STATUS OF MULE DEER IN NEVADA:

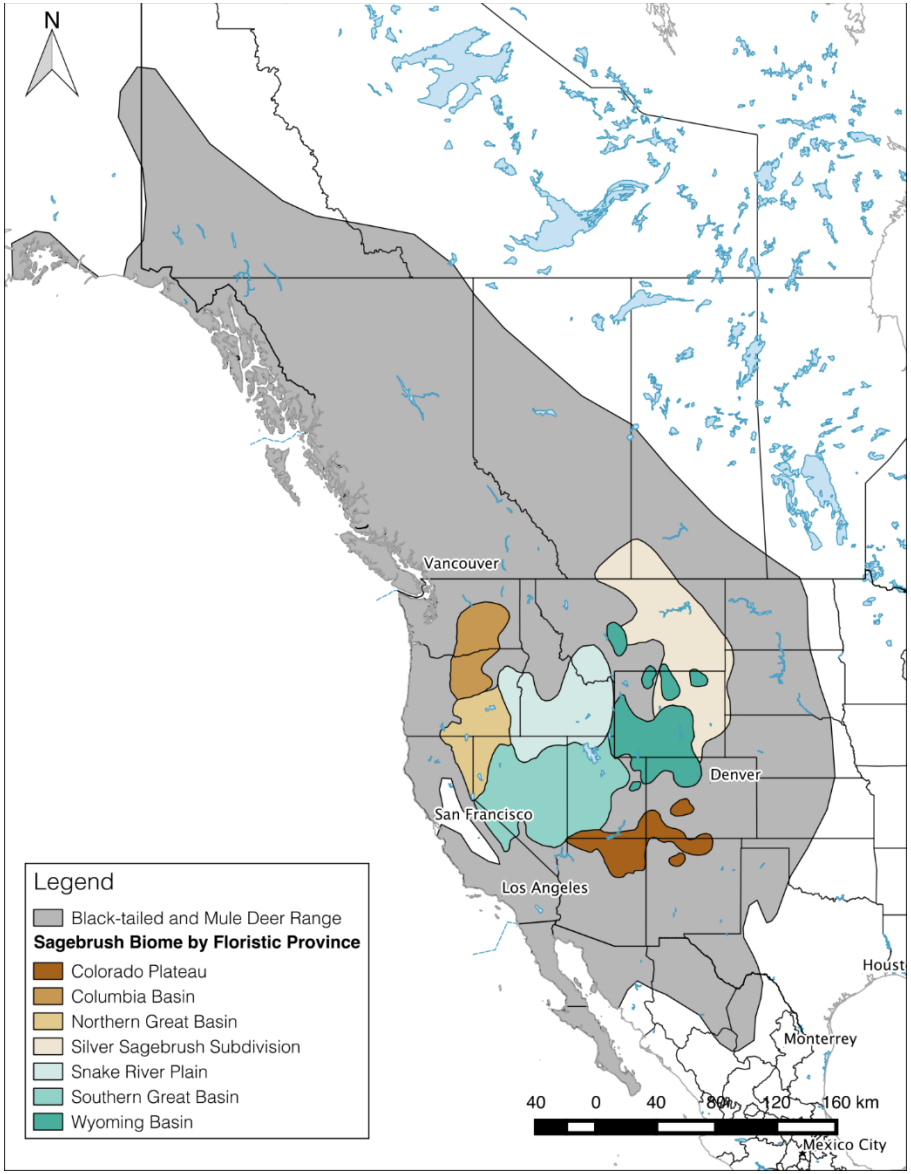
UPDATE TO THE NEVADA BOARD OF WILDLIFE COMMISSIONERS

Presented by: Cody A. Schroeder
Mule Deer Staff Specialist

Outline of Presentation

- Range Wide Status of Mule Deer in North America
- History of mule deer populations in Nevada
- Other big game species trends in Nevada
- Potential causes of mule deer population declines
- Habitat and environmental conditions
- Nutritional ecology of ruminants
- Density dependence in ungulate populations
- Impacts of fire on mule deer
- Predation management
- Current management issues

2018 RANGE-WIDE STATUS OF BLACK-TAILED AND MULE DEER



2018 RANGE-WIDE STATUS OF BLACK-TAILED AND MULE DEER

Range-wide estimation of population size, harvest, and hunter numbers of mule deer provided by member agencies of WAFWA.

	Estimated Population[1]	Total Harvest	% males in Harvest	Hunter Numbers
Alberta	154,762	15,198	48%	36,117
Arizona	85,000 - 100,000	10,964	96%	38,611
British Columbia[2]	100,000 - 170,000	13,292	87%	67,127
California[3]	470,000	29,394	98%	175,357
Colorado[4]	419,000	37,761	80%	84,185
Idaho	280,000	25,496	80%	85,067
Kansas	47,935	1,917	93%	17,471
Montana	386,075	55,544	77%	152,213
Nebraska	120,000 – 145,000	12,058	81%	No Estimate
Nevada	92,000	7,307	83%	16,100
New Mexico[4]	80,000 - 100,000	11,316	99%	32,017
North Dakota[5]	24,500 (Badlands)	6,147	71%	11,091
Oklahoma[6]	1,500 - 2,000	196	99%	No Estimate
Oregon	220,000 - 230,000	16,126	89%	60,695
Saskatchewan	40,000-60,000	6,275	55%	10,000
South Dakota[7,8]	69,000	7,300	81%	68,100
Texas[9]	285,918	9,804	90%	23,492
Utah	363,650	33,701	88%	101,527
Washington[10]	90,000 - 110,000	7,197	88%	106,977
Wyoming	396,000	31,237	88%	53,018
Yukon	1,000	10	100%	12

2018 RANGE-WIDE STATUS OF BLACK-TAILED AND MULE DEER

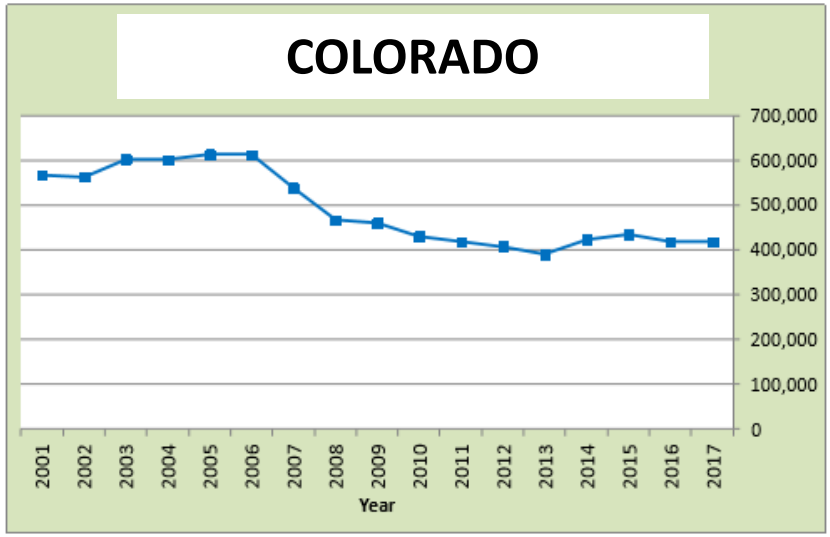
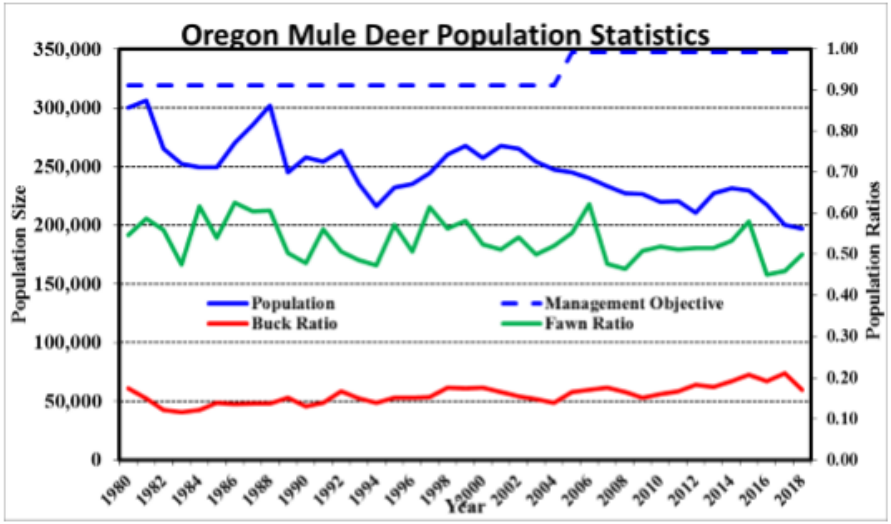
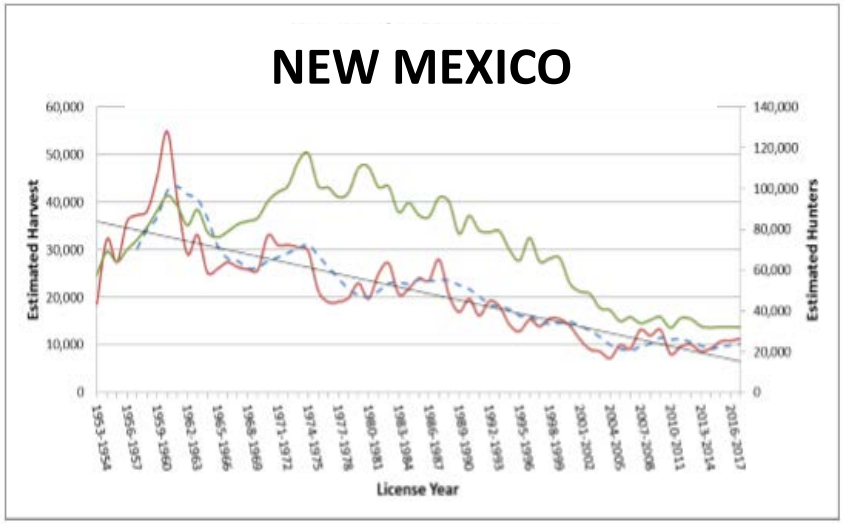
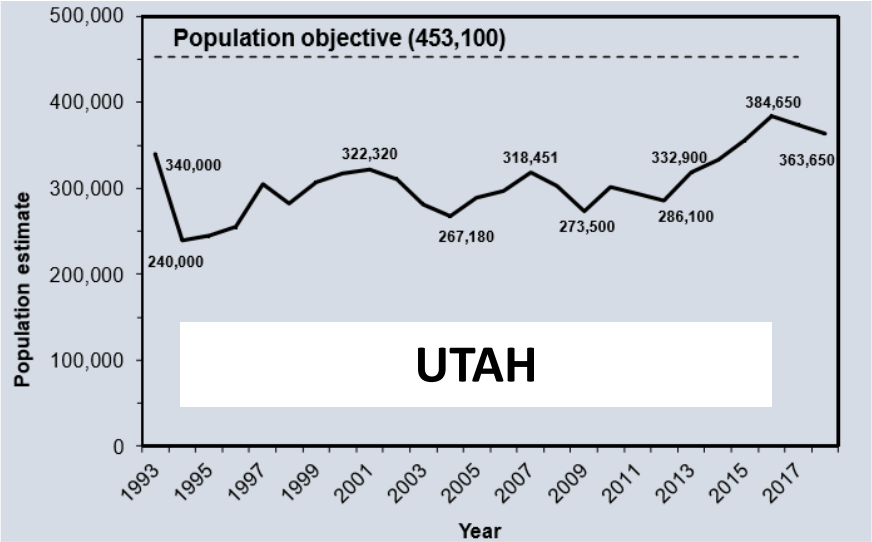


Figure 1. Colorado post-hunt deer population estimates from 2001-2017.

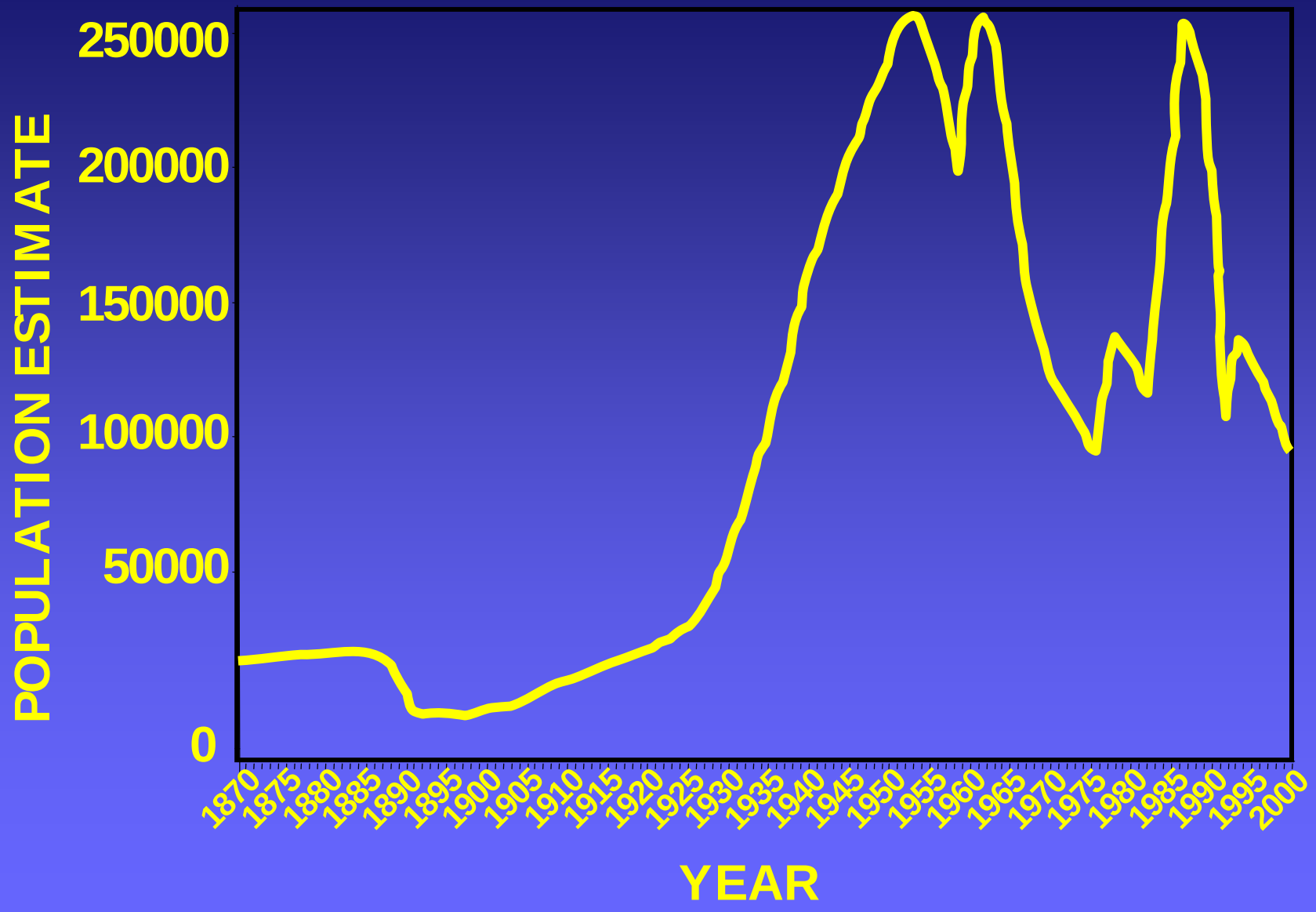


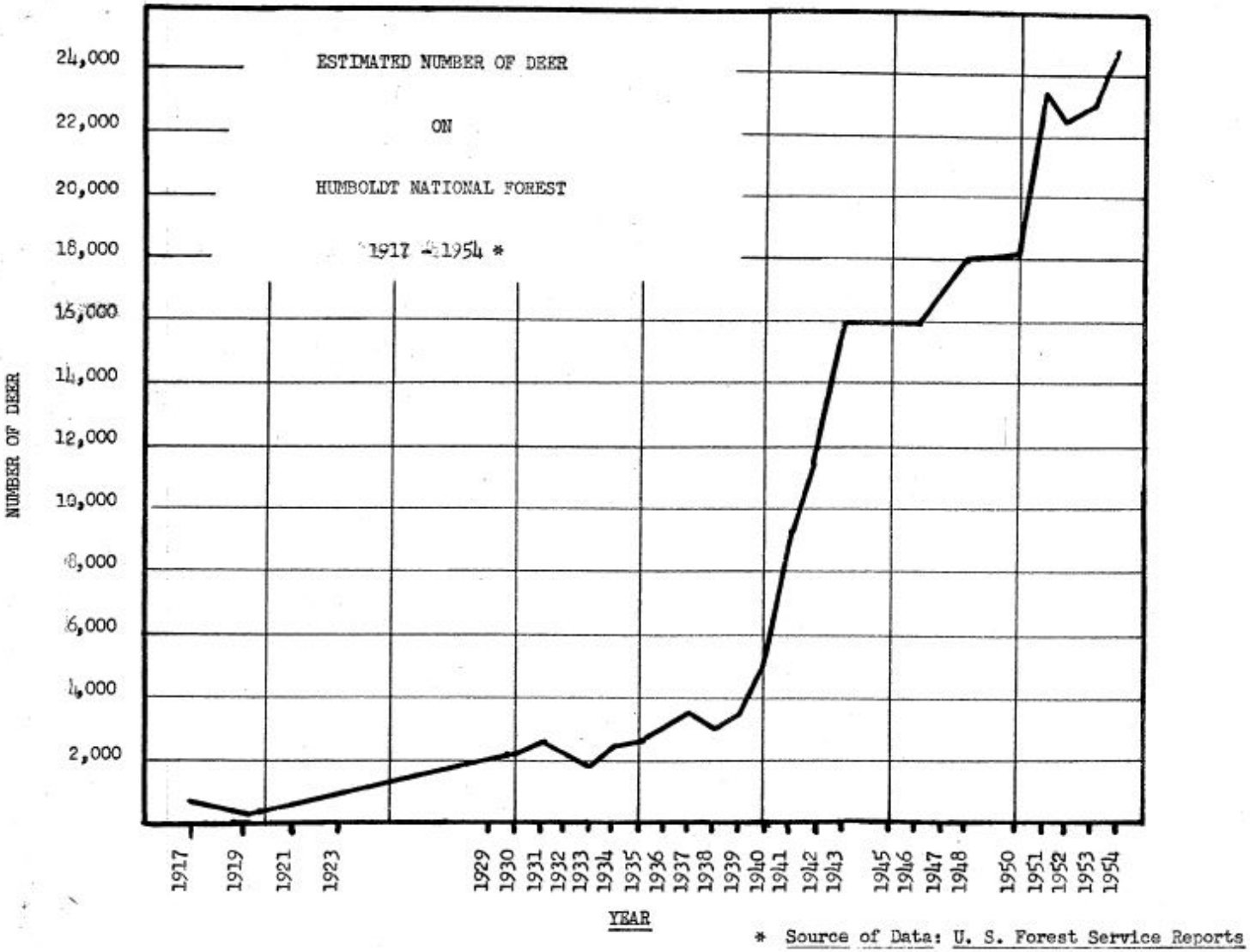
Trends in Oregon's mule deer population size and structure, 1979 – 2018.





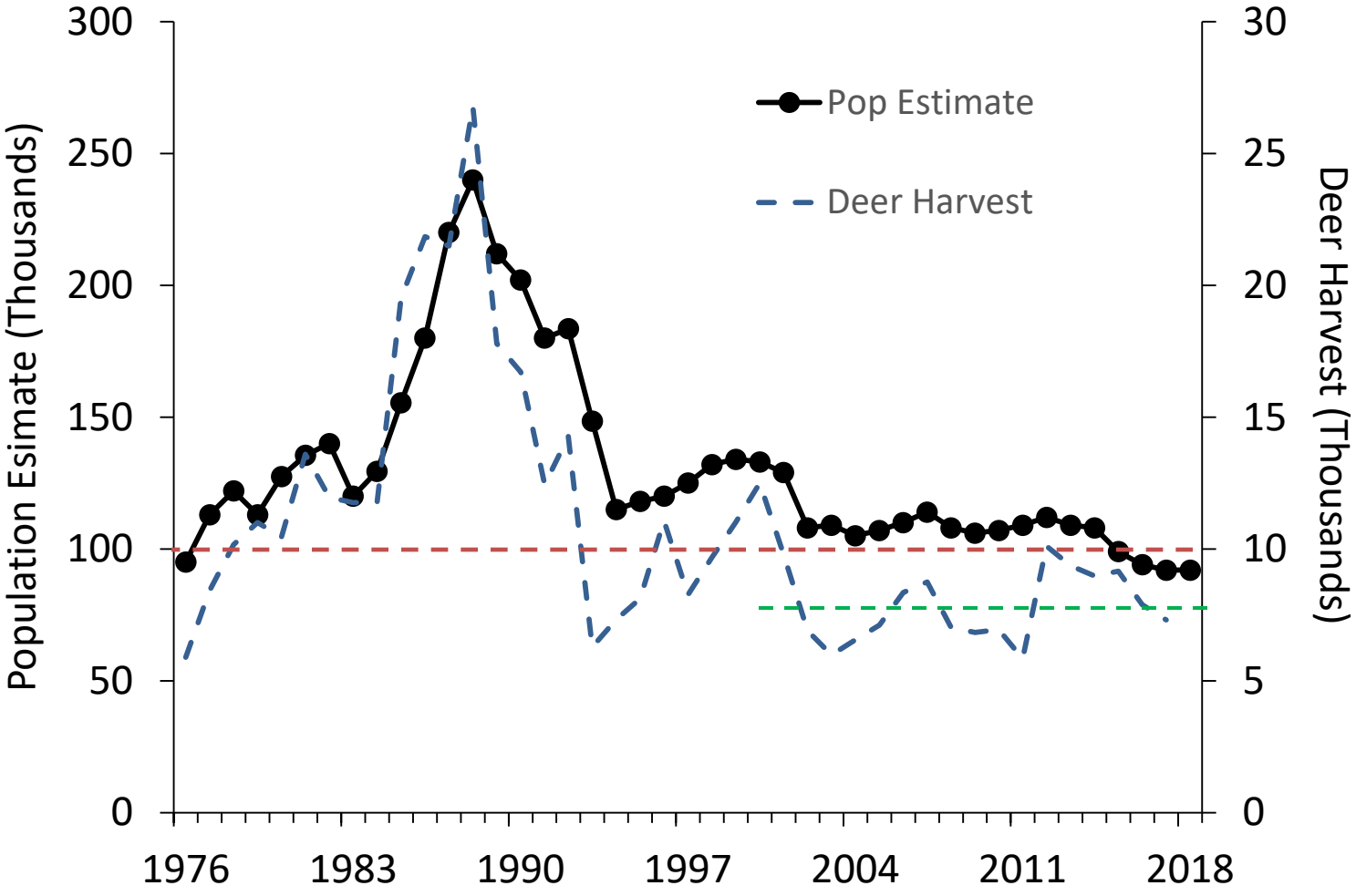
MULE DEER POPULATION DYNAMICS OF NEVADA
1870 - 2003



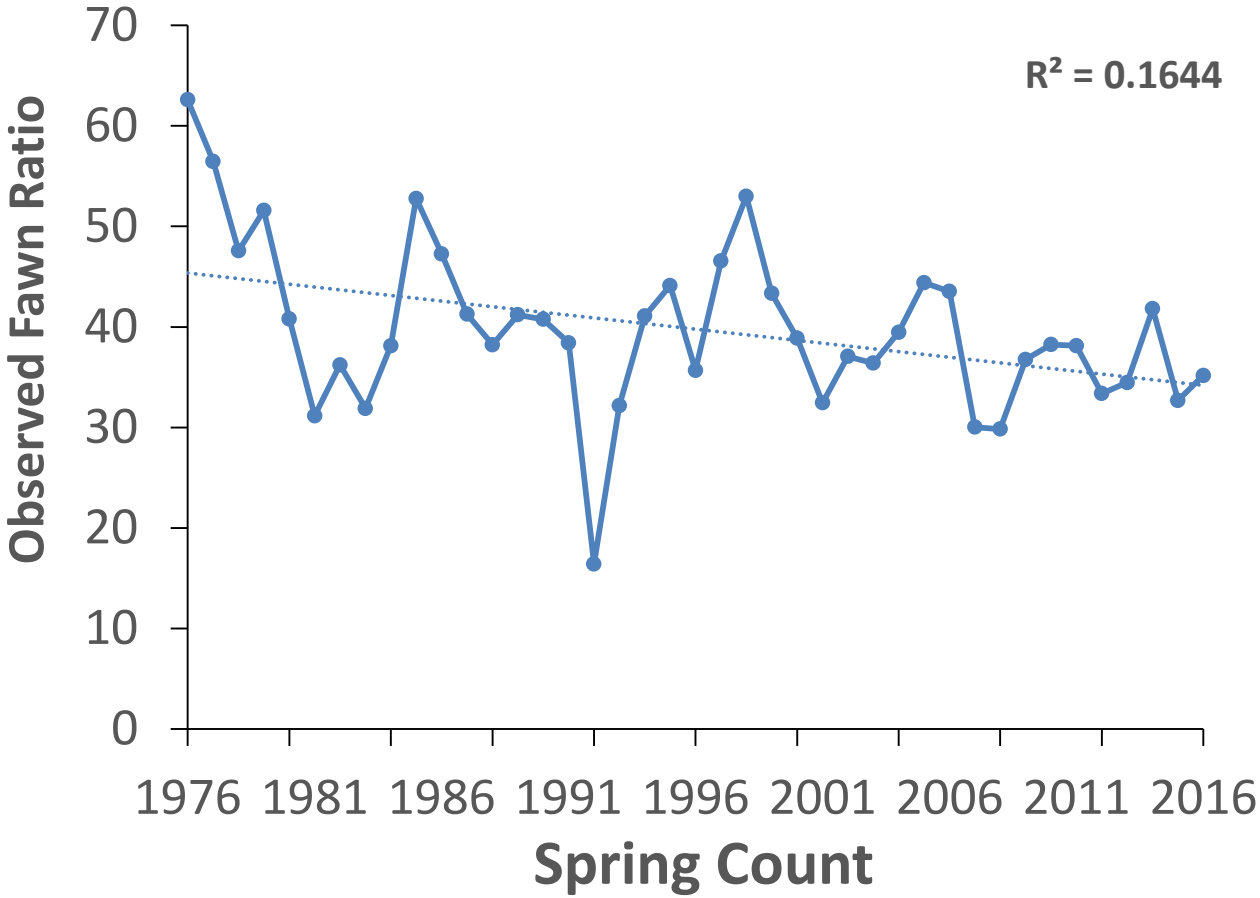


Source: Gruell 1960 Report to U.S. Forest Service

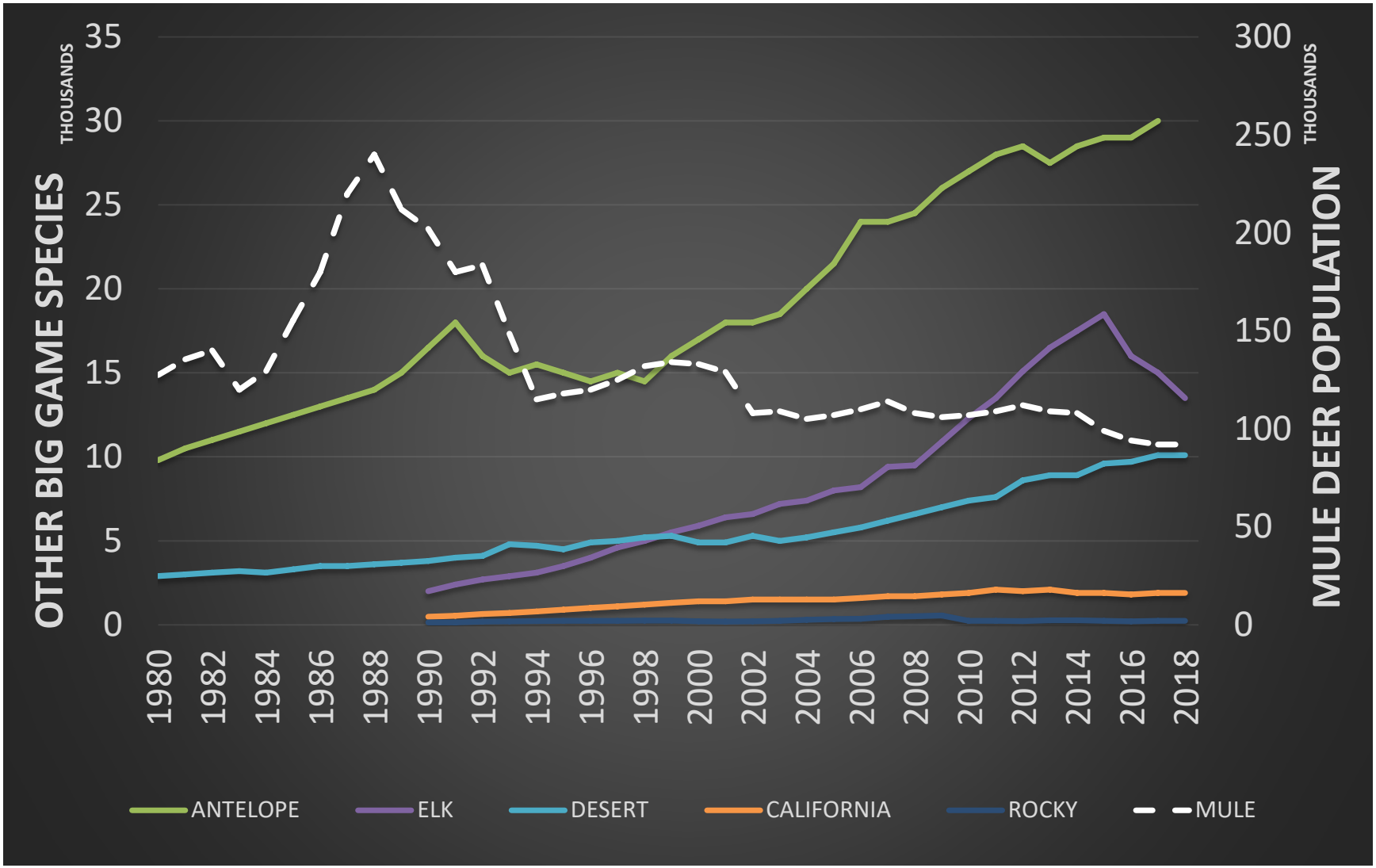
Nevada Mule Deer Population Trend 1975 - 2018



Nevada Mule Deer Population Trend



Nevada Big Game Population Estimates



Early Causes of Mule Deer Population Declines

- Market hunting by early settlers
- Disease (EHD, Blue Tongue, BVDV etc)
- Drought conditions
- Poor range conditions caused by domestic livestock

- Mule Deer have persisted through many decades despite these factors
- All other Big Game species in Nevada have been translocated or augmented in recent decades

Hypothesized Causes of Mule Deer Population Declines

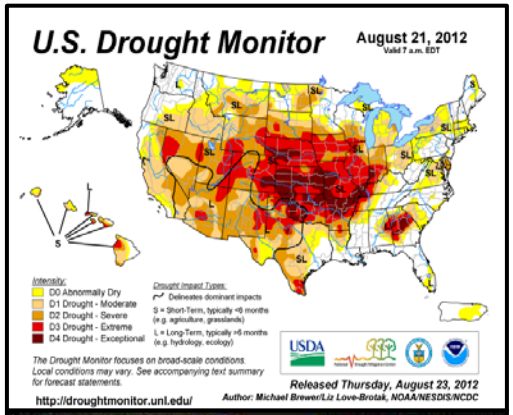
Cause for Decline	Reference	Mechanism
Climate Change	deVos and McKinney 2007	Poor recruitment; habitat quality
Predation	Bleich and Taylor 1998	Adult survival
Enviromental conditions	Unsworth et al 1999	Fawn recruitment; winter mortality
Density Dependence	White and Bartman 1998	Poor fawn recruitment
Increased Highway Traffic	Coe et al 2015.	Deer vehicle collisions
Predation	Hamlin et al 1984	Coyote fawn predation
Enviromental conditions	Hobbs 1989	Body condititition and winter mortality
Residential and Energy Development	Johnson et al 2017	Poor fawn recruitment
Oil and Gas Development	Swayer et al 2002	Migration corridor impediments
Habitat Quality	Bender et al 2007	Body condition; poor survival
Landscape Changes	MDWG 2003	Varies with region

Hypothesized reasons for population declines

Habitat quality

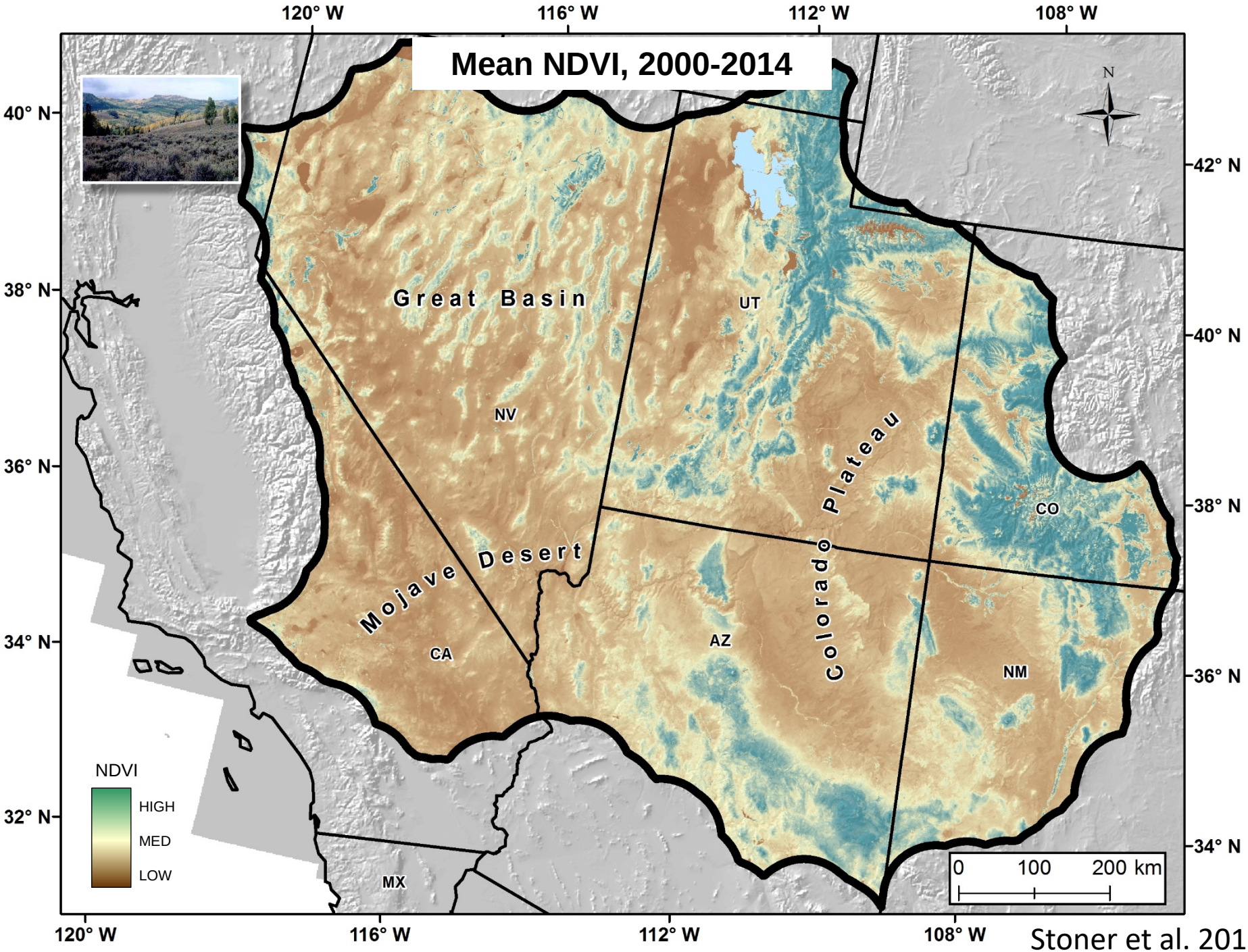
Land Use

Climate Change



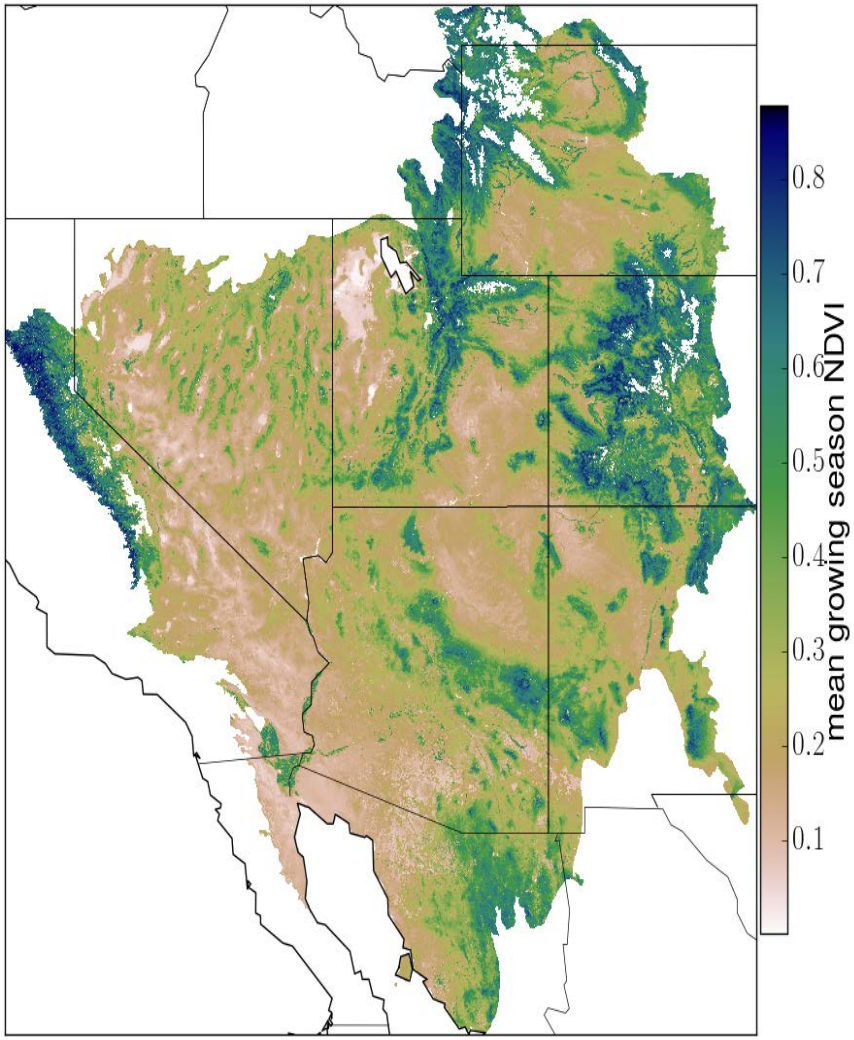
Habitat Conditions

- Normalized Difference Vegetation Index (NDVI)
  - Uses satellite imagery to quantify the amount of "greenness" in vegetation
  - Widely used by ecologists as a measure of forage quality for wildlife
    - Especially useful for species such as Mule Deer
    - Require highly quality forage in their diet
    - Increase body fat reserves

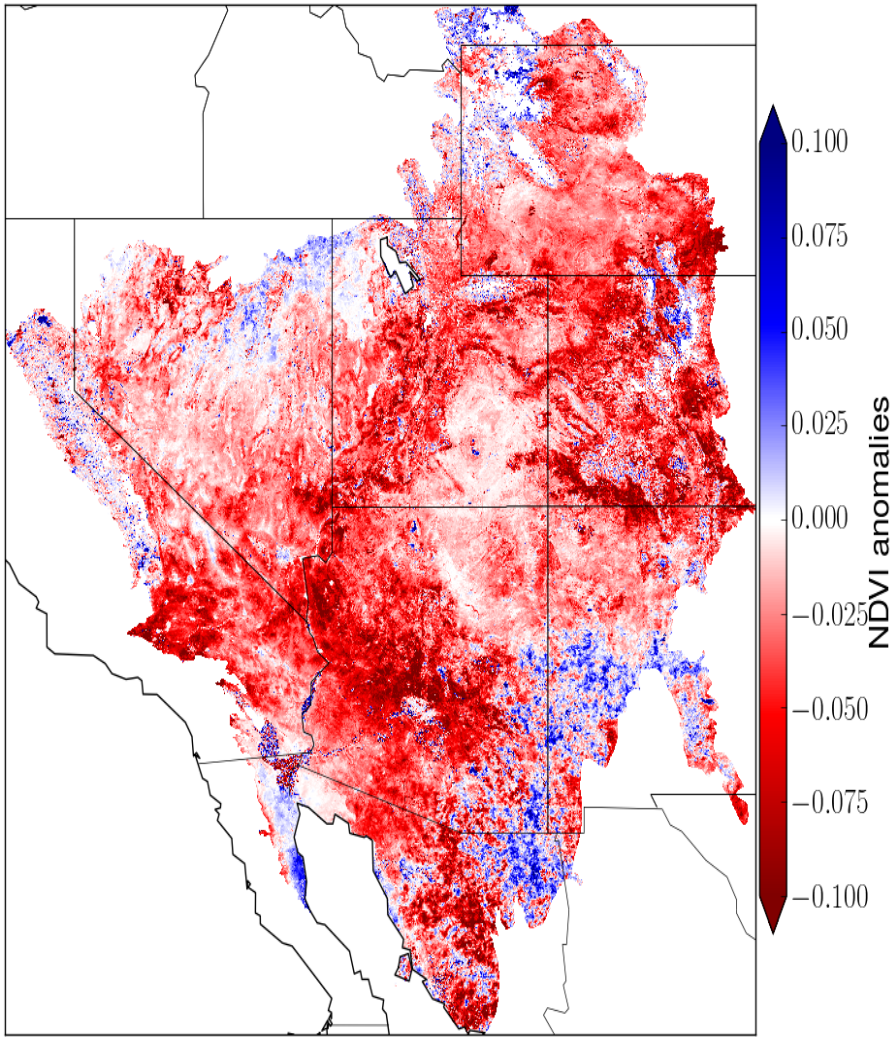


Stoner et al. 2017

Mean NDVI from 2000 to 2012 (excluding 2002)

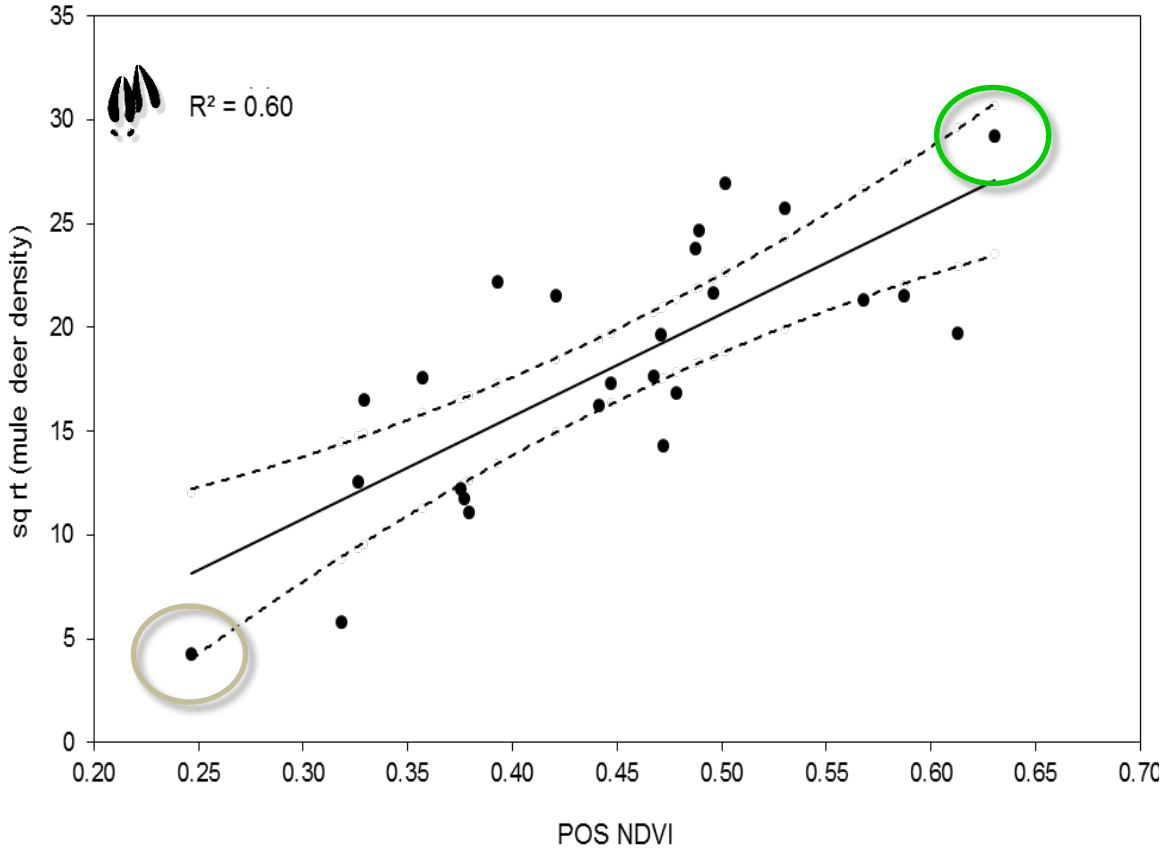


NDVI anomalies for 2002

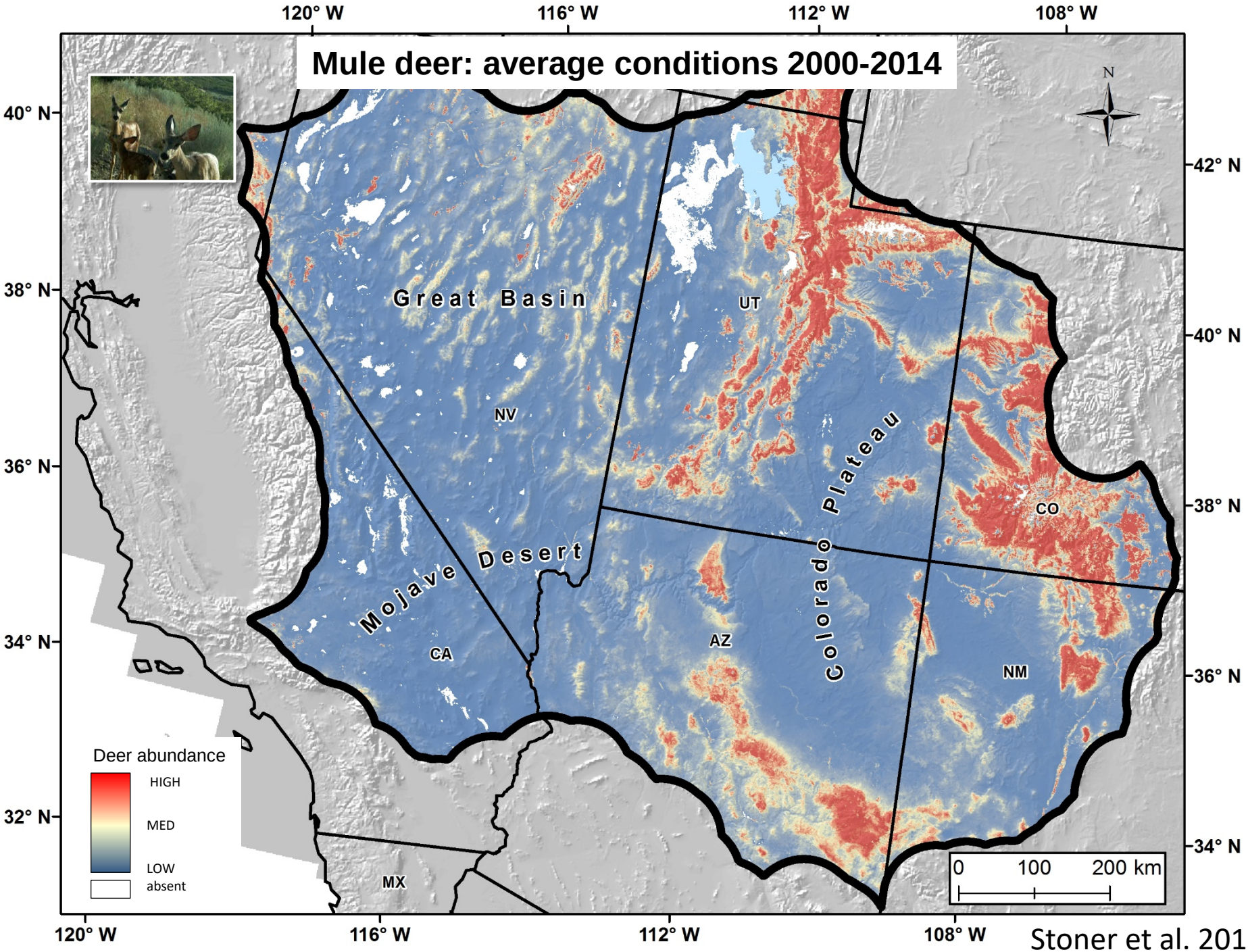


Stoner et al. 2017

Mule deer abundance increases with primary productivity

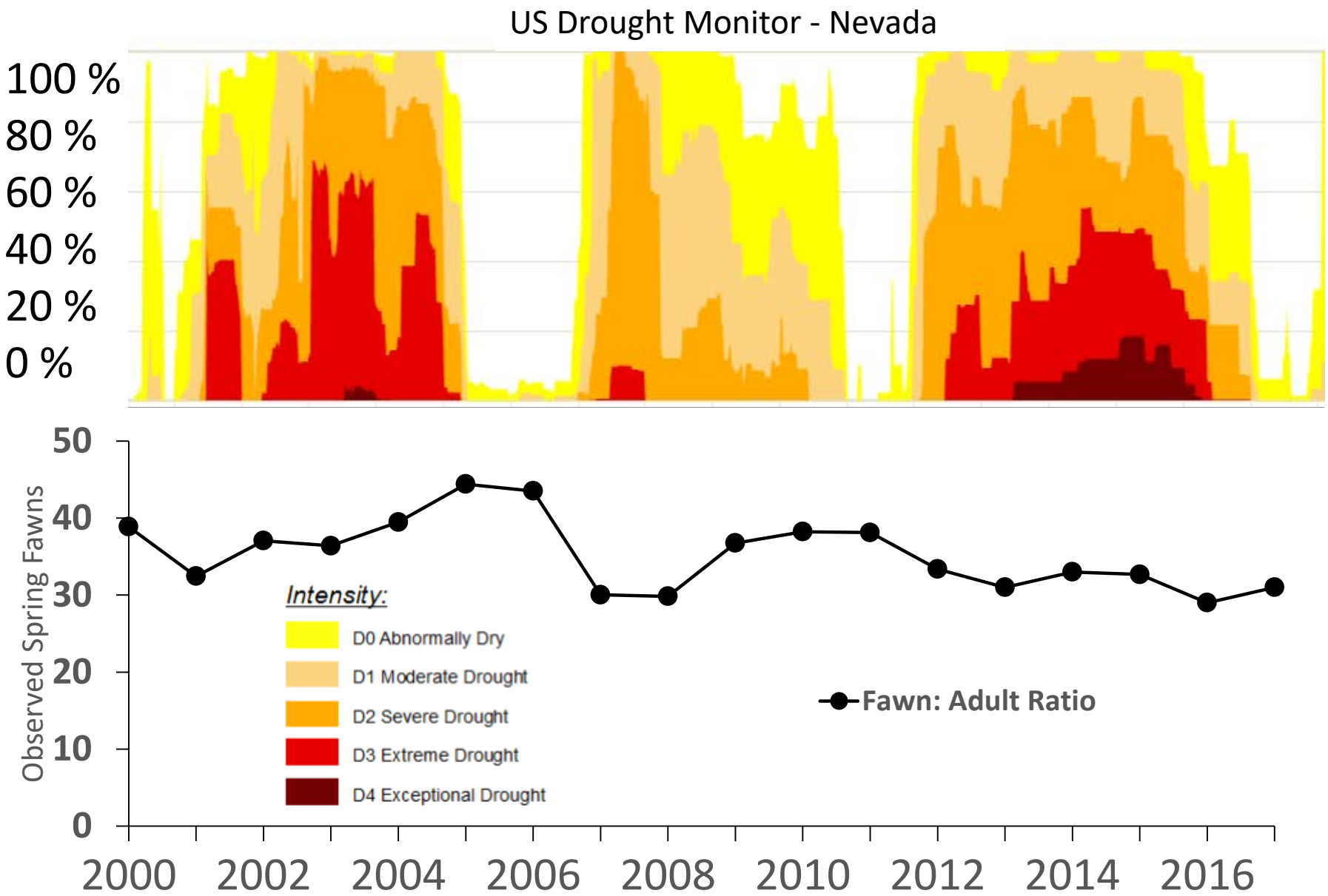


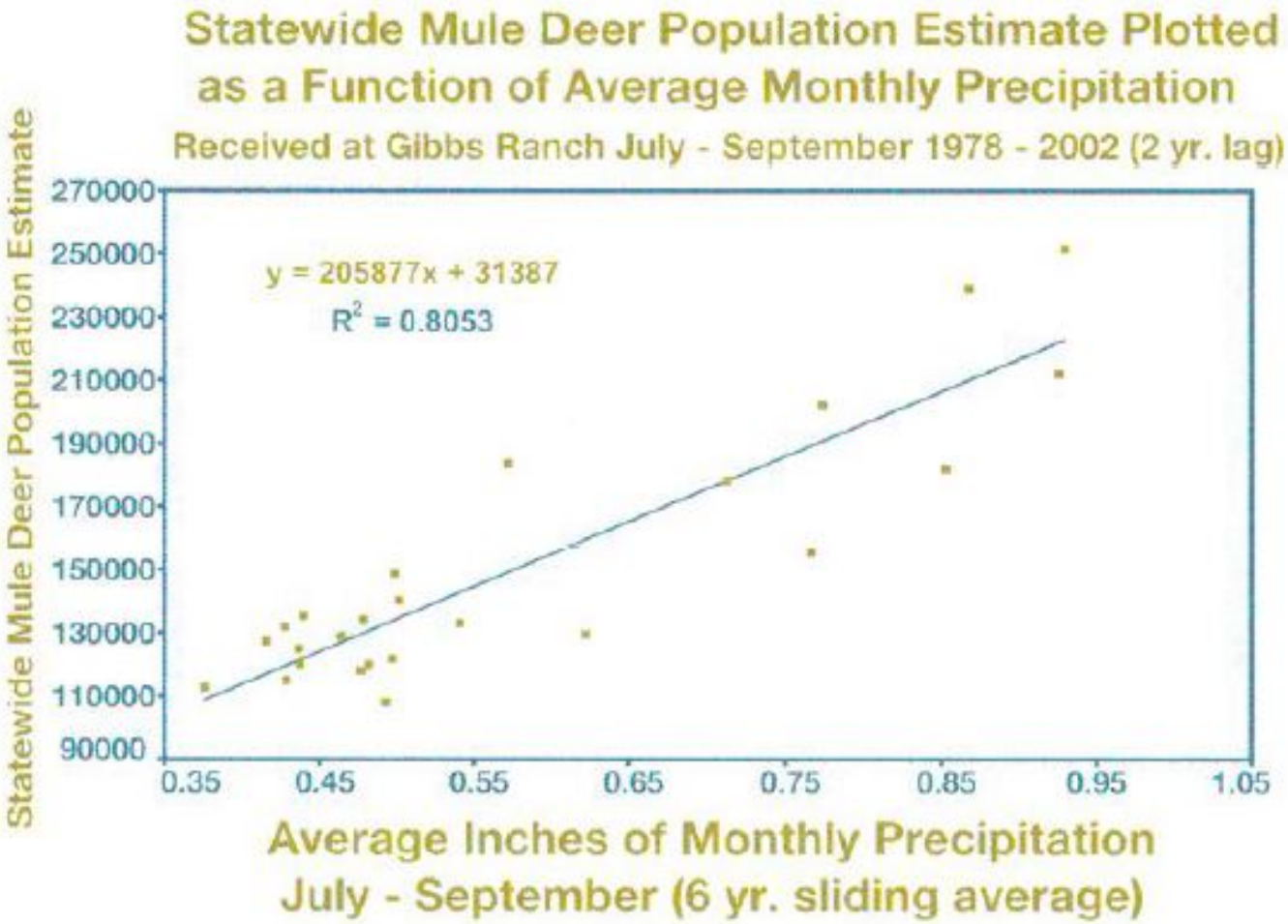
Stoner et al. 2017



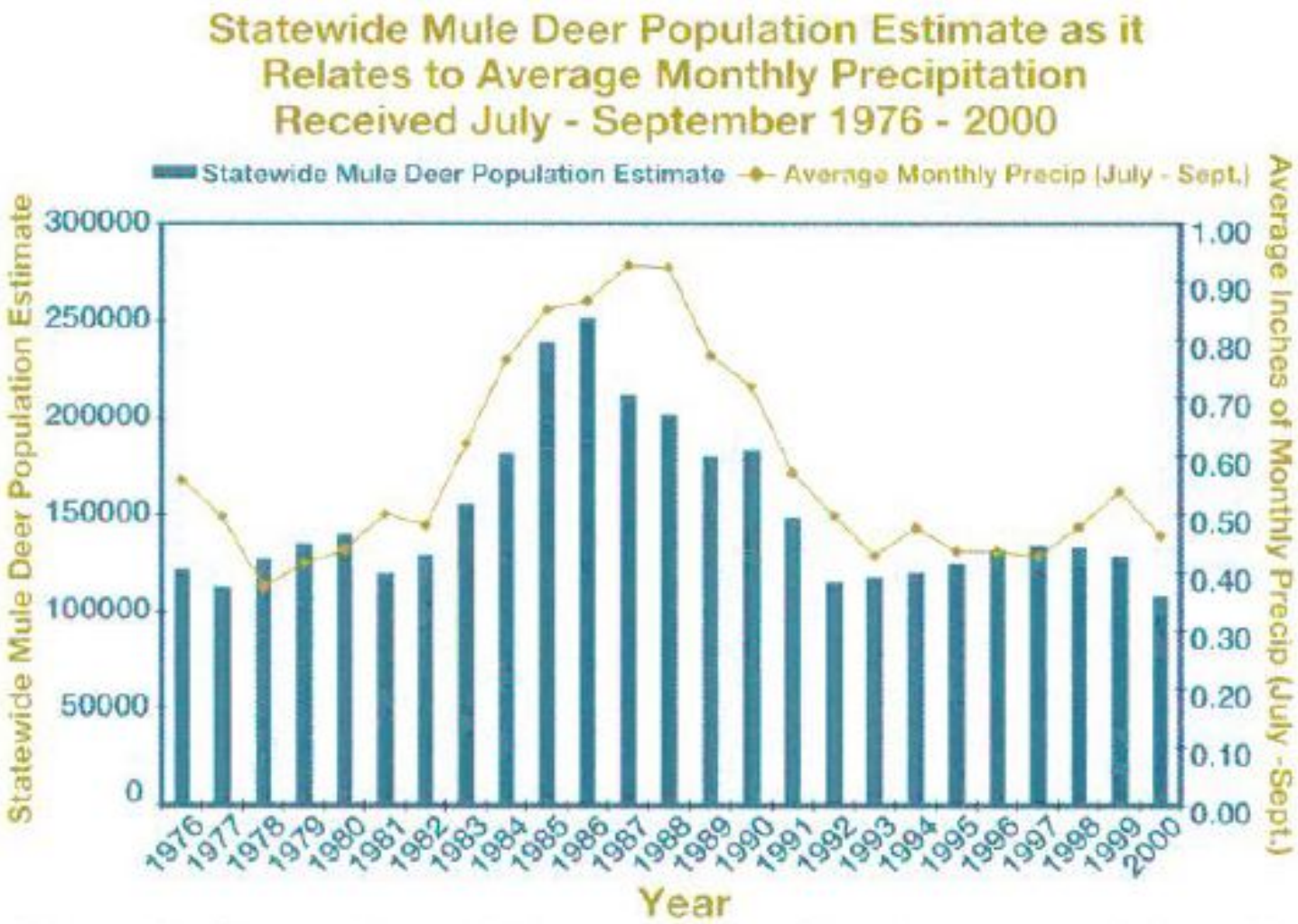
Stoner et al. 2017

Impacts of Drought on Mule Deer Populations - Nevada





Source: Mule Deer Population Dynamics - Issues and Influences Wasley 2004



Source: Mule Deer Population Dynamics - Issues and Influences Wasley 2004

Effects of Nutrition on Mule Deer

Ungulate Nutritional Ecology

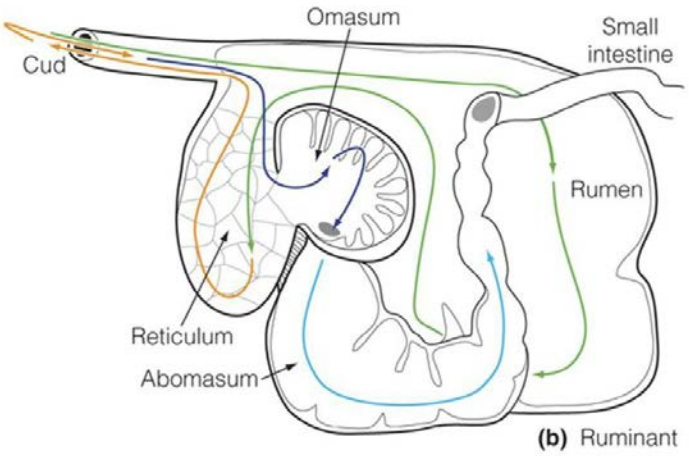
Types of herbivores

- **Grazers** - leaf tissue
- **Browsers** - woody tissue
- **Granivores** - seeds
- **Frugivores** - fruit
- **Nectivores** - nectar
- **Phloem** feeders - sap

- High cellulose (fiber), low protein
- Animals can't digest cellulose (no cellulase enzymes)
- Need symbiotic bacteria, protozoa

Ruminants

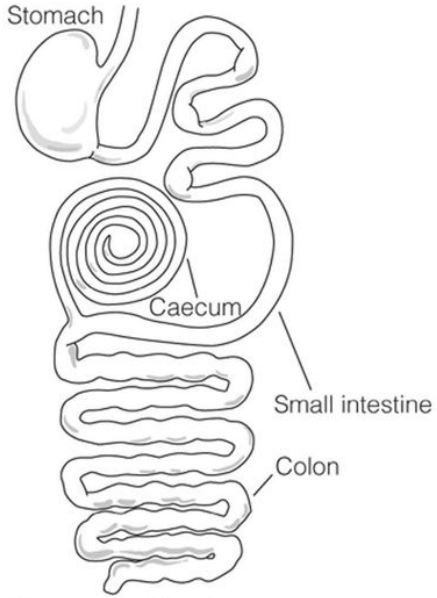
(e.g. cows, sheep, deer)



Ungulate Nutritional Ecology

Non-ruminants

(e.g. rabbits, horses)



(a) Nonruminant herbivore

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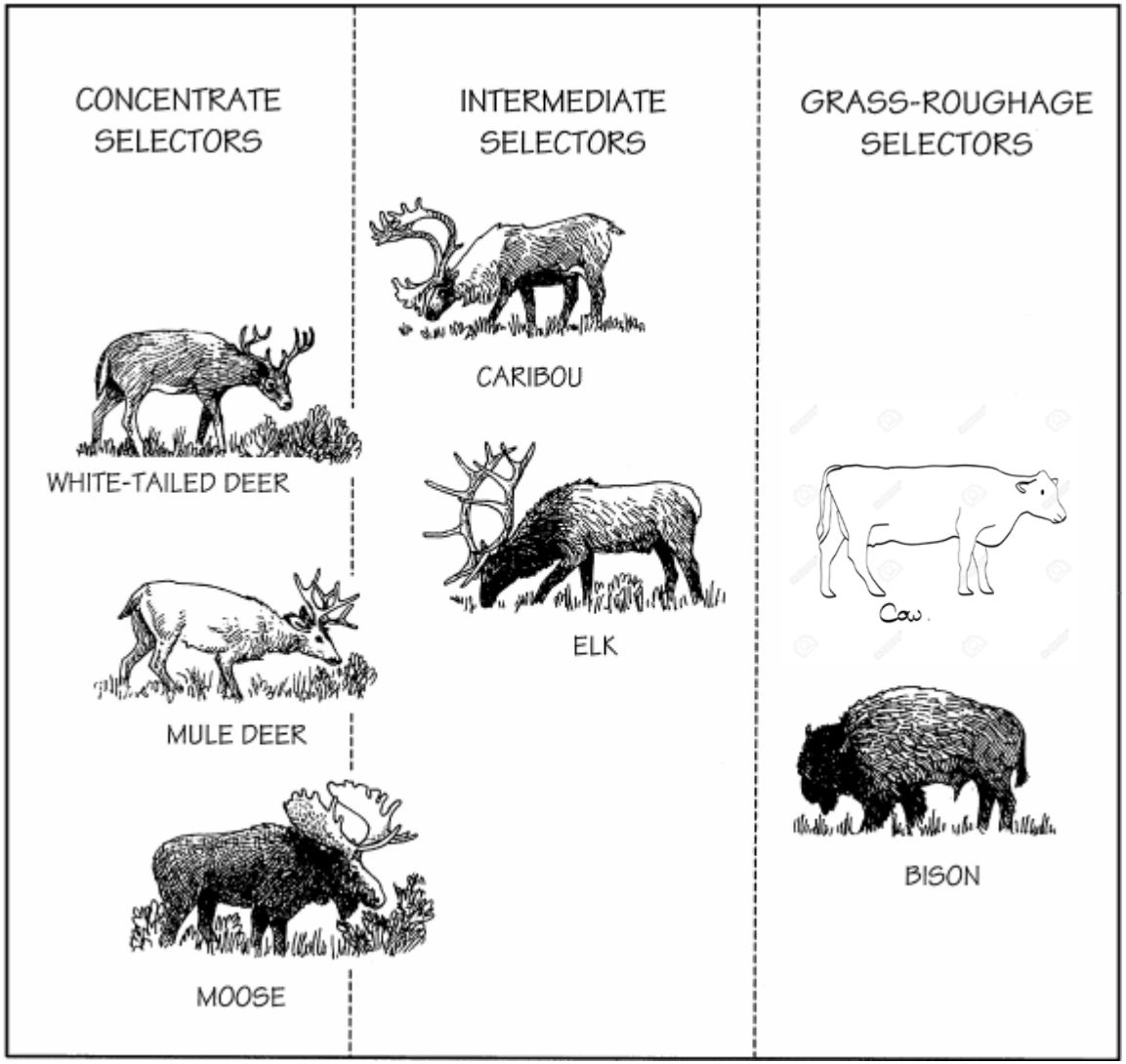
Ungulate Nutritional Ecology



Ungulate Nutritional Ecology

Concentrate Selector

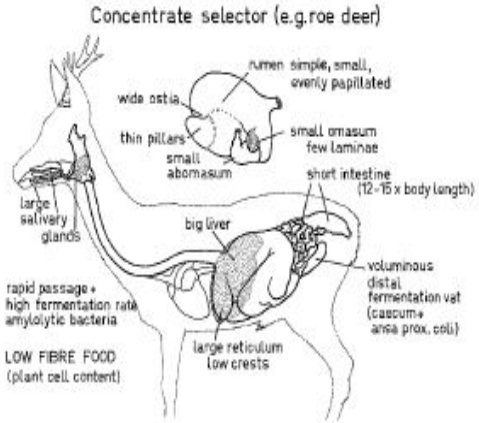


Fig. 6. Type example of a concentrate selector (roe deer) showing morphophysiological characteristics common to all ruminants belonging to this feeding type; from Hofmann 1985

Intermediate

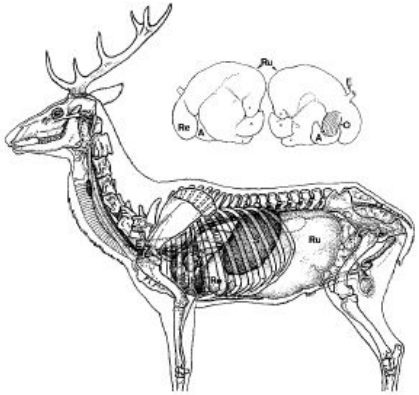


Fig. 4. Red deer as example of an intermediate, opportunistic mixed feeder, with stomach in situ and isolated. *Cervus elaphus*. Organ topography. A = abomasum; E = esophagus; H = heart; O = omasum; Re = reticulum; Ru = rumen; S = spleen

Grass/Roughage Selector

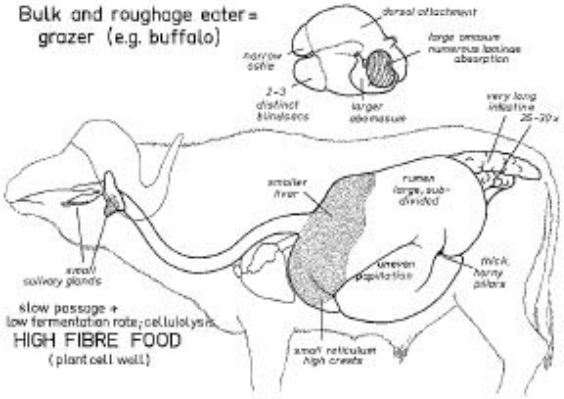


Fig. 7. Type example of a grass and roughage eater (buffalo); see legend of Fig. 6: from Hofmann 1985

Ungulate Nutritional Ecology

- Why is concentration selector vs grass/rougher selector important for conservation?
- Habitat is a dynamic condition
  - Constantly changing
  - Mule deer are early stage successional species that prefer new growth of browse for forage
  - More susceptible to changes in forage quality and quantity
    - fires, type conversion, old decadent browse

Mautz 1978. Sledding on a Brushy Hillside: The Fat Cycle in Deer.

Summer Range:

- Resource acquisition
- Provisioning offspring
- Mating

Winter Range:

- Forage Availability
- Slows Weight Loss

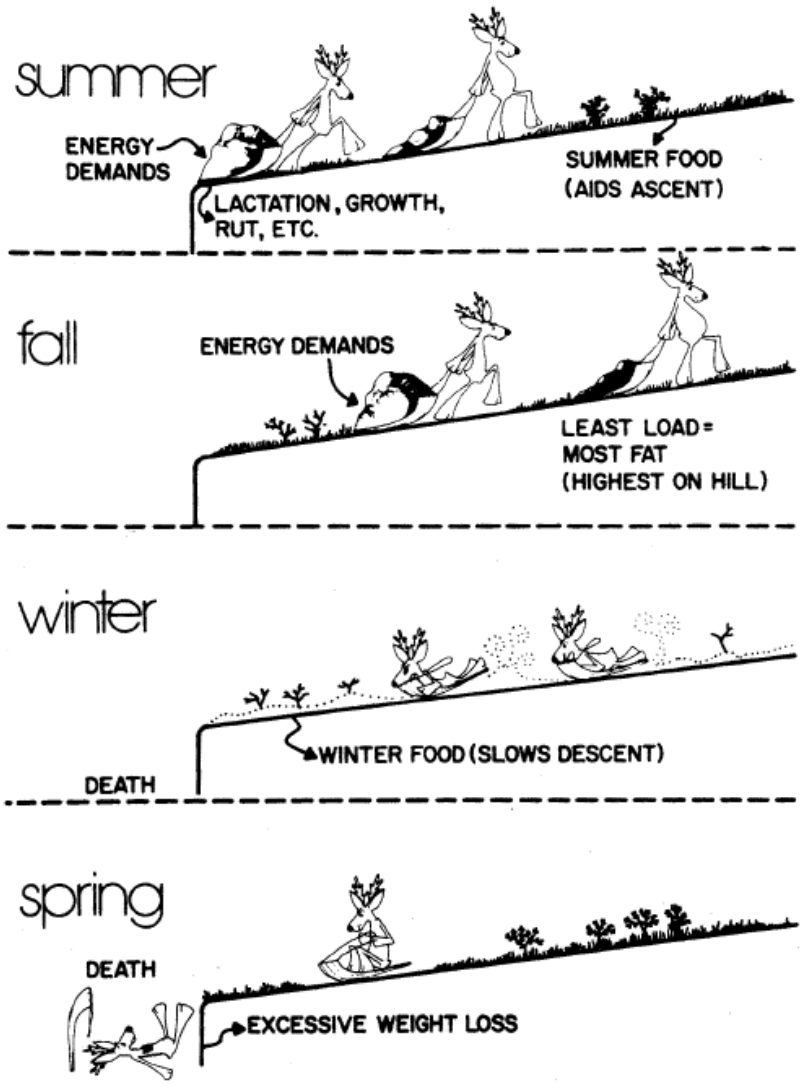
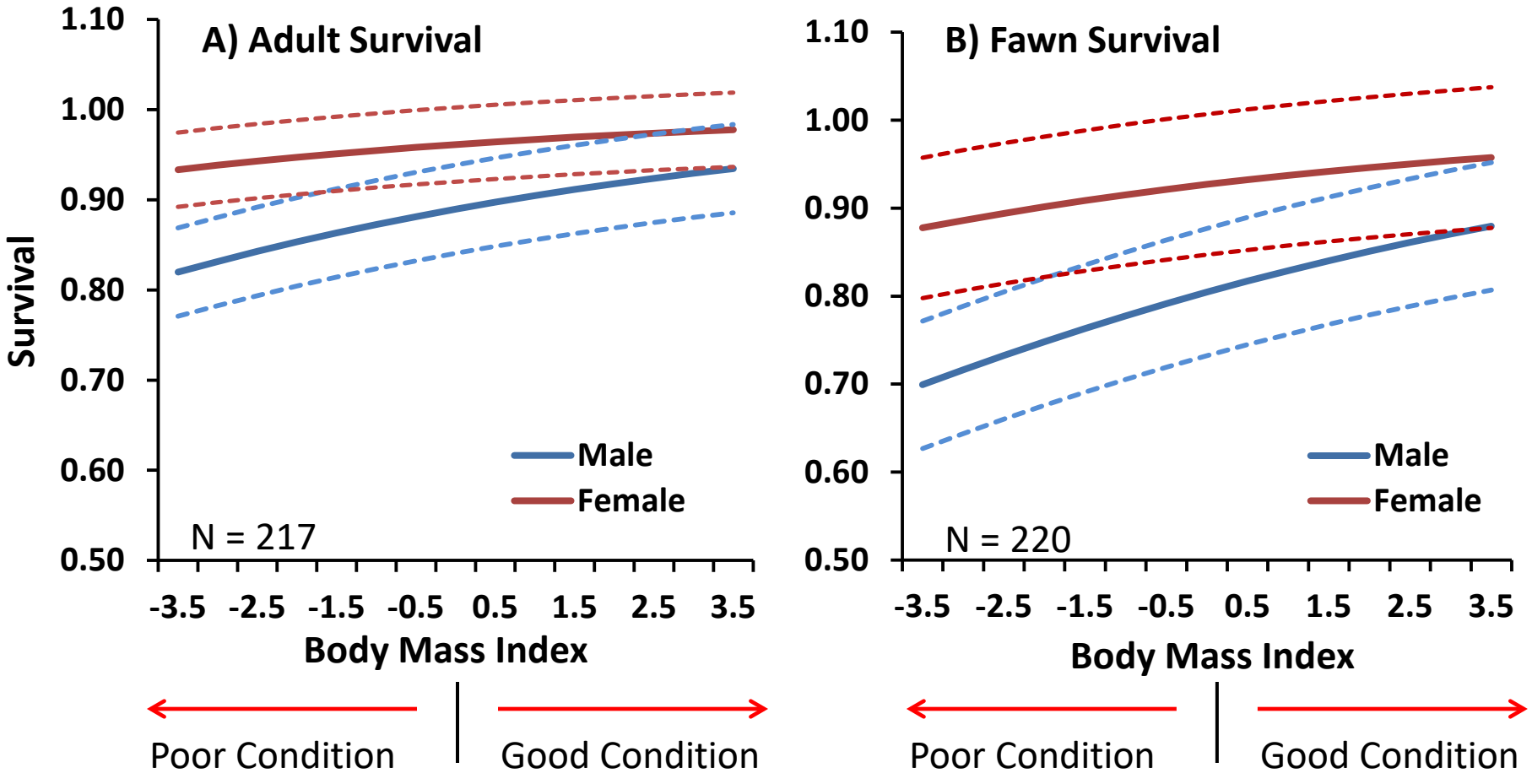


Fig. 1. An analogy of the yearly body fat cycle with deer (uphill climb represents fat accumulation; downhill slide represents fat catabolism or weight loss).

The Wildlife Society Bulletin 1978 6(2):88-90

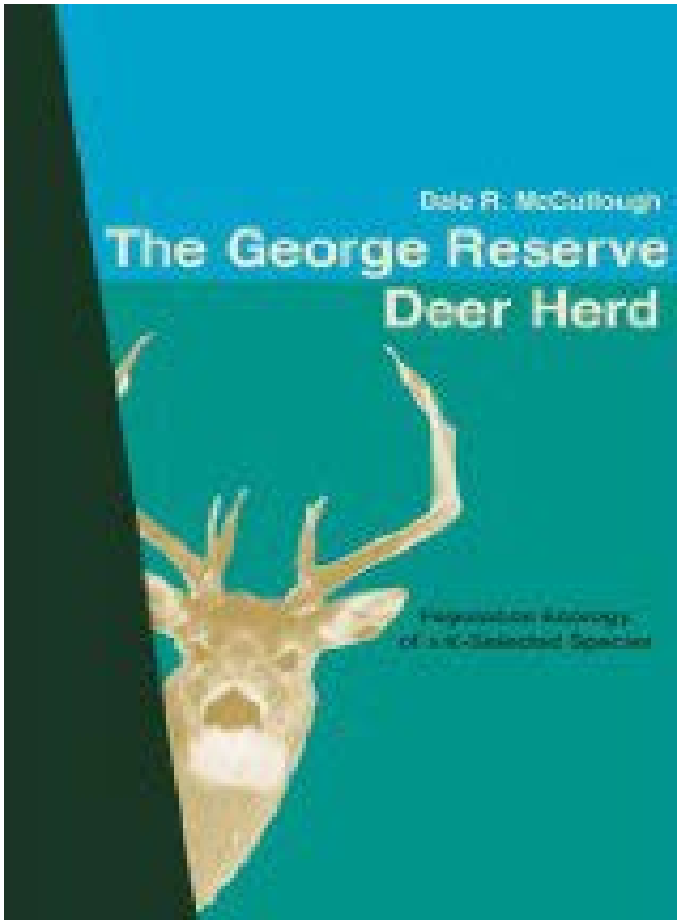
Nutrition (Body Condition) Influences Survival



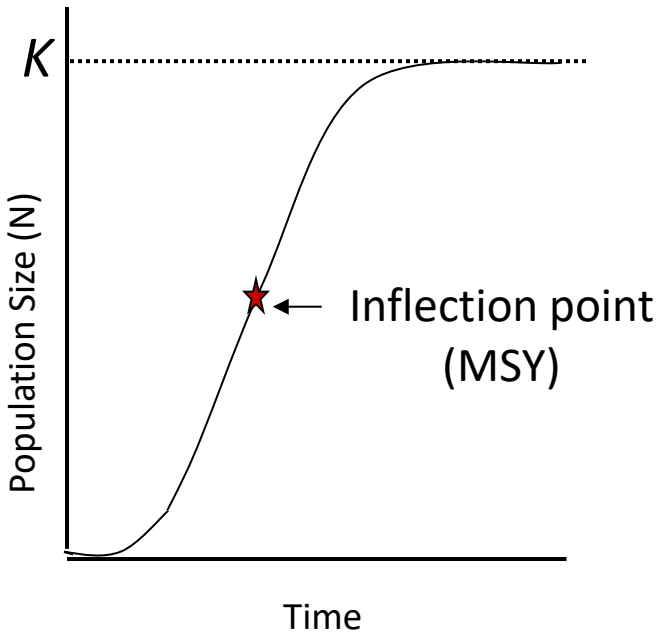
Body Mass Index = Body Mass corrected for body size

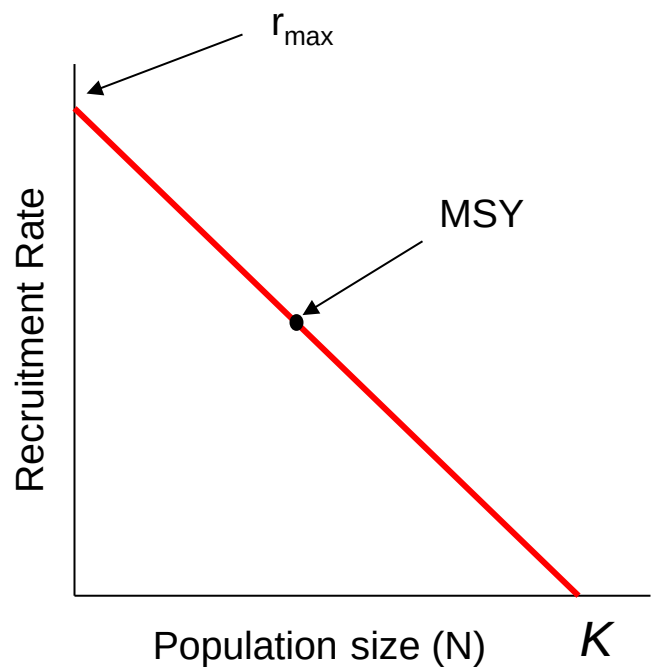
George Reserve Deer Herd 1979

- 15 year study
- White-tailed deer (*Odocoileus virginianus*)
- Population reduced to few animals (~10 adult females)
- Increased to high density
- Collected detailed reproductive and nutritional data on deer throughout the study
- Developed Ricker-like models of population growth and harvest



Density-Dependent Growth

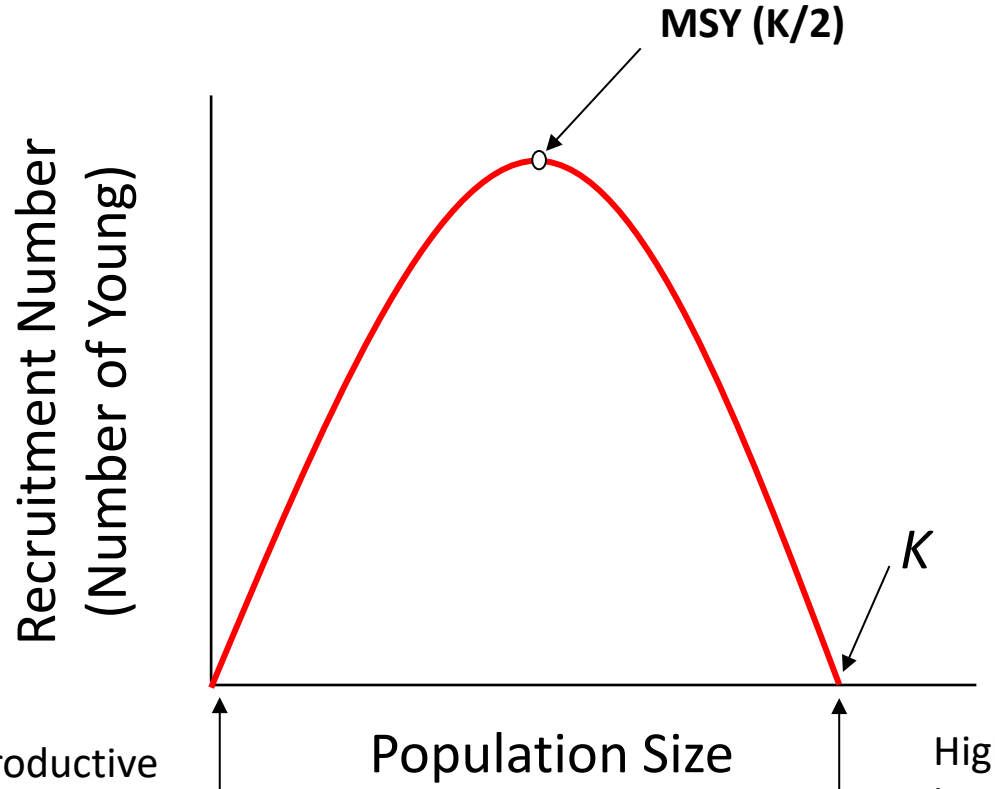


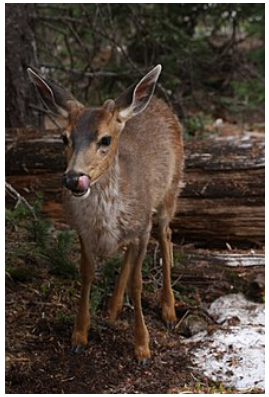


MSY = Maximum Sustained Yield

$$\frac{dN}{dt} = r\,N\frac{(K - N)}{K}$$

K = carrying capacity, births = deaths

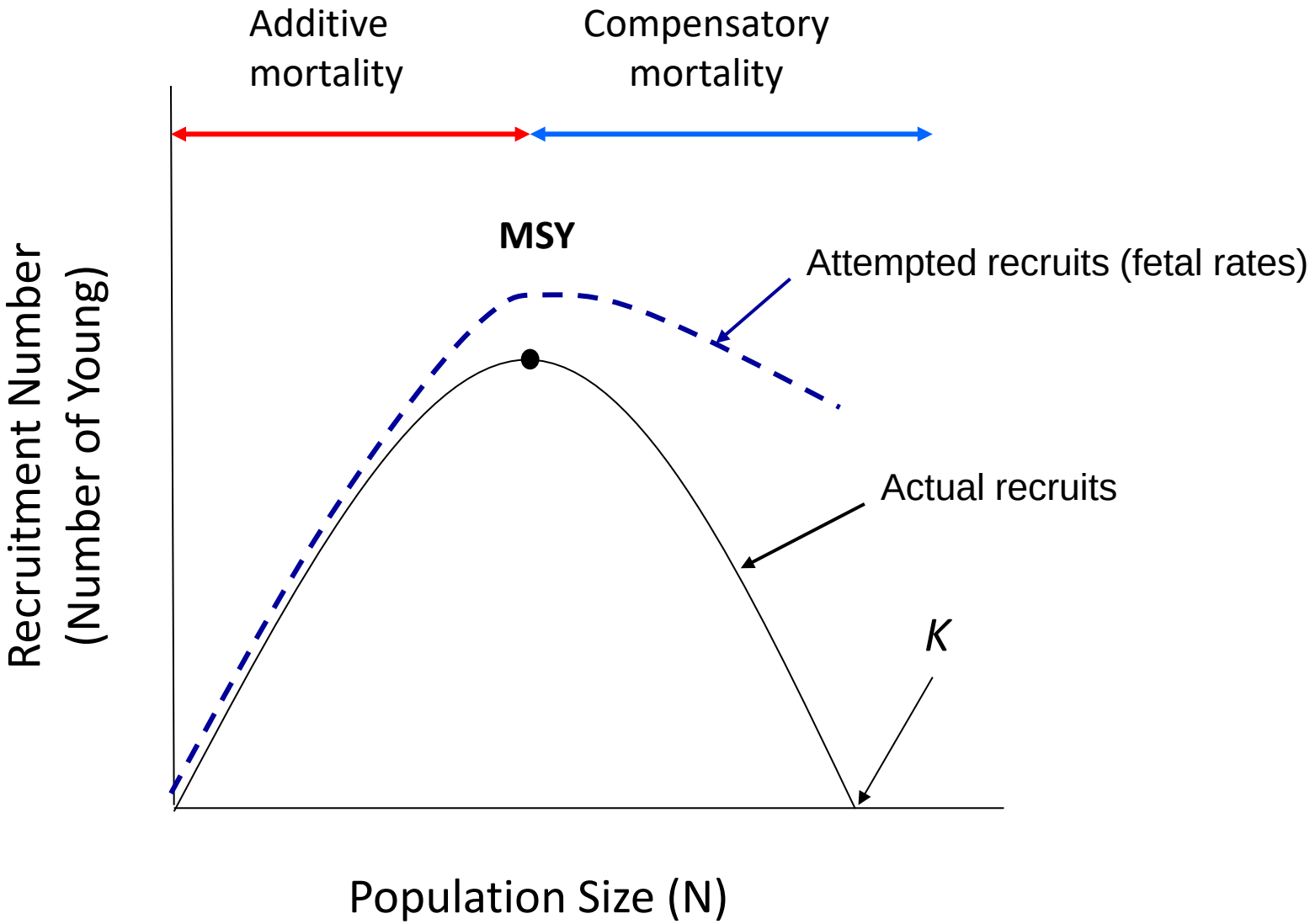

MSY (K/2)
Recruitment Number
(Number of Young)
K
Population Size
High reproductive rate, but small population size
High population size, but low reproductive rate with very few young



Types of Mortality

- Additive
  - Mortality is added to other types of mortality
  - Example: Predation + road mortality + harvest

- Compensatory
  - One form of mortality is compensated for by another.
  - Example: Harvest instead of starvation



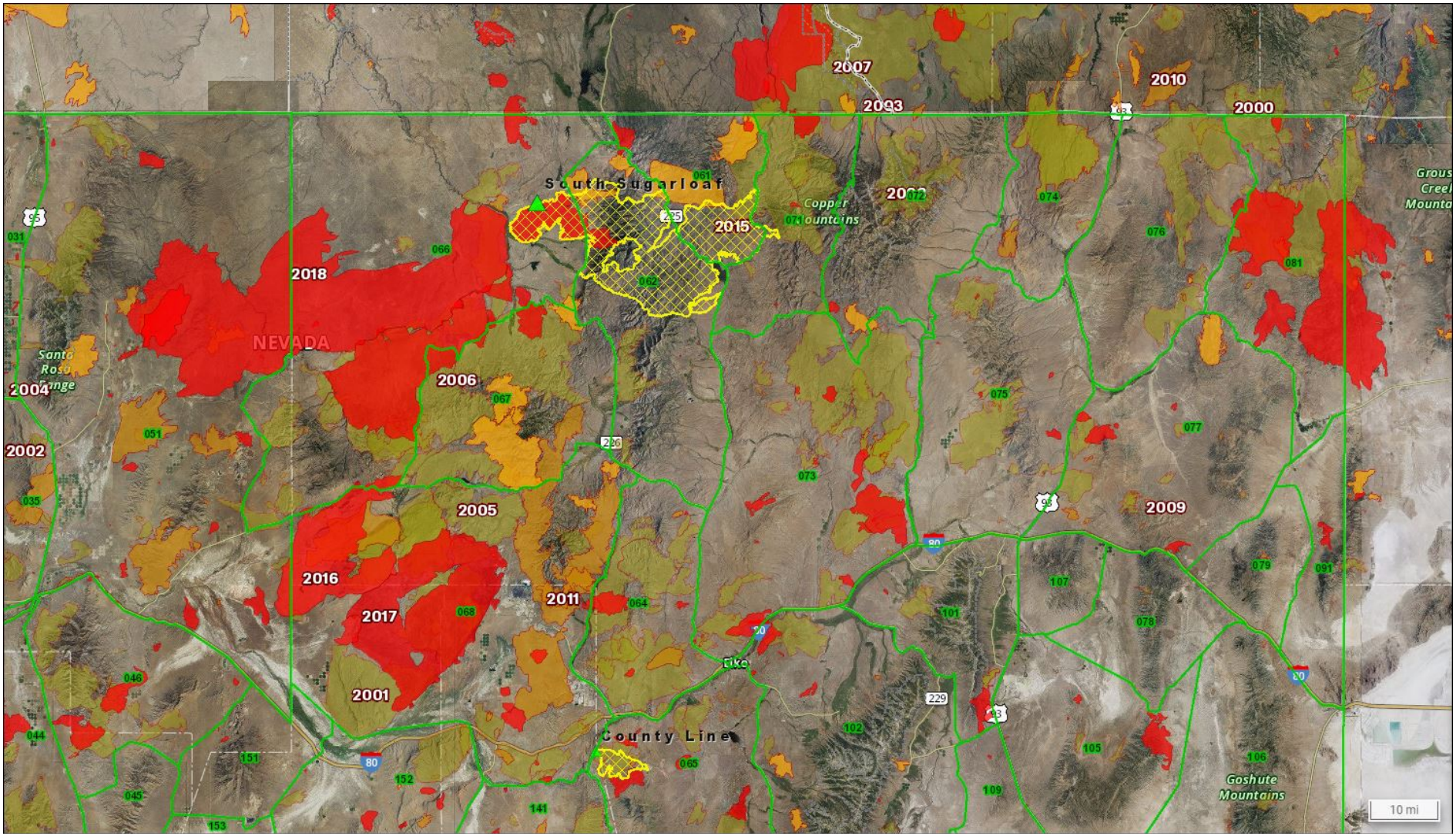
McCullough 1979. The George Reserve Deer Herd: Population Ecology of a K-Selected Species

Life-history characteristic	Population at or below MSY	Population near K
Nutritional condition of adult females	better	poorer
Pregnancy rate of adult females	higher	lower
Pause in annual production by females	less likely	more likely
Yearlings pregnant[a]	usually	seldom
Litter size[a]	higher	lower
Age at first reproduction for females	younger	older
Weight of neonates	heavier	lighter
Survivorship of young	additive	compensatory
Age at extensive tooth wear	older	younger

[a] Some species of ungulates may show limited variability in particular characteristics.

Bowyer et al. 2005

Impacts of Fire



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06/17/2017

UTM: 11S
399966mE 4341664mN
Elevation: 7522.08ft
Accuracy: 15.1ft
Azimuth: 348° (N)
Pitch: -39.7° (-0.6°)
Time: 08-30-2018 11:18
Note: bravo 17 _402
Powered by AngleC

UTM: 11T
249865mE 4440427mN
Elevation: 4331.43ft
Accuracy: 15.1ft
Azimuth: 286° (W)
Pitch: -17.3°
Time: 06-29-2018 11:09
Powered by AngleCam

UTM: 11S
399966mE 4341660mN
Elevation: 7551.61ft
Accuracy: 15.1ft
Azimuth: 263° (W)
Pitch: 7.6° (-5.5°)
Time: 08-30-2018 11:19
Note: bravo 17 _402
Powered by AngleC

Impacts of Fire on Great Basin Ecosystems

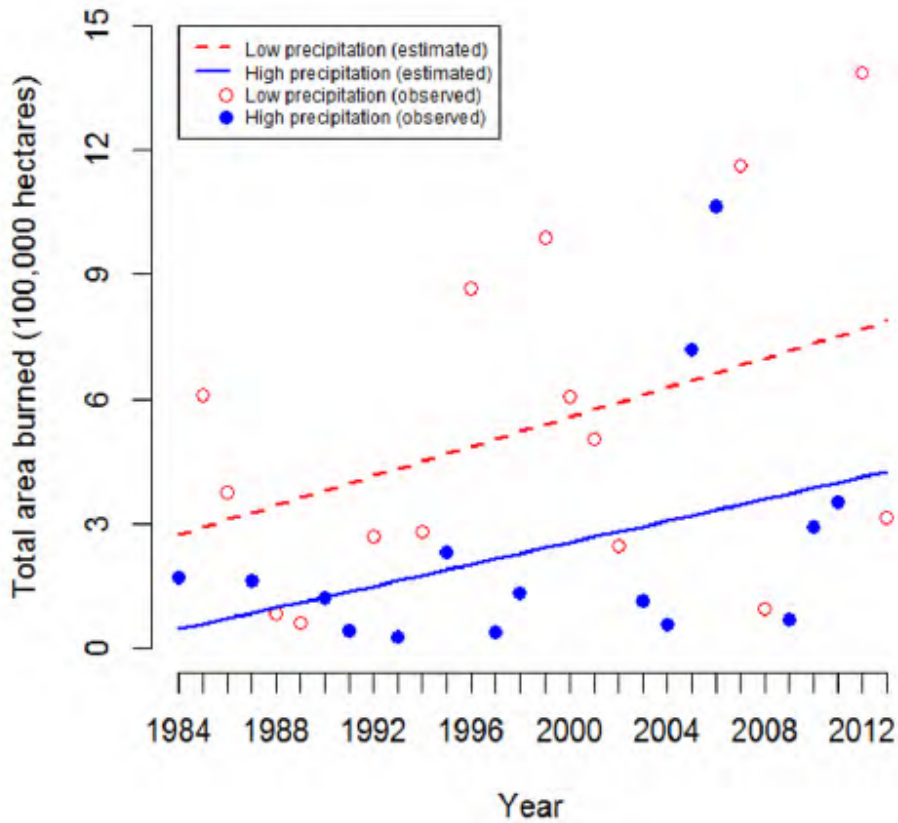


Figure 4. Relation between total burned area (acute) and time by low (<32.3 cm) and high (>32.3 cm) precipitation years in the Great Basin from 1984 to 2013.

Source: Coates et al. 2015

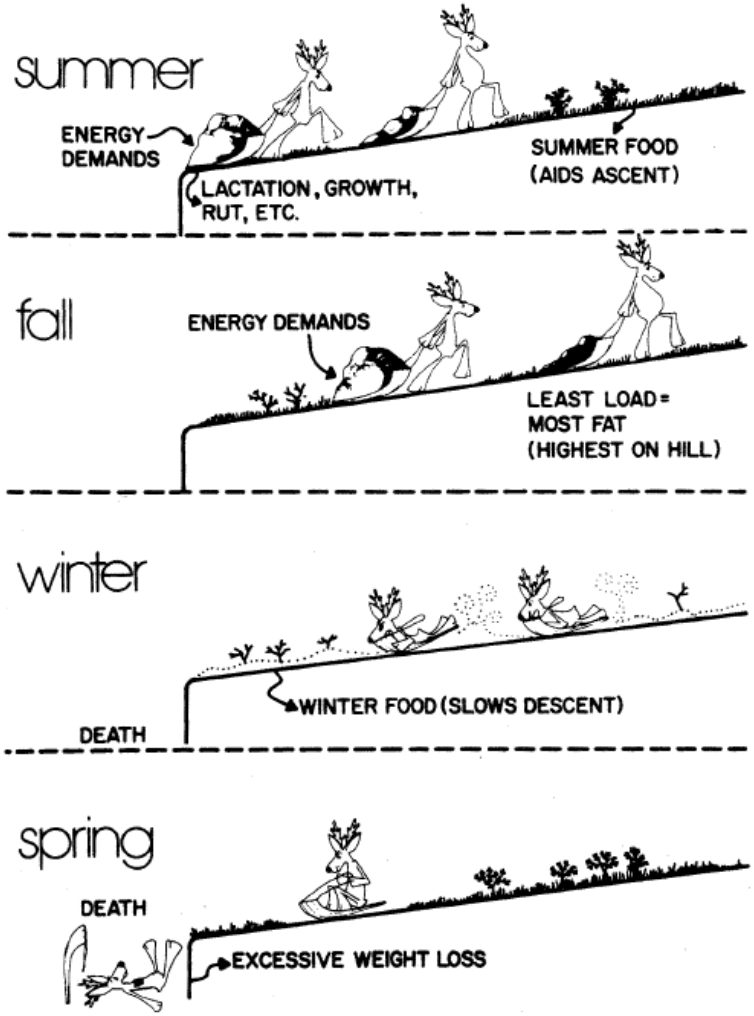


Fig. 1. An analogy of the yearly body fat cycle with deer (uphill climb represents fat accumulation; downhill slide represents fat catabolism or weight loss).

The Wildlife Society Bulletin 1978 6(2):88-90

Predation Management

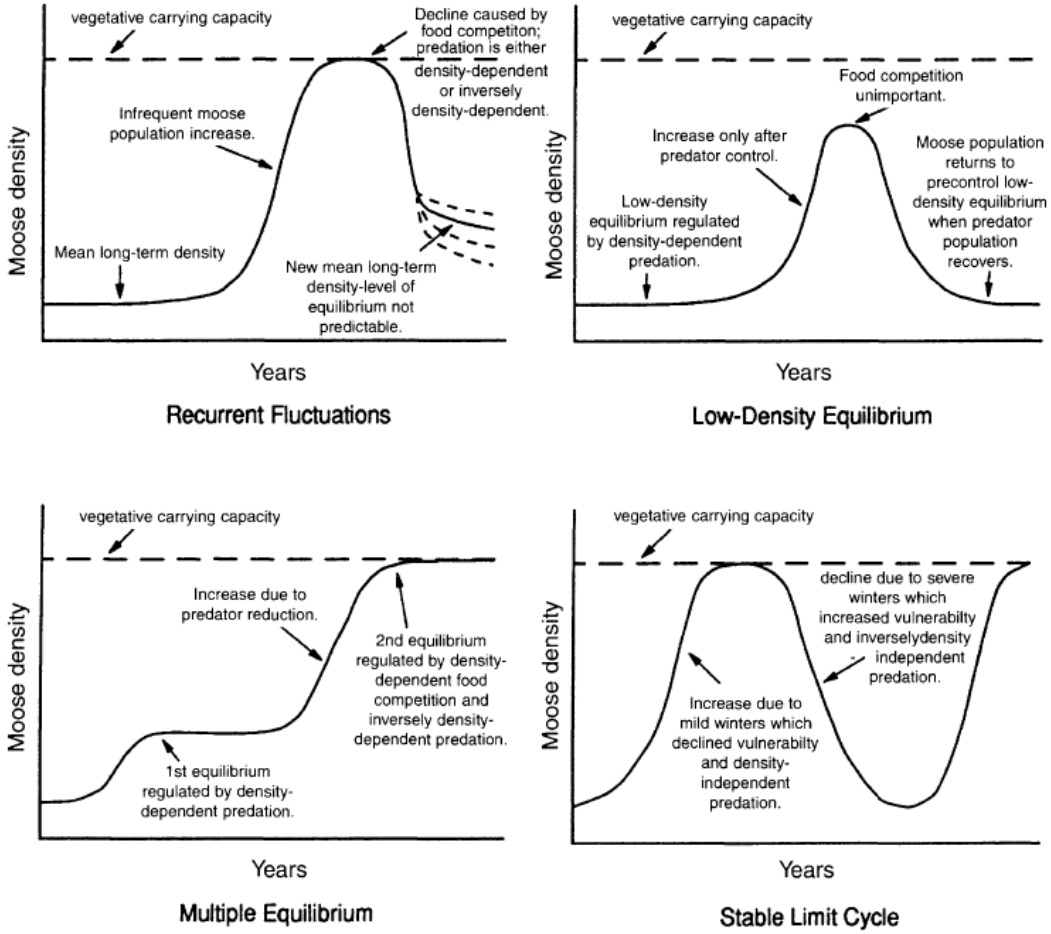


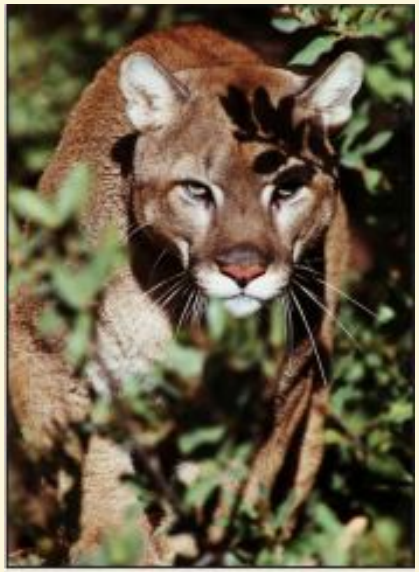
Figure 1. Conceptual models of ungulate population regulation by predation: low-density equilibria, multiple stable states, stable-limit cycles, and recurrent fluctuations (from Ballard and Van Ballenberghe 1997).

Source: Ballard et al 2001.

RELATIONSHIPS AMONG MULE DEER AND THEIR PREDATORS
Fact Sheet #1

USING SCIENCE TO GUIDE MANAGEMENT

- Predation was identified as a limiting factor
- Predator control was implemented when deer populations were below habitat carrying capacity
- Control efforts reduced predator populations sufficiently across the landscape to yield results (e.g., expected to be about 70% of a local coyote population)
- Control efforts were timed to be most effective (just prior to predator or prey reproduction)
- Control occurred at a focused scale (generally < 250 mi^2)



Predation Management

- Currently Nevada has one on-going predator removal project for mule deer in Eureka County
- Project 40 in current Predation Management Plan
- Focused on removal of coyotes for the protection of mule deer
- As of 2017, about 600 coyotes and 1 mountain lion were removed by Wildlife Services

Species	Annual Adult Survival Rates	Fall Young: Female Ratios	Spring Young: Female Ratios	Adult Female Annual Survival Rates
California Bighorn Sheep	< 90%	< 40:100	--	--
Rocky Mountain Bighorn Sheep	< 90%	< 40:100	--	--
Desert Bighorn Sheep	< 90%	< 30:100	--	--
Mule Deer	--	--	< 35:100	< 80%
Pronghorn	< 90%	< 40:100	--	--

Mule Deer Working Group

WAFWA
WESTERN ASSOCIATION OF FISH & WILDLIFE AGENCIES

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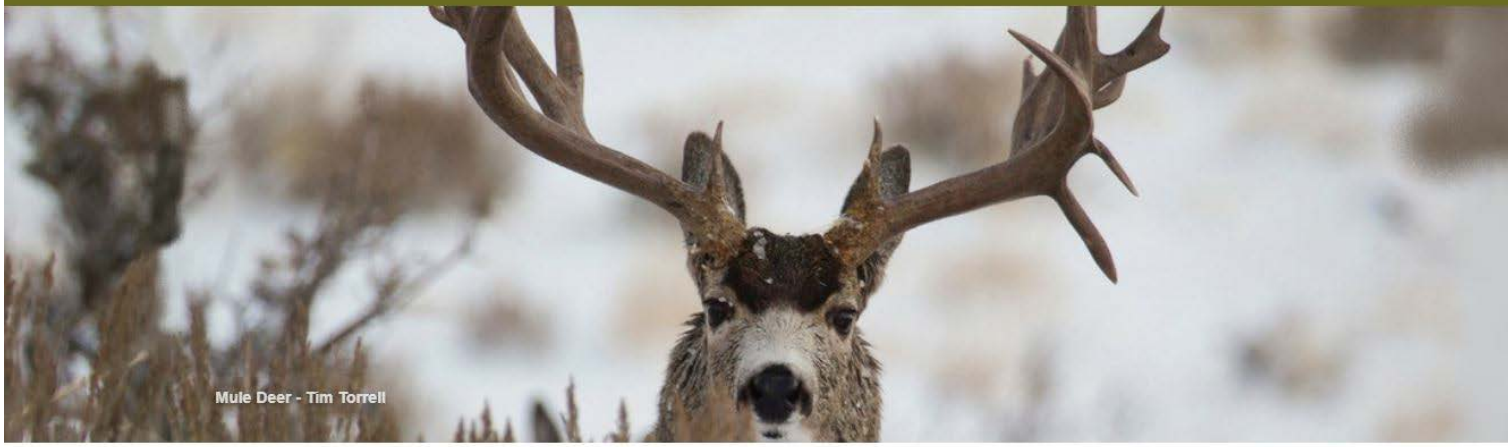


Mule Deer Working Group

- Members
- Deer/Elk Workshop Proceedings
- Minutes
- Wallmo Award
- Publications
- Accomplishments

Jim Heffelfinger, Chair
Arizona Game and Fish Department

Mule Deer Working Group

Statement of Purpose:

The purpose for this working group is to:

1. Begin to develop strategies to assist in management of declining mule deer populations throughout the West;
2. Improve communication among mule deer biologists throughout the West;
3. Provide a forum to respond to information needs from agency administration.

The Mule Deer Working Group has been very successful in their efforts to reach those goals and are considered one of the most active and productive working groups sponsored by WAFWA.

Background:

In 1997, the Western Association of Fish and Wildlife Agencies (WAFWA) established a Mule Deer Working Group (MDWG) consisting of a representative from each western state and western Canadian province. Since the time of the MDWG's inception, it has been successfully addressing mule and black-tailed deer concerns shared among

RELAT

OVERVIEW

Relationships between p
predators may influence
population. Only by un
if or when management

BACKGROUND

Mule deer are prey for m
predators are primarily r
dogs will also take mule
many factors interact to
control is simply the rem
between predators and t
predators. In most case
prohibitive. Therefore, p
management success, an

THE INFLUENCE OF P

The influence of predato

1) Relationship of the r
2) Overall habitat cond
3) Abundance and dist
4) Number, abundance

When mule deer popula
to have less influence on
are unlikely to result in a
conditions are favorable,
reduce susceptibility to p
can limit mobility and in
species occupy the same
prey from which to selec
predators may switch to
remaining mule deer. C
stable or high predator n
growth when below thei
predators, those predato
predator abundance (e.g
bobcat numbers). In sh
are complex, difficult to
management solutions.

CARRYING CAPACI

BACKGROUND

The land can only support a limited number
before resources are depleted. Exceeding the
resources results in poor animal body condit
fawns surviving to adulthood, and eventual d
to the habitat. Therefore, understanding relat
between mule deer and their habitats is nece
understanding deer themselves.

Most livestock operators understand the con
carrying capacity, which is the number of ani
given amount of land can support sustainabl
or allotment can only feed a certain number
given year.

This concept also applies to wildlife. As anim
productivity and survival decline. The numb
determined by the available habitat – food, w
seasonally, annually, and over time in accord

THE INFLUENCE OF HABITAT

Mule deer habitat is affected by a combinatio
habitat fragmentation, spread of invasive pla
other human factors such as urban developm

Mule deer occur in a diverse set of environm
by habitat type. In much of their southern ra
factor to populations. In other climates, mul
thrive in young habitats, where forbs, grasses
and water are available for the forage plants
not change, mule deer carrying capacity can

Quality habitat increases fawn survival. This
because half of the fawns that survive to adul

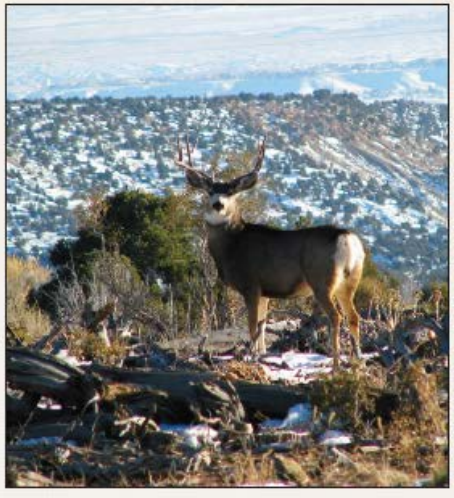
MONITORING

Because carrying capacity is always changing
Therefore, we monitor deer population perfo
appropriate for the amount and quality of av

UNDERSTANDING MULE DEER AND ANTLER POINT RESTRICTIONS

Fact Sheet #6

Antler restrictions are harvest restrictions that limit buck harvest to animals that meet specific antler criteria. The most common type of antler restriction is a point restriction. Antler point restrictions have been used as a harvest strategy with the hope they will increase the number of large-antlered bucks in a mule deer population. Experience of many states and provinces with antler point restrictions suggest this harvest strategy has very limited potential to produce more trophy bucks and could result in other unintended challenges.



BACKGROUND

Increasing the number of big-antlered bucks is typically the basis for hunter demands to implement antler point restrictions. The idea seems straightforward and promising; if we just don't allow hunters to harvest young bucks, they will grow older and bigger and be available for harvest later. Most western states and provinces have, at one point in time, employed some type of antler point restriction attempting to increase the number of "trophy" bucks in their herds.

THE GOOD

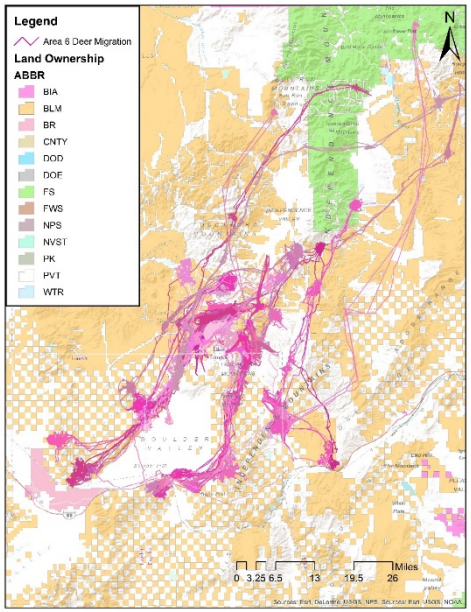
- Decreases hunter pressure and total buck harvest by discouraging some hunters who do not want to be restricted to a particular antler-sized buck. This can be beneficial when harvest is heavy in relation to the number of available bucks, but not heavy enough to warrant changing to limited quota seasons.
- In some cases, antler point restrictions have increased the proportion of bucks in the population, but this effect may not be long-lasting.
- In remote areas with limited access, antler point restrictions have been used in combination with general seasons to maintain hunter opportunity.

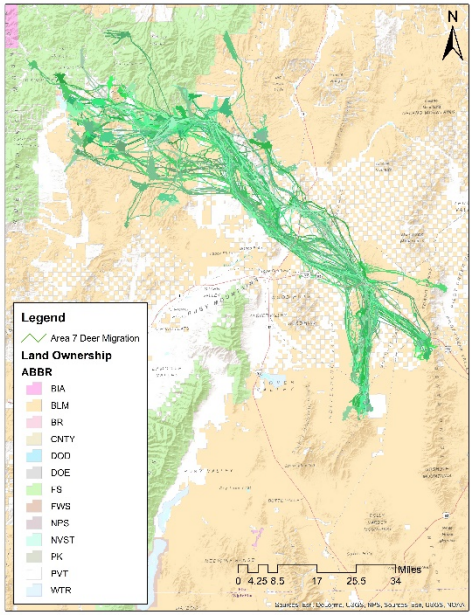
THE BAD

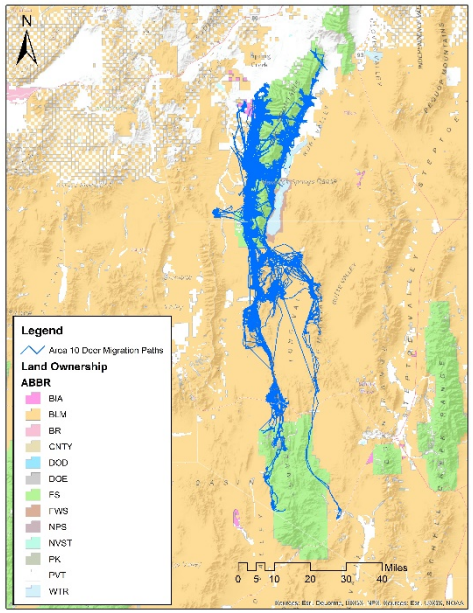
- Antler point restrictions focus all the hunting pressure on the oldest age classes of bucks, gradually decrease the average age of the buck segment of the population, and make it more difficult for bucks to reach the older age classes due to the displaced harvest pressure.
- Antler point restrictions have been shown to reduce the number of trophy bucks over time by protecting only the smaller-antlered young bucks.
- Antler point restrictions do not increase fawn production or population size. Even in herds with very low buck:doe ratios (<10:100), pregnancy rates are well over 90%. Large increases in buck ratios result in relatively few, or no, additional fawns.

Secretarial Order 3362

- Released by Department of Interior (DOI) February 9, 2018
- Improving Habitat Quality in Western Big-Game Winter Range and Migration Corridors
- Called for 11 Western States to work collaboratively with BLM, FWS, and NPS to prioritize winter range habitats and migration corridors for mule deer, pronghorn, and elk







Secretarial Order 3362

- Nevada hosted a workshop along with partners from USGS, Wyoming Migration Initiative, and NV Chapter of TWS
- Provided training for biologist to run advanced statistical models using Brownian Bridge Movement Models
- Policy forum for land management agencies, university faculty and biologists from other states
- Representatives from UT, AZ, and Wyoming attended

Conclusions

- Mule deer populations have fluctuated widely over the past century across many Western States, including Nevada
- Populations have experienced a downward trend in Nevada and many other states
- Several issues have been identified as causal factors including:
  - Changes in habitat quality
  - Fire regimes
  - Impacts to migration corridors
  - Predation
  - Climate change and severe droughts

Conclusions

- Mule deer have highly evolved digestive systems that require diverse diets that are low in plant cellulose and high in crude protein
- Mule deer are limited by density dependent factors that regulate population growth rate
- Predation can be limiting factor under certain conditions (generally when populations are below K)
- Indicators of population at or above K include:
  - poor body condition
  - reduced fawn recruitment
  - pauses in reproduction
  - Increased tooth wear at younger ages