A Petition to Identify and Delist the Northern Continental Divide Distinct Population Segment of the Grizzly Bear (*Ursus arctos horribilis*) Under the Endangered Species Act

Submitted to the United States Fish and Wildlife Service
by Governor Greg Gianforte and the Montana Department of Fish, Wildlife and Parks
on behalf of the State of Montana

December 17, 2021

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To Whom It May Concern:

Pursuant to 50 C.F.R. §424.14(c) and (d), Governor Gianforte, for the State of Montana provides the following information in support of a formal petition to identify and delist the Northern Continental Divide Distinct Population Segment of the grizzly bear (*Ursus arctos horribilis*), a listable entity.

Governor Greg Gianforte
State of Montana

State Capitol, Room 204
P.O. Box 200801
Helena, MT 59620-0801
Phone: (406) 444-3111

December 17, 2021

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Pursuant to 50 C.F.R. §424.14(c) and (d), the Department of Fish, Wildlife and Parks on behalf of the State of Montana provides the following information in support of a formal petition to identify and delist the Northern Continental Divide Distinct Population Segment of the grizzly bear (*Ursus arctos horribilis*), a listable entity.

Director Henry Worsech
Montana Department of Fish, Wildlife & Parks

P.O. Box 200701
Helena, Montana 59620-0701
Phone: (406) 444-5618

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EXECUTIVE SUMMARY

Governor Greg Gianforte, on behalf of the State of Montana, and the Department of Fish, Wildlife and Parks, submits this petition to request the U. S. Fish and Wildlife Service (Service) both to designate a Northern Continental Divide Ecosystem Distinct Population Segment (NCDE DPS) and to delist the grizzly bears (*Ursus arctos horribilis*) therein. Montana Department of Fish, Wildlife and Parks (MFWP) contends this action is appropriate and warranted because the distinct and separate NCDE DPS contains a recovered grizzly bear population that is no longer in need of the protection afforded by threatened status of the ESA. The precedent established for designating the NCDE DPS and changing the status of a species in a single action is found at p. 30516, Federal Register Vol. 82, Number 125, (June 30, 2017).

Distinct and significant DPS. This petition shows that the DPS is both distinct and significant and supports the designation. Simultaneously, without acknowledging the need legally to do so, MFWP commits that, where necessary, genetic connectivity will be provided from this delisted DPS to other grizzly bear populations in the northern Rocky Mountains to assure continued recovery in other grizzly bear populations after delisting the NCDE DPS. This shall include the option of translocating grizzly bears as well as any grizzly bears naturally moving between recovery zones.

Requisite recovery criteria have been met. This petition documents continued adherence to recovery criteria articulated in the Recovery Plan and Conservation Strategy documents for 8 consecutive years (i.e., the species is recovered). Threats to this species have been ameliorated due to the decades of hard work on the part of Federal, State, Tribal, local, and private interests: crucial habitats are now secure, the population has been increasing for over three decades, and regulatory mechanisms are in place to assure that the species remains in little danger of again needing protection of the ESA.

Five factor review. This petition reviews and documents the five factors considered in listing/delisting decisions, showing why the NCDE DPS population no longer needs, or qualifies for, ESA protection.

Continued commitment to NCDE Conservation Strategy. Montana commits to comply with the standards and meeting the objectives of the NCDE Conservation Strategy (NCDE Subcommittee 2021) as outlined in Administrative Rule of Montana (ARM) 12.9.1403 (2018),

which functions as the primary regulatory mechanism assuring that this population would remain secure without the protections afforded by the ESA

Regulatory mechanisms support delisting. This petition shows how regulatory mechanisms would continue to support a recovered population and that delisting the NCDE DPS grizzly bear population would not affect the status and future prospects of the remaining (i.e., listed) populations of grizzly bears in the lower 48 states.

Adherence to the demographic objectives described in the Conservation Strategy and ARM 12.9.1403 should ensure a robust population within the demographic monitoring area (DMA), including bears dispersing out of the DMA to other ecosystems. Because of the robust population within the NCDE, the opportunity for translocation of animals to other areas also is available. MFWP commits to working with the Service and other states to cooperate and coordinate on any such recovery needs.

BACKGROUND

In July 1975, the United States Fish and Wildlife Service adopted a final rule to list the grizzly bear population in the conterminous forty-eight states of the United States as threatened under the Endangered Species Act. 40 Fed. Reg. 31743-31736 (July 28, 1975). This federal action extended ESA protections to the grizzly bear population in the NCDE. By 2013, the number of grizzly bears in the NCDE population had increased to the point where it was biologically recovered.

In the meantime, the Service has delisted the grizzly bear in the Greater Yellowstone Ecosystem twice and the courts have restated its listing twice through judicial action. *Crow Indian Tribe v. United States*, 343 F. Supp. 3d 999 (D. Mont. 2018) and *Crow Indian Tribe v. United States*, 965 F.3d 662 (9th Cir. 2020).

In affirming the district court judgment to reestablish listing, the Ninth Circuit identified three actions that either the Service or the affected states must take before the GYE DPS could be delisted. MFWP considers those three points here and commits to ensuring the same issues are not raised for the action requested in this petition.

First, the Ninth Circuit directed the Service to conduct a "further examination of the delisting's effect on the remnant grizzly population" living in the conterminous United States outside of the GYE DPS. *Crow Indian Tribe*, 965 F.3d at 678. In conducting this examination, the Service "must determine on remand whether there is a sufficiently distinct and protectable remnant population, so that the delisting of the DPS will not further threaten the existence of the remnant." *Id*.

Second, the Ninth Circuit determined that the states must adopt "concrete, enforceable mechanisms" that will "ensure long term genetic health of the Yellowstone grizzly." *Crow Indian Tribe*, 965 F.3d at 680. In particular, the states must adopt regulatory mechanisms that make a commitment "to take action if natural connectivity of grizzly bear populations does not occur." *Id*. The states' regulatory mechanisms must be "sufficiently certain and effective to alleviate a threat of endangerment" to the long-term genetic health of the Greater Yellowstone population. *Id*. (citation and internal quotation marks omitted).

Third, the Ninth Circuit held that "[r]ecalibration is needed in the event the FWS changes its method of estimating the Yellowstone grizzly bear population." *Crow Indian Tribe*, 965 F.3d at 680. The court explained that "[a] commitment to recalibration is necessary in the event that the

states adopt a new estimator, or else the effect of any future change will never be known." *Crow Indian Tribe*, 965 F.3d at 681.

The NCDE DPS delisting, proposed herein, addresses the issues raised in the *Crow* case, and goes further to ensure the continued recovery status of the grizzly bear.

FACTS AND INFORMATION IN SUPPORT OF PETITION

Pursuant to 50 C.F.R. §424.14(c) and (d), the Department of Fish, Wildlife and Parks on behalf of the State of Montana provides the following information in support of a formal petition to identify and delist the Northern Continental Divide Distinct Population Segment of the grizzly bear (*Ursus arctos horribilis*), a listable entity.

1. The NCDE Grizzly Bear Population Meets the DPS Criteria.

MFWP proposes the designation of a distinct and significant Northern Continental Divide Ecosystem Distinct Population Segment (NCDE DPS; Figure 1). In short, the NCDE DPS would be comprised of the NCDE Primary Conservation Area (PCA) as well as Management Zones 1, 2, and 3 as identified in Figure 7 of NCDE Subcommittee (2021) (which provided visual illustration of the northern, western, and southern boundaries). The following description would be used to describe the NCDE DPS.

a) The southern boundary of the proposed NCDE DPS would be Interstate 90 from St. Regis on the west to its conjunction with Interstate 94 (Interstate 90 was identified by the Service as the northern boundary of a Yellowstone DPS (50 CFR Part 17, RIN 1018–BA41, making it a logical southern boundary for the proposed NCDE DPS); and thence to the town of Glendive.

b) The northern boundary would be the Canadian border (international borders are recognized as valid boundaries, FR Doc. 96-2639, Federal Register February 7, 1996 (Vol. 61), p. 4722]).

c) The western boundary, delineating the NCDE DPS from the existing (and not petitioned for delisting) Cabinet Yaak Ecosystem, as indicated by NCDE Subcommittee (2021), the westernmost boundary of Management Zone 1.

d) The eastern boundary would start at the town of Glendive, continuing northeast along Highway 16 to the town of Sidney, and thence north to the Canadian border at the Port of Raymond.

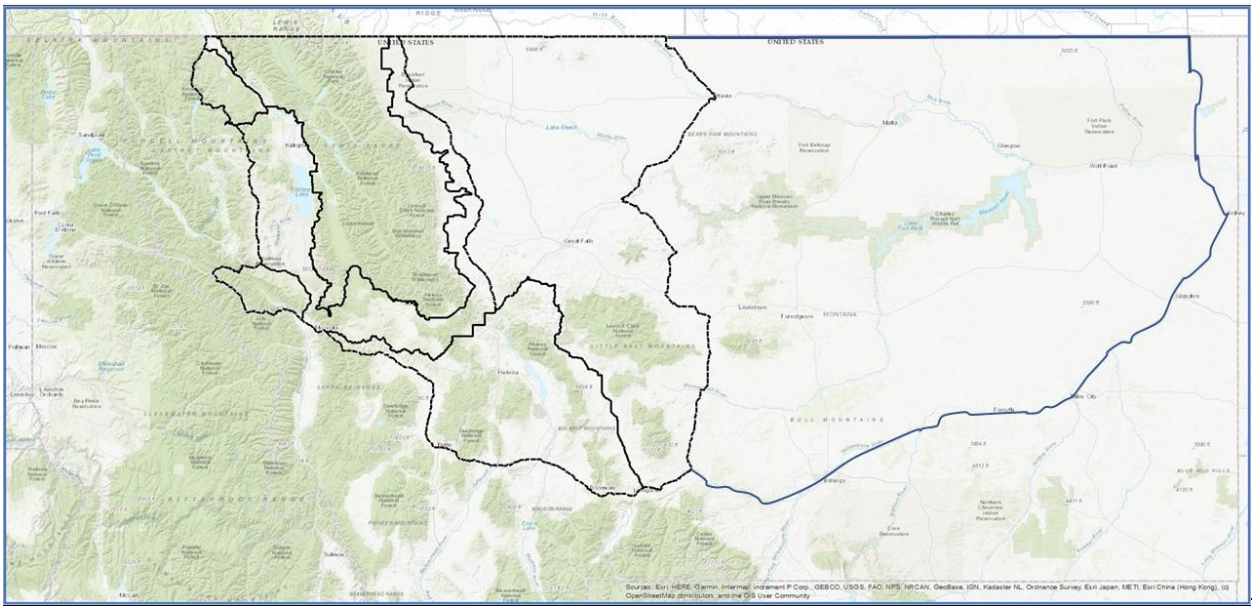

Figure 1. Approximate depiction of the proposed NCDE DPS, incorporating the NCDE Primary Conservation Area (PCA), Management Zones, 1, 2, and 3 (black outlines), and eastern extension (blue line) . The northern boundary of the proposed NCDE DPS is the Canadian border.

This DPS meets the definition of a valid DPS, as articulated in 1996 by the Service (FR Doc. 96-2639, Federal Register February 7, 1996 (Vol. 61), p. 4722]) because it is:

A. Discrete (geographically). The NCDE DPS proposed here is bounded by an international border, by a large reservoir (Lake Koocanusa) on the west, by large valleys containing a busily travelled interstate highway on the south, and by areas essentially devoid of grizzly bears on the east.

The NCDE, which forms the core of the proposed DPS, was identified as a separate "ecosystem" by the Service as early as the 1982 Recovery Plan, with unique recovery criteria, and has been managed by all agencies as an identifiable entity since that time.

The 1993 (revised) Recovery Plan (USFWS 1993) articulated the overall recovery objectives to be "Delisting of each of the remaining populations by population as they achieve the recovery targets", and further articulated that "Each individual population will remain listed until its specific recovery criteria are met", and that "…grizzly bear populations may be listed, recovered, and *delisted* separately" (emphasis added). Montana does not argue here that the proposed NCDE DPS is completely separate from other grizzly bear populations (i.e., that there is no movement of bears from or to it). The 1996 DPS policy does not require complete separation of one DPS from another, and occasional interchange does not undermine the

discreteness of a potential DPS (FR Doc. 96-2639). In fact, the regulatory mechanisms in place currently (and after delisting) are designed to allow gene flow from the NCDE to other populations, and the potential for this is greater now than at any time since grizzly bears in the Northern Rockies have been closely monitored. Montana does assert, however, that this proposed DPS qualifies as "markedly separated" from other populations of grizzly bears and as such, is eligible to be designated a DPS.

B. Significant. The NCDE DPS constitutes the largest existing population of grizzly bears in the lower 48 states. Because of this, and that it is contiguous with the population of grizzly bears to the north in Alberta and British Columbia (Proctor and Morehouse 2021), it is the most genetically diverse population of grizzly bears in the lower 48 states (Proctor et al. 2015; Proctor et al. 2012:12, USFWS 2021:174) and genetically more similar to those in the Canadian Rockies than to those in Yellowstone (Peatkau et al.1998). A cursory observation of distribution maps (e.g., Figure 2) makes clear the importance of this grizzly bear population to the greater grizzly bear population in the lower 48 states. Grizzly bears in the NCDE DPS not only define the ecosystem ecologically and in common perception, they have importance as reservoirs of genetic diversity for other, smaller populations of grizzly bears (USFWS 2020); a commitment Montana makes in this petition.

2. Status of Grizzly Bear Population and Range.

The recovery goals for the NCDE grizzly bear population have been met since 2013. The NCDE population had increased to an estimated 765 bears in 2004 and 960 (837-1,1089) in 2014. Since then, the population has continued to grow and now exceeds 1,000 bears.

The Service, in its most recent Five-Year Status Review, March 2021, categorized the current "condition" of the NCDE (evaluated to assess resiliency) to be "high." All of the habitat factors ("naturally high caloric foods," and "large intact blocks of land"), and five of the six demographic factors (adult female survival, population target, number of bears, total population, and inter-ecosystem connectivity) were categorized as "high" for resiliency, making the NCDE highly resilient, according to the Service's most recent status review. *See* Status Review, March 2021, pg. 8. The NCDE was considered "moderate" only for the demographic factor "fecundity," under a worst-case scenario indicated as "decreased conservation" caused by situations that would not be allowed by state management under any scenario. The current high resiliency of the

NCDE population was projected by USFWS (2021) to remain so even under the scenario called "decreased conservation."

This petition acknowledges that grizzly bears well east of the NCDE Recovery Zone within the proposed DPS are now and will continue to remain rare. However, these bears constitute a small fraction of the total number of bears in the proposed DPS, and do not significantly contribute to overall viability of the NCDE. Additionally, as acknowledged by NCDE Subcommittee (2021), these areas are largely private, agricultural land with little long-term capability to maintain viable grizzly bear populations. Designating the eastern boundary of the proposed DPS as proposed here would retain "Threatened" status for any grizzly bears that travel further east in Montana or into North Dakota, but any bears this far east would not be biologically relevant to the biological functioning of the NCDE population, and Montana anticipates any such instances would be exceedingly rare, with or without delisting the NCDE.

This petition also acknowledges that grizzly bears in the listed Cabinet Yaak Ecosystem (CYE) are not genetically unique from those in the NCDE. Genetic connectivity between the two recovery zones has occurred, despite there not having been recent evidence of natural effective immigration, because of artificial movement of bears from the NCDE implemented initially by the Service, more recently by MFWP (Servheen et al. 1987, Maguire and Servheen 1992, Kasworm et al. 2007, 2019, 2020). The 1996 DPS policy FR Doc. 96-2639) considers that genetic discontinuity *may* [emphasis added] provide evidence of marked separation, but does not require it.

3. The Grizzly Bear Population in the DPS has met Recovery Criteria.

Current population status, trend, and estimates of current population size and distribution in the wild all are consistent with the conclusion that the NCDE DPS has recovered. The 1993 Recovery Plan identified three demographic recovery criteria:

- establish a minimum population size through the monitoring of unduplicated females with cubs;
- ensure that reproductive females (i.e., females with young) are well distributed across the recovery zone; and
- outline human-caused mortality limits that would allow the population to achieve and sustain recovery.

These three criteria, in turn, were operationalized by NCDE Subcommittee (2021) into two specific demographic objectives (each containing sub-objectives). MFWP is required to manage as follows, (*see* ARM 12.9.1403):

Objective 1: Maintain a well-distributed grizzly bear population within the Demographic Monitoring Area (DMA). The specific thresholds for occupancy are that females with dependent offspring be documented in

a. at least 21 of the 23 BMUs (bear management units) within the NCDE Recovery Zone, and

b. in 6 of the 7 OUs (Occupancy Units) of the surrounding Zone 1 at least once in every six years.

Objective 2: Ensure that the abundance of grizzly bears within the DMA has at least a 90% probability of being over 800 animals[1] while avoiding a highly skewed sex ratio of adults, by demonstrating:

a. a 6-year rolling mean point estimate of **adult female survival** consistent with this abundance objective (based on accepted modeling techniques),

b. a 6-year rolling mean of the total reported and unreported[2] (i.e., estimated) **mortalities of independent females** within the DMA consistent with this abundance objective; and

c. a 6-year rolling mean of the total reported and unreported (i.e., estimated) **mortalities of independent males** within the DMA consistent with this abundance objective.

In addition, NCDE subcommittee (2021) articulated:

Objective 3: Monitor demographic and genetic connectivity among populations through biennial estimation of the spatial distribution of the entire NCDE population (i.e., including areas beyond the NCDE Recovery Zone and its surrounding DMA), as well as via DNA analyses of population origin to detect movements to and from other populations. The geographic

[1] This threshold has superseded the original Recovery Plan Criteria in USFWS (1993) that a running 6-year average of 12 unduplicated females with cubs be documented within the DMA and 10 within Glacier National Park, because sightings of unmarked grizzly bears are so rarely and unreliably obtained in these largely forested areas (USFWS 2019:5).

[2] In agency reports, the acronym 'TRU' (Total Reported and Unreported) mortality is often used. The number of unreported (i.e., unknown) bears dying is estimated using the number of reported deaths of non-radioed bears in high- and low-reporting rate categories (as per Cherry et al. 2002 and Costello et al. 2016).

distribution of the population is estimated using a peer-reviewed approach (Bjornlie et al. 2014a) with 49 km^2 (i.e., 7 km X 7 km) cells, raw data being comprised of a 10-year rolling window of verified grizzly bear observations (Costello and Roberts 2019). There was not a specific threshold or standard met for this objective; rather the objective was to monitor and document spatial expansion and genetic connectivity with other populations.

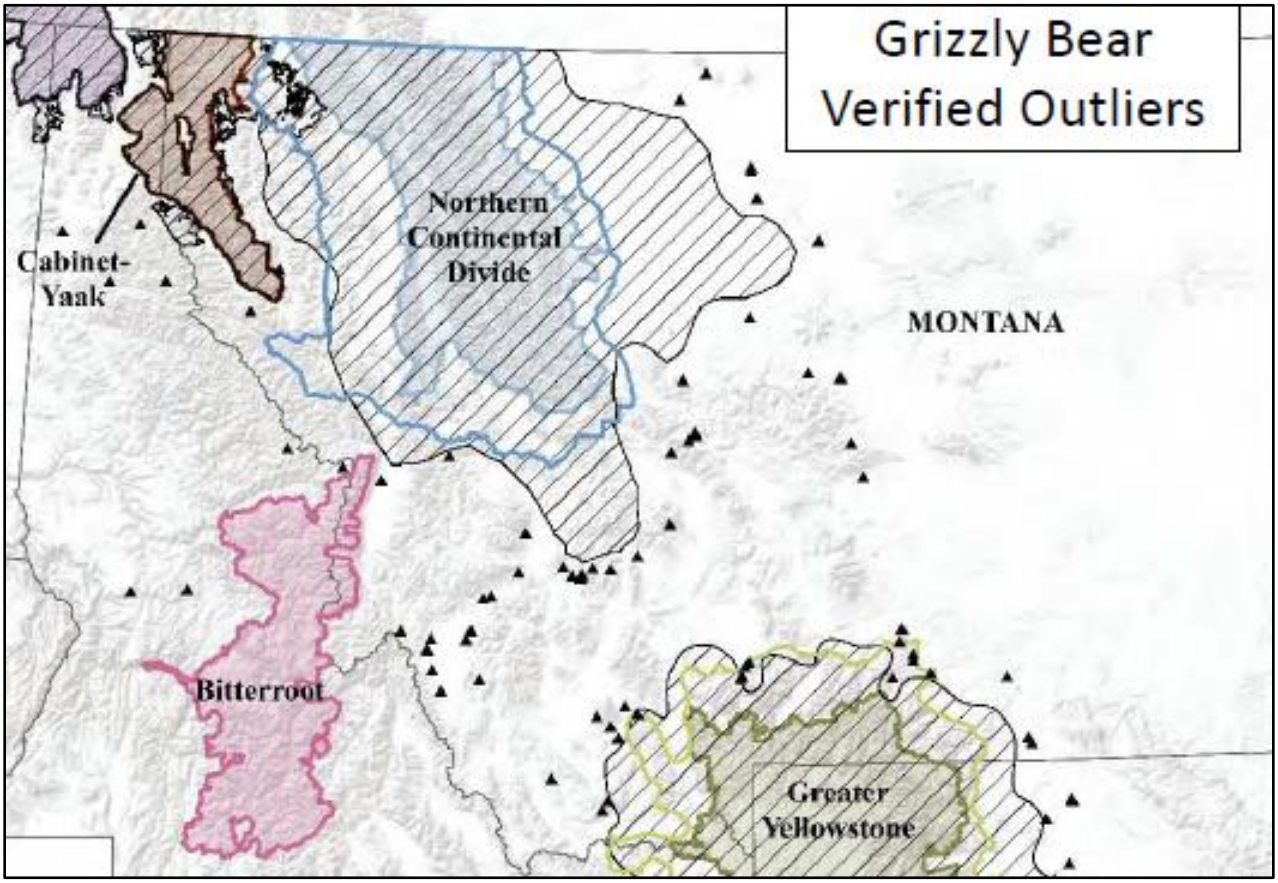

Figure 2. Estimated distribution of grizzly bears in Montana as of spring 2021 (diagonal hatching), showing the Montana portion of 4 'Grizzly Bear Ecosystems' (colored shading), and boundaries of the NCDE (blue line) and GYE (green line) demographic monitoring areas (DMA) . The hatched area should not be interpreted to suggest that grizzly bears are equally common in all areas. Also shown are estimated locations of verified "outlier" observations beyond current distributions (black triangles).

Figure 3. Areas (blue shading) in which grizzly bears "may be present" according to USFWS, January 2021. This includes scattered and/or dispersing individuals, and does not necessarily indicate the presence of a meaningful assemblage of grizzly bears in all outlying areas.

A. Demographic recovery objectives have been met for eight consecutive years.

Objective 1 has been met. For all eight 6-year periods ending in the years 2013 through 2020, the two occupancy thresholds (BMU and Zone OU) have been met or exceeded (Table 1; USFWS 2020, Costello and Roberts 2020).

Objective 2 has been met. For all eight 6-year periods ending in the years 2013 through 2020, the adult female survival threshold has been met or exceeded, and both genders' total mortality has been at, or below, the thresholds (Table 1; USFWS 2020, Costello and Roberts 2020). This implies that the total population size has > 90% probability of being over 800, and is most probably over 1,000 individuals, NCDE Subcommittee 2021:52). There has been less than a 10% probability of projected population size being below 800 bears since 2010 (NCDE Subcommittee 2021:52), and less than a 1% chance since 2012. In 2019, abundance was estimated at 1,068 bears (95% confidence interval 890-1,283; USFWS 2020:5).

Table 1. Demographic recovery thresholds and population achievements identified in the NCDE Conservation Strategy (NCDE Subcommittee 2021) during the eight 6-year periods ending in 2013 to 2020.

	---6-year running accumulation/mean ---							
BMU occupancy	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Threshold	21	21	21	21	21	21	21	21
Achieved	23	23	23	23	23	22	22	23
Zone 1 OU	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Threshold	6	6	6	6	6	6	6	6
Achieved	7	7	7	7	7	7	7	7
Female survival	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Threshold	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Achieved	0.95	0.95	0.96	0.95	0.95	0.93	0.94	0.93
TRU mortality – females	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Threshold	22	**22**	22	22	22	23	24	24
Achieved	11	14	14	16	14	15	16	13
TRU mortality - males	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Threshold	28	28	28	28	28	28	29	29
Achieved	15	16	16	15	19	21	21	21

B. Spatial expansion has continued, increasing the probability of connectivity to other populations.

Objective 3 has been met. The area occupied by the NCDE population as of 2018 was approximately 63,800 km^2 (24,000 mi^2), an increase of approximately 25% from that estimated in 2010, and of approximately 42% from that estimated in 2004. Of the 2018 occupied area, approximately 36% was beyond the exterior boundaries of the NCDE DMA (Costello and Roberts 2019). Additional, verified locations of grizzly bears (i.e., outliers) were documented and mapped well beyond the calculated "occupied area" (the statistical algorithm does not necessarily extend the boundary of occupied range to the furthest observation, thus some observations are considered verified but outliers). Assignment to population of origin (from DNA collected) continues (USFWS 2021), but to date, there is no evidence of genetic inputs

from immigrants from other populations into the NCDE, nor evidence of the same from the NCDE into the GYE. (As noted above, NCDE animals have been successfully moved into the CYE, thus providing genetic connectivity between these 2 populations).

Additionally, all habitat-based recovery criteria identified by NCDE Subcommittee (2021), primarily within the purview of federal land management agencies, have been met since the year 2011 (USFWS 2021).

4. Evaluation of the Five Factors Identified in Section 4(a)(1) of the ESA.

In order to delist grizzly bears in the NCDE DPS, MFWP is required to establish that the five factors the Service evaluates for purposes of listing a species no longer jeopardize the species' continued existence throughout all or a significant portion of its range. As defined in the ESA, "[t]he term 'species' includes any subspecies of fish or wildlife or plants, *and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature*." 16 U.S.C. § 1532(16) (emphasis added). Upon determining the status of a 'species' (including distinct population segment(s)) the Service may act to remove said entity from the Federal list of threatened and endangered wildlife, as was established for the DPS of GYE grizzly bears (*see* Fed. Reg. 82 at 30516-30520). Section 4(a)(1) of the ESA requires the Secretary must determine whether any species is an endangered species or a threatened species because of any of the following factors:

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;

(B) overutilization for commercial, recreational, scientific, or educational purposes;

(C) disease or predation;

(D) the inadequacy of existing regulatory mechanisms; or

(E) other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a)(1).

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Habitat fragmentation within the NCDE DPS. Partial constrictions of genetic exchange within the NCDE DPS have been identified by Kendall et al. (2009), primarily associated with US Highway 2 (Waller and Servheen 2005). Although these have generated discernible

population structure, they have not prevented genetic connectivity within the DPS (Mikle et al. 2016, USFWS 2021).

Private land development in the NCDE. Within the core portion of the proposed DPS here (in particular the PCA), approximately 93% is under public ownership (USFWS 2021:136). Of the remaining 7% within the PCA, 45% of private land is protected from additional development, either through being owned by a land trust or private conservation organization, or through voluntary conservation easements (USFWS 2021:135). Within Zone 1 (immediately surrounding the PCA), 47% of lands are privately owned, and 22% of those are at least partially protected from additional development via conservation ownership of voluntary easement. Within Zone 2 (where an objective is to facilitate connectivity to other listed populations), 11% of private lands are at least partially protected from additional development via conservation ownership of voluntary easement. Private lands (largely without conservation easements) predominate in the remainder of the proposed DPS, but further grizzly bear expansion is not anticipated or required in these areas.

Protection of core, largely wild areas within the PCA. The U.S. Forest Service and National Park Service, together, manage 78% of lands within the PCA. The primary factors related to past destruction or degradation of grizzly bear habitat on these lands (typically related to motorized human access) have been reduced (and are mandated to retain these lower levels) through changes in management practices that have been incorporated into their respective regulatory documents (USFWS 2021: 140). An additional 13% of the PCA is owned and managed by the 2 large Indian Tribes (Blackfeet, Confederated Salish and Kootenai), the Bureau of Land Management (BLM), or the Montana Department of Natural Resources and Conservation (DNRC). All 4 entities also have regulations designed to ensure the full function of grizzly bear habitat (USFWS 2021). Most of these regulations also apply to public lands within the Zone 1 buffer around the PCA (USFWS 2021:141).

Food resources. Grizzly bears in the NCDE DPS are habitat generalists, foraging on a wide variety of plant and animal resources. In general, they are less carnivorous than grizzly bears in the Greater Yellowstone Areas (USFWS 2021). With the exception of whitebark pine (*Pinus albicaulis*), Montana knows of no major losses in food resources for grizzly bears within the NCDE DPS. Whitebark pine has already declined by up to 50% from its historic abundance in alpine habitats within the NCDE DPS (Keane et al. 2012), during which time grizzly bears

have continued to increase. Although the loss of whitebark pine doubtless makes foraging more difficult for at least some grizzly bears, grizzly bear populations have thus far shown sufficient resiliency to cope with that loss (Bjornlie et al. 2014b, van Manen et al. 2016). Expected changes to whitebark pine and other plant species due to climate change are addressed below.

Overall. Destruction and modification of grizzly bear habitat within the proposed NCDE DPS will be limited by the rules and regulations adopted pursuant to NCDE Subcommittee (2021). Maintenance of the baseline values for secure core habitat, developed sites on public lands, and livestock allotments inside the PCA, as articulated in NCDE Subcommittee (2021), will adequately mitigate the stressors on grizzly bear habitat. USFWS (2021:208) concluded that although existing threats to habitat are likely to continue, they have been reduced to the point where they affect only individuals or small proportions of the NCDE population.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

MFWP knows of no utilization of grizzly bears, past or present, for commercial purposes, and anticipate none occurring in the future. Any use of wildlife for scientific or educational purpose would be permitted solely through obtaining a scientific collectors permit by MFWP. MFWP has no reason to anticipate overutilization for scientific or educational purposes, which are generally met by donation of carcasses, hides, or other parts when animals require removal due to irresolvable conflicts.

The primary concerns regarding possible future overutilization come from i) management removals subsequent to human-bear conflicts, ii) possible future recreational hunting, iii) vehicle strikes, iv) mistaken identity or accidental removal by hunters targeting other species, and v) malicious removal. Excepting ii) above (recreational hunting), all of these sources of mortality are present under the current listing status as a "Threatened" species. Yet, as shown above, none of the mortality thresholds established by NCDE Subcommittee (2021) for the NCDE DMA have been exceeded during any of the 6-year rolling periods ending in 2013 to 2020.

After delisting, grizzly bears within the proposed NCDE DPS would become a legal game animal in Montana (§87-1-304, 87-2-101, 87-5-302, MCA), and the Montana Fish and Wildlife Commission (Commission) could approve, hunting seasons. However, as required by NCDE Subcommittee (2020:54), recreational hunting would be limited to only the number of bears whose removal would not exceed the overall mortality thresholds. This portion of the overall discretionary mortality is under the regulatory control of the Commission, and thus,

MFWP and the Commission commit to amend the existing administrative rule to include a specific population trigger to close hunting. That is, this level of "discretionary mortality" (USFWS 2021:209) would not alter the fundamental commitment to adhere to the demographic management standards and thresholds articulated by the NCDE Subcommittee (2020).

MFWP is fully committed to continuing to monitor both survival of a sample of marked animals and mortalities documented (and estimated) from all sources, as it has been doing since 2004 (Mace et al. 2012, Costello et al. 2016), providing the raw data needed to continue assessing compliance with demographic management standard and thresholds.

C. Disease or predation.

Although grizzly bears have been documented to be infected with a variety of internal parasites and other disease-causing pathogens, fatalities are uncommon (LeFranc et al. 1987) and do not appear to have population-level impacts on grizzly bears (Rogers and Rogers 1976). Researchers have found grizzly bears infected by (or having been exposed to) brucellosis (type 4), clostridium, *Francisella tulearensis*, toxoplasmosis, canine adenovirus, canine distemper virus, canine parvovirus, canine hepatitis, *Leptospira* spp., rabies, *Toxoplasma gondii*, and *Trichinella* spp. (LeFranc et al. 1987, Knowles et al. 2018, Ramey et al. 2019, Zarnke et al. 1997, Cross et al. 2018). Parasites that have been documented from grizzly bears include the tapeworms *Diphyllobothrium cordyceps* and *Taenia ovis krabbei*, the tick *Rhipicephalus sanguieus*, Thorne et al. 1982. Seesee and Worley 1986) However, based on over 40 years of research by the Interagency Grizzly Bear Study Team (IGBST), MFWP, and other scientists, natural mortalities in the wild due to disease have not been documented (Schwartz et al. 2003, Cross et al. 2018, Haroldson 2020; MFWP, unpublished data). Based on this absence, MFWP concludes that mortalities due to bacteria, pathogens, or disease are negligible components of total mortality for grizzly bears and are likely to remain an insignificant factor in population dynamics. Therefore, although disease may affect individuals, it does not significantly influence the resiliency of grizzly bears in the proposed NCDE DPS. MFWP is not aware of evidence that would increase concern that this would change in the future.

Similarly, predation has not been identified, much less documented, as a substantial source of mortality for grizzly bears. Young cubs may be vulnerable to predation by wolves (*Canis lupus*), mountain lions (*Puma concolor*), but interspecific predation has generally not been identified as an issue with population-level consequences for grizzly bears. In contrast,

intraspecific predation may limit population growth in grizzly bears, but is more likely to occur where populations are dense (as suggested by van Manen et al. 2016) and operate in a density-dependent fashion.

D. Existing regulatory mechanisms.

The primary mechanism for MFWP management of grizzly bears to assure conservation of grizzly bears in the NCDE after delisting is through the administrative rule for demographic objectives for the NCDE. The rule is consistent with the standards and protocols of NCDE Subcommittee. *See* ARM 12.9.1403 and Strategy, 2021. This rule was adopted in 2018 to support delisting of grizzly bears and to manage for their continued recovery – both before and after delisting. The goal of NCDE Subcommittee (2021:14), adopted by reference in this administrative rule is "to maintain a recovered, genetically diverse grizzly bear population throughout the Demographic Monitoring Area (DMA: the Primary Conservation Area (PCA) and Zone 1) while maintaining demographic and genetic connections with Canadian populations and providing the opportunity for demographic and/or genetic connectivity with other ecosystems (Cabinet-Yaak, Bitterroot, Greater Yellowstone)." As articulated by USFWS (2021: 209), "…The management infrastructure to maintain habitat conditions and limit mortality is or will be in place, as described in the NCDE Conservation Strategy [NCDE Subcommittee 2021], prior to any final rule. Because the signatory agencies to the NCDE Conservation Strategy are the same agencies that have been managing grizzly bear habitat, population, and monitoring for the last 40 years, the management transition would be minimal".

Montana is in the process of amending the grizzly bear demographic objectives for the NCDE to include a more specific population trigger for halting discretionary mortality for hunting. The Fish and Wildlife Commission approved proposing rule language on December 14, 2021. The proposed rule language commits the commission to closing hunting if the probability that the grizzly bear population remains above 800 within the demographic monitoring area falls below 90% and would not resume until the probability is 90% or greater that the population of bears remains above 800. In addition, hunting will not be allowed in a year if mortality thresholds as described in ARM 12.9.1403(b)(ii) and (b)(iii) were exceeded in the previous year.

Further regulatory mechanisms intended to ensure grizzly bears maintain a recovered status are as follows.

Regulatory mechanisms to limit future habitat degradation or loss. Management practices to limit motorized access, limit grizzly bear access to human-related attractants, and limit disturbance to grizzly bears, and referenced by NCDE Subcommittee (2021) as consistent with the thresholds within, include:

a. Final Environmental Impact Statement for the Forest Plan for the Flathead National Forest (USDA FS 2018a);
b. Final Environmental Impact Statement for the Forest Plan Amendments: Incorporating Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population for the Helena-Lewis and Clark, Kootenai, and Lolo National Forests (USDA FS 2018b);
c. Blackfeet Forest Management Plan (Blackfeet Nation 2008);
d. Flathead Indian Reservation Forest Management Plan (CS&KT 2000);
e. Final Environmental Impact Statement for the Montana Department of Natural Resources and Conservation Forested Trust Lands Habitat Conservation Plan (DNRC 2010a, 2010b);
f. Glacier National Park Superintendent's Compendium implemented under the National Park System Organic Act (GNP 2019);
g. Bureau of Land Management's Record of Decision for the Garnet Resource Management Plan and the Environmental Impact Statement (BLM 1986);
h. Bureau of Land Management's Draft Resource Management Plan and Environmental Impact Statement for the Missoula Field Office (BLM 2019a); and
i. Bureau of Land Management's Draft Lewistown Resource Management Plan (BLM2019b).

Regulatory mechanisms to limit future human-caused mortality. Management practices to limit human-cause mortality and referenced by NCDE Subcommittee (2021) include:

a. 2011 Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones for the Kootenai, Lolo, and Idaho Panhandle National Forests (USDA FS 2011b);
b. Bear Management Plan and Guidelines for Bear Management on the Blackfeet Indian Reservation (Blackfeet Tribal Business Council 2013);
c. Blackfeet National Fish and Wildlife Code (Blackfeet Tribal Business Council 2018);

d. Administrative Rules of Montana 12.9.1403, which formalize and codify the demographic objectives of NCDE Subcommittee (2021), which states "Upon delisting from the Endangered Species Act, management of the grizzly bear and its habitat in the Northern Continental Divide Ecosystem (NCDE) will be guided by the Conservation Strategy for Grizzly Bears in the Northern Continental Divide Ecosystem (NCDE Conservation Strategy). The department and federal land management agencies will endorse and commit themselves to the NCDE Conservation Strategy by entering into a memorandum of understanding detailing their agreement to implement it...When and so long as the NCDE Conservation Strategy is in effect, the department and the commission shall, within their lawful authority to do so, maintain the recovered status of the grizzly bear in the NCDE by implementing interagency cooperation, population and habitat management and monitoring, and other provisions of the NCDE Conservation Strategy in accordance with the responsibilities described therein..". , ARM 12.9.1403 also reiterates the specific numeric demographic objectives of NCDE Subcommittee (2021), including management by the identified Zones.

As noted above (and formalized by the commitment made under ARM 12.9.1403), MFWP is fully committed to continuing to monitor both survival of a sample of marked animals and mortalities documented (and estimated) from all sources, as it has been doing since 2004 (Mace et al. 2012, Costello et al. 2016), providing the raw data needed to continue to assess compliance with demographic management standard and thresholds.

Prevention, public education, reduction, and response to human-bear conflicts. MFWP, along with Tribal and non-governmental partners, will continue its active program of human-bear conflict prevention. Within the DMA, response to human conflicts that have already occurred will follow NCDE Subcommittee goals (2021). Within Zones 2 and 3, response to conflicts will follow Dood et al. (2006) and MFWP (2013).

The total morality added by any future allowance for hunting would be limited by the allowable "total discretionary mortality" of the existing regulatory mechanism. In addition, any mortalities arising from newly enacted Montana revisions to statute, §87-6-106, MCA, that allows killing of a grizzly bear deemed to be threatening persons or livestock, as well as any grizzly bear inadvertently killed by increases in tools available for trapping wolves, or from the

initiation of a hound season for black bears (*Ursus americanus*) would count towards allowable mortality thresholds. Montana law requires that any person responsible for the death of a grizzly bear, for any reason, to deliver all parts of the grizzly bear to the department for inspection. *See* §87-3-131, MCA. Thus, any bears killed within the Conservation Strategy's DMA would add to the total reported and unreported mortality for that year (for the relevant gender), and reduce by that number of any discretionary mortality. As noted above, total reported and unreported (TRU) mortality includes an upward adjustment to account for the fact that some mortalities are never known with certainty and thus must be estimated based on previously obtained empirical data (Cherry et al. 2002).

E. Other natural or manmade factors affecting its continued existence.

The primary natural or manmade factor that could affect the continued existence of grizzly bears, not considered above, is climate change. Although warmer temperatures and altered precipitation patterns themselves are unlikely to substantially affect grizzly bears, the indirect effects of climate change on vegetation, grizzly bear activity, and grizzly bear denning are relevant to consider.

The effects of warmer temperatures directly on grizzly bear behavior, movements, and habitat use are poorly known. Pigeon et al. (2016) demonstrated that ambient temperatures affected grizzly bear habitat selection, with avoidance of open habitats during warm summer days but increased use of such areas during nighttime. Rickbeil et al. (2020) found that, post-denning, grizzly bears in Alberta tended to become active sooner in years with early snow melt. They also found, however, that the phenology of important food plants had advanced in tandem, lessening a concern that grizzly bears active so early in the spring would lack these food resources. Climate change is expected to alter the distribution and abundance of vegetation formations that provide grizzly bears foraging or resting habitat (Butler 2012). Climate change, directly or indirectly, will also alter the geographic distribution of many plant species used by grizzly bears (Holden et al. 2012, IGBST 2013, Roberts et al. 2014). The best studied and arguably most concerning example is the decline of white-bark pine caused by blister rust (*Cronartium ribicola*) and mountain pine beetle (*Dendroctonus ponderosae*) which has been ongoing for decades, and which is expected to be exacerbated by continued climate change-induced effects (Fortin et al. (2013), Hansen and Phillips (2015), Buotte et al. (2016), Shanahan et al. (2016)). In contrast, Roberts et al. (2014) projected that most plant species used by grizzly

bears in the Canadian Rocky Mountains will remain relatively stable, or increase in areal coverage under likely future climate change. Elevations of most species are projected to increase, but only two species known to be used by grizzly bears would "run out of room" from this elevational increase, and neither of these two (*Vaccinium scoparium, Empetrum nigrum*) are preferred dietary items.

Ransom et al. (2018) projected that while some important potential grizzly bear food items in the North Cascades of Washington would decline with future climate change (e.g., species preferring mesic soils such as glacier lily [*Erythronium grandiflorum*] and horsetails [*Equisetum* spp.]), other key food items (huckleberry, [*Vaccinium* spp.] and sweet vetch [*Hedysarum* spp.]) would either increase in abundance, move upward in elevation (potentially drawing grizzly bears away from conflict with people), or both. In contrast, Prevéy et al. (2020) projected a decline in habitat suitability for *Vaccinium membranaceum* within its North American distribution, although most of the decline appears to be situated on the periphery of current or prospective grizzly bear distribution in Montana.

The length of the grizzly bear denning season responds to latitude, with bears at the southern extent of their range (e.g., Montana) entering dens later and emerging earlier than those living in more northerly areas (Schwartz et al. 2003:567). Denning chronology can also be expected to change with increasingly warmer temperatures. Pigeon et al. (2016b) showed that grizzly bears in Alberta entered dens later when berry production was high than when low. Den emergence in Alberta was also weakly related to spring temperatures, occurring earlier during colder than warmer springs (Pigeon et al. 2016b). The duration of hibernation in black bears has also been shown to be decreasing, likely as a result of climate-change related warming, as well as increasing provision of anthropogenic foods (Johnson et al. 2017). Combined, these studies suggest that Montana can expect shorter denning seasons among Montana grizzly bears in the future as the climate warms (Cross and Servheen 2010, Servheen and Cross 2010), particularly those bears with access to high-quality anthropogenic foods.

Grizzly bears are highly adaptive. They have shown the ability to overcome changes in habitat and food sources, as illustrated above. The current consensus among experts in bear biology is that although climate change is real and projecting its effects is inherently uncertain, grizzly bears will adapt to changes in plant distribution and abundance (López-Alfaro et al. 2015). In addition, grizzly bears have adapted to summer drought conditions, estimated to

become increasingly common, though they may cause grizzly bears to seek succulent forage closer to humans, and thus increase the probability of human-bear conflicts. Shorter denning periods are likely to increase the probability of human-bear conflicts in late autumn and early spring, and thus increase the need to secure attractants. As mentioned above, currently, a consensus among biologists is that the omnivorous and adaptive character of grizzly bears equip them to cope well (Cross and Servheen 2009, Servheen and Cross 2010). The primary concerns are whether the adaptations the animals can make will put them at greater risk of conflicting with humans. MFWP has demonstrated an ability to adapt its management in response to these concerns.

5. Impact of Delisting on Other Segments of the Lower 48 States Grizzly Bear Population

When considering delisting a portion of a species, the Service must consider effects on populations remaining listed. This is particularly relevant here because the NCDE grizzly bear population is considered the most likely source population for potential immigrants to three others (the Greater Yellowstone [GYE], Cabinet-Yaak [CYE], and Bitterroot [BE]; NCDE Subcommittee 2021:47). Here, Montana provides justification for our conclusion that delisting the NCDE DPS would have no detrimental impact on the status and prospects of these three other populations.

NCDE. A primary reason that the NCDE population of grizzly bears can continue to function as a source of migrants to other populations after delisting is that, as per the population objectives and commitments made under NCDE Subcommittee (2021), the abundance of grizzly bears will remain similar to that under listed status. Montana acknowledges the particular biological value of grizzly bears living on the periphery of NCDE PCA and DCAs as stepping-stones or potential migrants to other populations. These are considered below.

GYE. Although demographically secure and having met recovery goals specified in the Recovery Plan (USFWS 1993), long-term (> 100 years) viability of the currently-isolated GYE population requires occasional infusion of genetic material from other bear populations (Miller and Waits 2003, Kamath et al. 2015). The states of Montana, Wyoming, and Idaho are adopting regulatory mechanisms that commit to translocation of bears into the GYE. The most likely source of grizzly bears into the GYE is the NCDE. This would most likely come from bears living primarily in the NCDE DPS. Because both the Greater Yellowstone and Northern Continental Divide populations of grizzly bears have expanded in abundance and distribution,

they are closer to becoming connected via natural movements of bears than at any time during at least the past 50 years (Peck et al. 2017, Figures 2, 3). Natural movements of bears from north to south into the Greater Yellowstone area has been recognized as desirable by Montana Fish, Wildlife and Parks (Dood et al. 2006:1, MFWP 2013:41). As per NCDE Subcommittee (2021), MFWP is committed to the objective of management in Zone 2 that will "… provide the opportunity for grizzly bears to move between the NCDE and adjacent ecosystems (e.g., the GYE)" (NCDE Subcommittee 2021:17, 31, 49, 59, 99). USFWS (2021:111) concluded that, because of measures committed to in NCDE Subcommittee (2021), "regulatory mechanisms are in place to ensure habitat management direction is compatible with providing genetic connectivity to other populations on land managed by BLM, USFS, and DNRC."

The potential for bears to move on their own from the NCDE to the GYE is largely a function of social tolerance. This, in turn, is greatly affected at the local level by conflict reduction efforts. MFWP has had bear managers (whose jobs are largely to facilitate human-bear coexistence) in place in the Greater Yellowstone Ecosystem for many years, and currently employs 3 full-time staff there. In 2019, MFWP funded and staffed a new bear manager position in Anaconda/Deer Lodge, with the expressed objective of responding in a timely manner to bear conflicts, educating local residents, and preventing future human-bear conflicts in this geographic area that is deemed particularly likely to be the scene of NCDE-GYE grizzly bear connectivity. MFWP will continue to put resources to the staff and efforts in reducing human-bear conflict scenarios.

Additionally, in summer 2021, MFWP initiated preliminary analyses and discussions on translocating non-conflict grizzly bears from the NCDE to the GYE to address the long-term genetic issues. Initially, the IGBST has been tasked with investigating the details of where such bears would be most likely to survive and contribute to future generations. The commitment to do so has been memorialized by the Fish and Wildlife Commission on December 14, 2021.

CYE. As articulated in Dood et al. (2006), policy has been to assist the Cabinet portion of the CYE by translocating 2-3 bears/year from the NCDE to the Cabinets, continuing the original augmentation program begun by the Service in 1990. After an initial 4 bears from British Columbia were released by the Service during 1990-94 (3 of which remained for > 1 year), MFWP began cooperating with the Service on the augmentation program in 2005. A total of 18 grizzly bears (10 females and 8 males) from the Flathead River drainage have been released in

the Cabinet area during 2005-19. Of the total 22 grizzly bears, 16 stayed at least 1 year, 3 (2 females and 1 male) are known to have produced offspring in the area, and 6 are known to have died.

In addition, the Salish Demographic Connectivity Area (DCA) is intended to facilitate the occasional movement of bears out of the NCDE to other grizzly bear populations and is incorporated into NCDE Subcommittee (2021). This DCA would be managed similarly regardless of listing status. Land management in this DCA is intended to facilitate the movement of grizzly bears between the NCDE and CYE populations.

BE. There is presently no resident population of grizzly bears in the Bitterroot area. However, individual grizzly bears have increasingly been documented living close to the BE. The Ninemile DCA is incorporated into NCDE Subcommittee (2021), and would be managed similarly regardless of listing status. Land management in this DCA is intended to facilitate the movement of grizzly bears between the NCDE and BE populations. Additionally, in 2021, the Montana Legislature approved funding for a bear specialist position to be stationed in the Bitterroot to help address conflict and build tolerance for grizzly bears that currently or in the future may inhabit the Bitterroot ecosystem. That position is currently in the process of being filled.

CONCLUSION

1. Evidence supports designation of a NCDE distinct population segment (DPS). As described in this document, the NCDE population is both discrete and significant, and meets the criteria of a DPS in the Services's 1996 DPS policy.

2. The grizzly bear population (i.e., the DPS defined herein) is recovered. It has met or exceeded the NCDE recovery criteria articulated in the 1993 Recovery Plan and the NCDE Conservation Strategy since at least 2013. The DPS no longer meets the definition of threatened or endangered under the ESA.

3. The population is secure. Existing regulatory mechanisms and management commitments, as described in the NCDE Conservation Strategy (NCDE Subcommittee 2021) and this petition, ensure the population will remain robust, sustainable, and secure, and will continue to exceed recovery criteria. Staffing is in place to help prevent conflicts and address conflicts that occur. Thresholds have been established that are in place to ensure mortalities from all causes are considered and are not exceeded. Annual monitoring is in place to

continually track the population status, adherence with established thresholds, and the progress of management efforts. Adaptive management measures are in place to make adjustments to habitat or population management as necessary.

4. As a result of all of the above, the NCDE population segment is recovered, secure, and no longer warrants listing as threatened under the Endangered Species Act. Delisting is warranted and should proceed.

APPENDIX

Status of grizzly bears in the proposed NCDE DPS

Abundance and trend

Using mark-recapture analyses (with marks being DNA recovered from hair), Kendall et al. (2009) estimated the population of grizzly bears within the 33,480 km^2 survey area in 2004 as 765 (95% CI = 715—831). Mace et al. (2012) used vital rates from bears studied during 2004-2009 to estimate λ, the annual rate of growth, as approximately 3%/year (1.031; 95% CI = 0.928—1.102). Projecting this rate of growth to the estimated abundance in 2004, they estimated population size at > 1,000 in 2009 (including some areas adjacent beyond the NCDE DMA). Costello et al. (2016) used similar methods in updating the rate of growth during the 2004-2014 period. Depending on how independent females whose fates were undetermined were handled in the analyses, λ was estimated as 1.020 or 1.027 (with a mean of 1.023). Stochastic simulations yielded a similar mean, with 95% confidence limits of 1.015—1.029. These analyses suggested a population size within the DMA in 2014 of 960 bears (95% CI = 946—1,089). Independently, and using similar mark-recapture and DNA approaches to Kendall et al. (2009) but in a spatially-explicit framework, Kendall et al. (2019) estimated λ during 2004-2012 within their 33,300 km^2 study area as 1.043 (95% 1.017—1.069), although slightly higher for females than for males. Updated population trajectories or estimates are not available since that time. However, within the DMA, survival of independent females, by far the most important driver of population trend, averaged 0.94 (SE = 0.01) during 2014-2019. Most likely, the population was at least stable, and possibly increasing slowly, during 2014-2019.

Habitat and range expansion

Using methods similar to those developed by Bjornlie et al. (2014a), occupied range of grizzly bears within the NCDE DPS increased from 1994 to 2018, when it was estimated at > 60,000 km^2. The pecentage of this occupied area beyond the DMA boundary increased from about 15% in 2004 to over 35% in 2018. Most of this spatial expansion occured in an easterly direction, and a substantial portion also occurred along the south-eastern frontier of the NCD population's core. By 2018, a greater proportion of the NCDE population's occupied range was on private land than on public land.

Genetics, isolation, connectivity

Genetic concerns have not been expressed in the scientific literature, because metrics of

genetic diversity provide no reason for concern, and because it is not isolated (i.e., is currently connected to Canadian populations to the north). Expected heterozygosity among selected genetic microsatellites in NCD area bears (Kendall et al. 2009, Mikle et al. 2016) was above the mean expected for that latitude (Proctor et al. 2012: 16), and was similar to that observed in large, connected populations in northern British Columbia. Kendall et al. (2009:10), in noting genetic discontinuities among sections of the NCDE population, pointed out that these differences were similar to those observed between NCDE bears and those in the Prophet population of northern British Columbia, some 1,150 km distant. With population growth and expansion, genetic diversity within the NCDE has increased (Mikle et al. 2016).

Proctor et al. (2012: 25) considered NCD area grizzly bears north of US Highway 2 to be within the same genetic grouping as those in Alberta and British south of Canada Highway 3 (which Proctor and Morehouse (2021) estimated as numbering approximately 210 bears). Although it would be naïve to view grizzly bear populations on the Canadian side of the border (or those north of Highway 3) as constituting an unending fabric free from concerns all the way to the Yukon, there does appear to be sufficient connectivity to provide for occasional genetic exchange. On the British Columbia side, density of grizzly bears in the upper Flathead drainage (studied for > 40 years) has varied, largley in response to huckleberry abundance (McLellan 2015) but was among the highest recorded amonng southern interior grizzly bear densities during the late 1990s, and was comparable to those estimated in the NCD area even at its lowest ebb. In Alberta's Castle Bear Management Area, between the Montana boundary and Highway 3, where grizzly bear management faces similar issues to those on Montana's East Front, density was estimated as approximately 20/km^2 in core conservation area and 17/km^2 in the adjacent Support Zone (Morehouse and Boyce 2016), similar to recent estimates in the NDE area, and was probably growing slowly.

Although Proctor et al. (2012) showed that Canadian Highway 3 reduced demographic connectivity among bears on either side of it, they also showed (their Fig. 9c) considerable genetic overlap among genetic signatures of bears north and south of the highway (produced primarily by male migration, athough some of this was caused by translocation of problem bears north across Highway 3). Efforts are currently underway to reduce the bottleneck to grizzly bear movement induced by Highway 3 (Proctor and Morehouse 2021). In turn, these southern Canadian populations, while affected by highways and development that constrict connectivity

and facing conservation challenges of their own, are not genetically entirely isolated from populations yet further north.

Background information: Species information

Evolutionary history

The Eurasian brown bear and the North American grizzly are considered the same species (*Ursus arctos horribilis*). A number of sub-species are typically recognized within Eurasia (Garshelis 2009), and in earlier days, a number of North American subspecies were also recognized (Pasitschniak-Arts 1993). Modern practice been to accept only 2 subspecies in North America (based on skull analyses by Rausch 1963): the Kodiak subspecies (*U. a. middendorffi*) and all others in North America (*U. a. horribilis*). In the most recently published review of the phylogeography of North American grizzly bears, Miller et al. (2006), recognized only a single extant clade within southern Canada and the U.S. Northern Rockies, and suggested that even the distinction recognized by Rausch (1963) may ultimately not withstand scrutiny, although perhaps the salmon-eating brown bears on the large islands off the Alaska coast might be considered separate (Miller et al. 2006).

Current theory holds that the species developed its large size, aggressive temperament, flexible feeding habits, and adaptive nature in response to habitats created by intermittent glaciations. It is believed that ancestors of the grizzly bear migrated to North America from Siberia across a land bridge at the Bering Strait at least 50,000 years ago (Schwartz et al. 2003, Miller et al. 2006). As the continental ice sheet receded about 10,000 years ago, the species began to work its way south over post glacial North America.

In North America, grizzly bears originally inhabited a variety of habitats from the Great Plains to mountainous areas, from central Mexico to the Arctic Ocean. European explorers encountered grizzly bears throughout most of the American West. It is not known exactly how many grizzly bears lived in the U.S. before 1700, but based on historical sightings and modern-day densities, it is estimated that around 50,000-100,000 bears lived in parts of 17 states.

Physical characteristics

Grizzly bears are generally larger than black bears and can be distinguished by longer, curved front claws, humped shoulders, and a face that appears concave (Schwartz et al. 2003, Garshelis 2009). A wide range of coloration from light brown to nearly black is common. Guard hairs are often paled at the tips; hence the name “grizzly”. Spring shedding, new growth,

nutrition, and climate all affect coloration.

In the lower 48 states where few grizzly bears have extensive access to salmon, mean weights of adult grizzly bears are 150-250 kg (330-550 lbs.) for males and 110-150 kg (240-330 lbs.) for females (Schwartz et al. 2003). Variation in body mass is affected by as age at sexual maturity, samples from within the population, season of sampling, and reproductive status.

Grizzly bears are relatively long-lived; animals in captivity have been documented as living as long as 37 years or even longer. In general, the oldest age classes are listed at 28 years for males and 23 years for females, although individuals can live longer. More pertinent to conservation and management than maximum longevity are estimates of survival rates among sex/age classes of grizzly bears (see below).

Social Organization and Behavior

Except when caring for young or breeding, grizzly bears are generally solitary. Strict territoriality is unknown, with intraspecific defense limited to specific food concentrations, defense of young, and surprise encounters (Schwartz et al. 2003, Garshelis 2009).

In contrast to their generally solitary nature, grizzly bears of all ages will congregate readily at plentiful food sources and form a social hierarchy unique to that grouping of bears. Except at concentrated food sources, mating season is the only time that adult males and females tolerate one another, and then it is only during the estrous period. Other social affiliations are generally restricted to family groups of mother and offspring, siblings that may stay together for several years after being weaned, and an occasional alliance of sub-adults or several females and their offspring (Schwartz et al. 2003, Garshelis 2009).

Individual grizzly bears evidently differ in their tolerance to close approaches by other bears or by people. Surprise is an important factor in many confrontations involving grizzly bears and humans. A female with young exhibits an almost reflexive response to any surprise intrusion or perceived threat to her “individual distance” or that of her cubs. Defense of a food supply is another cause of confrontation between humans and bears. Grizzly bears generally defend a kill or carrion out of perceived need.

Predaceous attacks on humans by grizzly bears are exceedingly rare (although they have been documented). Although grizzly bears are the more aggressive species and more likely to cause injury to people, predaceous attacks on people, although still rare, are more common among black than grizzly bears (Herrero 2002). Importantly, grizzly bears are much more likely

to become aggressive toward people (with attendant risk of serious injury) if they have first become habituated (Albert and Bowyer 1991, Gunther and Wyman 2008, Gunther et al. 2018), or worse, become conditioned to seek food from humans, their dwellings, or other attractants caused by humans (Mattson et al. 1992b, Herrero 2002, Herrero et al. 2005).

Dispersal and home range establishment

Young female grizzly bears usually establish home ranges within or overlapping their mother's (McLellan and Hovey 2001, Schwartz et al. 2003). This pattern of home range establishment can make dispersal of females across landscapes a slow process. Radio-telemetry and genetic data suggest females typically establish home ranges an average of 10 to 14 km (6 to 9 miles) away from the center of their mother's home range. Males typically disperse further away from their mothers, averaging 30 to 42 km (19 to 26 miles) (McLellan and Hovey 2001, Proctor et al. 2004), and in the Northern Rocky Mountains have been documented to disperse as far as 67 or even 176 km (42 –109 miles) (Blanchard and Knight 1991, McLellan and Hovey 2001, Peck et al. 2017). That said, females occasionally disperse distances up to 90 km (56 miles), typically on the periphery of expanding populations. Although the frequency of long-distance dispersal by females is lower than males, it can contribute to range expansion and demographic connectivity between populations (Swenson et al. 1998, Kojola and Laitala (2000), Jerina and Adamic 2008).

Habitats: Biophysical characteristics

Grizzly bears do not use forested stands highly for foraging (Mace and Waller 1996, Mattson 1997b, Apps et al. 2004, Milakovic et al. 2012), finding most of their preferred forage in relatively open areas, but do use forested cover for resting (particularly in otherwise open areas, Blanchard 1983). At a finer scale, some studies have shown grizzly bears to use edges between forested and open areas preferentially (Mattson 1997c, Stewart et al. 2013). Grizzly bears tend to use burned areas and areas of high vegetation diversity, and are associated with greenness and avalanche chutes, (Waller and Mace 1997, Ramcharita 2000, Serrouya et al. 2011) Kearney et al. (2019) provides a good overview of grizzly bear use of disturbed forests. Apps et al. (2004) showed that grizzly bears typically occupy relatively high elevations, often on steep slopes with rugged terrain, and low human access and linear disturbance densities. These landscapes also tend to be comprised of avalanche chutes, alpine tundra, barren surfaces, burned forests, and less young and logged forests. Riparian zones are often used both for foraging and travel (Servheen

1983, McLellan and Hovey 2001), particularly in otherwise open habitats (Aune 1994, Phoebus et al. 2017), a habitat relationship that has implications for human-bear conflict (Wilson et al. 2005, 2006; Eneas 2020).

Although grizzly bears may avoid intensively burned areas for few years after a fire, (Blanchard and Knight 1996, Podruzny et al. 1999), most studies have shown that they use burned areas preferentially, taking advantage of improved foraging substrate (Hamer 1999, Hamer and Herrero 1987, McLellan and Hovey 2001), availability of preferred forbs (Pengelly and Hamer 2006) and shrubs (Martin 1983). Other forest disturbances (e.g., logging) can also set back succession in ways that are advantageous to plants important to grizzly bears (Nielsen et al. 2004, Souliere et al. 2020), but the bears' tendency to avoid humans, whose presence is typically greater where industrial timber harvest has occurred (or to suffer higher mortality if they do not) can compromise much of this advantage (Zager et al 1983., Nielsen et al. 2008).

Habitats: Human influences

Motorized access: Displacement and mortality risk. Historically, grizzly bears have done poorly when in close proximity to humans, and recovered in the most remote habitats (Ciarniello et al. 2007; Lamb et al. 2017, 2018). Most grizzly bear research has focused on the effects of motorized access in displacing them (Mattson et al. 1987, McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace et al. 1996, 1999; Proctor et al. 2019). That said, grizzly bears do not necessarily respond to all roads in the same way. High-use roads are avoided more strongly than low-use roads (Chruszcz et al. 2003, Mace et al. 1996); roads open to unlimited use are avoided more strongly than roads open to only occasional or administrative use (Wielgus et al. 2002). Because female bears (especially with young cubs) tend to avoid male bears, and most bears (notably including males) avoid using areas near roads, some females relax their avoidance from roads in order to lessen their chance of encountering males (Mattson et al. 1987, Chruszcz et al. 2003, Graham et al. 2010, Stewart et al. 2013, Boulanger and Stenhouse 2014). Thus, they may increase their use of these habitats but at a cost: trading-off one danger (from conspecifics) for another (from people).

Apps et al. (2004) examined detection of bears at hair traps, Upper Columbia River Basin, B.C., as a function of human presence (along with other biophysical characteristics). They found a strong association of grizzly bear detection with terrain conditions that would inhibit human access and habitation: high elevations, steep slopes, and complex topography. Later

analyses at a larger scale largely confirmed these associations (Apps et al. 2016).

Studies have shown that grizzly bear survival (Mace et al. 1996, Nielsen et al. 2008, Schwartz et al. 2010, Boulanger et al. 2013, Boulanger and Stenhouse 2014, McLellan 2015, Parsons et al. 2021), or density (Linke et al. 2013, Lamb et al. 2018) is negatively correlated with the density of motorized access routes. A nuance more recently documented is that many grizzly bears become more nocturnal (particularly in agricultural and/or rural areas) where road density high but their actual use is low (Northrup et al. 2012, Lamb et al. 2020). Work by Chruszcz et al. (2003), and by Roever et al. (2008a,b) showed that, in some cases grizzly bears actually appeared to prefer being near low-use roads, not because they were attracted to people or traffic, but because roads were themselves associated with habitat characteristics likely to yield better foraging (e.g., early seral communities created by logging).

Ecological traps can occur if attractants near roads bring grizzly bears from secure habitats to places where their survival is too low to overcome the advantages those attractants provide (Lamb et al. 2017).

Highways and crossing structures. Grizzly bears, particularly males, are hesitant to cross high-volume highways (Gibeau et al. 2002, Chruszcz et al. 2003, Waller and Servheen 2005). Highways are known to be a source of considerable mortality for grizzly bears generally (Benn and Herrero 2002). Within the NCDE area, grizzly bears killed by vehicles in the past 30 years have been clustered along US Highway 93 in the Mission Valley, US Highway 2 along the southern boundary of Glacier National Park, Highway 83 in the Swan Valley near Condon, Highway 200 between Potomac and Lincoln, and to a lesser extent, along the East Front north of the Teton River (Costello et al. 2020.) Sawaya et al. (2013) and Ford et al. (2017) showed the grizzly bears preferred large overpasses to under-highway structures, and that use patterns took some time to develop. Females with cubs appear particularly reluctant to use highway crossings.

Diet

The wide historic distribution of grizzly bears in Europe and Asia as well as North America (from the Canadian Arctic to Mexico, Scandinavia to Greece, Siberia to Spain), provides a preview of the species' dietary flexibility. Although the digestive system of bears is essentially that of a carnivore, and they do kill and eat and/or scavenge animal prey (Mattson 1997a, Hilderbrand et al. 1999a,b; Zager and Beecham 2006) — carnivory being more pronounced among male than female grizzly bears (Jacoby et al. 1999, Milakovic and Parker

2013) — grizzly bears are successful omnivores, consuming a wide variety of plants and animals (Fortin et al. 2013, Gunther et al. 2014). In some areas grizzly bears are almost entirely herbivorous (McLellan 2011). Forbs (i.e., dicots) generally provide more protein and are more digestible than graminoids (Rode et al. 2001). Smaller-bodied grizzly bears are better able to subsist on a more herbivorous diet than are larger bodied grizzly bears (Welch et al. 1997, Rode et al. 2001).

Grizzly bears are opportunistic feeders and will prey or scavenge on almost any available food including ground squirrels, ungulates, carrion, and garbage. In areas where animal matter is less available, roots, bulbs, tubers, fungi, and tree cambium may be important in meeting protein requirements. High quality foods such as berries, nuts, and fish are important in some geographic areas. But grizzly bears diets are not random assemblages of whatever is available; animals make judicious foraging choices that vary by sex and age-class, as well as the food item availability, and these choices affect reproductive success (Mattson 2000).

Upon emergence from their dens, most grizzly bears seek lower elevations, drainage bottoms, avalanche chutes (Serrouya et al. 2011), and ungulate winter ranges. Herbaceous plants are eaten as they emerge, which is when crude protein levels are highest. Throughout late spring and early summer, most grizzly bears follow plant phenology back to higher elevations. In late summer and fall, there is a transition to fruit and pine nut sources, as well as herbaceous materials. During late summer and fall, a period termed “hyperphagia”, grizzly bears gain weight rapidly, attaining peak body mass just prior to hibernation. Conflicts with humans can increase during this time period, particularly as grizzly bears are attracted to (and some may make temporary movements to access) carcasses and/or gut-piles from hunter harvested ungulates (Green et al. 1997, Ruth et al., 2003, Haroldson et al. 2004, Ebinger et al. 2016, van Manen et al. 2019). Because bears rely solely on their stored energy reserves during hibernation, this pre-denning weight gain is essential for reproduction and survival. Bears metabolize fat and muscle during the denning period.

Grizzly bears must not only maximize energy intake while minimizing the costs of acquiring that energy, but must also balance macronutrients (protein, lipids, and carbohydrates) contained in their diets (Felicetti et al. 2003, Robbins et al. 2007, Coogan et al. 2014). Equipped with their carnivoran digestive system, one might initially expect grizzly bears to maximize protein sources whenever possible (Rode and Robbins 2000, Robbins et al. 2007), and indeed, it

is well established that bears with access to high protein sources (e.g., salmon, ungulate calves) grow larger and produce larger litter sizes than those without easy access to such high protein sources (Hilderbrand et al. 1999a,b; Robbins et al. 2004, López-Alfaro et al. 2015; Matsubayashi et al. 2016; although McLellan (2011) provided evidence that the proportion meat in diets was not correlated with population density in a study area lacking salmon). However, Erlenbach et al. (2014) found that when provided a variety of dietary items freely (including salmon and beef), captive grizzly bears did not maximize meat consumption, but rather converged on diets that averaged 17% protein by total metabolizable energy (22% by dry matter intake). That is, even given a chance to consume more protein, these bears allocated their intake of the 3 macronutrients more similarly to humans and mice than to other carnivores such as domestic dogs, cats, or mink. However, grizzly bears consumed lipids in higher proportions than other omnivores, and some preferred species of grizzly bears with high lipid content (e.g., white-bark (*Pinus albicaulis*) pine nuts, army cutworm moths (*Euxoa auxiliaris*) are in decline through the Northern Rockies.

Erlenbach et al. (2014) also showed that bears with less access to lipid-rich diets used carbohydrate-rich diets with similar efficiency, although the time and energy required to process small fruits such as huckleberries may limit the body growth of grizzly bears (Welch et al. 1997). In summary, Erlenbach et al. (2014) suggested that grizzly bears follow 3 broad rules in selecting dietary items when possible : i) maximize energy intake while optimizing dietary protein content, ii) prefer lipids over carbohydrates in order to limit protein intake and increase energy density (lipids typically contain more calories per unit weight than carbohydrates), and iii) use digestible carbohydrates if lipids are not available or difficult to exploit.

Denning

Grizzly bears in Montana generally enter winter dens beginning as early as late September to as late as early December; they emerge from dens as early as February, to as late as May (Haroldson et al. 2002, Graham and Stenhouse 2014). However, patterns underlying this generality have implications for conservation and management. The duration of denning is longer (beginning earlier and ending later) with more northerly latitude, as well as with higher elevation (Pigeon et al. 2016b). Pregnant females typically enter dens first, with about half having entered dens by the last week of October, and almost all by the end of November (Haroldson et al. 2002). Other females (with cubs, yearlings, or alone) follow, entering dens on

average in mid-November, with a few not denning until mid-December (Graham and Stenhouse 2014). Males enter dens slightly later than non-pregnant females. The reverse order is typical of den emergence in spring: Males (particularly sub-adult males) begin emerging from dens as early as February in the Yellowstone area (Haroldson et al. 2002) or late March further north in Alberta (Graham and Stenhouse 2014), with almost all abroad by late April. Females follow, with a few emerging in late March but most doing so during April. Females with newborn cubs are typically last to emerge (Pigeon et al. 2016b), typically in late April, with a few remaining in dens into early May.

Den entry is also affected by food availability in autumn; Pigeon et al. (2016b) showed that grizzly bear in Alberta entered dens later when berry production was high than when low. Den emergence in Alberta was also weakly related to spring temperatures, occurring earlier during colder than warmer springs (Pigeon et al. 2016b). European brown bears subsidized by human food (in the form of feeding stations) spent considerably less time in dens than predicted given the latitude of denning (Krofel et al. 2016). The duration of hibernation in black bears has also been shown to be decreasing, likely as a result of climate-change related warming, as well as increasing provision of anthropogenic foods (Johnson et al. 2017). Combined, these studies suggest that Montana can expect shorter denning seasons among Montana grizzly bears in the future as the climate warms (Cross and Servheen 2010, Servheen and Cross 2010), particularly those bears with access to high-quality anthropogenic foods.

Population Dynamics

Reproduction. Grizzly bears in Montana typically mate between May and July, and cubs are born in the den the following winter. The average litter size is two cubs (range 1-4). Male grizzly bears are sexually mature around 4.5 years of age but larger, dominant males may preclude young adult males from siring many offspring. Reproductive intervals for females average 3 years (but can be longer or shorter), and animals that lose young prior to or during the breeding season may come into estrus and breed again that same year. The mean age when cubs are first produced varies from as young as 4 old as 10 years (depending on population); in Montana, is has been reported as 5.8 (both in Yellowstone 1983-2001, Schwartz et al. 2006b; and the NCDE (Costello et al. 2016)). Offspring remain with their mothers for 2 to 4 years before weaning, again depending on various factors. Grizzly bears are promiscuous. Females can mate with multiple males and have a litter with offspring sired by different males. Males can sire

litters with multiple females in a breeding season.

Survival. In the great majority of populations in which survival rates and causes of mortality has been studied, most bears older than cubs are killed by people (McLellan et al. 1999, Schwartz et al. 2003, McLellan 2015), whether through regulated hunting (where legal), from management removals, by vehicles, self-defense, or from illegal killing. Only in the most remote populations is the cause of death other than at human hands for one reason or another. Thus, except for these very remote areas, the probability of death is a function of proximity to humans and their infrastructure (Johnson et al. 2004, Schwartz et al. 2010,Boulanger and Stenhouse 2014, Lamb et al. 2017, 2020). However, from the perspective of population dynamics, the important question is not what kills individual grizzly bears (all die eventually), but rather how long they live before dying.

Most natural mortality occurs outside of the denning season. Among the primary sources of natural mortality among grizzly bears are other grizzly bears (McLellan 1994, Swenson et al. 1997b, 2001a,b; Schwartz et al. 2003). Adult males kill juveniles and that adults also kill other adults (McLellan 2005). Parasites and disease do not appear to be significant causes of natural mortality but they may very well hasten the demise of weakened bears. Natural mortality during the denning period is not well documented. Several authors believe some bears die during denning, especially following periods of food shortages.

Density Dependence. Documenting density-dependence in a long-lived, low-density species is very difficult, so it not surprising that only long-term studies have done so. That said, it is clear that reproduction and survival in grizzly bears, as in most well-studied vertebrates, are negatively associated with population density. Where detailed information is available, relationships with density are indirect, being modulated by nutrition and intra-specific competition and aggression. Litter size has been shown to increase with the mother's access to high quality foods (Hilderbrand et al. 1999b, McLellan 2015), age (Gonzalez et a. 2012), and body condition (Keay et al. 2018); and to decrease with population size or density (Miller et al. 2003, Schwartz et al. 2006b, McLellan 2015. Age at first reproduction has been shown to decrease with resource competition among adult females (Støen et al. 2006), population size (McLellan 2015, Keay et al. 2018), and to increase with access to high quality foods (McLellan 2015). Number of years between successive cub litters was shown to be negatively related to population density (McLellan 2015, Van Manen et al. 2016), and access to high quality forage

(McLellan 2015). Growth rate of cubs was shown to be related to body fat of their mothers when initiating hibernation (Robbins et al. 2012); offspring body weight, in turn, was shown to be a predictor of lifetime reproductive success (Zedrosser et al. 2013)

Dependent offspring survival has been documented as being negatively to population density by Miller et al. 2003, Schwartz et al. 2006c, van Manen et al. 2014, Keay et al. 2018). Adult survival has not been documented as related to population density, but general pattens among long-lived mammals would not lead to an expectation that such a relationship would be found (Eberhardt 1977, Fowler 1987, Gaillard et al. 1998).

GLOSSARY AND ACRONYMS

ARM – Administrative Rules of Montana, which includes regulations passed by the Montana Fish and Wildlife Commission.

BE – Bitterroot Ecosystem

BMU - Bear Management Unit – an area about 400 mi2, in the portion of the NCDE for grizzly bears mapped as the primary conservation area, that meets yearlong habitat and population monitoring needs of both male and female grizzly bears.

Cub – A bear in its first year of life.

CYE – Cabinet-Yaak Ecosystem (population of grizzly bears)

DCA – Demographic Connectivity Area. Geographic areas identified and mapped in the Northern Continental Divide Ecosystem Conservation Strategy (NCDE Subcommittee 2021), nested within Zone 1, which are intended to facilitate the occasional migration of bears out of the NCDE to other grizzly bear populations. The Salish DCA is intended to facilitate movement to the Cabinet Yaak Ecosystem; the Ninemile DCA is intended to facilitate movement to the Bitterroot Ecosystem.

DMA – Demographic Monitoring Area. The PCA plus a buffer area (Management zone 1), roughly 10 miles outside the perimeter boundaries of the NCDE Recovery Zone (= Primary Conservation Area), within which demographic characteristics of the population are documented, and demographic thresholds apply. It is approximately 16,439 mi^2 (42,578 km^2) in size.

DPS – Discrete Population Segment. As defined by the USFWS DPS policy, published in the Federal Register, February 7, 1996 (Volume 61, p. 4722).

ESA – The Endangered Species Act of 1973 (as amended)

MFWP – Montana Department of Fish, Wildlife and Parks, the state of Montana's wildlife management agency

GYE – Greater Yellowstone Ecosystem (population of grizzly bears)

IGBST – Interagency Grizzly Bear Study Team

Independent bear – a bear not under the care of its mother (i.e., in a family group)

Management Zone 1 – The buffer (7,514 mi^2, or 19,450 km^2) surrounding the PCA where the population objective is continual occupancy by grizzly bears, and which, together with the PCA, comprises the DMA

Management Zone 2 – Lands identified in the Conservation Strategy (7,280 mi^2, or 18,854 km^2) where the object is to maintain existing resource management and recreational opportunities and allow agencies to respond to demonstrated conflicts, but also provide opportunity for grizzly bears to move between the NCDE and adjacent ecosystems.

Management Zone 3 – Lands within the proposed NCDE DPS but not within the PCA, Zone 1, or Zone 2, which may be occupied by grizzly bears but which in permanent occupancy may be incompatible with human presence (due to the predominance of private, agricultural land), which do not provide the opportunity for connectivity to other grizzly bear populations, and in which management will primarily consist of conflict prevention and response.

MCA – Montana Codes Annotated, statutes of the state of Montana

NCDE – Northern Continental Divide Ecosystem. The general area in northwestern Montana within which the Recovery Zone, outlying Management Zones identified in the Conservation Strategy (NCDE Subcommittee 2021), and the proposed DPS here lie. The term "ecosystem" in this context is not identical with meaning usually used in the general ecological literature, but take the meaning applied in the 1993 Recovery Plan.

PCA – Primary Conservation Area. The area (8,926 m^2, or 23,118 km^2) to be managed as a source area for the grizzly bear population. Identical with the Recovery Zone, the nomenclature changing after delisting.

Resiliency – As used here, the ability for populations to sustain in the face of environmental and demographic stochastic events, or for populations to recover from years with low reproduction or reduced survival, and is associated with population size, growth rate, connectivity, and the quality and quantity of habitats

Unduplicated female – An independent female grizzly bear that has not already been documented and counted and thus should count toward an identified (typically minimum) standard number

LITERATURE CITED

Albert, D. M., and T. R. Bowyer. 1991. Factors related to grizzly bear-human interactions in Denali National Park. Wildlife Society Bulletin 19: 339-349.

Apps, C. D., B. N. McLellan, J. G. Woods, and M. F. Proctor. 2004. Estimating grizzly bear distribution and abundance relative to habitat and human influence. Journal of Wildlife Management 68: 138-152.

Apps, C. D., B. N. McLellan, M. F. Proctor, G. B. Stenhouse, and C. Servheen. 2016. Predicting spatial variation in grizzly bear abundance to inform conservation. Journal of Wildlife Management 80:396–413.

Aune, K. 1994. Comparative ecology of black and grizzly bears on the Rocky Mountain Front, Montana. International Conference on Bear Research and Management 9: 451-458.

Benn, B., and S. Herrero. 2002. Grizzly bear mortality and human access in Banff and Yoho National Parks, 1971-98. Ursus 13: 213-221.

Bjornlie, D. D., D. J. Thompson, M. A. Haroldson, C. C. Schwartz, K. A. Gunther, S. L. Cain, D. B. Tyers, K. L. Frey, and B. Aber. 2014a. Methods to estimate distribution and range extent of grizzly bears in the Greater Yellowstone Ecosystem. Wildlife Society Bulletin 38:182–187.

Bjornlie, D. D., F. T. van Manen, M. R. Ebinger, M. A. Haroldson, D. J. Thompson, and C. M. Costello. 2014b. Whitebark pine, population density, and home-range size of grizzly bears in the Greater Yellowstone Ecosystem. PLoS ONE 9:e88160.

Blanchard, B. M. 1983. Grizzly bear-habitat relationships in the Yellowstone area. International Conference on Bear Research and Management 5: 118-23.

Blanchard, B. M., and R. R. Knight. 1991. Movements of Yellowstone grizzly bears. Biological Conservation 58:41–67.

Blanchard, B. M., and R. R. Knight. 1996. Effects of wildfire on grizzly bear movement and food habits. Proceedings of the second biennial scientific conference on the Greater Yellowstone Ecosystem: ecological implications of fire in Greater Yellowstone. International Association of Wildland Fire. Fairfield, WA.

Boulanger, J, M. Cattet, S. E. Nielsen, G. Stenhouse and J. Cranston. 2013. Use of multi-state models to explore relationships between changes in body condition, habitat and survival of grizzly bears *Ursus arctos horribilis.* Wildlife Biology *19: 274-288.*

Boulanger, J., and G. B. Stenhouse. 2014. The impact of roads on the demography of grizzly bears in Alberta. PLoS One 9:e115535.

Buotte, P. C., J. A. Hicke, H. K. Preisler, J. T. Abatzoglou, K. F. Raffa, and J. A. Logan. 2016. Climate influences on whitebark pine mortality from mountain pine beetle in the Greater Yellowstone Ecosystem. Ecological Applications 26: 2507-2524.

Butler, D. R. 2012. The impact of climate change on patterns of zoogeomorphological influence: Examples from the Rocky Mountains of the Western U.S.A.. Geomorphology 157-158: 183-191.

Cherry, S., M. A. Haroldson, J. Robinson-Cox, and C. C. Schwartz. 2002. Estimating total human-caused mortality from reported mortality using data from radio-instrumented grizzly bears. Ursus 13:175–184.

Chruszcz, B., A. P. Clevenger, K. E. Gunson, and M. L. Gibeau. 2003. Relationships among grizzly bears, highways, and habitat in the Banff-Bow Valley, Alberta, Canada. Canadian Journal of Zoology 81: 1378-1391.

Ciarniello, L. M., B. S. Boyce, D. C. Heard, and D. R. Seip. 2007. Components of grizzly bear habitat selection: density, habitats, roads, and mortality risk. Journal of Wildlife Management 71: 1446-1457.

Costello, C. M., R. D. Mace, and L. Roberts. 2016. Grizzly bear demographics in the Northern Continental Divide Ecosystem, Montana: research results (2004–2014) and suggested techniques for management of mortality. Montana Department of Fish, Wildlife and Parks, Helena.

Costello, C. M., and L.L. Roberts. 2019. Northern Continental Divide Ecosystem Grizzly Bear Monitoring Team Annual Report, 2018. Montana Fish, Wildlife & Parks, 490 N. Meridian Road, Kalispell, MT 59901. Unpublished data

Costello, C. M., and L.L. Roberts. 2020. Northern Continental Divide Ecosystem Grizzly Bear Monitoring Team Annual Report, 2019. Montana Fish, Wildlife & Parks, 490 N. Meridian Road, Kalispell, MT 59901. Unpublished data.

Costello, C. M., L. L. Roberts, and S. Courville. 2020. Analyses of Vehicle-caused Grizzly Bear Mortalities in the US Highway 93 Corridor. Montana Fish, Wildlife & Parks, 490 N. Meridian Road, Kalispell, MT 59901. Unpublished data.

Cross, M. and C. Servheen. 2010. Climate change impacts on wolverines and grizzly bears in the Northern U.S. Rockies: Strategies for conservation. Workshop Summary Report. May 24, 2010.

Cross, P. C., F. T. van Manen, M. Viana, E. S. Almberg, D. Bachen, E. E. Brandell, M. A. Haroldson, P. J. Hudson, D. R. Stahler, and D. W. Smith. 2018. Estimating distemper virus dynamics among wolves and grizzly bears using serology and Bayesian state-space models. Ecology and Evolution 8: 8726-8735.

Dood, A. R., S. J. Atkinson and V. J. Boccadori (2006) Grizzly Bear Management Plan for Western Montana: Final Programmatic Environmental Impact Statement 2006-2016. Montana Department of Fish, Wildlife and Parks, Helena, Montana. 163 pp.

Eberhardt, L. L. 1977. Optimal policies for conservation of large mammals, with special reference to marine ecosystems. Environmental Conservation 4: 205-212.

Ebinger, M. R., M. A. Haroldson, F. T. van Manen , C. M. Costello, D. D. Bjornlie, D. J. Thompson, K. A. Gunther, J. K. Fortin, J. E. Teisberg, S. R. Pils, P. J. White, S. L. Cain, and P. C. Cross. 2016. Detecting grizzly bear use of ungulate carcasses using global positioning system telemetry and activity data. Oecologia 181: 695-708.

Eneas, K. L. 2020. Influence of Livestock and Electrified Fences on Livestock Depredation and Habitat Selection by Grizzly Bears in the Mission Valley, Montana. Unpublished M.S.

Thesis, University of Montana. Graduate Student Theses, Dissertations, and Professional Papers. 11551.

Erlenbach, J. A., K. D. Rode, D. Raubenheimer, and C. T. Robbins. 2014. Macronutrient optimization and energy maximization determine diets of brown bears. Journal of Mammalogy 95: 160-168.

Felicetti, L. A., C. T. Robbins, and L. A. Shipley. 2003. Dietary protein content alters energy expenditure and composition of the mass gain in grizzly bears (*Ursus arctos horribilis*). Physiological and Biochemical Zoology 76: 256-261.

Ford, A. T., M. Barrueto, and A. P. Clevenger. 2017. Road mitigation is a demographic filter for grizzly bears. Wildlife Society Bulletin 41: 712-719.

Fortin, J. K., C. C. Schwartz, K. A. Gunther, J. E. Teisberg, M. A. Haroldson, and C. T. Robbins. 2013. Dietary adaptability of grizzly bears and American black bears in Yellowstone National Park. Journal of Wildlife Management 77:270–281.

Fowler, C.W. 1987. A review of density dependence in populations of large mammals, in Current Mammalogy (Genoways, H.H., ed.), pp. 401–441, Plenum Press.

Gaillard, J-M. M. Festa-Bianchet, and N. G. Yoccoz. 1998. Population dynamics of large herbivores: variable recruitment with constant adult survival. Trends in Ecology and Evolution 13: 58-63.

Garshelis, D. L. 2009. Family Ursidae. Pp. 448-497 in Wilson, D.E., and Mittermeier, R. A. eds., (2009). Handbook of Mammals of the World. Vol 1. Carnivores. Lynx Edicions, Barcelona.

Gibeau, M. L., A. P. Clevenger, S. Herrero, and J. Wierzchowski. 2002. Grizzly bear response to human development and activities in the Bow River Watershed, Alberta, Canada. Biological Conservation 103: 227-236.

Gonzalez, O., A. Zedrosser, F. Pelletier, J. E. Swenson, and M. Festa-Bianchet. 2012. Litter reductions reveal a trade-off between offspring size and number in brown bears. Behavioral Ecology and Sociobiology. DOI 10.1007/s00265-012-1350-3

Graham, K., J. Boulanger, J. Duval, and G. B. Stenhouse. 2010. Spatial and temporal use of roads by grizzly bears in west-central Alberta. Ursus 21: 43-56.

Graham, K. and G. B. Stenhouse. 2014. Home range, movements, and denning chronology of the grizzly bear (*Ursus arctos*) in west-central Alberta. Can Field Nat 128:223–233.

Green, G. I., D. J. Mattson, and J. M. Peek. 1997. Spring feeding on ungulate carcasses by grizzly bears in Yellowstone National Park. Journal of Wildlife Management 61: 1040-1055.

Gunther, K. A., R. R. Shoemaker, K. L. Frey, M. A. Haroldson, S. L. Cain, F. T. van Manen, and J. K. Fortin. 2014. Dietary breadth of grizzly bears in the Greater Yellowstone Ecosystem. Ursus 25: 60-72.

Gunther, K. A., K. Wilmot, S. L Cain, C. T. Wyman, E. Reinertson, and A. M. Bramblett. 2018. Managing human-habituated bears to enhance survival, habitat effectiveness, and public viewing. Human-Wildlife Interactions 12: 373-386.

Gunther, K. A., and C. T. Wyman. 2008. Human habituated bears: the next challenge in bear management in Yellowstone National Park. Yellowstone Science 16: 35-41.

Hamer, D. 1999. Forest fire's influence on yellow hedysarum habitat and its use by grizzly bears in Banff National Park, Alberta. Canadian Journal of Zoology 77: 1513-1520.

Hamer, D., and S. Herrero. 1987. Wildfire's influence on grizzly bear feeding ecology in Banff National Park, Alberta. International Conference on Bear Research and Management 7: 179-186.

Hansen, A. J., and L. B. Phillips. 2015. Which tree species and biome types are most vulnerable to climate change in the US Northern Rocky Mountains? Forest Ecology and Management 338: 68-83.

Haroldson, M. A., M. Clapham, C. C. Costello, K. A. Gunther, K. C. Kendall, S. D. Miller, K. E. Pigeon, M. E. Proctor, K. D. Rode, C. Servheen, G. B. Stenhouse, and F. T. van Manen. 2020. Brown bear (*Ursus arctos*; North America). In Press. V. Penteriani and M. Melletti, editors. Bears of the World: Ecology, Conservation and Management. Cambridge University Press.

Haroldson, M. A., C. C. Schwartz, S. Cherry, and D. S. Moody. 2004. Possible effects of elk harvest on fall distribution of grizzly bears in the Greater Yellowstone Ecosystem. Journal of Wildlife Management 68: 129-137.

Haroldson, M.A., M. A. Ternant, K. A. Gunther, and C.C. Schwartz. 2002. Grizzly bear denning chronology and movements in the Greater Yellowstone Ecosystem. Ursus 13:29–37.

Herrero, S. 2002. Bear attacks: their causes and avoidance, Revised edition. Lyons and Burford, New York, New York, USA.

Herrero, S. T. Smith, T. D. DeBruyn, K. Gunther, and C. A. Matt. 2005. From the field: brown bear habituation to people – safety, risks, and benefits. Wildlife Society Bulletin 33: 362-373.

Hilderbrand, G. V., S. G. Jenkins, C. C. Schwartz, T. A. Hanley, and C. T. Robbins. 1999a. Effect of seasonal differences in dietary meat intake on changes in body mass and composition in wild and captive brown bears. Canadian Journal of Zoology 77: 1623-1630.

Hilderbrand, G. V., C. C. Schwartz, C. T. Robbins, M. E. Jacoby, T. A. Hanley, S. M. Arthur, and C. Servheen. 1999b. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. Canadian Journal of Zoology 77: 132-138.

Holden, Z. A., W. F. Kasworm, C. Servheen, B. Hahn, and S. Dobrowski. 2012. Sensitivity of berry productivity to climatic variation in the Cabinet–Yaak Grizzly Bear Recovery Zone, Northwest United States, 1989–2010. Wildlife Society Bulletin 36: 226-231.

Interagency Grizzly Bear Committee (IGBC) 1993. Historical summary of interagecy grizzly bear Committee (IGBC) membership since 1983. http://igbconline.org/wp-content/uploads/2016/02/1993_IGBC-Historical-Summary-1.pdf.

Interagency Grizzly Bear Study Team (IGBST) 2013. Response of Yellowstone grizzly bears to changes in food resources: a synthesis. Report to the Interagency Grizzly Bear Committee and Yellowstone Ecosystem Subcommittee. Interagency Grizzly Bear Study Team, U.S. Geological Survey. Northern Rocky Mountain Science Center, Bozeman, MT.

Jacoby, M. E., G. V. Hilderband, S. Servheen, C. C. Schwartz, S. M. Arthur, T. A. Hanley, D. T. Robbins, and R. Michener. 1999. Trophic relations of brown and black bears in several western North American ecosystems. Journal of Wildlife Management 63: 921-929.

Jerina, K., and M. Adamiĉ. 2008. Fifty years of brown bear population expansion: effects of sex-biased dispersal on rate of expansion and population structure. Journal of Mammalogy 89: 1491-1501.

Johnson, C. J., M. S. Boyce, C. C. Schwartz, and M. A. Haroldson. 2004. Modeling survival: application of the Andersen-Gill model to Yellowstone grizzly bears. Journal of Wildlife Management 68:966-978.

Johnson, H. E., D. L. Lewis, T. L. Verzuh, C. F. Wallace, R. M. Much, L. K. Willmarth and S. W. Breck. 2017. Human development and climate affect hibernation in a large carnivore with implications for human-carnivore conflicts. Journal of Applied Ecology 55: 663-672.

Kamath, P. L., M. A. Haroldson, G. Luikart, D. Paetkau, C. Whitman and F. T. van Manen 2015. Multiple estimates of effective population size for monitoring a long-lived vertebrate: an application to Yellowstone grizzly bears. Molecular Ecology 24: 5507-5521.

Kasworm, W. F., and T. L. Manley. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana. International Conference on Bear Research and Management 8: 79-84.

Kasworm, W. F., M. F. Proctor, C. Servheen, and D. Paetkau. 2007. Success of grizzly bear population augmentation in northwest Montana. The Journal of Wildlife Management 71:1261-1266.

Kasworm, W. F., T. G. Radandt, J. E. Teisberg, T. Vent, A. Welander, M. Proctor, H. Cooley and J. Fortin-Noreus. 2019. Cabinet-Yaak grizzly bear recovery area 2018 research and monitoring progress report. U.S. Fish and Wildlife Service, Missoula, Montana. 98 pp.

Kasworm, W. F., T. G. Radandt, J. E. Teisberg, T. Vent, A. Welander, M. Proctor, H. Cooley and J. Fortin-Noreus. 2020. Cabinet-Yaak grizzly bear recovery area 2019 research and monitoring progress report. U.S. Fish and Wildlife Service, Missoula, Montana. 105 pp.

Keane, Robert E., D. F. Tomback, C. A. Aubry, A. D. Bower, E. M. Campbell, C. L. Cripps, M. B. Jenkins, M. F. Mahalovich, M. Manning, M, S. T. McKinney, M. P. Murray, D. L. Perkins, D. P. Reinhart, C. Ryan, A. W. Schoettle, and C. M. Smith. 2012. A range-wide restoration strategy for whitebark pine (*Pinus albicaulis*). Gen. Tech. Rep. RMRS-GTR-279. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 108 p.

Kearney, S. P., N. C. Coops, G. B. Stenhouse, S. E. Nielsen, T. Hermosilla, J. C. White, and M. A. Wulder. 2018. Grizzly bear selection of recently harvested forests is dependent on

forest recovery rate and landscape composition. Forest Ecology and Management 449: 117459.

Keay, J. A., C. T. Robbins, and S. D. Farley. 2018. Characteristics of a naturally regulated grizzly bear population. The Journal of Wildlife Management: 82: 789-801.

Kendall, K. C., T. A. Graves, J. A. Royle, A. C. Macleod, K. S. McKelvey, J. Boulanger and . S. Waller. 2019. Using bear rub data and spatial capture-recapture models to estimate trend in a brown bear population. Scientific Reports 9: 16804.

Kendall, K. C., J. B. Stetz, J. Boulanger, A. C. Macleod, D. Paetkau, and G. C. White. 2009. Demography and genetic structure of a recovering grizzly bear population. Journal of Wildlife Management 73:3–17.

Knowles, S. B. B. Bodenstein, T. Hamon, M. W. Saxton, and J. S. Hall. 2018. Infection canine hepatitus in a brown bear (*Ursus arctos horribilis*) from Alaska, USA. Journal of Wildlife Diseases 54: 642-645.

Kojola, I., and H-M. Laitala. 2000. Changes in the structure of an increasing brown bear population with distance from core areas: another example of presaturation female dispersal? Annales Zoologici Fennici 37: 59-64.

Krofel, M. M. Spacapan, and K. Jerina. 2016. Winter sleep with room service: denning behavior of brown bears with access to anthropogenic food. Journal of Zoology 302: 8-14.

Lamb, C. T., A. T. Ford, B. N. McLellan, M. F. Proctor, G. Mowat, L. Ciarniello, S. E. Nielsen, and S. Boutin. 2020. The ecology of human–carnivore coexistence. www.pnas.org/cgi/doi/10.1073/pnas.1922097117.

Lamb, C. T., G. Mowat, B. N. McLellan, S. E. Nielsen, and S. Boutin. 2017. Forbidden fruit: human settlement and abundant fruit create an ecological trap for an apex omnivore. Journal of Animal Ecology 86:55-65.

Lamb, C. T., G. Mowat, A. Reid., L. Smit, M. Proctor, B. N. McLellan, S. E. Nielsen, and S. Boutin. 2018. Effects of habitat quality and access management on the density of a recovering grizzly bear population. Journal of Applied Ecology 55: 1406-1417.

LeFranc, M. N. Jr., M. B. Moss, K. A. Patnode, and W. C. Sugg III, editors. 1987. Grizzly bear compendium. The National Wildlife Federation, Washington, D.C., USA.

Linke, J., G. J. McDermid, M-J. Fortin, and G. B. Stenhouse. 2013. Relationships between grizzly bears and human disturbances in a rapidly changing multi-use forest landscape. Biological Conservation 166: 54-63.

López-Alfaro, C. S., C. P. Coogan, C. T. Robbins, J. K. Fortin, and S. E. Nielsen. 2015. Assessing nutritional parameters of brown bear diets among ecosystems gives insight into differences among populations. PloS One 10: e0128088.

Mace, R. D., D. W. Carney, T. Chilton-Radandt, S. A. Courville, M. A. Haroldson, R. B. Harris, J. Jonkel, B. McClellan, M. Madel, T. L. Manley, C. C. Schwartz, C. Servheen, G. Stenhouse, J. S. Waller, and E. Wenum. 2012. Grizzly bear population vital rates and trend in the Northern Continental Divide Ecosystem, Montana. Journal of Wildlife Management 76: 119-128.

Mace, R. D., and J. S. Waller. 1996. Grizzly bear distribution and human conflicts in Jewel Basin Hiking Area, Swan Mountains, Montana. Wildlife Society Bulletin 24: 461.467.

Mace, R. D., J. S. Waller, T. L. Manley, K. Ake, and W. T. Wittinger. 1999. Landscape evaluation of grizzly bear habitat in western Montana. Conservation Biology 13: 367-377.

Mace, R. D., J. S. Waller, T. L. Manley, L. J. Lyon, and H. Zuuring. 1996. Relationships among grizzly bears, roads and habitat in the Swan Mountains, Montana. Journal of Applied Ecology 33: 1395-1404.

Maguire, L. A., and C. Servheen. 1992. Integrating biological and sociological concerns in endangered species management: augmentation of grizzly bear populations. Conservation Biology 6:426-434.

Martin, P. 1983. Factors influencing globe huckleberry fruit production in northwestern Montana. International Conference on Bear Research and Management 5: 159-165.

Matsubayashi, J., I. Tayasu, J. O. Morimoto, and T. Mano. 2016. Testing for a predicted decrease in body size in brown bears (*Ursus arctos*) based on a historical shift in diet. Canadian Journal of Zoology 94: 489-495.

Mattson, D. J. 1997a. Use of lodgepole pine cover types by Yellowstone grizzly bears. Journal of Wildlife Management 61: 480-496.

Mattson, D. J. 1997b. Selection of microsites by grizzly bears to excavate biscuitroots. Journal of Mammalogy 78: 228-238.

Mattson D. J. 1997c. Use of ungulates by Yellowstone grizzly bears. Biological Conservation 71: 161-177.

Mattson, D. J. 2000. Causes and Consequences of Dietary Differences Among Yellowstone Grizzly Bears (*Ursus arctos*). Unpublished Ph.D. dissertation. University of Idaho. 173 pp.

Mattson, D. J., R. R. Knight, and B. M. Blanchard. 1987. The effects of developments and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. International Conference on Bear Research and Management 7: 259-273.

Mattson, D. J., R. R. Knight, and B. M. Blanchard. 1992. Yellowstone grizzly bear mortality, human habituation, and whitebark pine seed crops. Journal of Wildlife Management 56: 432-442.

McLellan, B. 1994. Density-dependent population regulation of brown bears. Pages 15-24 *in* M. Taylor, editor. Density-dependent population regulation of black, brown, and polar bears. International Conference on Bear Research and Management Monograph Series No. 3.

McLellan, B. N. 2011. Implications of a high-energy and low-protein diet on body composition, fitness, and competitive abilities of black (*Ursus americanus*) and grizzly (*Ursus arctos*) bears. Canadian Journal of Zoology 89: 546-558.

McLellan, B. N. 2015. Some mechanisms underlying variation in vital rates of grizzly bears on a multiple use landscape. The Journal of Wildlife Management 79:749-765.

McLellan, B. N., and F. W. Hovey. 2001. Habitats selected by grizzly bears in a multiple use landscape. Journal of Wildlife Management 65: 92-99.

McLellan, B. N., F. W. Hovey, R. D. Mace, J. G. Woods, D. Carney, W., M. L. Gibeau, W. L. Wakkinen, and W. F. Kasworm. 1999. Rates and causes of grizzly bear mortality in the interior mountains of British Columbia, Alberta, Montana, Washington, and Idaho. Journal of Wildlife Management 63:911-920.

McLellan, B. N., and D. M. Shackleton. 1988. Grizzly bears and resource-extraction industries: effects of roads on behavior, habitat use and demography. Journal of Applied Ecology 25: 451-460.

Mikle, N., T. A. Graves, R. Kovach, K. C. Kendall, and A. C. Macleod. 2016. Demographic mechanisms underpinning genetic assimilation of remnant groups of a large carnivore. Proceedings of the Royal Society B: 283: 20161467.

Milakovic, B. and K. L. Parker. 2013. Quantifying carnivory by grizzly bears in a multi-ungulate system. Journal of Wildlife Management 77: 39-47.

Milakovic, B., K. L. Parker, D. D. Gustine, R. J. Lay, A. B. D. Walker, and M. P. Gillingham. 2012. Seasonal habitat use and selection by grizzly bears in Northern British Columbia. Journal of Wildlife Management 76: 170-180.

Miller, C. R., and L. P. Waits. 2003. The history of effective population size and genetic diversity in the Yellowstone grizzly (*Ursus arctos*): implications for conservation. Proceedings of the National Academy of Sciences of the United States of America 100:4334-4339.

Miller, C. R., L. P. Waits, and P. Joyce. 2006. Phylogeography and mitochondrial diversity of extirpated brown bear (*Ursus arctos*) populations in the contiguous United States and Mexico. Molecular Ecology 15:4477-4485.

Miller, S. D., R. A. Sellers, and J. A. Keay. 2003. Effects of hunting on brown bear cub survival and litter size in Alaska. Ursus 14:130-152.

Montana Fish, Wildlife and Parks (MFWP). 2013. Grizzly Bear Management Plan for Southwestern Montana 2013: Final Programmatic Environmental Impact Statement. Helena, Montana, 81 pp.

Morehouse, A. T., and M. S. Boyce. 2016. Grizzly bears without borders: spatially explicit capture-recapture in southwestern Alberta. Journal of Wildlife Management 80:1152–1166.

NCDE Subcommittee. 2021. Conservation strategy for the grizzly bear in the Northern Continental Divide Ecosystem. (169 pages + appendices).

Nielsen, S. E., M. S. Boyce, and G. B. Stenhouse. 2004. Grizzly bears and forestry: I. Selection of clearcuts by grizzly bears in west-central Alberta, Canada. Forest Ecology and Management 199: 51-65.

Nielsen, S. E., G. B. Stenhouse, H. L. Beyer, F. Huettmann, and M. S. Boyce 2008. Can natural disturbance-based forestry rescue a declining population of grizzly bears? Biological Conservation 141: 2193-2207.

Northrup, J. M., G. B. Stenhouse, and M. S. Boyce. 2012. Agricultural lands as ecological traps for grizzly bears. Animal Conservation 15: 369-377.

Parsons, B. M., N. C. Coops, S. P. Kearney, A. C. Burton, T. A. Nelson, and G. B. Stenhouse. 2021. Road visibility influences habitat selection by grizzly bears (*Ursus arctos horribilis*). Canadian Journal of Zoology 99: 161-171.

Pasitschniak-Arts, M. 1993. Ursus arctos. Mammalian Species: 1-10.

Peatkau, D. L. P. Waits, P. L. Clarkson, L. Craighead, E. Vyse, R. Ward, and C. Strobeck. 1998. Variation in genetic diversity across the range of North American brown bears. Conservation Biology 12: 418-429.

Peck, C. P, F. T. van Manen, C. M. Costello, M. A. Haroldson, L. A. Landenburger, L. L. Roberts, D. D. Bjornlie, and R. D. Mace. 2017. Potential paths for male-mediated gene flow to and from an isolated grizzly bear population. Ecosphere 8(10):e01969. 10/1002.ecs2/1969.

Pengelly, I. and D. Hamer. 2006. Grizzly bear use of pink hedysarum roots following shrubland fire in Banff National Park, Alberta. Ursus 17: 124-131.

Phoebus, I., G. Segelbacher, and G. B. Stenhouse. 2017. Do large carnivores use riparian zones? Ecological implications for forest management. Forest Ecology and Management 402: 157-165.

Pigeon, K. E., E. Cardinal, G. Stenhouse, and S. D. Côté. 2016a. Staying cool in a changing landscape: the influence of maximum daily ambient temperature on grizzly bear habitat selection. Oecologia 181: 1101-1116.

Pigeon, K. E., G. Stenhouse, and S. D. Côté. 2016b. Drivers of hibernation: linking food and weather to denning behavior of grizzly bears. Behavioral Ecology and Sociobiology 70: 1745-1754.

Podruzny, S. R., D. P. Reinhart, and D. J. Mattson. 1999. Fire, red squirrels, whitebark pine, and Yellowstone grizzly bears. Ursus 11: 131-138.

Prevéy, J. S., L E. Parker, C. A. Harrington, C. T. Lamb, and M. F. Proctor. 2020. Climate change shifts in habitat suitability and phenology of huckleberry (*Vaccinium membranaceum*). Agricultural and Forest Meteorology 280: 107803.

Proctor, M. F., B. N. McLellan, C. Strobeck, and R. M. R. Barclay. 2004. Gender-specific dispersal distances of grizzly bears estimated by genetic analysis. Canadian Journal of Zoology 82:1108–1118.

Proctor, M. F, and A. T. Morehouse. 2021. Assessment of grizzly bears (*Ursus arctos*) north of the Canada-U.S. border and their relationship to populations in the lower-48 States. Appendix E in U.S. Fish and Wildlife Service. 2021. Biological report for the grizzly bear (*Ursus arctos horribilis*) in the Lower-48 States. Version 1.1, January 31, 2021. Missoula, Montana. 370 pp.

Proctor, M. F., B. N. McLellan, G. B. Stenhouse, G. Mowat, C. T. Lamb, and M. S. Boyce. 2019. Effects of roads and motorized human access on grizzly bear populations in British Columbia and Alberta, Canada. Ursus 30: article e2.

Proctor, M. F., S. E. Nielsen, W. F. Kasworm, C. Servheen, T. G. Radandt, A. G. MacHutchon, and B. S. Boyce. 2015. Grizzly bear connectivity mapping in the Canada-United States trans-border region. Journal of Wildlife Management 79: 544-558.

Proctor, M. F., D. Paetkau, B. N. McLellan, G. B. Stenhouse, K. C. Kendall, R. D. Mace, W. F. Kasworm, C. Servheen, C. L. Lausen, M. L. Gibeau, W. L. Wakkinen, M. A. Haroldson, G. Mowat, C. D. Apps, L. M. Ciarniello, R. M. R. Barclay, M. S. Boyce, C. C. Schwartz, and C. Strobeck. 2012. Population fragmentation and inter-ecosystem movements of grizzly bears in western Canada and the northern United States. Wildlife Monographs 180:1–46.

Ramcharita, R. K. 2000. Grizzly Bear Use of Avalanche Chutes in the Columbia Mountains, British Columbia. Unpublished M.S. thesis. 42 pp.

Ramey, A. M., Cleveland, C. A., Hilderbrand, G. V., Joly, K., Gustine, D. D., Mangipane, B., Leacock, W. B., Crupi, A. P., Hill, D. E., Dubey, J. P., and Yabsley, M. J. 2019. Exposure of Alaska brown bears (*Ursus arctos*) to bacterial, viral, and parasitic agents varies spatiotemporally and may be influenced by age. Journal of Wildlife Diseases 55: 576-588.

Ransom, J. I., M. Krosby, and A. L. Lyons. 2018. Climate change implications for grizzly bears (*Ursus arctos*) in the North Cascades Ecosystem. Natural Resource Report NPS/NOCA/NRR—2018/1814. National Park Service, Fort Collins, Colorado.

Rausch, R. L. 1963. Geographic variation in size in North American brown bears, *Ursus arctos* L., as indicated by condylobasal length. Canadian Journal of Zoology 41:33-45.

Rickbeil, G. J. M., N. C. Coops, E. E. Berman, C. J. R. McLelland, D. K. Bolton, and G. B. Stenhouse. 2020. Changing spring snow cover dynamics and early season forage availability affect the behavior of a large carnivore. Global Change Biology 26:6266-6275.

Robbins, C. T., M. Ben-David, J. K. Fortin, and O. L. Nelson. Maternal condition determines birth date and growth of newborn bear cubs. 2012. Journal of Mammalogy 93: 540-546.

Robbins, C. T., J. K. Fortin, K. D. Rode, S. D. Farley, L. A. Shipley, and L. A. Felicetti. 2007. Optimizing protein intake as a foraging strategy to maximize mass gain in an omnivore. Oikos 116: 1675-1682.

Robbins, C.T., C. C. Schwartz, and L. A. Felicetti, L.A., 2004. Nutritional ecology of Ursids: a review of newer methods and management implications. Ursus 15: 161–171.

Roberts, D.R., S. E. Nielsen, and G.B. Stenhouse. 2014. Idiosyncratic responses of grizzly bear habitat to climate change based on projected food resource changes. Ecological Applications 24: 1144-1154.

Rode, K. D., and C. T. Robbins. 2000. Why bears consume mixed diets during fruit abundance. Canadian Journal of Zoology 78: 1640-1645.

Rode, K. D., C. T. Robbins, and L. A. Shipley, L.A. 2001. Constraints on herbivory by grizzly bears. Oecologia 128: 62–71.

Roever, C. L., M. S. Boyce, and G. B. Stenhouse. 2008a. Grizzly bears and forestry I: Road vegetation and placement as an attractant to grizzly bears. Forest Ecology and Management 256: 1253-1261.

Roever, C. L., M. S. Boyce, and G. B. Stenhouse. 2008b. Grizzly bears and forestry II: Grizzly bear habitat selection and conflicts with road placement. Forest Ecology and Management 256: 1262-1269.

Rogers, L. L., and S. M. Rogers. 1976. Parasites of bears: a review. Pages 411–430 *in* Bears: their biology and management. Proceedings of the 3rd International Conference on Bear Research and Management, Binghamton, New York, USA.

Ruth, T. K., D. W. Smith, M. A. Haroldson, P. C. Buotte, C. C. Schwartz, H. B. Quigley, S. Cherry, K. M. Murphy, D. Tyers, and K. Frey. 2003. Large-carnivore response to recreational big-game hunting along the Yellowstone National Park and Absaroka-Beartooth Wilderness boundary. Wildlife Society Bulletin. 31: 1150-1161.

Sawaya, M. A., A. P. Clevenger, and S. T. Kalinowski. 2013. Demographic connectivity for Ursid populations at wildlife crossing structures in Banff National Park. Conservation Biology 27: 721-730.

Schwartz, C. C., M. A. Haroldson, and S. Cherry. 2006b. Reproductive performance of grizzly bears in the Greater Yellowstone Ecosystem, 1983-2002. Pp. 18-23 in Schwartz, C.C., M. A. Haroldson, G. C. White, R. B. Harris, S. Cherry, K. A. Keating, D. Moody, and C. Servheen. 2006. Temporal, spatial, and environmental influences on the demographics of grizzly bears in the Greater Yellowstone Ecosystem. Wildlife Monograph 161: 1–68.

Schwartz, C. C., M. A. Haroldson, and G. C. White. 2006c. Survival of cub and yearling grizzly bears in the Greater Yellowstone Ecosystem, 1983-2001. Pp. 25-31 in Schwartz, C.C., M. A. Haroldson, G. C. White, R. B. Harris, S. Cherry, K. A. Keating, D. Moody, and C. Servheen. 2006. Temporal, spatial, and environmental influences on the demographics of grizzly bears in the Greater Yellowstone Ecosystem. Wildlife Monograph 161: 1–68.

Schwartz, C. C., M. A. Haroldson, and G. C. White. 2010. Hazards affecting grizzly bear survival in the Greater Yellowstone Ecosystem. Journal of Wildlife Management 74: 654-667.

Schwartz, C. C., S. D. Miller, and M. A. Haroldson. 2003. Grizzly bear. Pages 556-586 *in* G. A. Feldhamer, B. C. Thompson, and J. A. Chapman, editors. Wild mammals of North America: biology, and management, and conservation. The Johns Hopkins University Press, Baltimore, Maryland, USA.

Servheen, C., 1983. Grizzly bear food habits, movements, and habitat selection in the Mission Mountains, Montana. Journal of Wildlife Management 47: 1026-1035.

Servheen, C. and M. Cross. 2010. Climate change impacts on grizzly bears and wolverines in the Northern U.S. and Transboundary Rockies: Strategies for Conservation. Workshop Summary Report, September 13-15, 2010, Fernie, British Columbia 23 pp.

Shanahan, E., K. M. Irvine, D. Thoma, S. Wilmoth, A. Ray, K. Legg, and H. Shovic. 2016. Whitebark pine mortality related to white pine blister rust, mountain pine beetle outbreak, and water availability. Ecosphere 7: e01610.

Seesee, F. M., and D. E. Worley. 1986. *Taenia ovis krabbei* from grizzly bears, Ursus arctos, in Montana and adjacent areas. Proceedings of the Helminthological Society of Washington. 53: 298-300.

Serrouya, R., B. N. McLellan, G. D. Pavan, and C. D. Apps. 2011. Grizzly bear selection of avalanche chutes: testing the effectiveness of forest buffer retention. Journal of Wildlife Management 75: 1597-1608.

Servheen, C., W. Kasworm, and A. Christensen. 1987. Approaches to augmenting grizzly bear populations in the Cabinet Mountains of Montana. International Conference on Bear Research and Management 7:363-367.

Souliere, C. M., S. C. P. Coogan, G. B. Stenhouse, and S. E. Nielsen. 2020. Harvested forests as a surrogate to wildfires in relation to grizzly bear food-supply in west-central Alberta. Forest Ecology and Management 456: 117685.

Stewart, B. P., T. A. Nelson, K. Laberee, S. E. Nielsen, M. A. Wulder, and G. Stenhouse. 2013. Quantifying grizzly bear selection of natural and anthropogenic edges. Journal of Wildlife Management 77: 957-964.

Støen, O-G., A. Zedrosser, P. Wegge, and J. E. Swenson. 2006. Socially induced delayed primiparity in brown bears *Ursus arctos*. Behavioral Ecology and Sociobiology 61:1-8.

Swenson, J. E., B. Dahle, and F. Sandegren. 2001a. Intraspecific predation in Scandinavian brown bears older than cubs-of-the-year. Ursus 12:81-92.

Swenson, J. E., F. Sandegren, and A. Söderberg. 1998. Geographic expansion of an increasing brown bear population: evidence for presaturation dispersal. Journal of Animal Ecology 6:819–826.

Swenson, J. E., F. Sandegren, S. Brunberg, and P. Segerstrom. 2001b. Factors associated with loss of brown bear cubs in Sweden. Ursus 12:69-80.

Swenson, J. E., F. Sandegren, A. Söderberg, A. Bjärvall, R. Franzén, and P. Wabakken. 1997b. Infanticide caused by hunting of male bears. Nature 386:450-451.

Thorne, E. T., N. Kingston, W. R. Jolley, and R. C. Bergstrom, Editors. 1982. Diseases of wildlife in Wyoming. Wyoming Game and Fish Department. Cheyenne.

U.S. Fish and Wildlife Service (USFWS) 1993. Grizzly bear recovery plan. Missoula, MT. 181. Pp.

U.S. Fish and Wildlife Service (USFWS) 2019. Grizzly bear recovery program. 2019 annual report. Grizzly Bear Recovery Program, Missoula, MT.

U.S. Fish and Wildlife Service (USFWS) 2020. Grizzly bear recovery program. 2020 annual report. Grizzly Bear Recovery Program, Missoula, MT.

U. S. Fish and Wildlife Service (USFWS) 2021. Biological report for the grizzly bear (*Ursus arctos horribilis*) in the Lower-48 States. Version 1.1, January 31, 2021. Missoula, Montana. 370 pp.

van Manen. F. T, M R. Ebinger, D. D. Gustine, M A. Haroldson, K. R. Wilmot, and C. L. Whitman. 2019. Primarily resident grizzly bears respond to late-season elk harvest. Ursus 30: 1-15.

van Manen. F. T, M R. Ebinger, M A. Haroldson, R. B. Harris, M. D. Higgs, S. Cherry, G. C. White, and C. C. Schwartz. 2014. Re-Evaluation of Yellowstone grizzly bear population dynamics not supported by empirical data: Response to Doak & Cutler. Conservation Letters 7: 323–331.

van Manen, F. T., M. A. Haroldson, D. D. Bjornlie, M. R. Ebinger, D. J. Thompson, C. M. Costello, and G. C. White. 2016. Density dependence, whitebark pine, and vital rates of grizzly bears. The Journal of Wildlife Management 80:300–313.

Waller, J. S., and R. D. Mace. 1997. Grizzly bear habitat selection in the Swan Mountains, Montana. Journal of Wildlife Management 61: 1032-1039.

Waller, J. S., and C. Servheen. 2005. Effects of transportation infrastructure on grizzly bears in northwestern Montana. Journal of Wildlife Management 69: 985-1000.

Welch, C. A., J. Keay, K. C. Kendall, and C. T. Robbins. 1997. Constraints on frugivory by bears. Ecology 78: 1105-1119.

Wielgus, R. B. P. R. Vernier, and T. Schivatcheva. 2002. Grizzly bear use of open, closed, and restricted forestry roads. Canadian Journal of Forest Research 32: 1597-1606.

Wilson, S. M., M. J. Madel, D. J. Mattson, J. M. Graham, J. A. Burchfield, and J. M. Belsky. 2005. Natural landscape features, human-related attractants, and conflict hotspots: a spatial analysis of human-grizzly bear conflicts. Ursus 16: 117-129.

Wilson, S. M., M. J. Madel, D. J. Mattson, J. M. Graham, and T. Merrill. 2006. Landscape conditions predisposing grizzly bears to conflicts on private agricultural lands in the western USA. Biological Conservation 130: 47-59.

Zager, P. C., and J. Beecham. 2006. The role of American black bears and brown bears as predators on ungulates in North America. Ursus 17: 95-108.

Zager, P. C. Jonkel, and J. Habeck. 1983. Logging and wildfire influence on grizzly bear habitat in northwestern Montana. International Conference on Bear Research and Management 5: 124-132.

Zarnke, R. L., and M. B. Evans. 1989. Serologic survey for infectious canine hepatitis virus in grizzly bears (*Ursus arctos*) from Alaska, 1973 to 1987. Journal of Wildlife Diseases 25:568-573.

Zarnke R. L., R. Gamble, R. A. Heckert, and J. Ver Hoef. 1997. Serologic survey for *Trichinella* spp. in grizzly bears from Alaska. Journal of Wildlife Diseases 33:474–479.

Zedrosser, A., F. Pelletier, R. Bischof, M. Festa-Bianchet, and J. E. Swenson. 2013. Determinants of lifetime reproduction in female brown bears: early body mass, longevity, and hunting regulations. Ecology 94: 231-240.