

# U.S. Department of the Interior Bison Conservation Science Initiative

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Wildlife Conservation Society*

*Species of Common Conservation Concern:  
Continental Scale Bison Conservation*

XXI Meeting of Trilateral Committee for Wildlife & Ecosystem Conservation & Management  
Ottawa, Canada May 19, 2016





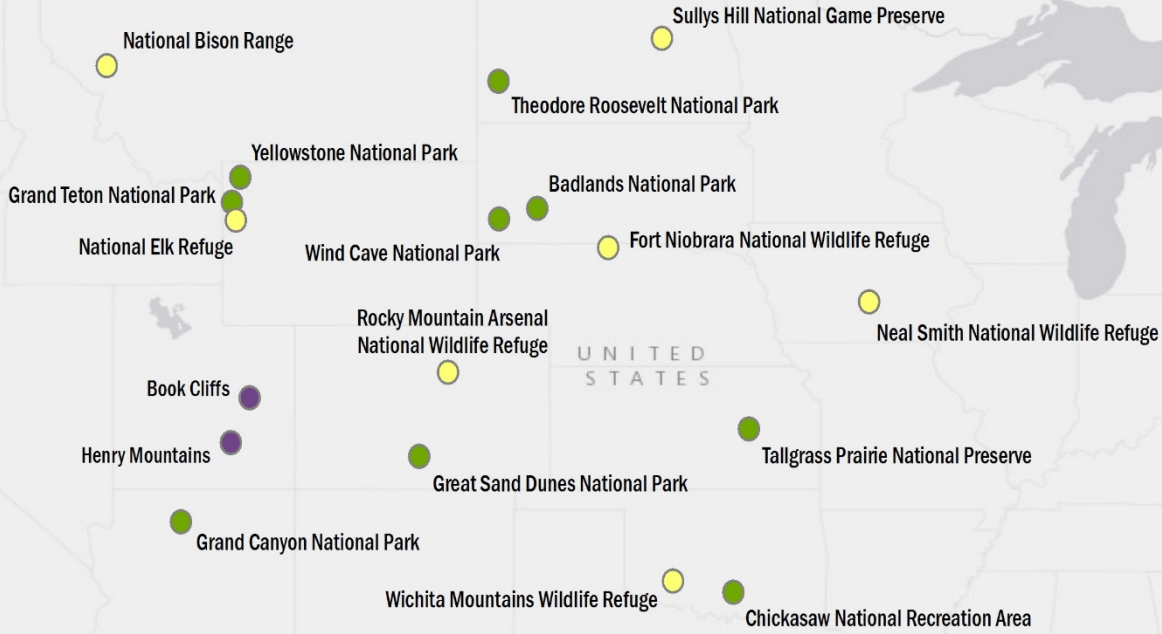
WCS – NPS Task Agreement  
Bison Conservation Science  
Initiative Partners



# 19 DOI Bison Herds



-  Fish & Wildlife Service
-  National Park Service
-  Bureau of Land Management



# DOI Bison Portfolio

Agency	# Herds	Approx. # Bison	Approx. Area (ac)
National Park Service	10	9,740	2,897,180
US Fish and Wildlife Service	7	2,340	468,240
Bureau of Land Management	2	775	1,700,000
<b>Total</b>	<b>19</b>	<b>12,055</b>	<b>4,705,420</b>



# DOI Bison Portfolio

Herd Name	State	Managing Agency	Fenced or Ranging	Approx. Herd Size	Approx. Area Size (ac)
Book Cliffs	UT	BLM / UT DWR	Ranging	450	1,400,000
Henry Mountains				325	300,000
Fort Niobrara National Wildlife Refuge	NE	FWS	Fenced	350	17,000
National Bison Range	MT	FWS	Fenced	380	19,000
Neal Smith National Wildlife Refuge	IA	FWS	Fenced	70	700
Rocky Mtn. Arsenal National Wildlife Refuge	CO	FWS	Fenced	75	12,000
Sullys Hill National Game Preserve	ND	FWS	Fenced	25	540
Wichita Mountains National Wildlife Refuge	OK	FWS	Fenced	640	59,000
Grand Teton Nat'l Park / Nat'l Elk Refuge	WY	NPS / FWS	Ranging	800	360,000
Badlands National Park	SD	NPS	Fenced	650	64,000
Chickasaw National Recreation Area	OK	NPS	Fenced	10	80
Grand Canyon National Park / House Rock	AZ	NPS / AZ G&F	Ranging	300	23,000
Tallgrass Prairie National Preserve	KS	NPS	Fenced	20	1,100
Theodore Roosevelt National Park	ND	NPS	Fenced	500	71,000
Wind Cave National Park	SD	NPS	Fenced	450	28,000
Wrangell-St. Elias National Park and Preserve	AK	NPS / AK F&G	Ranging	110	100,000
Yellowstone National Park	MT WY	NPS	Ranging	4,900	2,200,000
Great Sand Dunes Nat'l Park and Preserve	CO	TNC / NPS	Fenced	2,000	50,000

# DOI Bison Science Initiative Goals

- ▶ Build Collaborative Science & Stewardship Team
- ▶ Establish standardized baseline herd genetic/demographic data for population viability analyses and modeling
- ▶ Identify key bison conservation threats, opportunities & meta-population management approaches
- ▶ Develop collaborative management strategies
- ▶ Develop adaptive management evaluation methods
- ▶ Communications and Outreach / Human Dimensions



# 2016 Objectives

- ▶ Engage collaborators, science collaboration group; refine key science and management questions
- ▶ Population Viability Analyses (PVA)
  - ▶ Collect genetic & demographic data to parameterize models
  - ▶ Model individual herd viabilities under current management
  - ▶ Model potential management scenarios including meta-population strategies
- ▶ Collaboratively assess potential conservation and shared stewardship opportunities, contingency scenarios



# Population Viability Analyses



- ▶ Builds on IUCN Red List Assessment PVA Process



# Vortex Simulation Modeling

*Models population dynamics as discrete sequential events that occur according to defined probabilities.*

Simulates effects of:

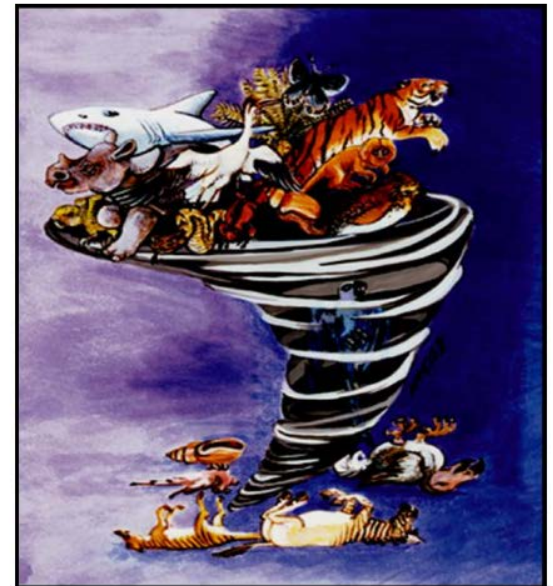
- ▶ Life history traits, genetics
- ▶ Specific threats/management
- ▶ Stochastic processes
  - ▶ Demographic stochasticity
  - ▶ Environmental variation
  - ▶ Catastrophes / Disease
  - ▶ Genetic drift and inbreeding

on the future of a population.

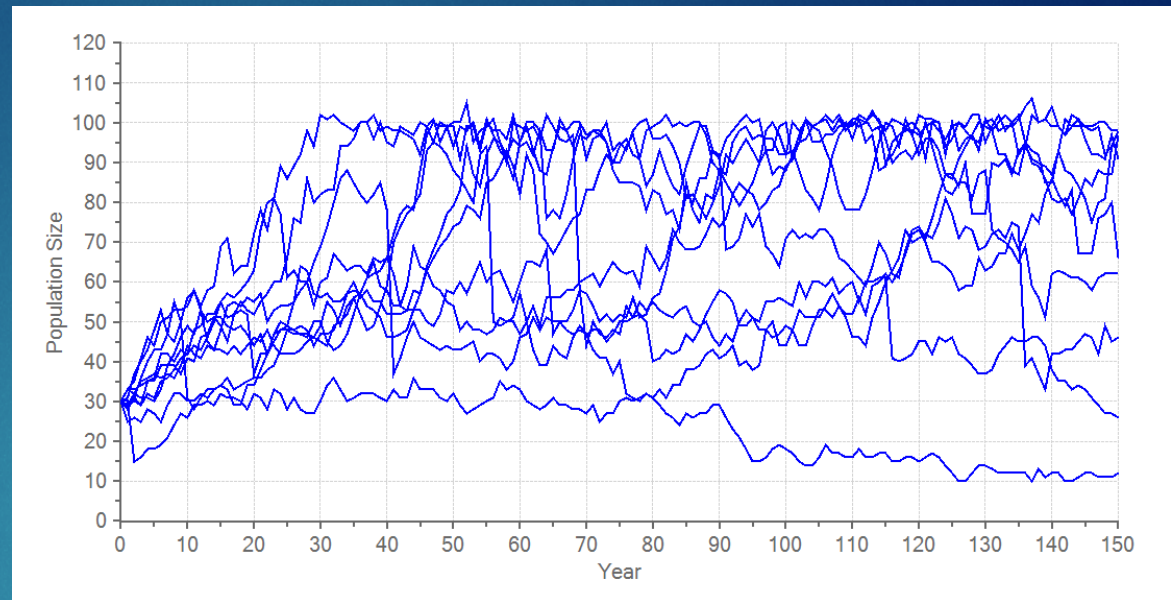
## Vortex 10

A stochastic simulation of the extinction process

Version 10.0.0.4




# Vortex Model Outputs



Distribution of outcomes across large number of runs (iterations) – mean and SD

- ▶ Population size
- ▶ Trend (population growth or decline) – stochastic  $r$
- ▶ Probability of and time to extinction
- ▶ Loss of genetic variation (heterozygosity, # alleles, # lethal alleles, mean inbreeding, genetic distance)

A photograph of a herd of bison in a grassy field. The bison are brown and have thick fur. They are grazing on the grass. The background is a bright, sunny day with green grass and some purple flowers.

# Vortex Inputs: Population characteristics

- ▶ Individual or multiple populations
- ▶ Movement among populations
- ▶ Options for removal (e.g., harvest, cull)
- ▶ Catastrophes (e.g., disease outbreak)
- ▶ Vital rates and EV can be population-specific
- ▶ Carrying capacity and future trends in K

# Vortex Inputs: Demographic rates



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- ▶ Mating system
- ▶ Reproductive lifespan
- ▶ Age- and sex-specific fecundity and mortality rates
- ▶ Maximum longevity
- ▶ Options for density-dependence effects
- ▶ Environmental variation in rates
- ▶ Options for individual characteristics that can affect demographic rates

# 2015 Red List Workshop: Herd-Specific Inputs

76 ♀♀ br.  
 Females - 3-20 - wood (Elk Isl.)  
 - 5% (2y)  
 - 50% (4-5y)  
 - 80% (6-17y)  
 - 50% (18-19y)  
 - 20% (20y)

use for 5 wild pps  
 Keith & Dennis will sort out survival rates

Females - 2-20 ↓ Plains (Wind cave)  
 - 10% (2yr)  
 - 67% for rest - SD=10% (7yrs)  
 not used for these 9 pps.

these 'Plains' pps. are at edge of range, north latitude or high elevation → acting more like wood  
 → breed pool/don → look at pop. grey female

MACKENZIE (not BS) cattle ranches in area  
 N = 714 (2013 est) - few calves so maybe lower now  
 K (biological) = 4000 → estimated from Greg  
 K (imposed) = 2000

Experienced Anthrax 2yrs ago → 0.33 of herd (all age + sex classes) → fatal  
 Prior to this, ~10% in min. outbreak

## THREATS

DISEASE - Anthrax outbreaks - major  
 DISEASE - TB  
 DISEASE - Brucellosis } risk of EXT in presence of wolves, lower λ/k

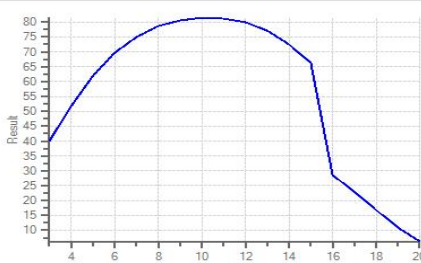
SEVERE WINTERS, FLOODING, FIRES → handled by EV  
 FAD (foreign animal disease) outbreak → lose mgt control → national emergency (both countries)  
 CLIMATE CHANGE → acknowledged, not incl. → ind. incoercive

- not sure of impact on bison → evidence to be gathered  
 - may alter land available to bison  
 - one suggestion: + EV by some amt.?  
 - further discussion? - compile existing info + how it might affect bison

Look at cat. events (50% ↓) in these 9 herds + risk of such cat. events

Ad. genetic risk to all

$$100 \left[ e^{-2.3+(0.738 \cdot A)} - (0.036 \cdot A^A) \right] \left( 1 + \left[ e^{-2.3+(0.738 \cdot A)} - (0.036 \cdot A^A) \right] \right)^{-1} - \left( \frac{A-15}{0.5} \right)$$



## GREATER WOOD BUFFALO - Spops

N = 4000 (2014 est)  
 K (biological) = 10,000  
 K (imposed) = none  
 K (checked) → 10,000  
 Pop. kept lower due to diseases + wolves  
 No culling or hunting  
 Recent trend - declining to stable  
 N is more dynamic than other pps - predation (larger EV for survival)

Greg will ✓  
 All discuss more re: vital rates + SD

Catastrophe → decide to exterminate herd to eliminate disease + repopulate  
 Diff. vital rates due to disease?

Brucellosis - ♀♀s abort 1st calf  
 TB → maybe older animals are more vulnerable to predation  
 Anthrax present → add risk of outbreak

## NAHANNI

N = 431 (2011 est) - ~500 if stay near river  
 K (biological) = 2000 (somewhat arbitrary) → possible to extend for  
 K (imposed) = none

Not controlled, no boundaries (Started in late 80s w/ 100 animals)  
 Recent slow growth, stable ~ 7yrs, all concentrated near river  
 ↳ if decide to disperse in future, can expand  
 No disease  
 Hunting → cows + older bulls (much Aboriginal)  
 Occasionally hit by barges on river  
 All come from Elk Island (all wood bison)  
 Use wild bison fecundity

Scenario Settings	Mortality Rates
Species Description	Mortality of females as %
State Variables	Mortality of males as %
Dispersal	Population1
Reproductive System	Mortality from age 0 to 1
Reproductive Rates	SD in 0 to 1 mortality due to EV
Mortality Rates	Mortality from age 1 to 2
Catastrophes	SD in 1 to 2 mortality due to EV
Mate Monopolization	Mortality from age 2 to 3
Initial Population Size	SD in 2 to 3 mortality due to EV
Carrying Capacity	Annual mortality after age 3
Harvest	SD in mortality after age 3
Supplementation	Mortality of males as %
Genetics	Population1
Copy input values from	Mortality from age 0 to 1
Copy	SD in 0 to 1 mortality due to EV
Copy	Mortality from age 1 to 2
Copy	SD in 1 to 2 mortality due to EV
Copy	Mortality from age 2 to 3
Copy	SD in 2 to 3 mortality due to EV
Copy	Mortality from age 3 to 4
Copy	SD in 3 to 4 mortality due to EV

# Current Project Status



*Herding herd  
managers and  
biologists*

- ▶ **Collecting herd demographic information**
- ▶ **Collecting genetic data and genetic samples**
  - ▶ Genetic analyses at UC Davis Veterinary Genetics Lab
  - ▶ Archiving samples at American Natural History Museum
- ▶ **Summer workshop:**
  - ▶ Assess/adjust PVA model parameterization & preliminary outputs
  - ▶ Collaboratively discuss potential management scenarios
- ▶ **Fall: Model management scenarios**



*Next  
steps?*

Meta-database  
development

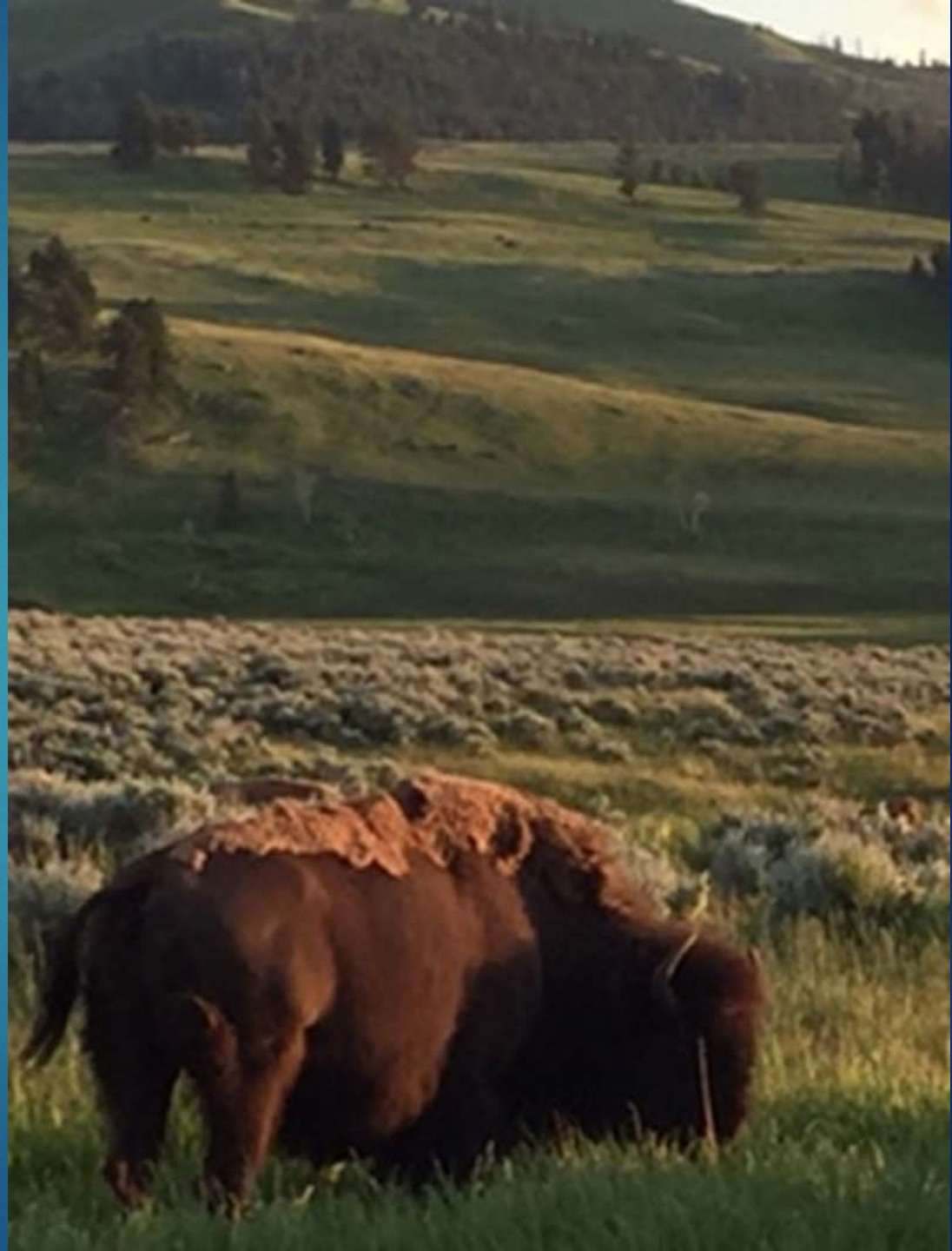
Human Dimensions

Communications  
& Outreach

**SCALE UP ecological restoration collaborations**

*Application  
beyond DOI?*

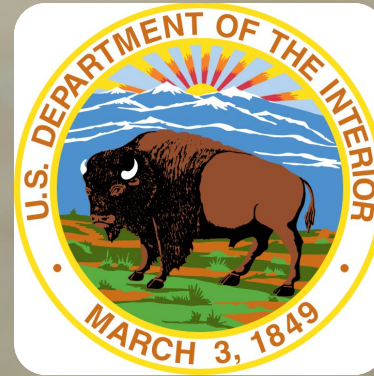
Opportunity to  
assess  
continental-  
wide species  
conservation  
strategies and  
opportunities?







# Questions?



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