United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE

February 2, 2022

Hank Worsech, Director
Montana Fish, Wildlife & Parks
1420 East Sixth Ave
PO Box 200701
Helena, MT 59620-0701

Dear Director Worsech,

The US Fish and Wildlife Service appreciates the opportunity to provide comments on the draft Montana Grizzly Bear Management Plan (Plan) and associated Environmental Impact Statement. We provide general comments here and detail more specific comments in attached form.

We commend Montana Fish Wildlife and Parks (FWP)for recognizing the importance of strong commitments to demographic objectives for grizzly bears inside designated ecosystems. However, the Plan remains silent on recently enacted legislation that impacts or has the potential to impact grizzly bears (through incidental catch), such as Senate Bill 98 and other laws targeting wolves and black bears. We suggest the Plan include discussion on how FWP will minimize impacts from these laws to grizzly bears in these important areas.

We suggest clarification on your commitment to connectivity. Although the Plan states that connectivity of the species is a guiding principle, several other statements throughout the document contradict this commitment. We also believe the discussion on connectivity would benefit from incorporation of Costello (2020, p.4; attached): “In grizzly bears, demographic connectivity is best achieved by maintaining residency of females and males in the areas between sub-populations. This is because female bears most often set up their home range in proximity to their mother’s range, and only rarely disperse long distances (although it has been observed). If sub-populations are too distant from one another, they are unlikely to exchange females. By default, demographic connectivity also achieves genetic connectivity.”

Finally, as written, the Plan lacks clarity on management of non-conflict bears outside core ecosystems and connectivity zones, and in places suggests potential "no bear zones." While lower tolerance for grizzly bears involved in conflicts or persisting near human residences in these areas is a reasonable assumption, explaining that bears will not be removed if they are conflict-free and residing away from humans would signify a stronger commitment to maintaining recovered populations on the landscape.

Thank you for your consideration of this project. If you have any questions regarding our comments, please feel free to contact me hilary_cooley@fws.gov or 406-273-8002.

Sincerely,

Hilary Cooley

Attachments

USFWS Comments on Montana Grizzly Bear Management Plan DRAFT

General Comments:

Outside ecosystems and connectivity areas, we would view a commitment to allow non-conflict bears to persist in areas away from human residences as a stronger regulatory mechanism than current language, which suggests potential "no bear" zones.

We are pleased to see commitment to connectivity. However, suggest adding commitments for female occupancy in connectivity areas, as described in Costello (2020, p.4, attached): "In grizzly bears, demographic connectivity is best achieved by maintaining residency of females and males in the areas between sub-populations. This is because female bears most often set up their home range in proximity to their mother's range, and only rarely disperse long distances (although it has been observed). If sub-populations are too distant from one another, they are unlikely to exchange females. By default, demographic connectivity also achieves genetic connectivity."

Specific Comments:

p. 5 ¶ 1 – Previous plans were for western not northwest Montana, it is correctly stated elsewhere.

p. 5 last ¶ – Suggest clarifying the types and goals for connectivity referenced here. Whereas genetic connectivity is sufficient for the GYE, demographic connectivity is needed for the BE. Bears will need to occupy the intervening areas, albeit at lower densities, to obtain both types of connectivity but it is particularly important for demographic connectivity.

p. 6 ¶ continuing from p. 5 – Translocation is not necessarily the same as connectivity (applies in several other areas of the document also including Table 1). If this section is referencing translocations within the intervening area then this may help with connectivity but if so, they need to specify this type of translocation.

p. 6 ¶ 1 – It is unclear if core areas include only the recovery zones or also the DMAs. It should be the DMAs, but these have not yet been identified for the BE and CYE. Possibly refer to the current 10- mile buffer from the Recovery Plan for the BE and CYE, and recognize the potential for change in the future, particularly with development of a CS for the CYE? In Table 1 it seems that core is referring to DMAs, where they exist, and recovery zones elsewhere. Same lack of clarity on p. 13 under definition of core.

p. 8 Table 1 – Under "numerical objectives" a commitment to the recovery goal in the BE should be added under column B "FWP Preferred Alternative."

p. 10 Table 1 – Under "population and research monitoring" Alt A there is a typo, it currently reads in the "NCDE and CYE CSs and in the CYE" but should read "NCDE and GYE CSs and in the CYE." What happens when/if the CYE has a CS?

p. 12 Definition for CS – Suggest that this definition is modified such that it would refer to the most recent version of the CS given that revisions are ongoing and could otherwise make the state management plan quickly outdated.

p. 12 Definitions for CYE, GYE, and NCDE – These geographic areas are not provided in the Recovery Plan, rather the Recovery Plan outlines recovery zones and the USFWS has said that "Ecosystems are generally considered to be the larger area surrounding the recovery zones in which grizzly bears may be anticipated to occur as part of the same population" (USFWS 2022: the SSA).

p. 12 Definition for DPS – Should acknowledge that in light of the court decision the DPS boundary was also vacated. Same for 2017 and on p. 18 ¶ 4.

p. 13 Definition for connectivity – Appears inaccurate with respect to the description of genetic versus demographic connectivity. Suggest replacing with definitions of genetic and demographic connectivity from the Costello document that was developed for the Governor's Advisory Council: Connectivity: a primer for Montana grizzly bear conservation (Costello 2020, pp. 3-4; attached).

p. 18 ¶ 1 – "within their entire range" could imply they are not listed elsewhere, and potentially confuses folks with "occupied range." Suggest simply stating that they are listed throughout the lower-48 States. It should also be 1975 for the listing.

p. 18 ¶ 5 – There is a mandatory period of at least 5 years of post-delisting monitoring, where USFWS will be in an oversight role.

p. 19 Figure 3 – This is very outdated map of distributions and outliers.

p. 19 Figure 4 – Outdated

p. 20 Sidebar 1 – Suggest not referencing such time-specific things such as the petition review quickly outdates this document. The rest of the sidebar is informative, and it seems like it'd be good just to remove the third sentence.

p. 27 First full sentence "neither CS provides explicit guidance for managing and conserving grizzly bears in the buffer zone-or Demographic monitoring area (DMA)-outside of its own Ecosystem." – This sentence is confusing. The DMA is widely recognized as part of the ecosystem. The CSs do have some guidance in the DMA outside of the Recovery Zone (Zone 1 in the NCDE). The ecosystem is the larger area surrounding the recovery zones in which grizzly bears may be anticipated to occur as part of the same population, which includes the DMA and areas outside the DMA for the NCDE and GYE.

p. 27 ¶ 2 – In referring to management of Zone 2, it should be clearer that the intent is for genetic connectivity to the GYE.

p. 30 5th bullet – As currently worded, the last sentence in this paragraph implies that conflicts with humans are inevitable. Conflict is not inevitable and significant resources in MT go towards preventing it. Suggest adding the word, "potentially" – "it also potentially increases conflict with humans, particularly where unsecured attractants occur and habitat use overlaps."

p. 31 last bullet – Update information on North Cascades proposed reintroduction and status of the IGBC consideration of the augmentation program if changed prior to finalizing this document.

p. 32 4th bullet "Population research and monitoring" – FWP is currently monitoring in the BE ecosystem (new bear specialist position added in 2022). Suggest including in the list.

P. 33 Sidebar 4 – It is unclear in bullet 3 how they think the USFWS uses the word ecosystem. May want to clarify that for the Service "Ecosystems are generally considered to be the larger area surrounding the recovery zones in which grizzly bears may be anticipated to occur as part of the same population" (USFWS 2022: the SSA).

p. 35 "numerical objectives" – Commitment to demographic criteria for CYE and BE is unclear.

p. 35 "There are no explicit goals for the CYE" – Inaccurate. There are in fact explicit goals documented in the Recovery Plan. A CS has not yet been developed for this ecosystem but will be developed prior to delisting. Same for BE.

p. 35 "distributional objectives" – "No explicit distributional objective has been identified". There are objectives for the distribution of reproductive females outlined in the GYE and NCDE Conservation Strategies and in the recovery plan for CYE and BE.

p. 37 5th bullet "Orphaned cubs" – Not mentioned here is that cubs too young to be left in the wild are frequently sent to zoos and similar facilities. Same comment applies to p. 43 3rd bullet.

P. 38 "Population research and monitoring" – There is no mention of the CYE, though general support was stated earlier on page 32.

P. 43 "Conflict management organizational structure" – The town Choteau is mis-spelled.

p. 48 – Bullet (c) has been updated to reflect the revised MOA and recalibration but (b) still refers to the model-averaged Chao2 method.

p. 49 – Statement is unclear: "Mortality of individual animals will not result in any irretrievable commitment of grizzly bear populations." Bears are not making any commitments.

p. 49 – "Conversely, because grizzly bears and other wildlife are a major factor in Montanans' quality of life, contributing to the attraction of new residents and an expanding human population, *the state is seeing some additional commitment of resources.* Subdivisions, energy development, and other developments are slowly but steadily altering grizzly habitat. While FWP can moderate this loss somewhat by allowing grizzly bears to expand into currently unoccupied habitats to meet their needs, it cannot control human population growth." Suggest re-writing for clarity.

p. 51 ¶ 1 – Given the continual occurrence of outliers in eastern parts of Montana it would seem applicable to include additional counties in this plan to account for that expansion.

p. 64 ¶ 2 (1st ¶ under "Species and evolutionary history") – The 2nd and 3rd sentences in this paragraph, starting with "In the most recently published review…" should be deleted. It conflates two separate species methods and is unnecessarily confusing. The last sentence should say Ursus arctos horribilis if, as in the previous sentences, we recognize the north American subspp of brown bear.

p. 64 ¶ 3 – "Current theory holds that this species developed its large size, aggressive temperament, flexible feeding habits, and adaptive nature in response to habitats created by intermittent glaciations." Citation needed.

p. 65 Sidebar 5 – "Outside of North America, the most common name for Ursus arctos is simply 'brown bear'" is also true of coastal Alaska.

p. 65 2nd ¶ (below sidebar 5) – Grizzly bears have lived to be 37 in the wild (Cabinet Mtns) not just captivity.

p. 67 "Highways and crossing structures" – If this will be used as a document to help with crossing structures then suggest adding more detail. A few things from our multi-agency comments on Hwy 93 Ninepipes. Solitary grizzly bears and family groups are three and five times, respectively, more likely to use overpasses compared to underpasses when correctly designed (Ford et al. 2017). Adequate fencing is crucial for effectiveness of crossings structures. Rytwinski et al. (2016) found that crossing structures are ineffective at reducing large mammal road mortalities if fences are absent or are too short in length. The Wildlife Crossing Structure Handbook (Federal Highway Administration, 2011) recommends that underpasses are a minimum of 40 feet wide and 15 high for grizzly bears.

p. 69 bottom onto p. 70 – Should add average age of first reproduction of 6.3 for the CYE (Kasworm et al. 2021).

p. 70 "Survival" – First sentence should be changed to "independent bears are killed by people" because the high mortality amongst yearlings is primarily due to natural causes. Also, may need to add something about avian flu given recent occurrences.

p. 70 "Density dependence" – First paragraph, the sentence beginning "age at first reproduction" should be reversed, age increases with competition and population size and decreases with high quality foods.

p. 70, last sentence – Beginning "adult survival has not been documented…" Given the long-term dataset for Yellowstone and other evidence of density dependence I'm not sure this is true. Should look at bear specific research.

p. 74 Sidebar 7 – At the beginning of the paragraph, "The first rule of thumb is the 500 long-term rule…" it should be made clear from the beginning that it is effective population size and not census or estimated population size. The paragraph explains it later but to be clear to the reader it should be included in the first sentence, something as simple as, "The first rule of thumb is the long-term rule of 500 effective population size." Then continue the explanation later.

P. 74 Sidebar 7 – Last paragraph, should include information that it is believed that the generation interval is 10 years for the NCDE and CYE populations. We assume it to be this long but have never really calculated it using the sex and age survival statistics.

p. 75 "Abundance" – Suggest deleting all reference to the mark-resight approach because it didn't work and is not being reported anymore. Keep first sentence of ¶ 1 then delete the rest and jump straight into second ¶.

p. 75 ¶ 3 – Should clarify why we don't have information about abundance outside the DMA, that the surveys for females with cubs does not occur outside the DMA upon which the population estimate inside the DMA is based.

p. 75 and throughout – Data seems only to be included through 2019, suggest updating.

p. 76 – "(typically more than half by agency staff following otherwise unresolvable conflicts)." Many of these conflicts are resolvable, but the landowner was unwilling or reluctant to resolve.

p. 77 ¶ 3 – Should use 14 years for generation interval, specific to the GYE, as calculated by Kamath et al. and previously referenced in this document.

p. 78 ¶ 1 – Sentence beginning "These analyses suggested a 2014 population size…" The population estimate for the NCDE is not limited to the DMA because it is based on an initial population and estimated growth rate, it does not account for dispersal or geographic area. Suggest deleting the rest of the sentence after "population size."

p. 78 – Check for consistency on acronyms – some places use NCD, others use NCDE.

p. 80 ¶ 1 – last sentence, should clarify that the CYE has had a positive annual estimated growth rate for ~16 years now. It is unclear what is implied by "recently." Suggest update the data with the 2021 growth rate which is closer to 2% (Kasworm et al 2022). Same with 2019 occupancy data.

p. 80 ¶ 2 – Suggest adding the number of first, second and third generation offspring that have been produced prior to the last sentence. As it currently reads, 3 augmentation individuals having produced offspring doesn't sound like much. Also, now up to 5 augmentation bears producing offspring with 15 first generation, 23 2nd generation and 4 third generation (Kasworm et al 2022).

p. 80 ¶ 3 – Only Cabinet Bears are genetically indistinguishable due to moving bears there from NCDE. Yaak bears are distinguishable.

p. 80 ¶ 4 – Need to be clearer about reproduction by immigrants to be clear that none from the NCDE, outside of augmentation individuals, are known to have reproduced. Suggest updating this entire paragraph as it relies on data that is several years old. Most recently there were 17 known individuals documented moving from BC into the Yaak (Kasworm et al. 2022). Gene flow has been identified through reproduction by four immigrants from the North Purcells (four males and one female) resulting in 14 offspring in the CYE.

p. 81 ¶ 2 – First sentence, an individual was also documented from the Selkirk Ecosystem. The second sentence should be clarified that these are only 3 known cases for which fate is known, we have multiple verified sightings of other individuals for which their fate is unknown and could still be in the area.

p. 81 – The studies cited for population size of the Bitterroot are specific to the Bitterroot Recovery Zone, rather than the broader Ecosystem.

p. 84 ¶ from previous page – Should clarify that Lamb et al.'s reference to wilderness is not the capital "W" of official designation as we refer to it in the US but rather "areas of minimal human influence." There is a footnote but I think those are often overlooked by readers and the footnote could be more clear with the above quote from the paper of what Lamb et al. meant by wilderness.

p. 85 – It would be nice if there was rationale to why the model doesn't extend down to the GYE. Suggest addressing the limitations of this model in meeting the intent set forth in the last paragraph on p. 84.

p. 88 ¶ 1 – The first sentence could reinforce fear. Suggest moderating with "potentially dangerous animals." Consider expanding on the instances and outcome of those attacks in which bear spray was

used. This section seems like an opportune place for messaging on safely living and recreating in bear country, even if only briefly and then referring to the State and IGBC websites.

p. 88 – FWS attack data is draft, and incomplete. Suggest remove. At least needs qualifications that it is likely not complete and need to add citation.

p. 90 – 676 claims of cattle depredation – are these confirmed, probable or both? Suggest defining, "Verified."

p. 94 Figure 19 – Several superscripts listed in the Figure caption do not line up with the figure - #4 in particular.

p. 94 Figure 19 – The IGBC guidelines do not actually link to the "ecosystem-specific mortality threshold." The recovery plan and Conservation Strategies link to the mortality threshold.

p. 94 Figure 19 – Suggest adding something like, "Is landowner unwilling to secure attractant that is reasonably possible to secure."

pp. 94–95 – This section seems confusing. Suggest rewording for a more concise and clearer summary of conflicts and responses, depending on what the purpose of this reporting is.

p. 96 last ¶ – Appears to be an inaccurate description of how BORZ are designated and then included in "occupied" range. Should this section include the allowance for changes to the method? Agencies have a meeting in February to discuss differences in methods to estimate distributions between ecosystems and will be discussing if changes can be made to be more consistent between ecosystems. Data used in the BORZ process includes: credible observations, telemetry, mortality, DNA samples, and trail camera photos within a 15 year moving window.

p. 97 "Destination of bears captured in conflict settings" – Should other FWP regions be included? (R-3, R-4, and R-5)?

p. 104 ¶ 1 – Demographic commitments in the tri-state MOU are currently undergoing review and will likely change.

p. 105 Sidebar 10 – "Geographic limitations." Might be clearer to state "closed to harvest to facilitate genetic connectivity between the NCDE and GYE."

p. 105 Sidebar 10 "Estimation of number of permits" – (1) The Chao2 estimate is no longer the method used to estimate the population so there is no longer a known low bias. (4) 34% is based on the portion of the GYE DMA in MT not the estimated proportion of the population.

p. 110 Approach 4 "Description" – The sentence "where the geographic distribution of bears has expanded into areas that are outside of DMAs, and/or that provide no connectivity with other populations" should be changed to "and" to be consistent with bullet 3 under "Characteristics" ("Hunting would not occur where connectivity between population cores can occur."). There is no discussion of limits on this and therefore, theoretically there could be unlimited hunting in these areas creating a de facto "no bear" zone.

p. 116 Issue 3 – Critics claim that number of mortalities have increased. The IGBST does not argue that they haven't increased but rather the mortality rate has remained stable. This is an important

distinction. As discussed more tin the sentence, "IGBST has reported that documented and estimated mortalities...has been lower than estimated 'limits' for all years since monitoring began." Under the model-averaged Chao2, there were some years in which the limits were exceeded but long-term trends were below. We haven't received all updated data yet for the revised Chao2 but will with the SSA updates.

p. 118 Issue 5 – Second sentence, it is important to note that range expansion is also the result of population growth. In the following paragraph, it is crucial to note that the population estimate only applies within the DMA, bears outside of the DMA are not being counted and that is where the majority of range expansion is occurring.

pp. 119–120 – Should also include that the slowing of population growth rate began prior to the decline in whitebark pine and only a small portion of the GYE population had access to cutthroat trout as a food resource.

p. 122 last sentence – It is inaccurate to state that "in national parks, grizzly bear taking is governed by NPS, rather than USFWS regulations." The ESA still applies to NPS-managed lands.

p. 121 "Human dimensions" – Is FWP aware of Canepa et al. 2008 Cabinet-Yaak Grizzly Bear Public Opinion Survey?

p. 124 "1993 Recovery Plan" – This is a somewhat inaccurate representation of the 1993 Recovery Plan. It identifies six areas for recovery, with recovery zones for the Yellowstone, NCDE, SE and CYE established in the 1993 Recovery Plan. It also states that recovery zones are currently being delineated for the North Cascades and BE. Further discussion of these ecosystems occur in supplemental chapters to the Recovery Plan. Grizzly bears were known to exist in the North Cascades in 1993. The San Juan Mtns are also identified as an area for evaluation. The various Recovery Plan supplements should be included in this discussion. (Same comment for p. 176 of draft EIS.)

p. 125 ¶ 1 – Last sentence fails to mention the Bitterroot subcommittee.

p. 125 "GYE CS" – date is wrong for the GYE CS, it was last signed in 2016 and although updates have been made to Ch. 3, it hasn't been incorporated into the full CS. If delisting of the GYE would occur, it would not be "within the GYE RZ" but within a proposed DPS that would encompass the ecosystem. In the previous 2017 delisting (82 FR 30502, June 30, 2017) a separate monitoring strategy was not developed by the USFWS but rather we used the CS.

p. 126 "NCDE CS" – If delisting of the NCDE would occur, it would not be "within the NCDE RZ" but within a proposed DPS that would encompass the ecosystem.

p. 126 – For the Tri-State MOA and FWP-USDA-WS MOU, suggest including a process to update documents.

p. 211 ¶ 1 – The use of the word hybrid implies that the GYE population are separate spp. or subspp. Suggest using another word to avoid implying this, particularly in light of certain arguments that bears in the GYE are members of a distinct genetic clade.

Additional comment – Despite discussing other state regulations, such as grizzly bears being a game animal post-delisting, the management plan remains silent on legislative laws recently passed that

directly impact or have the potential to impact grizzly bears, such as Senate Bills 98, 314, and House Bills 224, 468, and 225. We suggest the plan state how FWP will minimize impacts to grizzly bears from these regulations.

Comments on DRAFT Montana Grizzly Bear Management Plan Environmental Impact Statement

All comments on the draft management plan apply to the same or similar language in the draft EIS.

Fig 2 – The plan only covers 30 counties. What does that mean for areas outside of those counties?

P. 34 Issue 5 – "Most planning for grizzly bear recovery in the U.S. has assumed that public lands would form the backbone of needed habitat, and *grizzly bears would rarely occupy private lands*." Not necessarily true. Early versions of the 4d rule envisioned bears on private lands on the east front. Suggest revising.

P. 35 Issue 10 – Need to update North Cascades statement – the process is no longer on hold. Also, the USFWS never formally proposed moving bears there. Reintroduction was part of a draft EIS never finalized.

p. 36 Issue 14 – FWP is involved in BE monitoring. Missing from the discussion

p. 45 last ¶ – Developed site language needs to be updated to reflect recent revisions to the CS (same on pp. 87, 92). In addition, the discussions for the two CSs, in this paragraph and the next, are inconsistent in their content. Suggest revising content for consistency. One focuses more on habitat standards while the other talks more about amount of federal land.

p. 57 Monitoring table – Under first row, "demographic" a commitment to the recovery goal in the BE should be added under column "Relevant Plan/Requirement." The BE goal should also be added under the second row "distribution." In addition, there is a typo under several rows that says "YE" where I believe it's meant to say "CYE"?

p. 87 "Secondary Impacts" ¶ 1 – There are additional habitat protections in Zone 1 and the DCAs under the NCDE CS that would provide protections similar, albeit to a lesser extent, as the PCA. Food storage orders also extend beyond the PCA under the NCDE CS. Same comment to discussions on pp. 91–92

p. 87 "Secondary Impacts" ¶ 2 – Suggest adding attractant storage rules for the GYE both within and outside the PCA.

p. 87 "Secondary Impacts" – Although there isn't currently a CS for the CYE, there are habitat standards incorporated in Forest Plans that benefit other species that should be discussed.

p. 86 "Direct impacts" ¶ 1 – "Grizzly bears will continue to inhabit the analysis area at low density." This is not true for the RZs and DMAs. Same comment throughout discussion of proposed action.

p. 90 ¶ 1 – The CSs do not equate the "ecosystem" to the "DMA," the ecosystem is the larger area that could encompass individuals of the same population and both CSs recognize that the population has and is likely to continue to expand outside the DMA.

p. 96 3.3.3.1 – “No new developments on the public lands in these areas will help maintain water quality and quantity on public lands in the PCAs.” This statement is inaccurate. The NCDE CS and recent changes to the GYE CS allow for increases in developments on public lands within the PCAs. The language under 3.3.3.2 on this page is more accurate as it says “limits.” This occurs elsewhere in the analysis.

Note: Under the preferred alternative, habitat standards are described under the CSs and the ESA. These habitat standards apply to the no action alternative, as well. Suggest adding habitat standards under no action alternative.

Connectivity: a primer for Montana grizzly bear conservation

Theoretical Basis for Connectivity

The best-case scenario for the long-term persistence of grizzly bears in the Lower-48 (and nearby areas of Canada) is the existence of multiple grizzly bear populations that exchange individuals but have somewhat independent dynamics. This complex of interconnected populations is known as a ***metapopulation***. Below is an explanation of why connectivity among populations is helpful for their long-term persistence.

Based on both theory and empirical evidence, scientists have identified several factors that influence extinction risk, or conversely, the potential for long-term persistence of species. We know that larger, genetically diverse, and interconnected populations are more resilient to environmental change (providing more assurance of persistence) than smaller, genetically uniform, and/or isolated populations (Figure 1).

To illustrate numerical effects, consider the impact to a species of a weather, disease, or predation event that results in the deaths of 40 individuals (for example a flood). It is easy to understand that a population numbering 500 (8% lost to flood, now numbering 460) would likely fare better than a population numbering 50 (80% lost to flood, now numbering only 10). Now, consider if the population of 50 was not the only such population, but rather was one of 10 similarly sized populations that occurred in reasonably close proximity. As in the scenario of the single, larger population of 500, the impact of the mortality event on the species would be lessened, even if 1 of the 10 populations went extinct. Now, imagine the added benefit if at least 1 of the 10 populations was large, thereby further buffered against local extinction. Finally, suppose that individuals were able to move relatively freely among the various populations on the landscape. These movements might help modulate changes in population size due to environmental factors and would even allow for recolonization of areas where smaller populations may have died out. Simply put, a species consisting of larger, interconnected populations is more resilient to the rigors of an unknown future than a species made up of smaller, isolated populations.

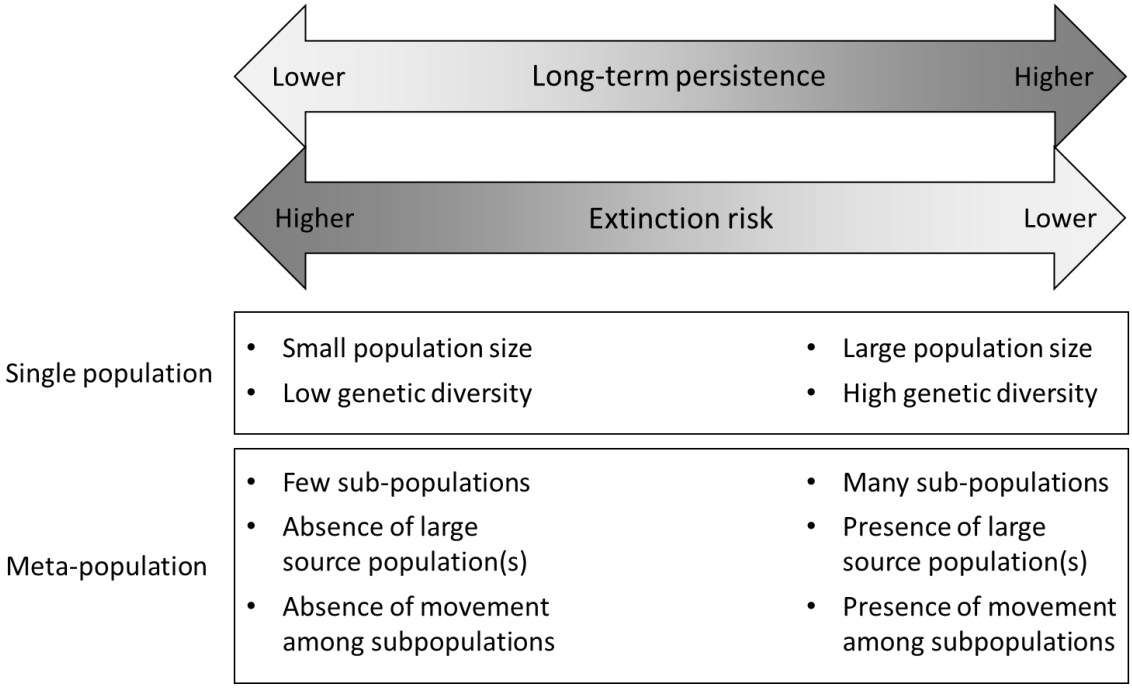

Figure 1. Factors that may influence the risk of extinction or, conversely, the long-term persistence of populations and metapopulations.

The size of a population can also influence its overall genetic health and the viability of its members, with both short-term and long-term consequences of small size. One potential consequence of small or isolated populations is increased inbreeding, or the mating between related individuals. The genetic make-up of a population might be described as consisting of "building blocks" (i.e., alleles). As you might recall from your high school biology, these building blocks are organized in pairs. If a gene carries two identical copies of a building block, it is homozygous. If it carries two different copies of a building block, it is heterozygous. Inbreeding increases the frequency of homozygous genes. Severe inbreeding can cause *i**nbreeding depression***, which is the reduced ability to reproduce and survive normally resulting from the expression of deleterious traits coded by homozygous pairs. Breeders of domestic livestock or pets are well acquainted with these basic principles, which also apply to wildlife. Species typically possess strategies to avoid inbreeding, however as fewer and fewer individuals are present within a population it becomes more difficult to avoid breeding with relatives. In very small populations, inbreeding effects may be immediately apparent and may influence short-term population viability. In larger populations, inbreeding effects might not be as apparent, but may accumulate over time.

Another impact to small or isolated populations is reduced ***genetic diversity***, which might be described as the number and variety of the genetic "building blocks" within a population. Having a wider variety of building blocks allows a population to adapt successfully to a changing environment, because it is more likely that at least some individuals will possess traits suited for the new environment. These are the animals that might survive to produce offspring, allowing the population to persist in the changed environmental conditions. Conversely, populations with fewer of these building blocks may lack the ability to adapt to the changing environment and may eventually perish.

Large or inter-connected populations generally have more of these building blocks than smaller, isolated ones, because they are better at retaining those they already have, and because they are better at creating new ones. In small populations, where fewer individuals mean fewer copies of each building block, it is more likely that some would be lost simply by chance. For example, imagine if only 2 individuals possess copies of a rare building block, and they both happen to die before reproducing. That building block would be forever lost. This random loss of genetic material is known as ***genetic drift***. Large populations are less prone to drift, because more individuals mean more copies of each building block and fewer losses. Additionally, new building blocks arise from random mutations, which occur more frequently in larger or inter-connected populations than in smaller or isolated populations. Higher genetic diversity enhances the adaptive capacity of a population in the long-term, however changes in a population's genetic diversity can happen relatively quickly, especially if the population is very small.

In any population, large or small, loss of genetic diversity and negative effects of inbreeding can be countered by ***gene flow***, or the movement of genetic material from one population to another through movement of individuals. Connectivity within a metapopulation is especially important for small populations which are more prone to negative genetic characteristics.

Applying the Concept to Grizzly Bears

As shown above, dispersal movements of individuals from one sub-population to another can provide multiple benefits. When neighboring populations exchange individuals and gene flow is achieved through reproduction of immigrants (and their descendants), this is referred to as ***genetic connectivity***. Genetic connectivity helps populations maintain or increase genetic diversity and reduce inbreeding. In grizzly bears, genetic connectivity is most easily achieved through exchange of males, who typically disperse larger distances than females. Of course, these males must not only disperse from one sub-

population to another but breed with a female whose cubs then carry some of his genetic information. Full-time residency of bears in areas between sub-populations is not necessarily needed, however movements between sub-populations are more likely when the distance separating the sub-populations does not exceed male dispersal distances. That is, males are more likely to get to a new sub-population if born to a mother who already lives relatively close by.

When neighboring populations exchange individuals and immigrants (and their descendants) contribute significantly to population dynamics, this is referred to as ***demographic connectivity***. Demographic connectivity can produce immediate conservation benefits in small populations where the addition of immigrants can mean the difference between population decline and stability or growth, often referred to as a ***rescue effect***. In turn, the long-term maintenance of demographic connectivity provides for stability within a metapopulation complex. In grizzly bears, demographic connectivity is best achieved by maintaining residency of females and males in the areas between sub-populations. This is because female bears most often set up their home range in proximity to their mother's range, and only rarely disperse long distances (although it has been observed). If sub-populations are too distant from one another, they are unlikely to exchange females. By default, demographic connectivity also achieves genetic connectivity.

The Northern Continental Divide Ecosystem) population represents the chief segment of the largest and one of the most genetically diverse populations within the region shared with southern British Columbia and Alberta. We believe the NCDE is large enough, and the habitat is secure enough, to consider it self-sustaining and a likely source for dispersing individuals. Demographic and genetic connectivity exists with neighboring population(s) to the north in Canada and inbreeding is unlikely to be an issue. Still, connectivity to the west and south would enhance its long-term adaptive capacity by minimizing genetic drift and maintaining low levels of inbreeding.

The GYE is numerically large, self-sustaining, and a likely source of dispersers like the NCDE. Levels of inbreeding are low in this population. However, evidence indicates the GYE population has been isolated for about 100 years and exhibits lower genetic diversity than many other populations in the region. Therefore, genetic connectivity with other populations to the north would enhance its long-term adaptive capacity and provide more assurance of long-term persistence.

The populations in the other two occupied Recovery Zones (SE and CYE) are quite small. These two ecosystems hold 3 somewhat distinct populations within the Selkirk, Purcell, and Cabinet Mountains. At

present, there is evidence of some limited natural movements and gene flow among these 3 sub-populations. Additionally, augmentation of the Cabinet Mountain sub-population, through translocation of individuals from Canadian and US portions of the NCDE population, has resulted in demographic contributions and gene flow. Nonetheless, both the SE and CYE populations remain below recovery goals numerically, exhibit lower genetic diversity than many neighboring populations, and are prone to inbreeding. Thus, these small populations would greatly benefit from both demographic and genetic connectivity among themselves and with larger source populations.

How does the Bitterroot ecosystem (BE) fit into the metapopulation concept? If a population were established, the likelihood of long-term persistence of the species in Montana would be substantially increased by the existence of 5 sub-populations instead of 4 sub-populations. The 5 sub-populations would be separate enough that environmental perturbations might act independently on each, minimizing the potential for the metapopulation to go extinct, even under extreme circumstances. The mixture of genetic material among all populations (likely supplemented by populations in Canada) would provide for increased genetic diversity, counteract and eventually minimize inbreeding effects, and increase the capacity for the populations to adapt to potential environmental changes. An established population in the BE could, in the future, act as a stepping-stone between the CYE, NCDE, and GYE populations, making exchange of individuals more effective within the metapopulation.

Currently, there is not an existing population in the BE. Natural recolonization of this ecosystem could be accomplished through demographic connectivity. As such, at least some residency of females would be needed between the BE and the potential source populations (NCDE, GYE, and/or CYE). If the population were reestablished through a reintroduction effort, either genetic or demographic connectivity with neighboring populations would be beneficial, depending on population size.

The support team's view is that, due to population growth and range expansion, the goal of connectivity among sub-populations is achievable and that we are closer to achieving it than at any time during the past 100 years or so. However, little to no genetic or demographic connectivity has been observed to date. Achieving this goal will be a challenge that will require dedicated effort and resources.

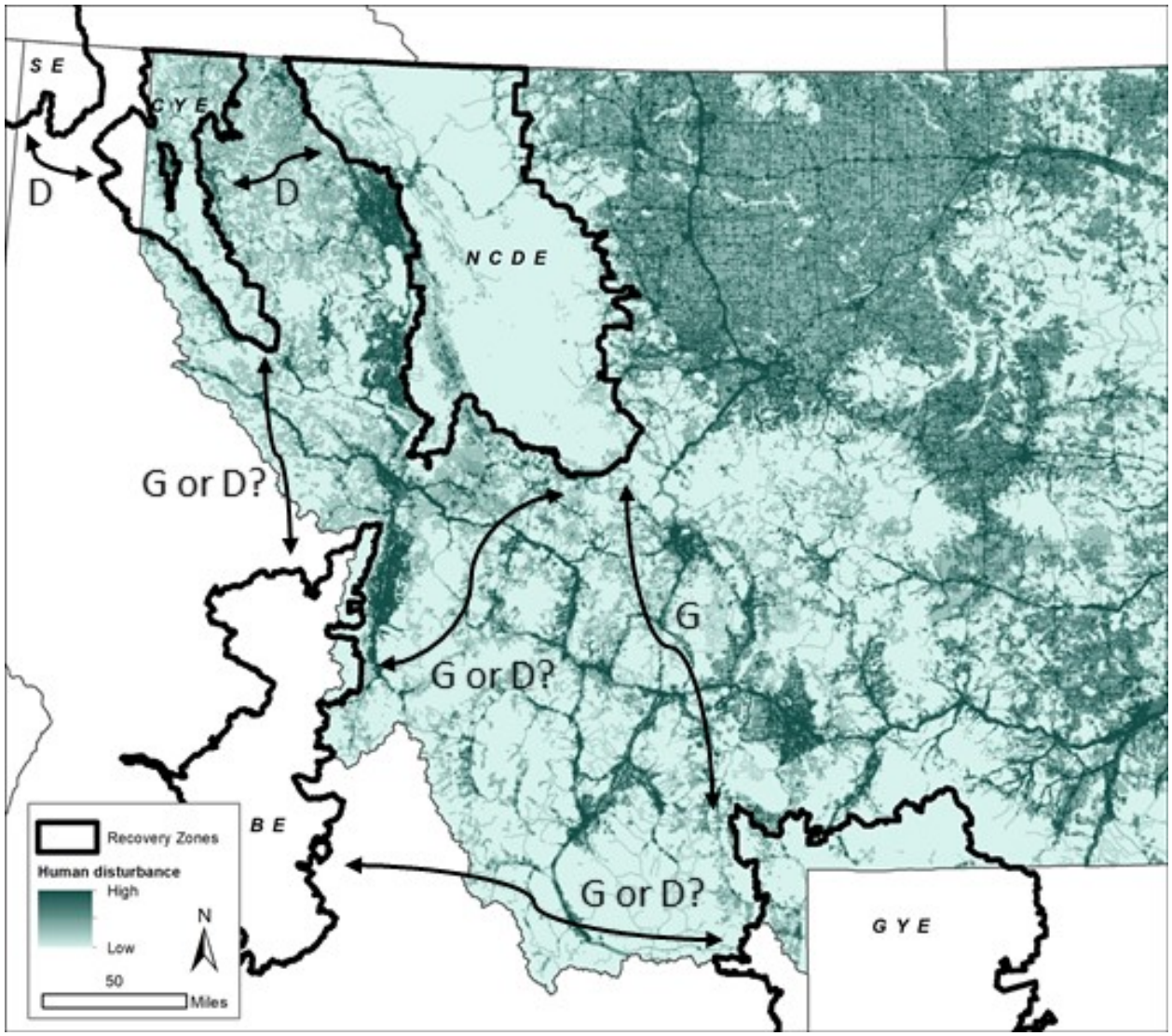

Figure 2. Potential future connectivity among grizzly bear populations in or adjacent to Montana, including the Selkirk Ecosystem (SE), Cabinet-Yaak Ecosystem (CYE), Northern Continental Divide Ecosystem (NCDE), Bitterroot Ecosystem (BE; unoccupied), and Greater Yellowstone Ecosystem (GYE). Arrows are not intended to depict specific routes, but to illustrate the connections between Ecosystems. The types of connectivity, genetic (G) or demographic (D), are referenced in the text. The background map depicts an index of human disturbance based on 6 categories, including development, transportation, agriculture, resource extraction/energy development, introduced vegetation, and forestry practices. Lighter areas are less disturbed and darker areas are more disturbed (Montana Human Disturbance Index, Montana Natural Heritage Program, Montana State Library, 2014).