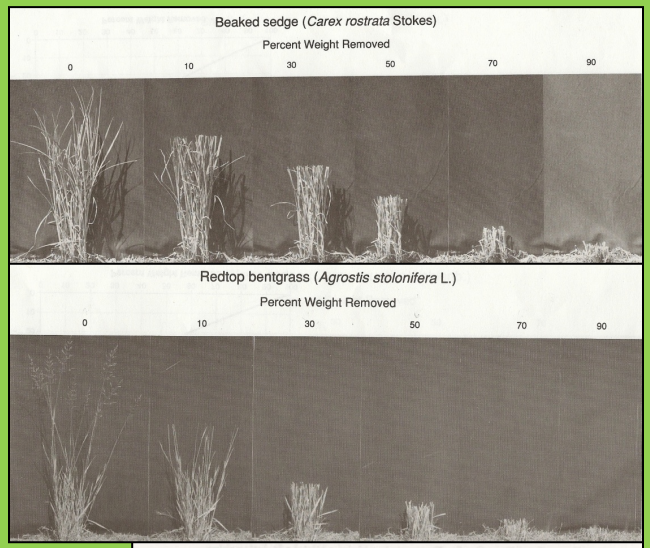
Birney et al. (1976)

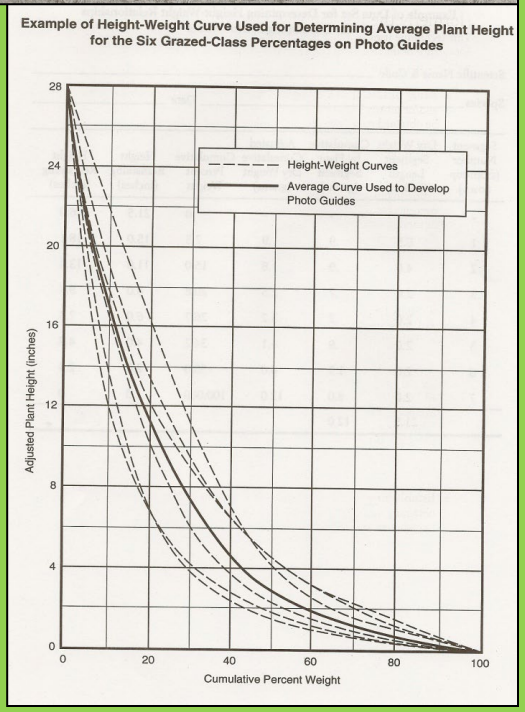
A Few Variables

Weight of Vegetation Above about 2 Inches

Weight of Herb Veg. Above 2 inches
(*for a Plant Community*)

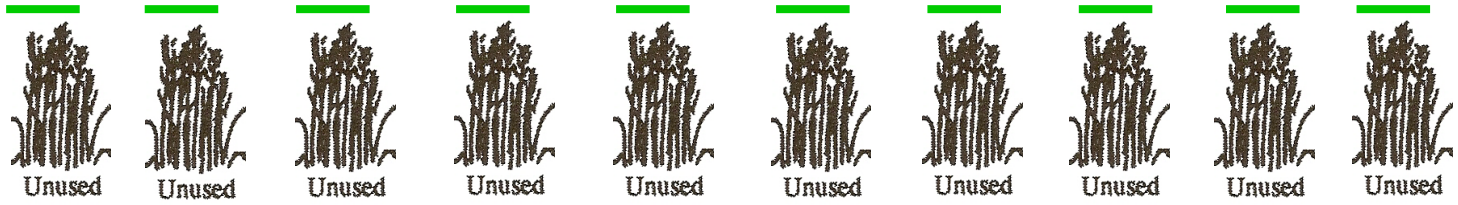
2-inch height



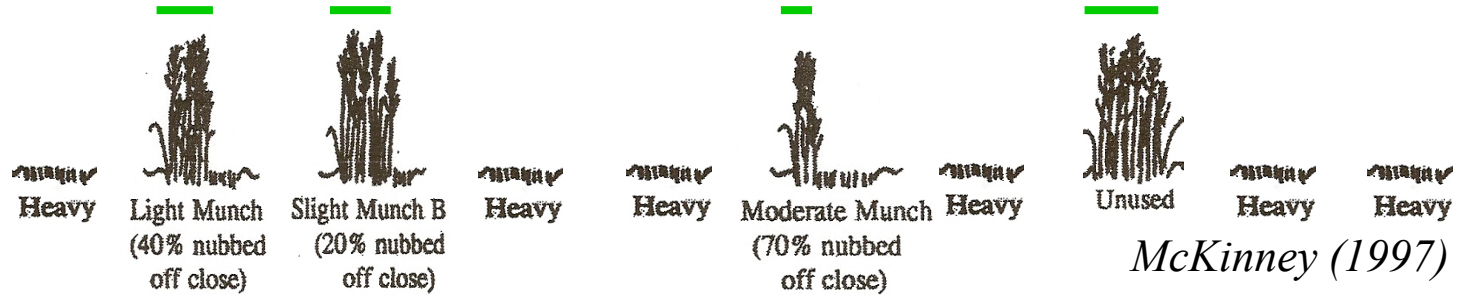


A Few Variables

Canopy Cover of Relatively-Intact Vegetation



50% Canopy Cover (with 100% Retention)



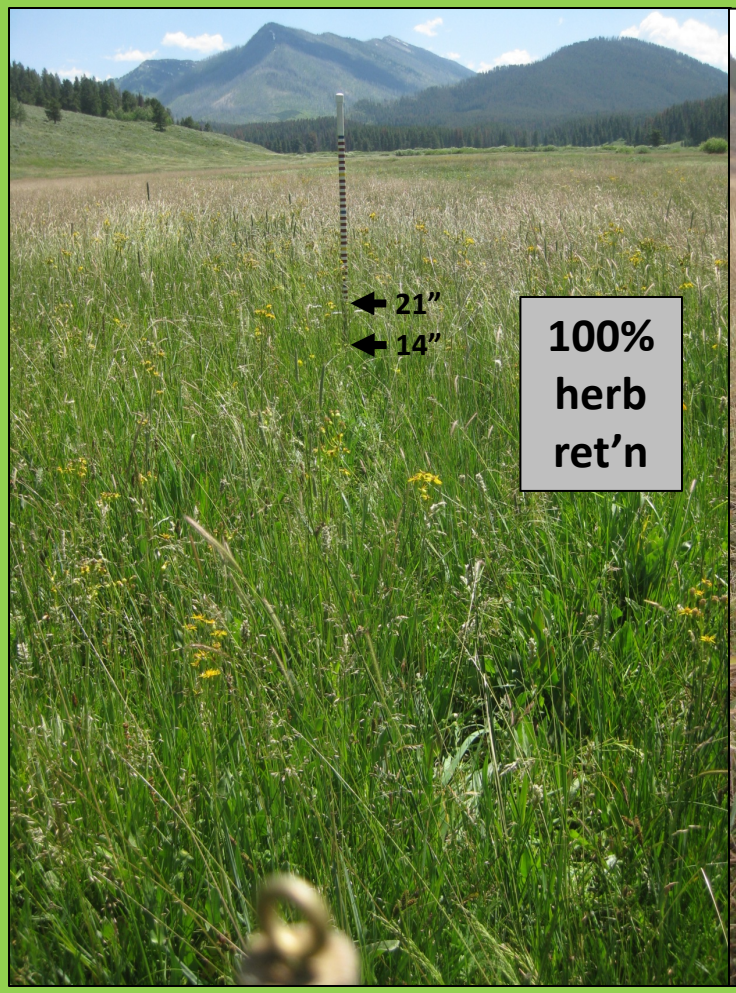
McKinney (1997)

15% Canopy Results from 50% Retention

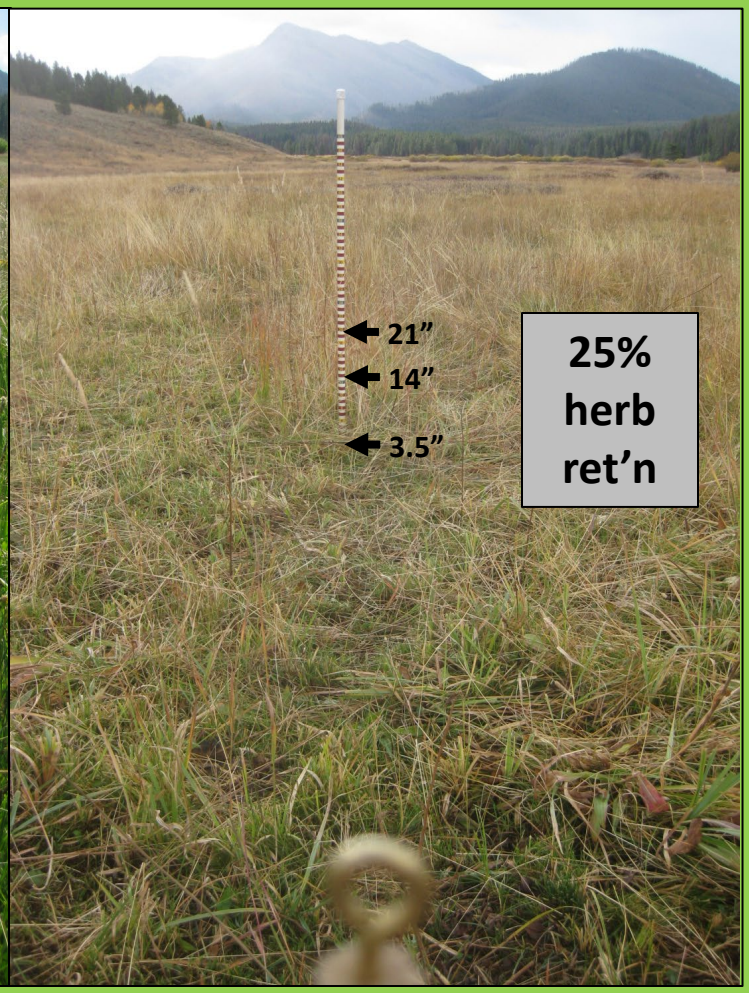
A Few Variables

Robel Pole Readings (visual obstruction) → indicator of hiding cover

Data was also collected on total herb weight

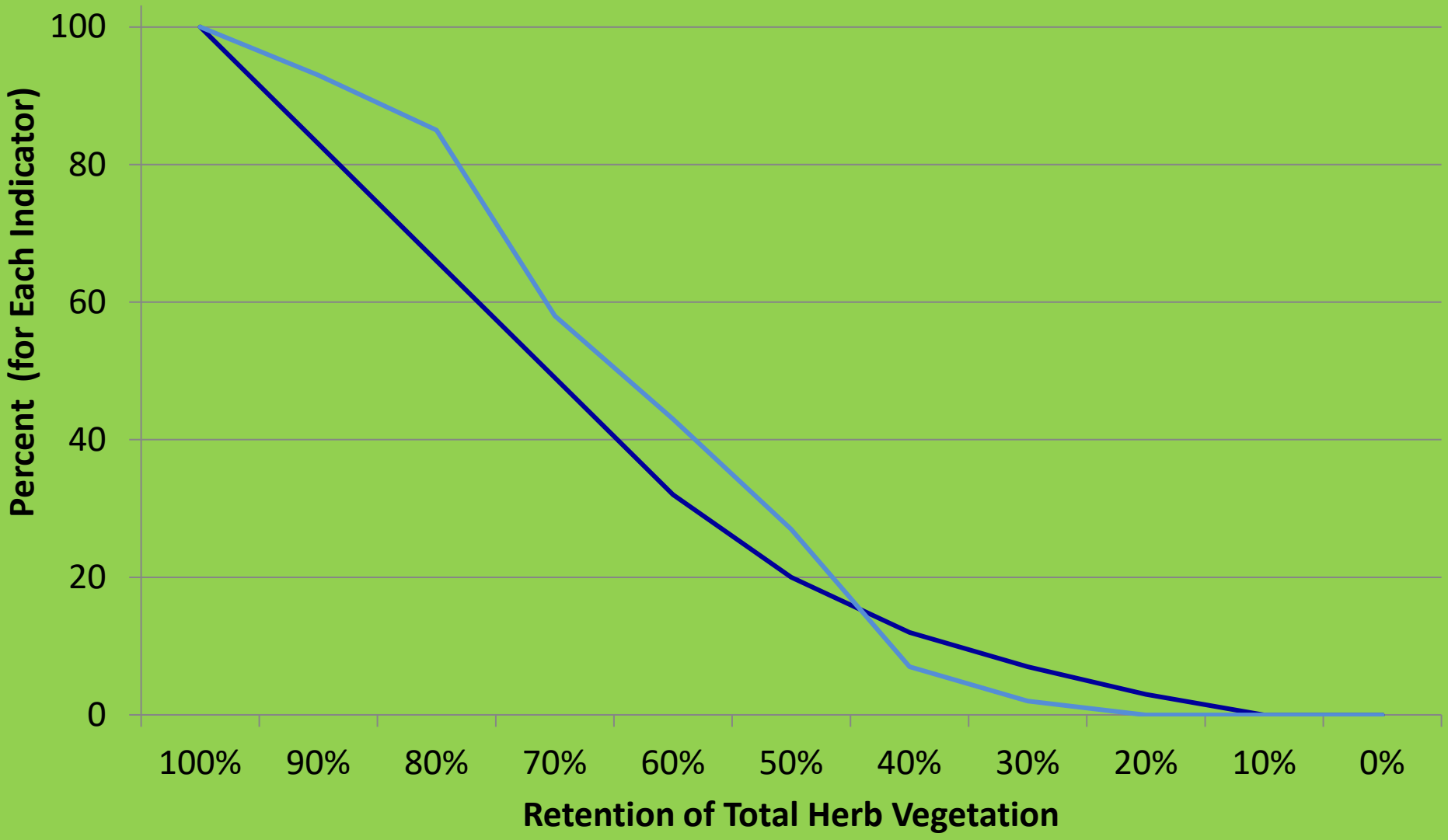


From 4 meters

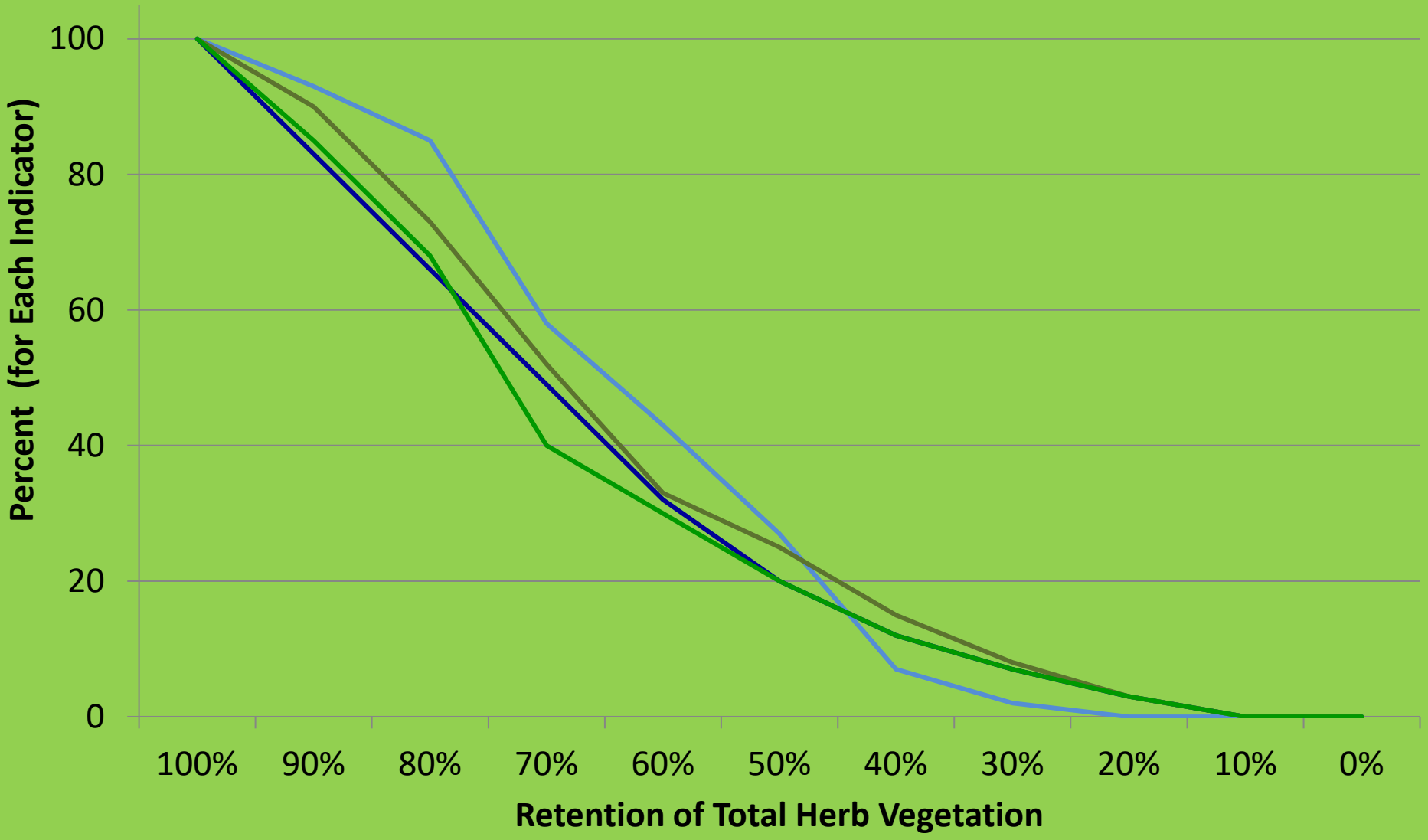


From 4 meters

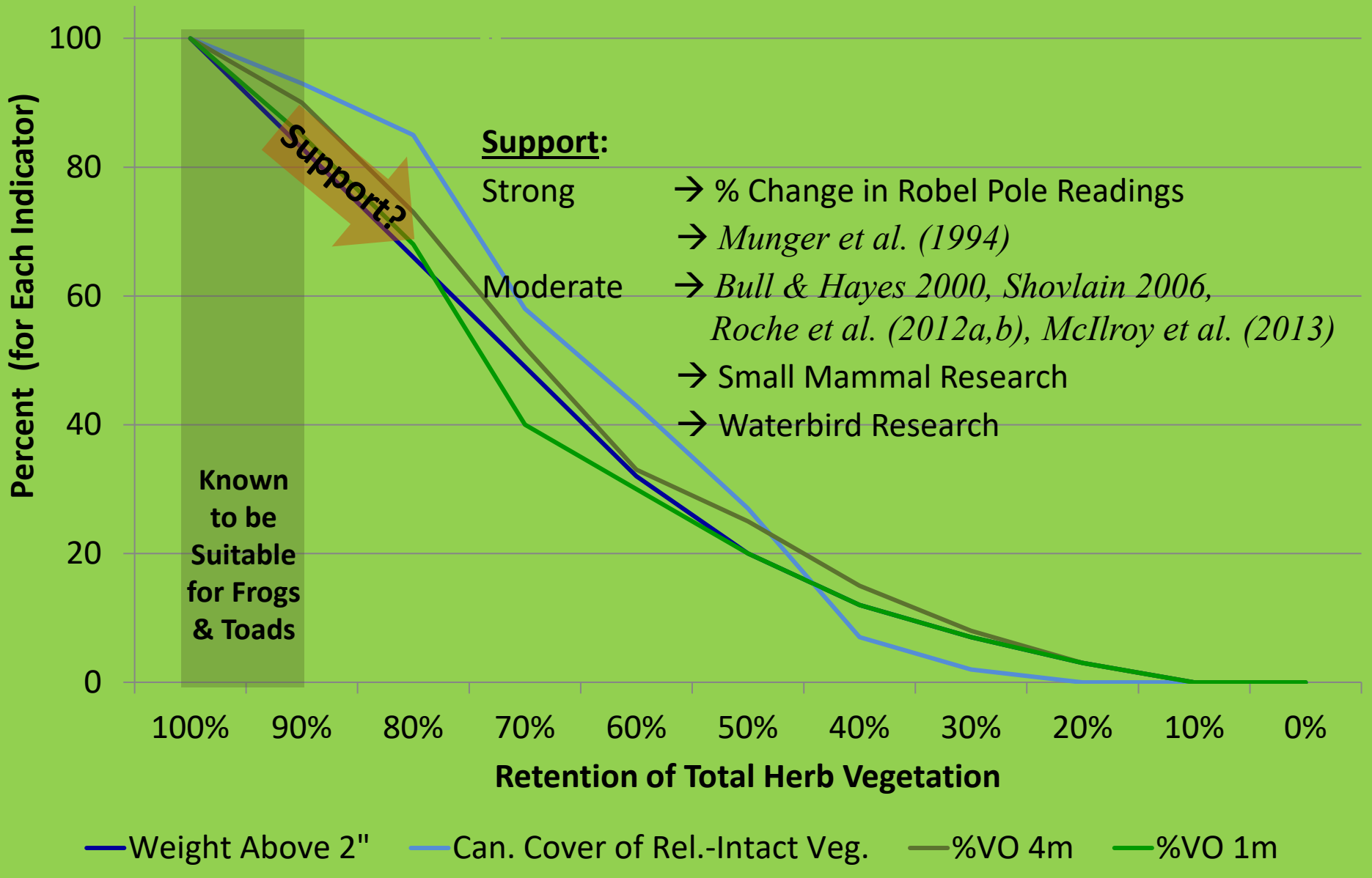
Relationship between Herbaceous Retention and Visual Obstruction



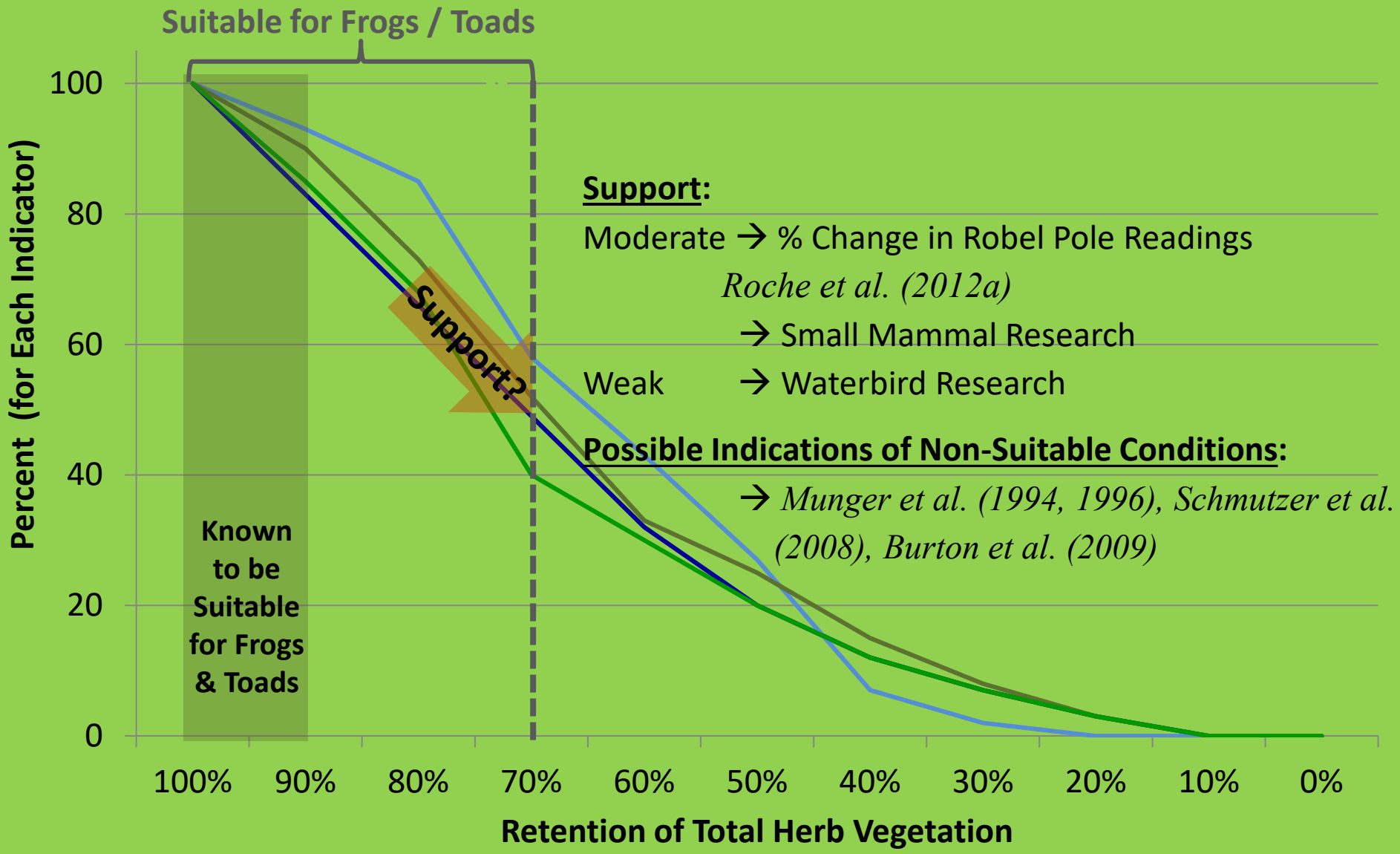
Relationship between Herbaceous Retention and Visual Obstruction



Relationship between Herbaceous Retention and Visual Obstruction



Relationship between Herbaceous Retention and Visual Obstruction



Support:

Moderate → % Change in Robel Pole Readings

Roche et al. (2012a)

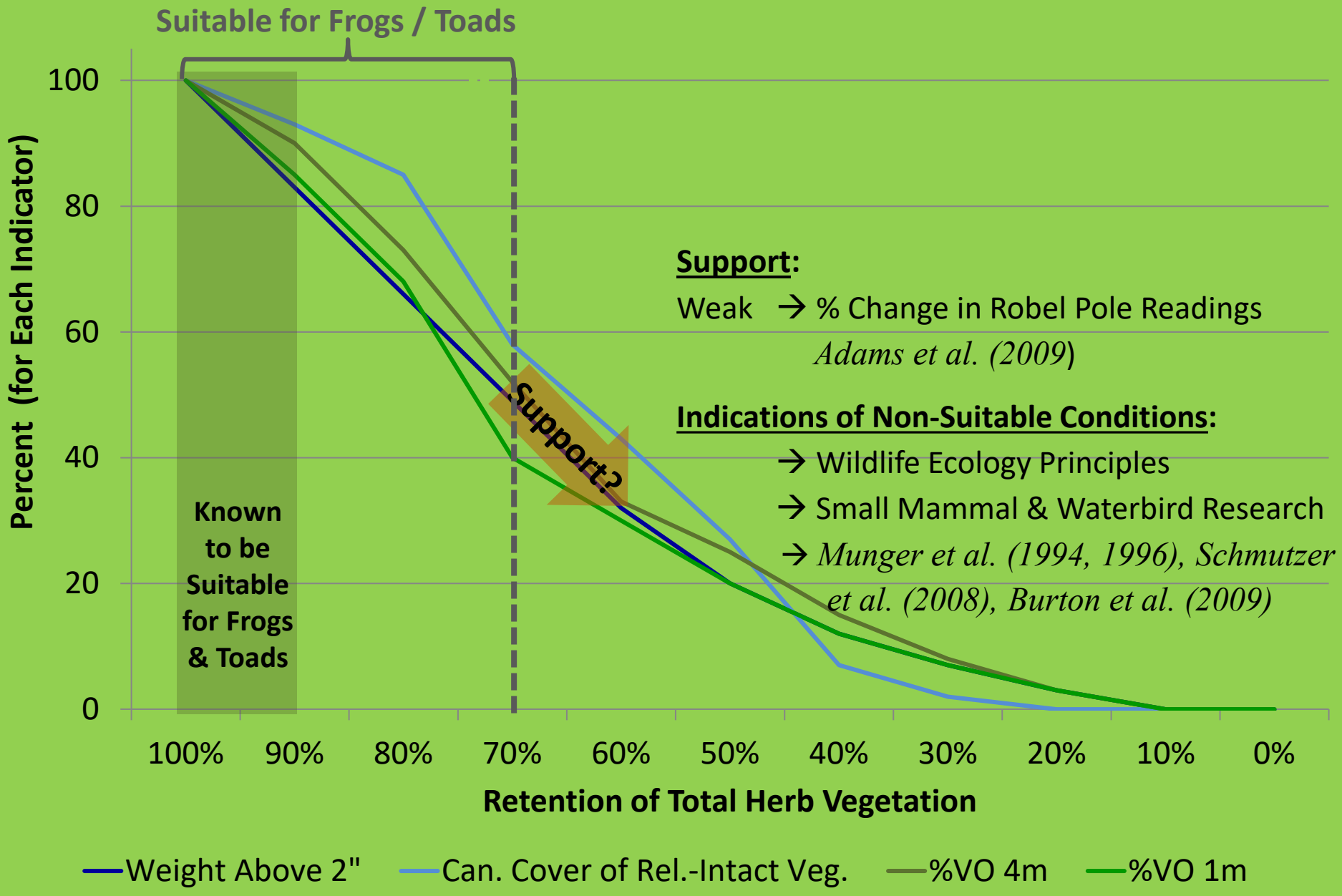
→ Small Mammal Research

Weak → Waterbird Research

Possible Indications of Non-Suitable Conditions:

→ *Munger et al. (1994, 1996), Schmutzer et al. (2008), Burton et al. (2009)*

Relationship between Herbaceous Retention and Visual Obstruction



Support:

Weak → % Change in Robel Pole Readings

Adams et al. (2009)

Indications of Non-Suitable Conditions:

→ Wildlife Ecology Principles

→ Small Mammal & Waterbird Research

→ *Munger et al. (1994, 1996), Schmutzer et al. (2008), Burton et al. (2009)*

Hiding & Escape Cover

Percent of Robel Pole Readings Retained

100% 80% 60% 40% 20% 0%

100%

70-100%

60-85%

Substantial Hiding Cover Provided

>50%

35-70%

<50%

25-50%

10-40%

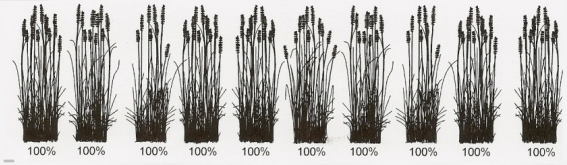
Negligible or No Hiding Cover Provided

0-30%

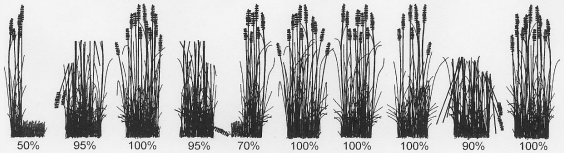
0-20%

Retention

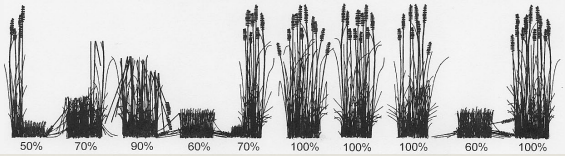
near-100%



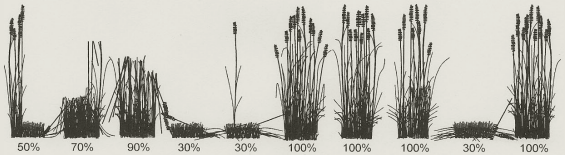
90%



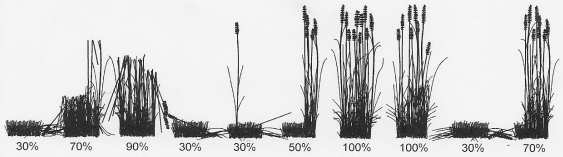
80%



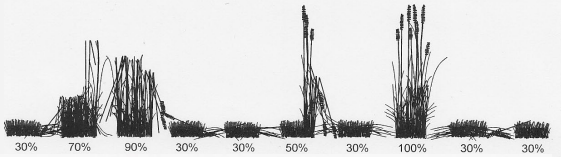
70%



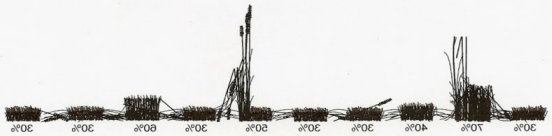
60%



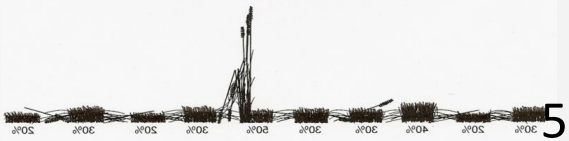
50%



40%



30%



A.4 — Forage for Tadpoles

- Herb vegetation (including detritus) is important for tadpole forage.

  (Warkentin 1992, Jansen and Healey 2002, Schmutzer et al. 2008)

Studies on Livestock Grazing & Amphibians

(Studies Did not Specifically Assess Effects on Tadpole Forage)

No effects on tadpole survival were detected* where retention averaged:

- ~80% *(Bull & Hayes 2000)*
- ~50-60% *(Adams et al. 2009)*

32-41% lower survival of tadpoles in grazed wetlands

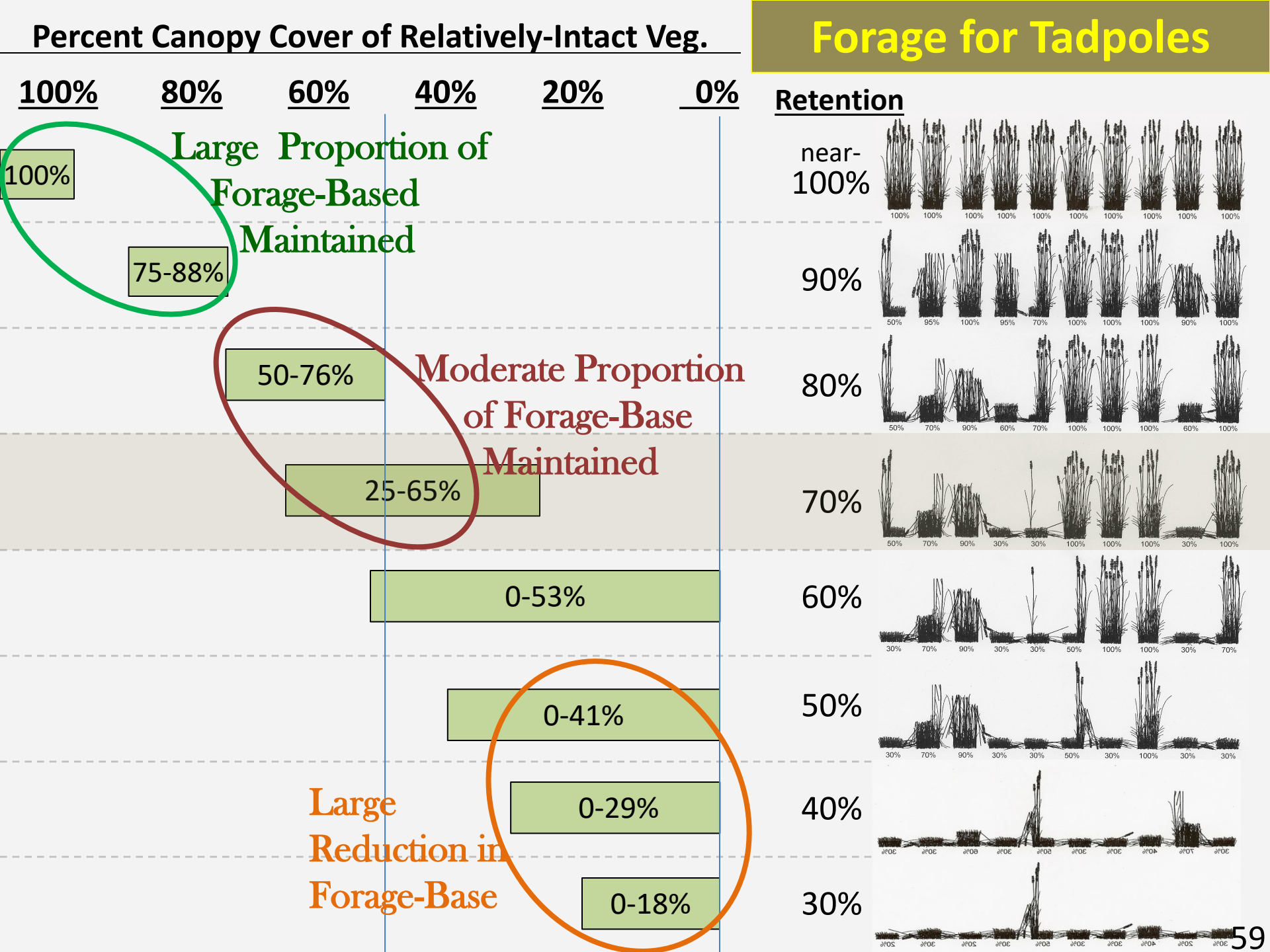
Tadpole diversity and abundance was significantly reduced where retention averaged:

- ~70-85% *(Schmutzer et al. 2008)*

  - Detritus was markedly higher in ungrazed wetlands than grazed wetlands (70-85% herb retention)
  - Tadpole diversity & abundance were sign. lower in grazed wetlands (70-85% herb retention) than in ungrazed wetlands.

*This does not mean there were no effect

Forage for Tadpoles



A.5 — Insect Forage, Cover, & Substrate

- Spotted frogs are opportunistic predators, and variety appears to be an important aspect of their prey base. They feed on a large variety of insects, spiders, and worms.

  (several studies cited in: *Patla and Keinath 2005, Reaser and Pilliod 2005)*

- Wetlands, wet meadow, and moist terrestrial habitats are important for spotted frogs for feeding.

  (Patla and Keinath 2005, Reaser and Pilliod 2005, Bishop et al. 2014)

- Boreal toads feed on a wide variety of insects, spiders, and worms in terrestrial habitats.

  (Campbell 1970, Barrentine, 1991, Leonard et al. 1993, Luce et al. 1997, Keinath and McGee 2005, Muths 2005)

- At two study sites, boreal toads fed nearly exclusively on ants and beetles (but it is not clear how this affects survival and reproduction).

  (Bartelt 2000)

A.5 — Insect Forage, Cover, & Substrate (cont'd)

- There is little scientific info. demonstrating native insect-communities are enhanced by grazing levels above natural levels.

- The number of insect species and their abundance in tall, dense plant communities decline with reductions in height, density, and availability of needed plant parts.

  (Morris 1983, Welch et al. 1991, Morris 2000, Kruess and Tscharntke 2002, New 2004, Poyry et al. 2004, Ringwood et al. 2004, Foote and Rice Hornung 2005, Samways 2005, Janz et al. 2006, Baur et al. 2007, Black et al. 2007, Black et al. 2009, Yamamoto et al. 2007, Littlewood 2008, New 2009, Kimoto 2010, Black et al. 2011, Bennett and O'Grady 2012)

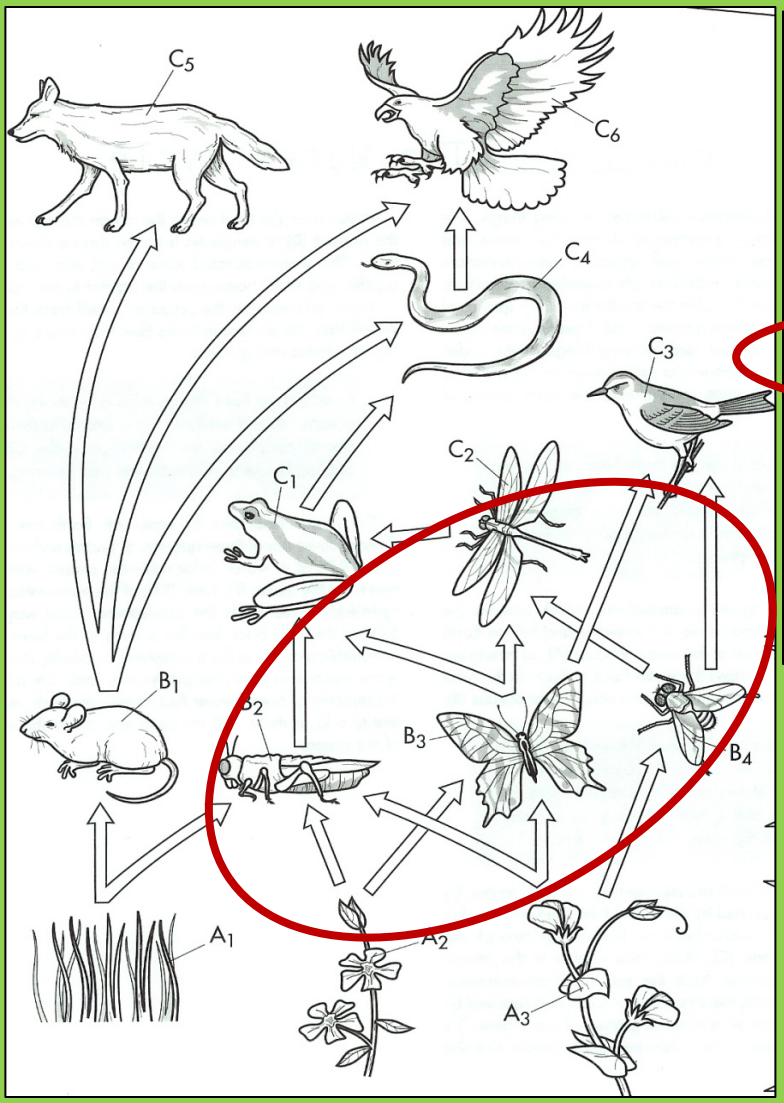
- For some taxa, rapid declines begin at / shortly after ~80% retention.

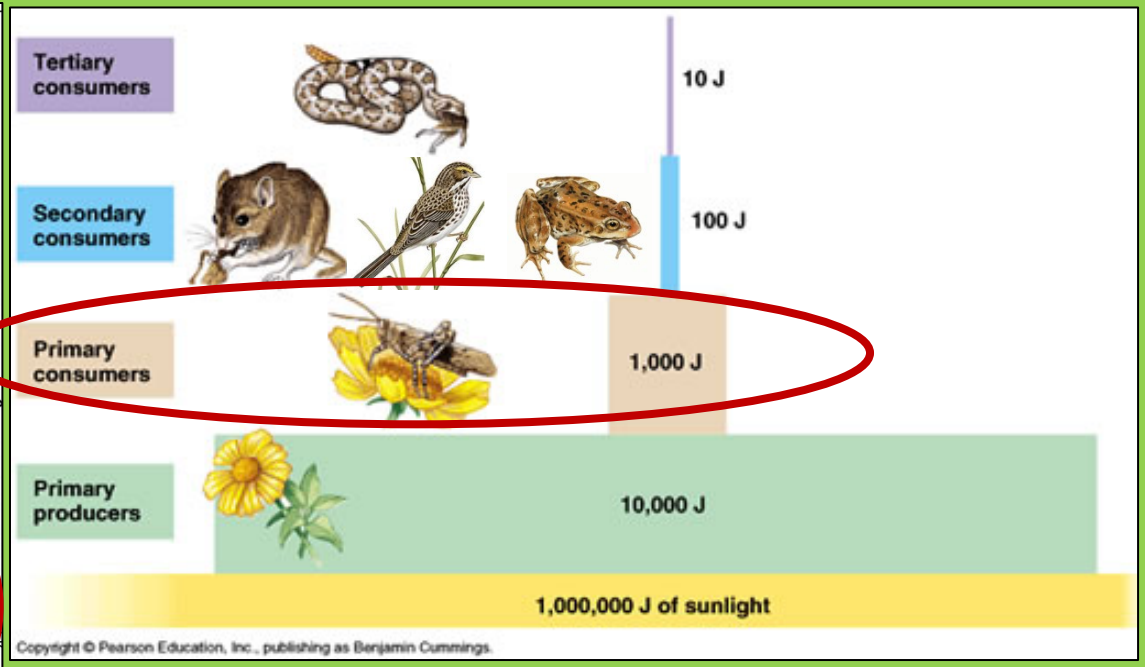
  (Hornung and Rice 2003, Foote and Rice Hornung 2005, Kimoto 2012)

- Light grazing can be neutral or beneficial to many insect species.

  (Samways 2005, Vulliamy et al. 2006, Littlewood 2008, Black et al. 2011)

A.5 — Insect Forage, Cover, & Substrate (cont'd)



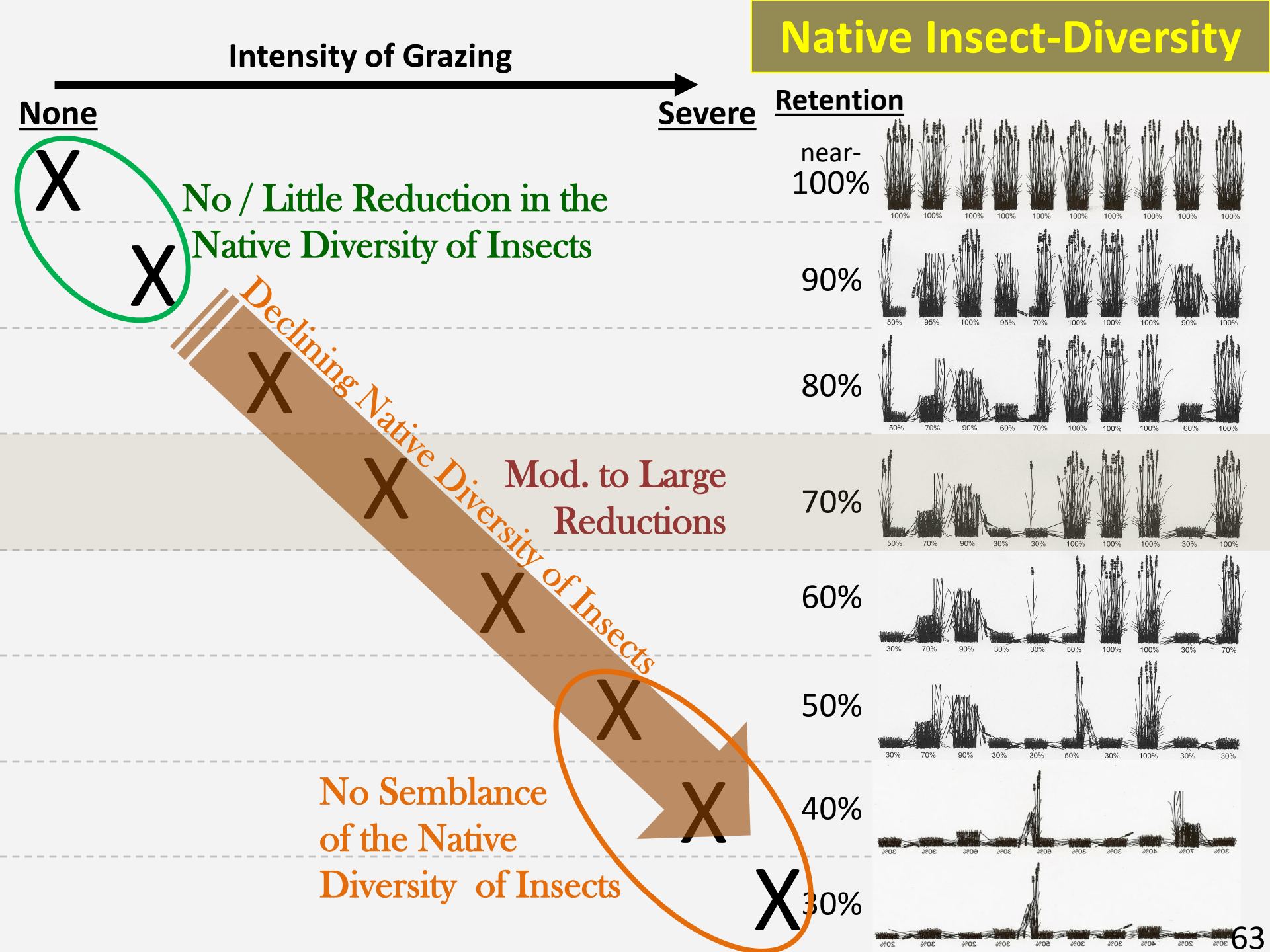


Numerous species of amphibians, reptiles, mammals, and birds (and invertebrates) depend on insects for food, maintaining habitat, and for other ecosystem services.

- Insect diversity is **HUGE**!
- The best way to conserve all insectivores is to approximate a natural diversity of insects.

(All citations supporting 2012 Planning Rule's coarse-filter approach; and… *Wyo. Partners in Flight 2003, Samways 2005, Nat'l Research Council 2007*)

Native Insect-Diversity



Insect Diversity (SFs & BTs only)

Intensity of Grazing

None → Severe

Retention

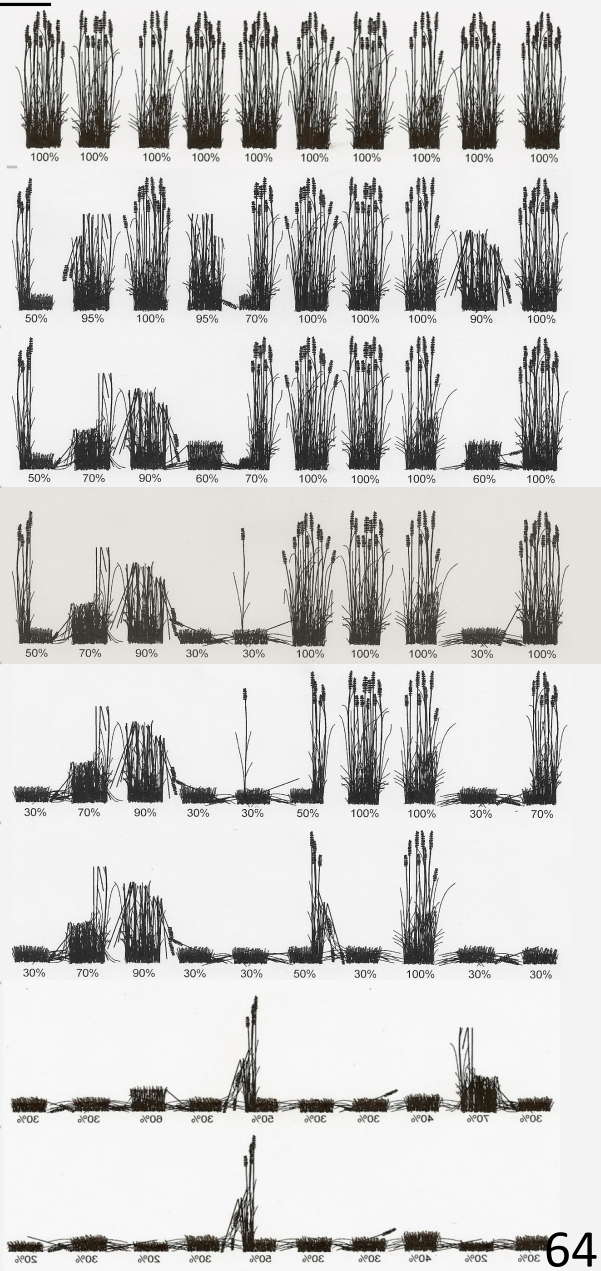
No Reduction in the Variety & Abundance of Insects

Possible Increases in Variety & Abundance

Abundance of Some Prey Species Likely Acceptable

Major Declines in Other Prey Species

Reductions in Abundance of Most Insect Species



A.6 — Open (Sunny) Patches

- Anecdotal observations indicate small open patches are important to spotted frogs & boreal toads in extensive stands of tall, dense veg.

  (Maxell 2000, Watson et al. 2003, Bull 2005, Shovlain et al. 2006)

- Spotted frogs did not select against light grazing in one study.

  (Shovlain et al. 2006)

- However, some studies involving tall, dense sedge cover did not detect avoidance of tall, dense vegetation.

  (Roche et al. 2012, McIlroy et al. 2013)

- Vegetation in most breeding wetlands on the BTNF is not overly dense.

- Implications to chytrid fungus (Univ. of Wyoming).

Small Open Patches

Percent Canopy Cover of Relatively-Intact Veg.

100% **80%** **60%** **40%** **20%** **0%**

100%

No Small Open Patches Provided – No Support

85-100%

Small Open Patches Provided

70-85%

50-65%

Beyond Small Open "Patches"

35-50%

20-35%

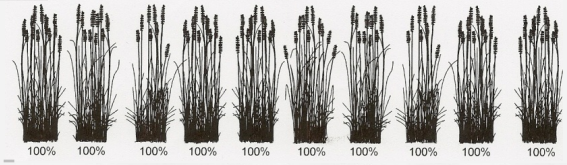
Well Beyond Small Open "Patches"

≤15%

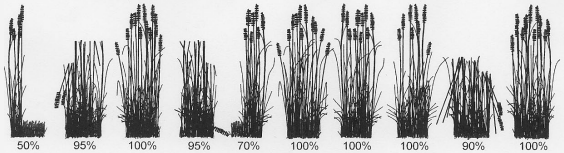
≤5%

Retention

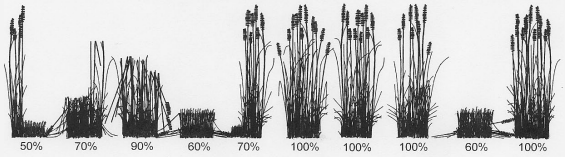
near-100%



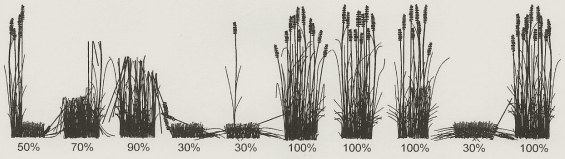
90%



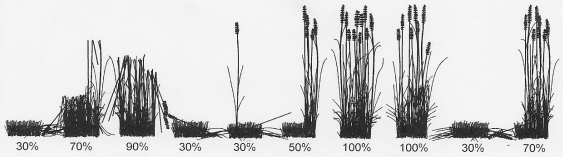
80%



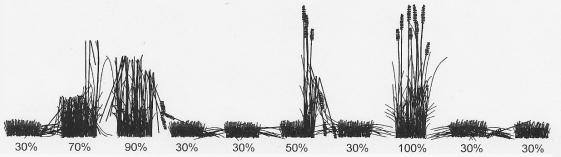
70%



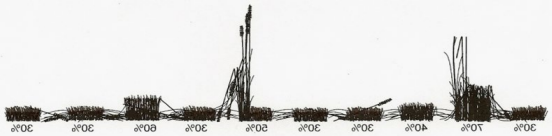
60%



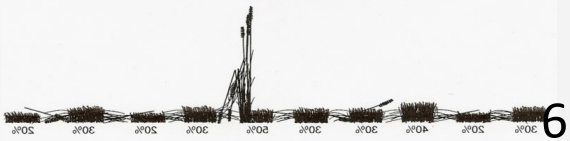
50%

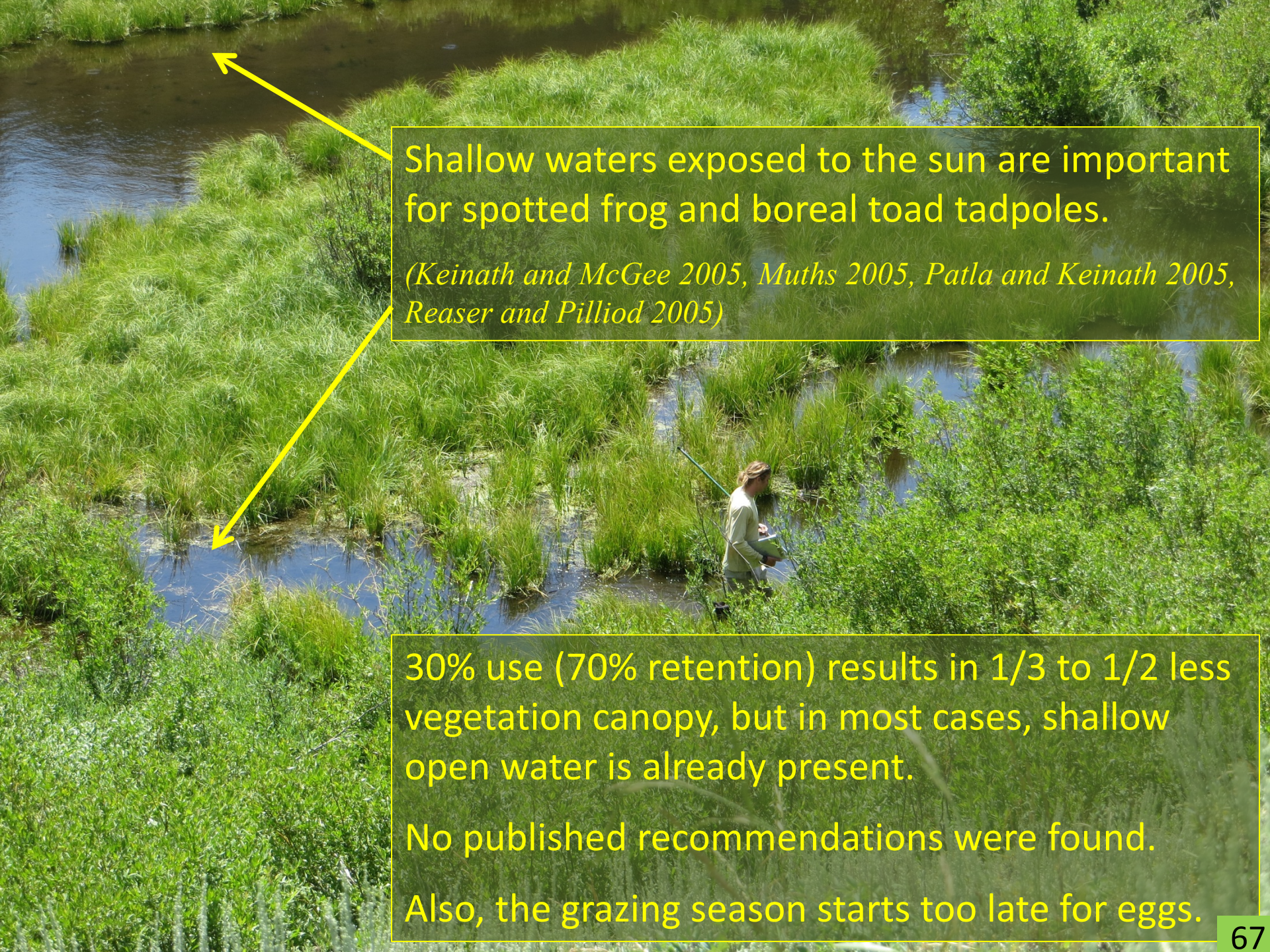


40%



30%





Shallow waters exposed to the sun are important for spotted frog and boreal toad tadpoles.

(Keinath and McGee 2005, Muths 2005, Patla and Keinath 2005, Reaser and Pilliod 2005)

30% use (70% retention) results in 1/3 to 1/2 less vegetation canopy, but in most cases, shallow open water is already present.

No published recommendations were found.

Also, the grazing season starts too late for eggs.

B.1 — Water Quality

- Reduced water quality can impact tadpole survival.

  (Marco et al. 1999, Maxell 2000, Jansen and Healey 2002, Knutzen et al. 2004, Hogrefe et al. 2005, Keinath and McGee 2005, Patla and Keinath 2005, Burgett et al. 2007, Schmutzer et al. 2008)

- Nitrate, nitrite, ammonium, phosphate, dissolved oxygen, and dissolved solids are particularly important. *(see above)*

- Livestock urine & feces increase nitrate, ammonium, and phosphate, and can contribute to lower dissolved oxygen levels.

  (Ball et al. 1979, Miller et al. 1992, Stout et al. 1997, Hubbard et al. 2004, Agouridis et al. 2005, Carpenter et al. 2005, Vidon et al. 2008)

- Livestock trampling in wetlands increases dissolved solids.

  (Jansen and Healey 2002, Schmutzer et al. 2008)

- Water quality declines as livestock use increases.

  (Moore et al. 1979, Mosley et al. 1999, Scrimgeor and Kendall 2002, Holechek et al. 2004)

Effects of Nitrate on Tadpoles:

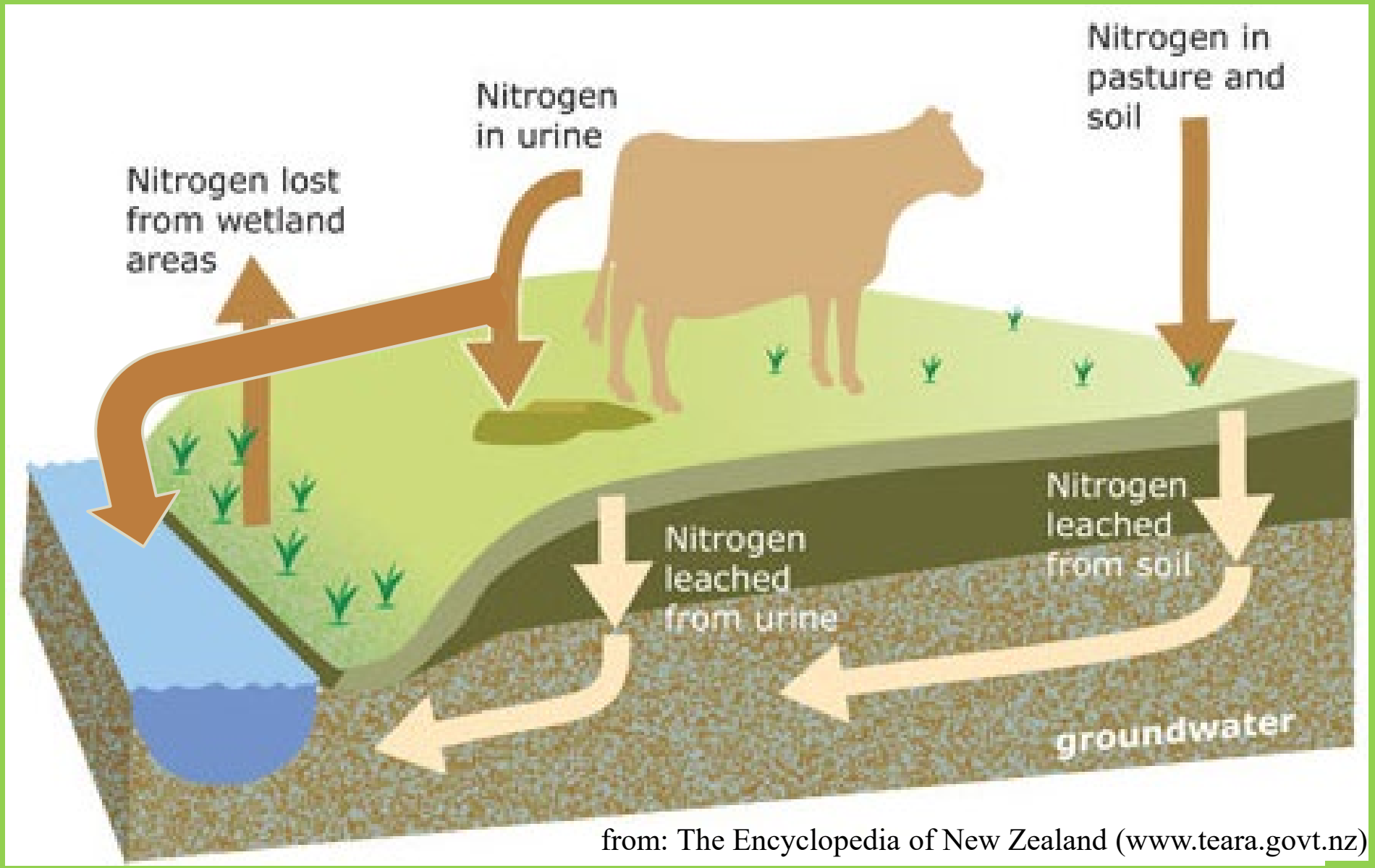
- Altered behavior of tadpoles begins 2.5 mg/L – 10 mg/L.
  (Hecnar et al. 1995, Marco et al. 1999)

- Increased mortality begins at approx. 5 mg/L, with substantial mortality at >10 mg/L (but thresholds may be higher for some toad populations).
  (Hecnar et al. 1995, Marco et al. 1999)

- Ungrazed nitrate levels can range from 1 to 7 mg/L or higher (especially in shallow waters and small pools).
  (Maret et al. 1987, Schmutzer et al. 2008)

- Does not take much of an increase caused by livestock to begin affecting tadpole survival, especially in shallow or small water bodies.

- Major die-offs can occur.



from: The Encyclopedia of New Zealand (www.teara.govt.nz)

Effects of Nitrite on Tadpoles:

- Increased mortality begins well below 1.75 mg/L for spotted frog tadpoles and below 3.5 mg/L nitrite for toads.

  (Marco et al. 1999, Marco and Blaustein 1999)

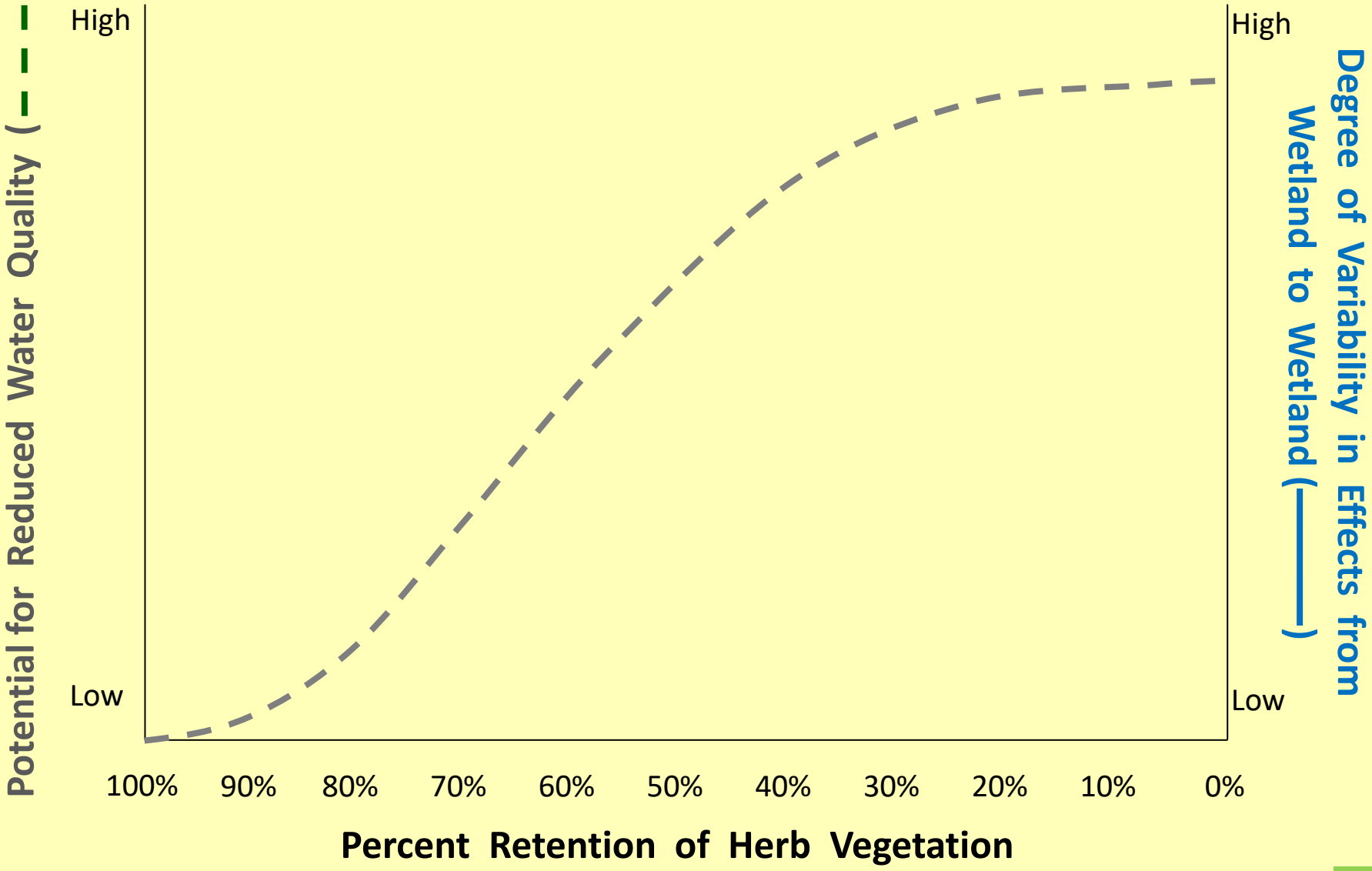
Tadpoles are also adversely impacted by:

- Elevated ammonium concentrations
- Eutrophication and reduced dissolved oxygen
- Increased turbidity

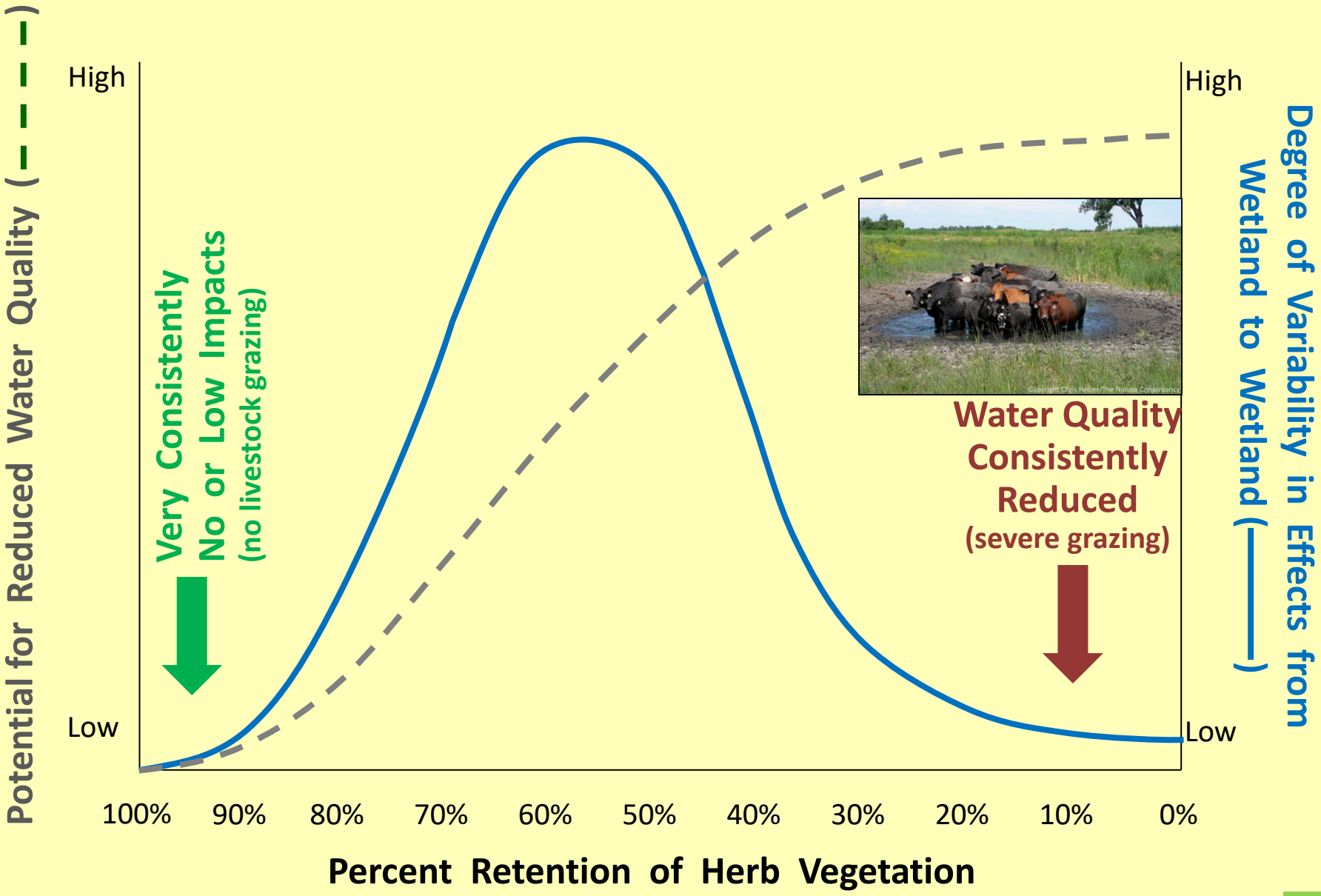
  (Ricklefs 1979, Mathews et al. 1994, Carpenter et al. 1998, Thomas 2002, Hornung and Rice 2003, Hubbard et al. 2004, Agourdis et al. 2005, Camargo et al. 2006, Adamus 2007, Vidon et al. 2008, Schmutzer et al. 2008)

- Major die-offs can occur.

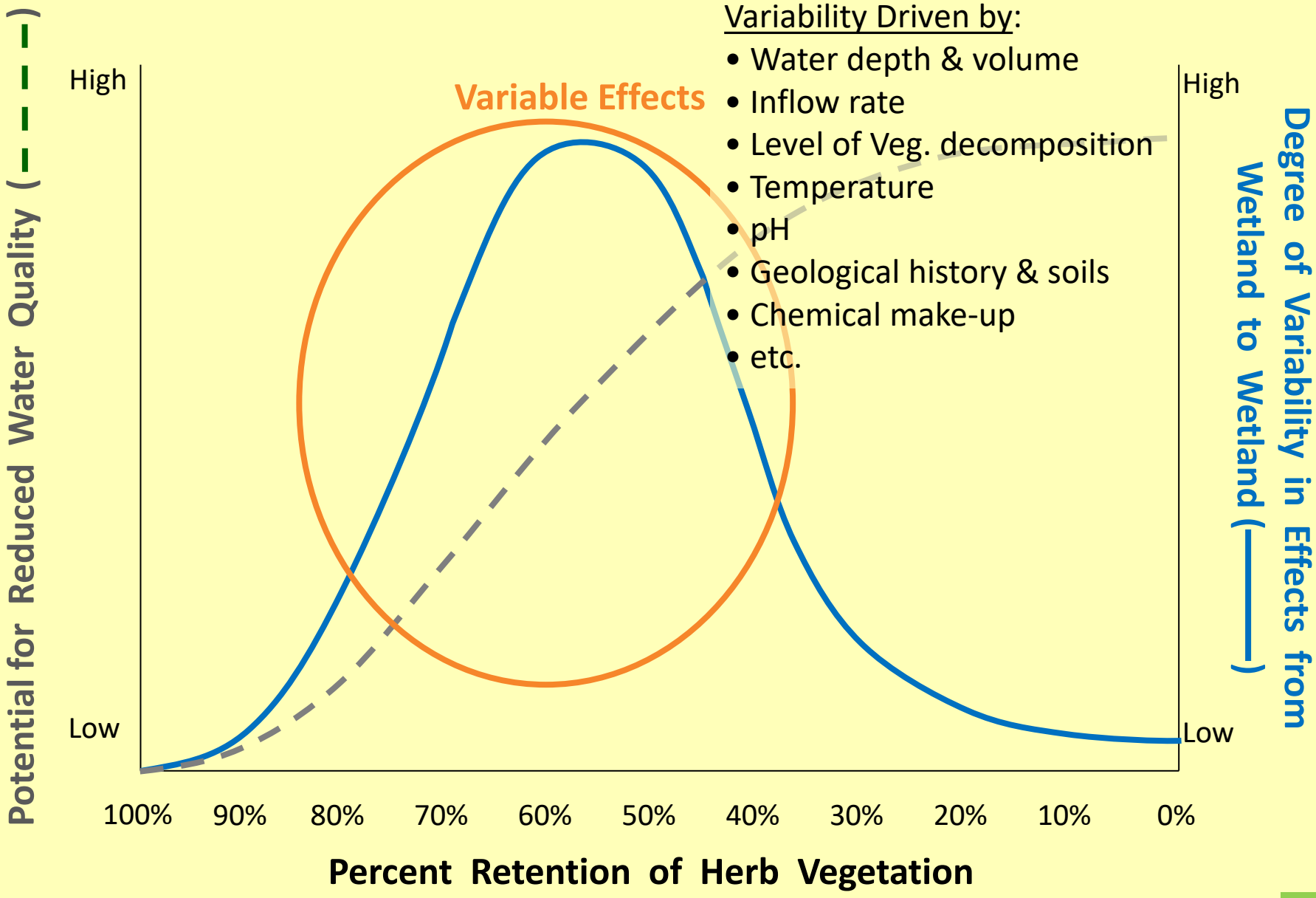
Effects of Livestock Grazing on Water Quality & Tadpoles



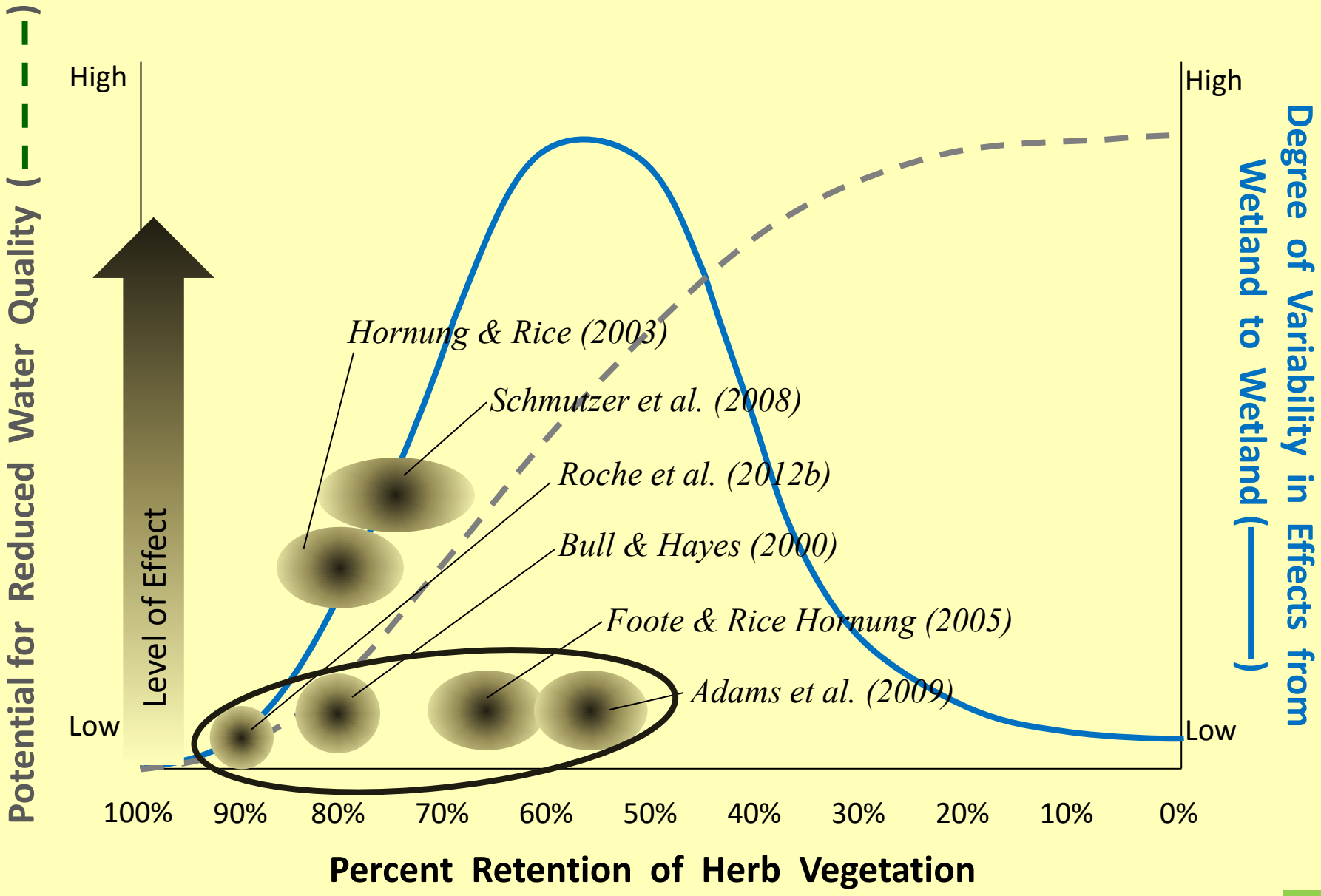
Effects of Livestock Grazing on Water Quality & Tadpoles



Effects of Livestock Grazing on Water Quality & Tadpoles



Effects of Livestock Grazing on Water Quality & Tadpoles



Water Quality

Intensity of Grazing

None — Severe

Retention

near-100%

90%

80%

70%

60%

50%

40%

30%

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)*
- 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

Drinking by livestock has potential to contribute to 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%

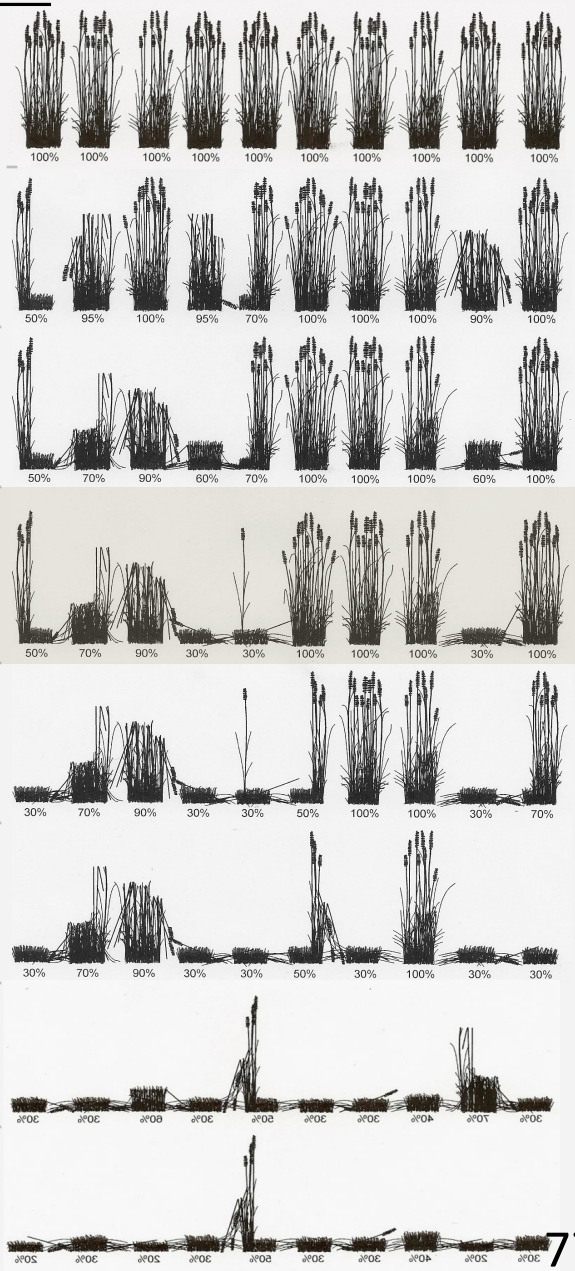
70%

60%

50%

40%

30%



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.

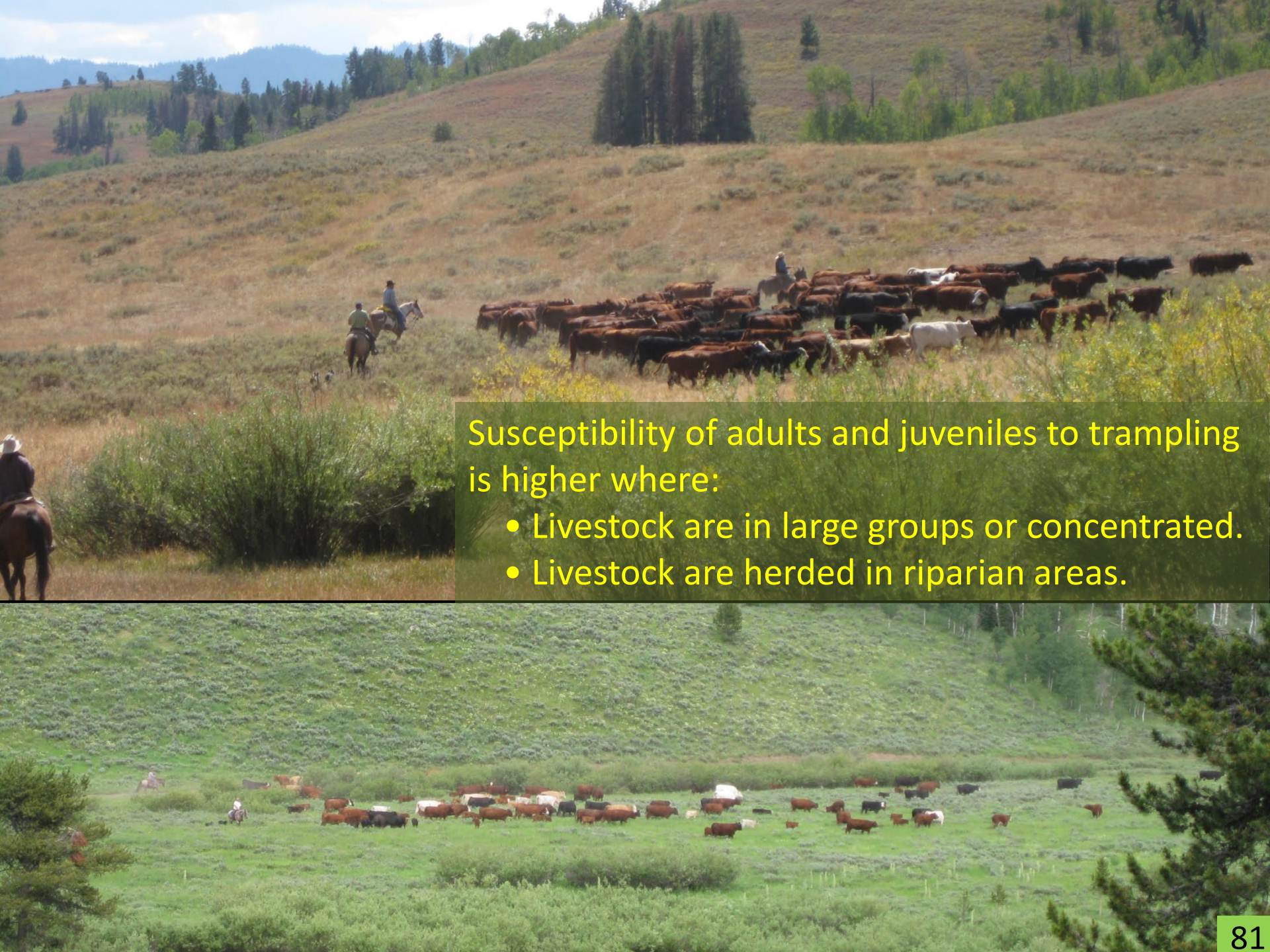
  *(*6 papers cited by *Muths 2005)*

- 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.

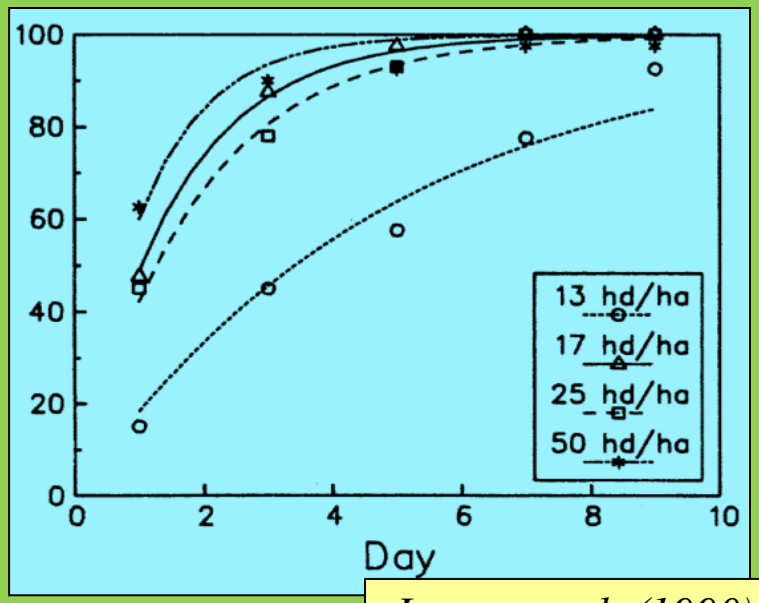
- While results likely overestimate the magnitude of trampling impacts in many situations, they

  (1) likely approximate effects under some situations, and

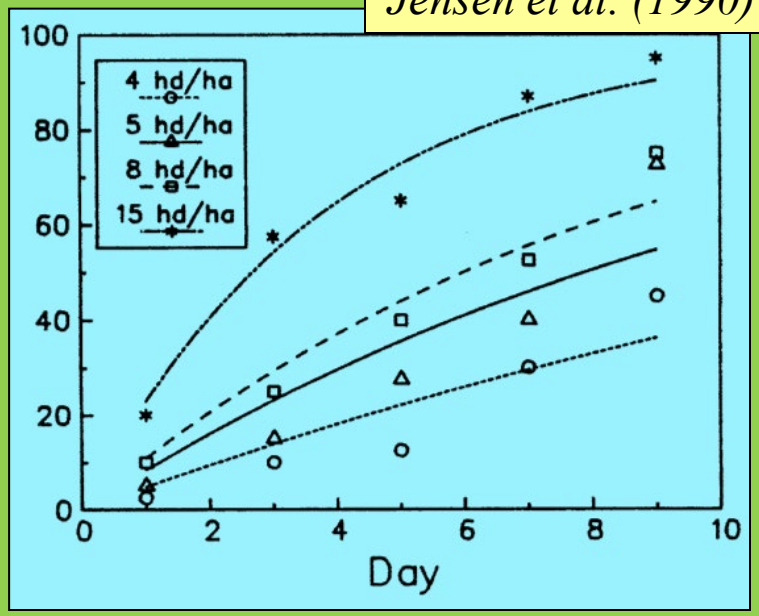
  (2) provide an indication of the rate of increase in potential impacts.

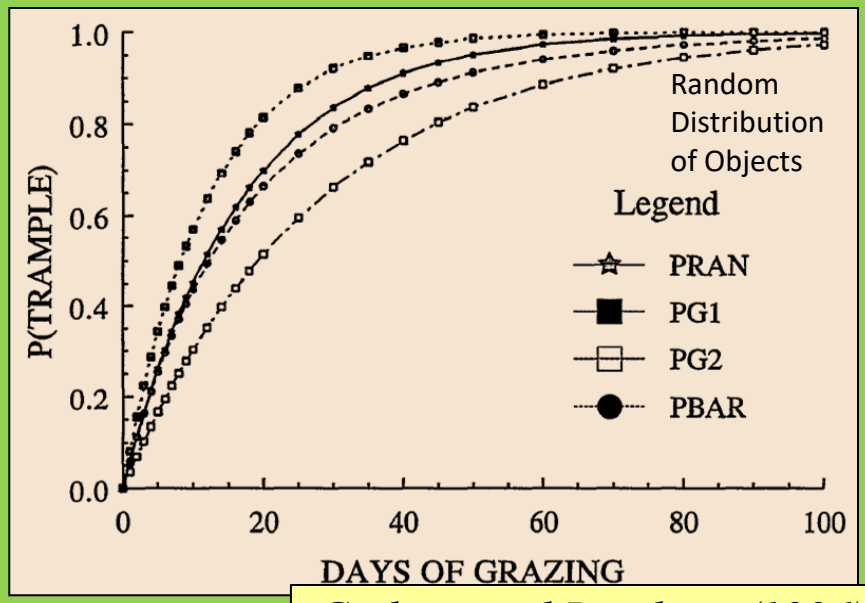
Two examples:

Percent of Clay Pigeons Trampled

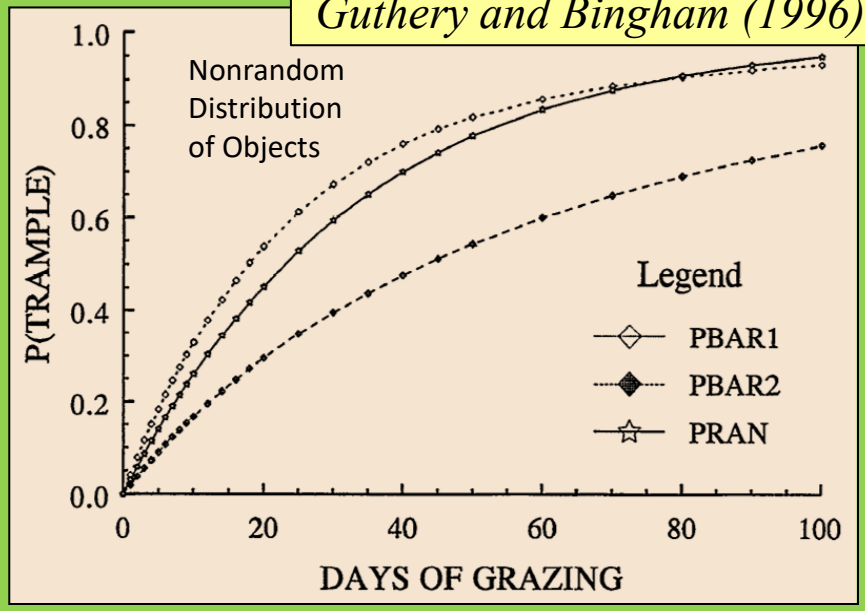


Jensen et al. (1990)





Guthery and Bingham (1996)



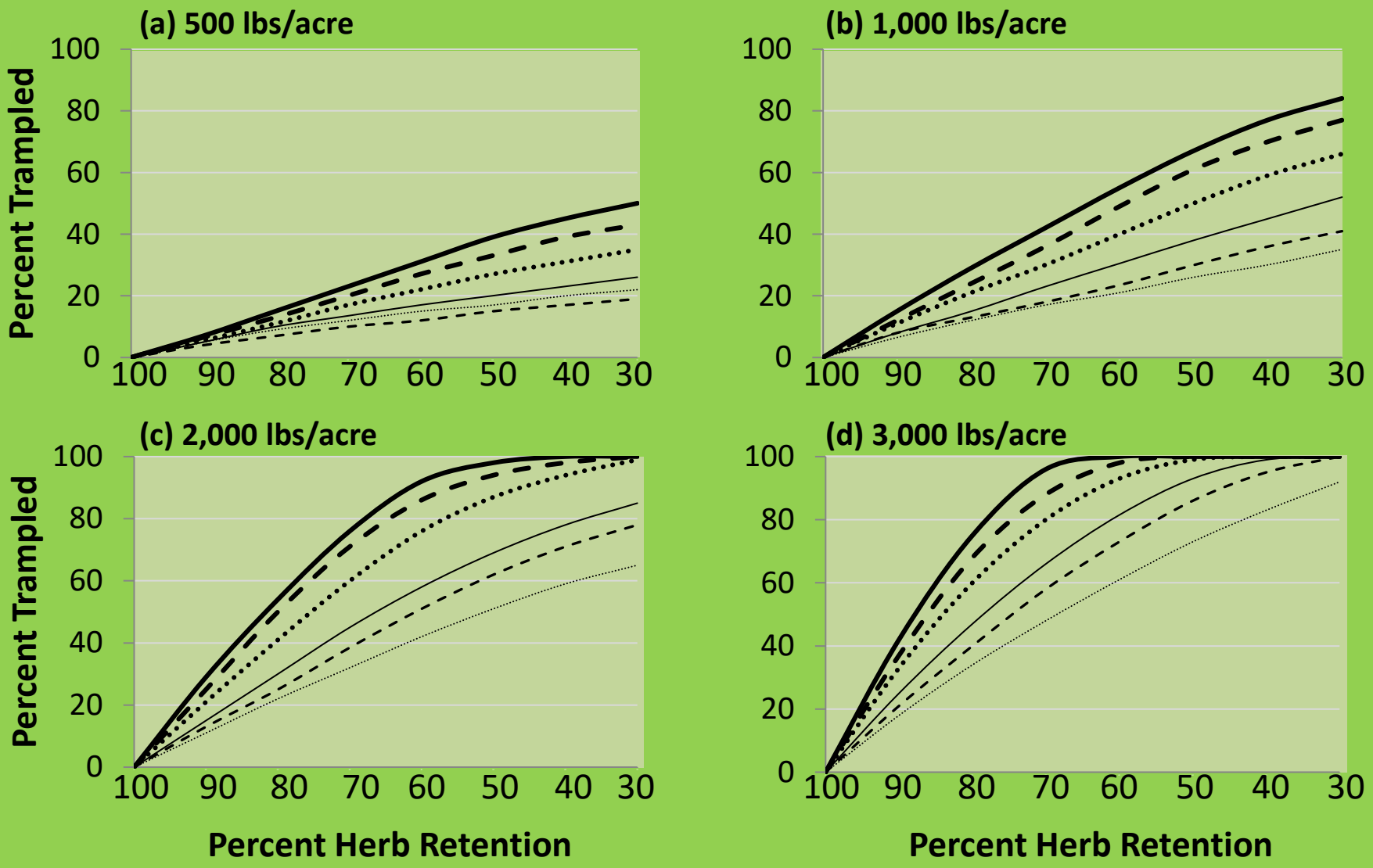
Livestock Grazing Intensity →

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



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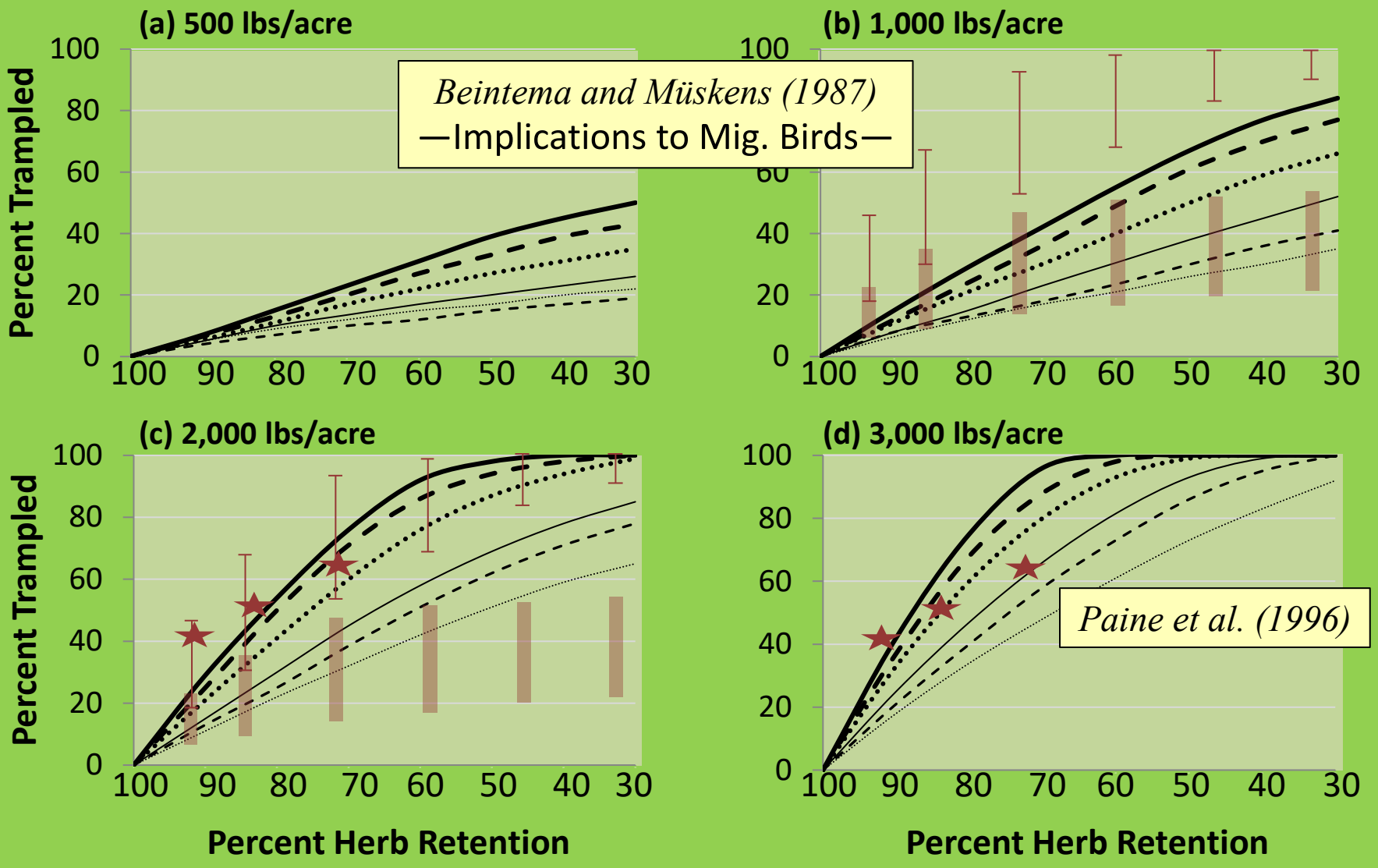

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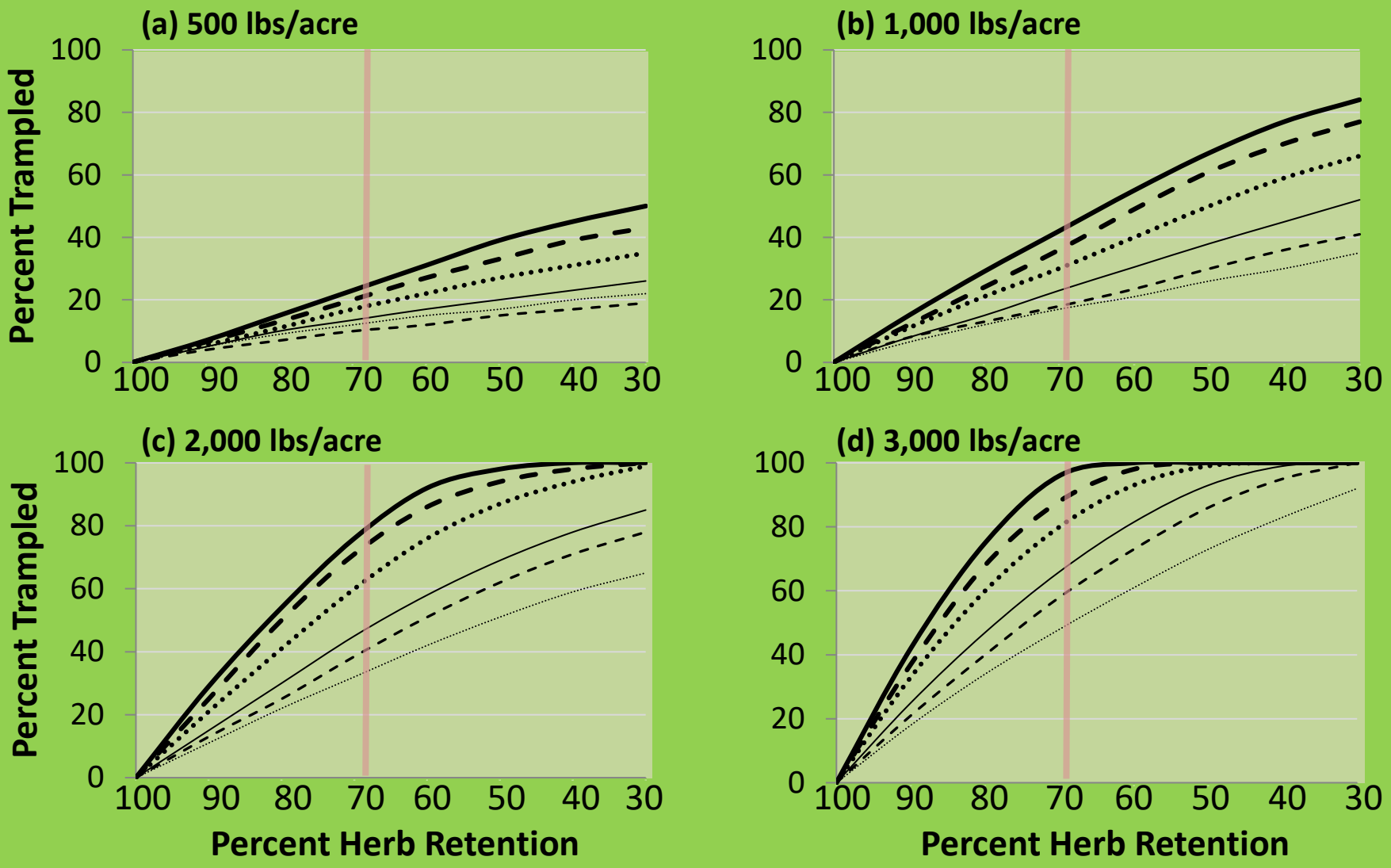
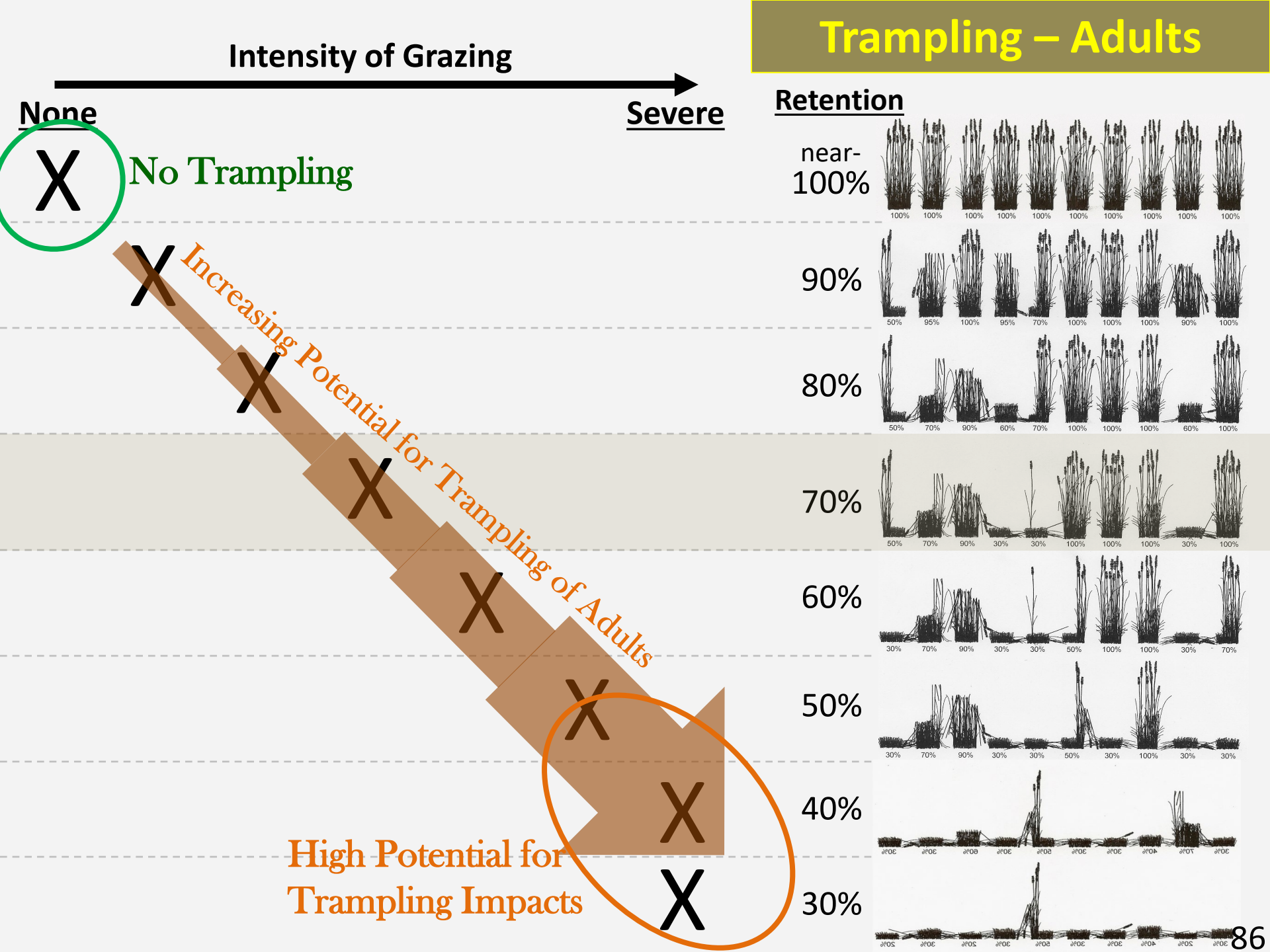
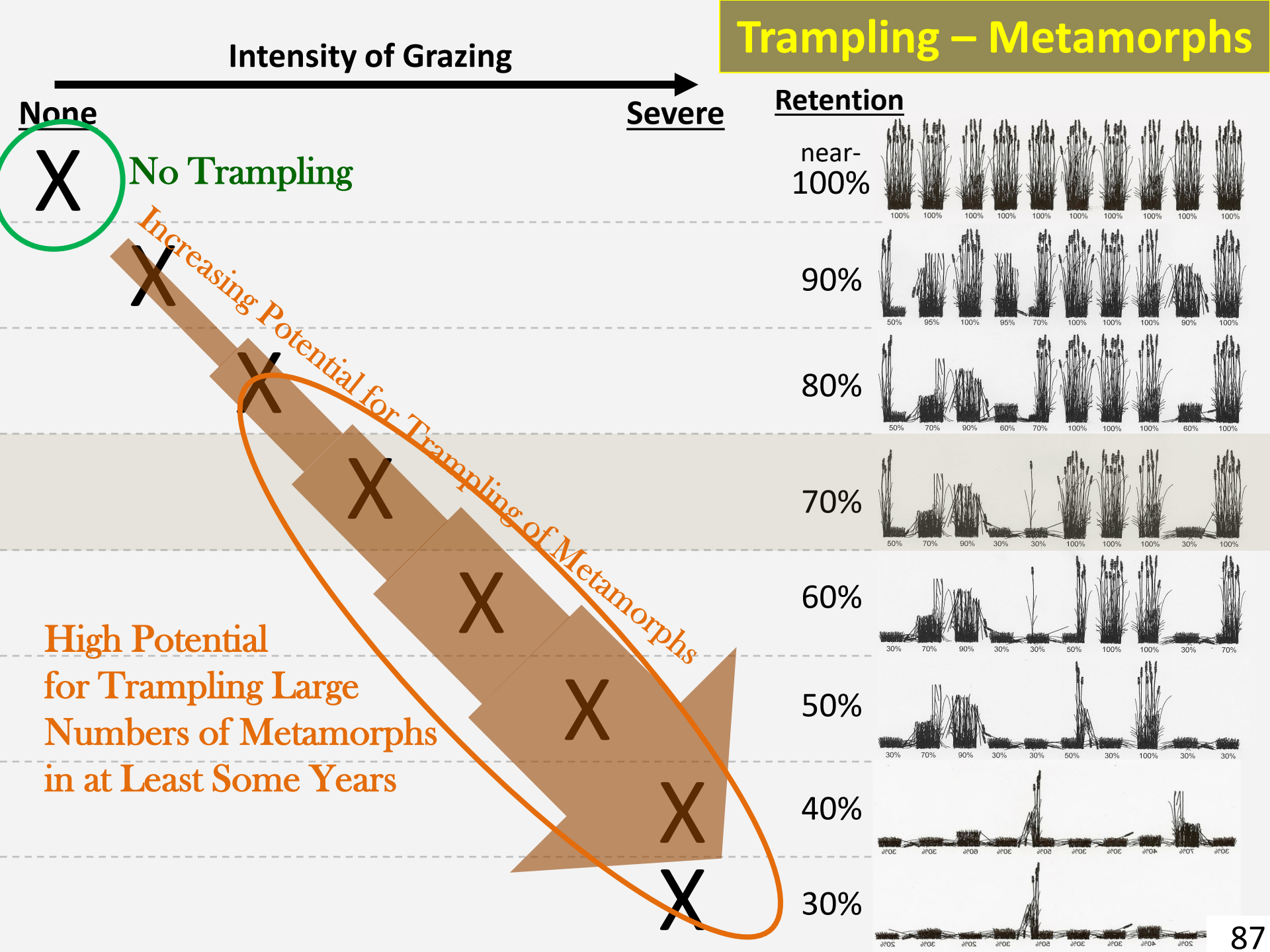


Trampling – Adults



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.

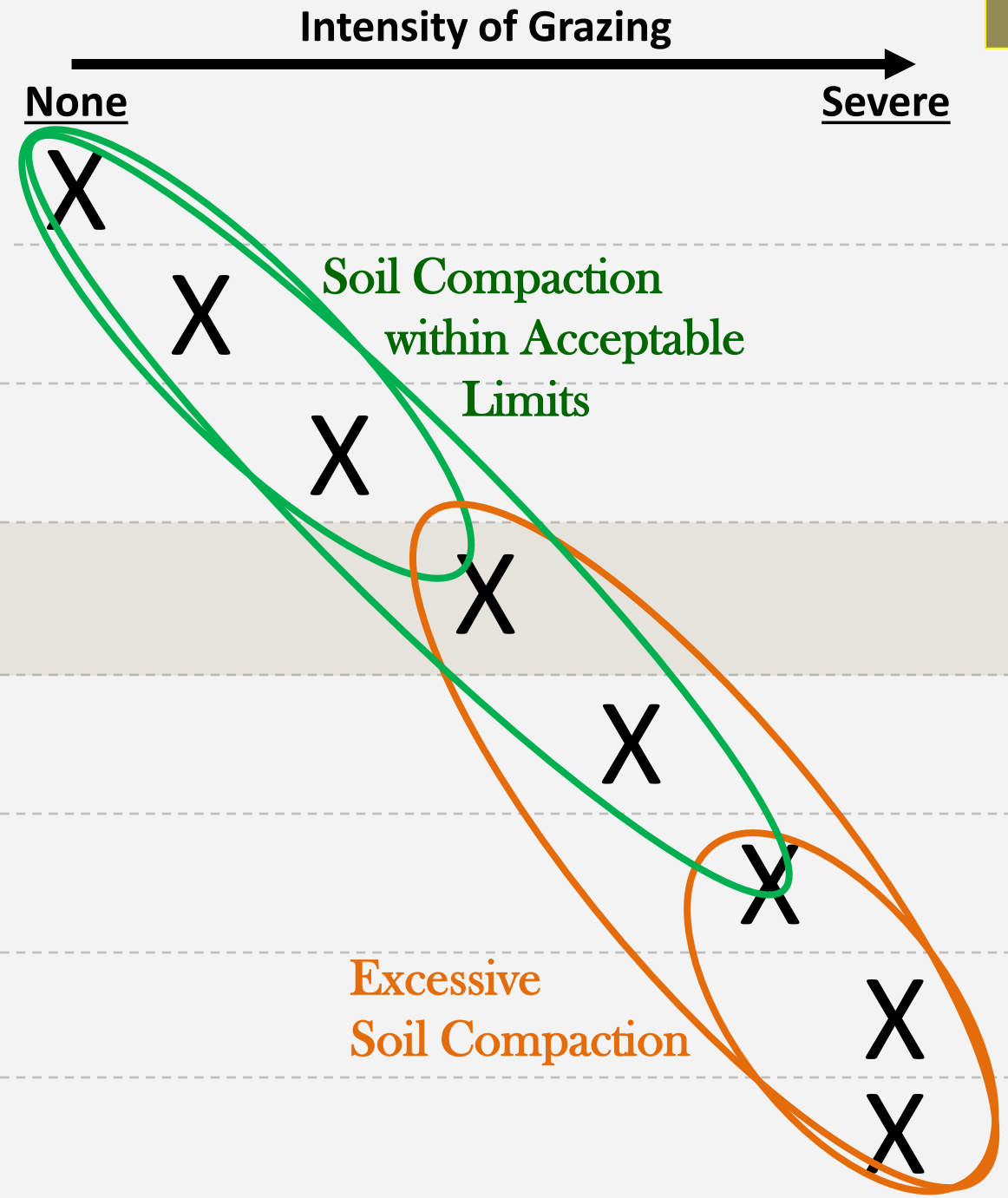
  (Moore et al. 1979, Kaufman and Krueger 1984, Pluhar et al 1987, Leffert 2002:24-25, Hubbard et al. 2004)

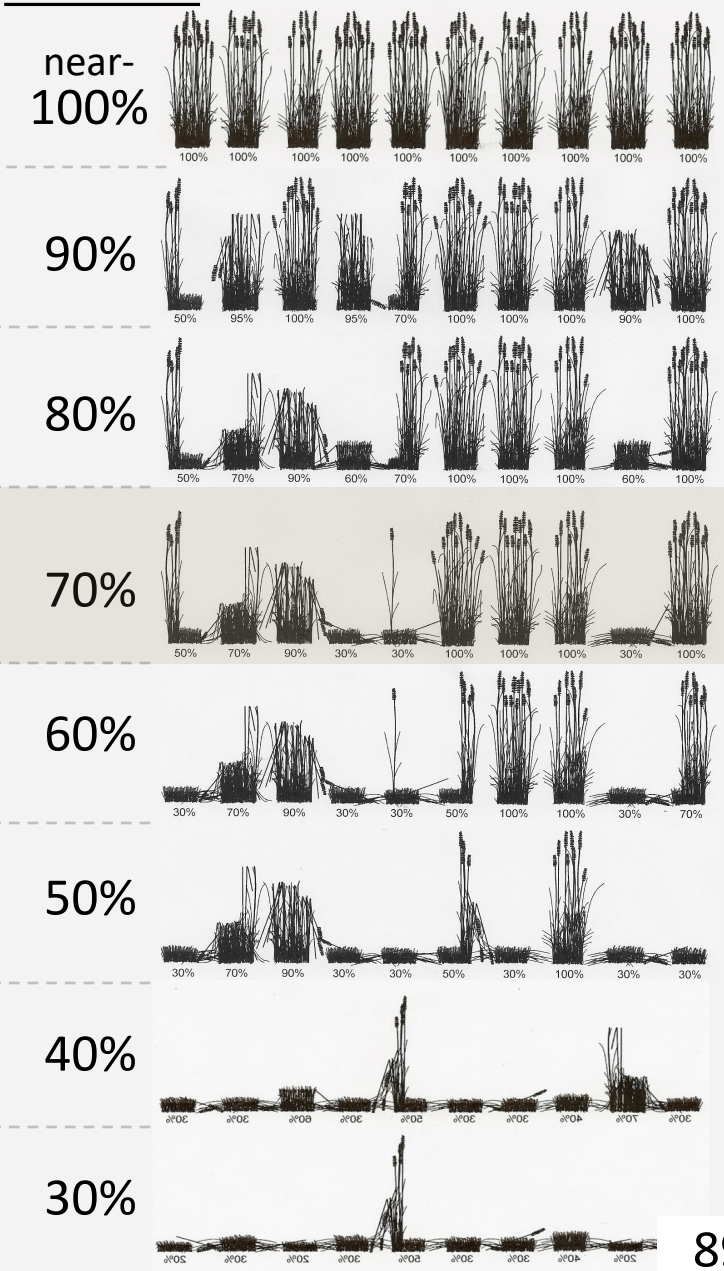
- Soil compaction from livestock grazing can prevent frogs and toads from burrowing to prevent desiccation or freezing. *(Douglass et al. 1999, Maxell 2000, Keinath and McGee 2005, Patla and Keinath 2005, Bull 2006)*

- 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).

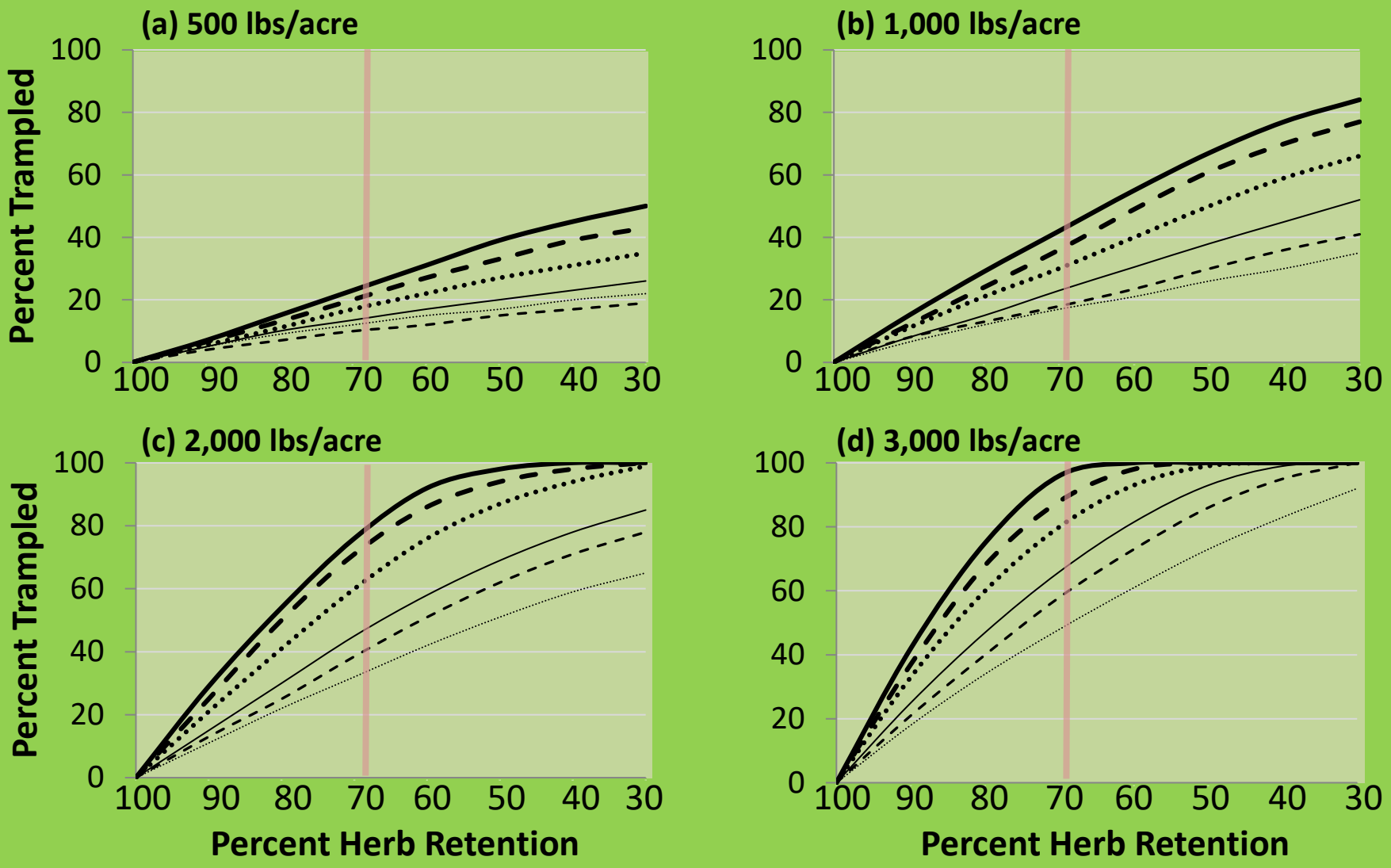
- Livestock can crush burrows (making them unavailable) and can crush toads within burrows.

  (Maxell 2000, Keinath and McGee 2005)

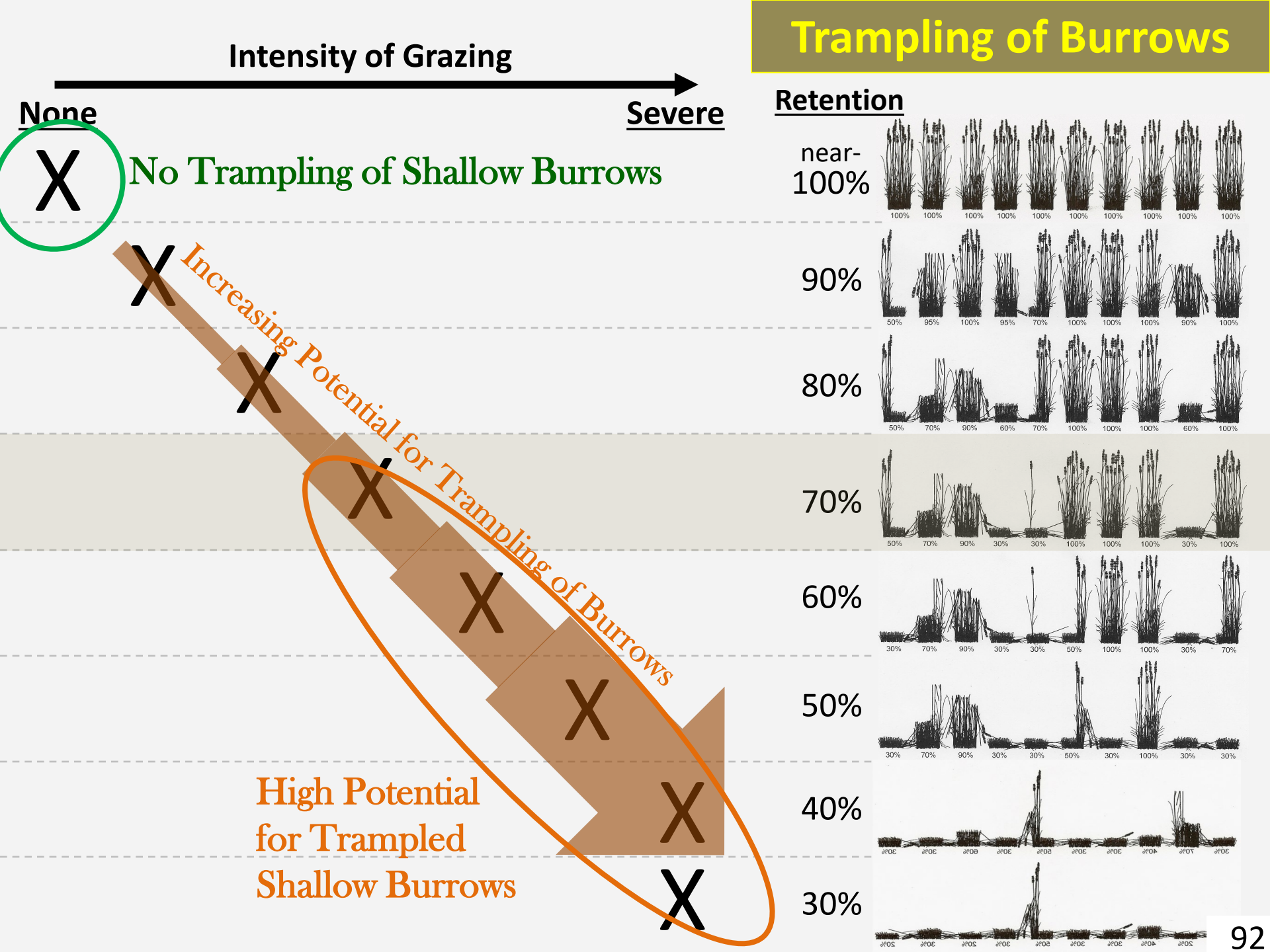
- The potential for crushing burrows is directly related to the depth of burrows and livestock grazing intensity.

  → 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
Surf. Water Retention
Survival (Trampling)
Soil Looseness
Burrow Retention

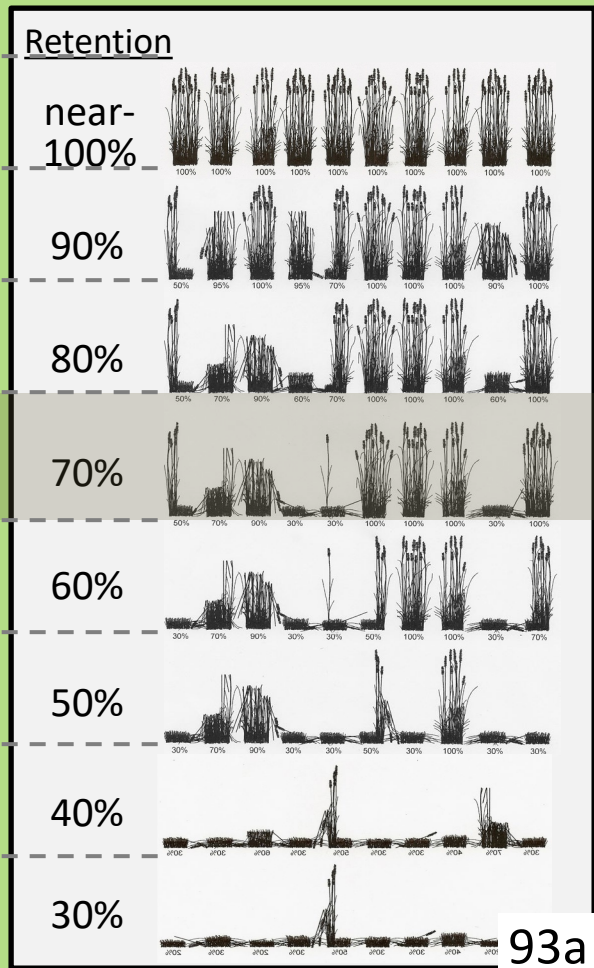
Known Suitable Conditions

Relatively Strong Support

Moderate Support

Weak Support

No Support



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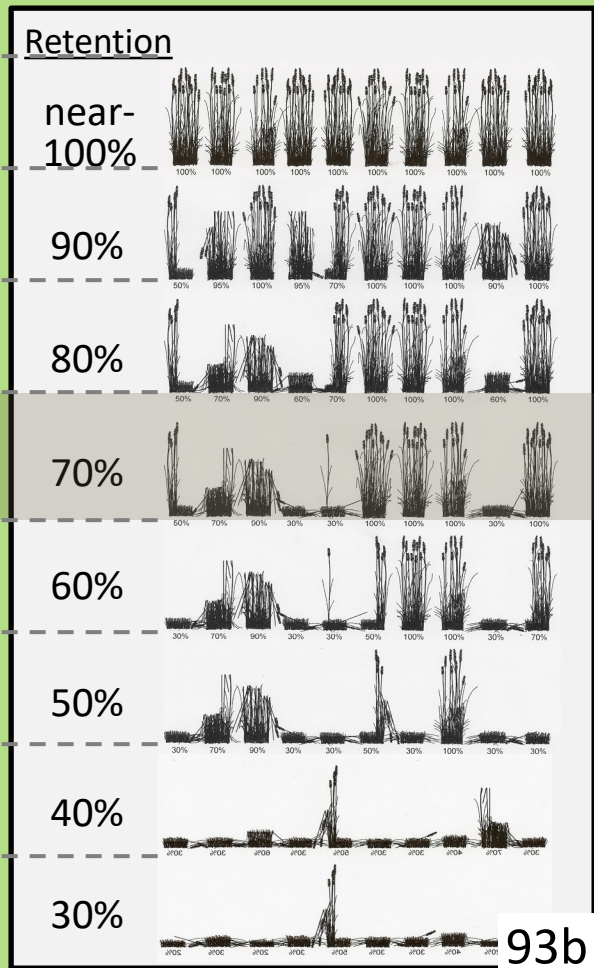
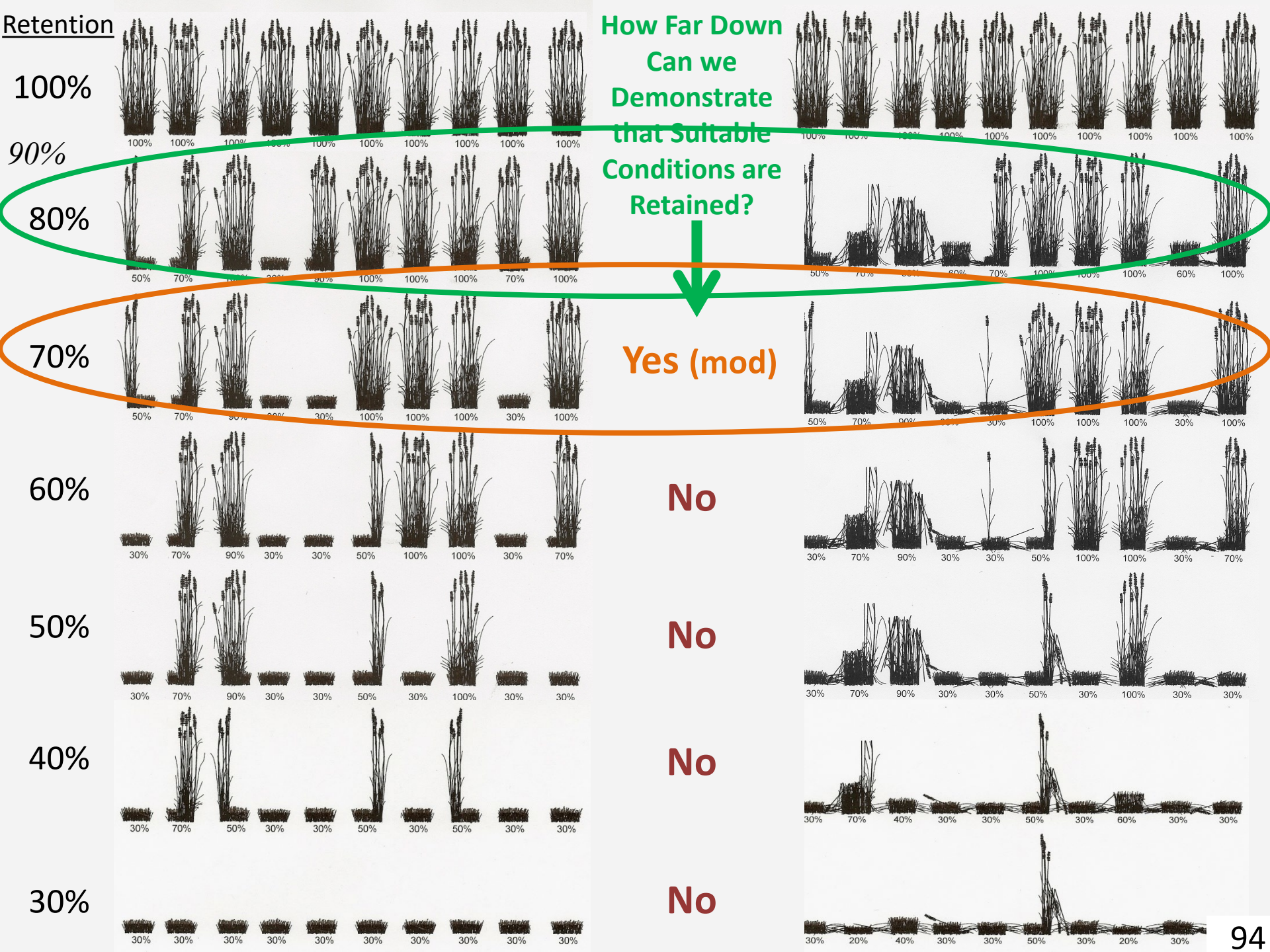
No Support




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

Purpose of Presentation

To outline the scientific basis of 70% herb retention to meet Forest Plan requirements for:

- Providing an adequate amt of suitable hbtt for sensitive amphibs.
- Protecting sensitive amphibs from the activity of livestock grazing.

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

Relationship to Native Wildlife-Community