Response to Public Feedback
Chapter 2: Post-Delisting Demographic Criteria and Monitoring

Yellowstone Ecosystem Subcommittee (YES)
Small Team Working Group

Terminology

- What the Conservation Strategy *IS*:
  - Overarching guidance, framework and commitments to maintain a recovered grizzly bear population in a "post-delisting" world

    "This Conservation Strategy was developed to be the document guiding management and monitoring of the GYE grizzly bear population and its habitat upon recovery and delisting. The Conservation Strategy will remain in effect for the foreseeable future, well beyond recovery and delisting. Ongoing review and evaluation of the effectiveness of this Conservation Strategy is the responsibility of the state, tribal, and federal managers in the GYE."

Terminology

- What the Conservation Strategy is *NOT*:
  - **NOT a Delisting Rule**
  - ...Nor a Recovery Plan
 - ...Nor a Hunting Regulation

Background

- This did not happen overnight…

- Fall 2022 – IGBST Demographic Workshop
  - Update *Rates and Ratios* – Integrated Population Model
  - Revamp of previous methodology to calculate survival rates, population growth (λ); necessitating a change to demographic criteria

- Winter 2023 – Demographic Workshop – Bozeman, MT
  - Member agencies of YES and IGBST, outside peer experts
  - Revisit "recovery criterion" – subsequent adaptations spring/summer/fall 2023

Background continued...

- Evolution and adaptation of demographic criteria for a recovered population
  - Manage within/above a range of grizzly bears indicative of a recovered population in the Demographic Monitoring Area
  - Annual evaluation of specific grizzly bear sex and age cohorts
- November 2023 YES Meeting Jackson, WY
  - Provide updated Chapter 2 to YES and seek for feedback
- Winter 2023-2034 → Today
  - Review and address feedback, updates to Chapter 2
  - Response to Feedback
  - Update Full Conservation Strategy document

Feedback Received (Nov. 15 – Dec. 15, 2023)

- 201 comments received through feedback period

Chapter 2 Feedback Synthesis - Online
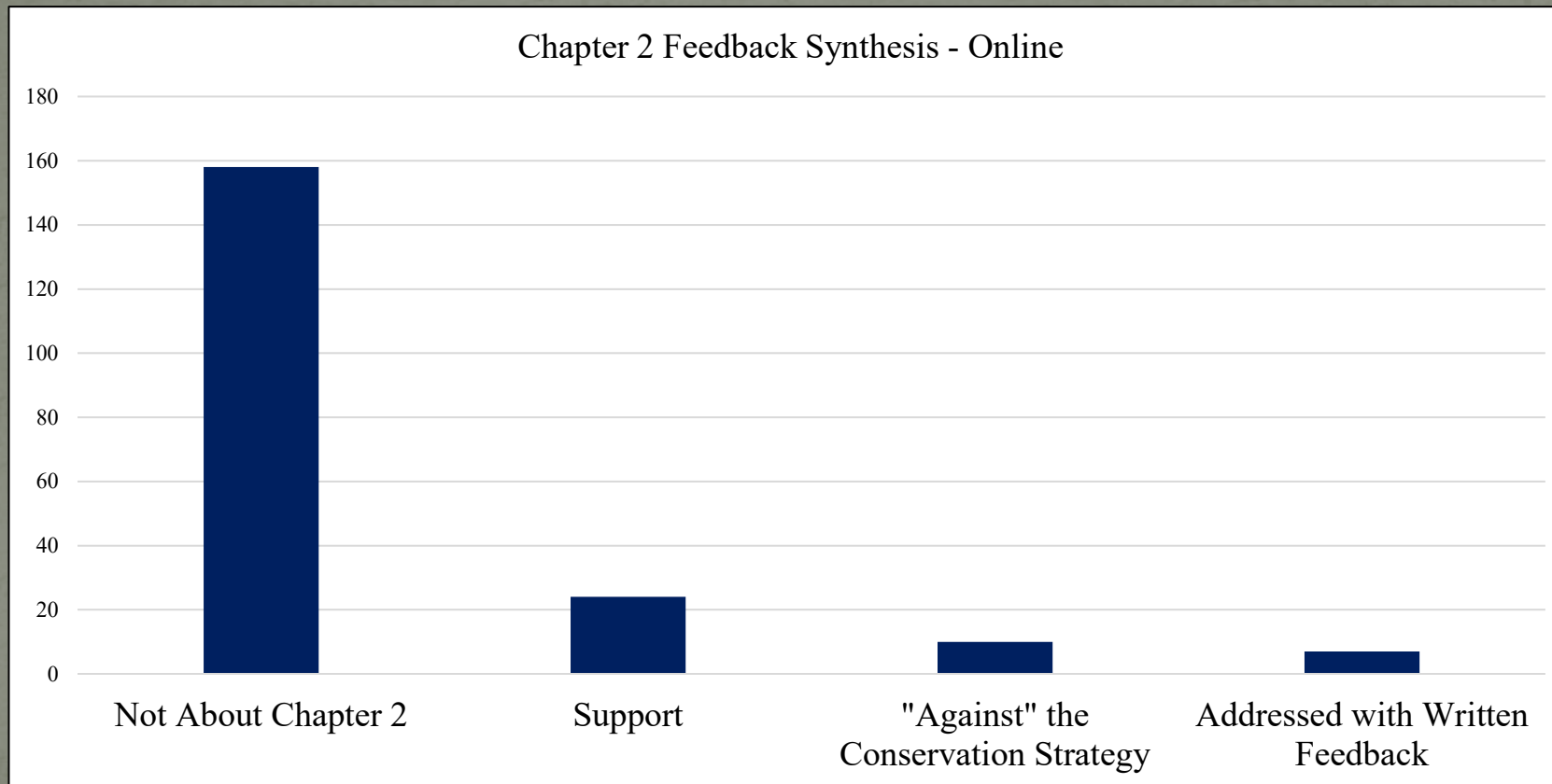
Feedback...

- We received nine letters/portal inputs providing more detailed feedback from the following organizations and individuals:
  - Alliance for the Wild Rockies
  - Defenders of Wildlife
  - Gallatin Wildlife Association
  - Greater Yellowstone Coalition
  - R. Harris
  - Idaho Conservation League
  - Montana Wildlife Federation
  - National Parks Conservation Association and Natural Resources Defense Council
  - People and Carnivores

Substantive Feedback – Major Themes:

- Integrated Population Model (IPM)
  - General questions and concerns
- DMA/Source Sink Dynamics
  - Questions as to the concept of the DMA, also linked to mortality evaluation
- Post-Delisting Demographic Criteria
  - Seeking clarity and basis for new management objectives
- Breeding Female Occupancy (Recovery Criterion 2)
  - Questions as to spatial component of occupancy in relation to recovery
- Mortality Evaluation and Management
  - Clarifying questions
- Genetic Management and Connectivity
  - Comment and questions as to the role of connectivity, clarification
- Relationship of Chapter 2 to Tri-State Memorandum of Agreement
  - Questions as to timeline and processes

IGBST Science Relevant to Ch. 2 Feedback

Integrated Population Model

Photo: J. Davis

Feedback example :

"While I understand that a peer-reviewed manuscript explaining it may be some time off, the CS should provide more detail of how the IPM works ."

R. Harris

Interagency Grizzly Bear Study Team Monitoring Program

Annual estimates: vital rates, total *N*, lambda

| 1983 | 1985 | 1987 | 1989 | 1991 | 1993 | 1995 | 1997 | 1999 | 2001 | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 | 2015 | 2017 | 2019 | 2021 | 2023 |

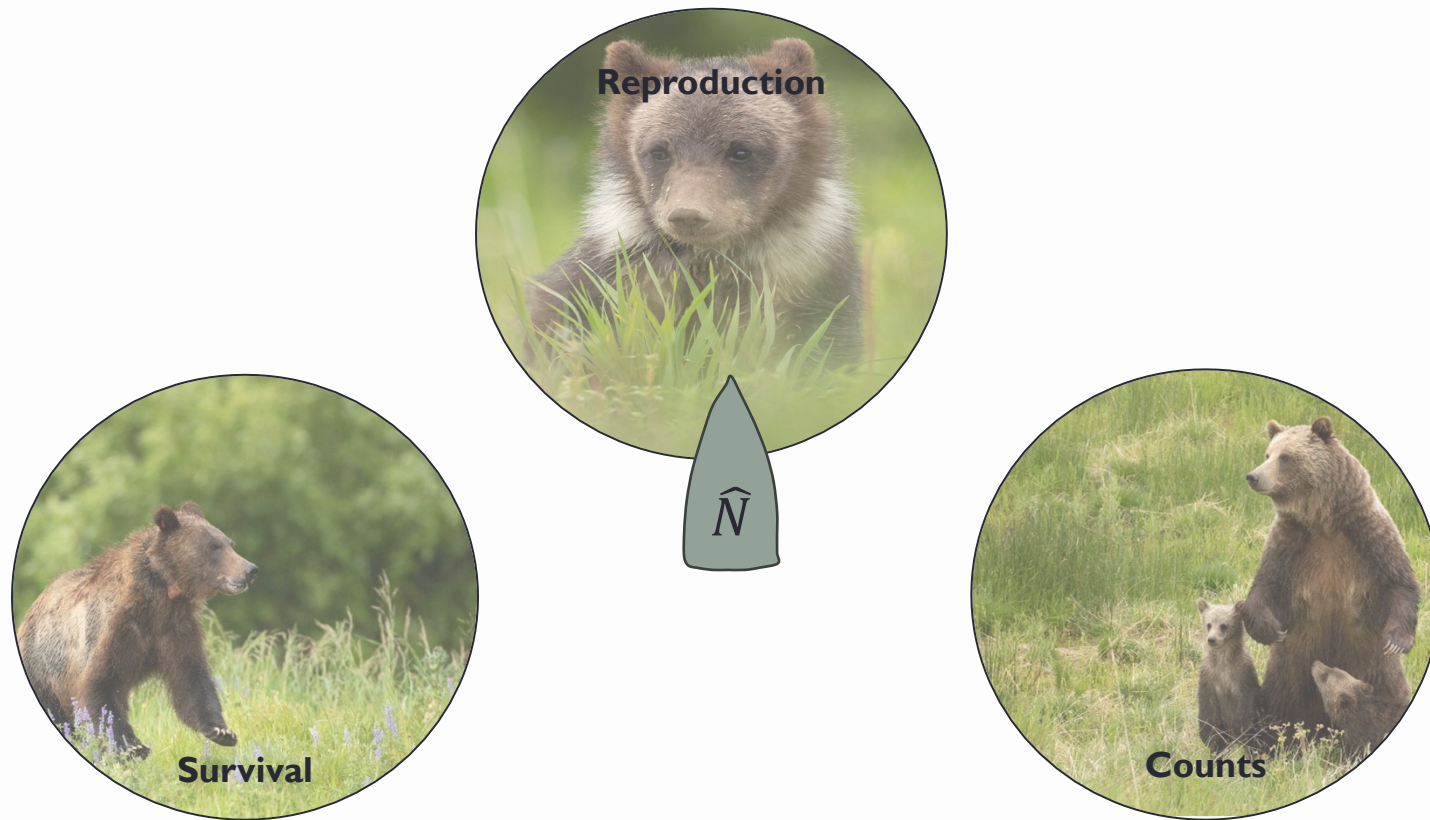

Photo: J. Davis

$$\hat{N}_{\text{Chao2}} = m + \frac{f_1^2 - f_1}{2(f_2 + 1)}$$

Integrated population model (IPM)

- "Any model that jointly analyses data on population size and demographic parameters" (Schaub and Abadi 2011)
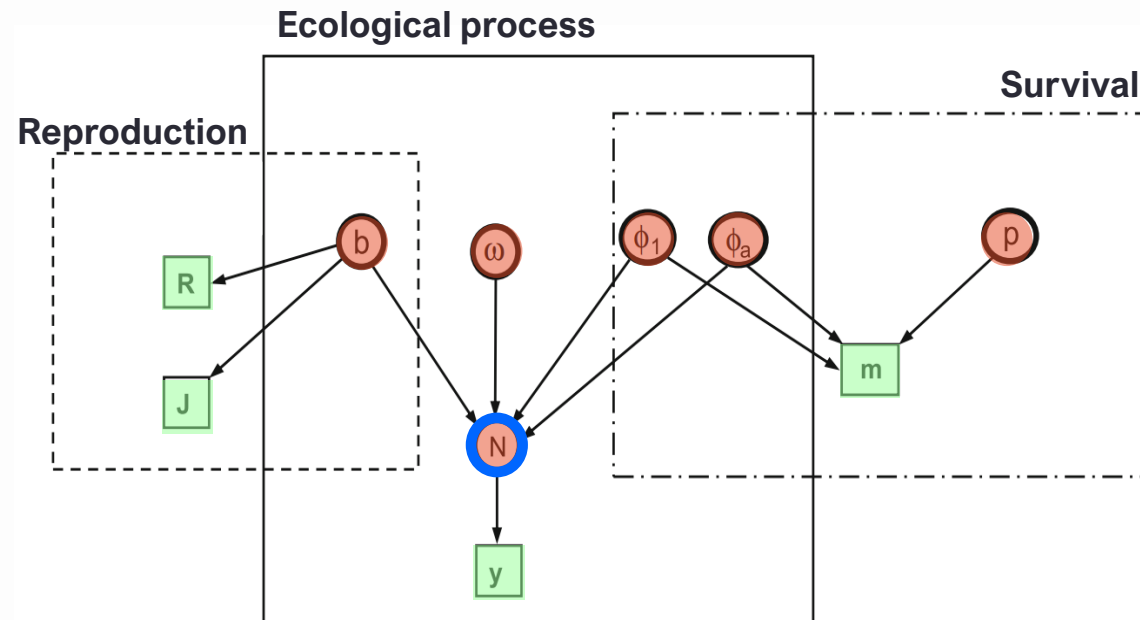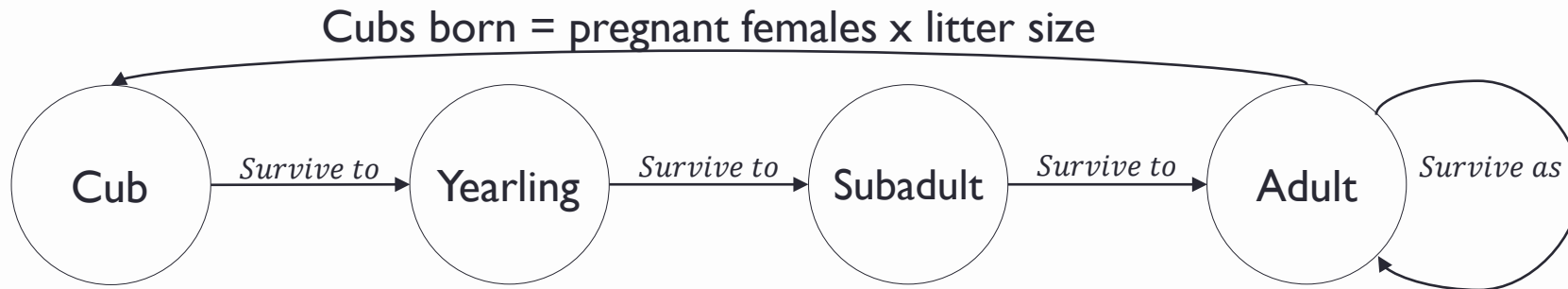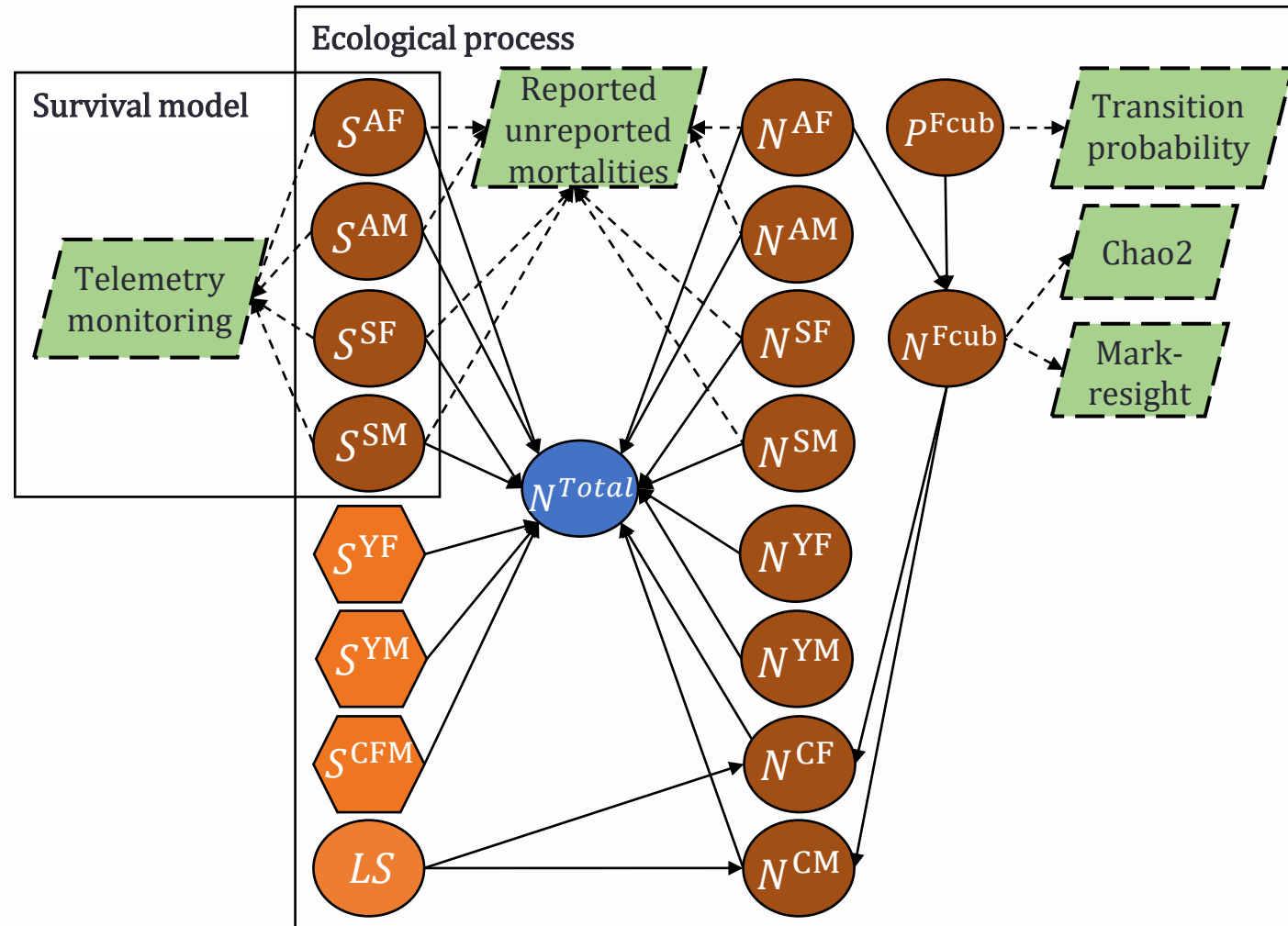

Source: Schaub and Abadi 2011
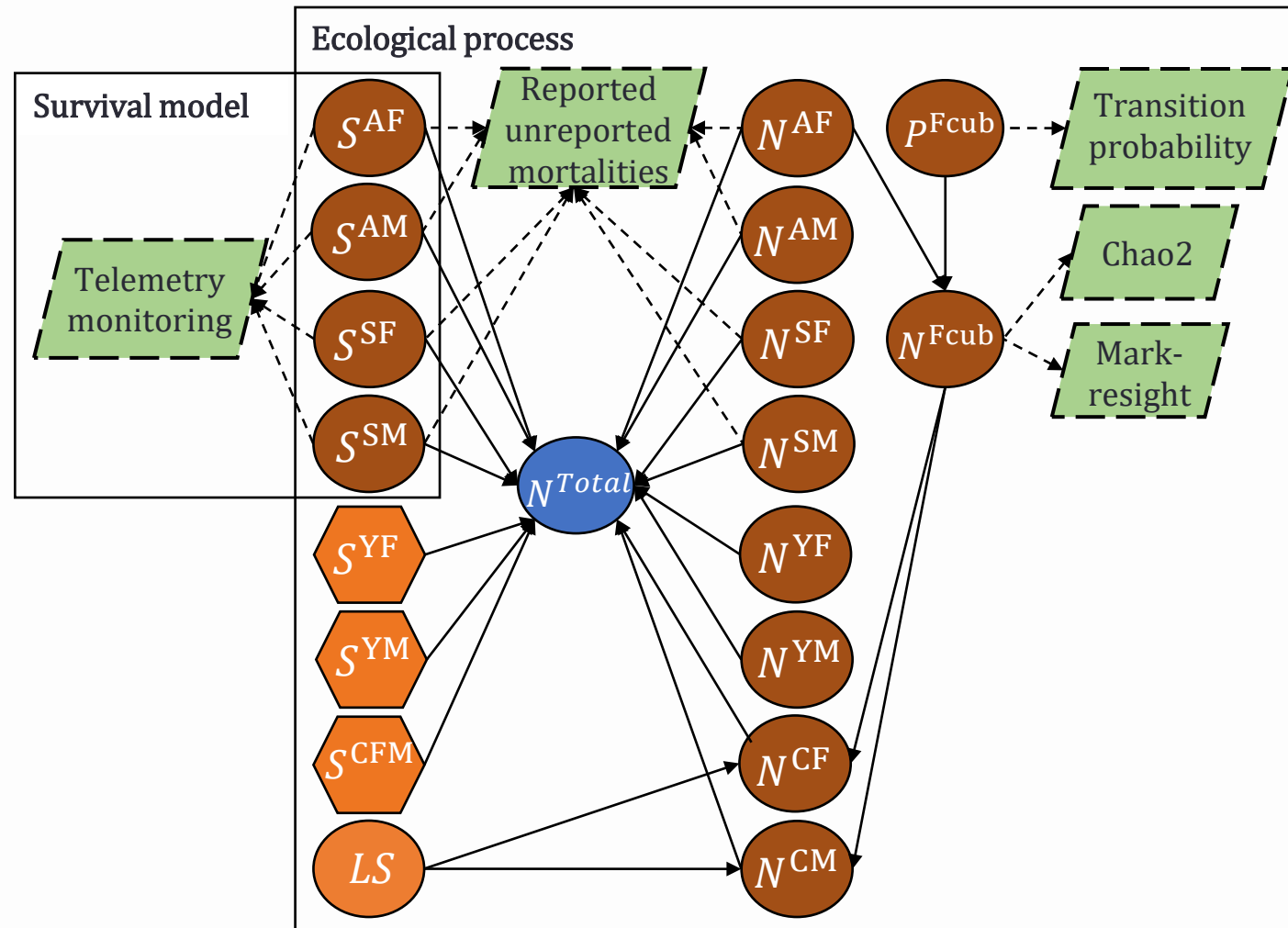
"Overlapping consensus"

Photos: J. Davis

Grizzly bear ecological process

Cubs born = pregnant females x litter size

Cub → *Survive to* → Yearling → *Survive to* → Subadult → *Survive to* → Adult → *Survive as*
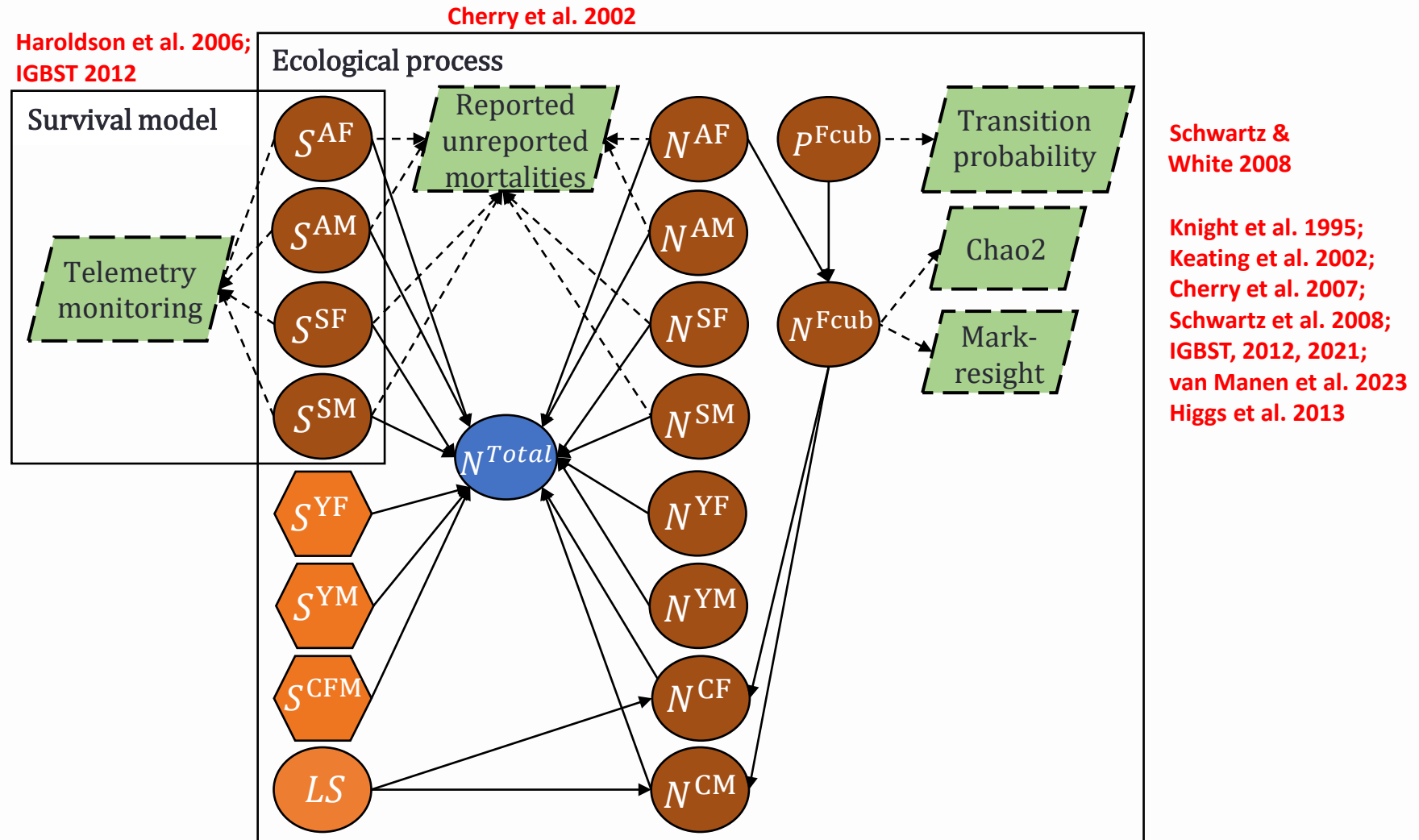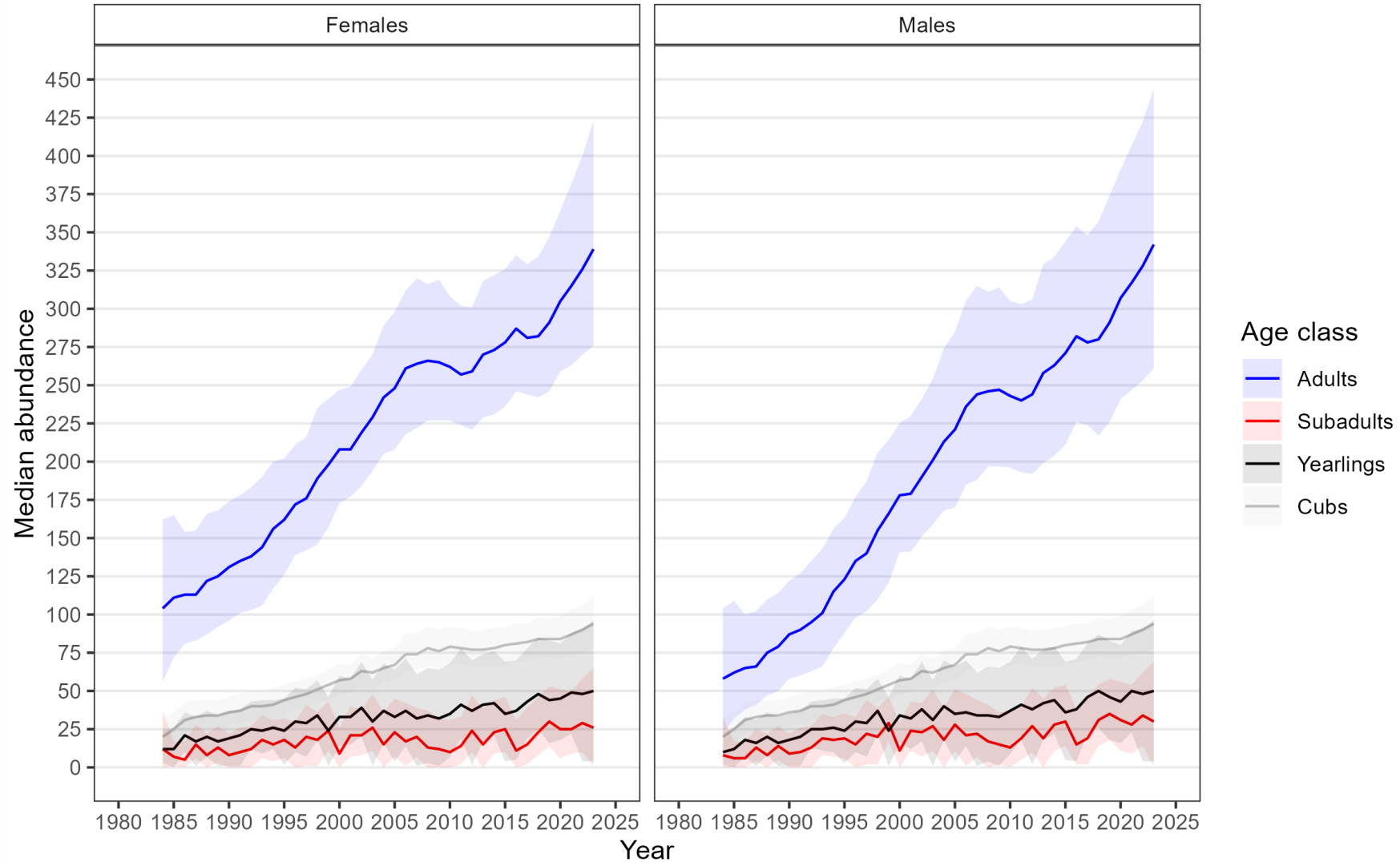
Integrated population model structure

Integrated population model structure

Integrated population model structure

Abundance by population segment

Total abundance
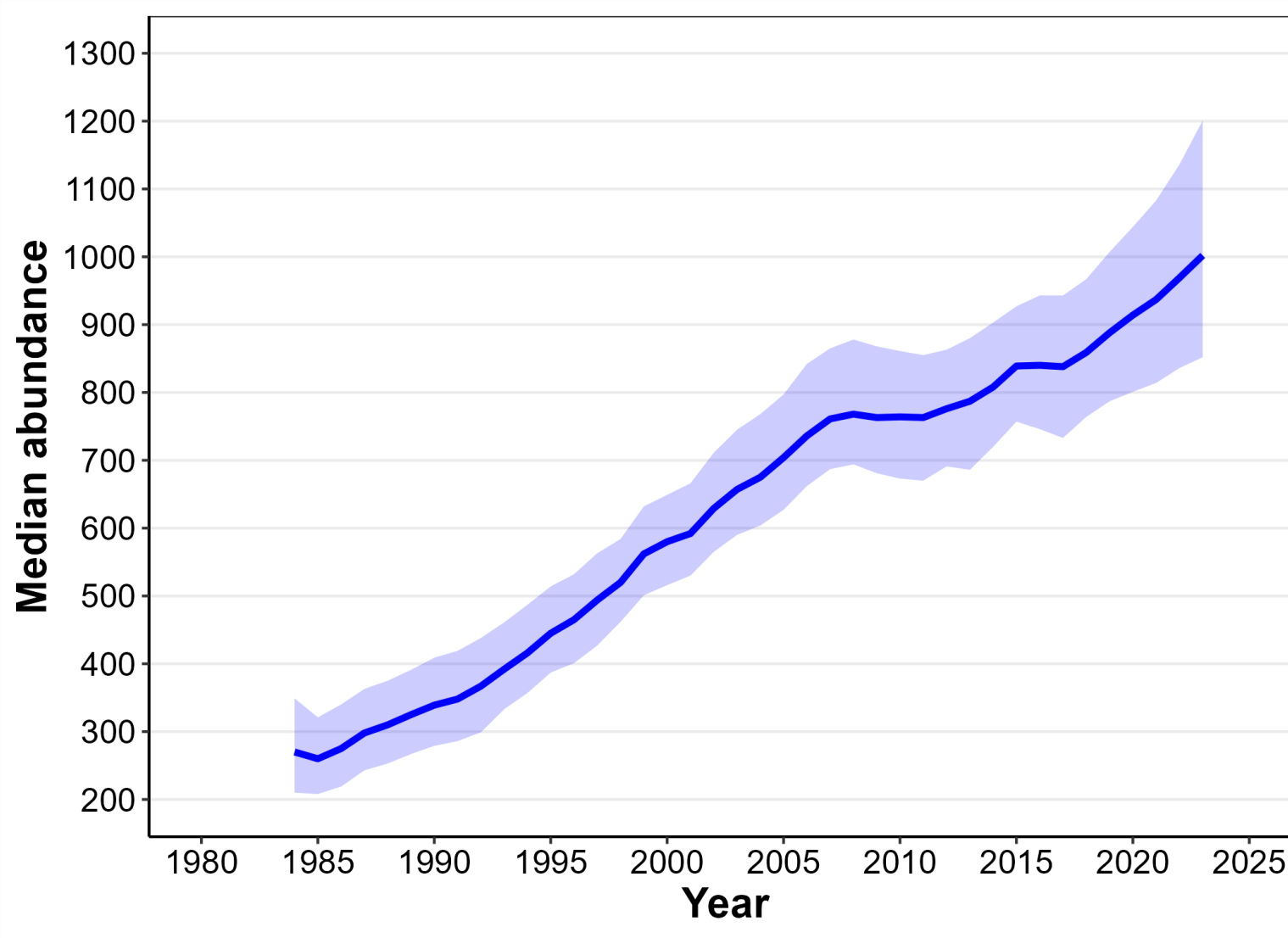
Key Points

- Unified analysis framework capable of generating <u>annual</u> estimates of vital rates, abundance, and population trend

- Improves estimation process through 'overlapping consensus'

- Foundation for the Conservation Strategy monitoring framework

- Inferences inform adaptive management strategies and policy decisions

IGBST

Photo: Jake Davis

Uncertainty in statistical estimation
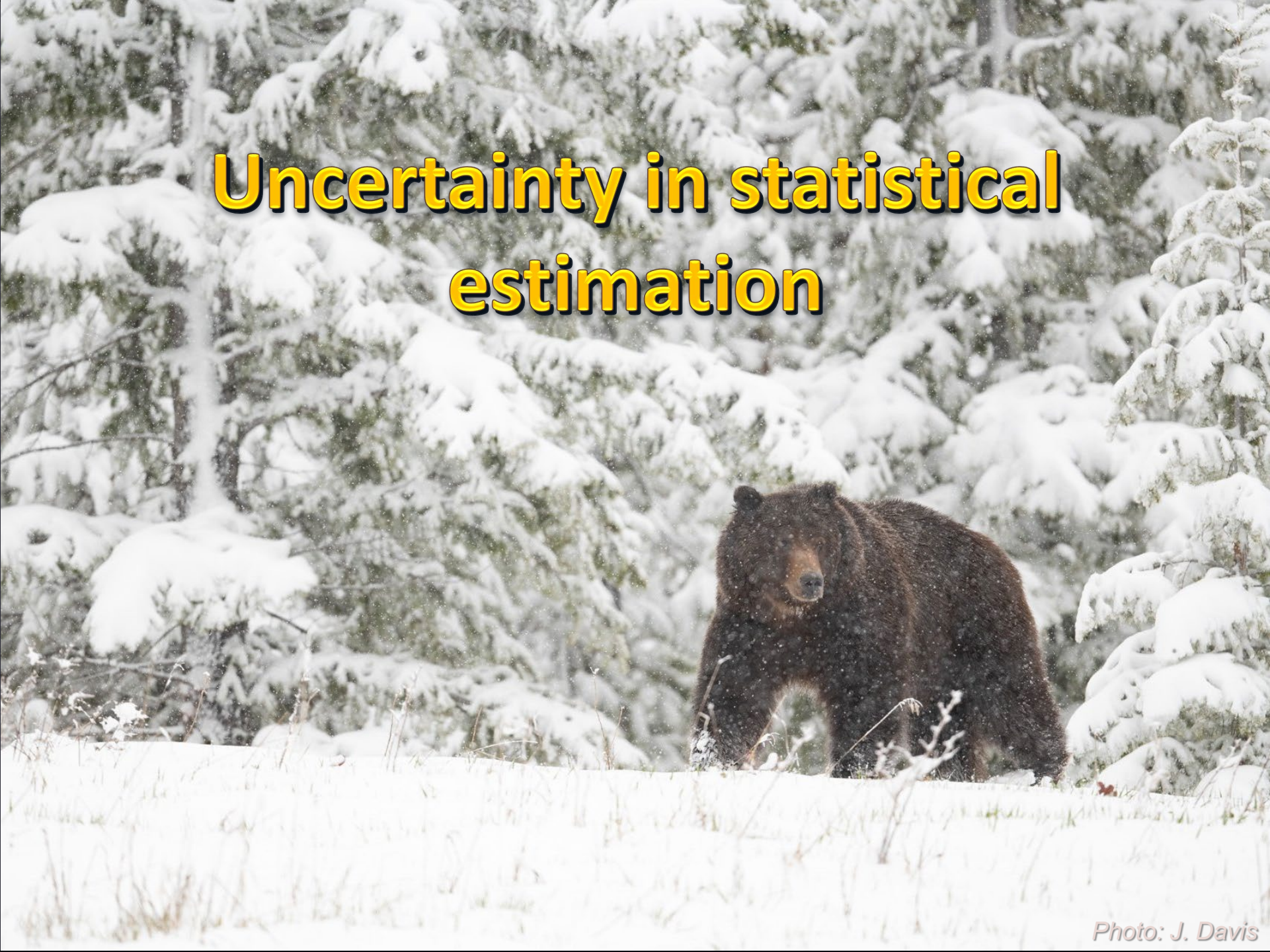
Photo: J. Davis

Feedback example :

"Assuming similar uncertainty (+/-146) around a point estimate of 800 grizzly bears, the lower bound of the credible interval could be as low as an estimated 654 grizzly bears within the DMA."

Greater Yellowstone Coalition

Total population size (IPM, DMA)
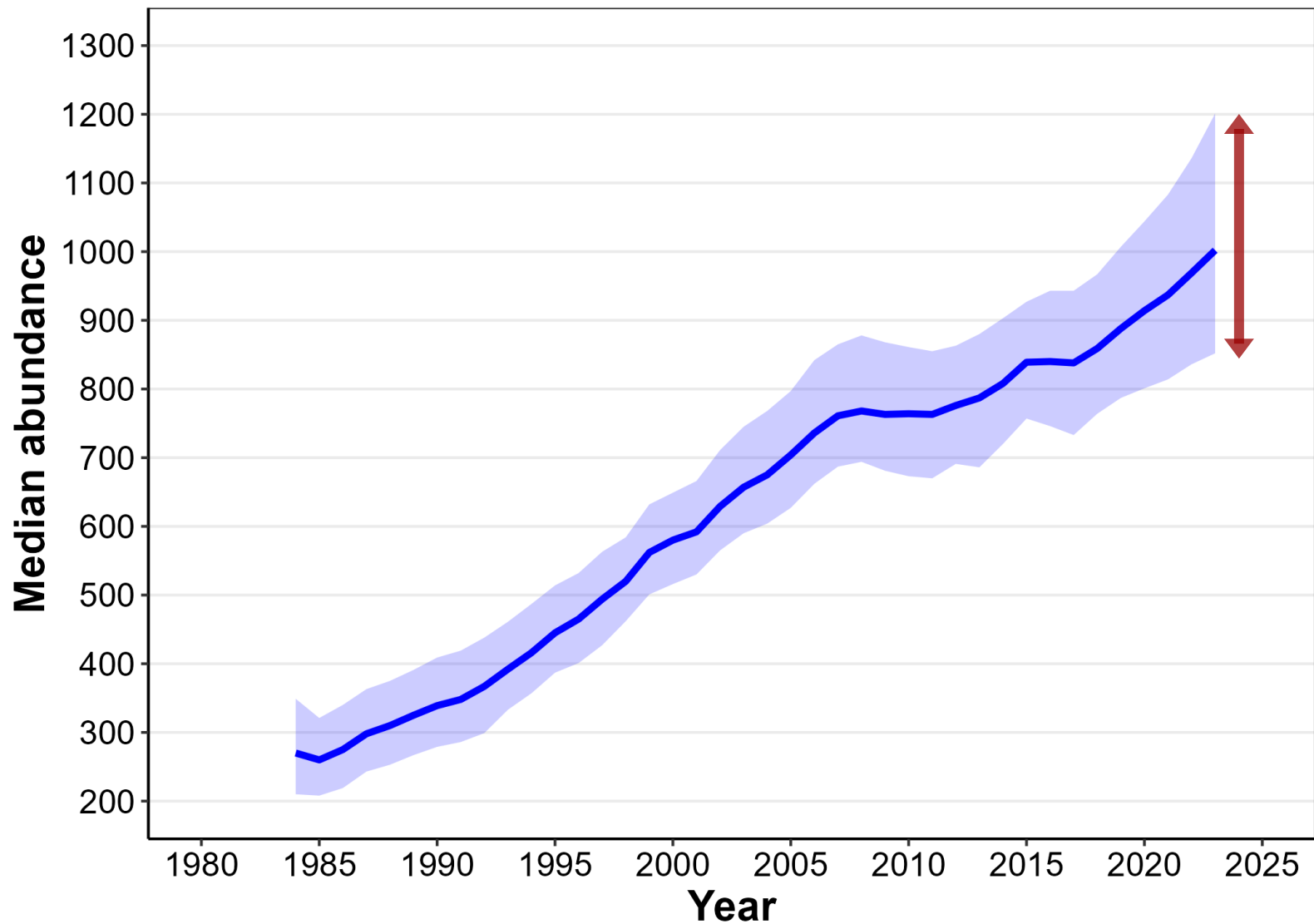
Total population size (IPM, DMA)
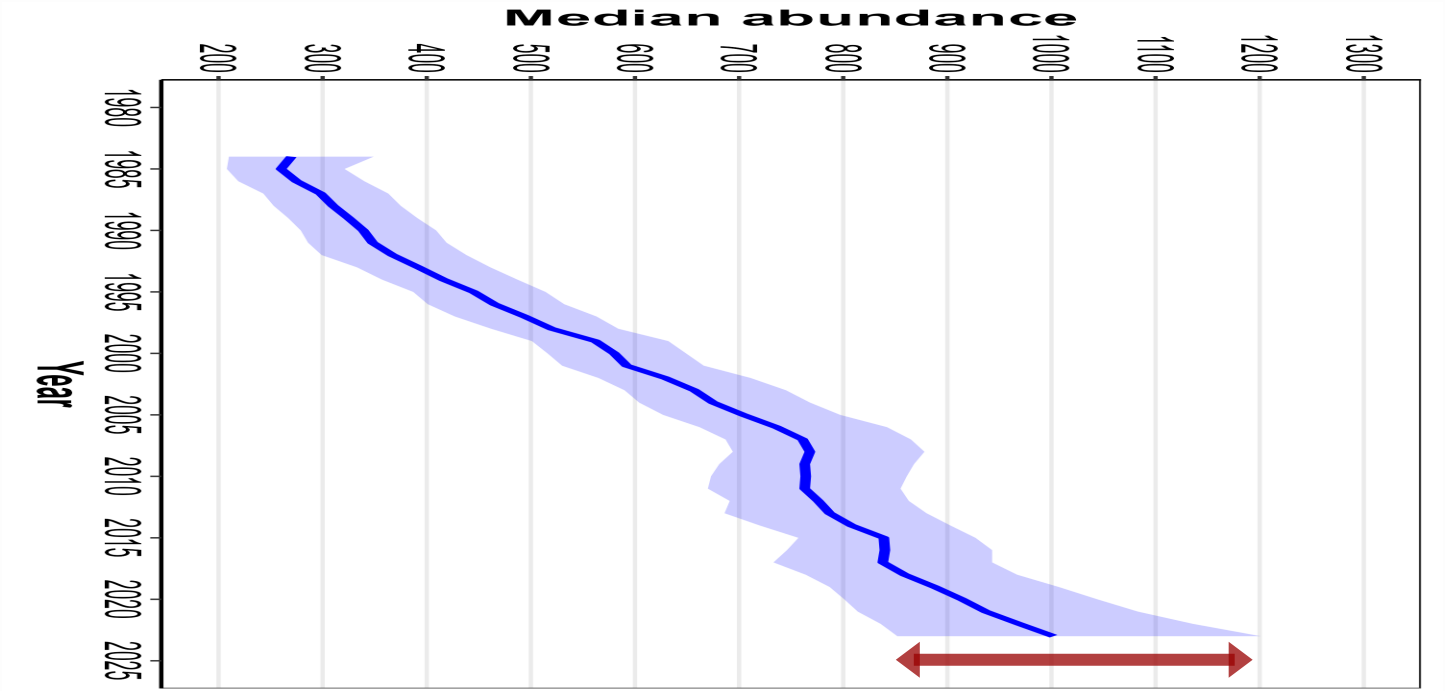
Uncertainty in estimation

Likelihood of value occurring (density) vs Total abundance

Lower credible limit → 852

Upper credible limit → 1201

Median = 1002

95% credible interval
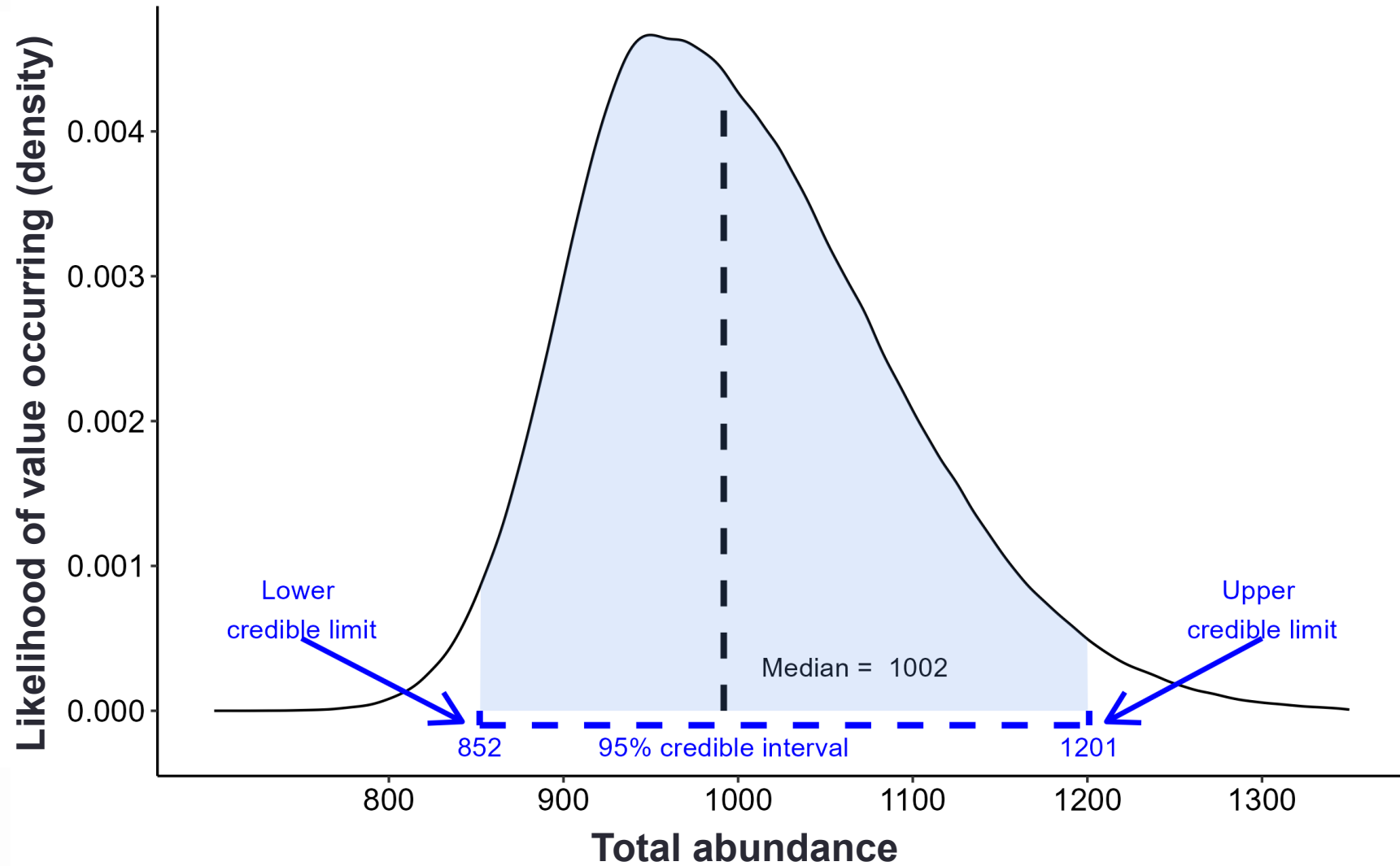
"…we see no escape from uncertainty. To claim that no decision about ___ ___ has occurred should be adopted until u___ ___ ___ or to claim that the only a___ ___ ___ opts some lower confide___ ___ reject the role of science. If ___ ___ ___ ulation decline is treated as t___ ___ decline (even where ove___ ___ uggests otherwise), there is n___ ___ ___ y on research or monitoring be___ ___ gement approach would be identical rega___ ___ of what data were produced."
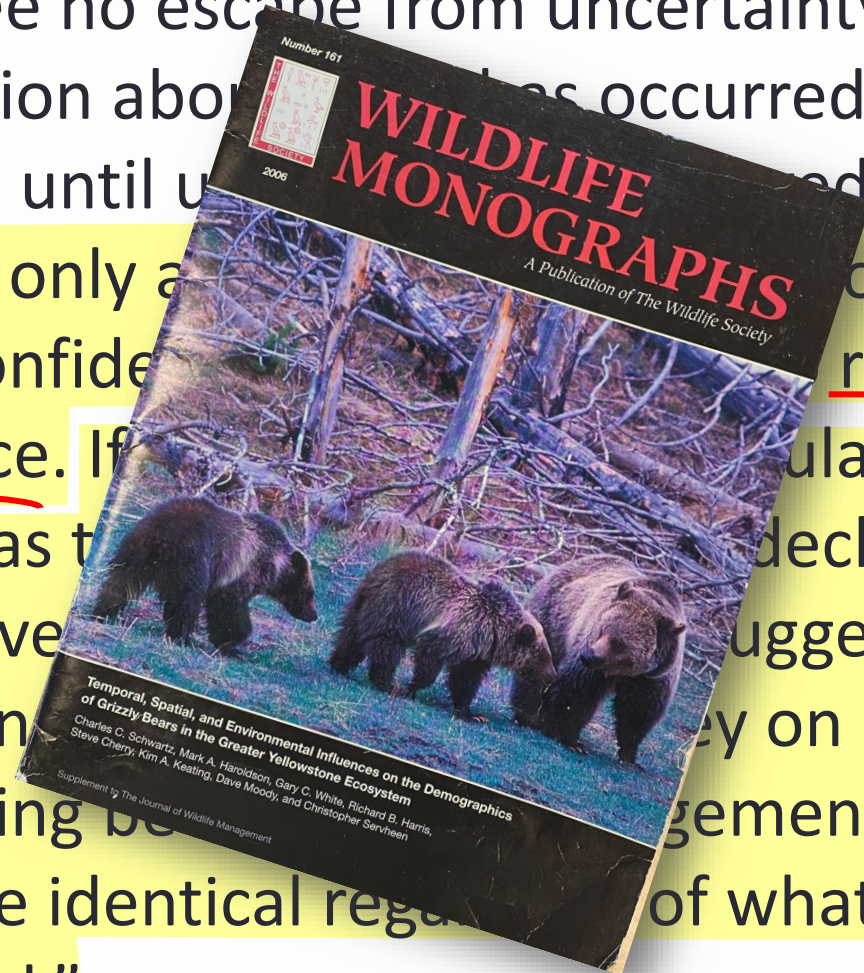
Source-Sink Dynamics

Photo: Jake Davis

Feedback example:

"The Montana Wildlife Federation strongly recommends that the entire GYE population be carefully evaluated for the impacts of a source/sink dynamic inside and outside the DMA boundary as part of the revision of Chapter 2."

Montana Wildlife Federation

Source-sink dynamics
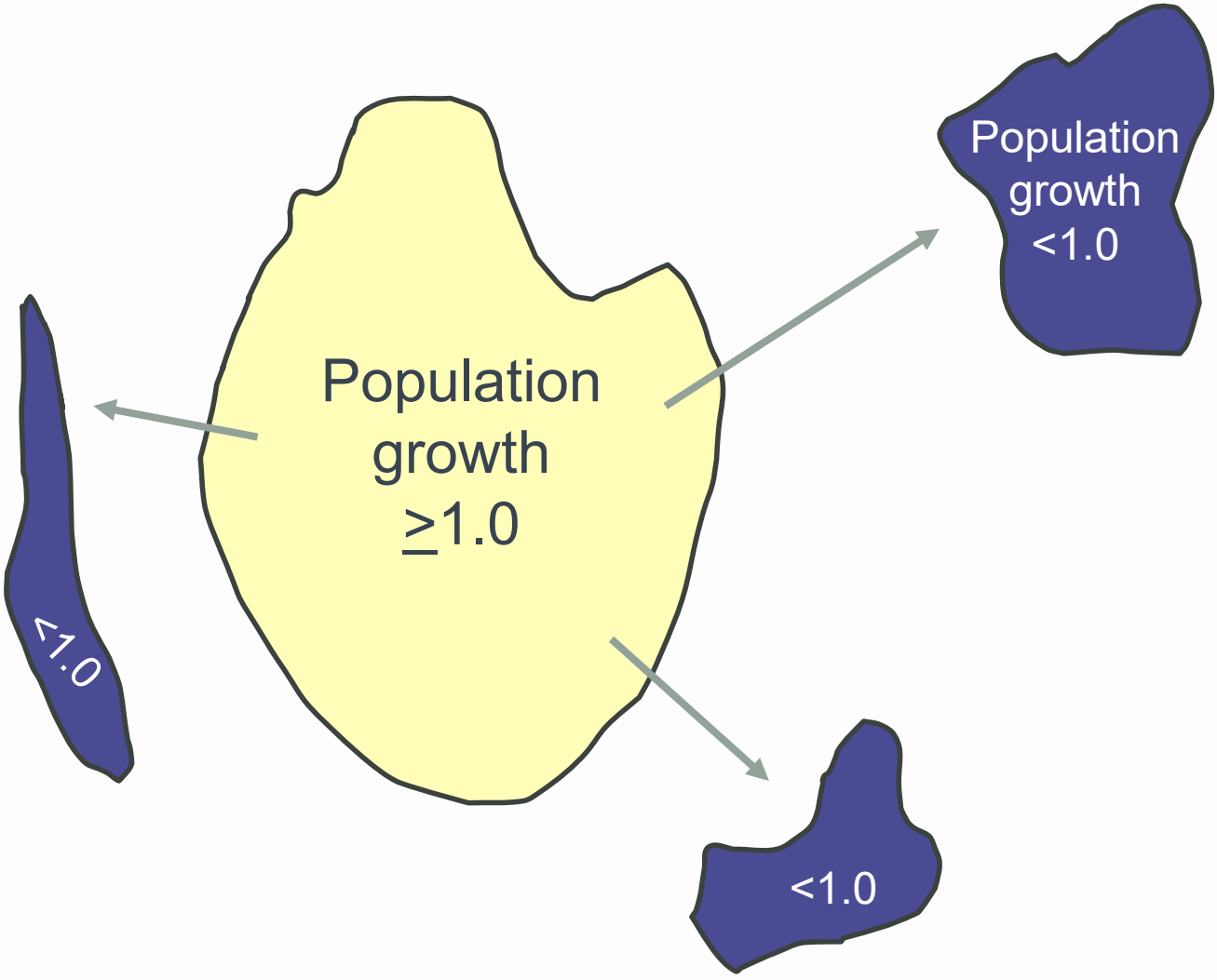
Source-sink dynamics

Source-sink dynamics

Population growth $\geq$1.0

Population growth <1.0

IGBST

Source-sink dynamics

Female survival

Survival < 0.91   Survival >= 0.91

Survival   0.0 0.5 0.6 0.7 0.8 0.91 0.95 1.0 No data   Lakes
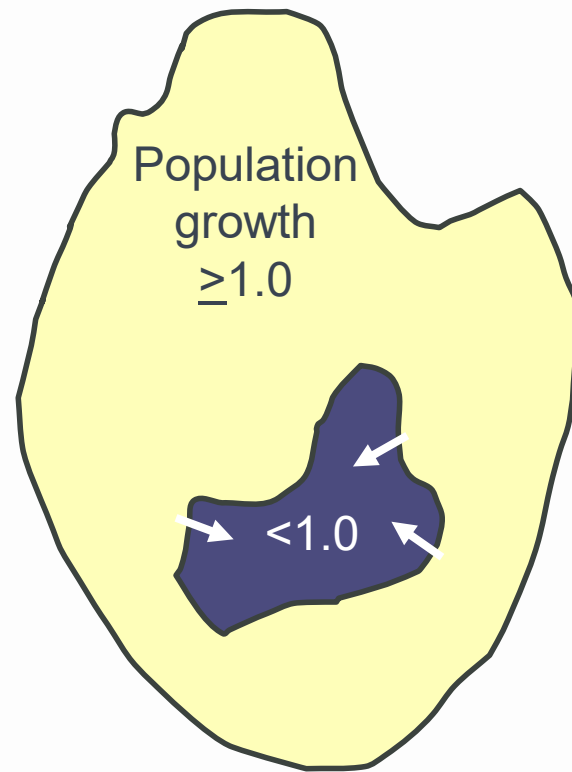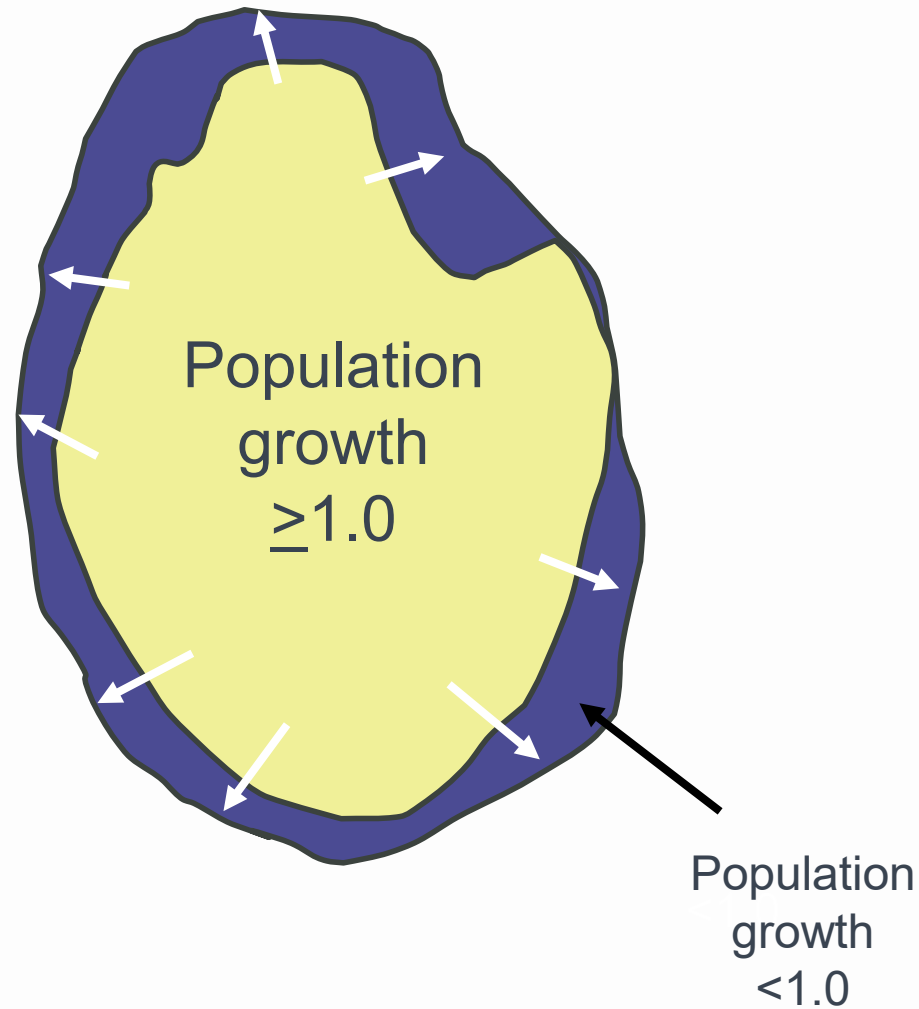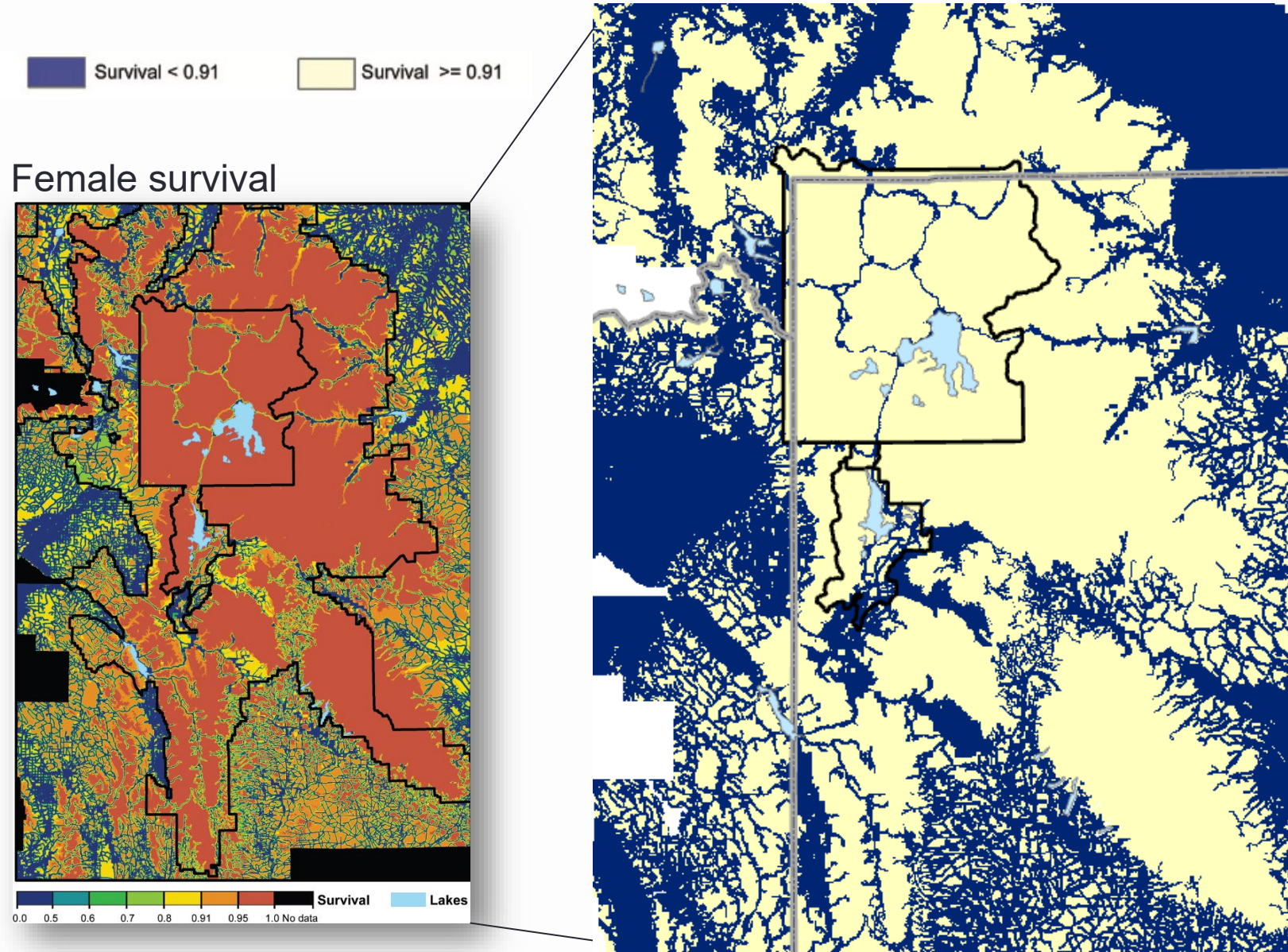
Source: Schwartz et al. (2010)

Source-sink dynamics

Female survival

Survival < 0.91   Survival >= 0.91

0.0 0.5 0.6 0.7 0.8 0.91 0.95 1.0 No data   Survival   Lakes
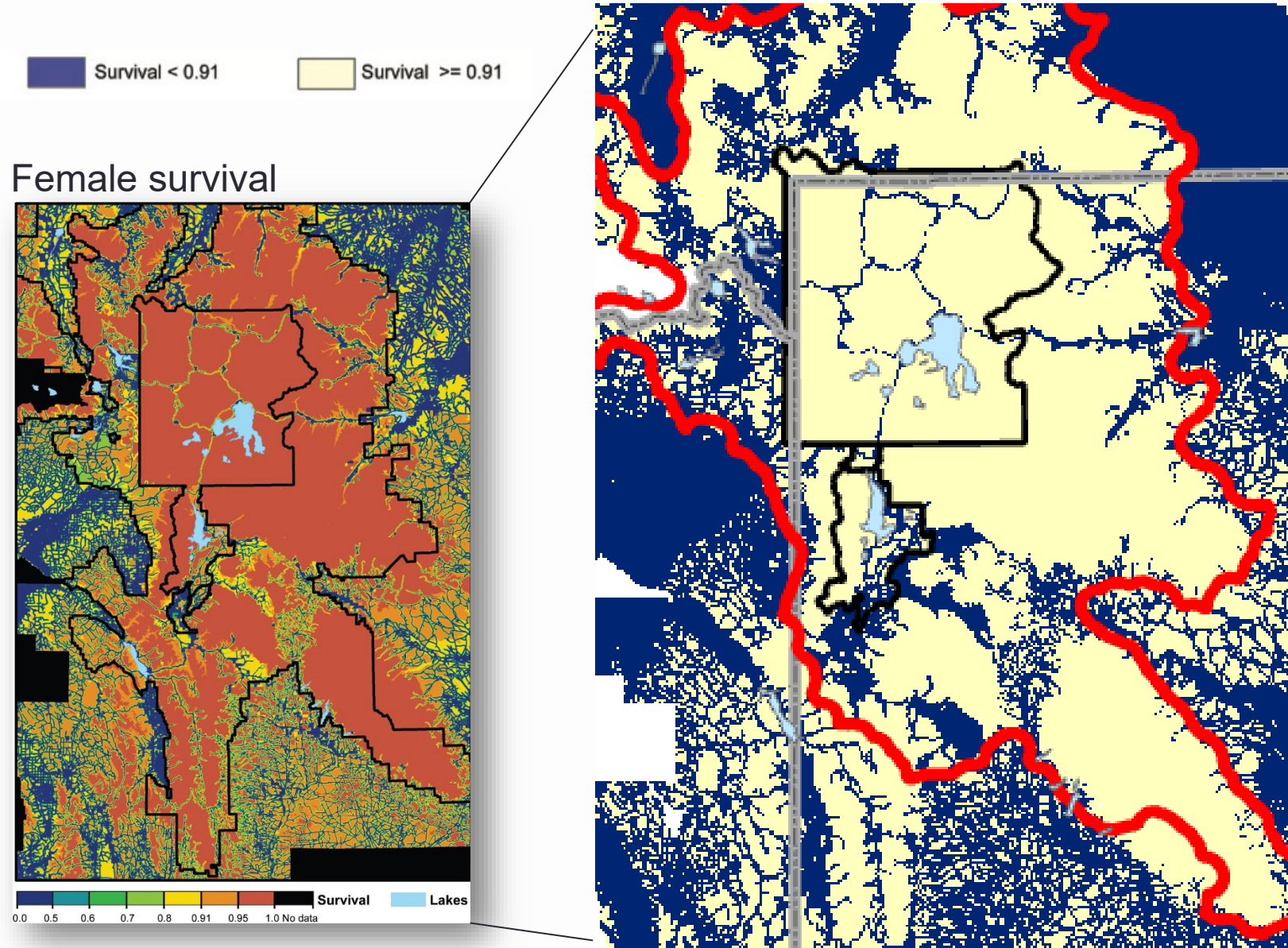
Source: Schwartz et al. (2010)

Genetics

Photo: J. Davis

Potential for Genetic Connectivity

60 miles

Sources: IGBST (2023)
Costello and Roberts (2023)
Kasworm et al. (2023)
USFWS (2023), Peck et al. (2017)

Interstate Highways
Grizzly Bear Recovery Zone
NPS Lands
Estimated Occupied Grizzly Bear Range
USFWS Grizzly May Be Present (07-20-2023)

0 40 80 120 160
Kilometers

N

Copyright:© 2013 National Geographic Society, i-cubed
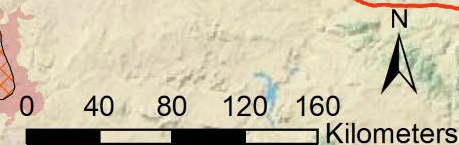
Integrated Population Model (IPM)

- Directly from Chapter 2:

  "A key advancement of IPMs is that the full suite of demographic data collected by the IGBST is integrated on an annual basis, allowing the simultaneous estimation of multiple demographic parameters with greater accuracy and precision. An important benefit of the IPM is that it explicitly links changes in population size over time with variations in vital rates, thus providing managers with better scientific information for decision making."

Historical Context on Boundaries

- 1993 Recovery Plan and 2007 Conservation Strategy

Chapter 2 Population Standards and Monitoring

To maintain a healthy (recovered) grizzly bear population in the GYA, it is necessary to have adequate numbers of bears that are widely distributed with a balance between reproduction and mortality. This section details the population criteria in the *Recovery Plan* that were necessary to achieve recovery, and the population standards necessary to maintain it. *Recovery Plan* criteria focus on the PCA and a 10-mile perimeter, whereas standards in the Strategy and the parameters in appended state plans focus beyond the PCA and encompass the entire GYA. Because grizzly bears are a difficult species to monitor and manage, multiple standards with additional monitoring items are identified to provide sufficient information upon which to base management decisions. It is the goal of the agencies implementing this Conservation Strategy to manage the Yellowstone grizzly population in the entire GYA at or above a total of 500 grizzly bears.

2006

Grizzly Bear Recovery Zone

Demographic Monitoring Area (DMA)

Total Grizzly Bear Occupied Range

0 10 20   40   60   80 Miles
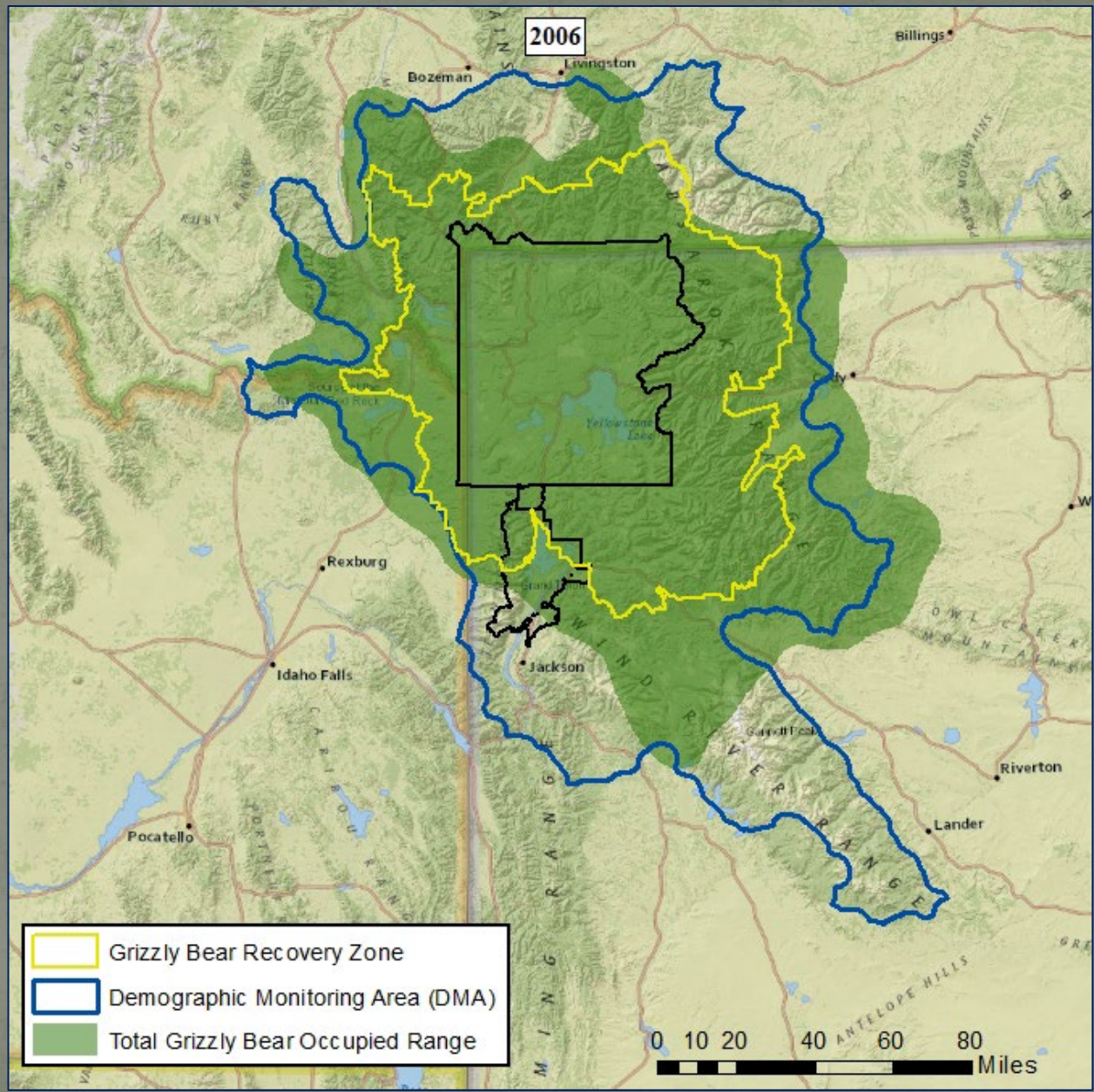
2016 – Incorporating a "Demographic Monitoring Area"

Chapter 2 Population Standards and Monitoring

To maintain a healthy (recovered) grizzly bear population in the GYE, it is necessary to have adequate numbers of bears that are widely distributed with a balance between reproduction and mortality. This section details the population criteria in the *Recovery Plan* that were necessary to achieve recovery, and the population standards necessary to maintain it (USFWS 2017). The Conservation Strategy will continue to assess demographic recovery criteria within the Demographic Monitoring Area (DMA) created by the *Recovery Plan*. Because grizzly bears are a difficult species to monitor and manage, multiple standards with additional monitoring items are identified to provide sufficient information upon which to base management decisions. It is the goal of the agencies implementing this Conservation Strategy to manage the GYE grizzly bear population within the area called the DMA, to ensure a recovered population in accordance with the established Recovery Criteria.
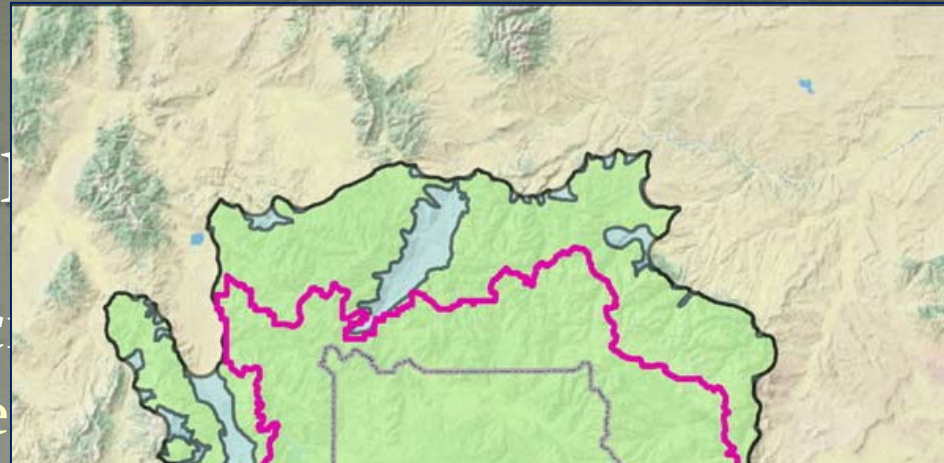
Demographic Monitoring Area (DMA)

- Background on Suitable Habitat
  - USFWS developed a model of suitable habitat for GYE grizzly bears (2007)

> Suitable habitat is considered the area capable of supporting a viable grizzly bear population now or in the foreseeable future. We defined suitable habitat for grizzly bears as areas having three characteristics—(1) being of adequate habitat quality and quantity to support grizzly bear reproduction and survival; (2) contiguity with the current distribution of Yellowstone grizzly bears such that natural re-colonization is possible; and (3) having low mortality risk as indicated through reasonable and manageable levels of grizzly bear mortality.
>
> Our definition and delineation of suitable habitat is built on the widely accepted conclusions of extensive research (Craighead 1980, pp. 8–11; Knight 1980, pp. 1–3; Peek *et al.* 1987, pp. 160–161; Merrill *et al.* 1999, pp. 233–235; Pease and Mattson 1999, p. 969; Schwartz et al. 2010, p. 661) that grizzly bear reproduction and survival is a function of both the biological needs of grizzly bears and remoteness from human activities, which minimizes mortality risk for grizzly bears. Mountainous areas provide hiding cover, the topographic variation necessary to ensure a wide variety of seasonal foods, and the steep slopes used for denning (Judd *et al.* 1986, pp. 114–115; Aune and Kasworm 1989, pp. 29–58; Linnell *et al.* 2000, pp. 403–405).

DMA and Sou[rce]

- Deriving the DMA c[riteria]
  - IGBST evaluated re[...]se and suggested inc[...] inc[...]ted int[...]

  The DMA is based on delineation of suitable grizzly bear habitat in the GYE, along with narrow areas along valleys bounded by suitable habitat that could act as potential mortality sinks (IGBST 2012). IGBST (2012) noted that mortalities in these areas would be outside suitable habitat but could have disproportionate effects on the population generally contained within suitable habitat, potentially acting as mortality sinks. The DMA includes suitable habitat (46,035 km^2; 17,774 mi^2), plus the potential sink areas for a total area of approximately 49,928 km^2; 19,279 mi^2).

- GYE [...]
  - Monitor the popula[...]
  - Emphasize the imp[...]ionship to conflict potential/private la[...]table habitat

Legend:
- ---- Yellowstone National Park
- ▬▬ Recovery Zone
- ▢ USFWS Suitable Habitat
- ▢ Additions for counting mortalities

0 12.5 25   50   75   100
Kilometers
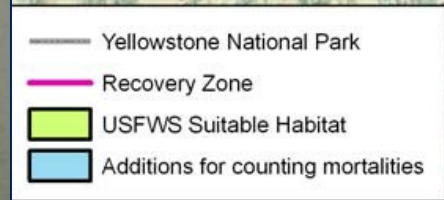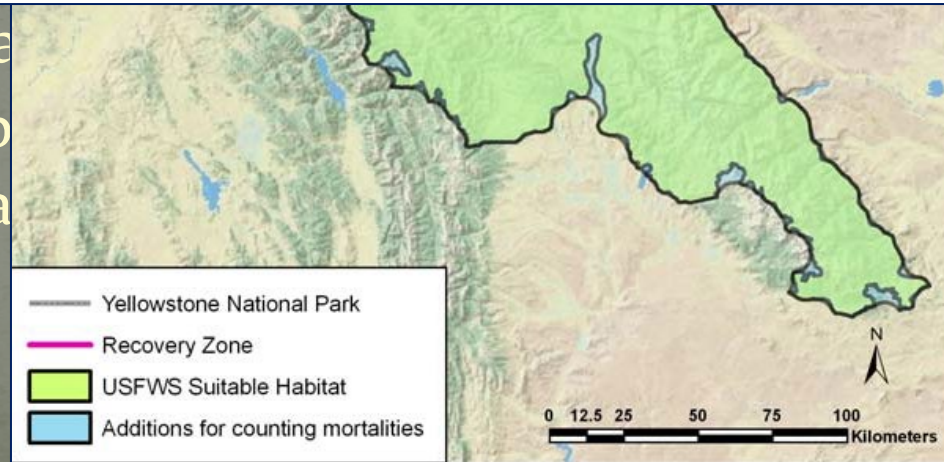
To assure that the area of mortality management was congruent with the area where population abundance is estimated, the DMA was developed by the IGBST and adopted by YES in 2012. The basis for the DMA is the suitable habitat boundary designated by the USFWS in 2007, with the addition of narrow areas along valleys bounded mostly by suitable habitat that could act as potential mortality sinks. The DMA is approximately 49,931 km^2, including 46,035 km^2 of suitable habitat, an area sufficiently large to meet all habitat needs for a viable grizzly bear population.

The DMA is thus appropriate for evaluating the population and application of mortality thresholds. The IGBST's 2012 report noted that because the suitable habitat boundary was drawn using mountainous ecoregions, there were narrow, linear areas along valley floors that did not meet the definition of suitable habitat and where population sinks may be created. These edge effects are exacerbated in small habitat patches that are long and narrow and in wide-ranging species such as grizzly bears because they are more likely to encounter surrounding, unsuitable habitat. Mortalities in these areas would be outside suitable habitat but could have disproportionate effects on the population generally contained within the suitable habitat zone, potentially acting as mortality sinks. USFWS accepted the recommendation of the IGBST in the 2012 report for a revised boundary that includes these narrow areas outside of, but largely bounded by, suitable habitat (Figures 1 and 2). The final designation of the DMA includes suitable habitat plus the potential sink areas for a total area of approximately 49,928 km^2 (19,279 mi^2).

Post-Delisting Demographic Criteria

- Based on feedback regarding previous recovery/demographic criteria and current proposed management framework, we revised to Demographic Criterion 1 and 2:

- *Demographic Criterion 1* —Maintain the population within the DMA to within or above a range of 800 to 950 grizzly bears (applying the IPM population size estimate) by determining and applying annual mortality thresholds for independent females and independent males ($\geq$ 2 years old), according to the management framework in Table 2 (see Appendix O).

- *Demographic Criterion 2*—Sixteen of 18 bear management units within the PCA (Figure 2) must be occupied by females with young, with no two adjacent bear management units unoccupied, during a 6-year sum of observations. This criterion is important as it ensures that reproductive females occupy the majority of the PCA and are not concentrated in only one portion of the ecosystem.

Table 2. Management Framework based on DMA Population Size
(IPM Population Size Estimate)
(See Appendix O, Tri-State MOA)

800* – 950	> 950
- Manage to maintain the population within or above this range. - Use IPM to determine mortality limits for population stability, slight increase, or slight decrease, remaining within or above the population range: $0.98 \leq \lambda \leq 1.02$ - Manage conflicts and authorize hunting at individual agency discretion, based on allocated mortality limits.	- Manage to maintain/reduce population. - Use IPM to determine mortality limits for population stability or decrease. $0.95 \leq \lambda \leq 1.00$ *If mortality limits are determined for a population decrease, the decrease will not exceed* 5% ($\lambda \geq 0.95$). - Manage conflicts and authorize hunting at individual agency discretion, based on allocated mortality limits.

* See below for management strategies if the population falls below 800.
Note: Lambda (λ) denotes the change in population size from one year to the next: $\lambda = 1.0$ represents no change in population size between two years: $\lambda > 1.0$ indicates population increase and $\lambda < 1.0$ indicates population decrease.
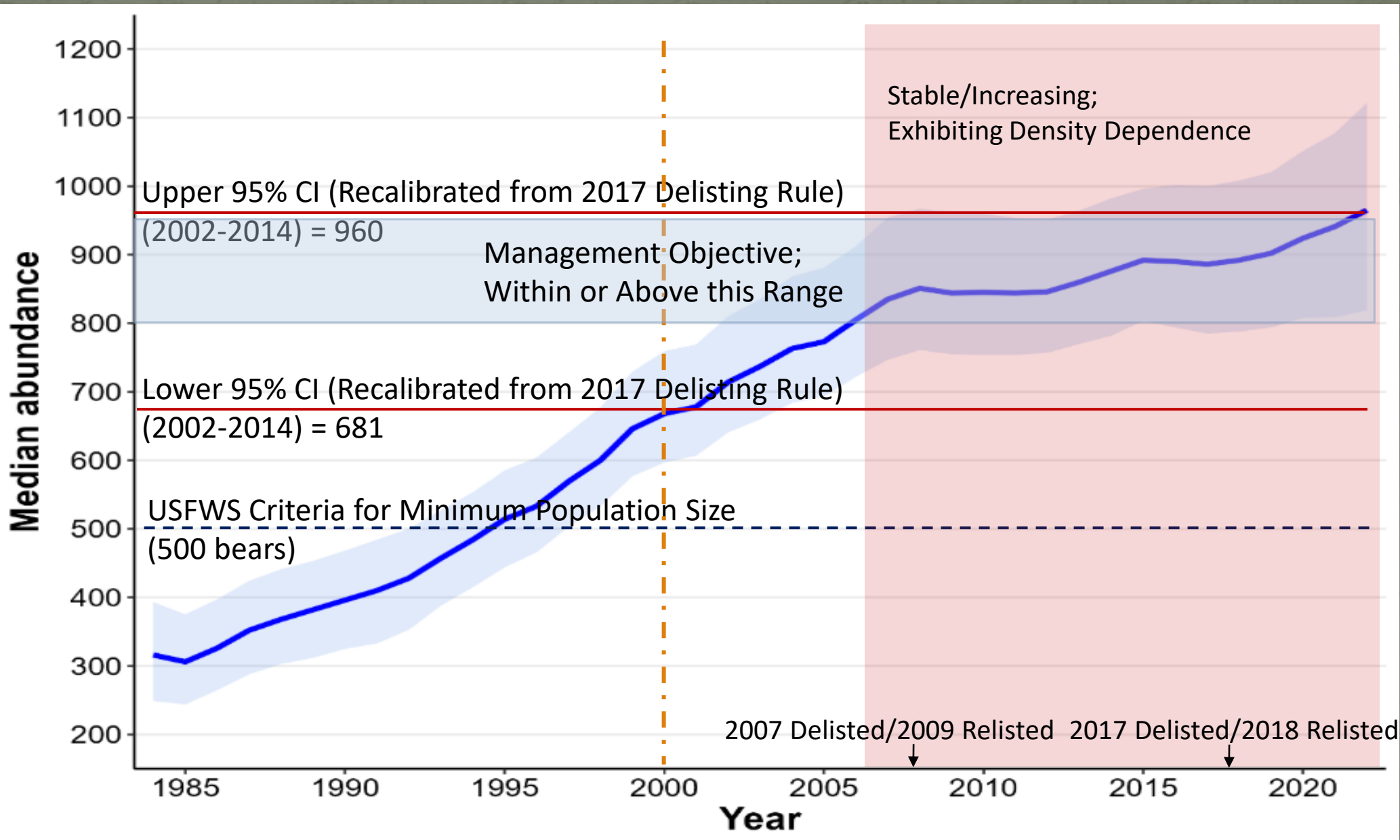
2020
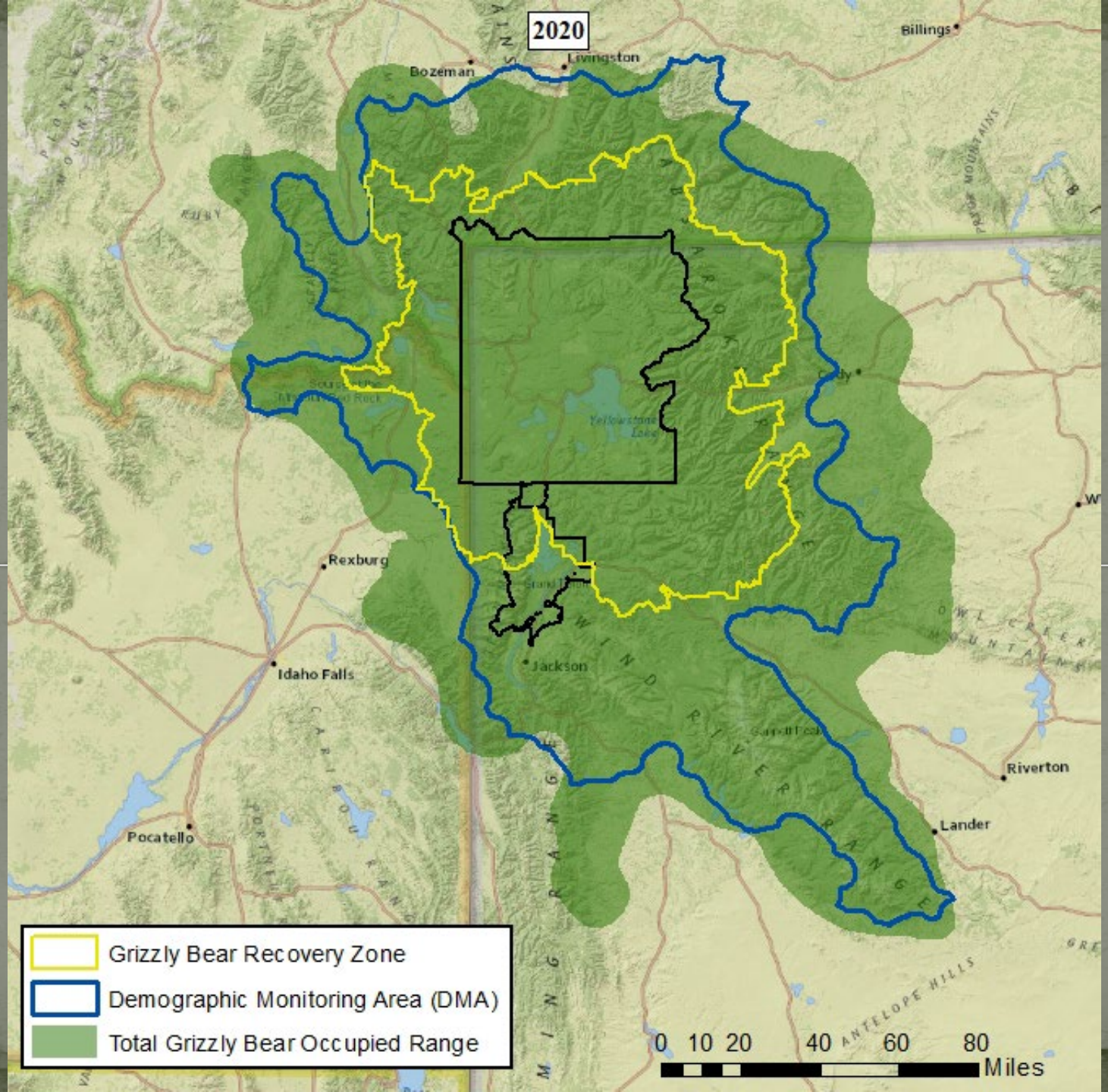
Legend:
- Grizzly Bear Recovery Zone
- Demographic Monitoring Area (DMA)
- Total Grizzly Bear Occupied Range

0 10 20   40   60   80 Miles
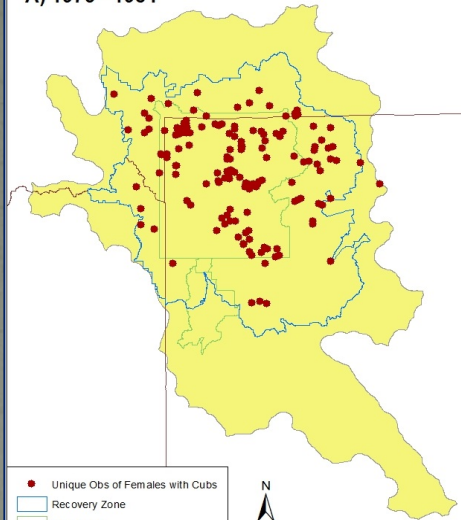
Selection of Population Management Range

- Additional section of clarifying language added:
  - Verbal description of aforementioned figure that incorporates population theory, empirical data, density dependence and context

Selecting a management objective for stability within a range allows for natural fluctuations while maintaining that population abundance, density and distribution are adequate to maintain a viable population in perpetuity. A management range also allows for flexibility to manage for stability (i.e., a range of population abundance that reflects the recovered state of the population) into the future, taking all data into account as well as being able to detect and evaluate any potential changes in the population through the IPM.
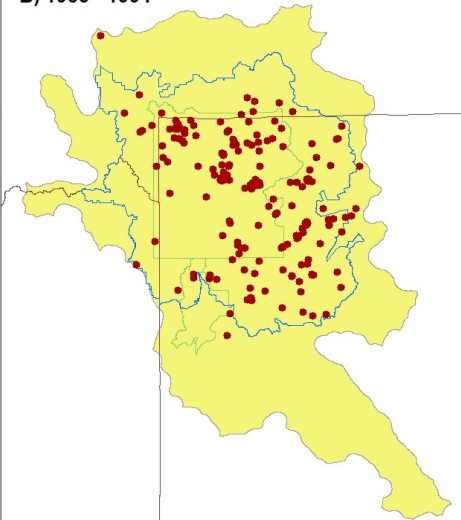
Breeding Female Occupancy (Recovery Criterion 2)

- We received feedback suggesting expanding the criterion for breeding female occupancy beyond the Primary Conservation Area (PCA). However, we did not see a need to expand the geographic scope of this criterion, which corresponds to the longstanding USFWS recovery zone and related female occupancy recovery criterion

- This demographic criterion ensures that reproductive females occupy the majority of the PCA (recovery zone) and are not concentrated in only one portion of the PCA. **The IGBST will continue to monitor and report females with any offspring for the GYE, both inside and outside the PCA and DMA**
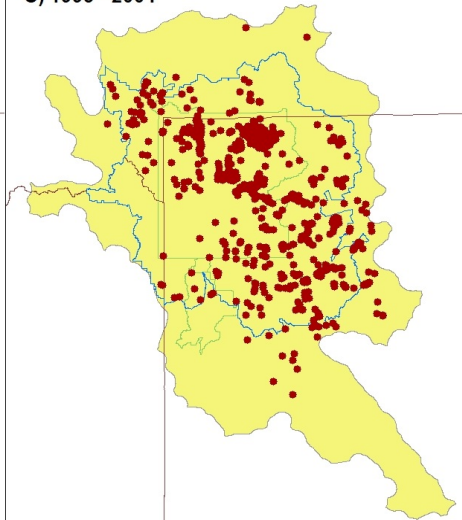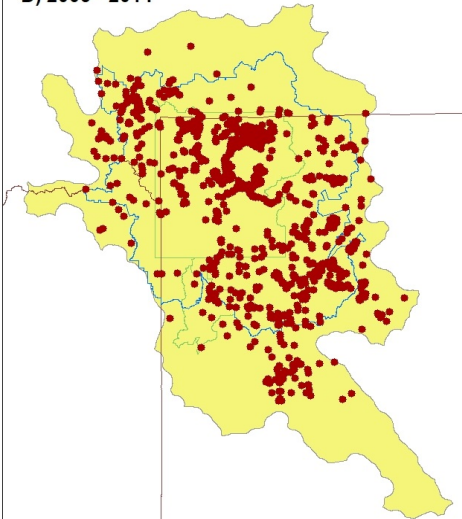
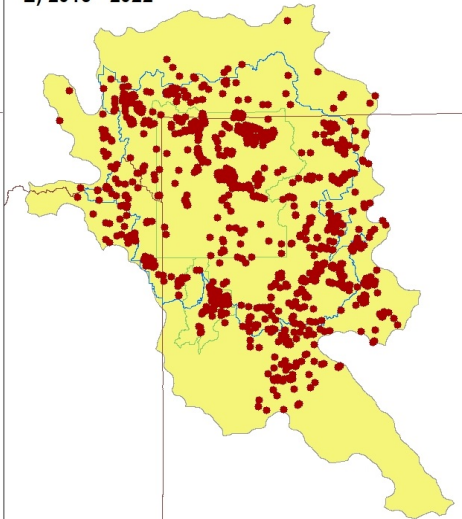A) 1975 - 1984   B) 1985 - 1994   C) 1995 - 2004

D) 2005 - 2014   E) 2015 - 2022

Unique Obs of Females with Cubs
Recovery Zone
NPS Lands
Demographic Monitoring Area
State Boundaries

N

0 20 40 60 80 Kilometers

Mortality Evaluation and Management

- Clarifying language added:
  - All mortalities quantified annually throughout the GYE
  - Estimates of survival, recruitment through reproduction, and mortality garnered through the IPM are specific to the DMA. However, these detailed demographic data allow for robust evaluation of all factors contributing to changes in the population trajectory
- Questions regarding mortality allocation
  - Clarifying language: IGBST estimates all mortality with the IPM annually within the DMA (including any that may occur on lands managed by the National Park Service or the Wind River Reservation), and this mortality is assessed before allocation of mortality available for harvest among the 3 states
  - As per the Tri-State Memorandum of Agreement: federal, state, and tribal representatives are included in annual allocation discussions

Genetics and Connectivity

- Clarifying language added within Chapter 2, for example:

These results collectively indicate that, at population levels consistent with the described management objective (maintain the population in the DMA within or above a range of 800–950 grizzly bears, applying the IPM population size estimate) and under current or similar environmental conditions, genetic factors do not pose a risk to the viability of the GYE grizzly bear population. Kamath *et al.* (2015) concluded that nonetheless, the historically small N_e, relatively low diversity, and isolation over many generations, suggest the grizzly population could benefit from increased fitness with additional gene flow, particularly given the unpredictability of future climate and habitat changes.

Genetics and Connectivity

- Continued:

The agencies recognize the value of providing connectivity between population cores (e.g., between the GYE and NCDE Recovery Areas). Occasional migration between population cores of grizzly bears that breed and whose offspring survive is sufficient for functional connectivity. Functional genetic connectivity should not be interpreted as requiring one seamless group of animals stretched across the various population cores. There are practical limitations for grizzly bear occupancy in the areas between populations due to human occupancy. We support active cooperation with partners to gradually increase capacity for naturally occurring genetic exchange between the GYE and other populations (see Montana State Grizzly Bear Management Plan, Appendix H). We remain optimistic that continued coordination of conservation efforts will ultimately support natural exchange and its potential benefits for long-term viability of the GYE population. In the absence of effective migration occurring naturally, the states are committed to translocation.

Relationship of Chapter 2 to Tri-State MOA

Feedback included comments about Chapter 2 references to the Tri-State MOA (Appendix O to the Strategy) and sequence of updates among agency documents. The relationship between the processes for updating the Conservation Strategy and the Tri-State MOA was described at the November 2023 YES meeting. Proposed updates to the Conservation Strategy, primarily for Chapter 2, were developed by a drafting review team previously identified by YES members.

Revisions to the Tri-State MOA are addressed via parallel individual state administrative processes (Idaho, Montana, and Wyoming), as coordinated by state representatives to YES. As of April 1, 2024, the Wyoming Game and Fish Commission and the Idaho Fish and Game Commission have discussed and approved revisions to the Tri-State MOA, which included state agency review of comments received by YES and additional comments received during the state administrative process.

In Closing….

- Multi-year interagency cooperative and collaborative effort

- Adopts and incorporates the best available science to evaluate and conserve the GYE grizzly bear population

- Addresses court ruling on the 2017 Delisting Rule
  - Recalibration with adoption of a new estimator
  - Genetic management

- **Ensures the long-term viability of grizzly bears in the GYE post-delisting**

Fin

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