

# **Yellowstone Ecosystem Subcommittee Response to Public Feedback Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem Chapter 2: Post-Delisting Demographic Criteria and Monitoring**

April 2024

At its November 8, 2023 meeting (Jackson, WY), the Yellowstone Ecosystem Subcommittee (YES) approved a draft update to Chapter 2 of the Grizzly Bear Conservation Strategy for the Greater Yellowstone Ecosystem (GYE). This draft was posted for public feedback from November 15, 2023 to December 15, 2023.

The November 2023 draft incorporated the use of the Integrated Population Model (IPM) for monitoring population demographics of GYE grizzly bears and related updates to post-delisting demographic criteria and monitoring objectives. Implementation of the IPM by the Interagency Grizzly Bear Study Team (IGBST) provides annual updates of primary demographic data and allows for a more proactive assessment of the population and demographic criteria to ensure recovered status of a delisted population.

The Subcommittee received a total of 201 comments. The YES drafting team reviewed all comments, and YES appreciates commenters' interest in GYE grizzly bears.

Most feedback consisted of brief general statements or questions (192 comments, 95%). This feedback included short statements of support for or opposition to the Conservation Strategy and short statements opposed to killing or hunting of grizzly bears and in favor of hunting grizzly bears.

In addition to the general feedback described above, 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
- Rich Harris
- Idaho Conservation League
- Montana Wildlife Federation
- National Parks Conservation Association and Natural Resources Defense Council
- People and Carnivores

The more detailed substantive feedback we received related to the IPM, demographic criteria, mortality evaluation and management, genetic management and connectivity, and the relationship between the Conservation Strategy and other documents.

Feedback resulted in revisions to the November 2023 draft revisions to Chapter 2. This Response document and a companion presentation to YES at its meeting on April 23, 2024 provide additional information to address the feedback we received.

### **Integrated Population Model (IPM)**

In response to feedback, we added additional discussion of the IPM to Chapter 2. The IPM continues to include documentation of females with cubs-of-the-year and associated point estimates derived using the Chao2 technique, which has been used for GYE population estimation since 2007, with refinements in the interim (van Manen *et al.* 2022). However, the IPM also uses other modeled and field-collected data inputs, such as survival, mortality, and reproduction data, and applies a Bayesian (probabilistic) statistical framework.

The IPM allows simultaneous estimation of multiple demographic parameters with greater accuracy and precision. Implementation of the IPM provides annual updates of primary demographic data and allows for a more proactive assessment of the population and demographic criteria to ensure recovered status of a delisted population.

The IGBST presentation at the April 2024 YES meeting explains the fundamentals of statistical concepts for GYE grizzly population estimators, such as credible intervals, confidence limits, and uncertainty around point estimates.

We also note the following previous presentations, discussions and reports regarding IPM:

#### **IGBST presentations to YES focused on IPM:**

[Spring 2018 YGCC: "Integrated Population Models \(IPM\)"](#)

[Spring 2020 YES: "Advancing Demographic Monitoring"](#)

[Fall 2020 YES: "Advanced Demographic Monitoring Approach"](#)

[Spring 2021 YES meeting: "Advancing Demographic Monitoring of Grizzly Bears"](#)

[Fall 2021 YES meeting: "Advancing Demographic Monitoring: Progress Report"](#)

[Spring 2022 YES meeting: "2021 Status Recap & Integrated Population Models"](#)

[Fall 2022 YES meeting: "2022 Demographic Workshop"](#)

[Spring 2023 YES meeting: "2022 Update & IPM Implementation"](#)

[Fall 2023 YES meeting: "2023 Research & Monitoring Update"](#)

#### **IGBST workshops:**

14-16 November 2022 IGBST Demographic Workshop

7-8 February 2023 IGBST-YES Demographic Workshop

#### **IGBST reports:**

Gould, M. J., F. T. van Manen, M. A. Haroldson, J. G. Clapp, J. A. Dellinger, D. Thompson, and C. M. Costello. 2023. Population size and vital rates. Pages 36–39 *in* F. T. van Manen, M. A. Haroldson, and B. E. Karabensh, editors. Yellowstone grizzly bear investigations: annual report of the Interagency Grizzly Bear Study Team, 2022. U.S. Geological Survey, Bozeman, Montana, USA.

Gould, M. J., J. G. Clapp, M. A. Haroldson, C. M. Costello, J. J. Nowak, H. W. Martin, M. R. Ebinger, D. D. Bjornlie, D. J. Thompson, J. A. Dellinger, M. A. Mumma, P. M. Lukacs, and

F. T. van Manen. *In prep.* A unified approach to long-term population monitoring of grizzly bears in the Greater Yellowstone Ecosystem.

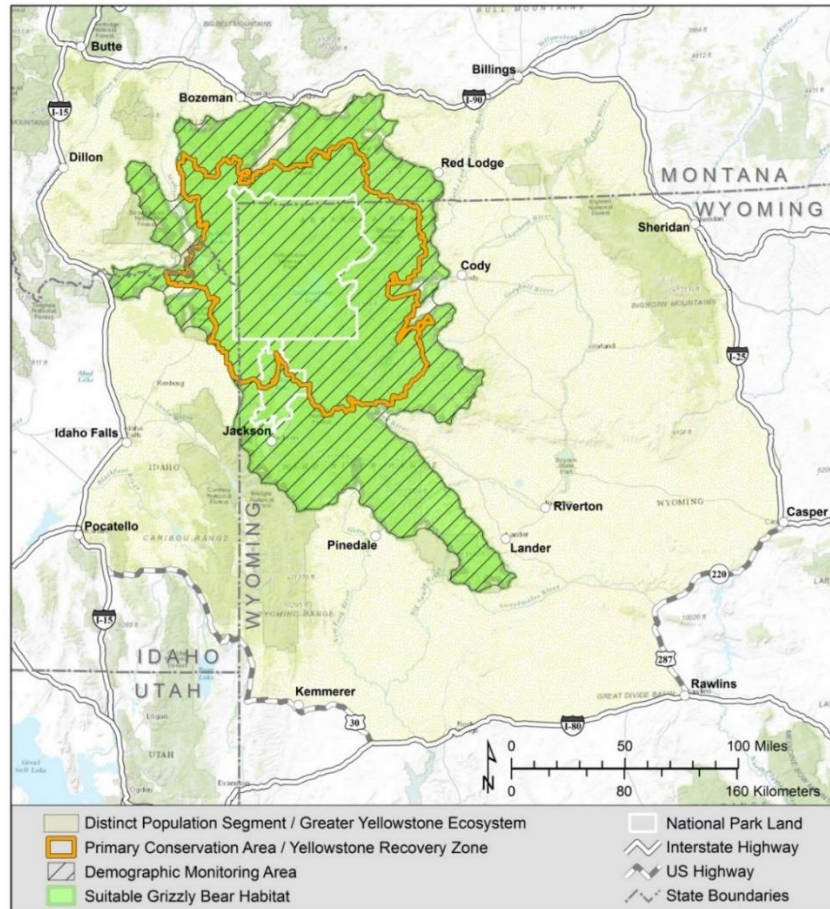
### **Demographic Monitoring Area (DMA) and Source-Sink Dynamics**

In response to feedback, we added some additional information describing the DMA, and its application to management and monitoring, to Chapter 2. Some feedback asked questions about or made comments on aspects of the DMA that Chapter 1 of the Strategy addresses (Chapter 1: Introduction and Background of the Conservation Strategy) (see below Figure 1). Other feedback asked the Strategy to address mortalities outside the DMA.

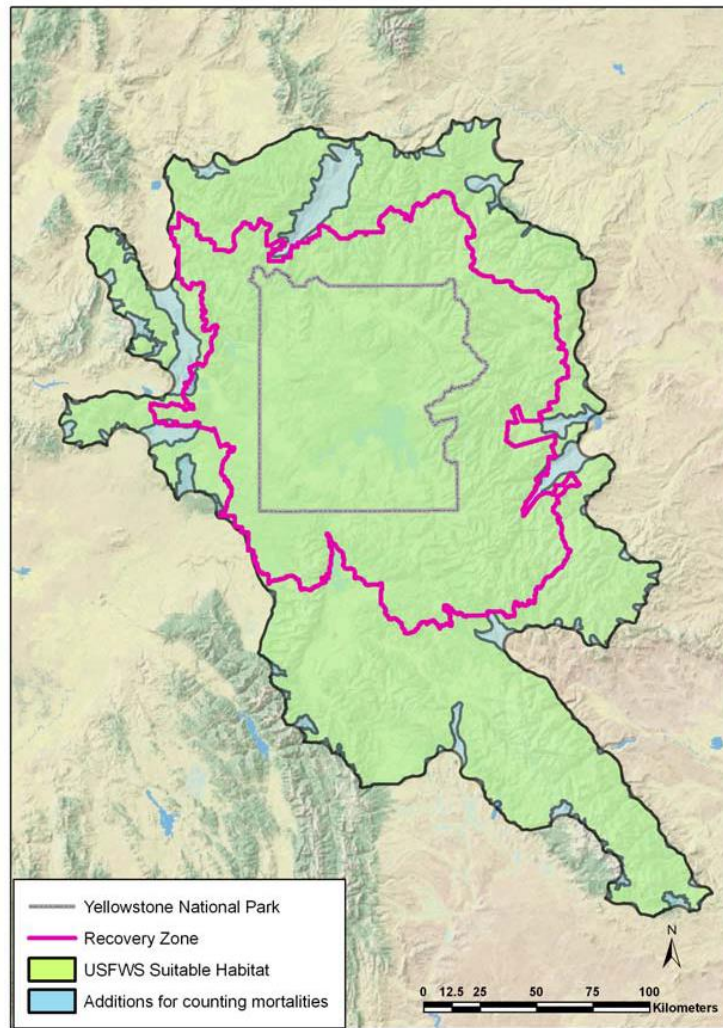
Chapter 1 of this Conservation Strategy defines the DMA and Primary Conservation Area (Figure 1). Under this Conservation Strategy, the IGBST will continue to report all mortalities and unique females with cubs-of-the-year within the GYE. Demographic criteria and IGBST monitoring are focused on the longstanding core of the population, the Primary Conservation Area (PCA, which corresponds to the longstanding GYE Recovery Zone), and a larger area of contiguous habitat, defined as the DMA (Figure 1; see Chapter 1).

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<sup>2</sup>, including 46,035 km<sup>2</sup> 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<sup>2</sup> (19,279 mi<sup>2</sup>).



**Figure 1 (which is Figure 1 in Chapter 1 of the Conservation Strategy).** Map of the Greater Yellowstone Ecosystem (GYE). Boundaries are shown for: (1) the GYE grizzly bear Distinct Population Segment Area (the legal boundary where grizzly bears would be delisted); (2) the Primary Conservation Area (PCA); (3) Suitable Habitat; (4) the Demographic Monitoring Area (DMA); and (5) National Park lands, which include Yellowstone National Park, Grand Teton National Park, and the John D. Rockefeller, Jr. Memorial Parkway.



**Figure 1B.** Map depicting suitable habitat as designated by U.S. Fish and Wildlife Service and additional areas included to serve as the Demographic Monitoring Area boundary based on analysis from the Interagency Grizzly Bear Study Team (IGBST 2012).

Importantly, the DMA framework allows for consistent evaluation of population demographics. The IGBST does not count bears “outside” the DMA as part of the overall estimate, nor are mortalities that occur “outside” the DMA evaluated against population abundance or growth trajectory ( $\lambda$ ). Population monitoring outside of the DMA would require significantly increased efforts to accurately estimate the bear population and evaluate mortalities outside these areas, which is further complicated by much lower bear densities, and could only occur at the expense of monitoring efforts in the DMA. Any wildlife monitoring program operates on finite resources and precludes quantifying grizzly bear population demographics in an area not contributing to the long-term viability of the GYE grizzly bear population.

Some feedback referred to the Lamb et al. 2023, 2020, and 2017 articles describing source-sink dynamics of grizzly bears in British Columbia. Such dynamics occur at localized scales and the

monitoring framework for the GYE addresses the potential for these type of effects. Specifically, the DMA was delineated to include narrow valleys outside suitable habitat that could have disproportionate effects on the population generally contained within nearby suitable habitat, potentially acting as local mortality sinks (IGBST 2012). Mortalities in other areas in the GYE peripheral to suitable habitat outside the DMA are not affecting the long-term viability of the GYE grizzly bear population. Additionally, as mentioned earlier and addressed in Chapter 2, implementation of the IPM allows for a more proactive assessment of the population and demographic criteria, including detection of changes in population abundance that may be influenced by factors outside the DMA.

### **Post-Delisting Demographic Criteria for the Greater Yellowstone Ecosystem**

In the November 2023 draft revision of Chapter 2 we included three post-delisting demographic criteria. We agree with feedback received that inclusion of the previously labelled Criterion 1 (based on the USFWS recovery criterion for minimum population) could confuse readers as to the agencies' intent to manage within or above the population range of 800-950 (labelled Criterion 3 in the November 2023 draft). Accordingly, we have changed the previously labelled Criterion 3 to become Criterion 1 in the revised Chapter 2. For further clarity, we have included additional language in Chapter 2 to describe the relationship of these revised post-delisting demographic criteria to the USFWS demographic recovery criteria (most recently updated in 2017).

#### **Objective to Manage Within or Above a Range of 800 - 950 Grizzly Bears in the DMA (Revised Post-delisting Demographic Criterion 1)**

We received feedback regarding the updated demographic criterion to manage within or above a range of 800–950 grizzly bears within the DMA (identified in the November 2023 draft as Criterion 3, and in the April 2024 revision as Criterion 1). Some of the feedback proposed different criteria or approaches therein. In response to this specific feedback, we added Figure 3 to the Strategy (corresponding to Figure 3A in the Chapter 2) to explain population size in the DMA, estimated by the IPM (1984–2022), relative to post-delisting management objective. We updated Chapter 2 to include additional discussion about the selection of the range, implementation of the IPM, the concepts of density dependence, and changes in the growth rate ( $\lambda$ ) of the GYE grizzly bear population. We will also discuss the aforementioned topics in our update to YES in April 2024.

Based on feedback, we also removed a sentence from Table 2 that created confusion. The sentence referred to the potential for the ability to make choices that would result in a lambda ( $\lambda$ ) larger than the lambda used for calculation, such as would be the case if a state chose to implement a hunting moratorium or chose to authorize hunting well below its allocation. However, some readers interpreted this sentence to mean the states could choose not to manage for a population increase if the estimate declined to 800, which would be contrary to the parties' intent.

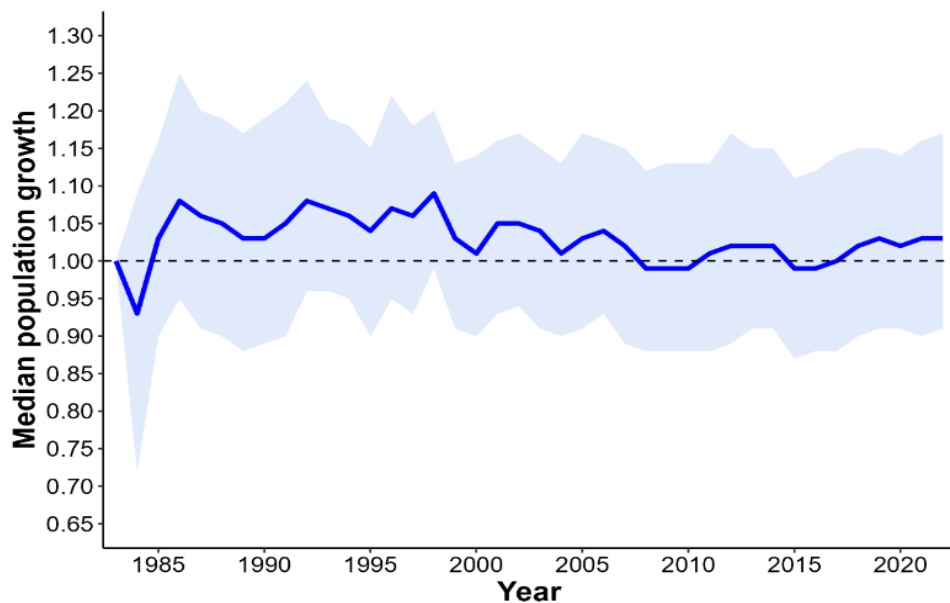
Below is additional information relative to feedback on this Demographic Criterion.



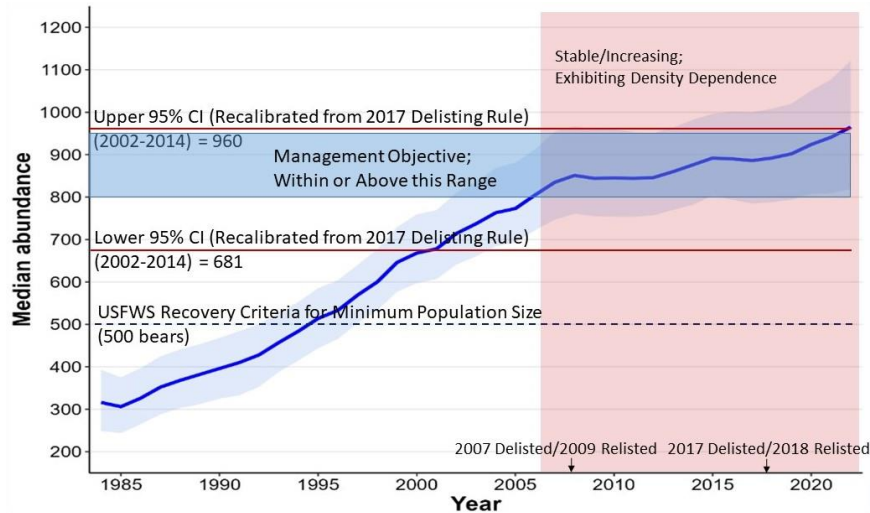
After adoption of the IPM, the IGBST “recalibrated” the Chao2 population metrics used for mortality thresholds described in the 2016 Conservation Strategy: the 2002–2014 model-averaged Chao2 estimate of 674, with 95% confidence intervals of 600–747. The corresponding population range using the IPM is a mean of 821 (median 823) with a 95% credible interval of 681–960 (see Figure 3).

Demographic analyses indicate robust population growth of the GYE grizzly bear population during the latter portions of 1980s and throughout the 1990s (Schwartz et al. 2006), and evidence of population growth slowing starting in the early 2000s (IGBST 2012). Data presented in van Manen et al. (2016) indicate the slowing of population growth beginning around the year 2000 was associated with density-dependent effects, with higher bear densities corresponding to lower cub and yearling survival and lower reproductive transition from females having no cubs to cubs. Estimates from IPM for the period 1983–2022 provide further support for those earlier findings. A change-point analysis of annual population growth ( $\lambda$ ) for 1983–2022 identified the time period since 2006 as a period of little change within the time series, with minor fluctuations around a long-term mean of 1.014 (1.4% annual growth; Figures 3 and 4). Corresponding IPM estimates of total population size for this time period ranged from 805 bears in 2006 to 965 in 2022 (Gould et al. 2023).

The IPM provides the ability to update demographic vital rates of the population on an annual basis, which was not feasible under previous monitoring protocols. Specifically, the IGBST will be able to detect potential changes that may occur in vital rates of specific sex/age cohorts post-delisting in relation to the demographic criteria. As a conservative management approach, the 681–799 portion of the recalibrated range was excluded from the management objective, and the demographic criterion instead relies on the IPM-supported framework with population objectives within or above the 800–950 range (Figure 4).



**Figure 2.** Annual population growth rate ( $\lambda$ ) estimates for grizzly bears in the Greater Yellowstone Ecosystem, 1984–2022 based on integrated population model (Gould *et al.* 2023).



**Figure 3 (added to Conservation Strategy as Figure 3A).** Grizzly bear population size in the Demographic Monitoring Area of GYE, estimated by the IPM (1983–2022; Gould et al. 2023), relative to post-delisting management objective and other metrics. The 95% credible intervals are shown as the blue shaded area on either side of the median line. The horizontal dashed line indicates the USFWS recovery criterion of a minimum population size of 500. The red lines represent the recalibrated 95% credible intervals for the population estimates for 2002–2014 (which were used for the mortality management framework in the 2017 Delisting Rule).

The documented changes in the population trajectory and role of density-dependent factors follow a predictable pattern for long-lived, vertebrate species (Eberhardt 2002). The population started exhibiting density-dependent traits in in the recovery zone and surrounding areas beginning around the year 2000, and the population trajectory changed as a result of multiple factors, including lower cub and yearling survival (van Manen et al. 2016). Additionally, Bjornlie et al. (2014) found that bear density was associated with home-range size; female home ranges in particular were smaller in areas with higher bear densities, possibly because of greater competition for available space and food resources as individuals saturate quality habitats. Also, in a recent analysis of body composition data, Corradini et al. (2023) found that individual lean body mass was negatively associated with population density, particularly for younger, growing-age females.

Combined, these studies provide considerable evidence of the role of grizzly bear density, rather than extrinsic factors, on demographics of the population beginning around the year 2000. Estimates based on the IPM indicate the period of slowing population growth has transitioned into an oscillating pattern around a longer-term mean  $\lambda$  of 1.014 (i.e., 1.4% annual growth) starting around 2006 (Fig. 3). Estimates of total population size for this period of relative population stability (i.e., 2006–2022) ranged from 805 to 965 (Gould et al. 2023). Density-dependent effects likely play a lesser role in peripheral areas of the ecosystem (see Interagency Grizzly Bear Study Team 2012:34), which is why there has still been some population growth during this period. Some of the preceding language was incorporated into updates to Chapter 2.

In addition, there were multiple comments regarding the demographic monitoring framework that seem to reflect misinterpretation or misunderstanding of statistical concepts, particularly



confidence limits, credible intervals, and uncertainty around point estimates. The reason the IPM reports annual median estimates is that those point estimates have the highest probability of reality, following the central tendency of the data and reflecting an important concept in statistics. It is important to report and consider levels of uncertainty associated with statistical estimates. However, focusing on the lowest or highest limits of confidence/credible intervals (by definition, the least probable estimates within the interval) as fact or targets for conservation metrics is contrary to the role of science (Schwartz et al. 2006). The presentation at the April 2024 YES meeting addresses this subject in more detail.

### Breeding Female Occupancy in the Primary Conservation Area (PCA) (Post-Delisting Demographic 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 UFWS recovery zone and related female occupancy recovery criterion. (From a nomenclatural standpoint the Recovery Zone applies to the listed population, the PCA is the same area for a delisted population).

The PCA is 9,210 mi<sup>2</sup>. The PCA is the core of the GYE population to which the most stringent habitat standards apply based on the 1998 baseline. The Demographic Monitoring Area (IGBST 2012) was developed to allow for a consistent monitoring framework and encompasses all suitable habitat inside and beyond the PCA, as well as some areas that are outside what is considered suitable but likely being used by grizzly bears that live within the DMA (see above).

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.

### Mortality Evaluation and Management

Comments addressed mortality in the GYE outside the DMA (see discussion about the DMA above). In response to comments, we added language in Chapter 2 to clarify that any and all grizzly bear mortalities in the GYE are quantified annually, regardless of where they occur in relation to the DMA boundaries. 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.

Comments questioned evaluation and management of mortality, and indicated reader confusion of how mortality occurring in the National Parks is included in consideration of discretionary mortality. We added language to Chapter 2 to clarify that the 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. These changes are consistent with pending revisions to provide similar clarification in the Tri-State MOA. In addition, federal

state, and tribal representatives are included in annual allocation discussions, and the State of Wyoming will work with the Eastern Shoshone and Northern Arapaho tribes of the Wind River Reservation in reference to the 4% of the tribes' DMA allocation within of the total annual allocation (58%) attributed to Wyoming.

### **Genetic Management and Connectivity**

Feedback addressed connectivity between the GYE and other grizzly bear populations and translocation versus natural connectivity. In response to feedback, we added explanation in Chapter 2 relative to the court decision on the 2017 GYE delisting rule, which directed a commitment to translocation in the absence of natural connectivity. We also added other language in Chapter 2 to discuss connectivity for genetic management, the value of natural connectivity, and practical limitations.

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.

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