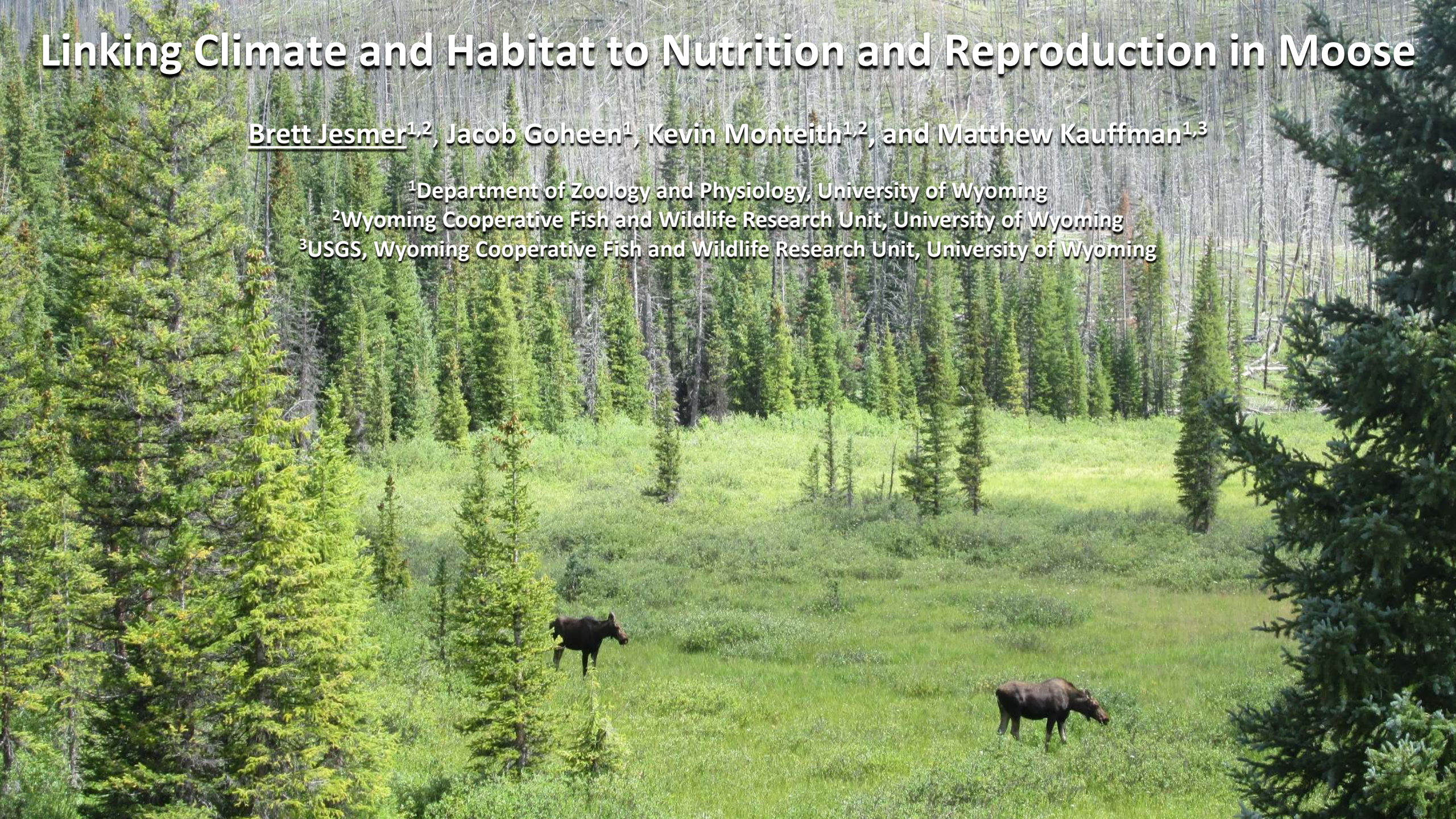
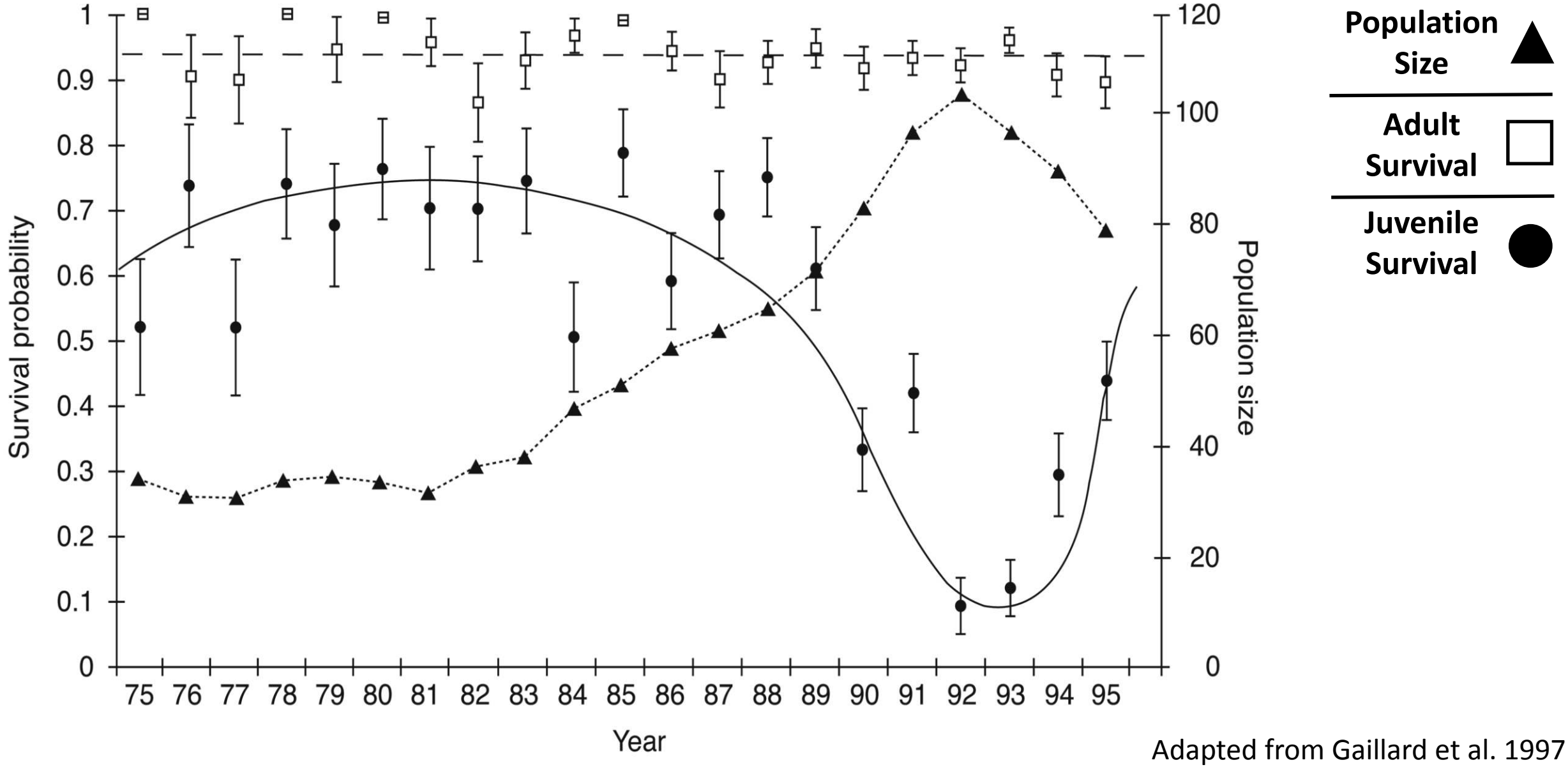
Linking Climate and Habitat to Nutrition and Reproduction in Moose

Brett Jesmer[1,2], Jacob Goheen[1], Kevin Monteith[1,2], and Matthew Kauffman[1,3]

[1]Department of Zoology and Physiology, University of Wyoming
[2]Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming
[3]USGS, Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming

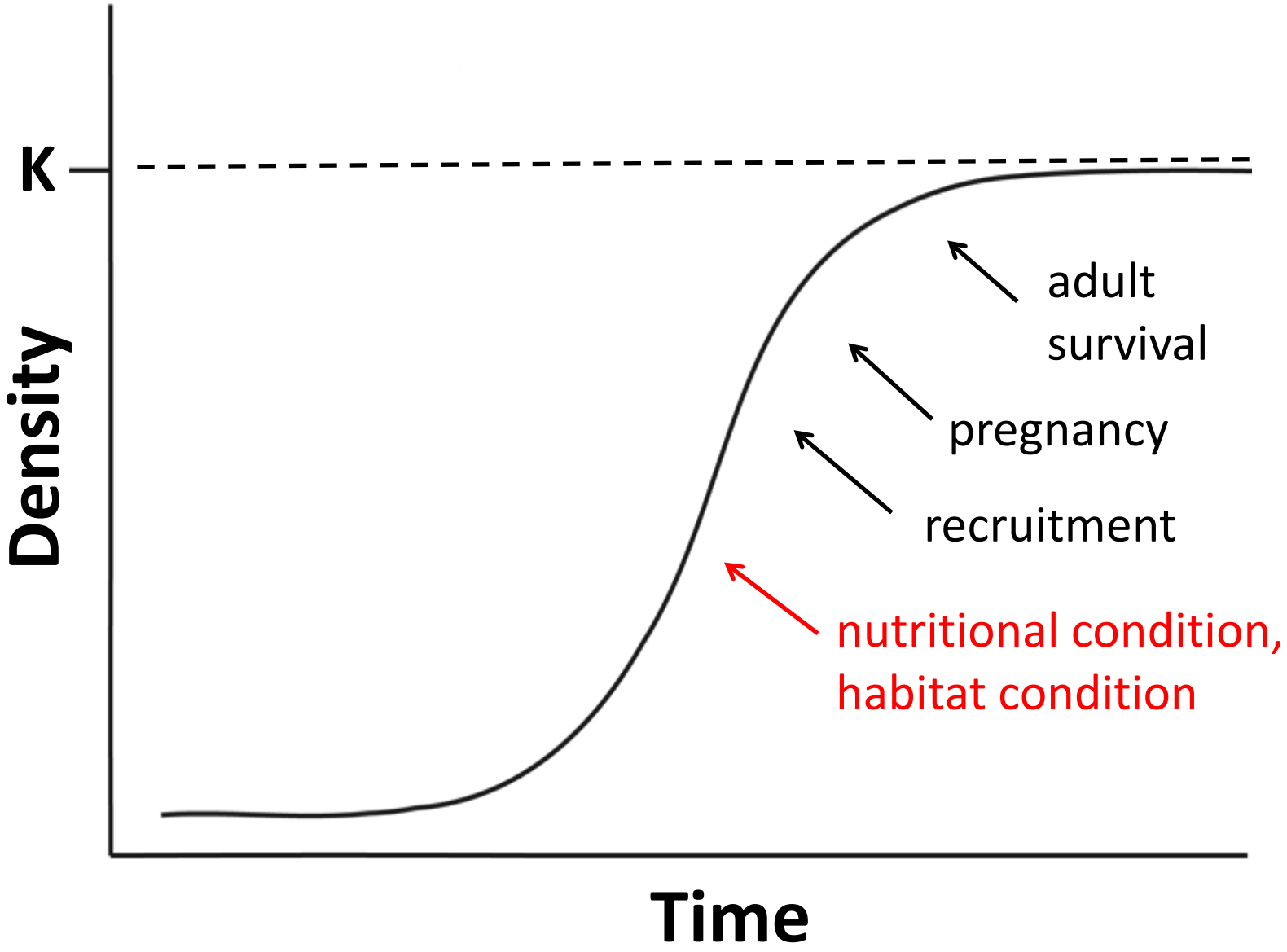


Density-Dependence



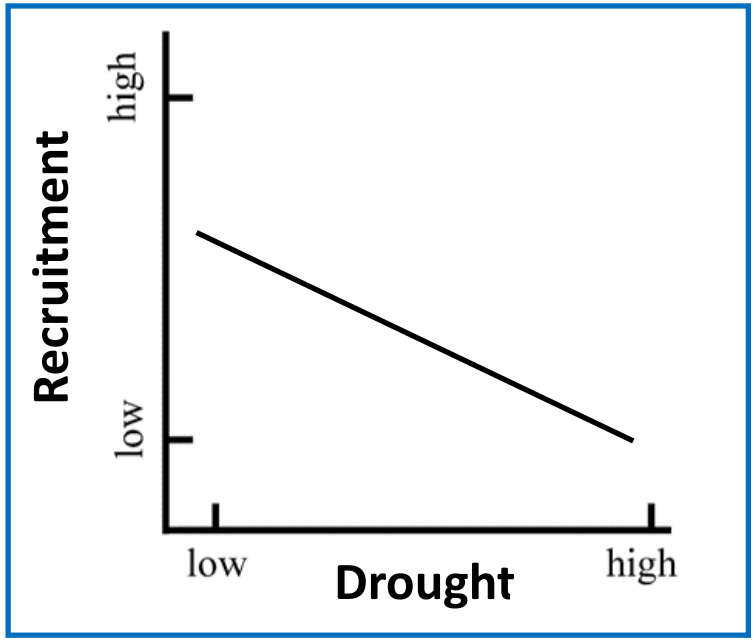
Adapted from Gaillard et al. 1997

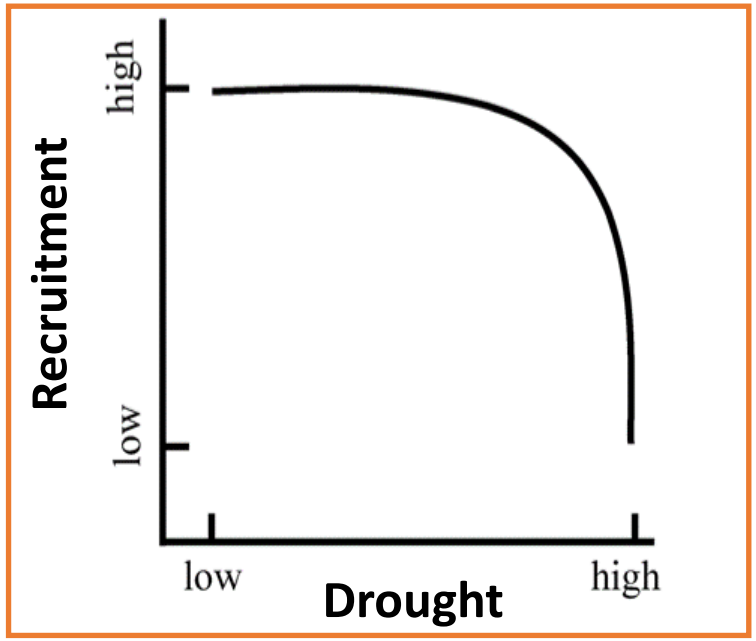
Density-Dependence and Life History

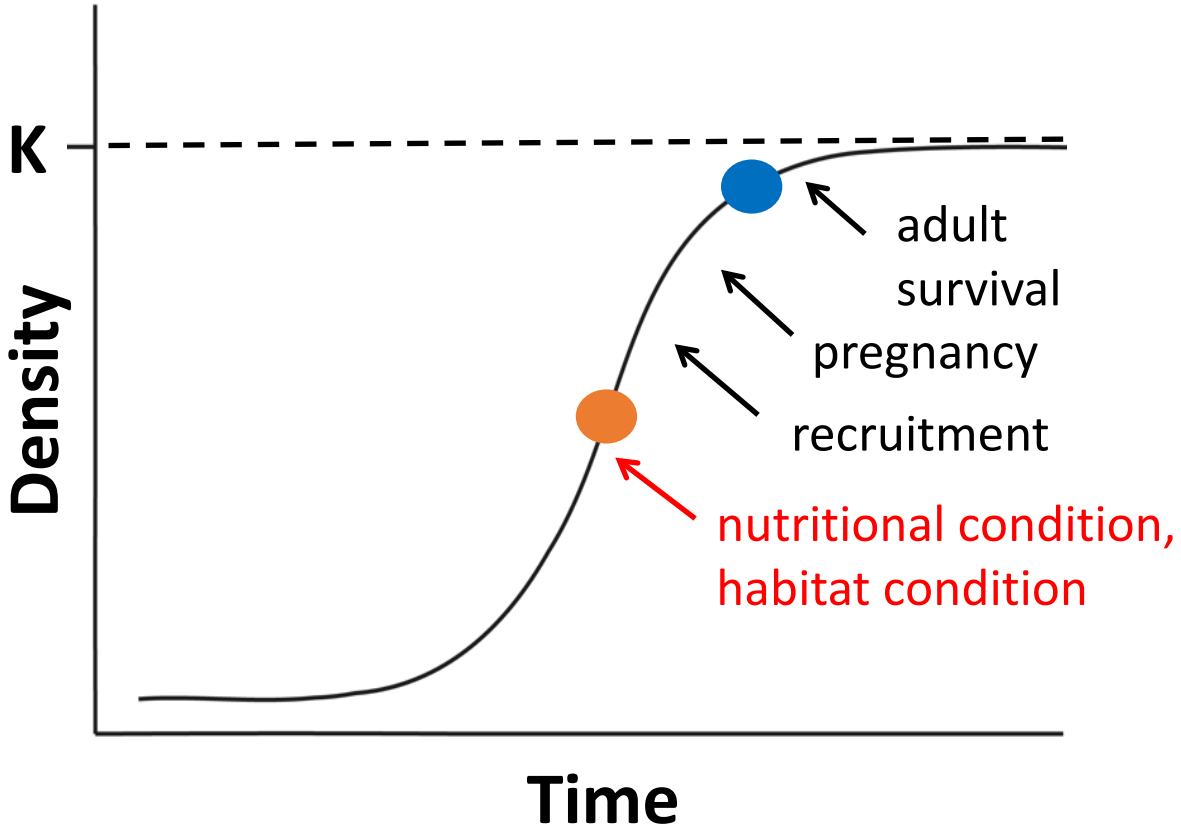


Eberhardt 2002, Keech et al. 2000, Boertje et al. 2007

Density-Dependence and Density-Independence



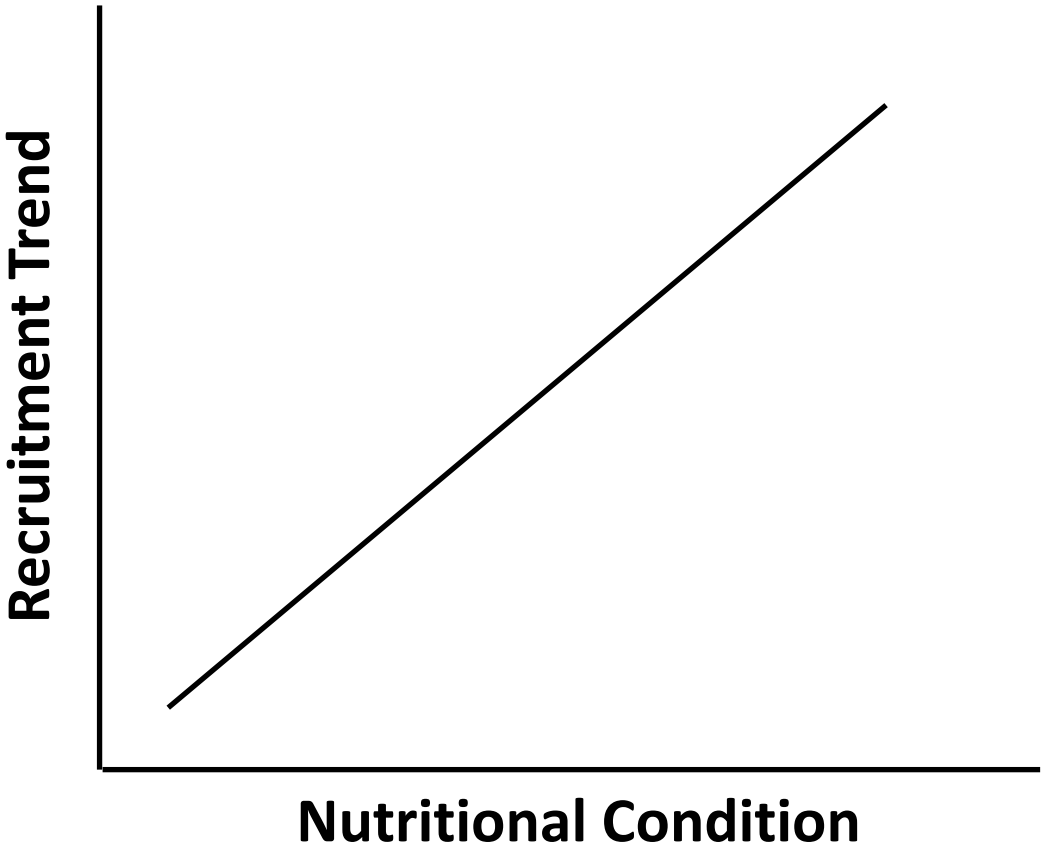




Adapted from Bowyer et al. 2000

Hypotheses and Predictions

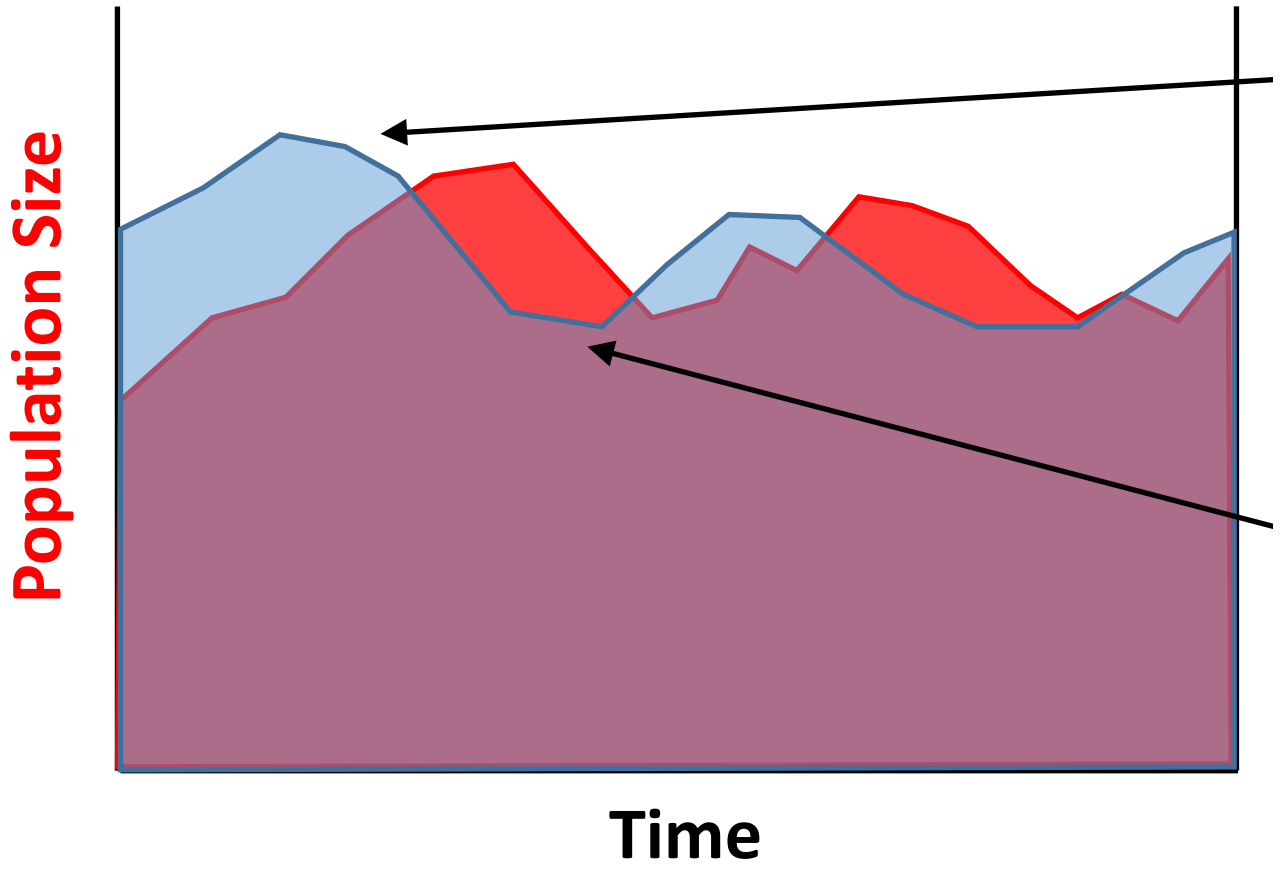
Density-Dependence Hypothesis: Populations with increasing calf recruitment are in good nutritional condition (i.e., below carrying capacity).



Boertje et al. 2007

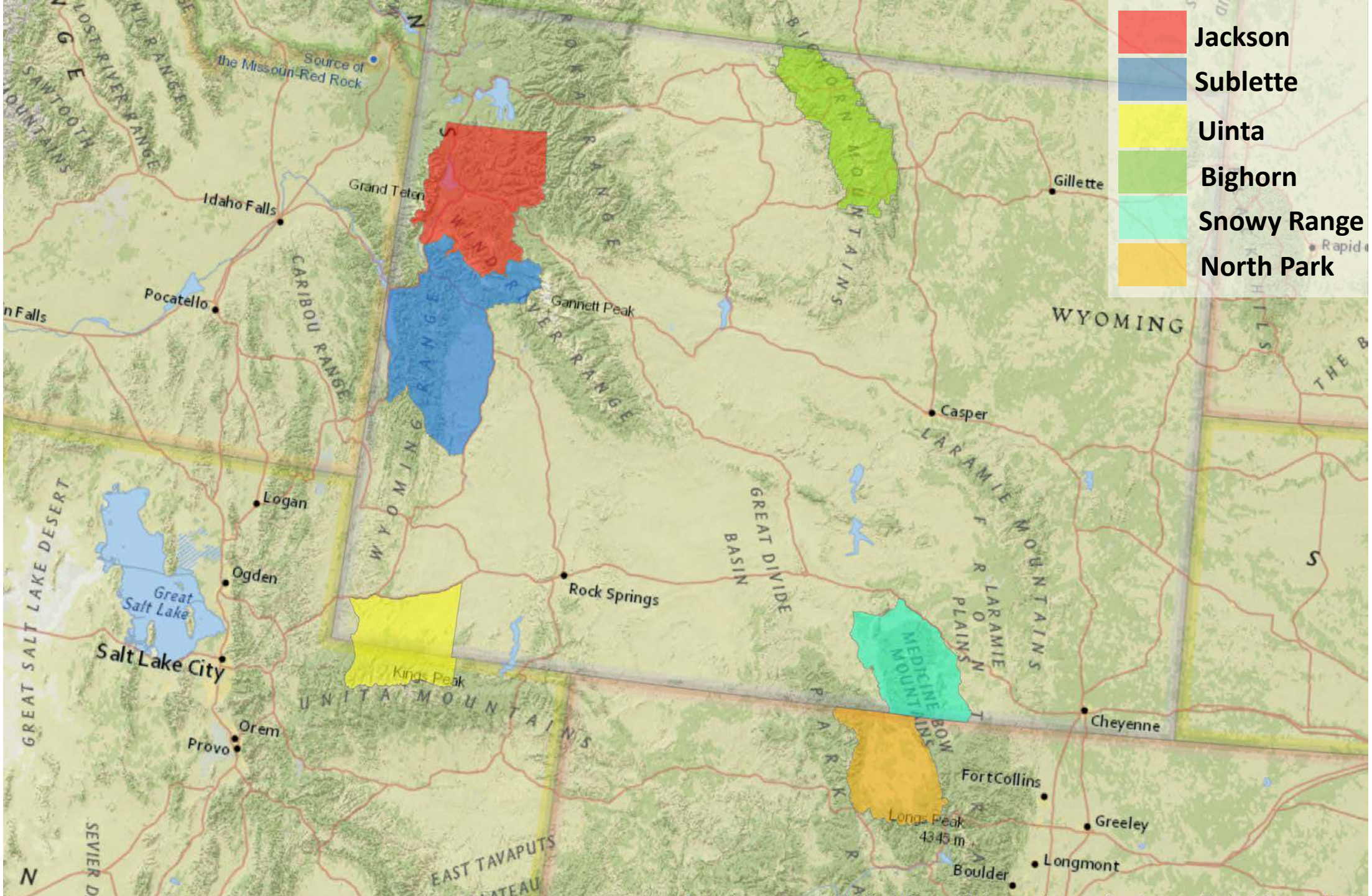
Hypotheses and Predictions

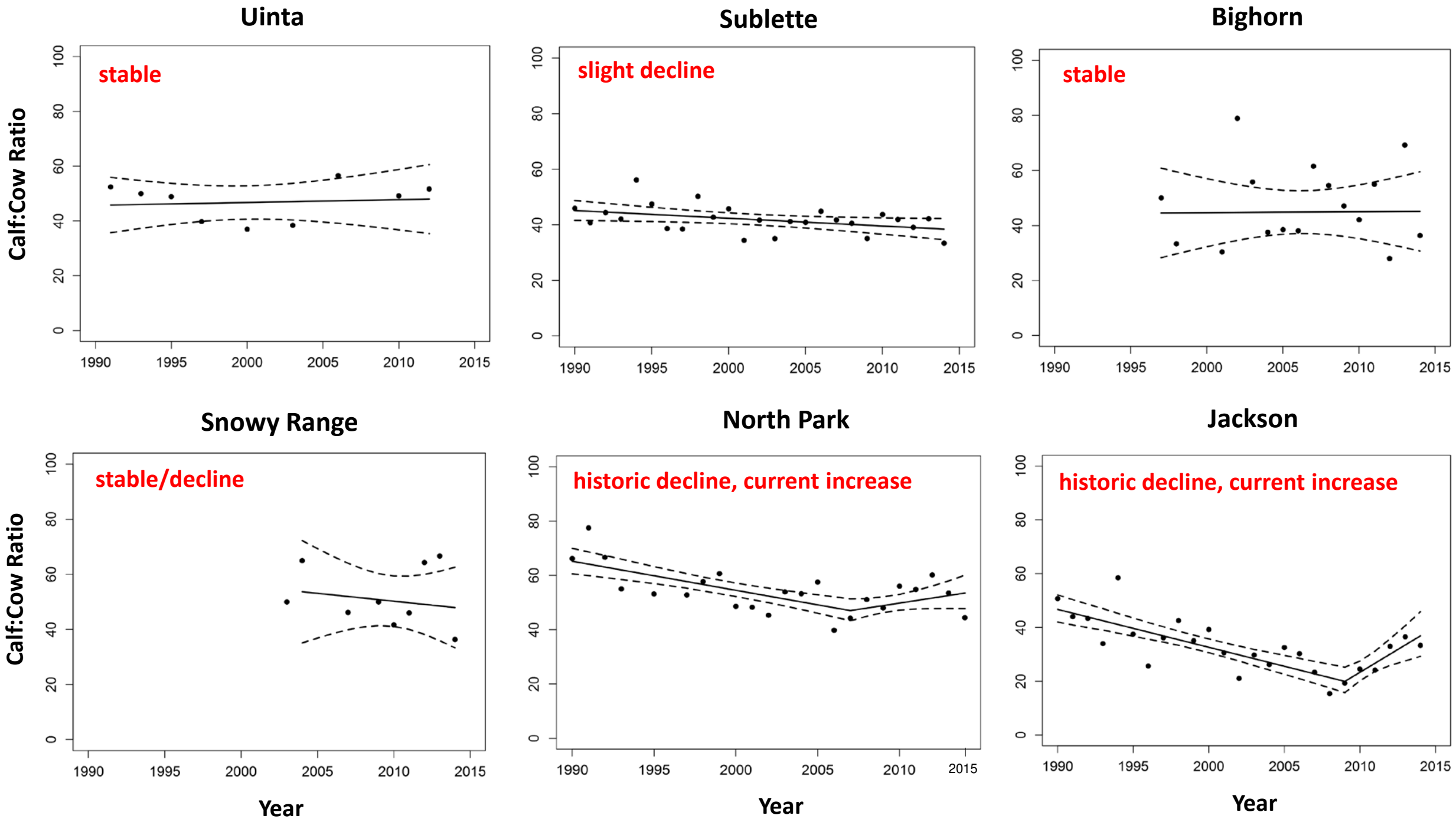
Nutritional Buffer Hypothesis: For populations closer to nutritional carrying capacity, recruitment is sensitive to climatic variation.



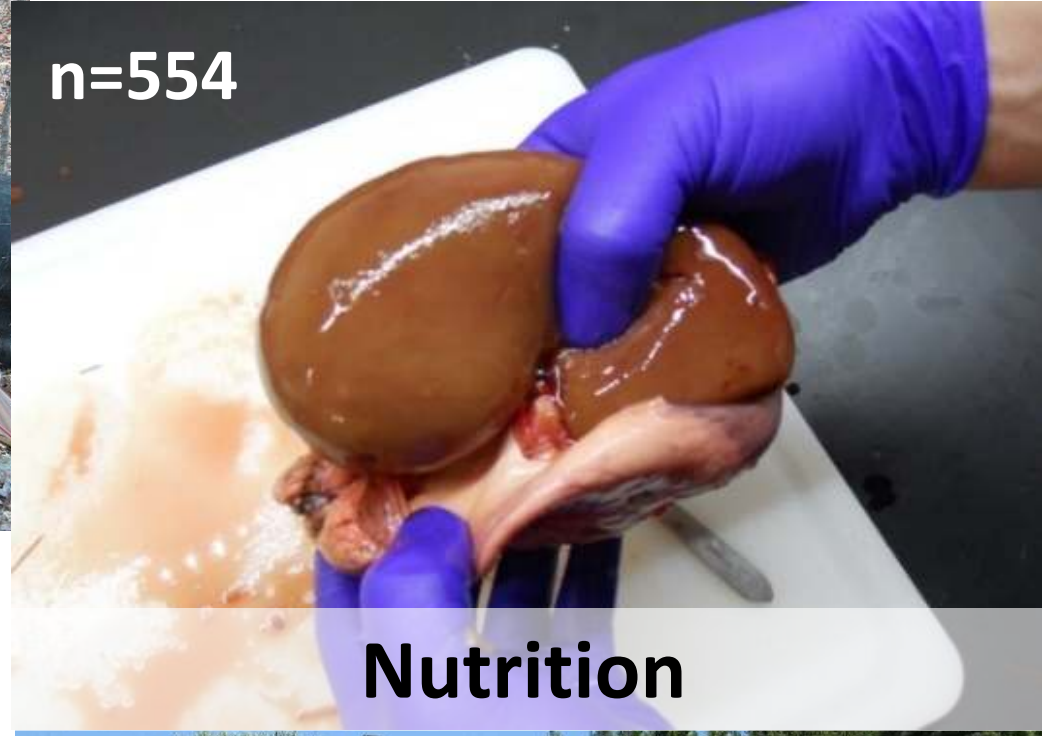
Nutritional Carrying Capacity

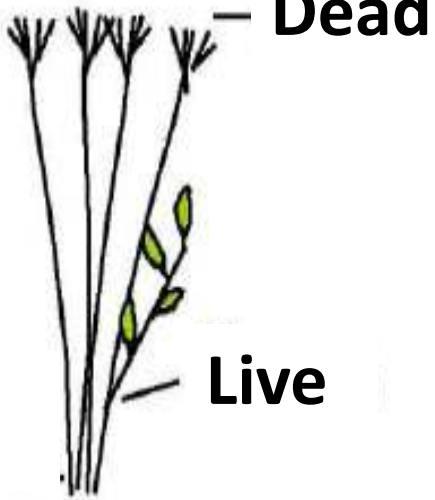
McCullough 1999, Monteith et al. 2015


Jackson
Sublette
Uinta
Bighorn
Snowy Range
North Park
Source of the Missouri-Red Rock
Idaho Falls
Grand Teton
Pocatello
Gannett Peak
Gillette
WYOMING
Casper
Logan
Ogden
Great Salt Lake
Salt Lake City
Rock Springs
Kings Peak
Orem
Provo
Cheyenne
Fort Collins
Greeley
Longs Peak
4345 m
Boulder
Longmont
GREAT SALT LAKE DESERT
CARIBOU RANGE
WIND RIVER RANGE
WYOMING RANGE
BIGHORN MOUNTAINS
GREAT DIVIDE BASIN
LARAMIE MOUNTAINS
LARAMIE PLAINS
MEDICINE BOW MOUNTAINS
UINTA MOUNTAINS
EAST TAVAPUTS PLATEAU
SEVIER D
SAWTOOTH MOUNTAINS
LOST RIVER RANGE
N

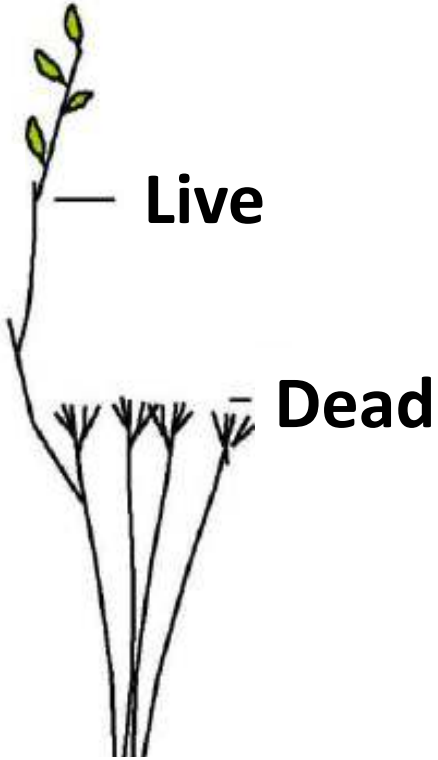

Uinta
stable
Sublette
slight decline
Bighorn
stable
Snowy Range
stable/decline
North Park
historic decline, current increase
Jackson
historic decline, current increase
Calf:Cow Ratio
Calf:Cow Ratio
Year
Year
Year
0
20
40
60
80
100
1990
1995
2000
2005
2010
2015

Recruitment



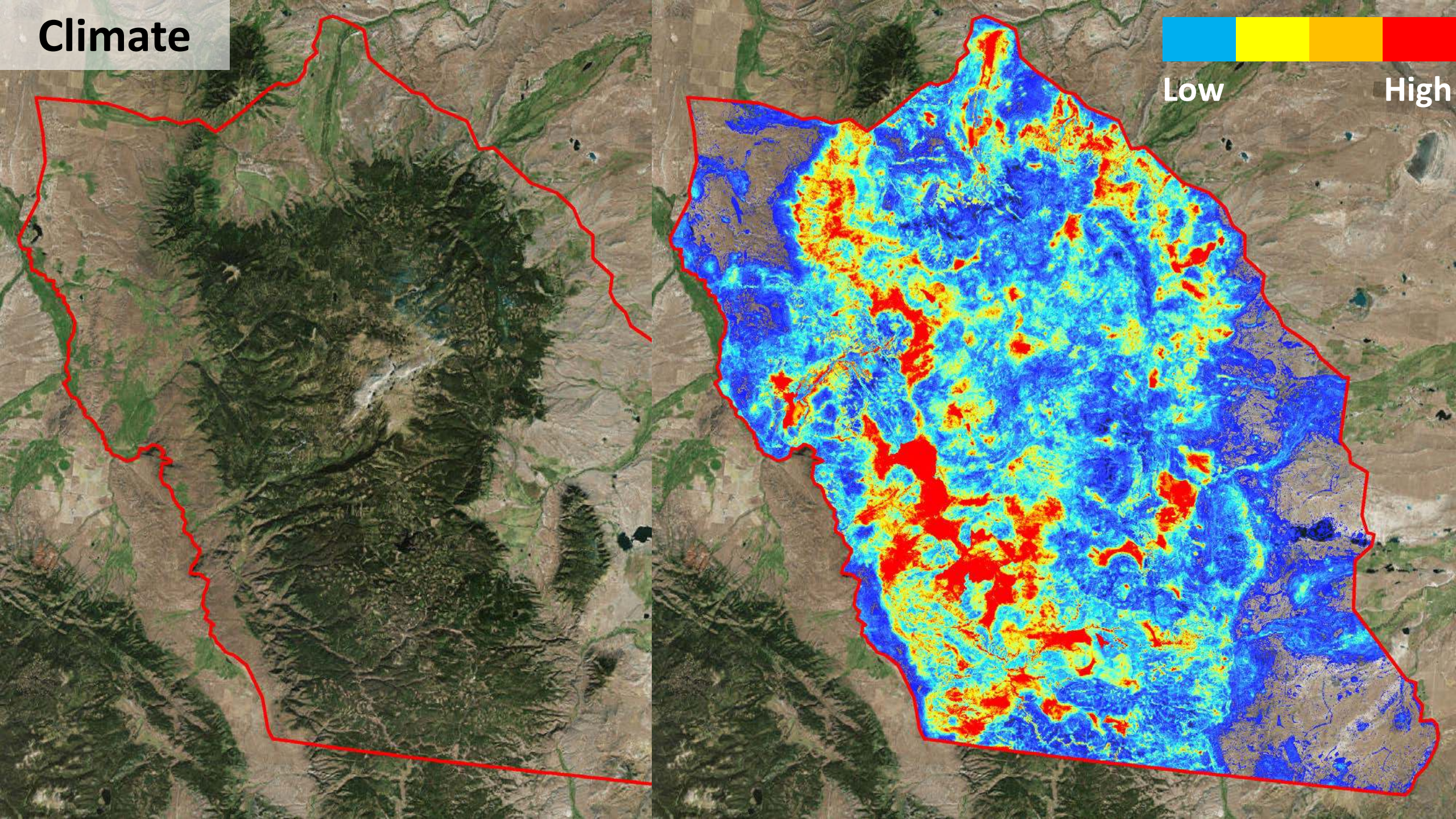


LD index < 0

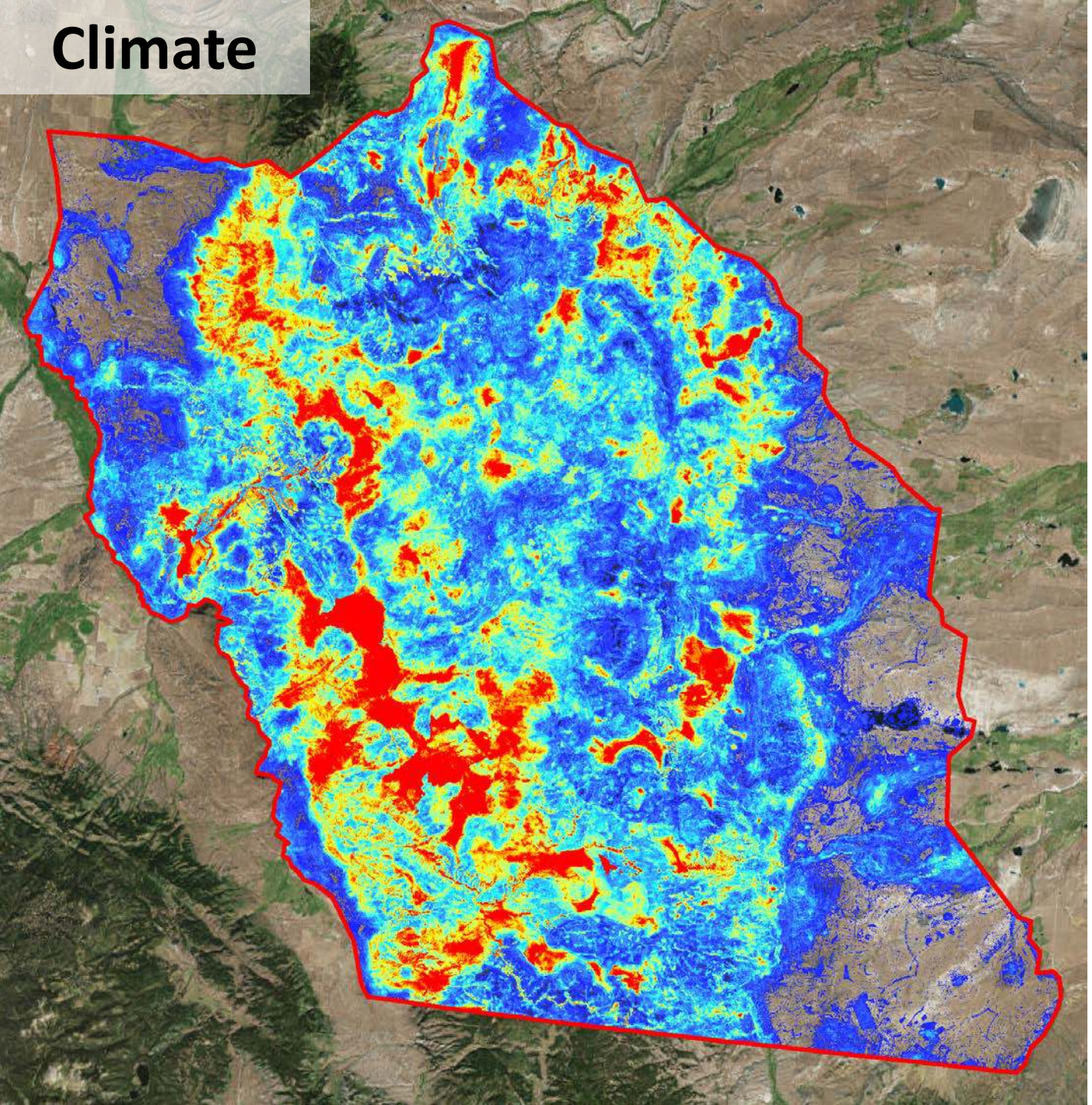


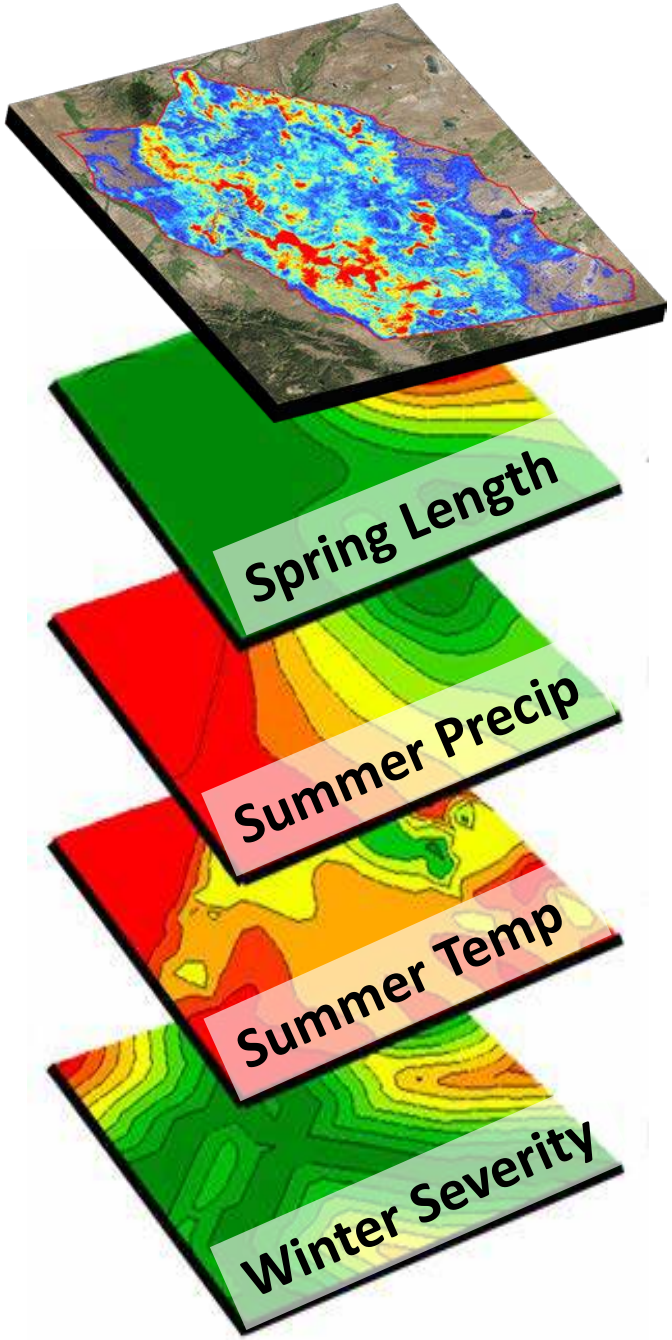
LD index > 0

Climate

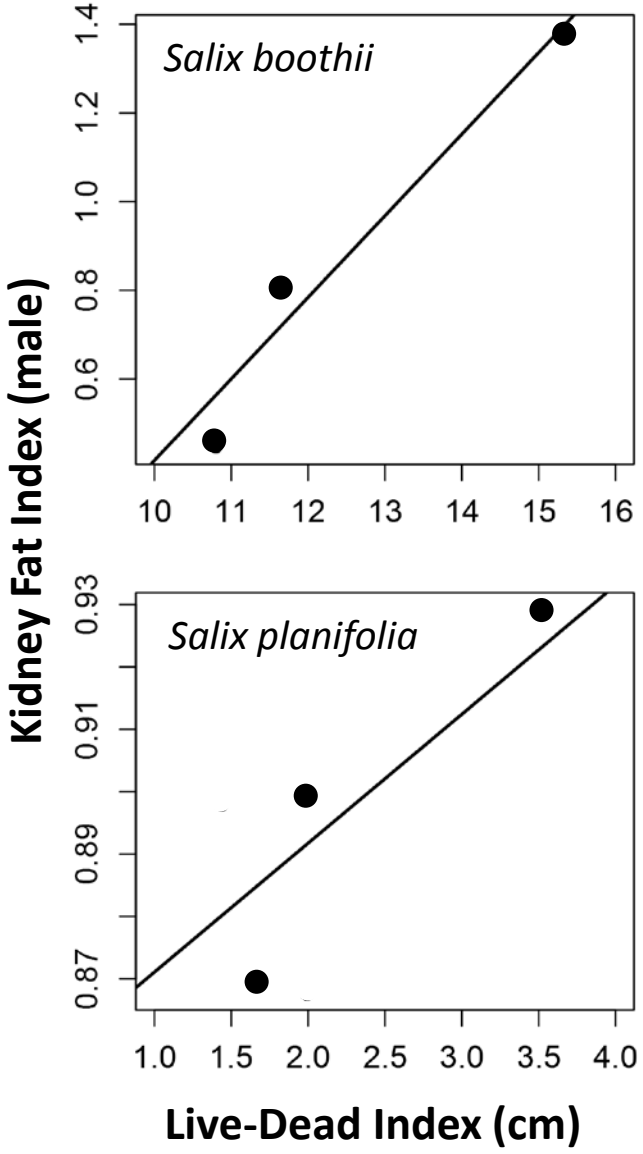


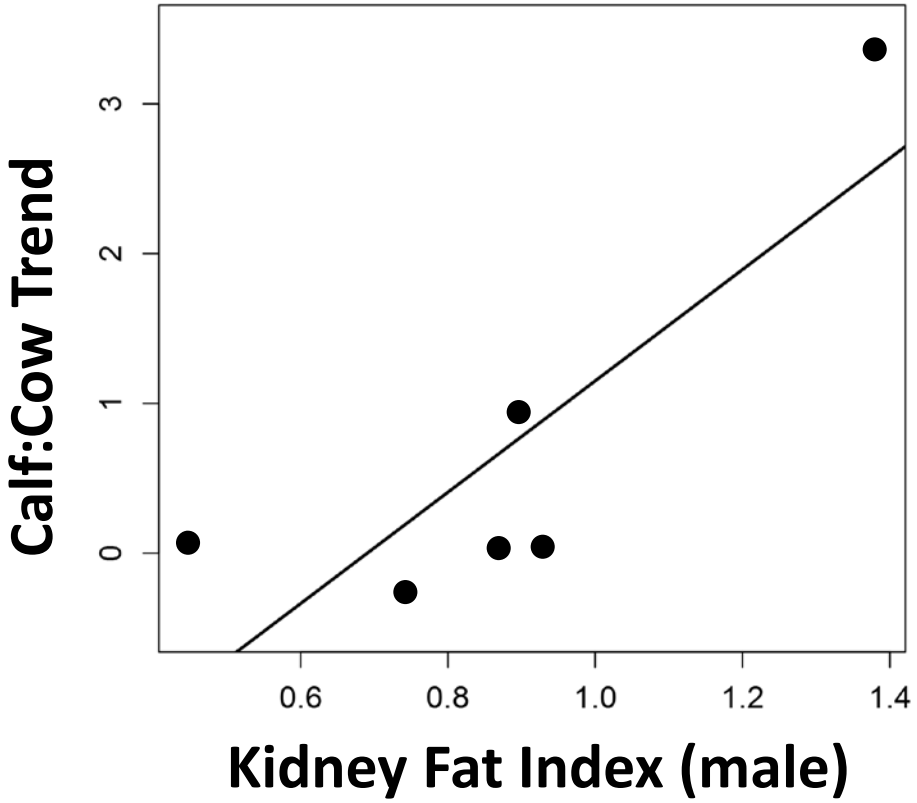
Climate

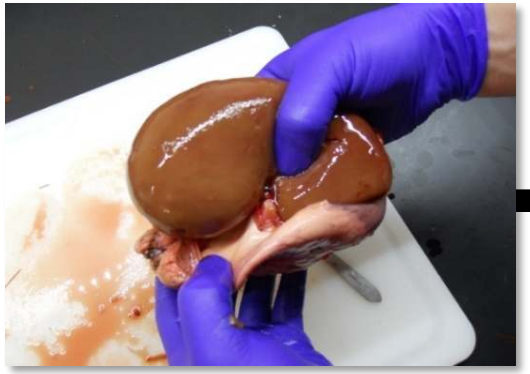




Support for the Density-Dependence Hypothesis

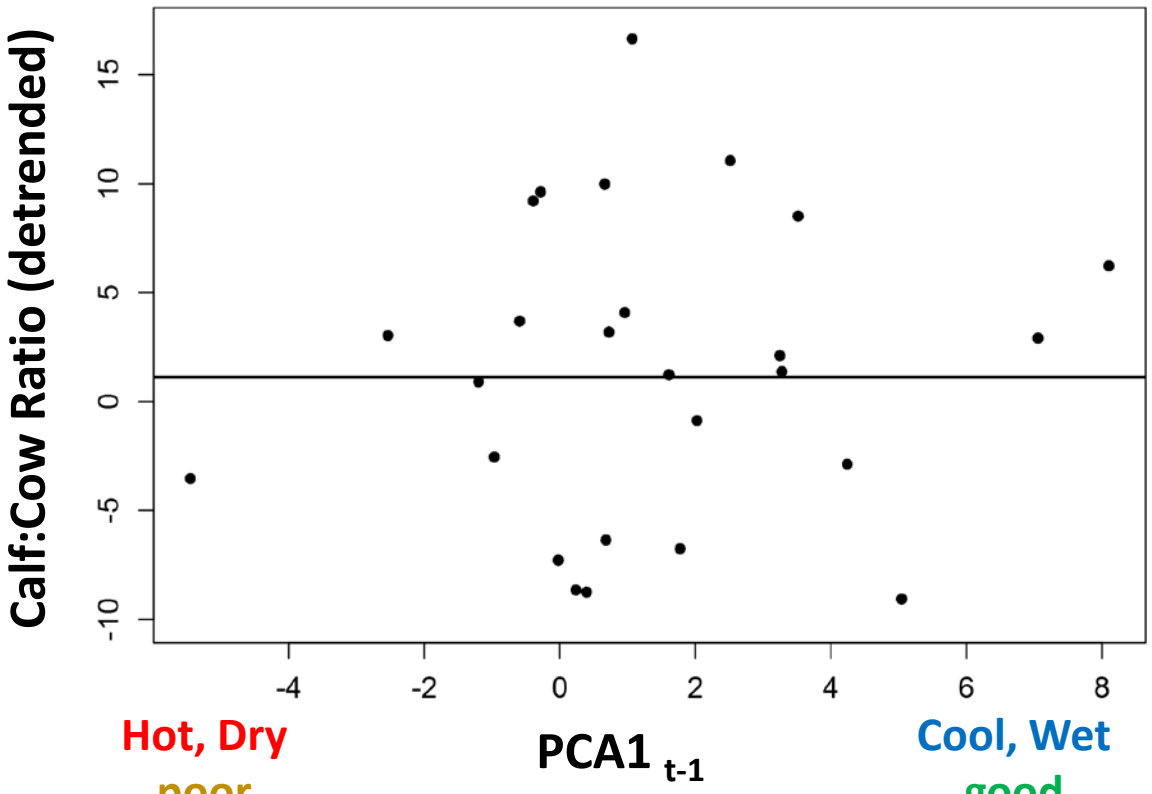






Support for the Nutritional Buffer Hypothesis

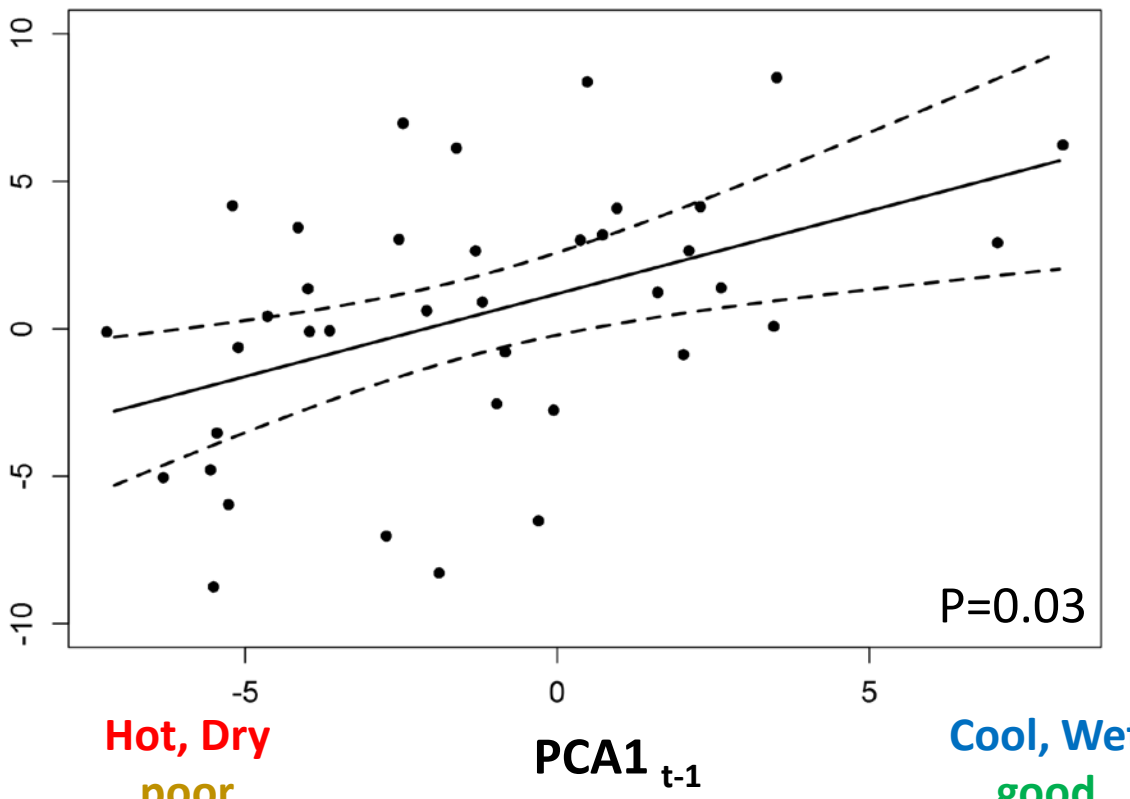
Stable Populations



Hot, Dry
poor
growing
conditions

Cool, Wet
good
growing
conditions

Declining Populations

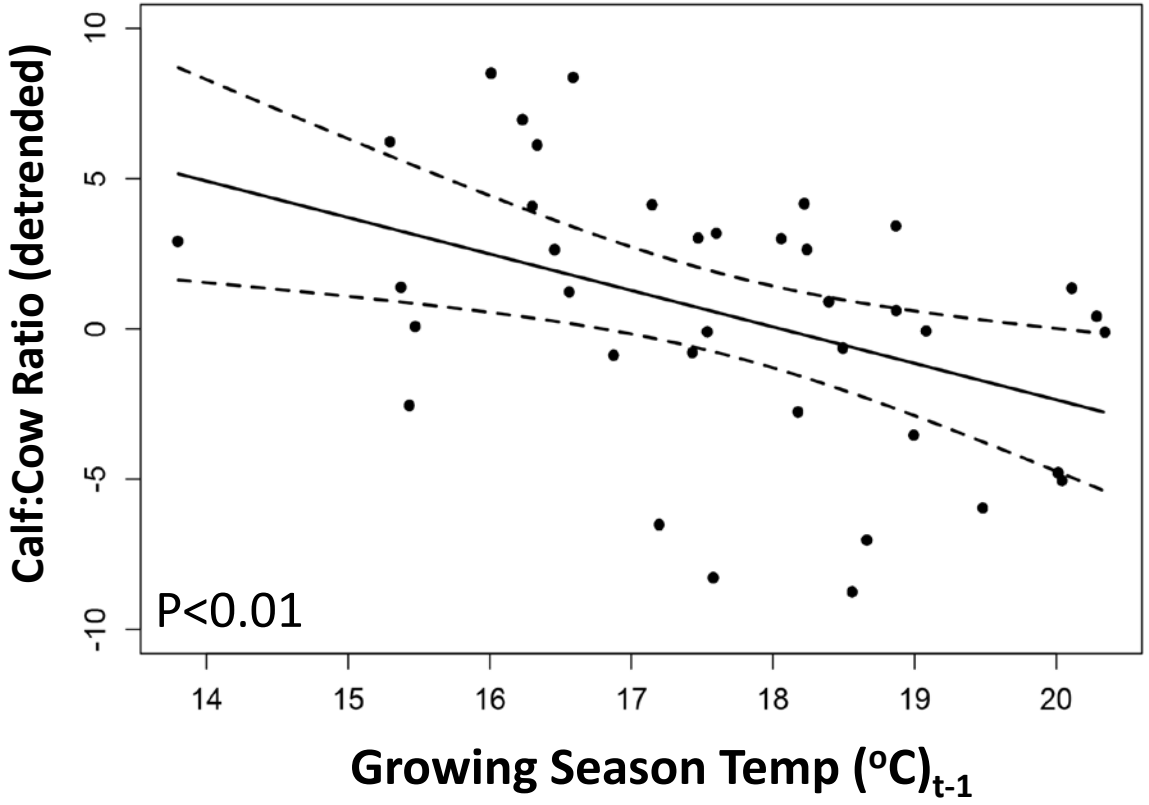


Hot, Dry
poor
growing
conditions

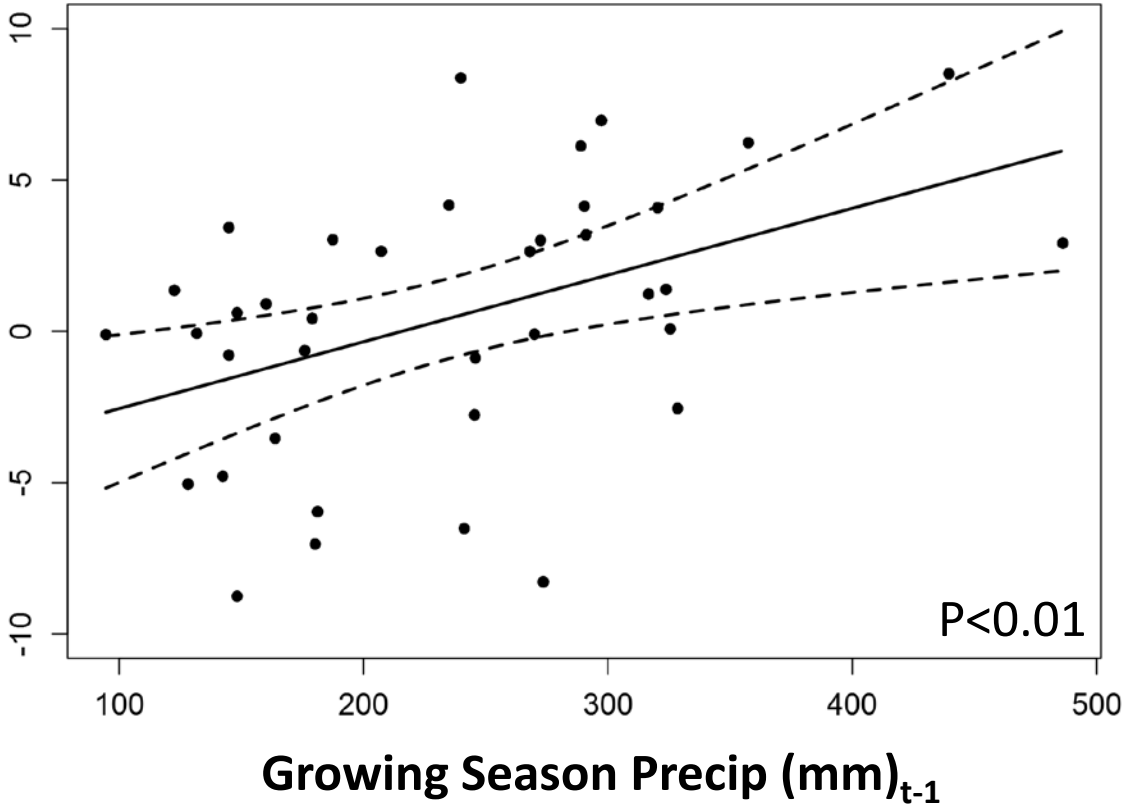
Cool, Wet
good
growing
conditions

Support for the Nutritional Buffer Hypothesis

Declining Populations



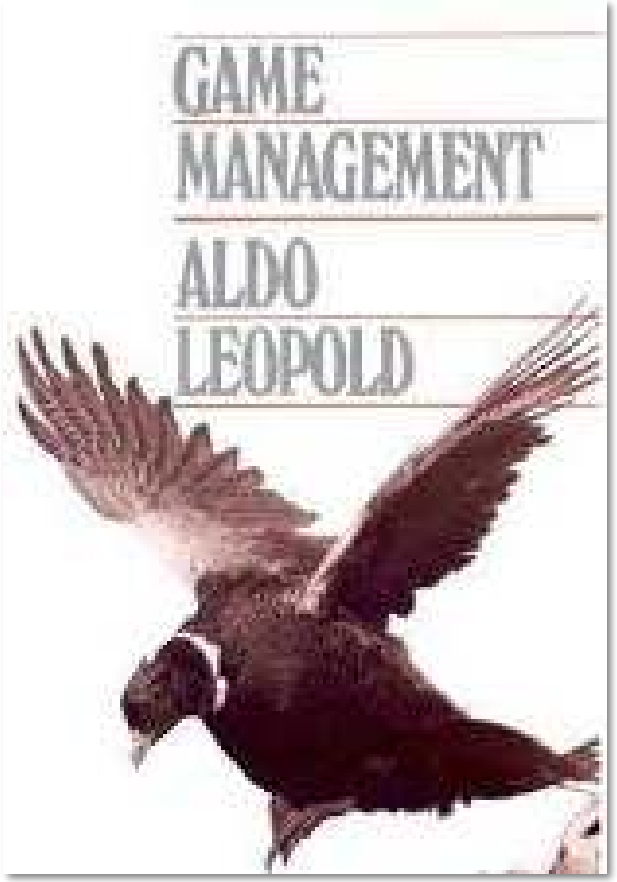
Declining Populations



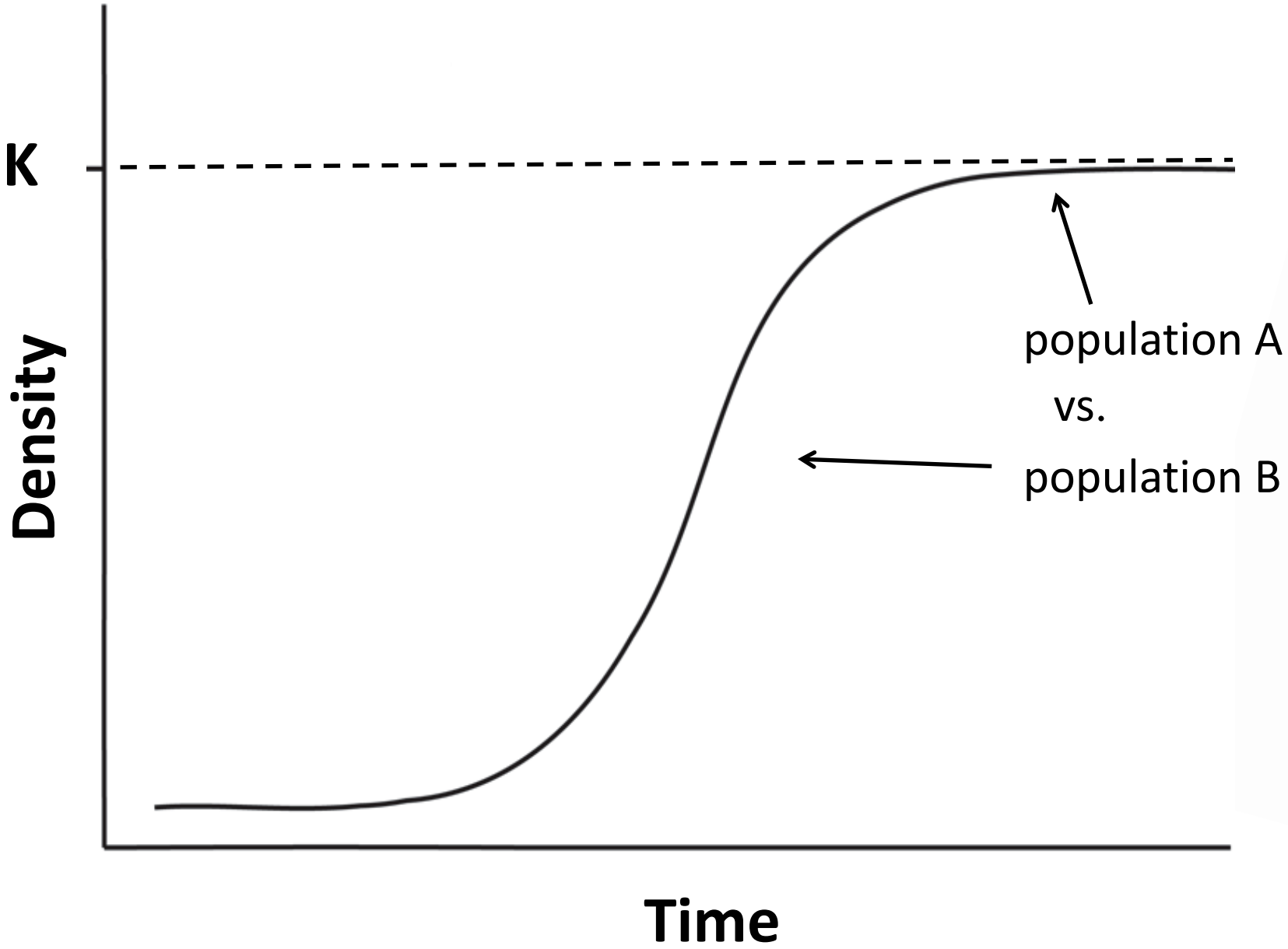
Management Applications

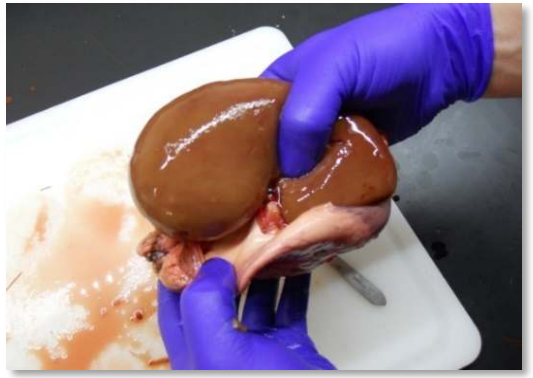
Aldo Leopold. Game Management. 1933

"[wildlife] management boiled down to its essentials is the control of population density… and is essential to successful practice."

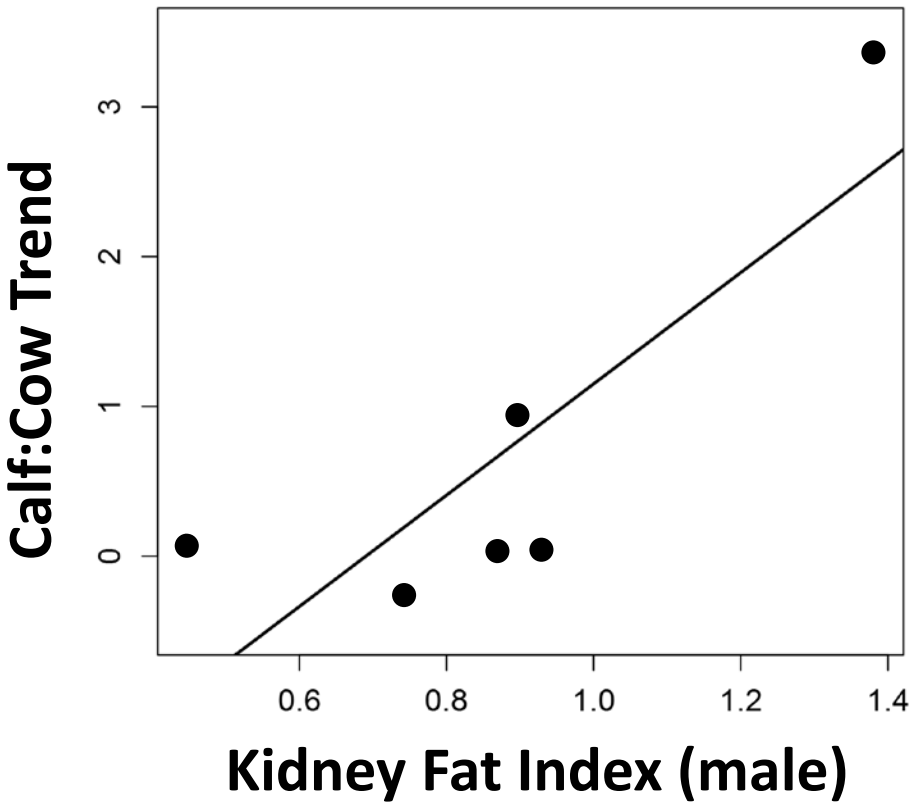


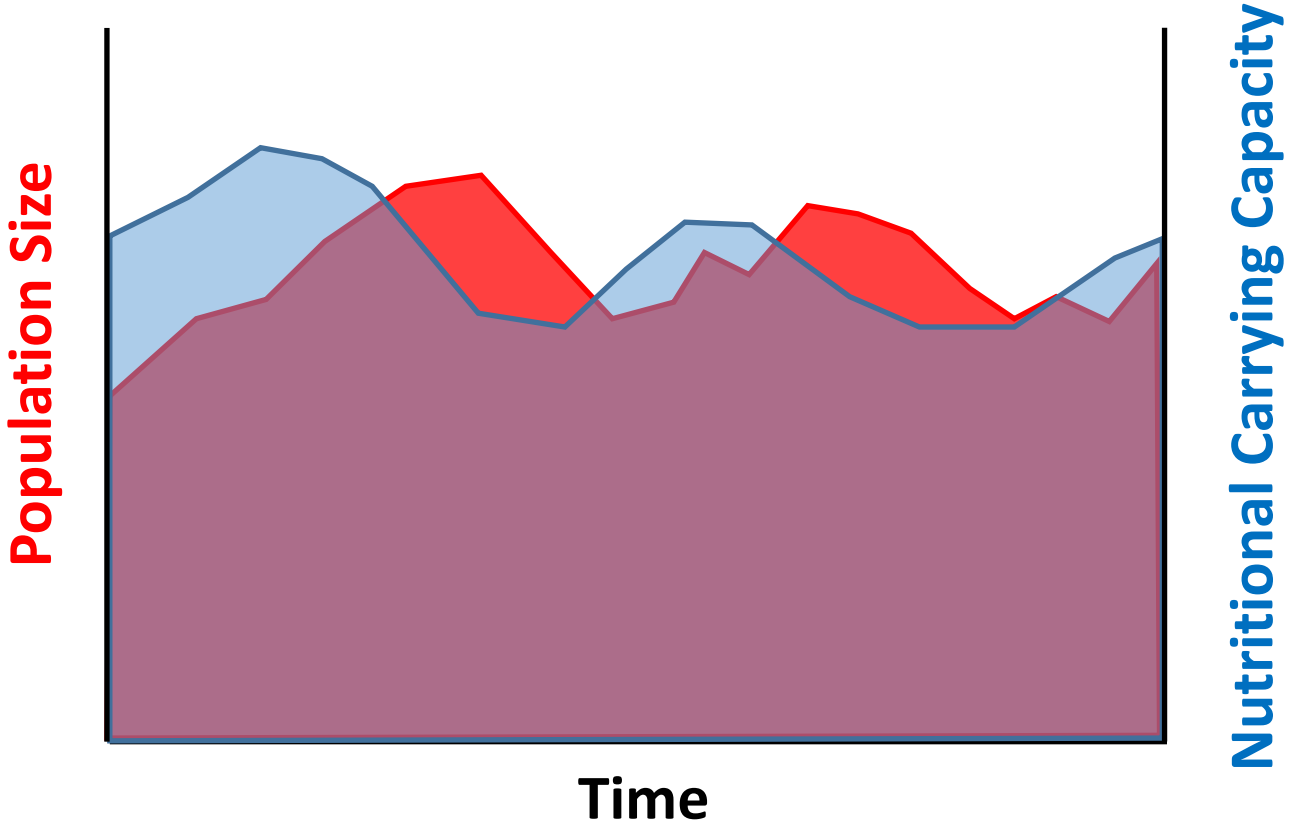
Management Applications





Management Applications





Partners and Funding

WGFD
Gary Fralick
Scott Smith
Aly Courtemanch
Dean Clause
Mark Zornes
Jeff Short
Tim Thomas
Dan Theile
Doug Brimeyer
Tim Fuchs
Terry Creekmore
Will Shultz
Ben Wise
Jill Randall
Bert Jellison
Travis Cundy
Steve Kilpatrick
Bob Lanka
Grant Frost
And Many Others!

CPW
Jeff Yost
Josh Dilley
Jeremiah Rummel
Shannon Schwab
Darby Finley

USFS
Meg McElveen (MRNF)
Kerry Murphy (BTNF)
Joe McFarlane (WCUNF)
Luke Decker (BNF)

USFWS
Ann Timberman (AWR)
Lizzy Berkley (AWR)
Eric Cole (NER)

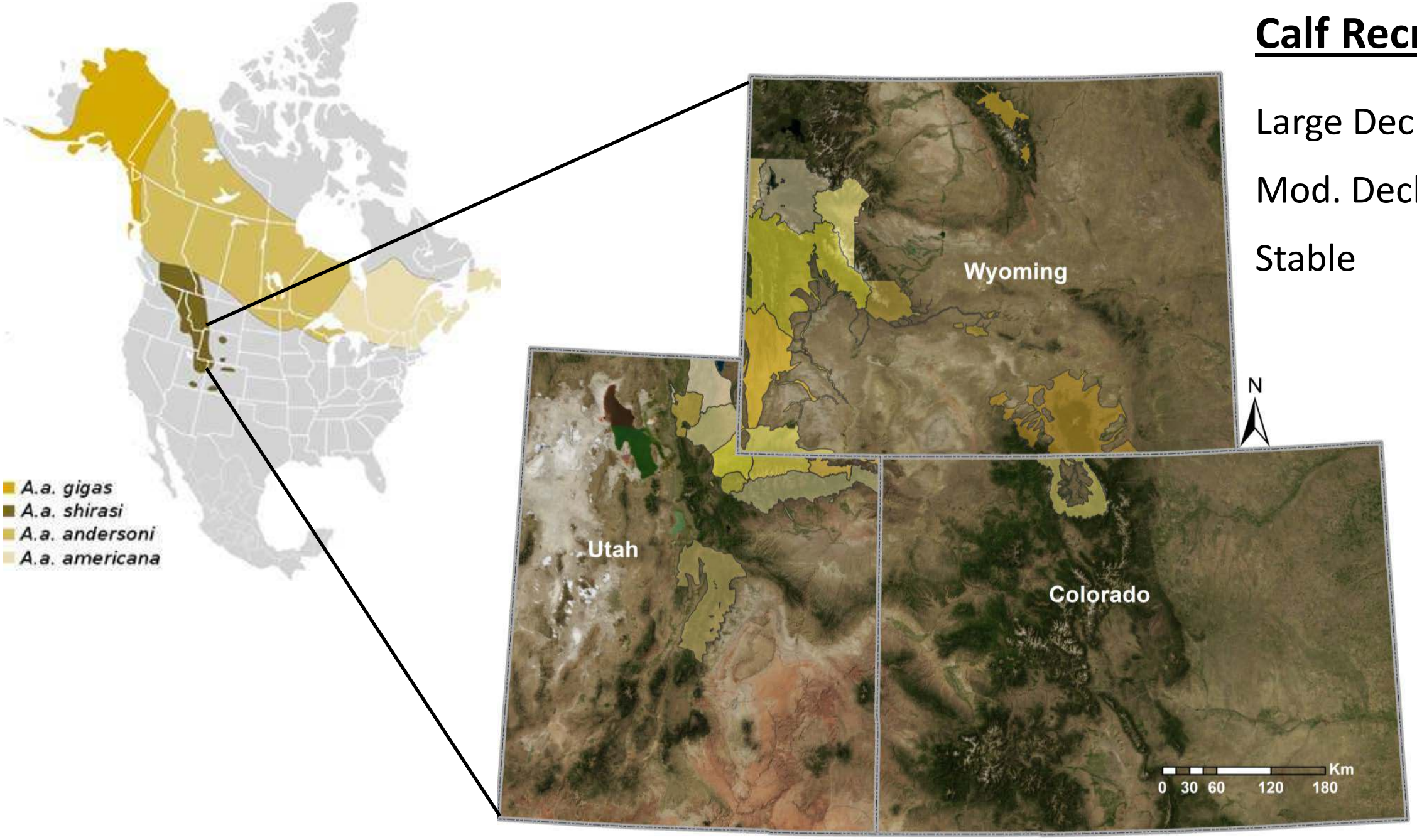
NPS
Sarah Dewey

Lab Mates
Jerod Merkle
Brendan Oates

Contributors
Wyoming Game and Fish Department
WY NASA Space Grant Consortium
UWYO- NPS Research Center
Colorado Parks and Wildlife
NSF-DDIG

Questions?

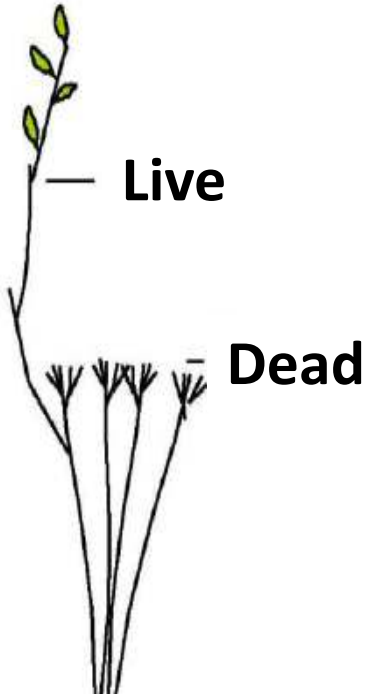
Calf Recruitment



Monteith et al. 2015

Additional Pieces of the Puzzle (Cont'd Work)

Quantity (winter) vs. **Quality (winter & summer)**



LD index

Additional Pieces of the Puzzle (Cont'd Work)

Pregnancy