

# Interagency Grizzly Bear Study Team

## Research and Monitoring Summary 2015



# Overview

- Population estimation and trend
- Grizzly bear mortalities
- Occupancy by females with offspring
- Known-fate monitoring
- Food monitoring
- Summary

**Preliminary results**



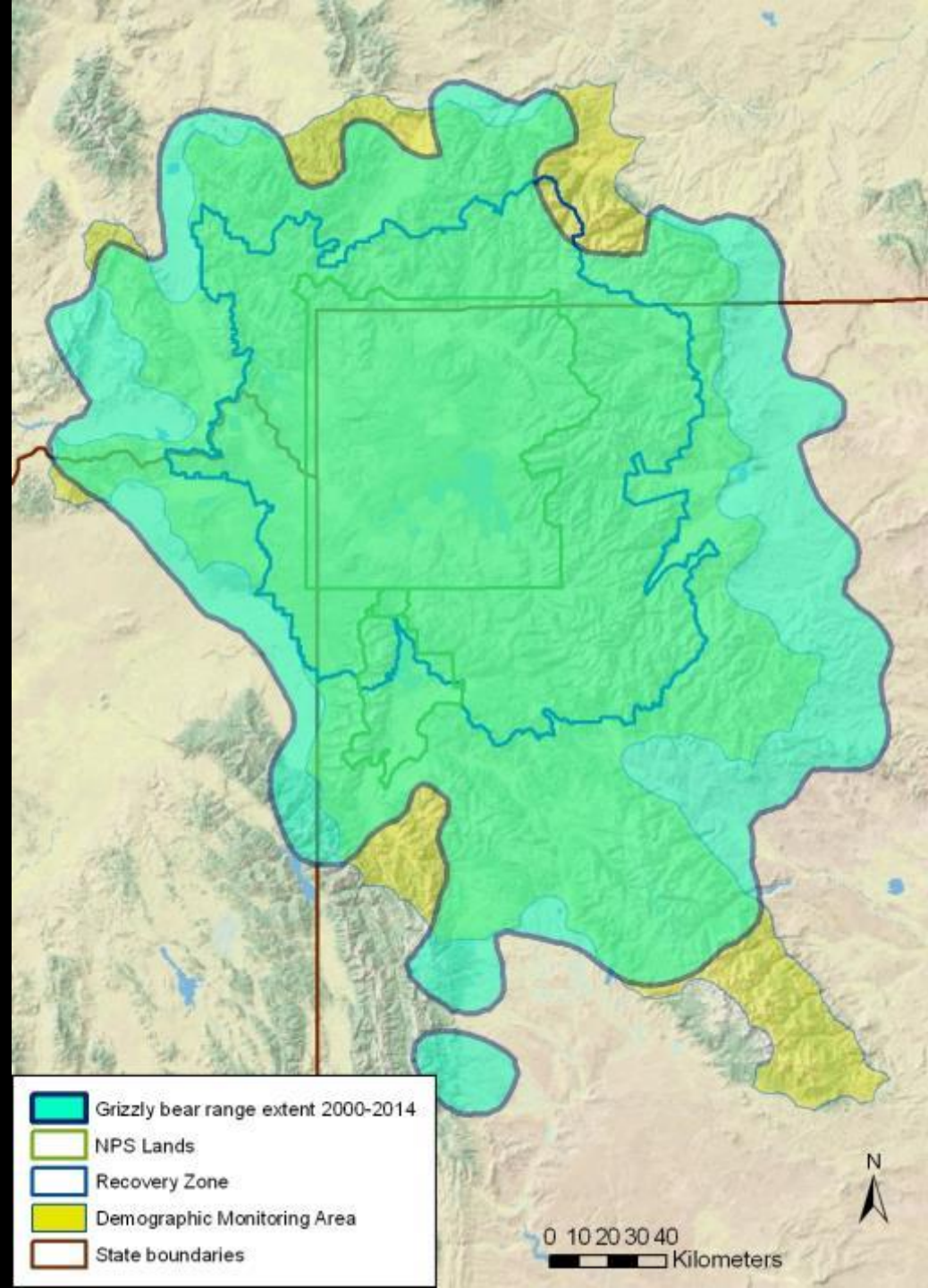
# Greater Yellowstone Ecosystem

- National Park lands = 10,344 km<sup>2</sup>
- Recovery Zone = 23,828 km<sup>2</sup>
- Demographic Monitoring Area (DMA) = 49,931 km<sup>2</sup>



# Greater Yellowstone Ecosystem

- National Park lands = 10,344 km<sup>2</sup>
- Recovery Zone = 23,828 km<sup>2</sup>
- Demographic Monitoring Area (DMA) = 49,931 km<sup>2</sup>
- Estimated grizzly bear distribution 2000-2014 = 58,314 km<sup>2</sup>





# Population and Trend Estimation

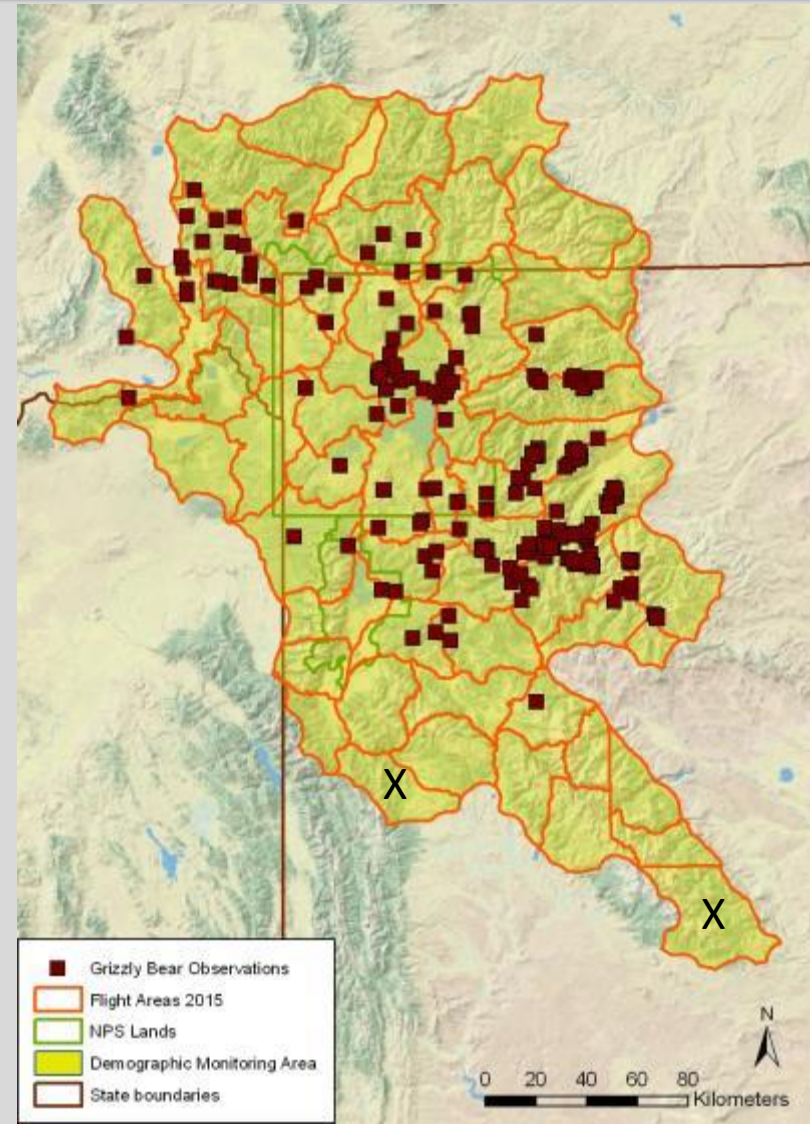


# Number of Females with Cubs: Chao2 Estimator

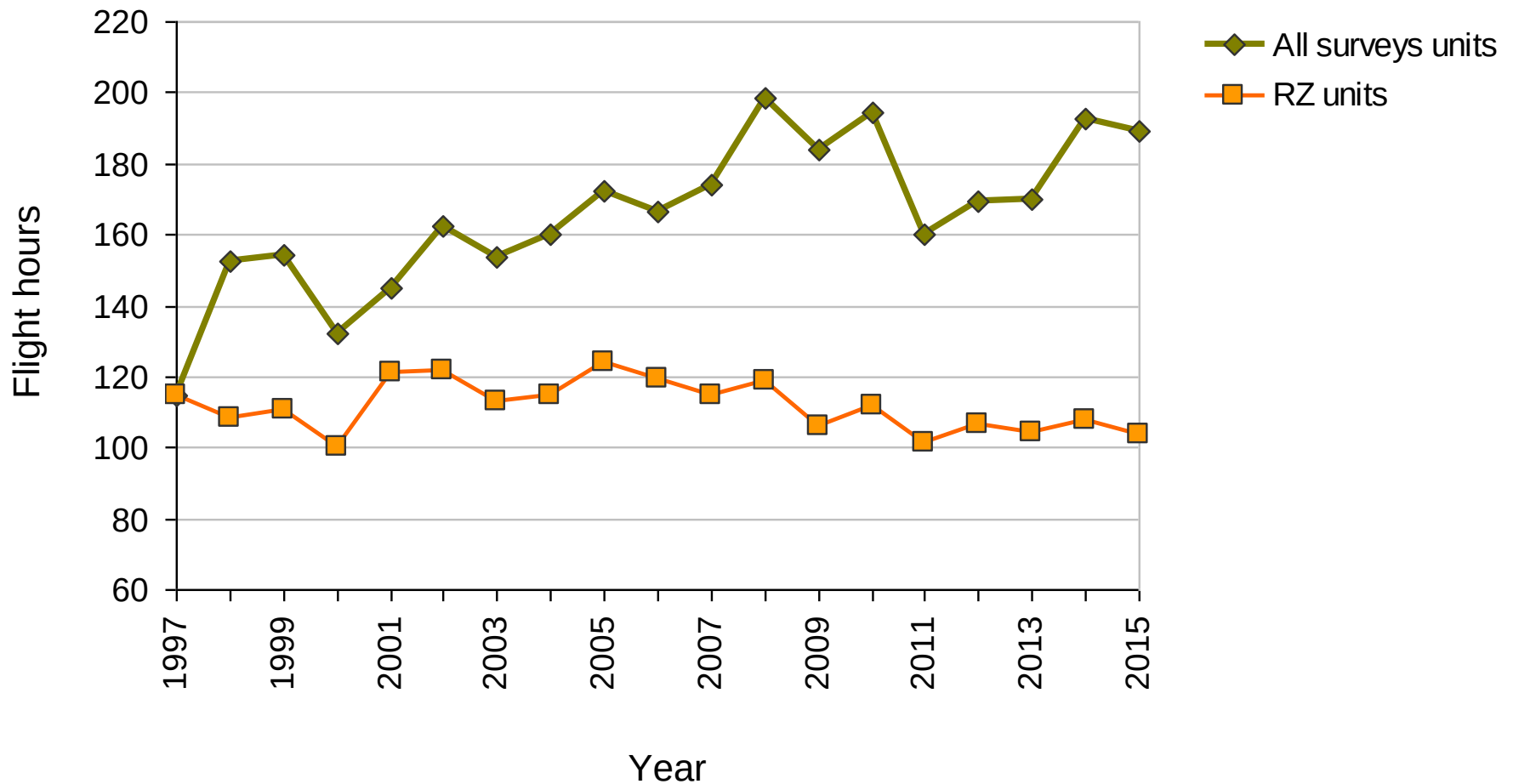
- Annual counts based on Knight et al. (1995)  
“rule set”: sightings of unique females with cubs
- Cherry et al. (2007) applied estimator to correct for sighting heterogeneity (Chao2)
- Trend over time

# Observation Flights 2015

- 54 aerial observation areas
  - Round 1: 52 units, 104 hours
  - Round 2: 43 units, 87 hours
  - 3 units not flown (X)
- 189 survey hours
- 351 groups (501 grizzly bears)
- 43 observations of females with cubs
- 36 observations of females with older young



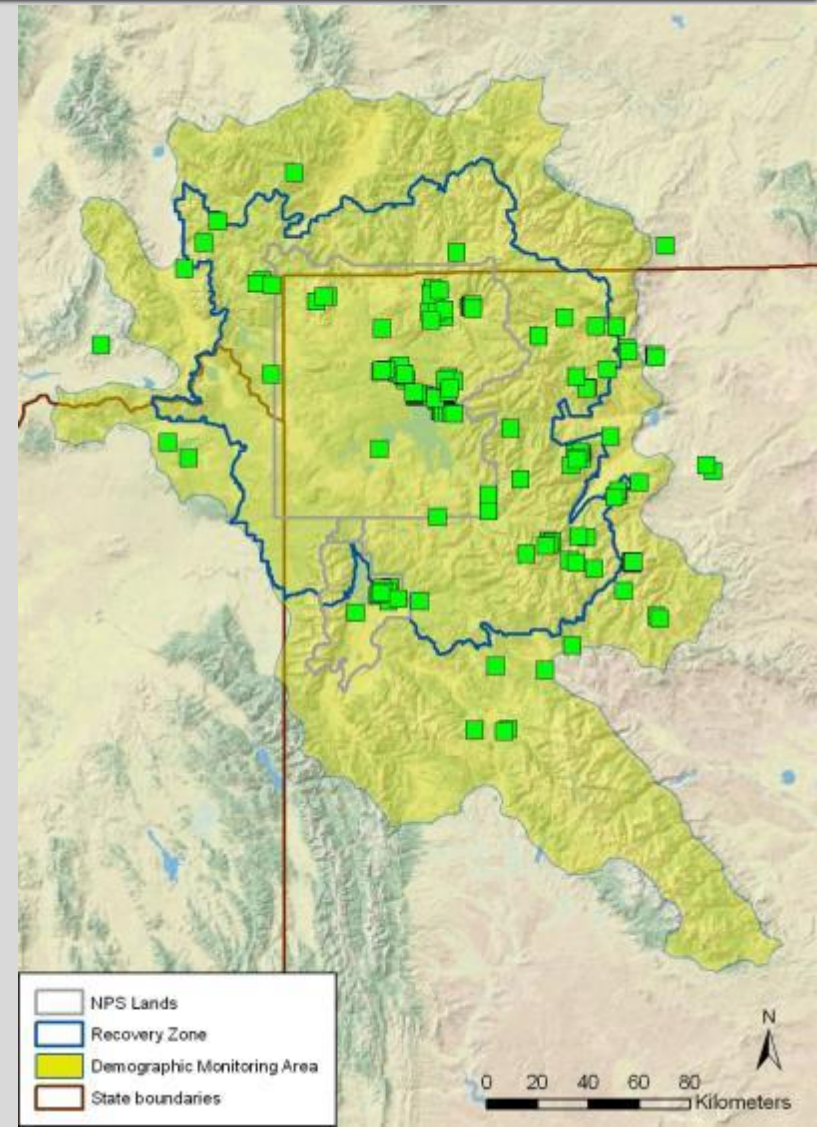
# Observation Flight Hours 1997-2015





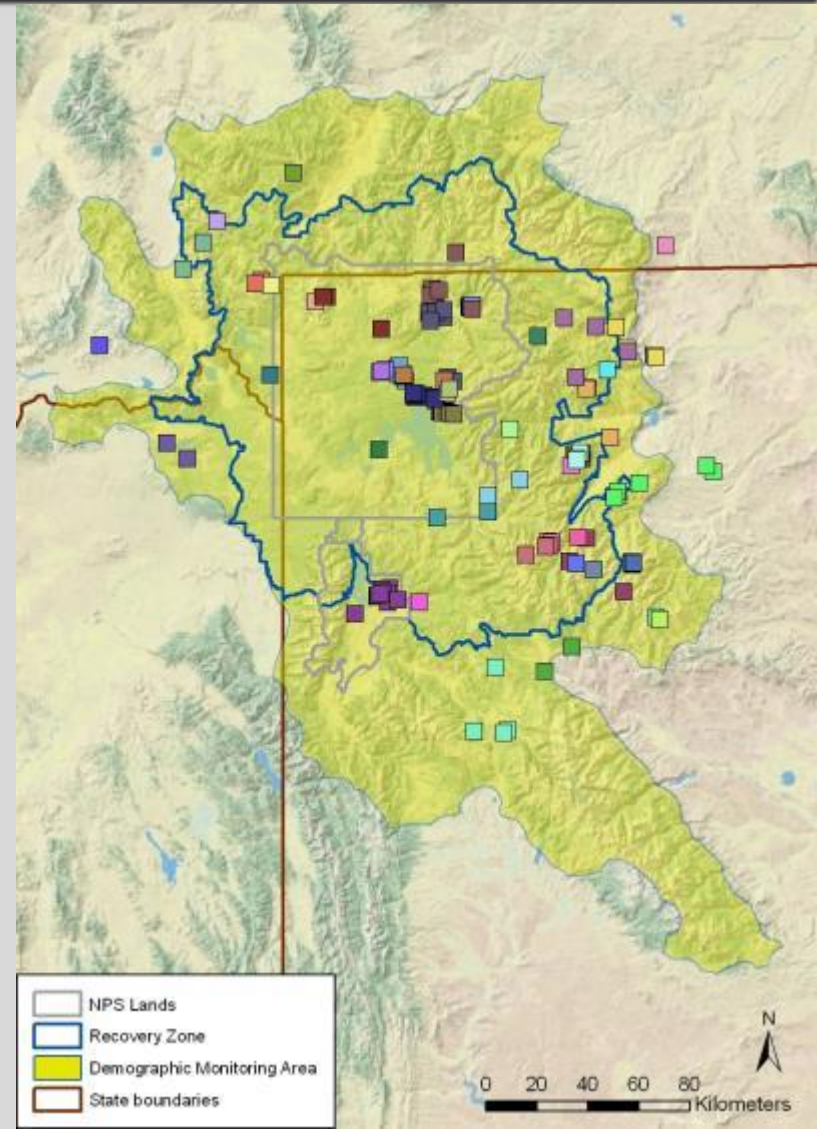
# Sightings of Females with Cubs 2015

- 155 observations
  - 75 aerial (48%)
  - 80 ground (52%)



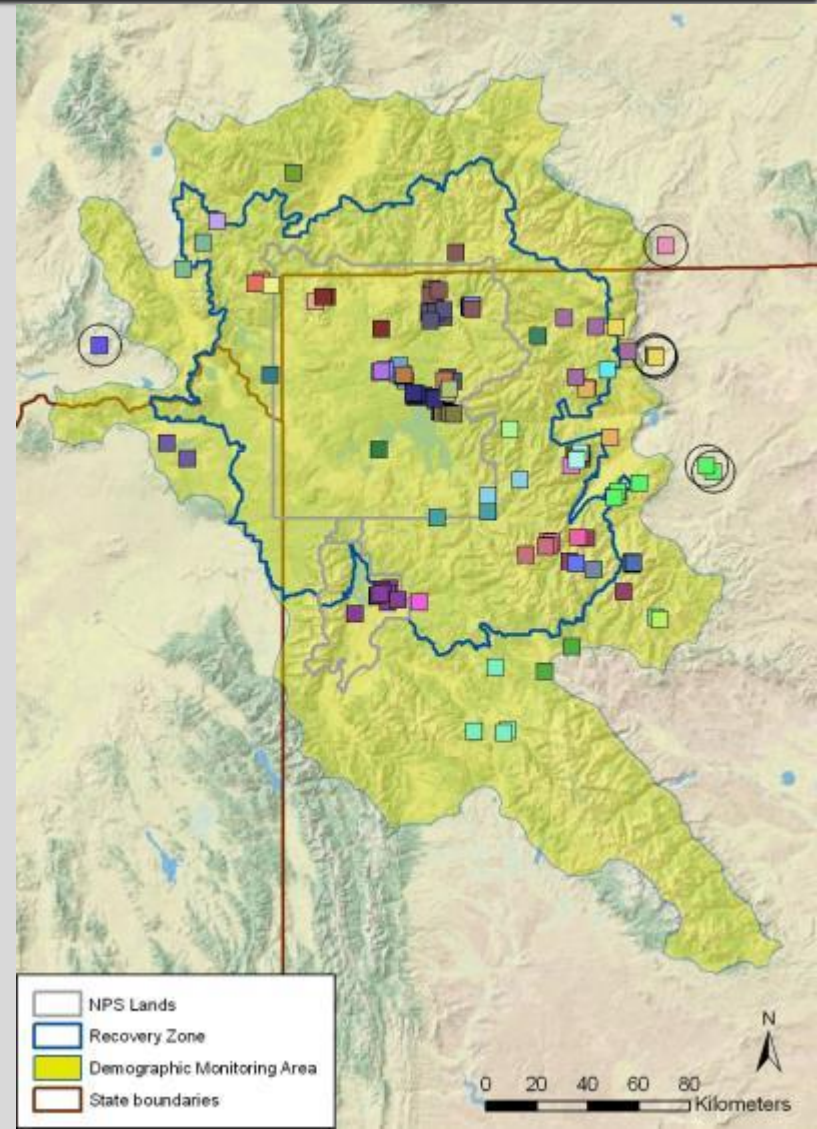
# 2015 Sightings of Females with Cubs

- 155 observations
  - 75 aerial (48%)
  - 80 ground (52%)
- 46 unique females with cubs
  - Mean litter size = 1.96
  - Litter sizes
    - 15 single (33%)
    - 18 twins (39%)
    - 13 triplets (28%)



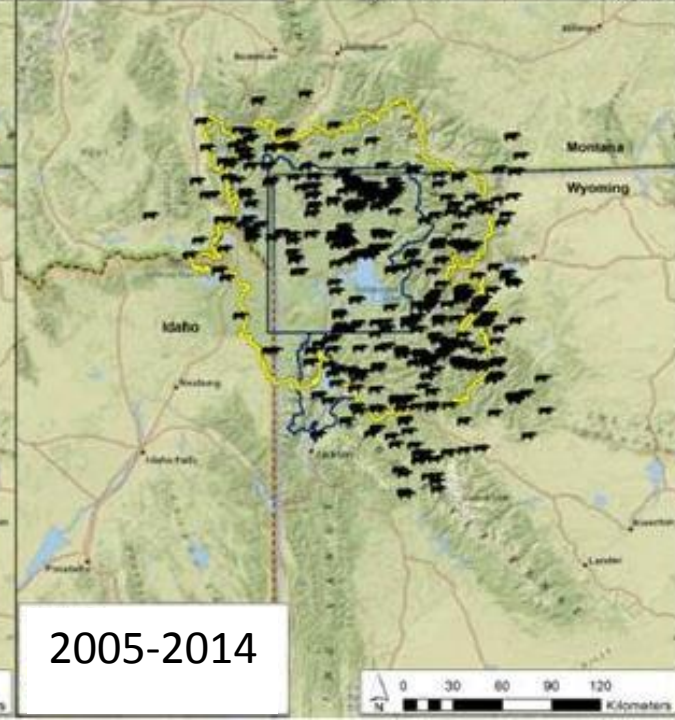
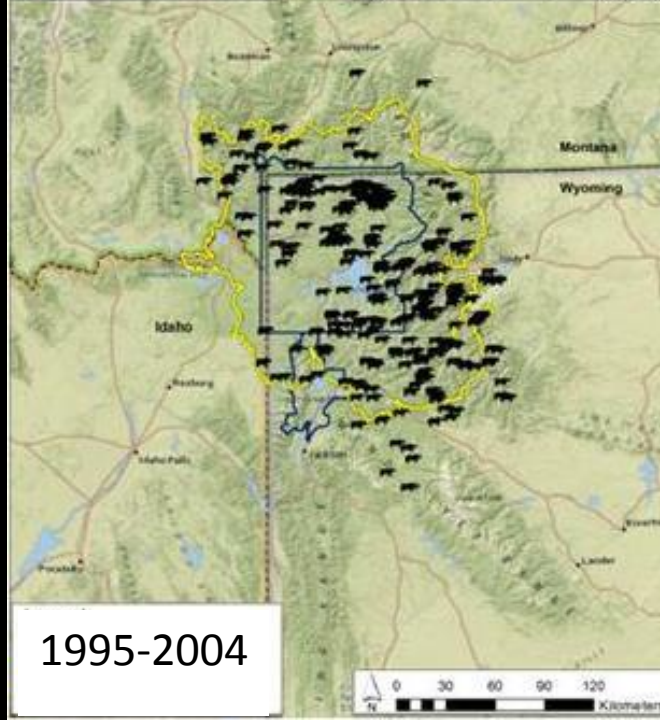
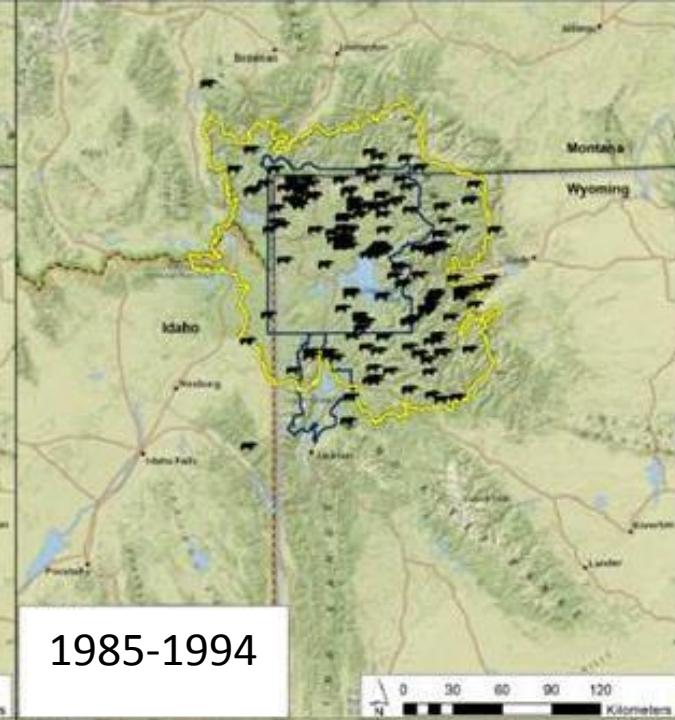
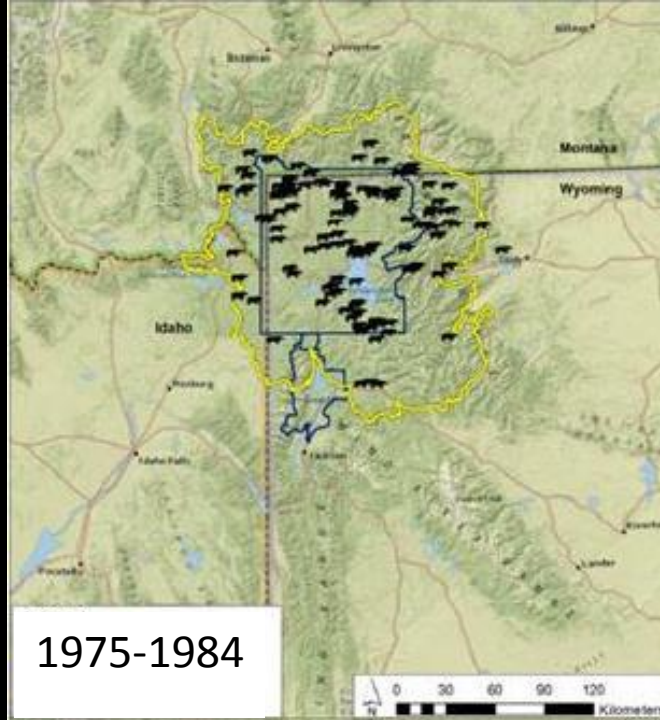
# 2015 Sightings of Females with Cubs

- 155 observations
  - 75 aerial (48%)
  - 80 ground (52%)
- 46 unique  $F_{COY}$  in the GYE
  - Mean litter size = 1.96
  - Litter sizes
    - 15 single (33%)
    - 18 twins (39%)
    - 13 triplets (28%)
- 44 unique females with cubs in DMA
  - 7 sightings (4 individuals) outside DMA
  - 2 individuals (2 sightings) fully outside the DMA

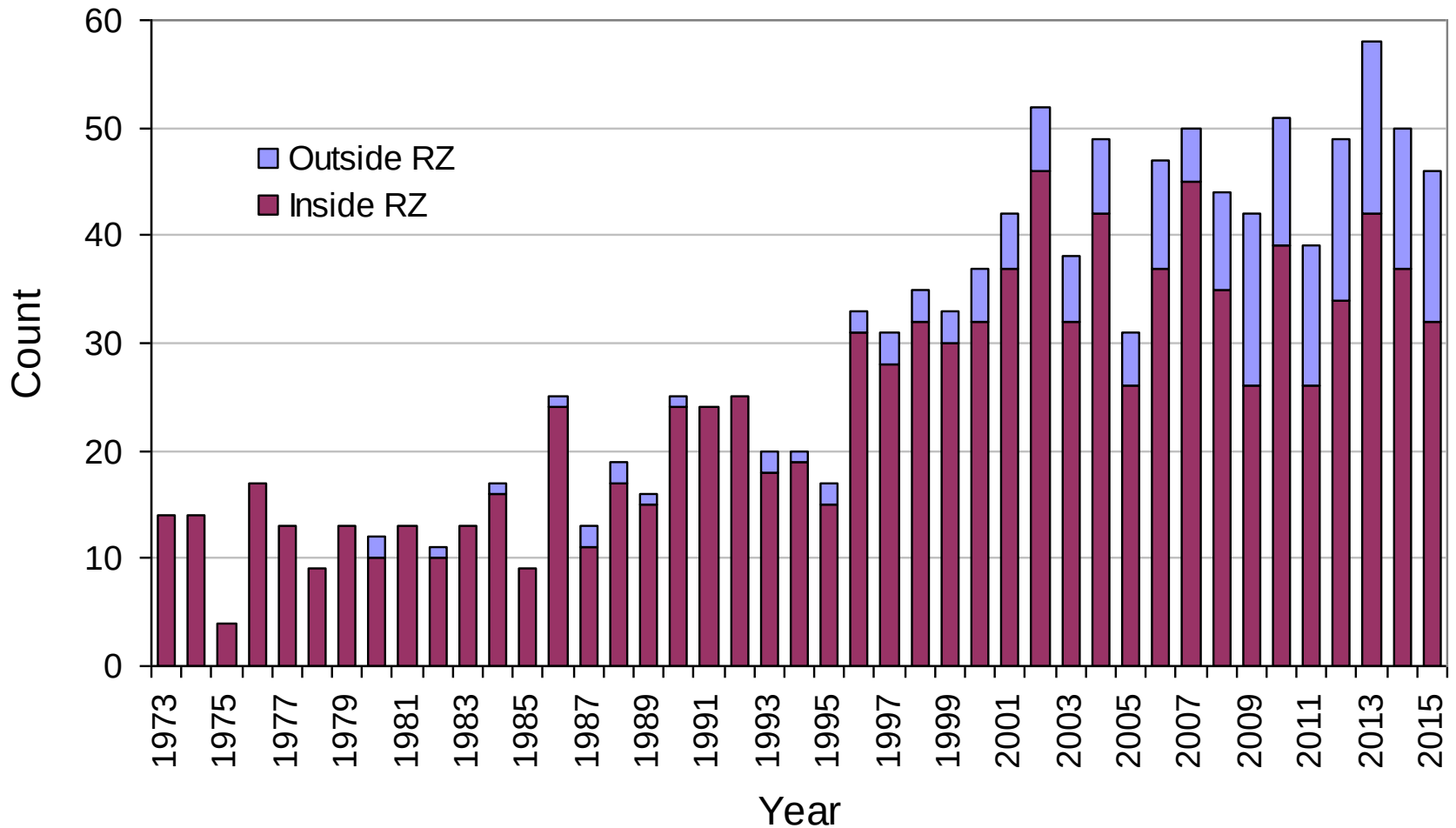




# Distribution of initial sightings of females with cubs by decade

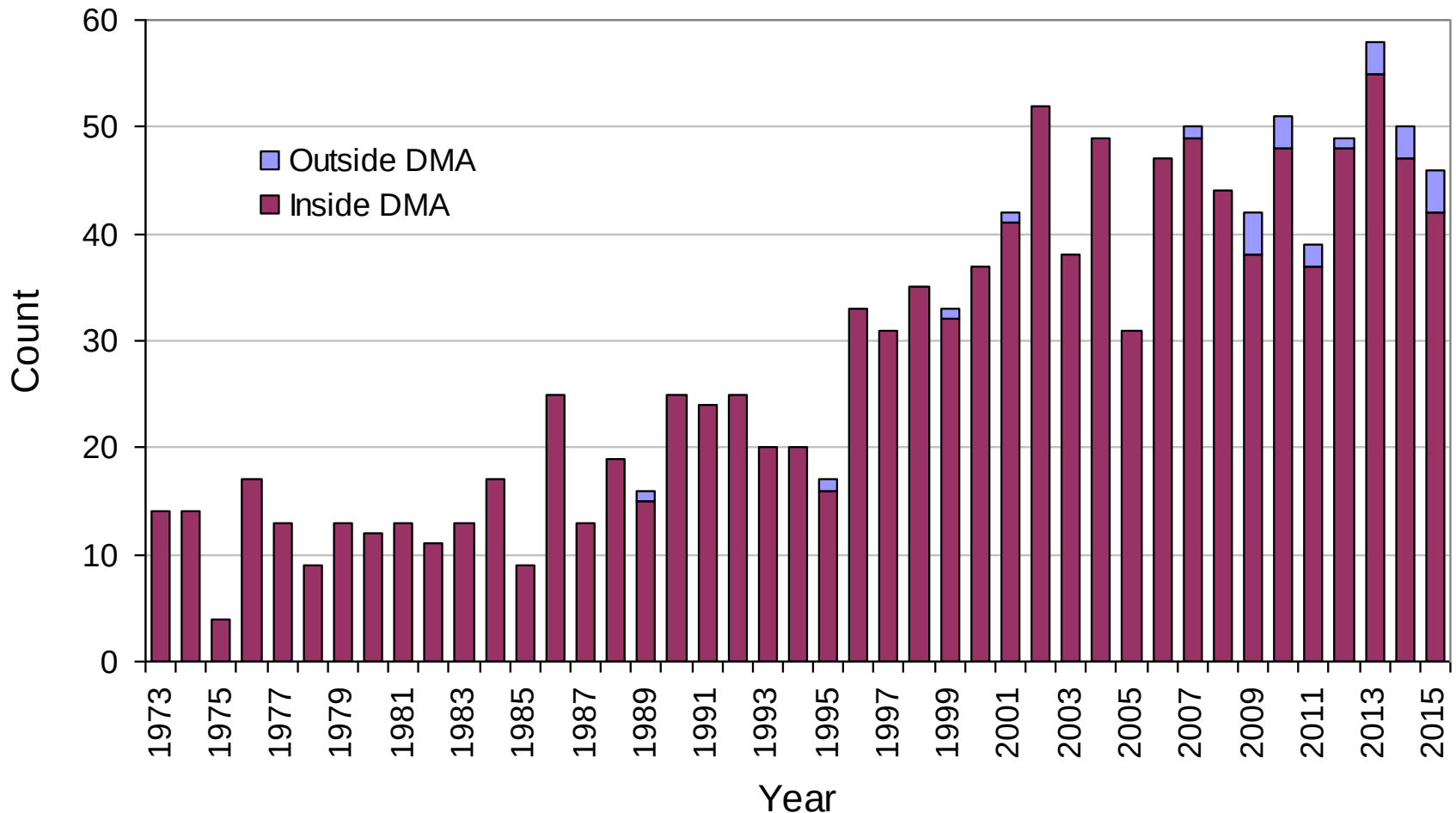


# Initial Sightings of Females with Cubs Recovery Zone 1973-2015



# Initial Sightings of Females with Cubs

## DMA 1973-2015

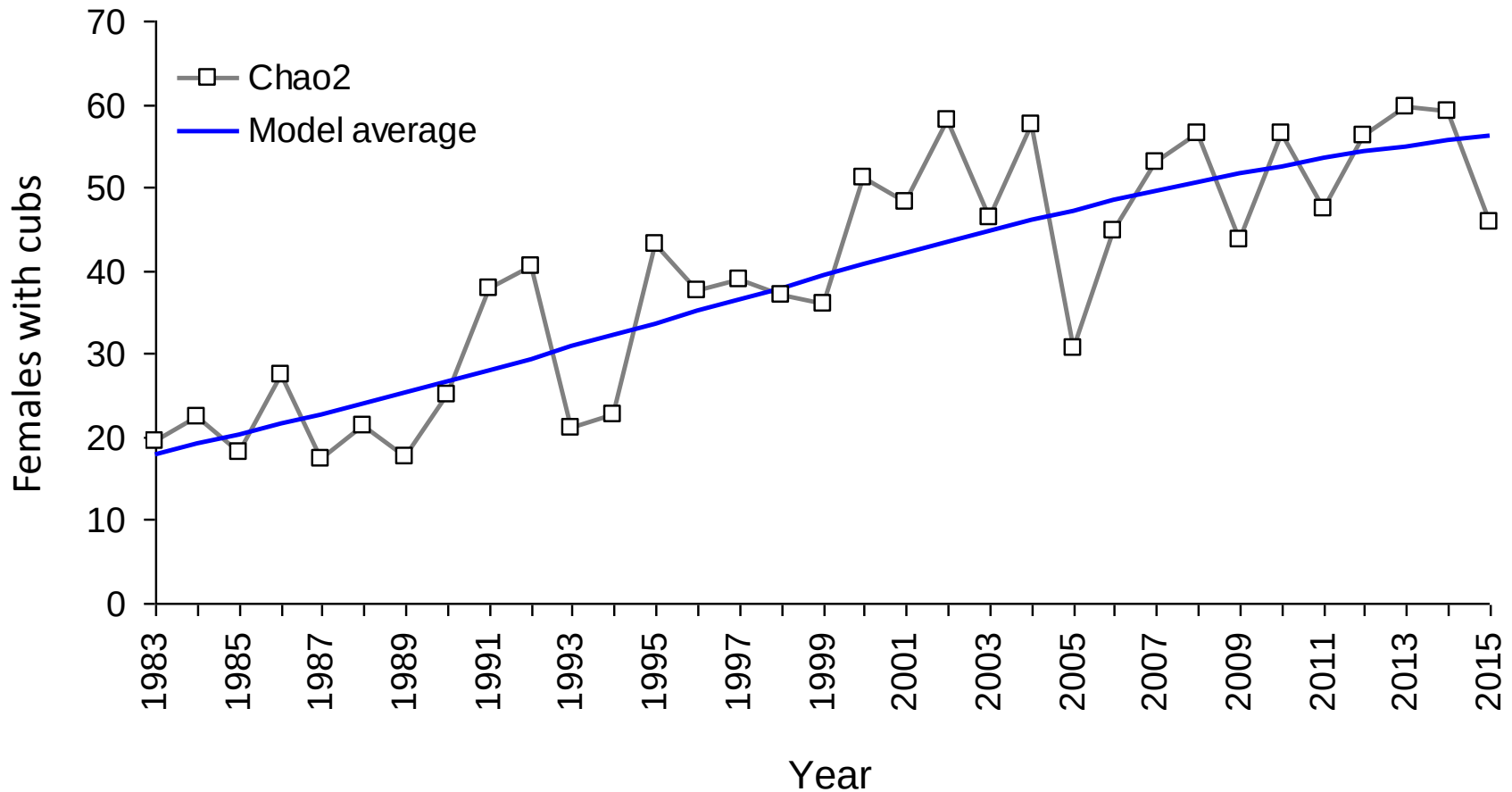




# Number of Females with Cubs in DMA 2015

| Parameter                | Estimate |
|--------------------------|----------|
| Unique females with cubs | 44       |
| Chao2                    | 46       |
| Model-averaged Chao2     | 56       |

# Trend of Females with Cubs 1983-2015



# Total Population Estimate

Derived from:

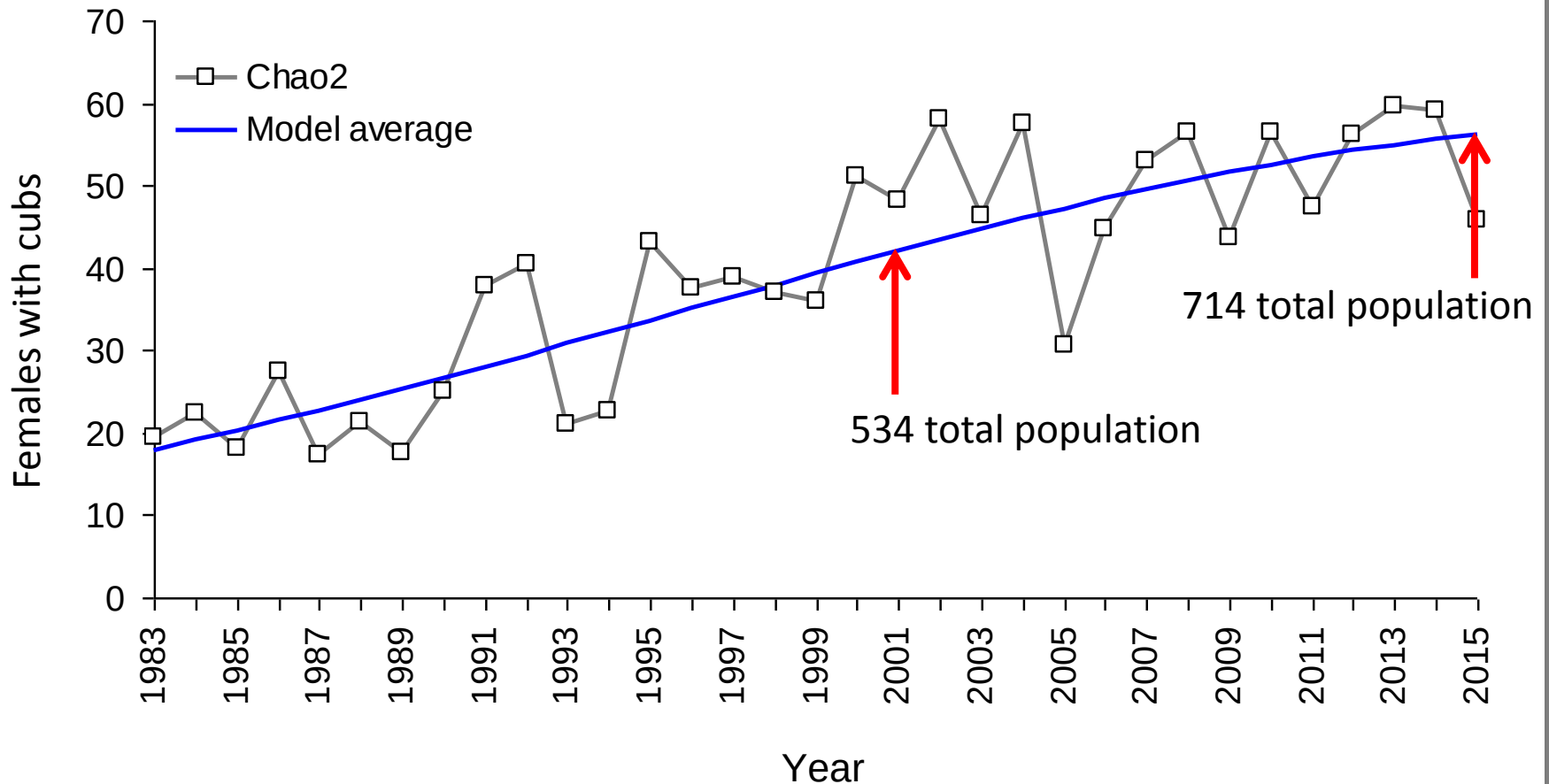
- Chao2 model-averaged estimate of number of females with cubs
- 2002-2011 vital rates and derived age structure to estimate population segments



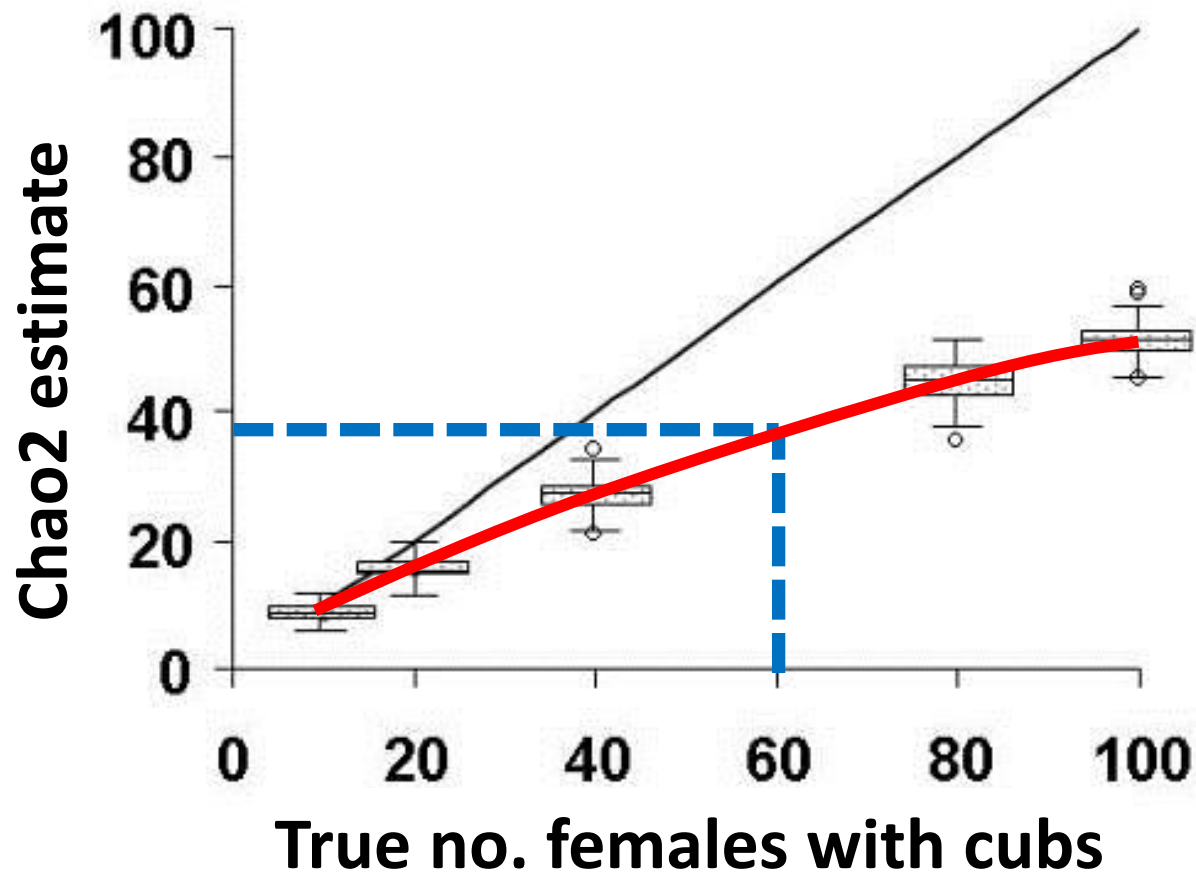
# 2015 Total Population Estimate: Chao2 Estimator

| Segment                                 | Estimate | 95% CI |       |
|-----------------------------------------|----------|--------|-------|
|                                         |          | Lower  | Upper |
| Independent females ( $\geq 2$ yrs old) | 246      | 196    | 296   |
| Independent males ( $\geq 2$ yrs old)   | 246      | 192    | 301   |
| Dependent young (COY and yearlings)     | 222      | 200    | 245   |
| Total                                   | 714      | 638    | 793   |

# Trend of Females with Cubs 1983-2015



# Bias in Chao2 Estimator



# Number of Females with Cubs: Mark-Resight Estimator (M-R)





# Demographic Workshop Report



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## Insights Into the Latent Multinomial Model Through Mark-Resight Data on Female Grizzly Bears With Cubs-of-the-Year

Megan D. HIGGS, William A. LINK, Gary C. WHITE,  
Mark A. HAROLDSON, and Daniel D. BJORNLI

Mark-resight designs for estimation of population abundance are common and attractive to researchers. However, inference from such designs is very limited when faced with sparse data, either from a low number of marked animals, a low probability of detection, or both. In the Greater Yellowstone Ecosystem, yearly mark-resight data are collected for female grizzly bears with cubs-of-the-year (FCOY), and inference suffers from both limitations. To overcome difficulties due to sparseness, we assume homogeneity in sighting probabilities over 16 years of bi-annual aerial surveys. We model counts of marked and unmarked animals as multinomial random variables, using the discrete frequencies of marked animals for inference about the latent multinomial frequencies for unmarked animals. We discuss undesirable behavior of the commonly used BUGS code for fitting such models. The application provides valuable insights into the subtleties of implementing Bayesian inference for latent multinomial models. We tie the discussion to our application, though the insights are broadly useful for applications of the latent multinomial model.

**Key Words:** Bayesian; Discrete uniform; Greater Yellowstone Ecosystem (GYE); Mark-recapture; Population size.

### 1. INTRODUCTION

Current methods for estimating the number of grizzly bears and setting mortality limits in the Greater Yellowstone Ecosystem (GYE) rely on estimating the number of female

Megan D. Higgs (25) is Assistant Professor of Statistics, Department of Mathematical Sciences, University, P.O. Box 172400, Bozeman, MT 59717-2400.  
A. Link is Mathematical Statistician, U.S. Geological Survey, Northern Rocky Mountain Science Center, 2215 North  
ican Health, Department of Health and Human Services, 1015 North

## Updating and Evaluating Approaches to Estimate Population Size and Sustainable Mortality Limits for Grizzly Bears in the Greater Yellowstone Ecosystem



10 September 2012

Interagency Grizzly Bear Study Team (IGBST)



# 2015 Project: Trend Detection

- Dr. Megan Higgs and Michael Lerch, MSU Dept. of Mathematics
- Determine ability to detect trend





Research Article

# Density Dependence, Whitebark Pine, and Vital Rates of Grizzly Bears

FRANK T. VAN MANEN,<sup>1</sup> U.S. Geological Survey, Northern Rocky Mountain Science Center, Interagency Grizzly Bear Study Team, 2327 University Way, Suite 2, Bozeman, MT 59715, USA

MARK A. HAROLDSON, U.S. Geological Survey, Northern Rocky Mountain Science Center, Interagency Grizzly Bear Study Team, 2327 University Way, Suite 2, Bozeman, MT 59715, USA

DANIEL D. BJORNLI, Wyoming Game and Fish Department, 260 Buena Vista, Lander, WY 82520, USA

MICHAEL R. EBINGER,<sup>2</sup> College of Forestry and Conservation, University Montana, University Hall, Room 309, Missoula, MT 59812, USA

DANIEL J. THOMPSON, Wyoming Game and Fish Department, 260 Buena Vista, Lander, WY 82520, USA

CECILY M. COSTELLO, College of Forestry and Conservation, University Montana, University Hall, Room 309, Missoula, MT 59812, USA

GARY C. WHITE, Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO 80523, USA

**ABSTRACT** Understanding factors influencing changes in population trajectory is important for effective wildlife management, particularly for populations of conservation concern. Annual population growth of the grizzly bear (*Ursus arctos*) population in the Greater Yellowstone Ecosystem, USA has slowed from 4.2–7.6% during 1983–2001 to 0.3–2.2% during 2002–2011. Substantial changes in availability of a key food source and bear population density have occurred. Whitebark pine (*Pinus albicaulis*), the seeds of which are a valuable but variable fall food for grizzly bears, has experienced substantial mortality primarily due to a mountain pine beetle (*Dendroctonus ponderosae*) outbreak that started in the early 2000s. Positive growth rates of grizzly bears have resulted in populations reaching high densities in some areas and have contributed to continued range expansion. We tested research hypotheses to examine if changes in vital rates detected during the past decade were more associated with whitebark pine decline or, alternatively, increasing grizzly bear density. We focused our assessment on known-fate data to estimate survival of cubs-of-the-year (cubs), yearlings, and independent bears ( $\geq 2$  yrs), and reproductive indices for grizzly bear density and whitebark pine mortality as individual covariates. Models indicated moderate support for an increase in survival of independent male bears over 1983–2012, whereas independent female survival did not change. Cub survival, yearling survival, and reproductive transition from no offspring to cubs all changed during the 30-year study period, with lower rates evident during the last 10–15 years. Cub survival and reproductive transition were negatively associated with an index of grizzly bear density, indicating greater declines where bear densities were higher. Our analyses did not support a similar relationship for the index of whitebark pine mortality. The results of our study support the interpretation that slowing of population growth during the last decade was associated more with increasing grizzly bear density than the decline in whitebark pine. Grizzly bear density and its potential effect on vital rates and population trajectory warrant consideration for management of the grizzly bear population in the Greater Yellowstone Ecosystem. Published 2015. This article is a U.S. Government work and, as such, is in the public domain in the USA.

# Primary Findings

- Slowing of population growth since early 2000s
- Proximate cause: lower survival of younger age classes
- Ultimate cause: higher bear densities (correlation)
- Potential drivers: intraspecific killing, increased competition
- Pattern follows predictions for populations of large vertebrates reaching carrying capacity (Eberhardt 1977)



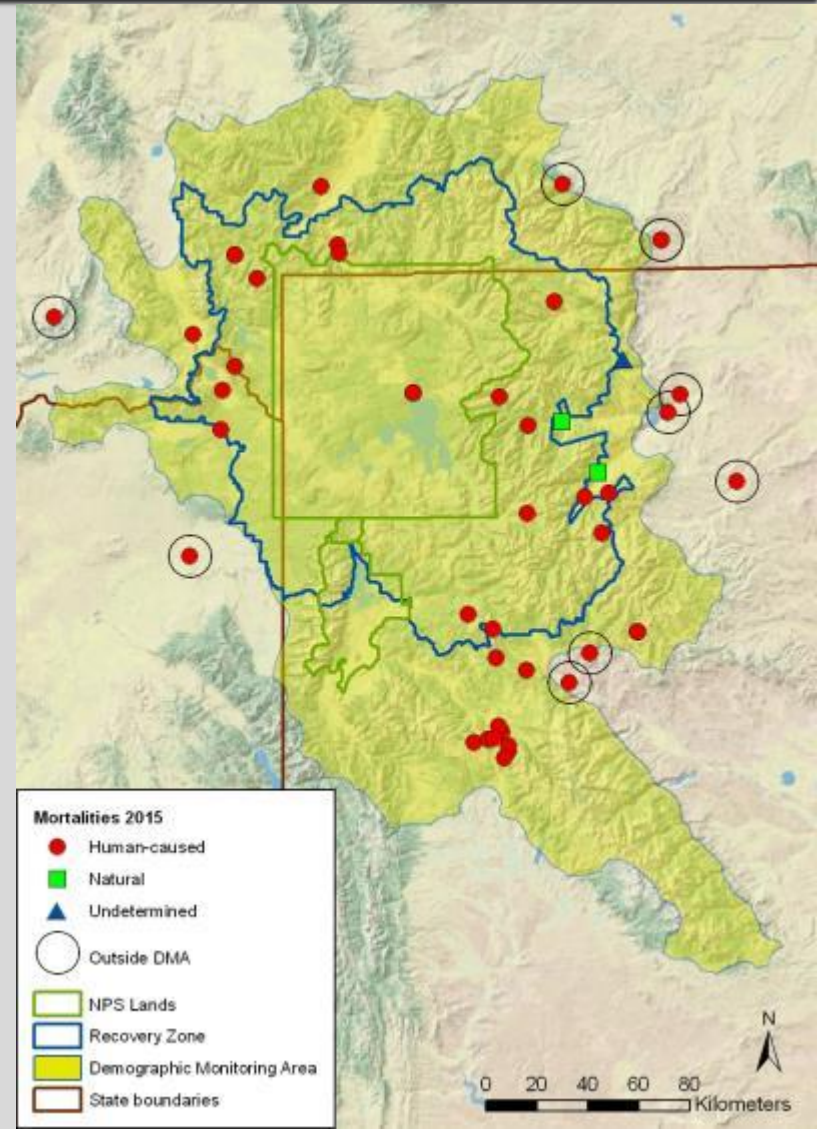
# Documenting Grizzly Bear Mortalities and Evaluating Annual Mortality Rates in the DMA



# Known and Probable Mortalities 2015

(10/31/2015)

- 52 known and probable mortalities
  - 47 human-caused
  - 2 natural
  - 3 undetermined cause
- 10 outside the DMA
  - All 10 human-caused



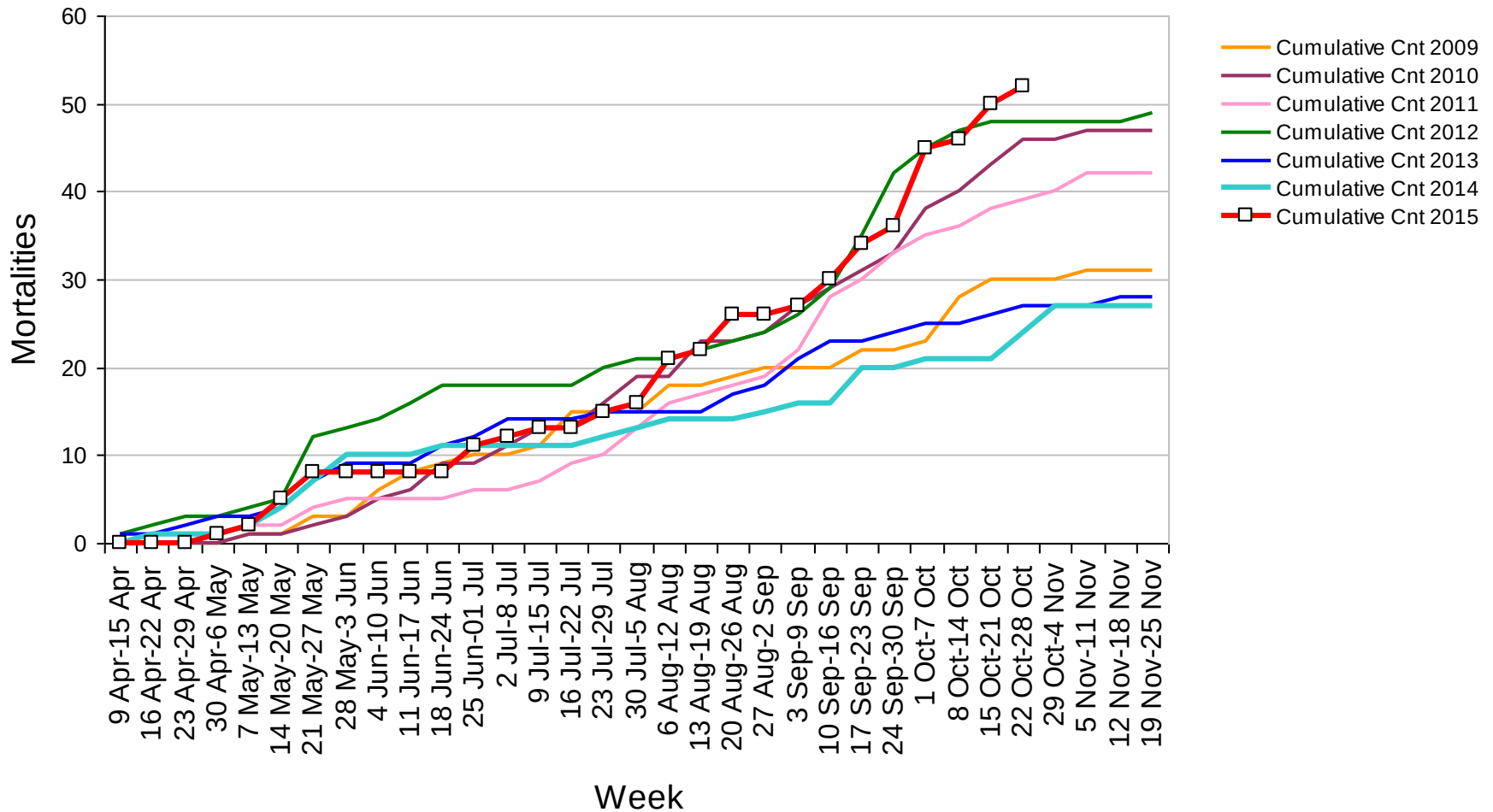


# 2015 Known and Probable Mortalities by Area, Sex, and Age class (10/31/2015)

| Area        | Sex     | Age class                   |                               | Total |
|-------------|---------|-----------------------------|-------------------------------|-------|
|             |         | Dependent<br>(<2 years old) | Independent<br>(≥2 years old) |       |
| Inside DMA  | Female  | 5                           | 8                             | 13    |
|             | Male    | 3                           | 19                            | 22    |
|             | Unknown | 5                           | 2                             | 7     |
|             | Total   | 13                          | 29                            | 42    |
| Outside DMA | Female  | 0                           | 3                             | 3     |
|             | Male    | 0                           | 7                             | 7     |
|             | Unknown | 0                           | 0                             | 0     |
|             | Total   | 0                           | 10                            | 10    |

# Cumulative Count of Known and Probable Mortalities by Week 2009-2015

(10/30/2015)





# Estimated Percent Mortality for Population Segments in the DMA (10/31/2015)

| Population segment                   | Estimated N | Documented mortality <sup>a</sup> | Estimated total mortality | Estimated % mortality |
|--------------------------------------|-------------|-----------------------------------|---------------------------|-----------------------|
| Independent aged females (≥2yrs old) | 246         | 8                                 | 14                        | 5.7                   |
| Independent aged males (≥2yrs old)   | 246         | 19                                | 28                        | 11.4                  |
| Dependent young (<2yrs old)          | 222         | 13 <sup>b</sup>                   |                           | 5.8 <sup>c</sup>      |

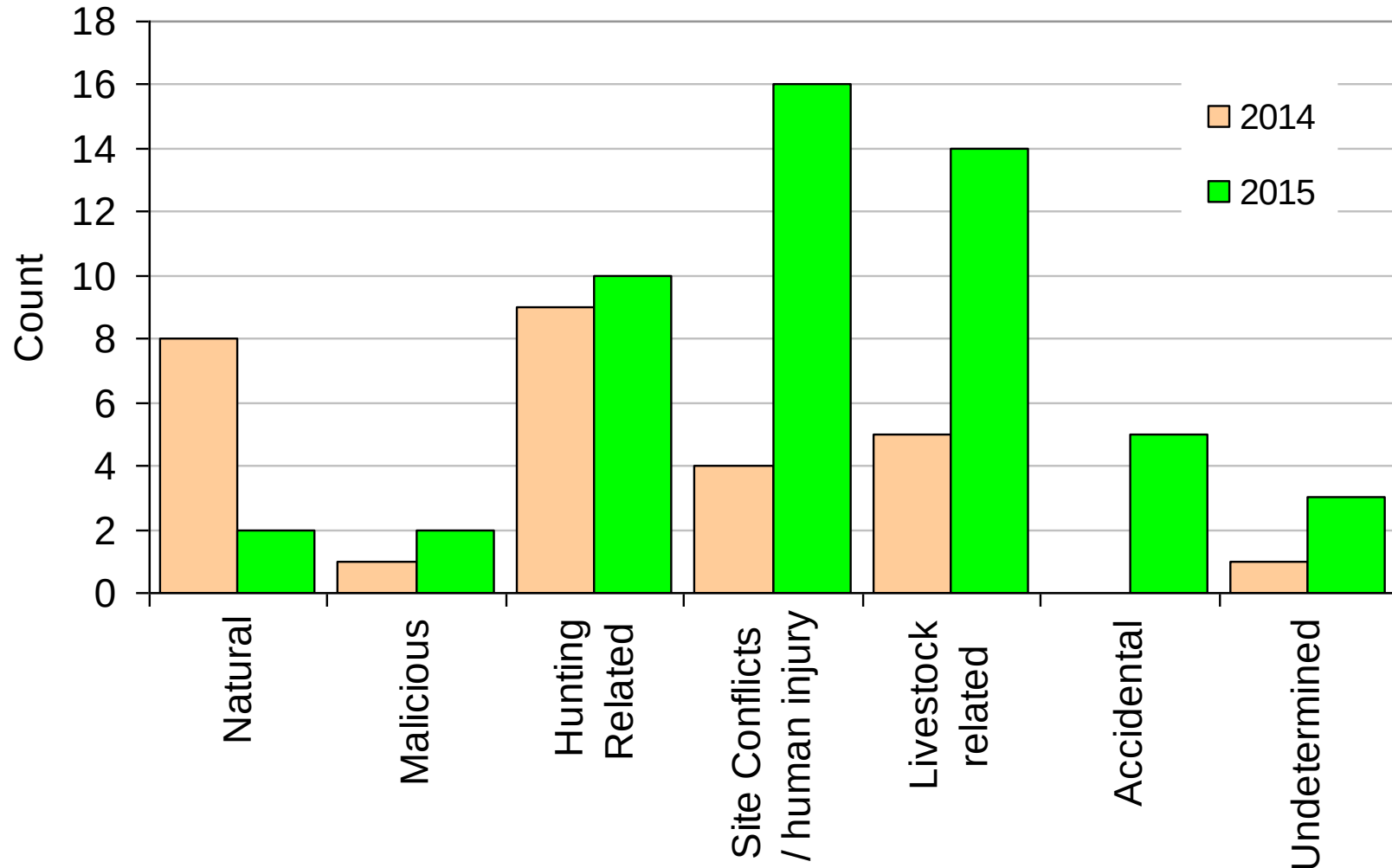
<sup>a</sup> Two independent aged mortalities of unknown sex, pending DNA analysis

<sup>b</sup> Unknown/Unreported estimate is not applied to loss of dependent young

<sup>c</sup> Estimated from documented mortalities only

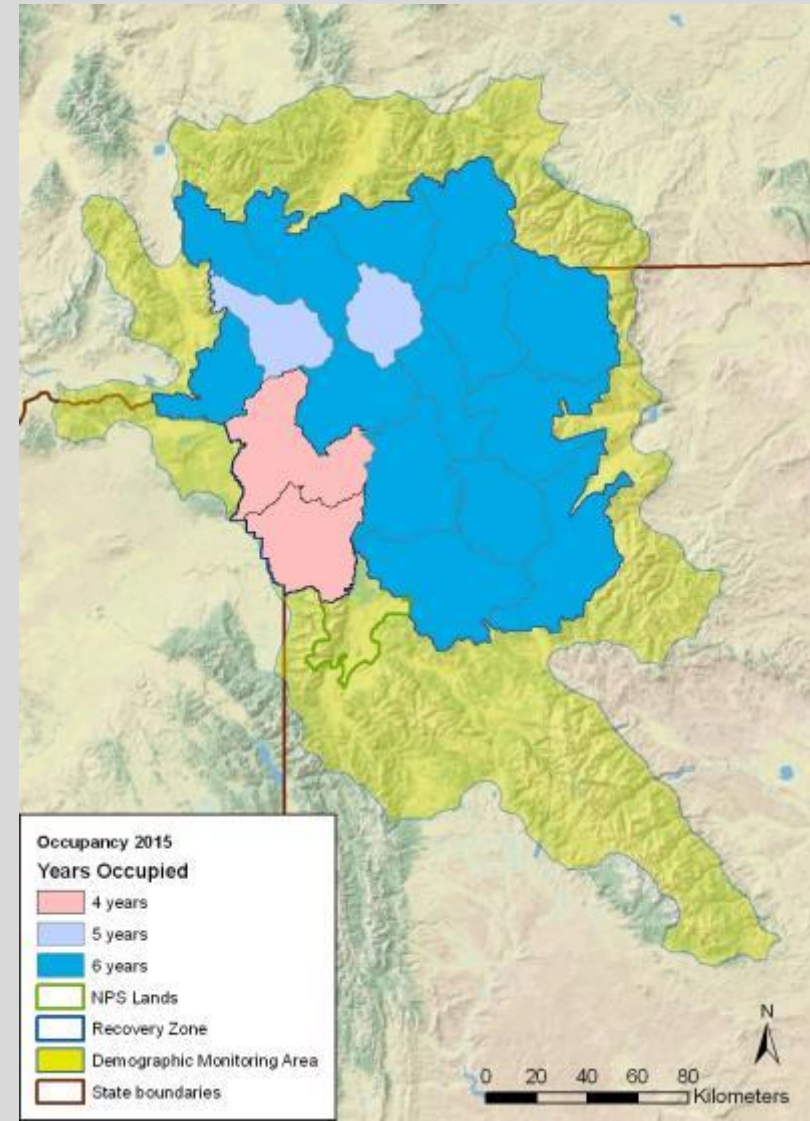
# Counts of Known and Probable Mortalities by Cause 2014-2015

(10/30/2015)



# Occupancy by Females with Young (cubs, yearlings, or 2-year-olds) 2015

- 17 of 18 Bear Management Units (BMUs) occupied during 2015
- 18 of 18 BMUs occupied at least 4 of last 6 years (2010-2015)



# Grizzly Bear Captures and Monitoring for Known-Fate Estimation of Population Trend

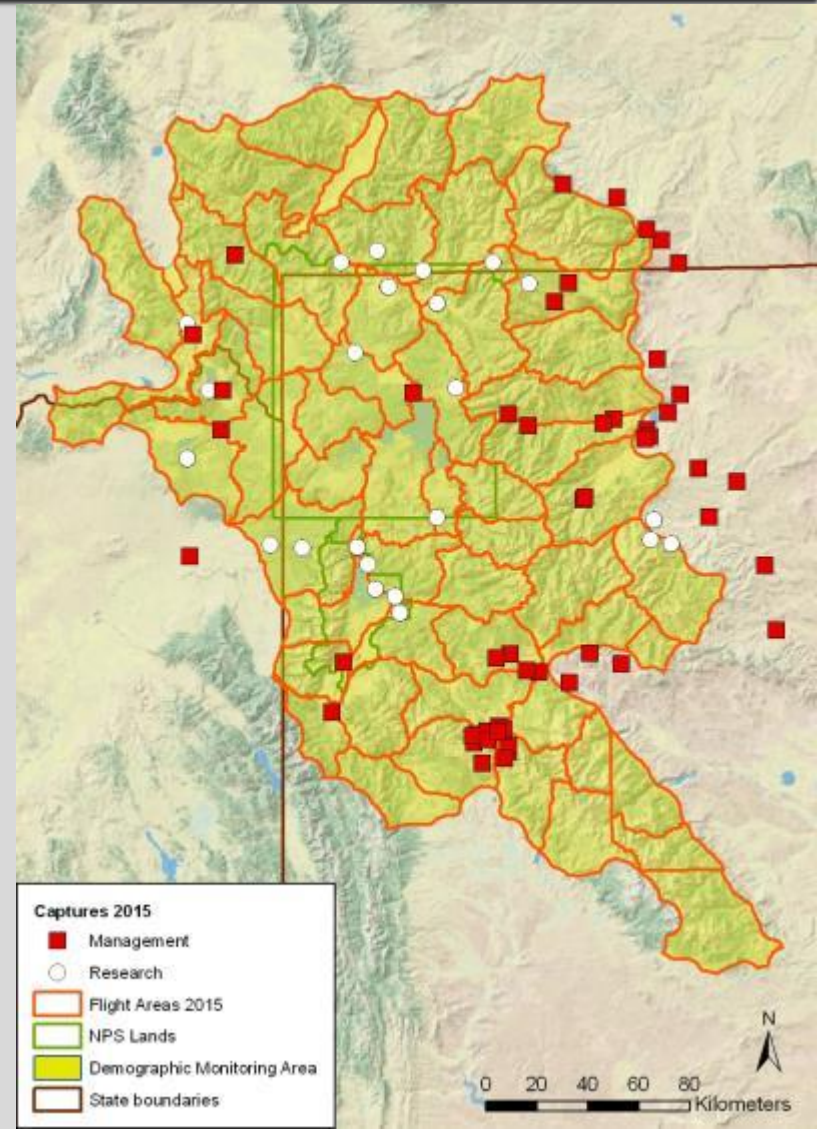




# Grizzly Bear Captures 2015

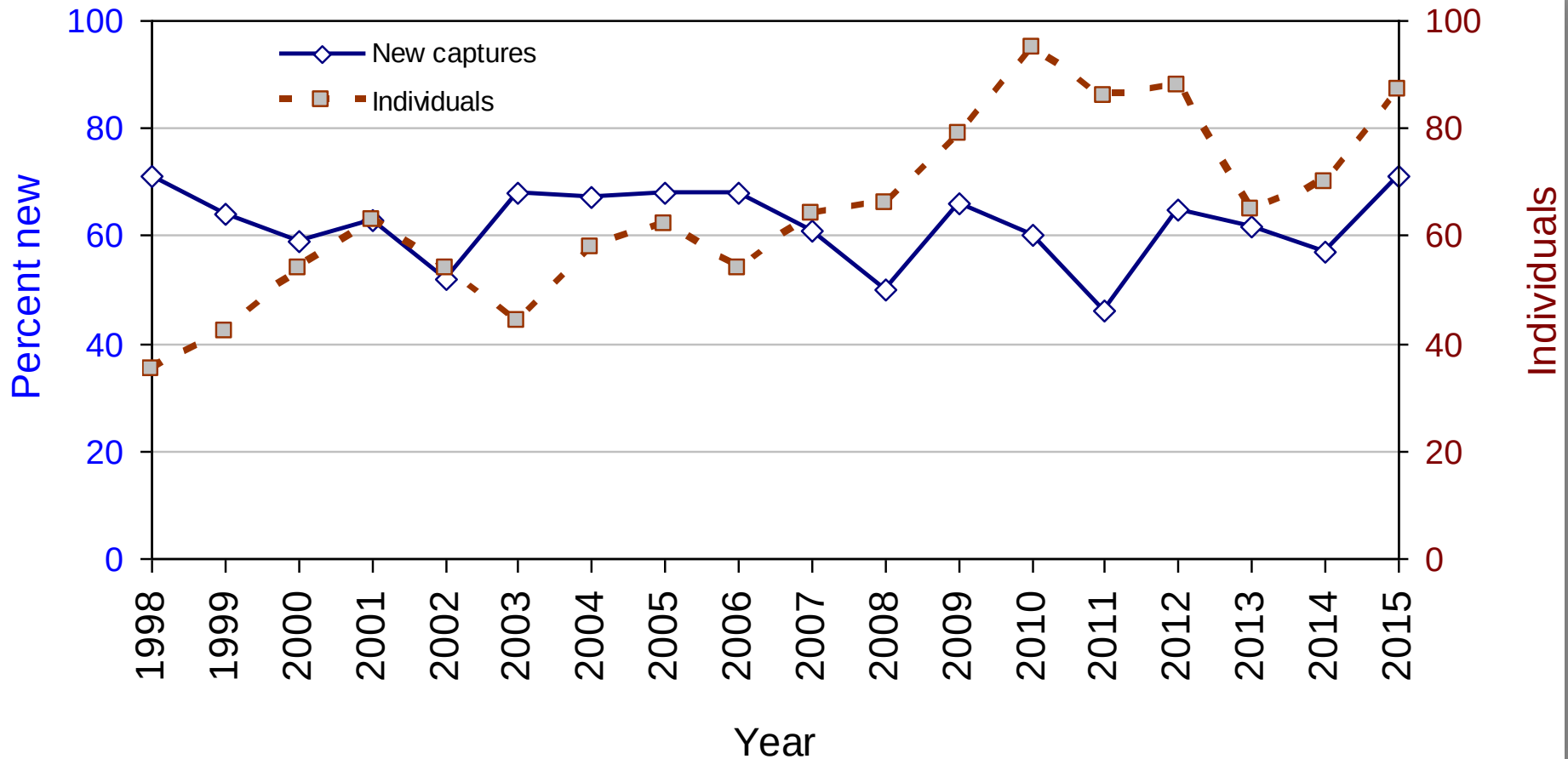
(10/29/2015)

- Total captures = 104
  - Research = 36
  - Management = 68
- Individuals bears = 87
  - Females = 21 (9 adults)
  - Males = 66 (40 adults)
- New bears = 62



# Number of Individuals and Percent New Captures 1998-2015

(10/29/2015)



# Grizzly Bears Radio-Monitored 2015

(10/29/2015)

**Total monitored = 107**

- Adult females = 30

**Currently radio-marked = 68**

- Females = 22 (19 adults)
- Males = 46 (29 adults)
- Bears missing = 4



Steve Ard



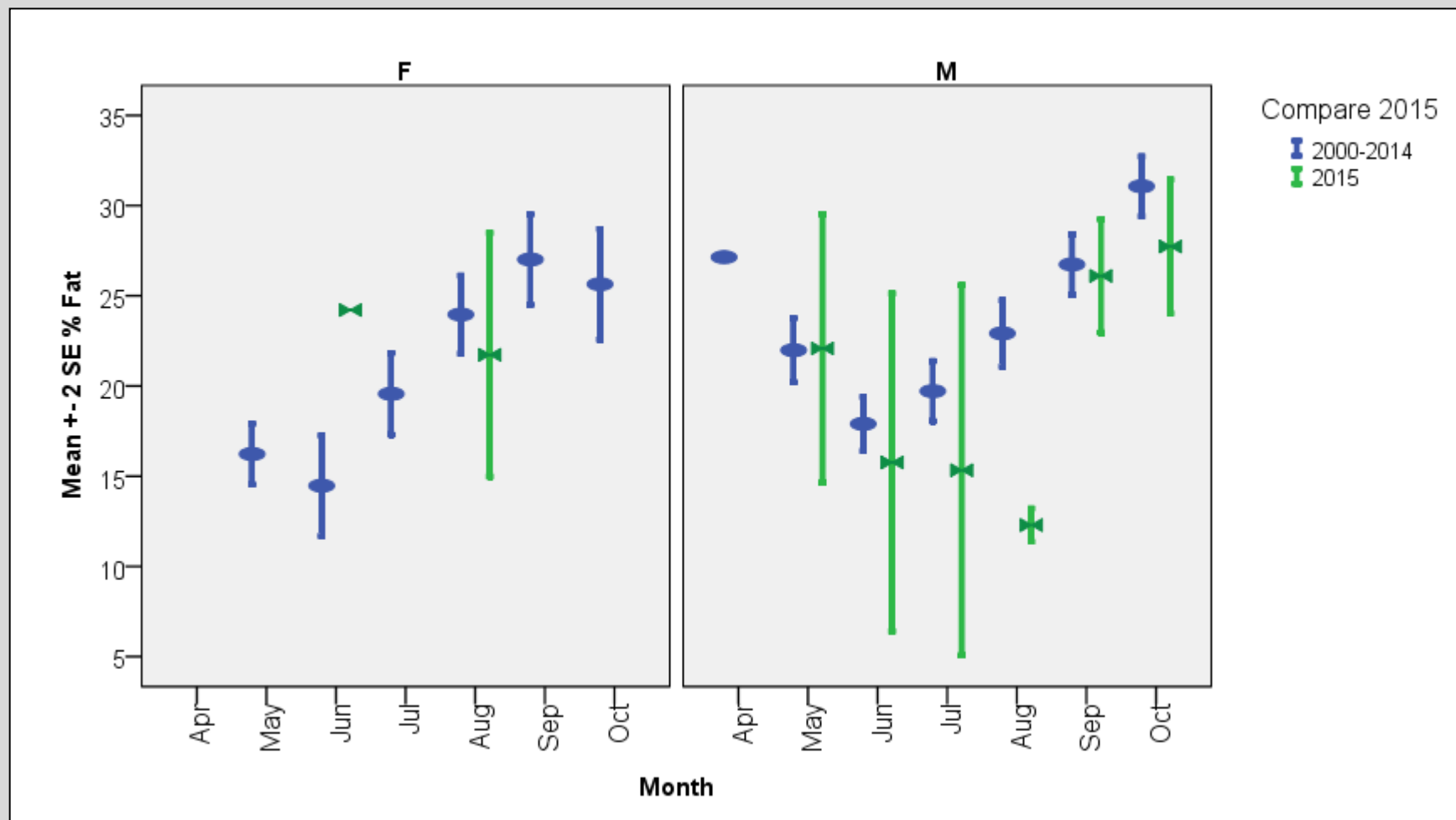
# Bioimpedance to Estimate % Body Fat



*IGBST photos*



# % Body Fat by Month for Independent-aged Grizzly Bears 2000-2014 vs. 2015



# Genetic Monitoring

- Results not back from 2014 field sampling
- 853 individuals genotyped (20 microsatellite markers) through 2013
- No evidence of non-GYE ancestry in any of the individuals genotyped to date



IGBST

# Foods Monitoring



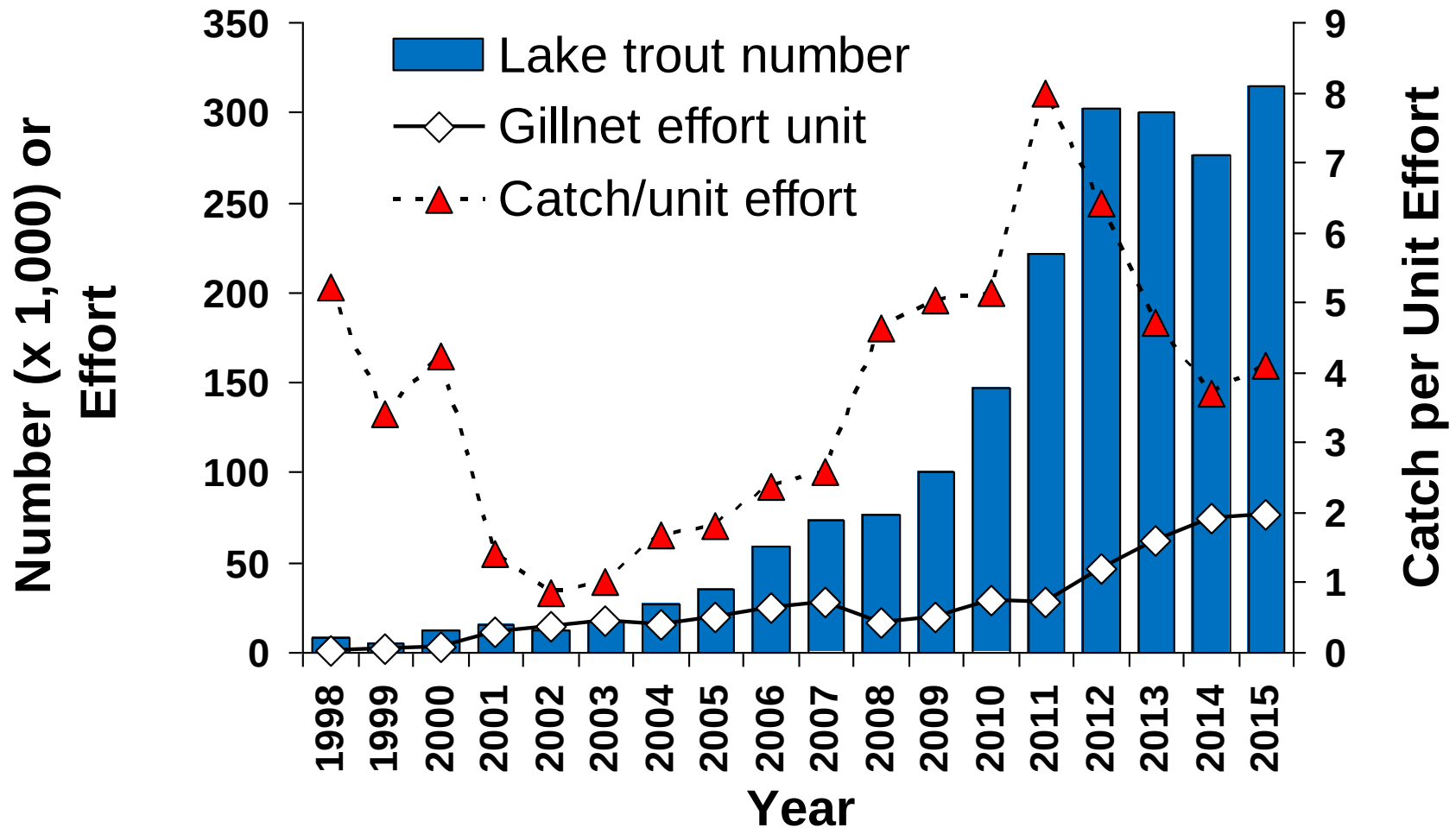


# Spring Carcass Surveys on Ungulate Winter Ranges, Yellowstone NP, 2015

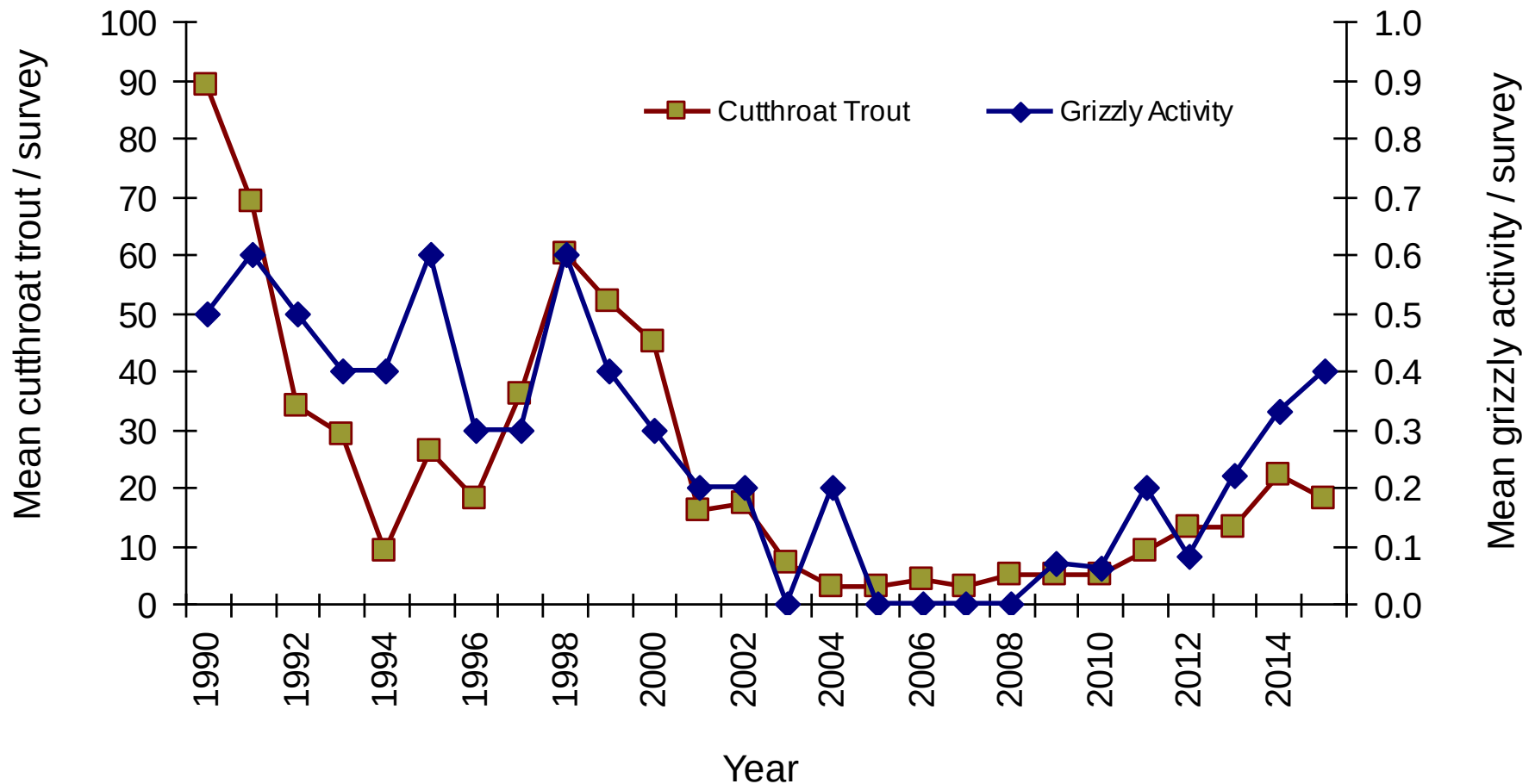
| Survey Area    | Total carcasses | Elk | Bison | Mule deer,<br>pronghorn,<br>bighorn | Carcasses/km |
|----------------|-----------------|-----|-------|-------------------------------------|--------------|
| Firehole       | 2               | 0   | 2     | 0                                   | 0.05         |
| Norris         | 0               | 0   | 0     | 0                                   | 0            |
| Heart Lake     | 0               | 0   | 0     | 0                                   | 0            |
| Mud Volcano    | 0               | 0   | 0     | 0                                   | 0            |
| Northern Range | 23              | 16  | 4     | 3                                   | 0.16         |
| Total          | 25              | 16  | 6     | 3                                   | 0.09         |



# Lake Trout Removal on Yellowstone Lake 1998-2015

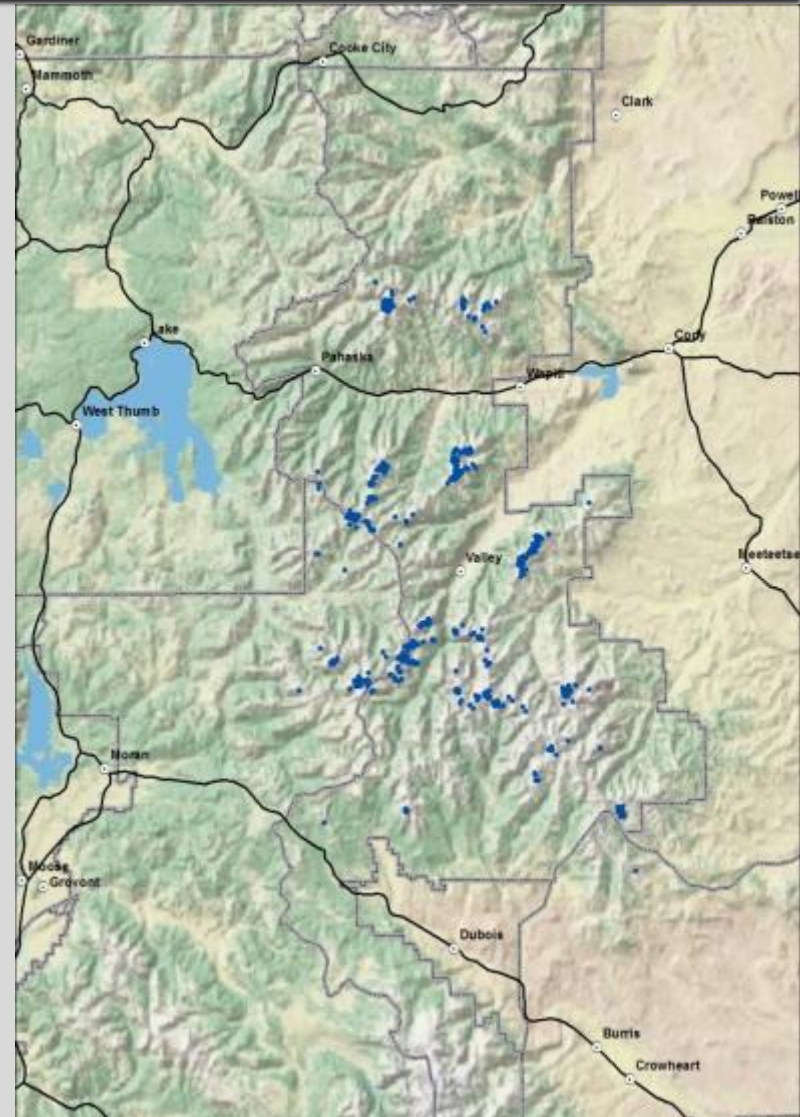


# Spawning Cutthroat Trout and Grizzly Bear Activity on Front-Country Tributary Streams 1989-2015

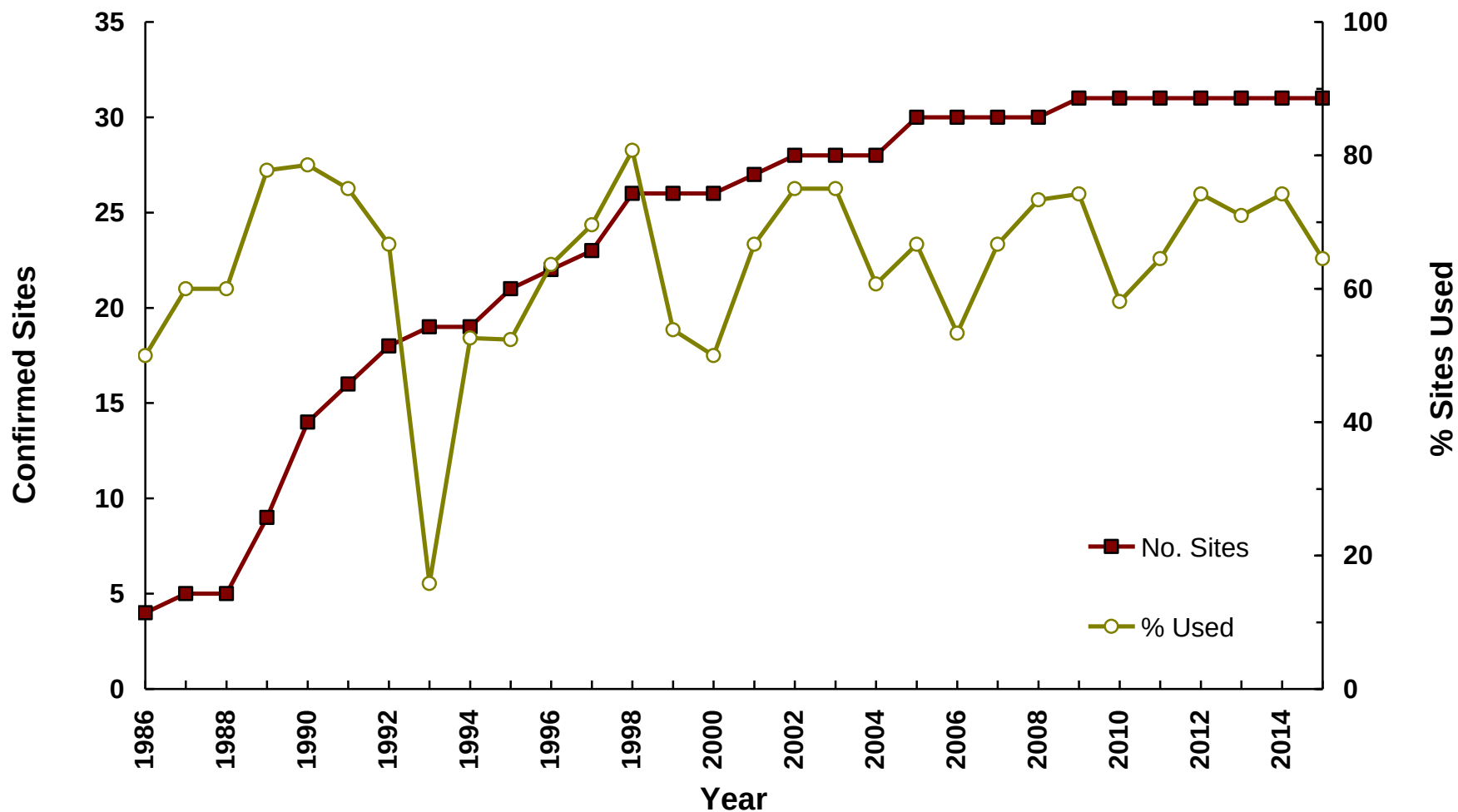


# Insect Aggregation Sites (Army Cutworm Moths) Used by Grizzly Bears ( $n = 46$ )

- 31 confirmed sites – multiple observations of bears feeding during more than 1 year
- 15 possible sites – single observation of bear(s) feeding

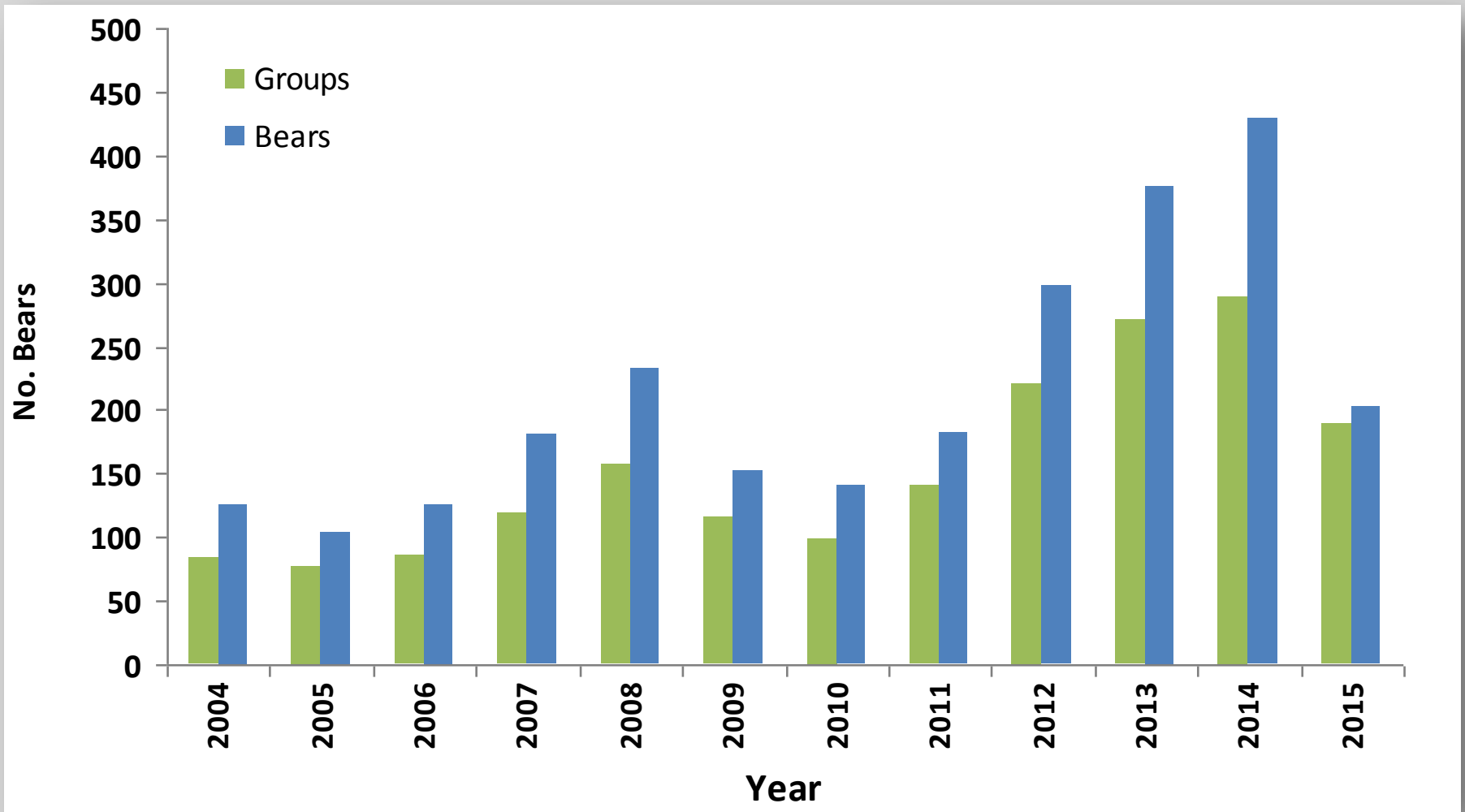


# Confirmed Moth Aggregation Sites and Percent Used 1986-2015

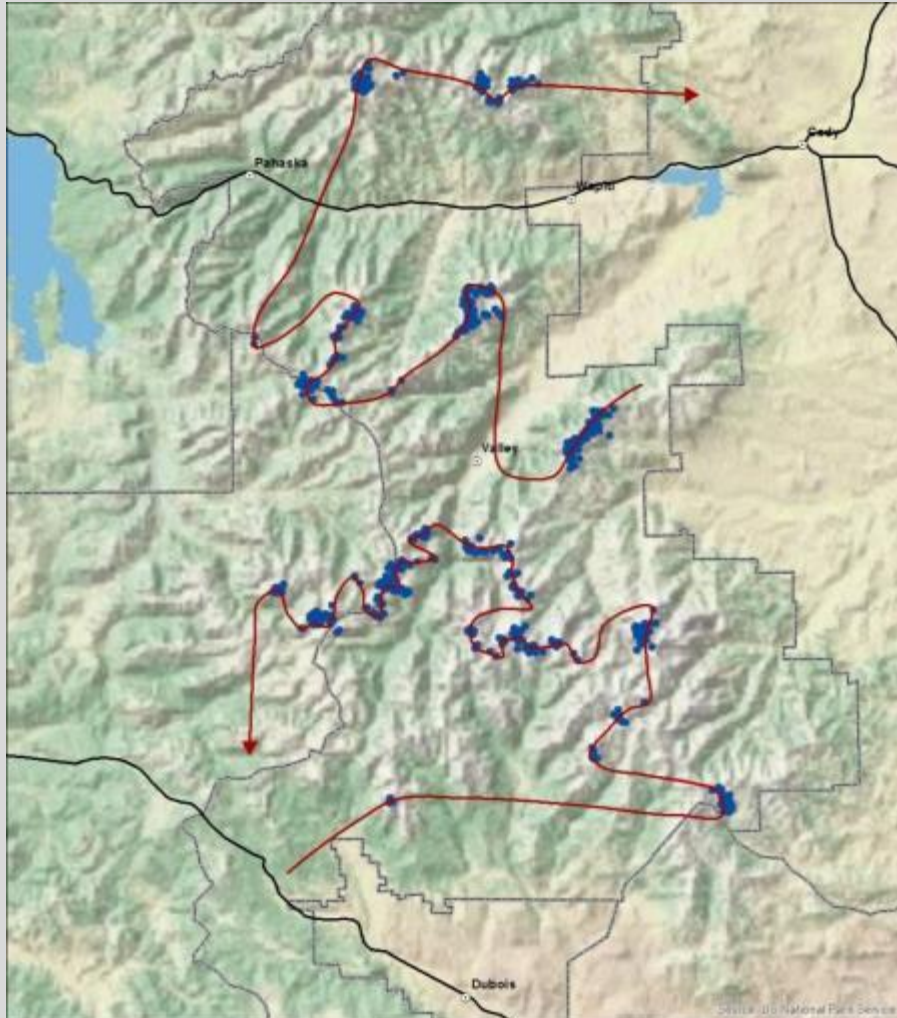




# Number of Grizzly Bear Sightings on Moth Aggregation Sites - Observation Flights 2004-2015



# Grizzly Bear Sightings on Army Cutworm Moth Sites (Moth Site-only Surveys) 2012-2015

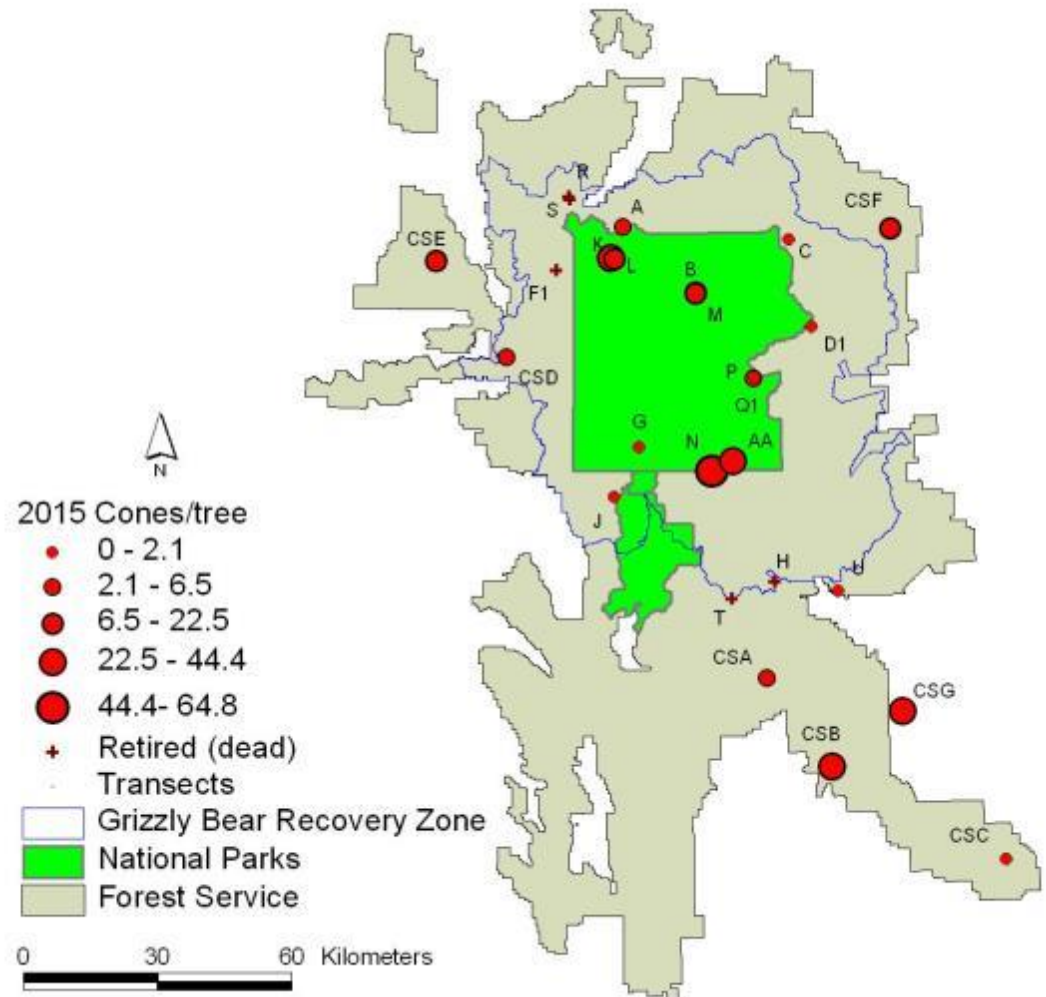


| Year  | Bears | F <sub>COY</sub> |
|-------|-------|------------------|
| 2012* | 100   | 10               |
| 2013  | 140   | 14               |
| 2014  | 220   | 19               |
| 2015  | 179   | 16               |

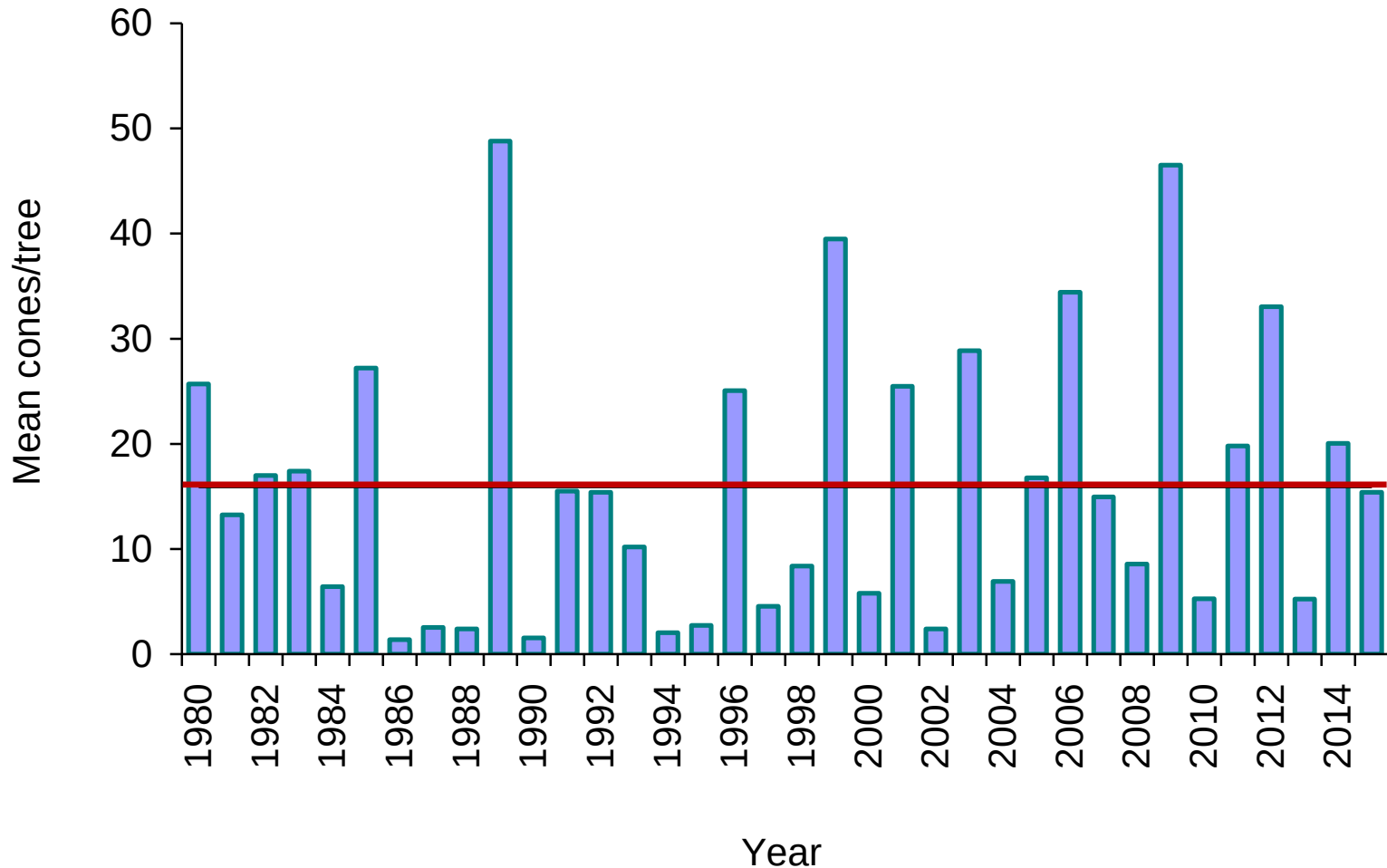
\* not all sites surveyed in 2012

# Whitebark Pine Transects 2015

- 21 transects
- 176 trees surveyed
- Average no. of cones/tree = 15.4

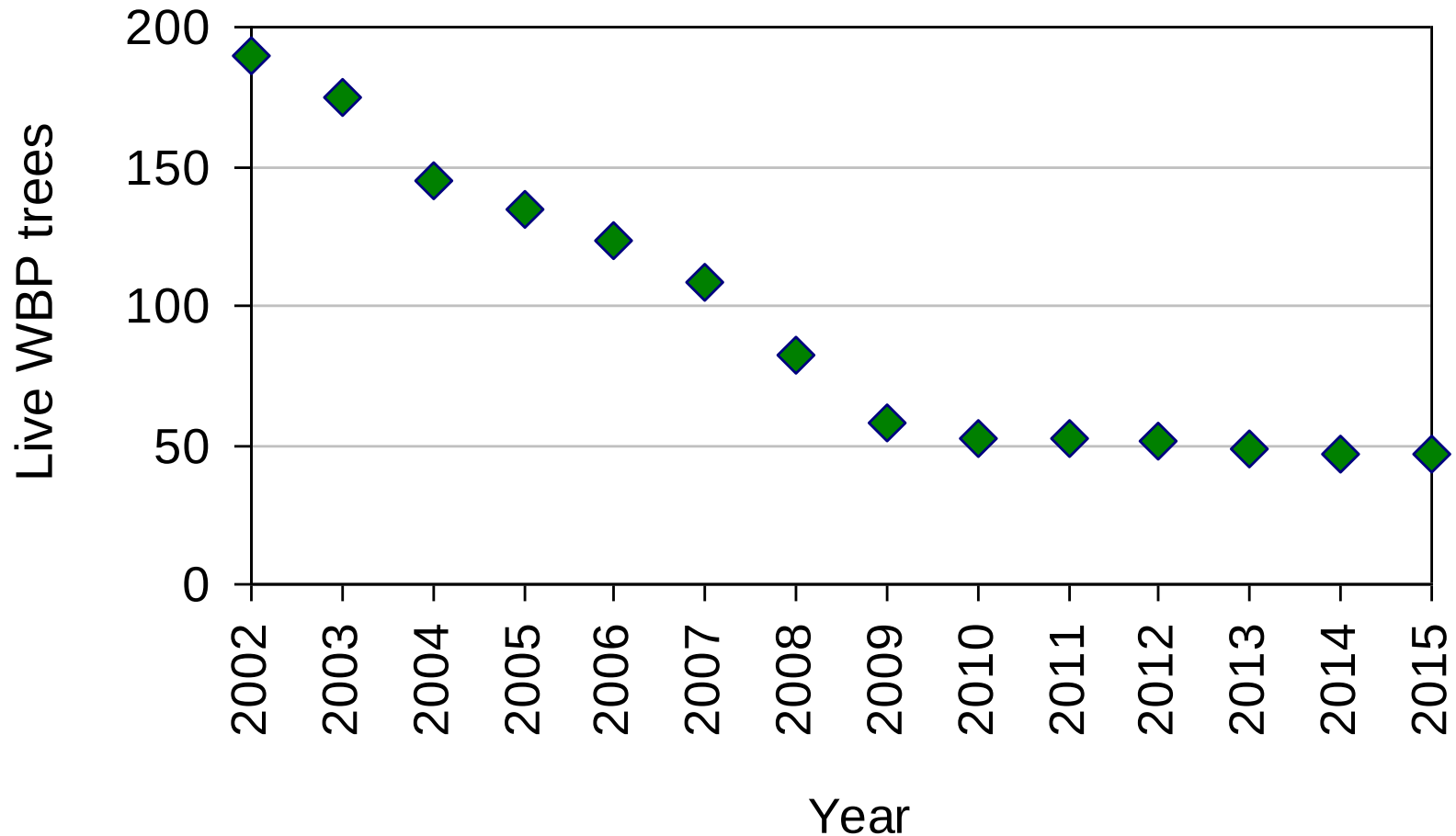


# Whitebark Pine Cone Production 1980-2015





# Whitebark Pine Tree Mortality on Cone Production Transects 2002-2015



# Summary

- Population
  - Population estimate = 714
  - No major change in long-term trend
  - No evidence of bears leaving core of ecosystem
- Mortality
  - Approximately 20% outside DMA
  - Livestock and site conflicts
  - 2015 mortality limits not exceeded so far
- Year of relatively low food supply
  - Average whitebark pine production
  - Low availability of winter-killed carcasses
  - Berry production low
  - Short season for moth foraging



A close-up photograph of a dense mass of woolly fibers, likely from a sheep or goat. The fibers are a mix of light tan and dark brown colors, creating a textured, shaggy appearance. The lighting is somewhat uneven, with brighter areas where the fibers are more exposed and darker areas in the shadows.

**2014 Annual Report, data, maps,  
and other products available at  
IGBST website:**

**Google “IGBST”**



# Acknowledgments 2015

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- **WS:** M. Foster, C. Hoover, K. Meidtke, R. Merrell
- **WYGF:** G. Anderson, C. Atkinson, B. Baker, K. Bales, D. Bjornlie, M. Boyce, D. Brimeyer, Burnette, J. Clapp, C. Clark, D. Clause, A. Courtemanch, B. DeBolt, L. Ellsbury, G. Fralick, M. Goche, Z. Gregory, C. Hansen, Hicks, A. Johnson, J. Kraft, B. Kroger, A. Lamotta, K. Lash, D. Lasseter, D. McWhirter, K. Mills, C. Nielsen, J. Stephens, S. Stephens, Stone, D. Thompson, B. Trebelcock, Z. Turnbull, J. Wilmot

