

Relevant Grizzly Bear Science Greater Yellowstone Ecosystem

Denver Meeting
18-19 February 2015



Keith Crowley

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Outline

Overview and background

1. Population estimation and trend

- A. Population trend
- B. New population estimation technique

2. Management flexibility

- A. Demographic Monitoring Area (DMA)
- B. Assessing sustainable mortality

Study Team Members

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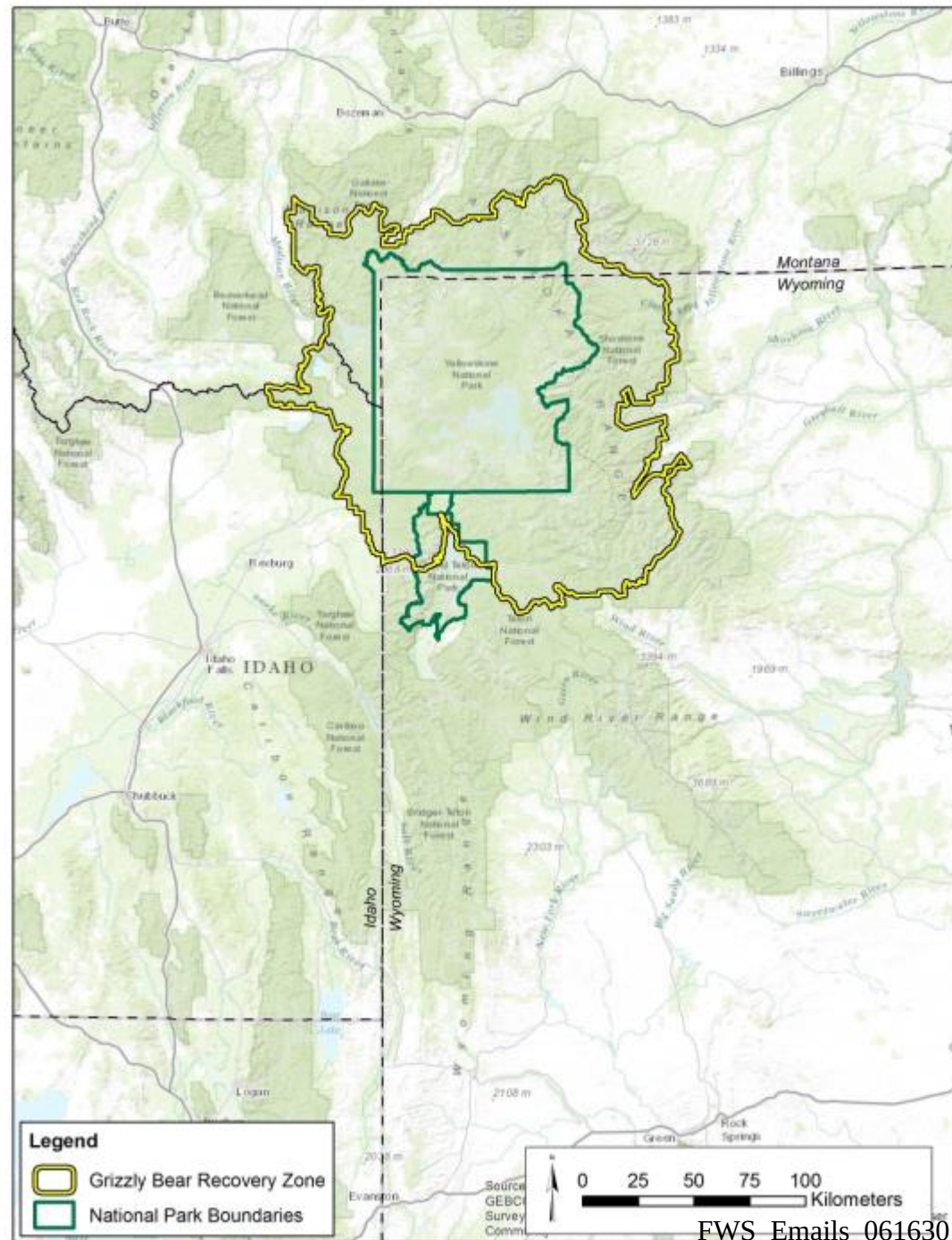


- National Park lands
10,344 km²



Greater Yellowstone Ecosystem

- National Park lands
10,344 km²
- Recovery Zone 1982
23,828 km²



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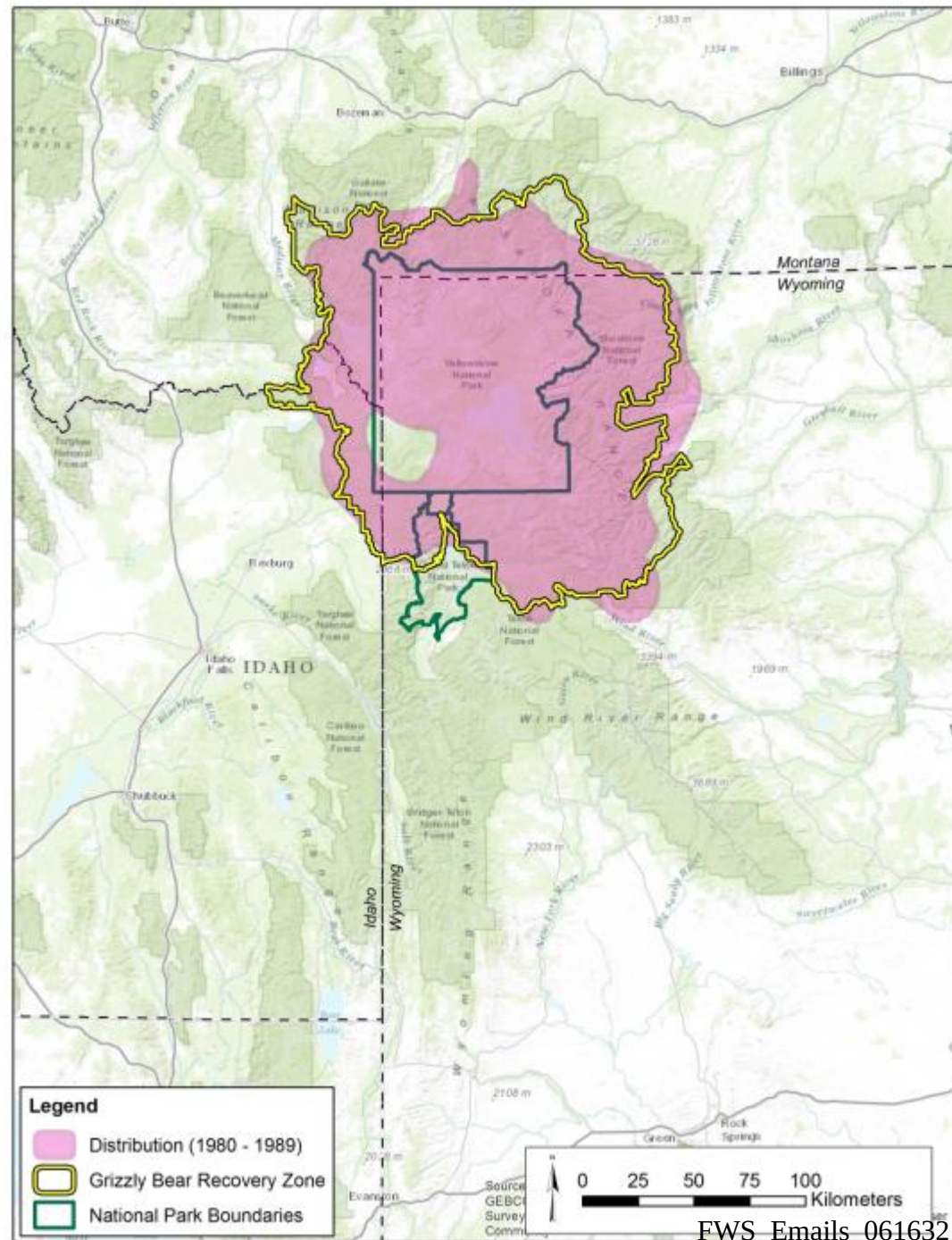
IGBST

- # IGBST



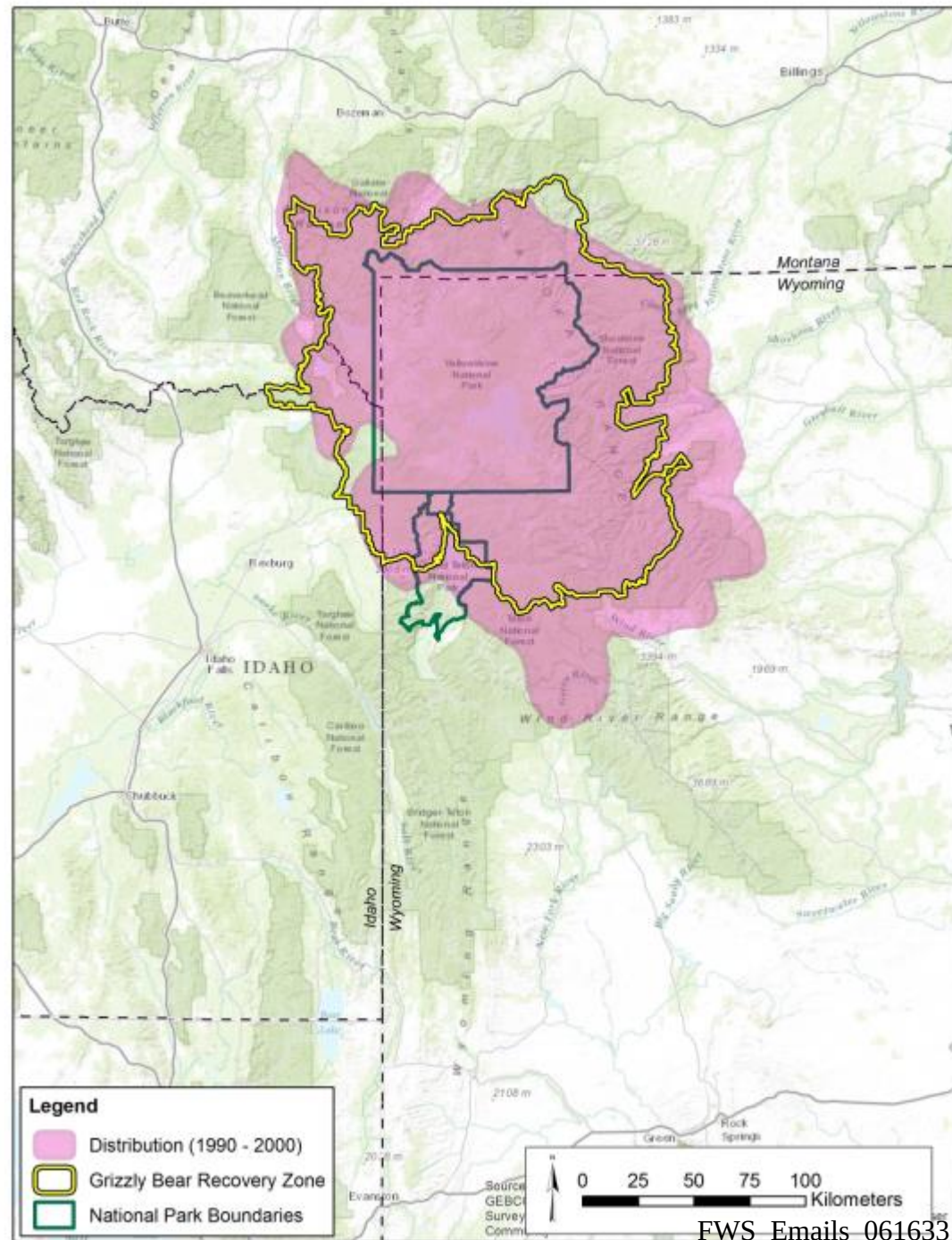
Greater Yellowstone Ecosystem

- Grizzly bear distribution
1980-1989
23,971 km²



Greater Yellowstone Ecosystem

- Grizzly bear distribution
1990-2000
33,298 km²



IGBST

- # IGBST



IGBST Demographic Workshops 2011-2012

- Directives from the Yellowstone Ecosystem Subcommittee (YES) of IGBC
- Two primary directives:
 - 1) Alternative population estimator
 - 2) Flexibility for mortality management
- 3 workshops (Feb 2011, Jul 2011, Feb 2012)
- IGBST members and external experts

Topic 1: Population Estimation and Trend

- A) Population trend based on 4 methods
- B) Mark-resight estimator

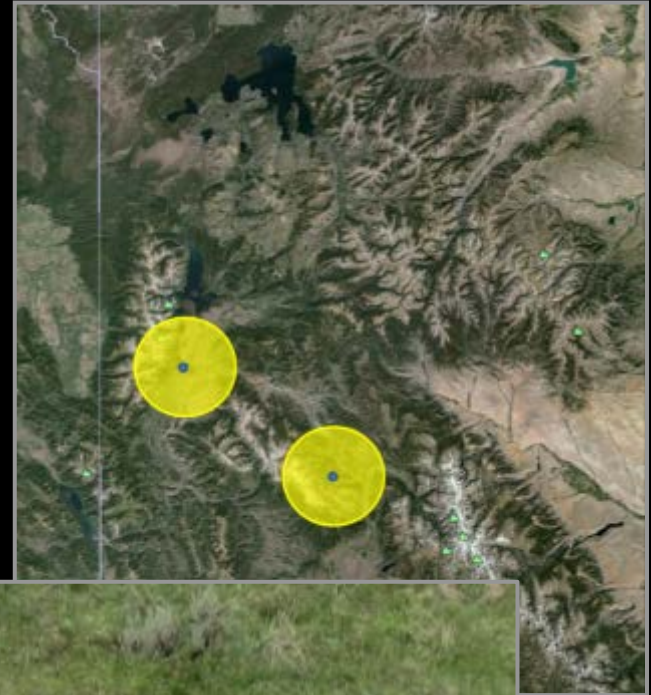
Challenges of Grizzly Bear Population Studies

- Low density and solitary
- Low observability (activity pattern, habitat)
- Remote and difficult terrain
- Achieving adequate sample size
- IGBST uses multiple methods for stronger inference

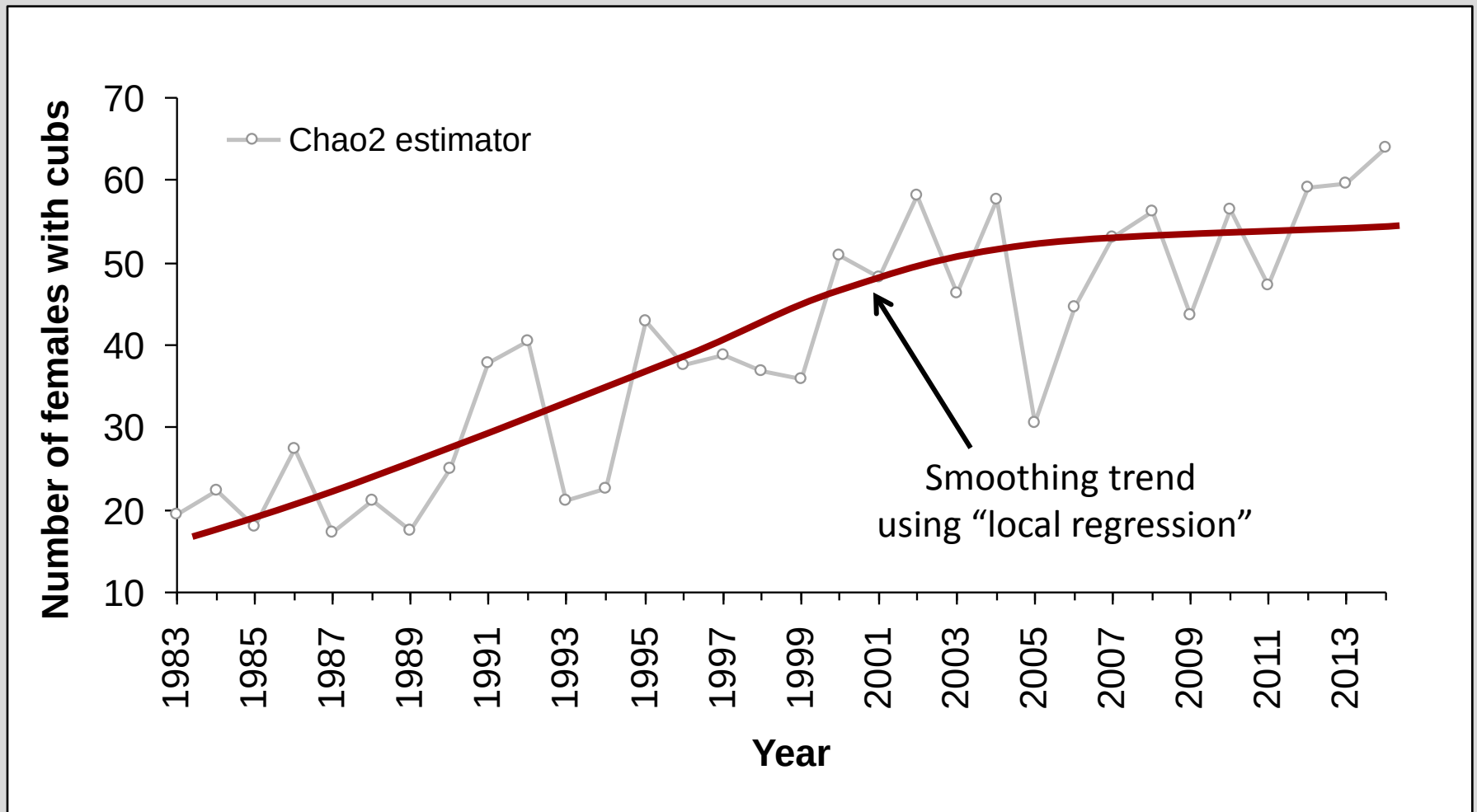
Population Trend



Method 1: Chao2 Estimator



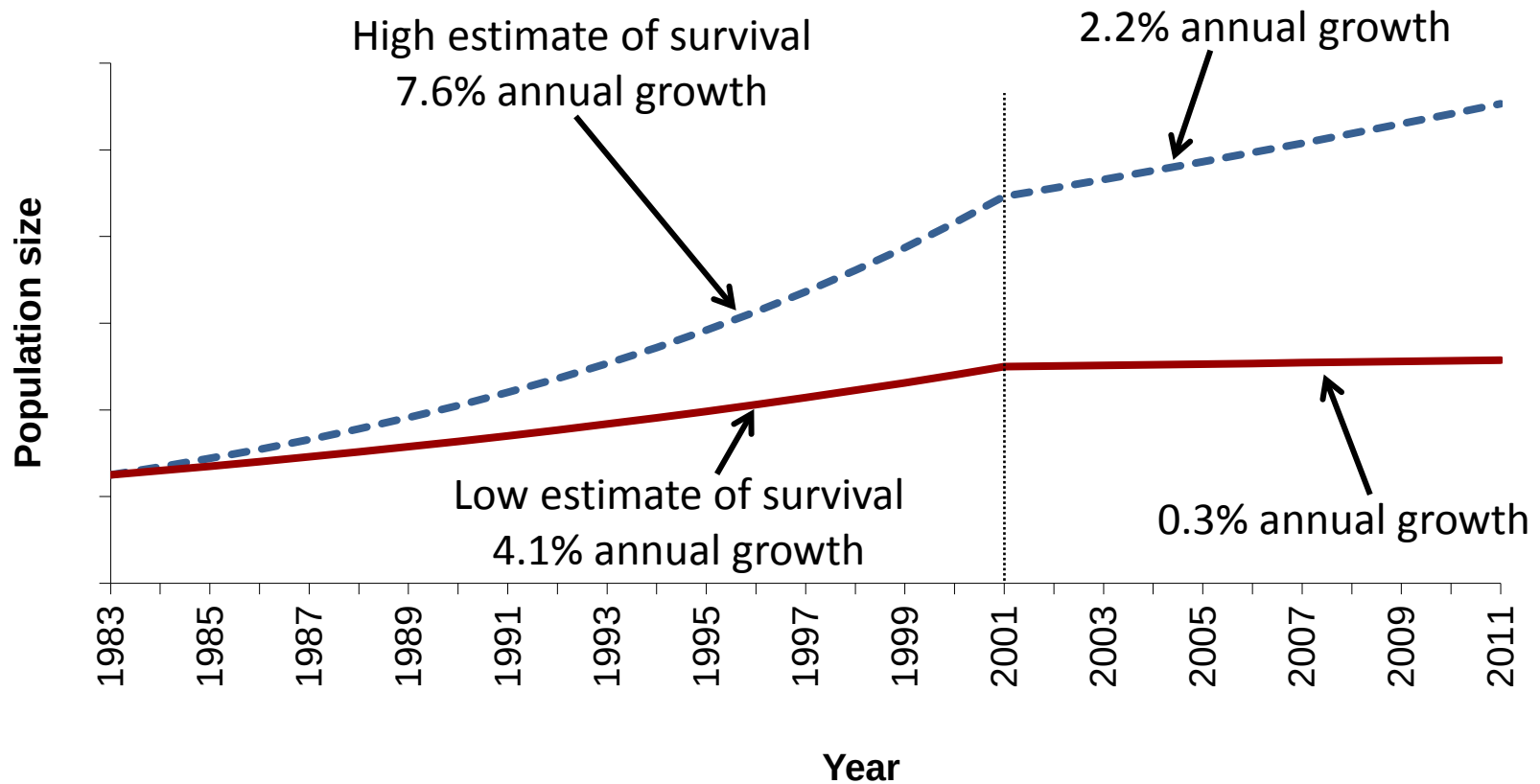
Chao2 Estimator



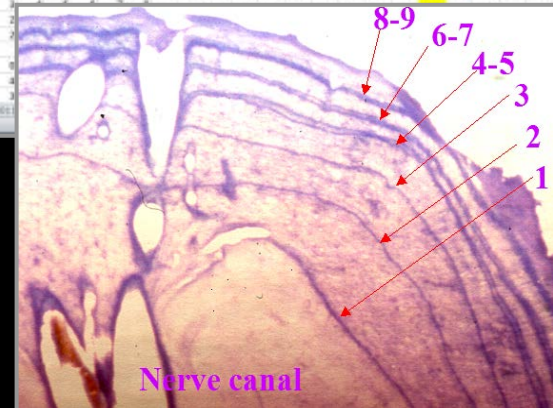
Method 2: Known-Fate Analysis



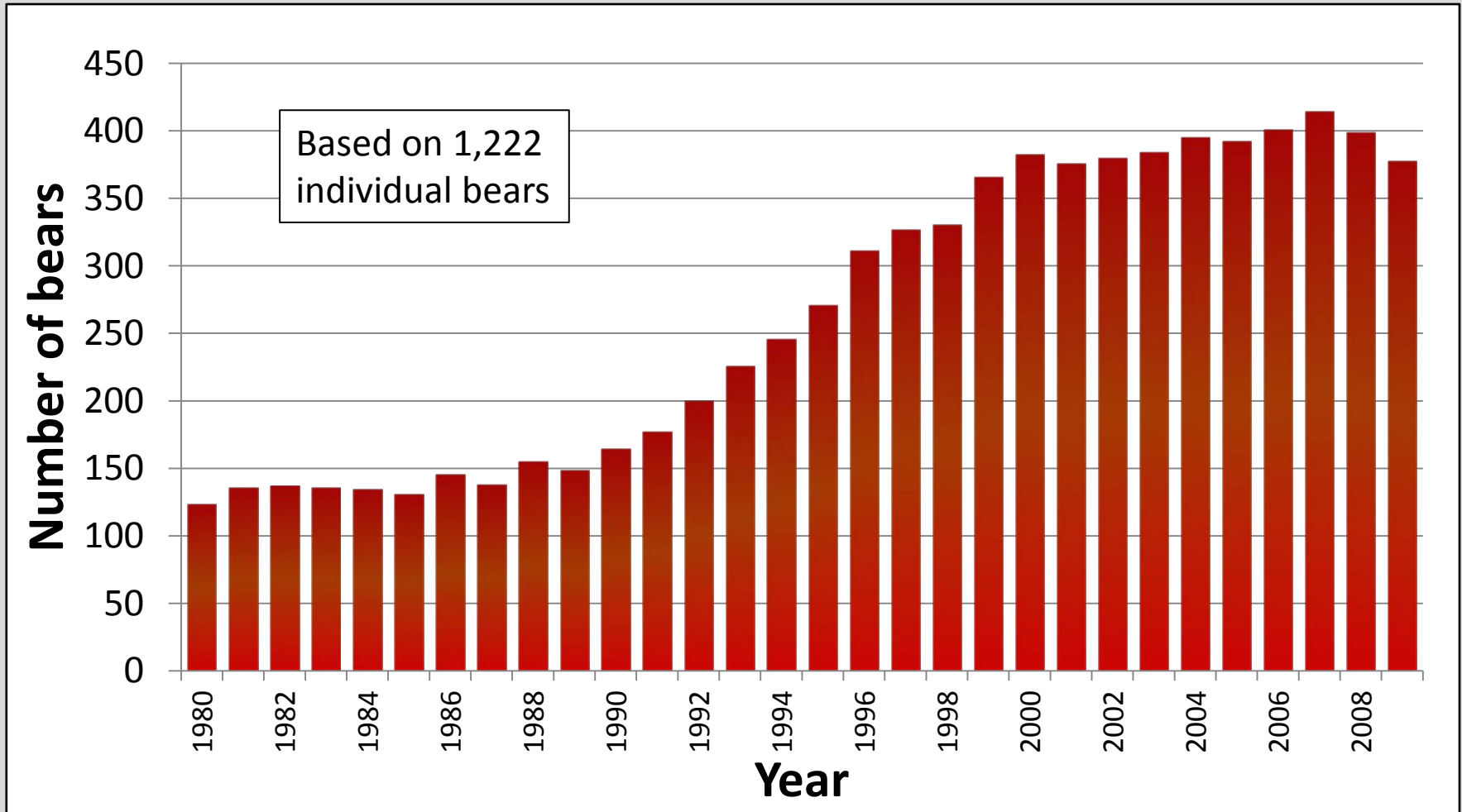
Population Projection



IGBST



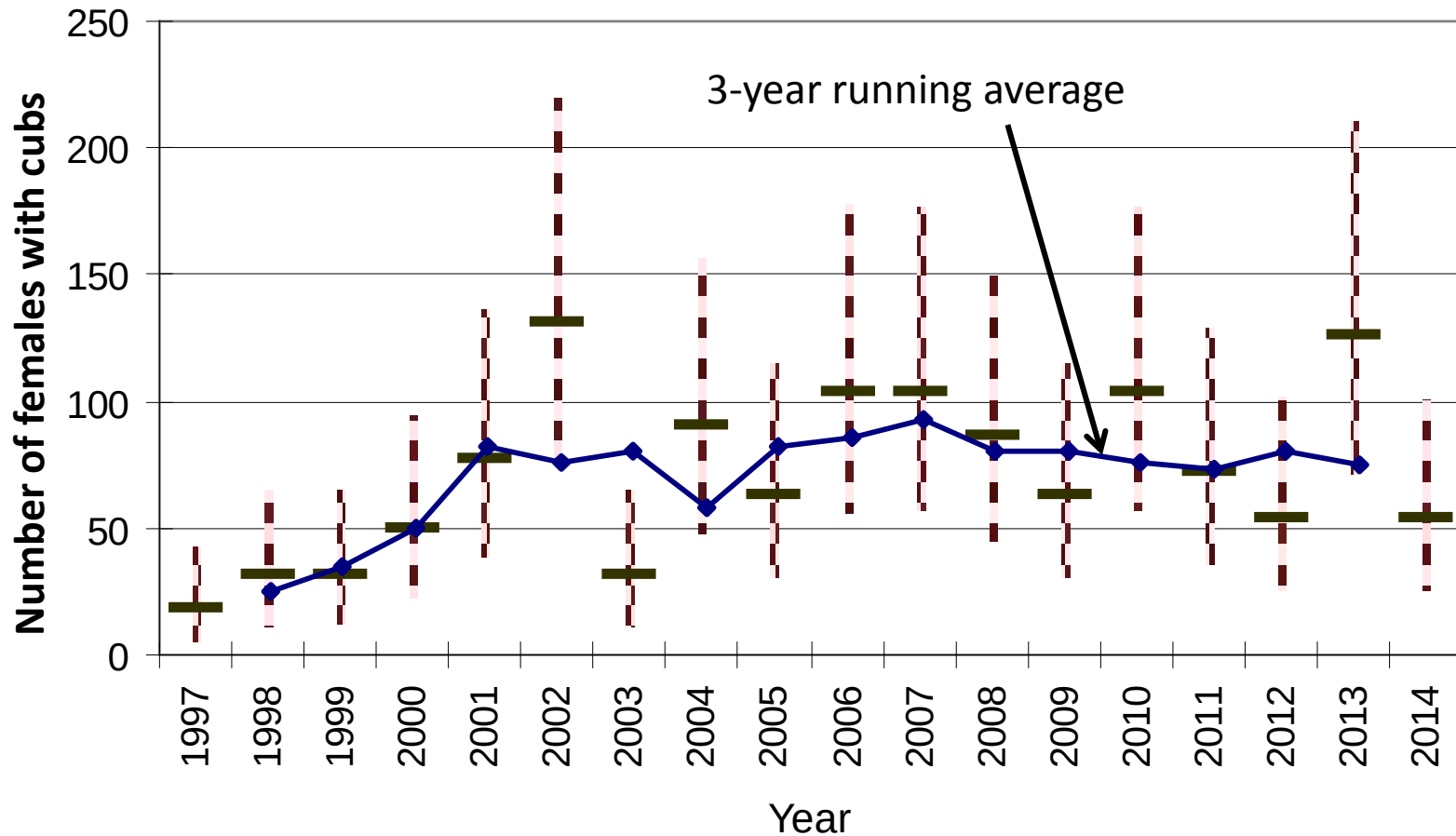
Population Reconstruction



Method 4: Mark-Resight of Radio-Marked Females with Cubs

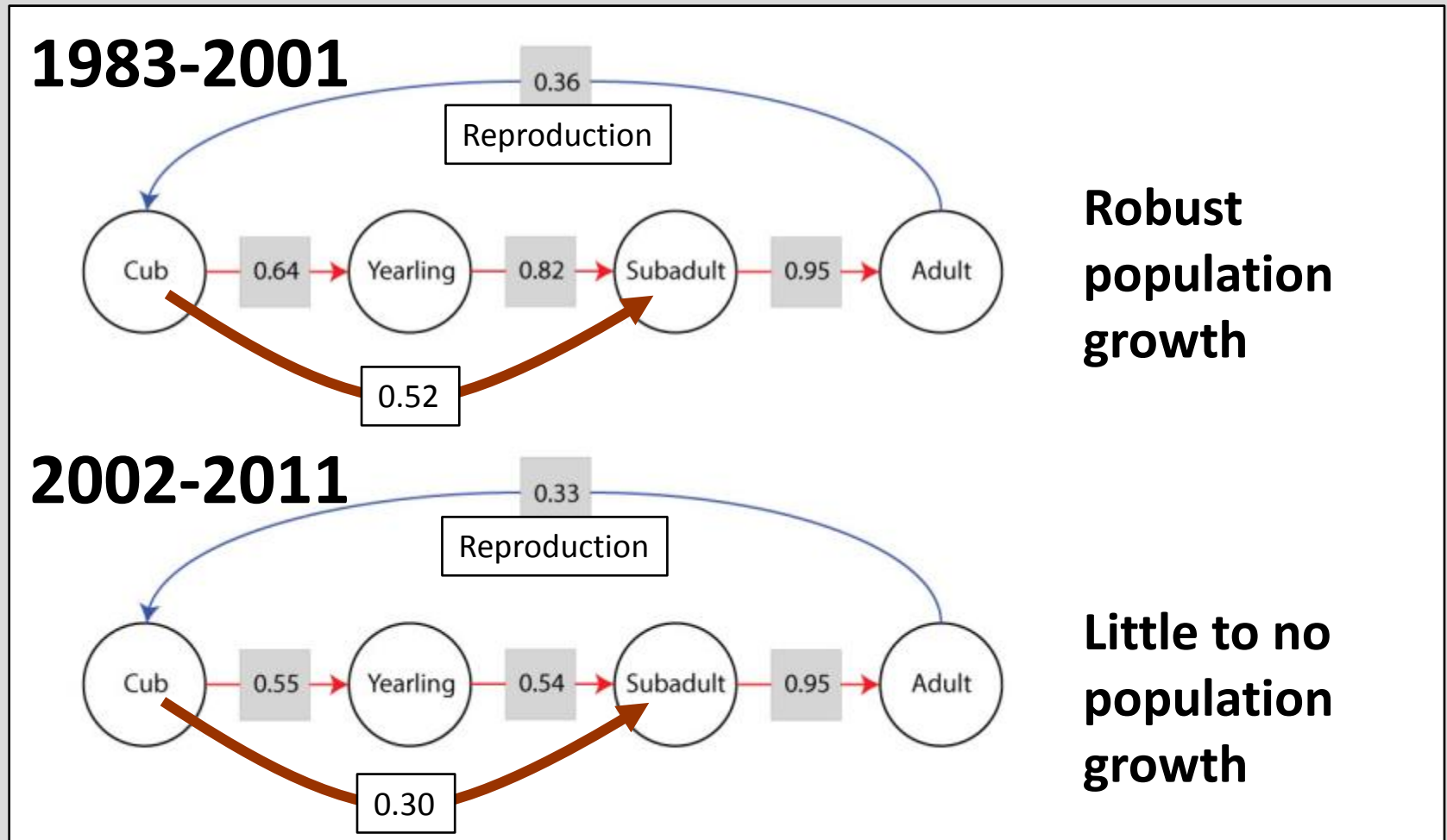


Mark-Resight Estimator

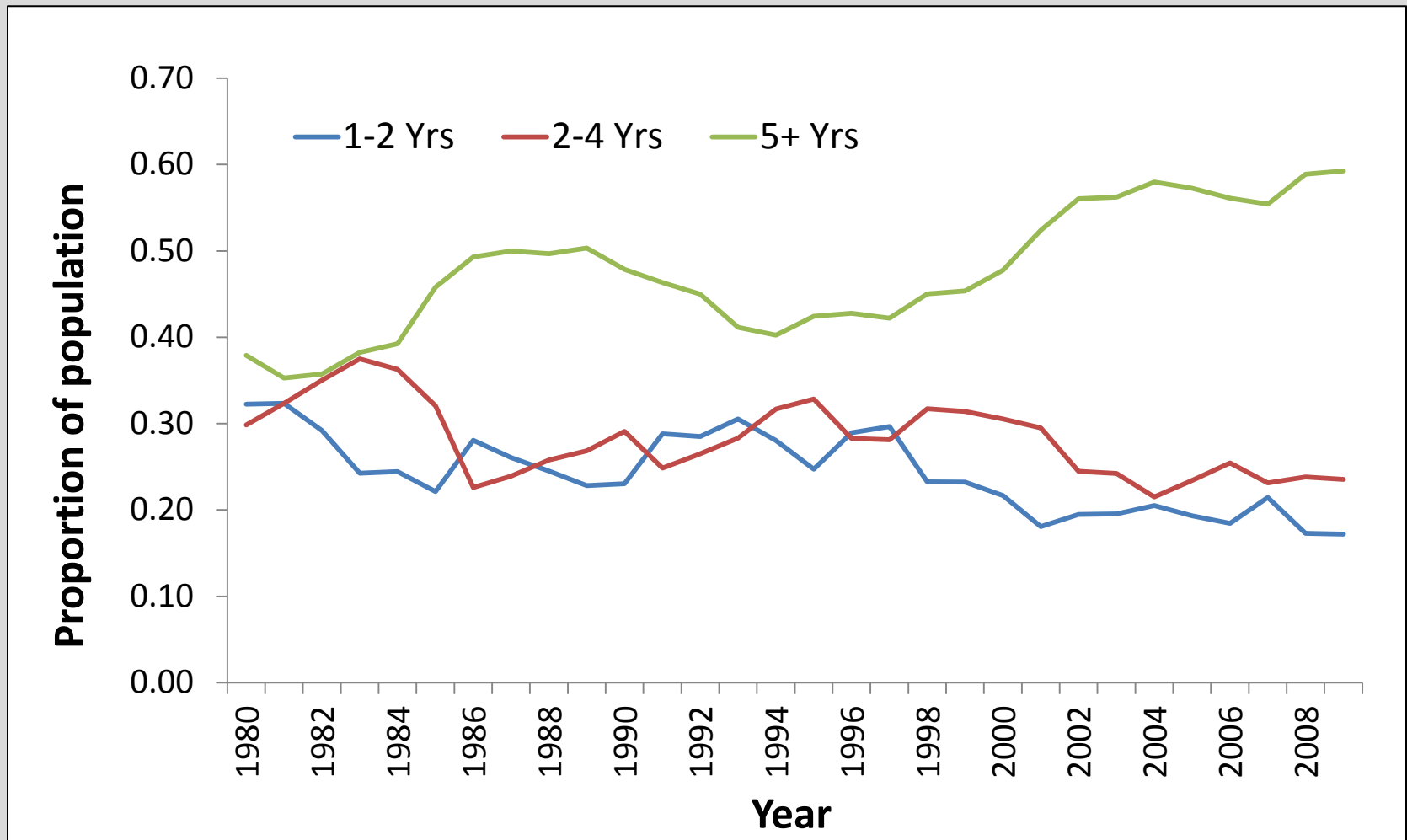


Mechanism Behind Slowing of Population Growth

Evidence from Known-Fate Analysis

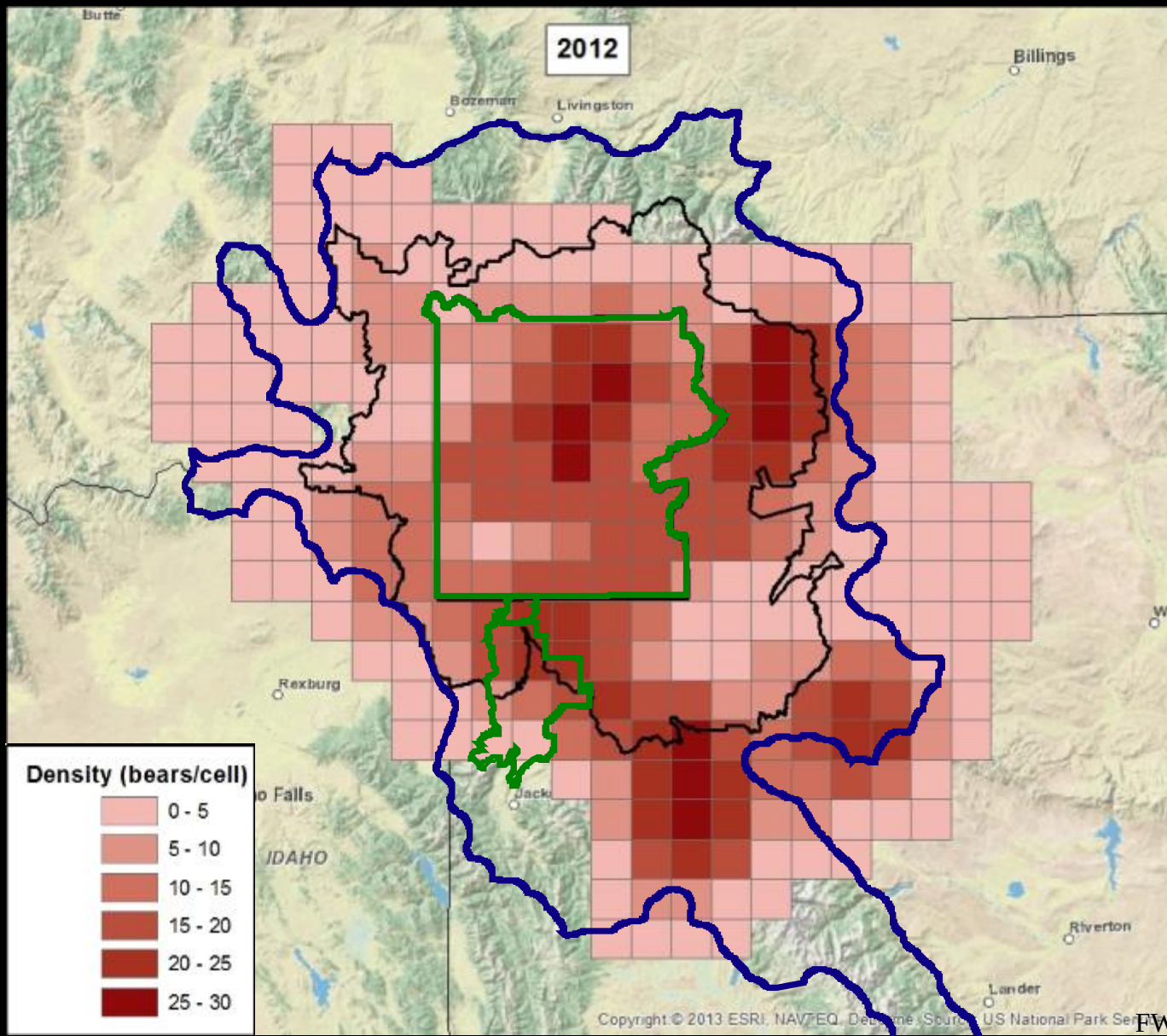


Changing Age Structure Population Reconstruction



Grizzly Bear Density Index

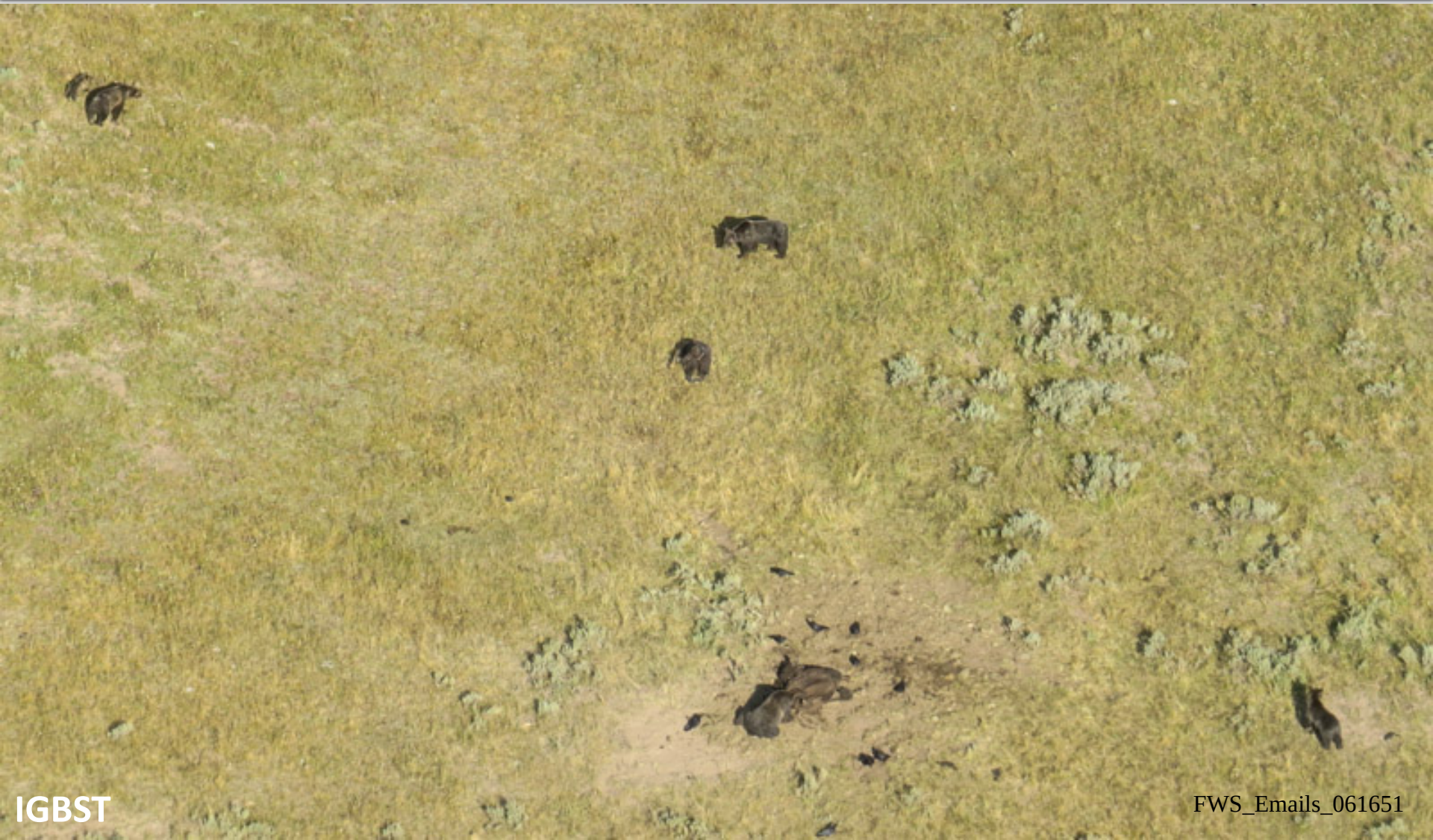
Based on 870 individual home ranges of bears ≥ 2 years of age



Conclusions: Population Trend

- 4 independent methods show minimal population growth since early 2000s
- First reported in 2012 (IGBST Workshop Report)
- Mechanism: lower survival of younger age classes
- Pattern follows predictions for populations of large vertebrates reaching carrying capacity (Eberhardt 1977)
- A population near carrying capacity is indicative of recovered population

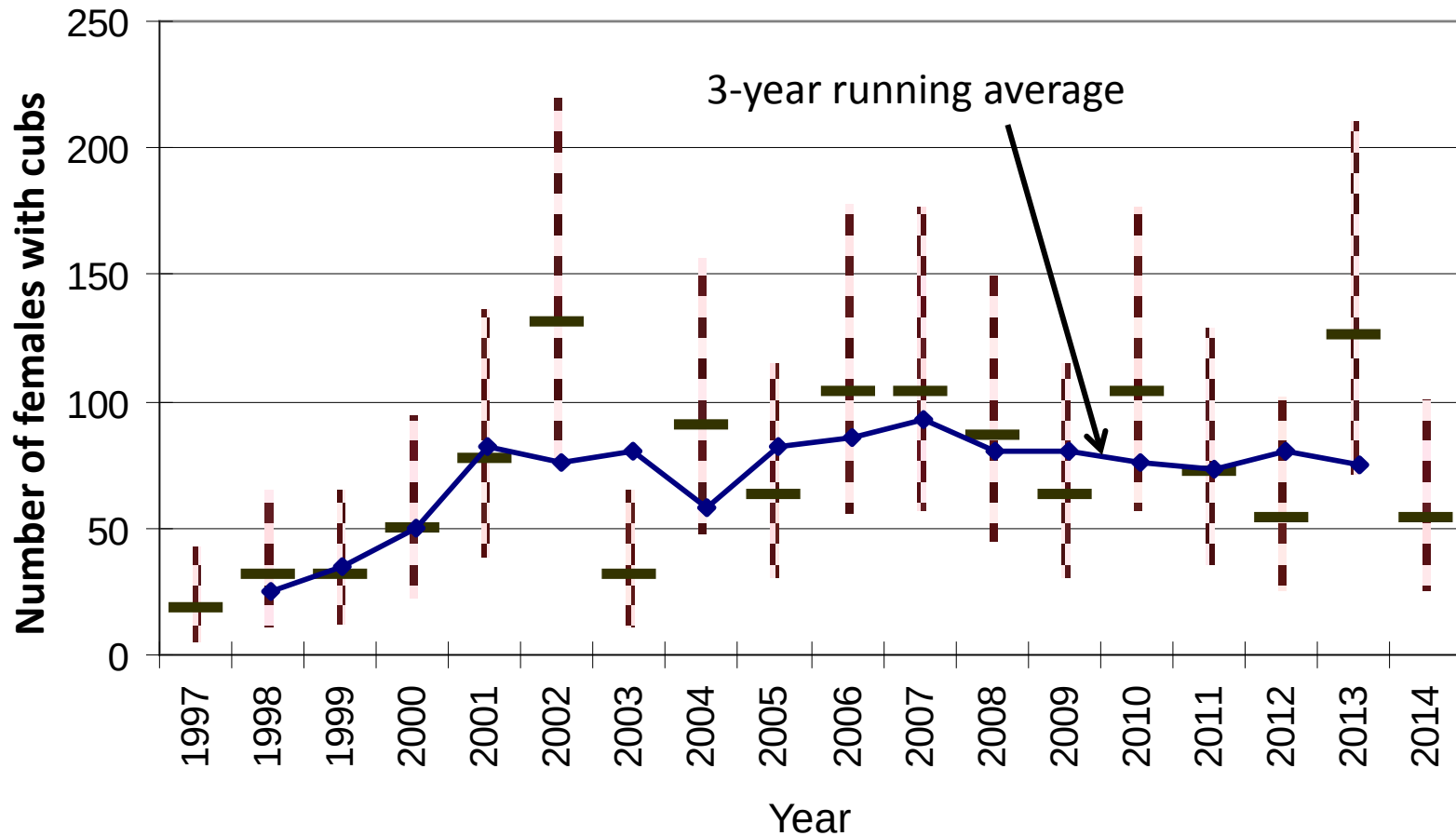
Population Estimation



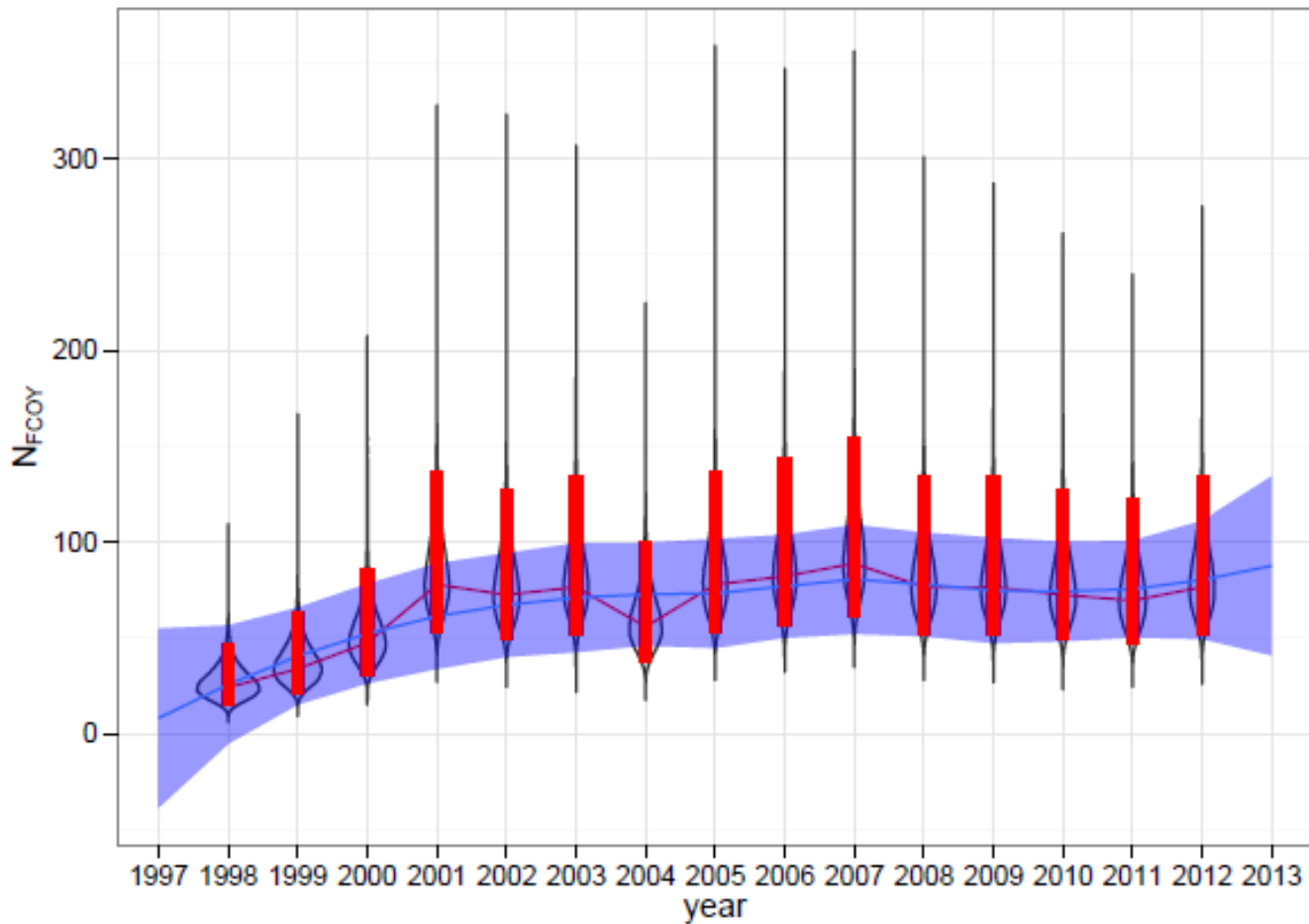
Mark-Resight: An Outcome from the Demographic Workshops

- Various new approaches were evaluated to address known underestimation in Chao2
- Workshop participants agreed mark-resight technique provided best alternative that can be applied with data collected since 1997
- Based on aerial observations of radio-marked vs. unmarked females with cubs
- Shown to be relatively unbiased but high variance (Higgs et al. 2013)

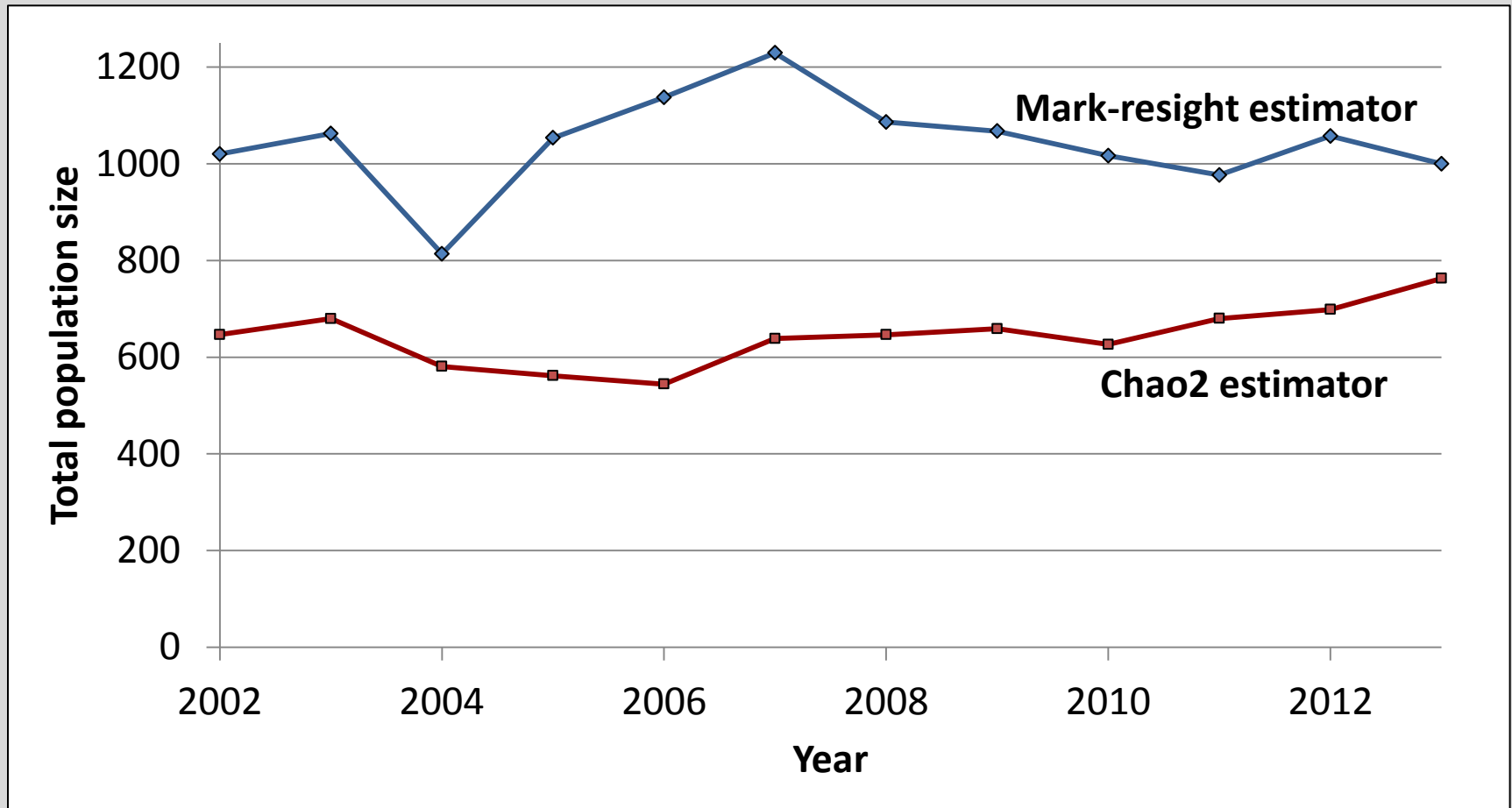
Mark-Resight Estimator



Mark-Resight Estimator



3-Year Running Average Chao2 and Mark-Resight Estimators



Implementation Steps for Mark-Resight Estimator

- 1) YES consensus to start implementation
 - Study team to address incorporating uncertainty into overall population estimate
- 2) Independent genetic approach to evaluate mark-resight
 - Evaluate if results support mark-resight
 - Publish findings in peer-review journal
- 3) Presentation to YES and IGBC – Summer/Fall 2015
 - Requires maintaining current sample (>25) of radio-marked, adult females; preferably more

Detecting Population Trends

- Grizzly bears have low reproductive potential; difficult to detect population change
- Chao2 estimator
 - Power to detect $\approx 5\%$ annual decline after 5 years (Harris et al. 2007)
- Mark-resight estimator
 - Power not yet tested but likely less than Chao2 estimator

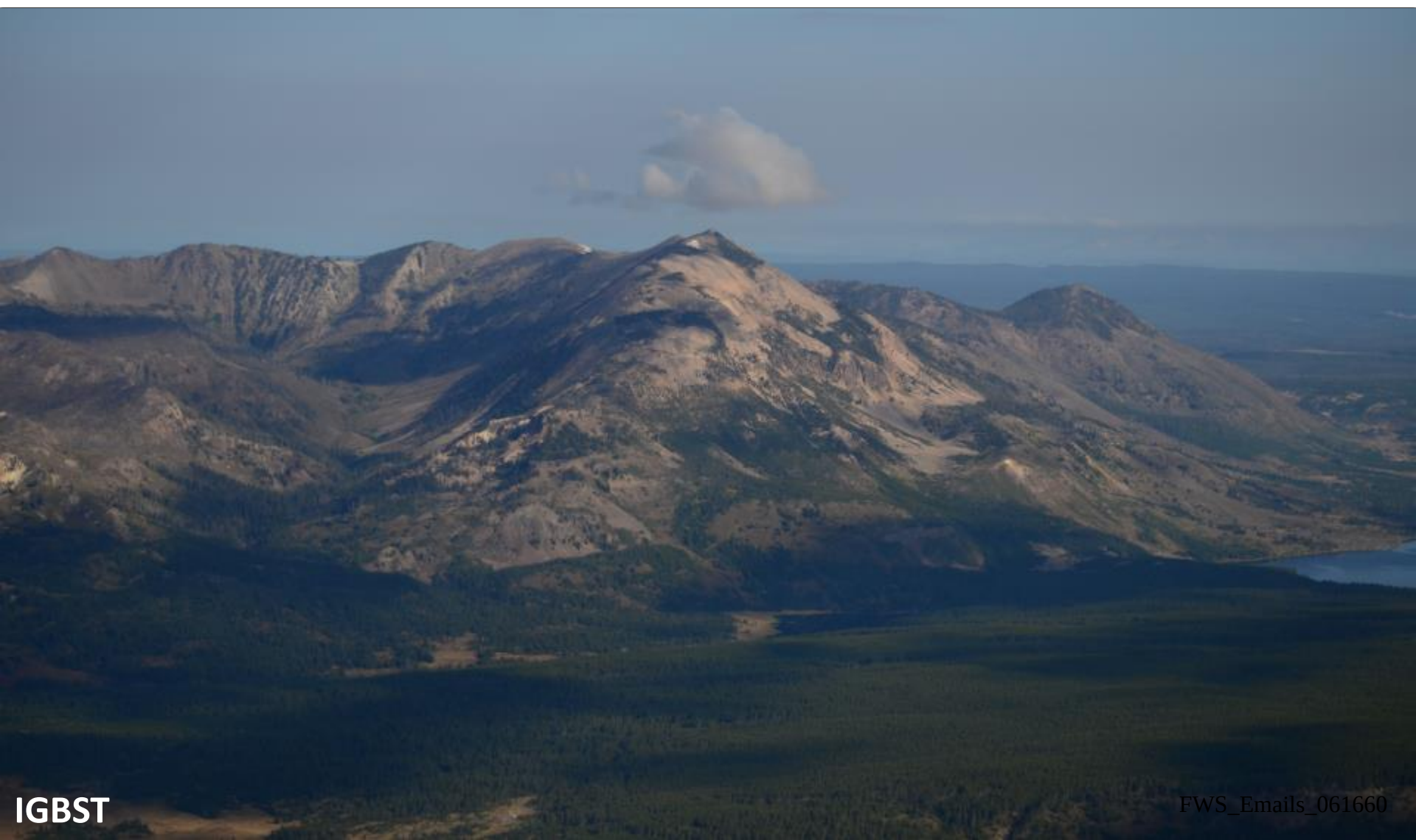
Conclusions: Population Estimation

- Mark-resight technique is relatively unbiased and produces higher population estimates
- Higher estimates are due to different technique, **NOT** an actual change in population size
- Mark-resight trend supports interpretation from other methods: minimum population increase since early 2000s

Topic 2: Management Flexibility

- A) Demographic Monitoring Area (DMA)
- B) Assess sustainable mortality

Demographic Monitoring Area (DMA)

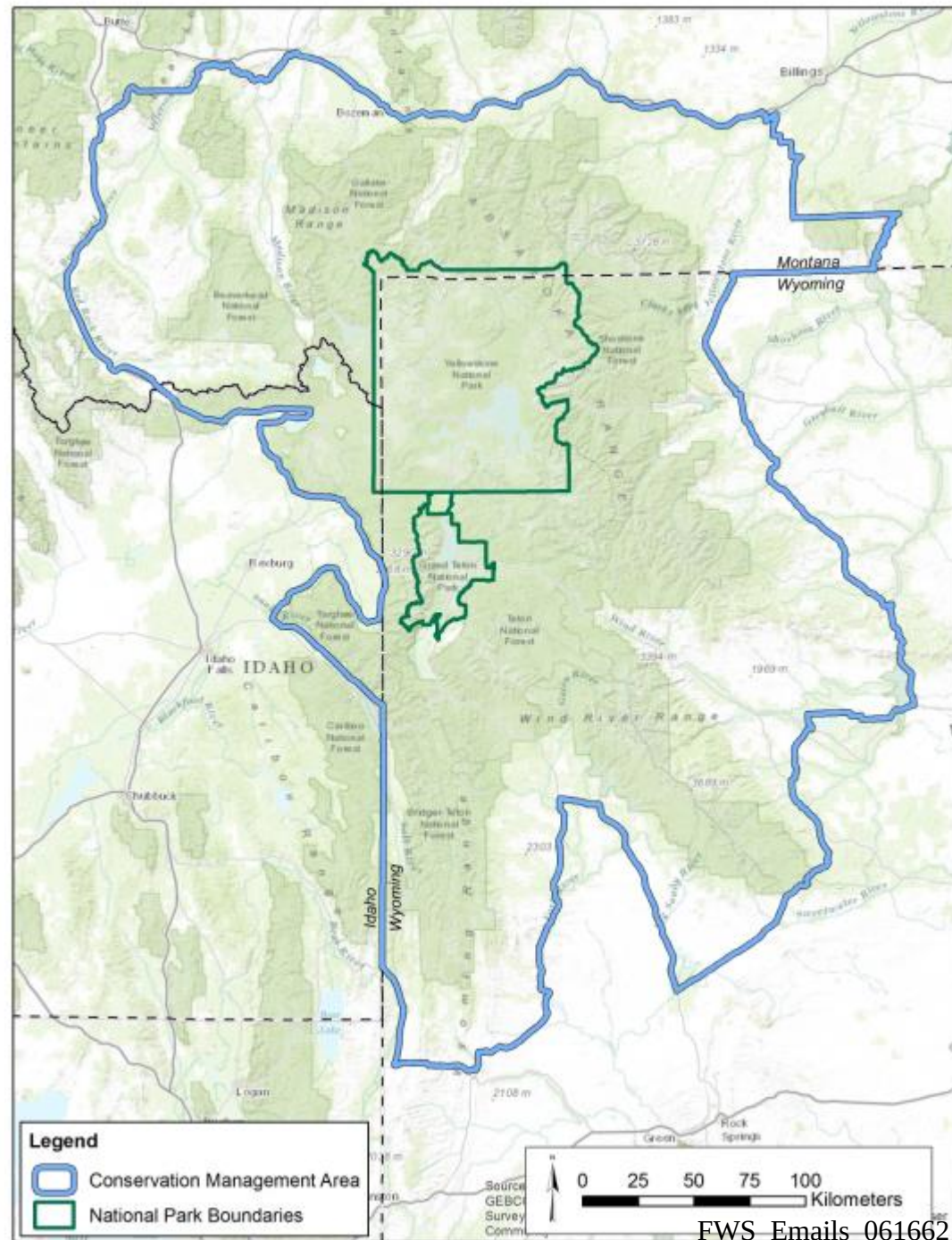


An Outcome from the Demographic Workshops

- Adopt the Demographic Monitoring Area (DMA) as the area for which population estimates will be derived and within which grizzly bear mortalities will be counted towards sustainable mortality limits
- Presented to Yellowstone Ecosystem Subcommittee Spring 2012
- Yellowstone Ecosystem Subcommittee approved adoption of DMA by committee vote

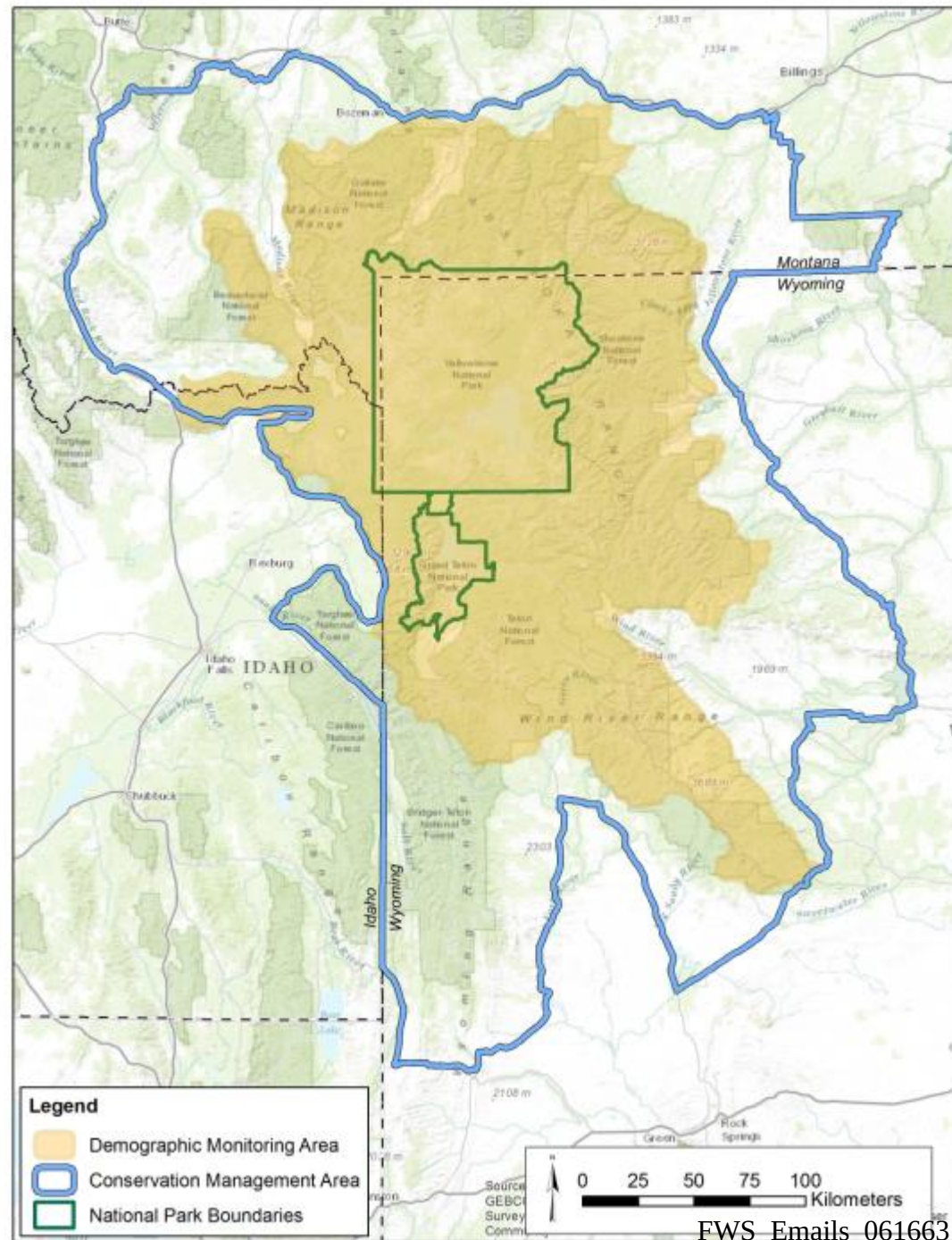
Demographic Management Boundaries

- Conservation Management Area
2007 Conservation Strategy
95,225 km²



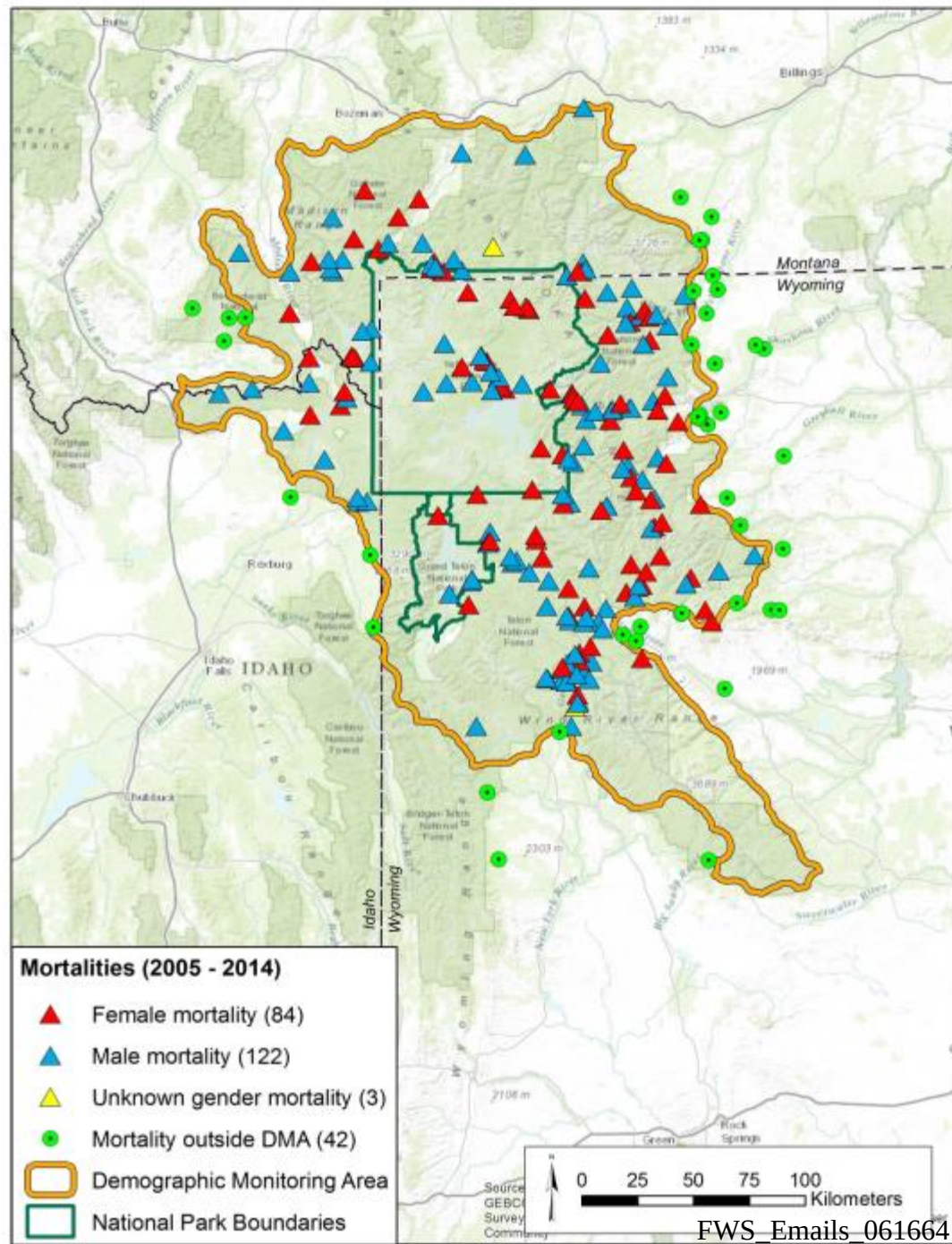
Demographic Management Boundaries

- Conservation Management Area
2007 Conservation Strategy
95,225 km²
- Demographic Monitoring Area
2012
49,931 km²

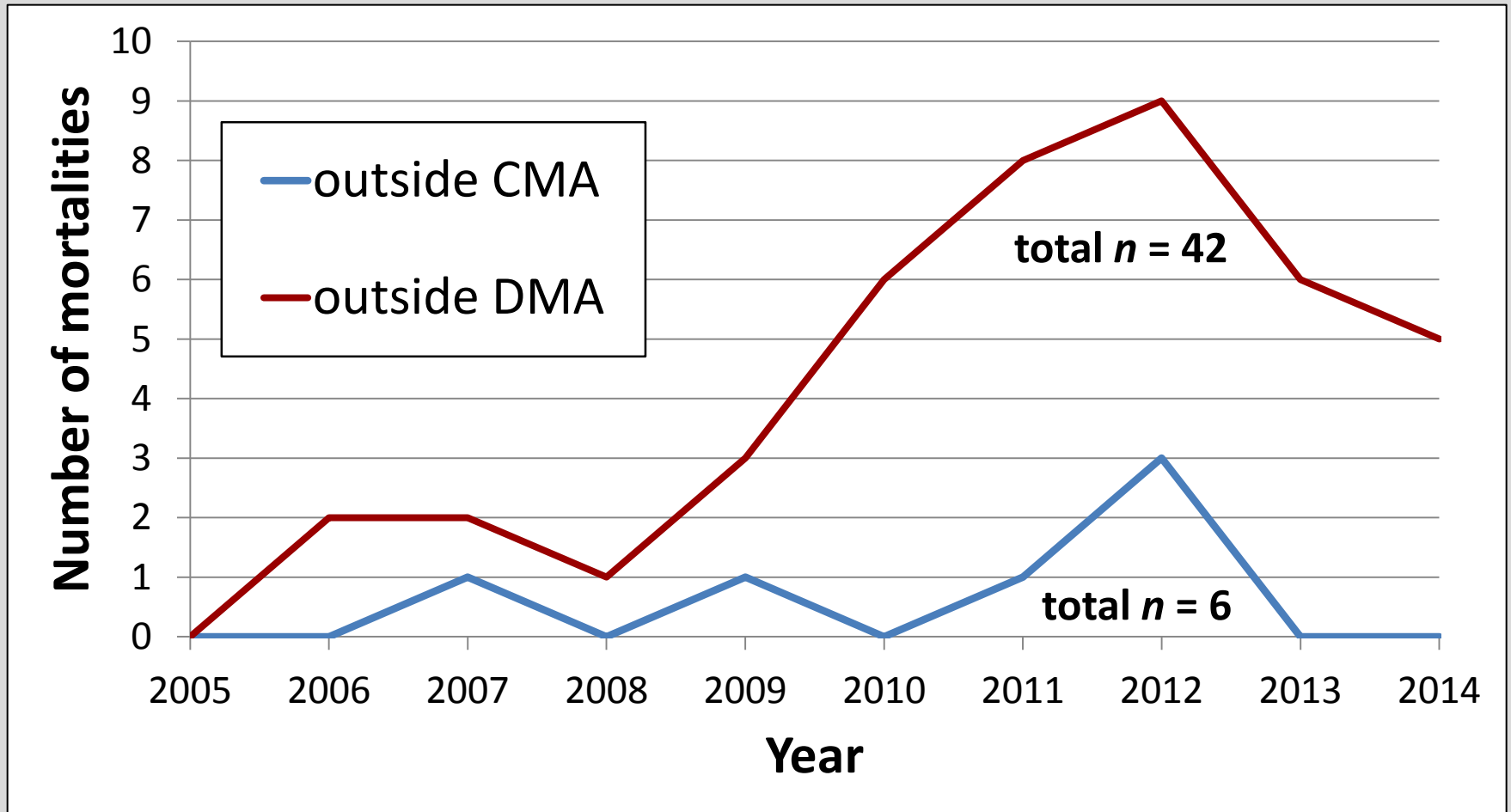


Mortality Locations Since 2005

- 42 mortalities outside the Demographic Monitoring Area
- 29 males, 13 females



Implications for Flexibility



Assessing Sustainable Mortality

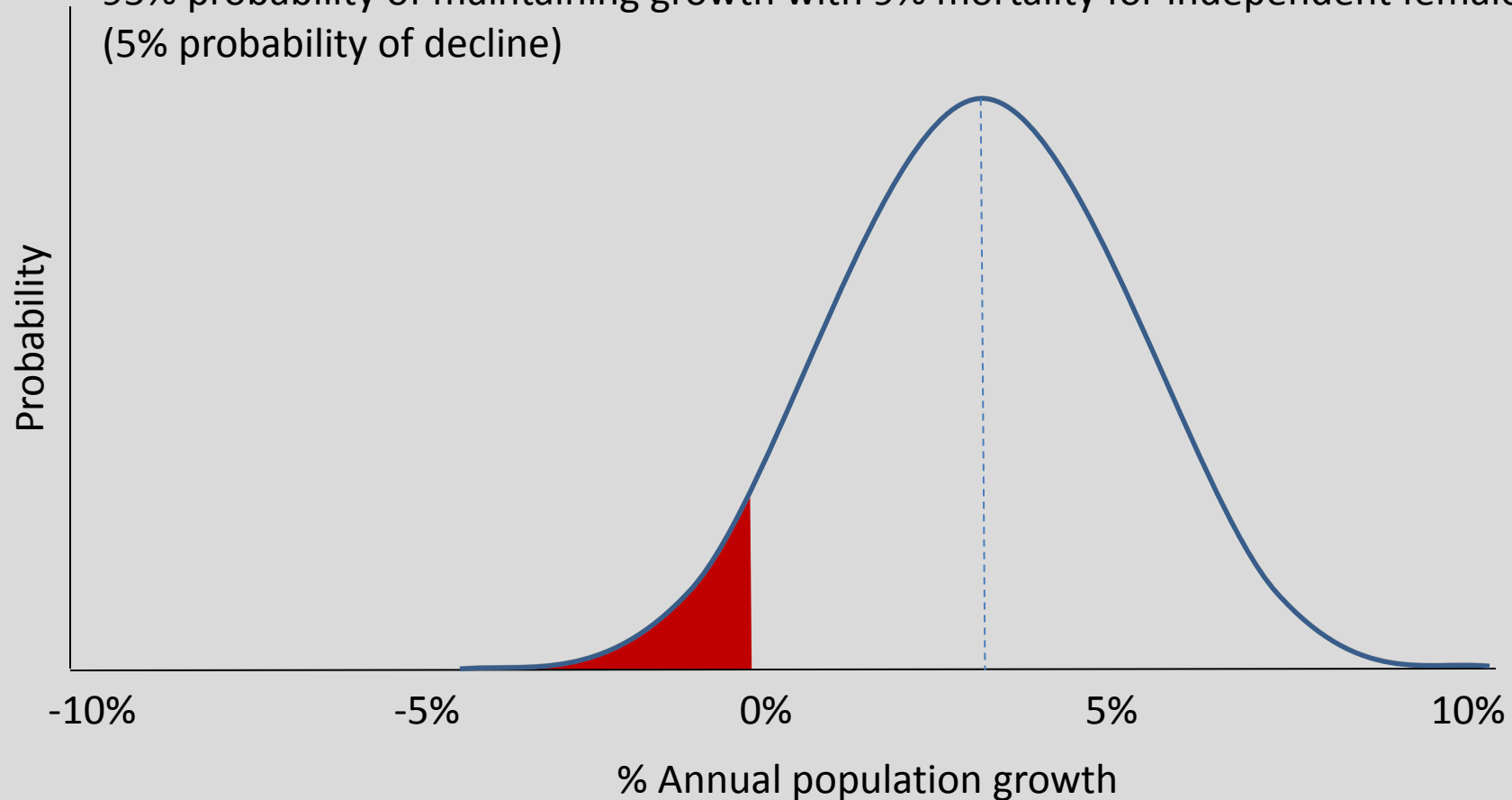
- Evaluated annually based on population estimate
- For independent females (≥ 2 yrs):
 - Previous: 9.0 % sustainable mortality (Schwartz et al. 2006)
 - New: 7.6% sustainable mortality (IGBST 2012)
- Reduced limit = less flexibility? **No**
 - Flattened population trajectory more vulnerable to decline
 - Flexibility from conceptual shift: managing for stability

Conceptual Shift in Assessing Sustainable Mortality

2007 Delisting Rule:

Robust population growth

95% probability of maintaining growth with 9% mortality for independent females
(5% probability of decline)



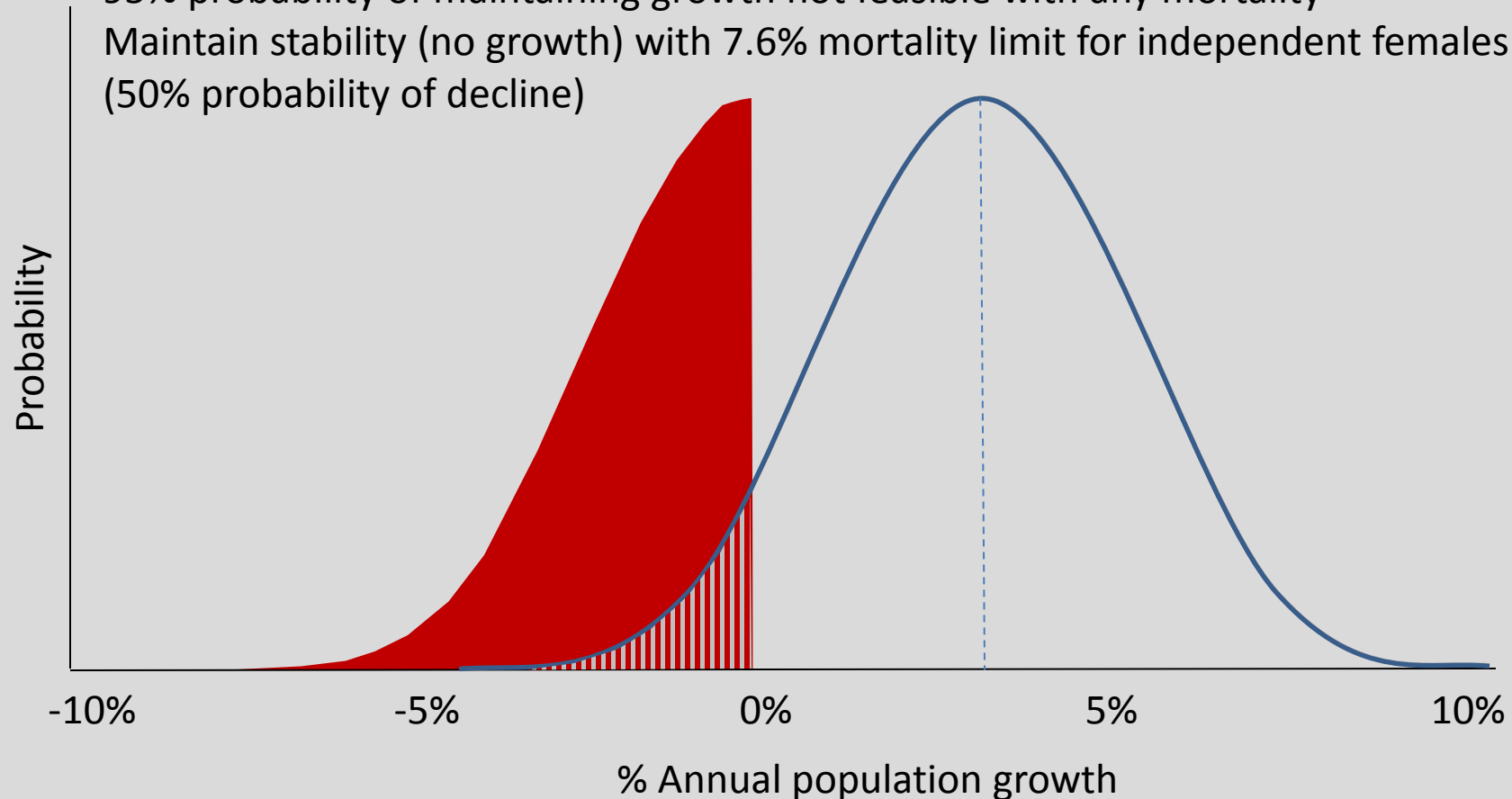
Conceptual Shift in Assessing Sustainable Mortality

2015 Delisting Approach:

Little or no population growth

95% probability of maintaining growth not feasible with any mortality

Maintain stability (no growth) with 7.6% mortality limit for independent females
(50% probability of decline)



Management Flexibility

Conclusions

- Scientific consensus and YES committee approval
- Demographic Monitoring Area most effective among options considered
- Conceptual shift in assessing sustainable mortality
- Flexibility anticipated to increase