

Somewhere we need to recognize the bias in the Knight rule set

APPLICATION PROTOCOL

Yellowstone Grizzly Bear Demographic Recovery Criteria
November 2012

To evaluate Demographic Recovery Criterion #1, the Interagency Grizzly Bear Study Team will use the following procedures to estimate total ^{minimum} population size:

1. Raw observations of sightings of females with cubs of the year will be separated into observations of unique females and repeat observations of the same female using the methods of Knight et al. (1995, p. 246).
2. The Chao2 estimator (Keating et al. 2002, p. 173) will be applied to sighting frequencies of unique females with cubs of the year to estimate the number of females with cubs of the year in the population.
3. The number of unique females with cubs of the year obtained from the Chao2 estimator each year will be added to the dataset and the model averaging process described in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 2-10)
4. The predicted number of females with cubs of the year obtained from the model fit will be used as the best estimate of the total number of independent females in the population accompanied by cubs of the year for that year.
5. The purpose of the model is to get the best estimate of the current number of females with cubs of the year borrowing information from past estimates, recognizing that with each iteration some change is expected. Estimates of females with cubs of the year for previous years will not be retrospectively adjusted with data from the current year.
6. The predicted number of females with cubs of the year will be divided by the proportion of females ≥ 4 years old estimated to be accompanied by cubs of the year (transition probability = 0.270). The resulting value represents the best estimate of the total number of females in the population ≥ 4 years old.
7. The number of females ≥ 4 years old will be divided by the estimated proportion of females ≥ 4 years old in the population of females ≥ 2 years old (0.844). The resulting value is the best estimate of the number of independent females (≥ 2 years old) in the population that year.
8. The number of independent males in the population will be based on the estimated ratio of independent males to independent females (1.000) derived via stochastic modeling described in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 10-11). The number of independent females in the population will be multiplied by 1.000 and the resulting value represents the best estimate of the number of independent males that year.
9. The number of cubs of the year in the annual population estimate will be calculated directly from the model-predicted estimate of females with cubs of the year (Interagency Grizzly Bear Study Team 2006, p. 17). The number of cubs of the year will be estimated by multiplying the modeled estimate by the mortality-adjusted mean litter size (2.49) observed from 2002–2011.
10. The number of yearlings will be estimated by multiplying the estimated number of cubs from the previous year by the mean survival rate for cubs (0.553) observed from 2002–2011.

Why using 1.0 when #7 on page 3 indicates 0.69?

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11. The estimated total population size will then be calculated as the sum of the estimates of each age and sex class:

independent females + independent males + cubs of the year + yearlings =
estimate of total population size, *biased low by knight rule set*

12. Estimates of uncertainty about the number of independent females, independent males, dependent young, and total population size will be derived following methods detailed in the Supplement to the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2006, pp. 10–15).

13. If the AICc weight favors models indicating decline in the rate of change of females with cubs (Interagency Grizzly Bear Study Team 2006, pp. 4–8), a full review of the population's demographics will be undertaken by the Study Team to better understand population status.

14. This estimate is considered conservative because of the bias in the Knight rule set, (Schwartz et al, 2008)

To evaluate Demographic Recovery Criterion #2, the Interagency Grizzly Bear Study Team will use the following procedures to document distribution of females with offspring in Bear Management Units:

1. The distribution of reproductive females in Bear Management Units is assessed using verified observations of female grizzly bears with young. This includes young of any age and/or young of unknown age.
2. Raw observations of females with young will be compiled annually by the Study Team. All grizzly bear observations and reports of sign (tracks, digs, etc.) by study personnel and the public were recorded. Grizzly bear sighting forms were sent to a variety of field personnel from different agencies to maximize the number of reports received. Sightings of grizzly bears were rated 1-5 with 5 being the best quality and 1 being the poorest. General definitions of these categories are presented below, but it was difficult to describe all circumstances under which sightings were reported. Only sightings receiving ratings of 4 or 5 were judged credible and used in reports. Sightings that rate 1 or 2 may not always be recorded in the database.
 - 5 - Highest quality reports typically from study personnel or highly qualified observers. Sightings not obtained by highly qualified observers must have physical evidence such as pictures, track measurements, hair, or sightings of marked bears where marks are accurately described.
 - 4 - Good quality reports that provide credible, convincing descriptions of grizzly bears or their sign. Typically these reports include a physical description of the animal mentioning several characteristics. The observer had sufficient observation time and was close enough or had binoculars to aid in identification. Observer demonstrates sufficient knowledge of identification characteristics to be regarded as a credible observer. Background or experience of observer may influence credibility.
 - 3 - Moderate quality reports that do not provide convincing descriptions of grizzly bears. Reports may mention 1 or 2 characteristics, but the observer does not demonstrate sufficient knowledge of characteristics to make a reliable identification. Observer may have gotten a quick glimpse of the bear or been too far away for a good quality observation.
 - 2 - Lower quality observations that provide little description of the bear other than the observer's judgment that it was a grizzly bear.

- 1 - Lowest quality observations of animals that may not have been grizzly bears. This category may also involve second hand reports from other than the observer.

To evaluate Demographic Recovery Criterion #3, the Interagency Grizzly Bear Study Team will use the following procedures to establish annual sustainable mortality rates and count numbers of grizzly bear mortalities:

1. The Study Team will estimate the ^{minimum} number of individuals in the population each year that are independent females, independent males, or dependent young using steps #4 – 10 under Demographic Recovery Criterion 1 above. The Study Team will then apply sustainable mortality rates to each of these age and sex classes to obtain mortality limits for that year.
2. Based on demographic analyses using data from 2002-2011, the ^{minimum} sustainable mortality rate for independent females is 7.6% of the population estimate of independent females. This rate will be applied to the estimate of the total number of independent females to obtain a mortality limit for that year.
3. Unknown and unreported mortality will be estimated based on the methods of Cherry et al. (2002, p. 179) and the Reassessing Methods Document (Interagency Grizzly Bear Study Team 2005, pp. 39-41).
4. Based on demographic analyses using data from 2002-2011, the ^{minimum} sustainable mortality rate for independent males is 15% of the population estimate of independent males. This rate will be applied to the estimate of the total number of independent males to obtain a mortality limit for that year.
5. Based on demographic analyses using data from 2002-2011, the sustainable mortality rate for dependent young (cubs and yearlings) is 7.6% of the annual estimate of dependent young. Only human-caused deaths (reported known and probable) will be tallied against this threshold. Unknown and unreported mortality will not be estimated for dependent young.
6. Sustainable mortality limits for independent males and females will be evaluated based on the total number of known and probable mortalities from all sources and an estimate of unknown/unreported mortality (Cherry et al. 2002). Because we are using model-averaged estimates, annual variability among years has been addressed and we recommend annual mortality limits based on the current year.
7. Dead bears reported in years subsequent to the actual year of mortality will be tallied against the estimated year of death and mortality total will be recalculated for that year. If mortality exceeds the threshold for that year, the difference (total mortality minus threshold) should be counted against the current years' threshold. If sex of the dead bear cannot be determined, sex will be assigned randomly using a ratio of 59:41 male:female, for independent aged bears, and 50:50 male:female for dependent young (Schwartz and Haroldson 2001, Annual Grizzly Bear Investigations 2000, Appendix A, page 120.).

2) These ~~are~~ sustainable mortality rates are considered a minimum because of the knight rule set bias identified in Schwartz et al, 2008.

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Request for Peer Review

Background

Grizzly bears (*Ursus arctos*) in the lower 48 States were listed as a threatened species under the Endangered Species Act (ESA) in 1975. Excessive, unregulated human-caused mortality was the primary factor leading to grizzly bear decline. Today, grizzly bears in the lower 48 States persist in five separate ecosystems, including the Greater Yellowstone Area (GYA), with Yellowstone and Grand Teton National Parks at its core. Since their listing in 1975, the GYA population of grizzly bears has nearly tripled in size and doubled its range. While human-caused mortality remains the limiting factor for nearly all grizzly bear populations in the world, including in the GYA, partner agencies and Tribes have successfully regulated this mortality to stay within sustainable limits that allow for population stability or growth.

I would not call GTNP core as it appears to be on the southern fringe

To effectively manage human-caused mortality, the U.S. Fish and Wildlife Service establish demographic recovery criteria that are monitored by the Interagency Grizzly Bear Study Team. Some mortality is unavoidable in a dynamic system where hundreds of bears inhabit large areas of diverse habitat with several million human visitors and residents. The objective of demographic recovery criteria is to ensure the long-term persistence of the GYA population of grizzly bears while allowing for removal of some individuals when they become a threat to human safety or livestock.

→ and inevitable forms of mortality

Substance of the Review

We are proposing to update portions of the Demographic Recovery Criteria in the GYA based on new scientific analyses, information, and methods. We are seeking peer review on these Proposed Revisions to gain an independent scientific perspective and ensure our management approach will allow us to meet our demographic objective. Specifically, we are seeking peer review on 2 documents that are interrelated: (1) the Proposed Revisions to the Demographic Recovery Criteria for the Grizzly Bear Population in the Greater Yellowstone Area; and (2) the Application Protocol for these Proposed Revisions. These proposed revisions were the result of a scientific report produced by the Interagency Grizzly Bear Study Team in 2012 titled: "Updating and Evaluating Approaches to Estimate Population Size and Sustainable Mortality Limits for Grizzly Bears in the Greater Yellowstone Ecosystem." Your review will require that you decide if, in your judgment, this report provides appropriate scientific support for the proposed revisions. The purpose of seeking independent peer review is to ensure that the best biological and scientific data are being used in this revision process, as well as to ensure that reviews by recognized experts are incorporated into the final Demographic Recovery Criteria.

And input

If you agree to be a peer reviewer of these documents, we ask you to consider, but not limit your responses, to the following questions and provide any other relevant comments, criticisms, or ideas:

1. Are assumptions and sources of uncertainties clearly identified and quantified in the Study Team (2012) Workshop report?
2. Given known (and unknown) levels of uncertainty, are the revised demographic criteria likely to support long-term conservation of grizzly bears in the GYA?
3. Would additional analyses or research reduce sources of uncertainty? If so, what analyses/research would be most helpful?
4. Is managing for stability (instead of an increasing population) an appropriate approach for this population of grizzly bears?

and to what extent?

or decreasing

4/

5. Is assessment of demographic criteria exclusively within the Monitoring Area identified a reasonable biological and statistical approach?
6. Do the proposed revisions and supporting documents provide all the necessary and pertinent literature to support our assumptions and conclusions?

Expectations & Outcomes

As a peer reviewer, you are asked to provide a brief written report evaluating the documents. This report would include a brief description of your organizational affiliation, credentials before responding to the questions above and describing your findings and conclusions. Reviewers are not expected to provide advice on the specific decision but rather ensure that scientific uncertainties are clearly identified and whether more research is likely to decrease key uncertainties. If you accept this responsibility, your name and reviews will be available to the public.

→ and to what extent

Proposed Revisions to the Demographic Recovery Criteria for the Grizzly Bear Population in the Greater Yellowstone Area

Summary

We propose to update portions of Demographic Recovery Criteria 1 and 3 for the Yellowstone grizzly bear population based on new scientific analyses and information. Since the last criteria were updated, new approaches and scientific protocols have been developed. These proposed updates are:

1. Update Criterion 1 to reflect the demographic goal of maintaining a minimum population size of 500 animals without tying it to a specific method to estimate total population size (e.g., Chao2) so we can rapidly implement improved scientific methods as they become available in the peer reviewed literature.
2. Update Demographic Criterion 3 that establishes sustainable mortality limits to allow for the incorporation and application of new demographic data, as they are developed.
3. Designate a Monitoring Area (Figure 1), within which all demographic criteria are assessed. This requires us to revise the area within which mortalities are counted against the mortality limits for independent females and males and dependent young so the area where population size is estimated is the same area where mortalities are counted. This means we would no longer count mortalities of bears in areas outside this Monitoring Area against sustainable mortality limits, and, conversely, we would not count bears observed outside this Monitoring Area toward our estimates of population size.

Background

In 2007, we supplemented the 1993 Grizzly Bear Recovery Plan with revised demographic criteria for the Greater Yellowstone Area (GYA) population (72 FR 11376, March 13, 2007). Since that time, new information relevant to these demographic criteria has become available. Consistent with Task Y11 of the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1993, p. 44) that directs the Service to "Reevaluate and refine population criteria as new information becomes available," we are proposing revisions to the demographic criteria, based on updated demographic analyses and the best available science.

In 2000, we began a process to reevaluate and update methods to determine the status of the GYA grizzly bear population, estimate population size, and determine the sustainable level of mortality in the GYA. The Wildlife Monograph: "Temporal, Spatial, and Environmental Influences on The Demographics of Grizzly Bears in The Greater Yellowstone Ecosystem" (Schwartz et al. 2006); the report: "Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear" (hereafter referred to as the Reassessing Methods Document) (Interagency Grizzly Bear Study Team 2005); and the report: "Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear Workshop Document Supplement 19-21 June, 2006" (hereafter referred to as the Supplement to the Reassessing Methods Document) (Interagency Grizzly Bear Study Team 2006) provided

the scientific basis for revising the demographic recovery criteria in the GYA in 2007. Similarly, the revisions we propose now are based on updated demographic analyses using the same methods as before (Schwartz et al. 2006), as reported in the Interagency Grizzly Bear Study Team's 2012 report: "Updating and Evaluating Approaches to Estimate Population Size and Sustainable Mortality Limits for Grizzly Bears in the Greater Yellowstone Ecosystem." This 2012 Study Team report provides the scientific basis for the changes proposed below.

The current demographic recovery criteria in the GYA are:

- Demographic Recovery Criterion 1 — Maintain a minimum of 48 females with cubs of the year in the GYA (Figure 1), as indicated by the model-averaged Chao2 estimate for that year. The number of females with cubs of the year cannot drop below 48 for any 2 consecutive years.
- Demographic Recovery Criterion 2 — Sixteen of 18 bear management units within the Recovery Zone (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 Recovery Zone and are not concentrated in one portion of the ecosystem.
- Demographic Recovery Criterion 3 — For independent females (at least 2 years old), the current annual mortality limit, not to be exceeded in 2 consecutive years and including all sources of mortality, is 9 percent of the total number of independent females. For independent males (at least 2 years old), the current annual mortality limit not to be exceeded in 3 consecutive years and including all sources of mortality, is 15 percent of the total number of independent males. For dependent young (less than 2 years old), the current annual mortality limit, not to be exceeded in 3 consecutive years and including only known and probable human caused mortalities, is 9 percent of the total number of dependent young.

The second criterion pertaining to the distribution of females with offspring will remain unchanged. We propose to revise the first and third criteria to reflect updated demographic analyses and facilitate implementation of the best available science, as it becomes available. We propose the following demographic recovery criteria to supplement the 1993 Recovery Plan:

- Proposed Demographic Recovery Criterion 1 — Maintain a minimum population size of 500 animals, as indicated by methods established in published, peer-reviewed scientific literature and calculated by the Study Team using the most updated Protocol, as posted on their website. The estimate of total population size cannot drop below 500 in any single year. *two consecutive years*
- Demographic Recovery Criterion 2 (NO CHANGE) — Sixteen of 18 bear management units within the Recovery Zone (Figure 2) must be occupied by females with young, with no 2 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 Recovery Zone and are not

concentrated in one portion of the ecosystem.

- Proposed Demographic Recovery Criterion 3 — Annual mortality limits will be established based on calculations by the Study Team of how much mortality independent females (> 2 years old), males, and dependent young (< 2 years old) can sustain without making the population decline (i.e., the “sustainable mortality rate”), as described in the Protocol Document on their website. This sustainable mortality rate will be calculated and reported by the Study Team using peer reviewed scientific methods such as known-fate analyses (see Harris et al. 2006). If mortality limits for independent females are exceeded in any 2 consecutive years, this will trigger a Biology and Monitoring Review by the Study Team. Similarly, if mortality limits for independent males or dependent young are exceeded in any 3 consecutive years, it will trigger a Biology and Monitoring Review.

We are proposing to change the first and third criteria because they no longer represent the best scientific data nor the best technique to assess recovery of the Yellowstone grizzly bear population because – (1) There are updated demographic analyses for 2002-2011 indicating that the rate of growth seen during the 1983–2001 period has slowed and sex ratios have changed; (2) there is consensus among scientists and statisticians that the area within which we apply mortality limits should be the same area we use to estimate population size; and (3) the need exists to make the demographic criteria dynamic so the Study Team can incorporate results from updated demographic analyses and implement new scientific methods based on peer-reviewed, scientific literature as they become available. These proposed criteria would replace the current Demographic Criteria and would be appended to the Yellowstone chapter of the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 1993, p. 44) and the Final Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area.

More information about Proposed Revisions to Demographic Criterion 1:

Because the GYA grizzly bear population is currently isolated from other grizzly bear populations, to adequately mitigate the potential effects of genetic drift and inbreeding depression, Miller and Waits (2003) recommended that the total population size for the GYA grizzly bear population be at least 400 bears. To assure that this goal is met and in order to adopt a conservative approach, the total population will be maintained at or above 500 grizzly bears in the GYA. The biological intent of this proposed revision is identical to the current criterion. The current criterion to maintain an annual estimate of at least 48 females with cubs of the year using the model averaged Chao2 value was chosen because that number corresponds to a total population size of approximately 500 individuals. The proposed revision to Demographic Criterion 1 simply removes the reference to the specific method to be used, thus allowing the USFWS to implement the best available science, as it becomes available.

we don't know this

Due to the increased level of uncertainty surrounding this estimate of population size as it becomes more removed from the raw data (i.e., number of females with cubs of the year), a Biology and Monitoring Review by the Study Team would be triggered if this

to restrictive: We may have very poor data collection years that has nothing to do with a drop. I suggest "two consecutive years"

criterion was not met in any single year. This is different than the current criterion that requires the number of females with cubs of the year to drop below 48 for two consecutive years before a Review is triggered.

More information about Proposed Revisions to Demographic Criterion 3:

The sustainable mortality limits established in the 2007 Demographic Criteria were based on data obtained between 1983 and 2002 from radio-collared bears and the modeling results of Harris et al. (2006). When these Demographic Criteria triggered a demographic review by the Study Team in 2011, they examined more recent data from 2002-2011 and compared the results of these new analyses with those from the previous time period. Between 2002 and 2011, population growth slowed and sex ratios changed, with more independent males in the population than previously documented (Study Team 2012). When sustainable mortality rates were re-calculated with this more recent data, the Study Team found that these rates had changed for some age and sex classes. Specifically, the sustainable mortality rate for independent females from all sources changed from 9.0% to 7.6% and the sustainable mortality rate for dependent young from human causes only also changed from 9.0% to 7.6% (Study Team 2012). Because these rates represent the best available science, we must revise Demographic Criterion 3 to reflect these new demographic analyses. To allow results from demographic analyses to be implemented as they become available and sustainable mortality rates adjusted accordingly, we are proposing to make the language in Demographic Criterion 3 more general without changing the overall intent to prevent population decline.

While the general biological intent of this proposed revision is identical to the current criterion (i.e., to establish mortality limits that prevent population decline), there is one important difference. The new rates were calculated based on a goal of population stability instead of population growth. No population can grow forever, since the resources it requires are finite. When a population grows too large for its environment to support continued growth, it is said to be at "carrying capacity." Carrying capacity in wild species that are habitat generalists like grizzly bears varies from year to year and even from day to day, which makes it more appropriate to regard carrying capacity as a band covering a range of population sizes, rather than a clearly defined, constant value. Accordingly, population growth may be positive or negative in any given year but over a longer time series, it will be roughly zero. Although carrying capacity varies widely in natural environments, there are several indications that the GYA grizzly bear population is at or near carrying capacity inside suitable habitat (see Schwartz et al. 2006; Study Team 2012). Therefore, the agencies accepted the Study Team's recommended strategy to manage this grizzly bear population with a goal of stability instead of indefinite growth (Study Team 2012).

Like the methods adopted in 2007, the proposed revision to Demographic Criterion 3 would continue to count deaths of independent (at least 2 years old) male and female grizzly bears from all sources against annual mortality limits while counting only known and probable human-caused mortalities against annual mortality limits for dependent young (less than 2 years old). For independent females and males, counted mortalities include: (1) known and probable human-caused mortalities; (2) reported

deaths due to natural and undetermined causes; and (3) calculated unreported human-caused mortalities. The Study Team would continue to use the methods of Cherry et al. (2002) to calculate and estimate unknown/unreported mortalities each year based on the number of known, reported deaths (Cherry et al. 2002, p. 179; Interagency Grizzly Bear Study Team 2005, pp. 39-41).

Unlike the methods adopted in 2007, the proposed revision to Demographic Criterion 3 would apply only within the Monitoring Area shown in Figure 1. The Study Team developed this Monitoring Area using USFWS suitable habitat (see 72 FR 14866, March 29, 2007) and adding areas which may serve as mortality sinks (Study Team 2012). Mortalities outside of the Monitoring Area would continue to be recorded and reported but would not count against the sustainable mortality limits for that year. Grizzly bear occupancy would not be actively discouraged outside the Monitoring Area but management emphasis would be on conflict response. Grizzly bears would not be removed from the population just because they occur outside the Monitoring Area but may be removed from the population or relocated if there are conflicts. Grizzly bears may also be preemptively relocated to avoid conflicts but their potential contribution to connectivity with other grizzly bear populations would be considered in any such moves. Preemptive moves would not be classified as conflicts.

Application of the proposed revisions to Demographic Criteria 1 and 3.

The application protocols to evaluate and measure these updated Demographic Criteria are available at the Study Team's website and will be updated as necessary to assure the use of the best available science. See: <http://nrmssc.usgs.gov/research/igbst-home.htm>

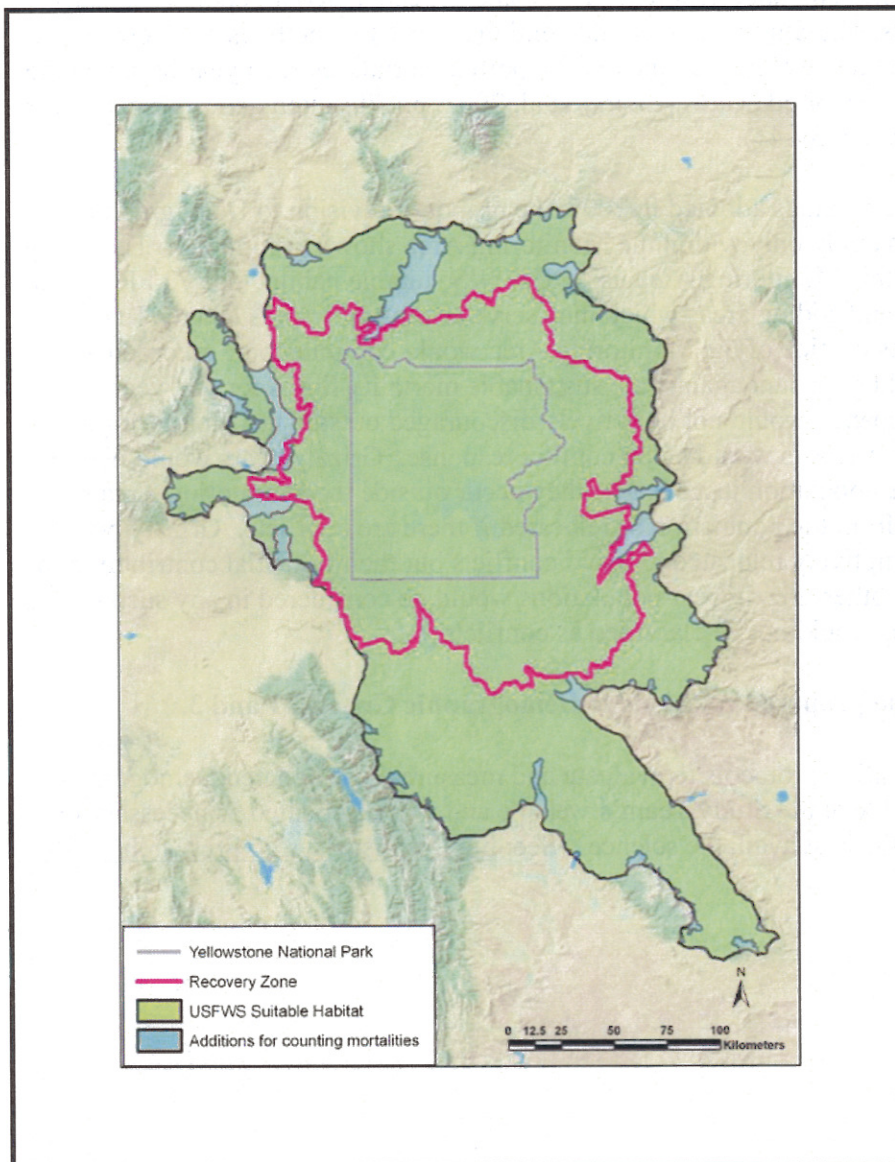


Figure 1. The Proposed Monitoring Area within which all demographic criteria would be assessed consists of the combined green and light blue areas.

Figure 2. Yellowstone recovery zone boundary showing bear management unit (BMU) and subunit boundaries for application of Demographic Criterion 2.



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Appendix A.

Implementation Schedule

The following Implementation Schedule outlines actions and estimated costs for the grizzly bear (*Ursus arctos horribilis*) recovery program over the next 5 years. Functioning as a practical guide for meeting the species' recovery goals, this schedule indicates action priorities, action numbers, action descriptions, duration of actions, and estimated costs. In addition, parties with authority, responsibility, or expressed interest in implementing a specific recovery action are identified: however, this neither obligates nor implies a requirement for the identified party to implement the action(s) or secure funding for implementing the action(s). However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and, therefore, is considered a necessary action for the overall coordinated effort to recover the grizzly bear. Also, section 7(a)(1) of the ESA, as amended, directs all Federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation threatened and endangered species.

Key to Implementation Schedule Priorities (column 1)

PRIORITY 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

PRIORITY 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

PRIORITY 3: All other actions necessary to provide for full recovery of the species.

Key to responsible parties in column 6:

USFS =	U.S. Forest Service
YNP =	Yellowstone National Park
USGS =	U.S. Geological Survey
MT =	Montana Fish Wildlife and Parks Department
ID =	Idaho Fish and Game Department
WY =	Wyoming Game and Fish Department
GTNP =	Grand Teton National Park

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Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	USFWS Lead	Total (annual) Costs	2007	20 08	20 09	20 10	20 11	Comments
3	Y11	Monitor total population size by counting females with cubs. Monitor mortality and set annual mortality limits.	Annual	USGS, MT, WY, ID, YNP, GTNP, USFS	N	678,193 ¹	339,097 ¹	0	0	0	0	

¹ The same funding applies to both monitoring population size and mortality management as they are interrelated.

DRAFT AND SUBJECT TO CHANGE

