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Comments on the

Endangered and Threatened Wildlife and Plants; Removing the Greater Yellowstone Ecosystem Population of Grizzly Bears from the Federal List of Endangered and Threatened Wildlife
AGENCY: Fish and Wildlife Service
ACTION: Proposed rule; reopening of comment period; availability of peer review and supplementary documents.
Federal Register 81(173): 61658-61661

And Related Materials

October 7, 2016

What follows in this document supplements comments that I submitted on 6 May 2016 in response to the Service's the first solicitation of comment regarding its proposal to remove the Greater Yellowstone Ecosystem Population of Grizzly Bears from the Federal List of Endangered and Threatened Wildlife. My comments here are submitted in response to the second solicitation of input that the Service published in the Federal Register 81(173). I refer the Service to my first round of comments for a description of my background and interests.

In summary, the Rule and supporting materials are profoundly deficient and require major revisions before they can constitute a credible basis for any deliberations regarding removal of ESA protections for Yellowstone's grizzly bear population. Contrary to the Service's contentions, the Yellowstone grizzly bear population continues to the threatened by deteriorating habitat conditions, unsustainable human-caused mortality, inadequate connectivity with grizzly bear populations elsewhere, intrinsically hostile state wildlife management regimes, and lack of adequate regulatory mechanisms should delisting occur. Moreover, the Service has offered the public a convoluted, perverse, and time-limited decision-making process that debars meaningful comment on the whole of the delisting package as well as any prospects for meaningful revision in light of public input. I can only conclude that this proposal by the Service is politically-driven and in cynical disregard of due process.

My comments are organized according to three numbered over-arching points under which I have differentiated subpoints. Referenced literature can be found at the end of this document.

1. The Service fails to adequately address the genetic health of Yellowstone's grizzly bear population by failing to rely on the best available science and by failing to account for relevant uncertainties.

The Service's current provisions in the Rule for managing the genetic health of Yellowstone's grizzly bear population are inadequate and additionally problematic. Problems with the Service's treatment fall into three broad categories:

1a. The Service ignores uncertainty and overstates the genetic health of Yellowstone's grizzly bears

Relying almost exclusively on Kamath et al. (2015), the Service overstates and otherwise misrepresents the current and prospective genetic health of Yellowstone's grizzly bear population. For previous articulations of this problem see the 10 May letter submitted by Earthjustice Legal Defense Fund and the 10 May letter jointly submitted by the American Society of Mammalogists (ASM) and Society for Conservation Biology (SCB) in response to the Service's first solicitation of comments on the Rule. Succinctly, the ASM and SCB state that "…adequate dispersal between GYE and other subpopulations to the north and west is necessary to sustain the genetic viability of the GYE population over the long-term." In addition to highlighting the *prima facie* implausibility of most results in Kamath et al. (2015) and the Service's interpretation of this and other genetic research, Earthjustice further points out that "…a finding of recovery that was dependent on…translocation would fail to satisfy the ESA's requirement for recovery of wild populations that are self-sustaining without affirmative human intervention to address basic needs."

Amplifying previous critiques here, the Service has clearly "cherry-picked" results from Kamath et al. (2015) to fit an apparent political agenda while ignoring critical uncertainties in the estimates it does chose to highlight. More specifically, the Service *failed to use the best available science* by **(1)** ignoring the comparative merits of metrics used by Kamath et al. (2015); **(2)** ignoring the distinction between and relative merits of featuring effective population size (N_e) versus number of effective breeders (N_b); **(3)** exclusively featuring a metric that has not been rigorously evaluated by researchers (EPA, or Estimator of Parentage Assignments) while ignoring the metric that is currently most highly recommended (SF/SA, or Sibship Frequency/Assignment); **(4)** because of exclusive emphasis on EPA versus SF/SA, grossly overstating the growth in numbers of effective breeders over time; and **(5)**, even in featuring EPA, completely ignoring the huge uncertainty in estimates produced by this method, of a range that further renders the Service's claims (and Kamath et al's results) all the more implausible. By way of explanation:

Kamath et al. (2015) used three methods to produce estimates of either N_e or N_b: EPA, which accounts for overlapping generations and produces a direct estimate of N_e; and SF/SA and LD (Linkage Disequilibrium), which deal only with a single reproductive episode (3-years in the case of grizzly bears given the 3-year reproductive interval of females) and estimate N_b rather than N_e. Both N_e and N_b indicate genetic health of a population, but only N_e has been directly related *in theory* to a presumed minimum number needed to reasonably guard against inbreeding depression and long-term losses of genetic diversity.

Of the three metrics used by Kamath et al. (2015), EPA is the most complex, contingent and assumption ridden (as are resulting estimates of N_e). Its computational contingencies and complexities are partly manifest in the large uncertainty of estimates (e.g., see Kamath et al. [2015] and my comments below). More importantly, in contrast to recent attempts by Jinliang Wang to rigorously evaluate single-sample estimators of N_b, including SF/SA and LD (Wang 2016; Wang et al. 2016), ETA has not been similarly rigorously evaluated, and so remains all the more uncertain. Importantly, as emphasized by Waples (2016), Wang (2016) represents the current "best available

science," specifically the conclusion that the single-sample SF/SA method (and corresponding estimates of N_b) is the most robust, accurate, and broadly applicable of any so far evaluated. Mysteriously, rather than emphasizing Kamath et al's SF/SA-based estimates of N_b, the Service instead exclusively features EPA-based estimates of N_e. This choice by the Service is not explained, nor thereby defensible, nor the "best available science."

Waples (2016) and Wang et al. (2016) make an additional important point about the reliability of all of the methods currently used to estimate N_b and N_e, including those evaluated by Wang (2016). Specifically, the current state of the art entails evaluation of only a fraction of the permuted scenarios of relevance to the several interacting assumptions related to population-sampling, genetics-sampling, population-demographic, and genetic processes that are certain to affect all estimators in some measure; this aside from the current under-assessment of EPA. Moreover, N_e can provide insight into historical rates of change in genetic diversity, but, given the wide range of N_e values among wildlife populations, including *Ursus arctos*, this metric offers much less when it comes to predicting future rates of change arising from contingencies on changing demographic processes, in turn contingent on the sorts of temporally- and spatially-explicit habitat changes occurring in Yellowstone's grizzly bear habitat. All methods are under-assessed and with limited predictive capabilities, which further amplifies uncertainties regarding current and future genetic health of Yellowstone's grizzly bear population.

Given these considerations, the Service's failure to account for even the uncertainty and implausibility of EPA-based estimates of N_e that it does feature is particularly egregious. These values, even taken at face value, are hugely variable and uncertain. Ninety-five percent confidence intervals for the 2004-2007 annual estimates of N_e reported in Kamath et al. (2015) range between roughly 185 and 870, with an annual amplitude of around 500-700, equivalent to 1.2-1.4-times the magnitude of the central tendency. The top end of these annual estimates is around 800-870, which is a staggering 60-90% of the most optimistic (Mark-Resight) estimates of census population size (N) for Yellowstone grizzly bears. The point estimates of N_e produced by EPA are likewise a staggering 70-90% of census population estimates produced by the Chao2 method, which the Service claims is "the best available science." These proportions would require that every available adult and subadult bear, plus some cubs and yearlings would need to have bred, and are far in excess of the previously documented ratios of N_e /N for populations of *Ursus arctos* that the Service itself cites on page 13211 of the Rule, in the range of 0.25-0.27. Nowhere does the Service attempt to account for the huge uncertainty in EPA-based estimates; nor does it attempt to reconcile the implausible estimates that it does field with previous research; nor does it attempt to provide a plausible biological/ecological explanation for that which is fundamentally inexplicable.

More defensibly, the Service would be better off featuring the SF/SA-based estimates of N_b that Kamath et al. (2015) provide, more rigorously updated by Wang (2016). Kamath et al's moving three-year means for N_b, 2004-2007, are roughly 140-150, with comparatively modest 95% Confidence Intervals ranging between 100 and 200. Wang (2016) comes in with a substantially lower point estimate of around 100 for the period 2008-2010. These numbers are still potentially high given even optimistic estimates derived from demographic data of the total number of bears available to breed during a given 3-year period. Even so, the SF/SA method is more defensible as "best available science" compared to the EPA method, although more obscure as a point measure of population-level genetic health. Perhaps more importantly, SF/SA-estimates of N_b show only a 2.2-fold increase in this measure during 1984-2007, in contrast to the 4.3-fold increase in N_e that EPA-based estimates purportedly show for the same period. This is a huge difference that cannot be ignored and needs to be accounted for by the Service as part of any prudent decision-making process.

In short, prudence and precaution would support concluding that the long-term genetic health and viability of Yellowstone's grizzly bear population depends upon natural connectivity with grizzly bear populations farther

north and west. Whatever the means, the Service needs to insure that infusion of genes into the GYE from elsewhere occurs on a regular basis—at least 1-2 successfully reproducing bears per generation (Miller and Waits 2003; but see my comments below).

1b. The Service contradicts itself

At the same time that it dismisses genetic concerns, the Service continues to argue that genetic connectivity is, in fact, desirable and beneficial—without making any attempt to reconcile this contradiction. More explicitly, on p. 13211 the Service argues "While [the] current effective population size of approximately 469 animals is adequate to maintain genetic health in this population, 1 to 2 effective migrants from other grizzly bear populations every 10 years would maintain or enhance this level of genetic diversity and therefore assure genetic health in the long term." The Service then goes on to state on p. 13212 that "Genetic concerns are not currently a threat to the GYE grizzly bear population." The Service can't have it both ways. But, more specifically, as per my first point, the GYE is, in fact, threatened by genetic isolation and, because of that, remedial measures are needed.

1c. The Service makes inadequate provisions for insuring genetic connectivity

The Service relies on unsubstantiated trust in vague commitments by the State of Montana.—Having argued for the benefits of genetic connectivity between Yellowstone and the NCDE, yet dropped any provisions for translocation of bears, the Service instead opts for reliance on vague assurances from the State of Montana to "…manage discretionary mortality in [the area between the GYE and NCDE] in order to retain the opportunity for natural movements of bears." The level of commitment ascribed by the Service to the State of Montana is an "indicated" intention (p. 13212).

The Service's reliance on this level of commitment for realization of something as critical as genetic connectivity is rendered all the more indefensible in light of a joint 9 May 2016 letter submitted by the states of Montana, Wyoming, and Idaho in response to the Service's first solicitation of comments on the Rule. The states make absolutely clear that they will not commit to any measures that would insure connectivity. For example, on page 12 of their comments they state "…*it is inappropriate* [emphasis added] for USFWS to impose additional requirements as to connectivity for delisting the GYE DPS, where connectivity and genetic exchange do not threaten the population." Presumably, the Service would have us trust the State of Montana in the absence of any commitments, assurances, or accountability. For more on this, see my comment 3, below.

The Service does not realistically provide for genetically successful migrants.—Adopting the assumption that an infusion of new genes will be required to sustain the genetic health of Yellowstone's grizzly bear population, the Service leaves the erroneous impression in the current and previous 2007 Rule that only two bears will need to be either translocated or arrive naturally to alleviate genetic concerns. But, as the Service makes clear, "…an effective migrant is an individual that immigrates into an isolated population from a separate area, *survives, breeds, and whose offspring survive* [emphasis added]" (p. 13211). In other words, the influx of new individuals, either naturally or by management action, needs to be many more than 2 per decade to translate into an effective introduction of new genetic material. Only a fraction of newly arrived bears will survive to successfully reproduce and have offspring recruited.

This begs the question of what the fraction of successful reproducers among migrants or translocated bears would be. Among bears native to Yellowstone and adapted to this environment, the fraction would probably be close to the ratio of N_e/N (effective population size/census population size). Depending on the sex and age of immigrant (or

translocated) bears, the ratio could be lower yet for non-natives. The ratio would be conditioned on survival rates of immigrants as well as their success at consummating reproductive opportunities.

With these considerations in mind, N_e/N ratios have been estimated for the Yellowstone population as well as for brown bear populations elsewhere, in the range of 0.05 to an absurdly high 0.90 (see my point 1). A more plausible range is probably 0.05 to, at most, 0.44. There is also relevant empirical data for the success of bears translocated into the Cabinet Mountains of northwestern Montana, including not only the number of bears that successfully reproduced, but also their annual survival rate. Given that 2 of 15 bears were known to have reproduced and an annual survival rate for these bears of approximately 0.848 (Kasworm et al. 2015), these numbers translate into a success rate of 0.0399 per bear year, where each year for each translocated animal subsequent to its introduction is weighted by the annual survival rate to arrive at a "bear year."

Using these figures, one can simulate various scenarios that entail introducing varying numbers of bears per decade in varying annual patterns, as well as varying sex-indifferent annual survival rates between 0.85 and 0.9 to derive a range of bears needed to achieve the goal of 2 genetically effective migrants per generation (i.e., roughly 10 years). Given that bears introduced or naturally arriving during one decade will survive to potentially reproduce the next, estimates are logically derived for 2-decade periods.

The results are perhaps surprising. Whether introduced by managers or arriving on their own, **the most optimistic scenario would require a front-weighted infusion of 13 bears over a 20 year period**, assuming 9 arrived the first decade. **The most pessimistic scenario would require an infusion of 30 bears over 2 decades**, assuming that 16 arrived the first decade. These numbers are **3-8 times greater** than the expected yield of genetically effective immigrants and would entail, on average, the annual translocation or natural immigration of an average **1-2 bears per year, or 7-15 bears per decade**.

The implication is straight-forward. Contrary to the innuendo of the Rule, translocation to achieve genetic goals would be a major and on-going logistical undertaking. Moreover, if the infusion of bears, as in the Cabinet-Yaak Mountains, were weighted towards females (e.g., around 75%) this would constitute a major toll on the source population(s) of roughly 10 females per decade. Likewise, natural connectivity would need to provide for more than the occasional arrival of a wide-ranging male. Connectivity would need to be robust enough to insure a routine and significant flux of bears into the Yellowstone ecoregion.

Conclusion: The Service needs to remedy its deficient representation, interpretation, and application of relevant literature pertaining to the genetic health of Yellowstone's grizzly bear population. Having done so, the Service needs to realistically and consistently address the issue of genetic health, including the logistical and other practical demands of assuring sufficient natural immigration or human-assisted translocation. This latter task requires a rigorous evidence-based approach rather than the current vague and innuendo-laden assertions of the Rule.

2. Provisions in both in the proposed Rule and in the MOA adopted by the states of Wyoming, Montana, and Idaho for managing post-delisting mortality of Yellowstone grizzly bears constitute an inadequate mechanism that will lead to sustained and uncorrected over-killing of bears in this ecosystem.

The Supplementary information published by the Service on 7 September 2016 in Federal Register 81(173): 61658-61661 essentially reiterates verbatim provisions originally specified in the proposed rule of 11 March 2016 for managing grizzly bear mortality in the Yellowstone ecoregion after removal of ESA protections, but with the additional statement that these provisions had been formally adopted by the states of Montana, Wyoming, and Idaho as a final Tri-State MOA. The Tri-State MOA is essentially an unmodified version of the "Final Draft" MOA that existed at the time that the Service's 11 March 2016 proposed rule was issued. As a result, all of the critiques and concerns that I submitted as part of my comments dated 5 June 2016 comments still hold, specifically my point 20 as well as elements of my point 19 in this previous document.

However, I have additional major concerns about methods described in the MOA, in addition to problems with semantics, how "discretionary" mortality is calculated (including lack of provision for unknown/unrecorded deaths), and critical discrepancies between the methods described by the Service in its proposed Rule and methods described in the Tri-State MOA. In short, the MOA is a grossly inadequate mechanism for post-delisting management of Yellowstone's grizzly bears, designed to produce catastrophic declines in certain grizzly bear cohorts that will not only be undetected, but additionally fail to trigger any corrective actions by the involved states. Moreover, the States have made clear in comments submitted on 9 May 2016 as well as in their respective state plans that none of the methods or triggers described by the Service are binding, and that all are wholly discretionary. Regarding the particulars:

2a. There are *prima facie* problems with proposed methods for managing post-delisting mortality sufficient to debar any confidence in these methods as an adequate mechanism.

There are *prima facie* reasons for concern about the prospective effects of fully implementing provisions of the MOA that arise from the fact that (1), barring any episodic re-estimation of population sex-age structure, population estimates are driven wholly by estimated numbers of reproductive females (more specifically females with COY), which are merely multiplied by various fixed factors to account for other bear cohorts in deriving an estimate of total population size; (2) independent males are currently estimated to be equal to numbers of independent females (a 1:1 ratio), without any employment of direct annual indicators; (3) calculations of "discretionary" mortality will be based on female-with-COY driven estimates of population size for the entire ecosystem, including bears residing partly or wholly in National Parks; (4) the brunt of "discretionary" mortality will be borne by bear living outside of Parks, including the totality of any sport hunting; (5) revision of population sex-age structure will be a discretionary option for the States only if mortality thresholds are violated three-years running; (6) discretionary thresholds for triggering changes in allowable mortality rates only occur at *estimated* populations sizes of 674 and 600; and (7) independent males are allowed to be killed at roughly twice the rate of independent females (15 versus 7.6%, and 20 versus 9%).

This last provision (number 7) gives rise to a nonsensical proposition embraced by the States and the Service: That managers can kill males at twice the rate as they do females and insure a more-or-less stable population; and this when males and females are born in roughly even numbers. Quite simply, there is no way that this can hold true. Moreover, this nonsensical proposition gives rise to many of the problems potentially anticipated with

implementation of the MOA, specifically, that males will be open to grossly unsustainable levels of mortality almost wholly concentrated outside of National Parks.

I emphasize the plight of male bears *outside* of Parks primarily because of an additional dynamic that predictably arises from including Park bears in calculations of allowable mortality that will be meted out primarily to bear outside of Parks (my point 3 above). Park bears will continue to enjoy high levels of protection post-delisting, which will stand in stark contrast to bears outside of Park boundaries. More egregiously, under terms of the MOA, Park bears will be used to subsidize levels of mortality allowed *outside* of Park boundaries. Put another way, compared to non-Park bears, Park bears of both sexes will be killed at a much lower rate than the ecosystem-wide target, and non-Park bears at substantially higher rates, especially so for independent males living outside Park boundaries. For example, both males and females inside Parks will probably continue to die at roughly a 5% per annum rate, whereas bears outside of Parks will be dying at allowable effective rates of greater than 7.6%, in the case of females, and far greater than 15% in the case of males. This discrepancy will be even further amplified if target rates were to be increased to 9 and 20%, or even 10 and 22%, if the population was "estimated" to be greater than 674 or 747 bears.

Consider this plausible scenario: The Yellowstone population is estimated to be >600 bears, in which case allowable mortality for the entire population is assumed to be 7.6 and 15% for males and females. This leads to a number that is considered "discretionary," all of which is allotted to the states of Montana, Wyoming, and Idaho, and none to the National Parks (as is the current provision). Bears in the Park die at a roughly 5% rate, and the number that die is presumably reliably estimated. The residuum is assumed to be sustainable by bears outside the Parks, which are thus killed at rates >7.6 and 15%, with the greatest differential borne by males. Whereas the non-Park subpopulation of males is hammered, the ecosystem-wide cohort of reproductive females remains more-or-less intact, thus continuing to produce relatively robust estimates of total population size, but with no on-going direct measure of what's happening to males. But independent males continue to be added to population estimates at a 1:1 ratio with independent females, regardless of the actual trajectory of the male subpopulation outside of the Parks, and, thereby, the overall trajectory of the male cohort ecosystem-wide. This continues to happen over a period of years, but without triggering any mortality or population thresholds because of methodological artifacts, and with a predictable dramatic decline in numbers of males outside of Park boundaries. This would constitute a major and currently unacknowledged deficiency in the MOA's and Rule's methods, and a methodological threat to Yellowstone's grizzly bear population.

2b. Simulated dynamics show that implementation of methods described in the Rule and Tri-State MOA lead to a substantial potential for over-killing of males without the introduction of corrective measures

Rather than leave this as a hypothetical, I undertook a modeling exercise in which methods described in the Rule and the Tri-State MOA were implemented for a simulated population parameterized using the latest estimates of vital rates for the Yellowstone grizzly bear population (mostly derived from Schwartz et al. 2006, Interagency Grizzly Bear Study Team 2012, and subsequent IGBST Annual Reports). This simulation model was not only structured by sex and age-class, but also as source (Park) and sink (non-Park), with provision for a net emigration of bears from the source to the sink. I derived my estimate of net emigration rate from data presented in Proctor et al. (2012). Independent bears were killed at an average 5.2% rate, regardless of sex, whereas independent bears in the sink population were killed at a *de facto* rate arising from methods employed by the Tri-State MOA. "Real" population size was tracked, although population size estimated according to current female-with-COY-based methods was used as a basis for adjusting simulated management regimes (i.e., allowable mortality rates) and for

calculating absolute allowable mortality. A stochastic element was introduced by randomly varying all vital rates plus the emigration rate for each time step.

Figure 1 shows the summarized results of a 10-time-step (i.e., 10-year) simulation. Figure 1A shows trajectories (plus or minus 1.96 * SD) for independent males and females, differentiated by whether they are in Park (i.e., source) or Non-Park (i.e., sink) jurisdictions. Figure 1B shows real total population trajectory (shades of turquoise) in juxtapose with the trajectory estimated based on methods building off of counts of females-with-COY (in gray). These real and estimated trajectories are show relative to the 600- and 674-bear thresholds that would ostensibly trigger discretionary changes in management regimes. Notably, once the total population is estimated to be >747, mortality rates for females and males can be increased from 9 and 20 to 10 and 22%, respectively. The dashed red line shows the magnitude of the discrepancy between "real" and estimated population sizes.

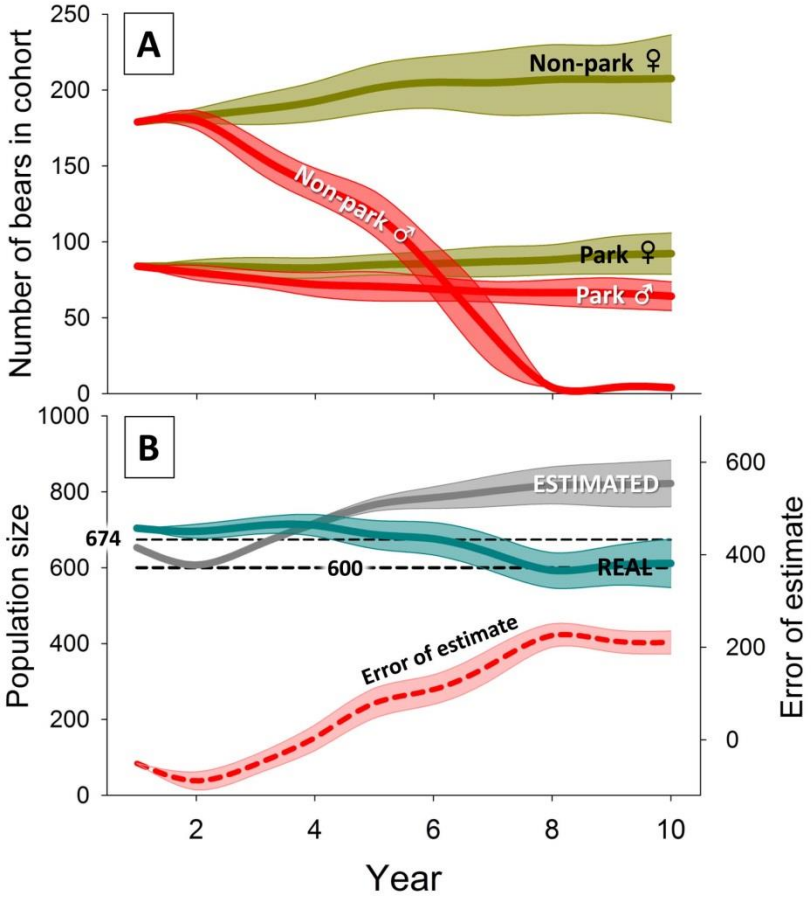

Figure 1. Results of a stochastic model simulating the results of implementing methods for post-delisting management of Yellowstone's grizzly bear population described in the proposed Rule and Tri-State MOA. Figure 1A shows trends in numbers of independent males and females in source (i.e., Park) and sink (i.e., Non-park) populations. Figure 1B shows trends in "real" and estimated total population sizes relative to population thresholds linked to management triggers, along the magnitude of discrepancy—or error—between estimated and real population sizes.

As with any model, the one I developed invokes a number of simplifying assumptions. Among the most important are the assumptions that: (1) managers have perfect information on numbers of reproductive females and numbers of mortalities, by sex, in the population; (2) humans have free access to Non-park bears and motivation sufficient to kill to annual allotted number of bears; (3) there are no kills of solitary females mistaken for males; (4)

there are no Allee effects among Non-park bears resulting in the failure of increasing numbers of females to breed simply as a function of scarce reproductive males; and (5) there is no provision for long-term environmental trends, of which there is ample current and foreseeable evidence. All but assumption 2 produce an optimistic rather than pessimistic bias insofar as the outcome of MOA methods is concerned.

The results of this structured simulation are pretty straight-forward. Subpopulations of reproductive females in Park and non-Park jurisdictions increase slightly and then tend to stabilize. As a result, *estimates* of total population size likewise increase slightly and then stabilize, with 75% of projections surpassing 800 by year 8—which thereby allows for an increase in allowable mortality rates to 10 and 22% for females and males, respectively. Meanwhile, numbers of independent males in the Park decrease slightly because of net losses to emigration, whereas independent males in non-Park jurisdictions experience a catastrophic decline (in fact, I introduced a floor of 4 males to prevent production of negative values). Primarily because of major population-wide declines of males, the "real" total population declines below 674 and then to a point at year 8 where 62% of projections are <600. The discrepancy between "real" population size and *estimated* population size increases steadily to where estimated size in inflated by around 200 over real size. As a result of structural problems with methods, not only is population size increasingly over-estimated, but management direction is towards increasing rather than decreasing allowable mortality rates. At no point are population or mortality limits surpassed, triggering an ostensible review or more conservative management—wholly as an artifact of method rather than as a reflection of "reality."

Conclusions: To emphasize what is perhaps the obvious: I do not make any claims regarding the definitiveness of the analysis I present here. The entailed modeling is complicated and involves a number of assumptions and related simplifications. Nonetheless, the results are amply sufficient to demonstrate the magnitude of potential problems with proposed methods for post-delisting management of grizzly bear mortality. Perhaps even more to the point, these results emphasize that the Service *needs to undertake a comprehensive analysis of its proposed methods in application* prior to inclusion in any finalized Rule. Indeed, the apparent problems are of such a magnitude, for such a critical component of the Rule, as to require additional iterations of critical review and input.

Aside from what may arise with additional analysis, it is clear that the methods described in the Tri-State MOA and in the Rule for post-delisting management of Yellowstone's grizzly bear population are patently deficient for multiple reasons (these here and others I made in my previous comments). The MOA's methods are guaranteed to produce artifacts more often than any reliable indications of population status and, correspondingly, lead to unsustainable over-killing of male bears. As important, none of the complicating or compromising dynamics identified here were apparently either anticipated or planned for by the Service or the involved States. This speaks to either incompetence or unconscionable indifference on the part of those involved on behalf of the accountable bureaus, neither of which is a recommendation for the delisting process currently being overseen by the Service, or the competence of the States as trustees for Yellowstone's grizzly bear population.

One final note of particular relevance to this issue: Because of the Service's apparent rush to complete the delisting process, it has sanctioned the furtherance of a process on the part of the States leading to finalization of the Tri-State MOA prior to any opportunity for meaningful public input or related opportunities for meaningful revisions. This is a transparent violation of good faith on the part of the Service.

3. The wildlife management regimes of Montana, Wyoming, and Idaho offer little basis for trusting that post-delisting management of Yellowstone's grizzly bears will be prudent or fulfill the public trust

I think it is safe to assume that the Service will fulfill the politically-driven mandate handed down by Director Ashe, promulgated by Deputy Regional Director Hogan, to issue a final rule to delist Yellowstone's grizzly bear population prior to the end of calendar-year 2016, regardless of whether any of the identified scientific or technical issues are adequately addressed, if at all. If so, then the national public will find itself reliant on wildlife managers and commissioners employed by the states of Wyoming, Montana, and Idaho to fulfill the public's trust in management of this nationally-iconic population of bears. The prospect should fill anyone who cares about democratic principles, the integrity of democratic institutions, and the future of Yellowstone's grizzly bears with an unnamed dread.

3a. The institution of wildlife management in the Tri-State region is despotic, driven by the interest of hunters, fishers, and livestock producers, and effectively designed to be a for-profit venture.

The reasons for this claim are amply evident and largely well documented:

(**1**) Tri-state wildlife management is governed by commissions and organizations that are slaved to the minority interests of regional hunters and fishers through financial dependencies, shared culture, and shared orientations towards killing animals;

(**2**) the primary constituency of regional state-level wildlife managers is not only comprised almost wholly of hunters, fishers, and livestock producers that live within state boundaries, but also of almost wholly less-well-educated white males who disproportionately live in rural areas;

(**3**) because of 1 and 2, regional management of grizzly bears by state wildlife managers will disenfranchise, not only in excess of 99% of the national public currently enfranchised by the ESA, but also the roughly 85% of state residents who don't hunt;

(**4**) Tri-state wildlife managers receive 98% of their funding from either grants funneled through the Service, generated by taxes on sales of arms and ammunition, or from the sale of "products" such as hunting licenses to hunters and fishers, resulting in an arrangement more closely resembling that of a for-profit venture rather than an enterprise serving the public trust;

(**5**) the vast majority of revenues generated by sales of licenses are for the hunting of ungulates such as elk and deer rather than for hunting carnivores such as wolves, mountain lions, or black bears;

(**6**) state wildlife managers see management as a zero-sum proposition in which any perceived diminishment of ungulate populations due to the perceived effects of predation is unacceptable; in other words, animals such as large carnivores are primarily seen as through the lens of lost opportunities to sell hunting licenses for deer and elk;

(**7**) as a consequence, large carnivores are managed primarily to achieve often inflated goals for maintaining or boosting ungulate populations, often with little scientific support.

Rather than undertaking an extensive and detailed review of the literature supporting these points, I direct the Service to a sampling of the relevant literature: (Clark 1997; Clark & Rutherford 2005; Clark & Zarella 2014; Decker et al. 1996; Gill 1996, 2004; Haygood 1997; Jacobson & Decker 2006, 2008; Jacobson et al. 2010; Mattson 2013, 2014, 2016a, 2016b; Mattson & Clark 2010, 2012; Miller et al. 1996; Nie 2003, 2004a, 2004b; Pacelle 1998; Riley et al. 2002).

As a bottom line, management of a post-delisted grizzly bear population in Yellowstone is virtually guaranteed to betray the public trust, certainly at the national level, and probably even regionally. This betrayal will play out in the form of despotic decision-making processes, with detrimental effects for the grizzly bear population, including subordination of goals focused on intrinsic or existence values and ecological function to instrumental goals serving the financial and exclusive political interests of wildlife managers.

This is consequential because the proposed Rule and referenced State management plans do not include any provisions that legally bind state managers post-delisting. In fact, state wildlife managers made clear in their comment letter dated 9 May 2016 that they will resist, if not refuse, any obligations to the Service once delisting occurs other than *perhaps* managing to maintain the population of grizzly bears above 500 animals. Other than that, both the Service and the States invoke a "trust" argument, devoid of obligation, when it comes to critical matters such as post-delisting management of mortality and measures for fostering connectivity with other existing (NCDE) or potential (Central Idaho) grizzly bear populations. This is a fool's bargain for the national public and anyone who cares about the long-term future of Yellowstone's grizzly bear population.

3b. The states of Wyoming, Montana, and Idaho have not proven that they are worthy of being given the public's trust because grizzly bears ended up on the Endangered Species list in 1975 primarily as a result of state management regimes.

This claim is a matter of fact. The Service frequently asserts that the Yellowstone grizzly bear population was at an absolute nadir at the time this population was listed under the ESA in 1975. However, the Service typically fails to explain why the population had been so diminished in the first place. There has been much written about the potential effects of closing garbage dumps in Yellowstone National Park in the late 1960s and early 1970s (e.g. Craighead et al. 1995), but very little written about the role of state management of bears in the majority of Yellowstone's grizzly bear range.

Known deaths on Non-park lands under state jurisdiction accounted for the majority (54%) of mortality, 1959-1970 (Craighead et al. 1995). Of the deaths overseen by state managers, 84% were attributable to predominantly sport hunting. Of these kills, 59% were adults; 33% adult males and 26% adult females. Craighead et al. (1995) concluded that adult bears bore a disproportional part of the mortality burden meted out by sport hunting. The most defensible conclusion to be reached from these data is that the states of Wyoming and Montana were administering a sport hunt that was unsustainable, manifest in the patently small size of the grizzly bear population circa 1970, especially compared to pre-extirpation populations of the 1800s and post-1975 populations under ESA protections. There is certainly little basis for concluding that state managers were managing for recovery of and related substantial increases in Yellowstone's grizzly bear population during the 1960s and early 1970s. More certainly, it is clear that the States remained wedded to a regime of sport hunting on the basis of principle and custom, and without reference to or regard for reliable information on population trend. Montana's devotion to the ethos of hunting is evident in the fact that this state continued to administer a sport hunt of grizzly bears in the NCDE, even after this population was listed under the ESA, until forced to stop in 1991 by litigation.

Although the States might argue that their approaches to management of wildlife, and grizzly bears in particular, have improved since the 1960s, the fact remains that the only historical referent for when States had sole authority is not encouraging. Moreover, as I point out above, there is little evidence that the fundamentals of state wildlife management have changed, including its culture, financial dependencies, and political imperatives.

3c. The states of Wyoming, Montana, and Idaho have not proven that they are worthy of being given the public's trust because of how they have managed wolves since removal of ESA protections.

Post-delisting management of wolves by the States of Idaho and Montana is a useful referent for any claims made by the states regarding their trustworthiness, emphasizing that fulfillment of the public trust is as much or more about decision-making processes as it is about numerical responses of wildlife populations. But focusing on the numbers, there has not, in fact, been much rigorous analysis of the post-delisting wolf management regime other than a scientific tit-for-tit about the putative effects of sport hunting (Creel and Rotella 2010, Gude et al. 2012, Creel et al 2015) culminating in an authoritative publication in *Science* concluding (among other things) that "Policies for hunting of wolves in the NRM do not specify maximum harvest or targets for population size or growth (other than avoiding decline sufficient to trigger relisting under the ESA)." This alone is cause for concern about the intentions and motivations of state managers charged by the national public with responsibly managing wolves in the Northern Rocky Mountains.

Augmenting this point, I undertook a cursory analysis of wolf management planning documents and temporal and spatial trends relevant to judging the purposes and outcomes of regimes imposed by the states of Idaho and Montana (Wyoming has not yet been given the "keys to the car" given their current egregiously regressive plans for managing delisted wolves).

Without providing exhaustive details, the first point to be made is that plans promulgated by Idaho and Montana give ample evidence of overweening priority given to killing wolves to minimize livestock depredation and meet often inflated goals for elk and deer populations. There is also ample evidence of what policy analysts call "restriction through partial incorporation," not unlike what can be found in existing state management plans for grizzly bears. In practice this appears as lip service given in certain places to "values" other than sport hunting or accommodation of livestock-related interests, juxtaposed with concrete details that make clear the near sole intent is to engage in actions that result in killing wolves (and grizzly bears) to satisfy sport hunters and putatively protect livestock, elk, and deer. The basic idea behind this strategy is to give the appearance of accommodation through use of token language while all the while protecting traditional core features of the management regime—in this case, the paramountcy of sport hunting and protection of agricultural interests. Moreover, even in the token language, there is no explicit acknowledgment that a substantial number of people value large carnivores simply because they exist or because of the ecological services they provide; nor is there any acknowledgment that a national rather than purely local constituency exists for either wolves or grizzly bears. The presumption seems to be that the only "values" worth explicitly referencing are those that instrumentalize and monetize animals, and that the only people who matter are those (at best) residing within state boundaries. These are major short-comings.

Insofar as post-delisting spatial and temporal patterns of wolf mortality are concerned, all of what I present below is derived from data presented in reports annually published by the Service and the states of Idaho and Montana, starting with temporal trends summarized in Figure 2. The figure caption explains the presented data, which show some telling trends. First, since 2011 breeding pairs of wolves in both Idaho and Montana have been driven down to near basement levels by a doubling of mortality rates. All of this increase has been driven by hunting, which now accounts for roughly 75% of total known mortality; depredation control accounts for most of the remainder. Livestock losses continue to be driven by depredation of sheep, which are notoriously vulnerable to predation. Although depredation losses have declined somewhat, retaliatory kills of wolves remain high, even with hunting now accounting for most wolf deaths. Interestingly, per head retaliatory kills have actually increased in Montana since delisting to the point where more wolves are being killed for depredation control than livestock are being lost.

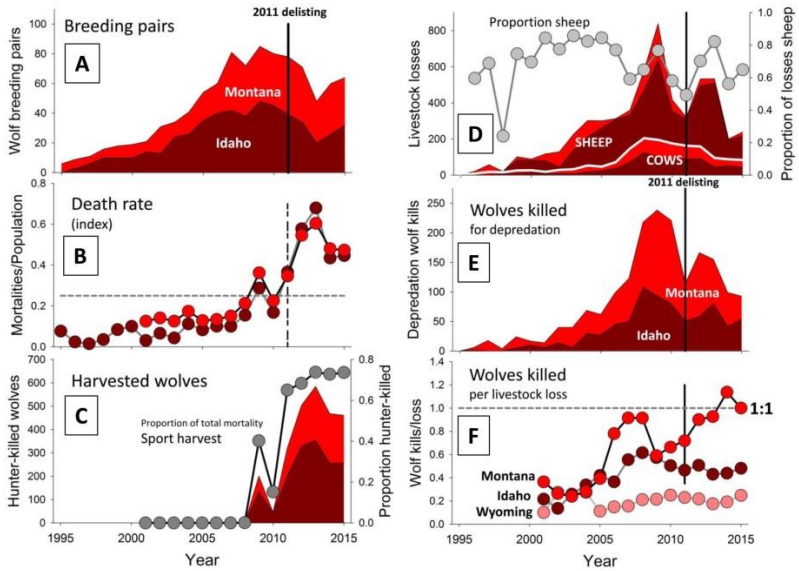

Figure 2. Temporal trends in wolf mortality and livestock depredation in Idaho and Montana before and after the culminating 2011 delisting. (A) shows stacked trends in numbers of breeding pairs; (B) an index of death rate derived by dividing number of known wolf deaths by the minimum estimated number of live wolves; (C) numbers of wolves killed by hunters as stacked shades of red and the proportion of all mortality attributable to sport harvest as gray dots; (D) absolute numbers of sheep and cows killed by wolves in Idaho (dark red) and Montana (red), including the proportion of the total that was sheep; (E) the numbers of wolves killed in retaliation for or to prevent depredation; and (F) the number of wolves killed per head of livestock lost for Idaho, Montana, and Wyoming.

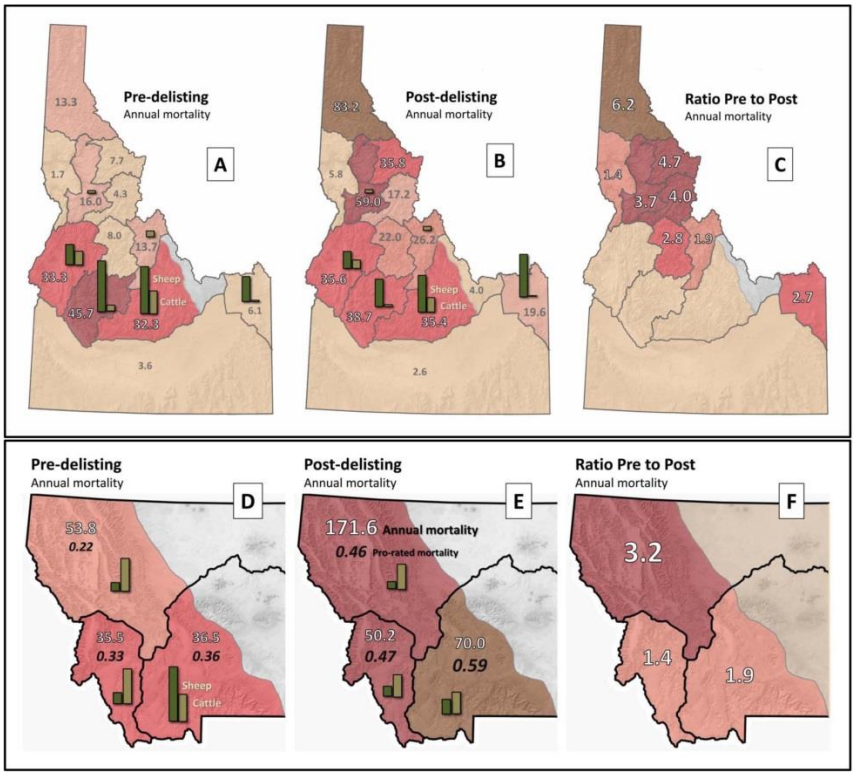

Figure 3. (A and D)Pre- and (B and E) post-delisting annual wolf kills by management units in Idaho (top) and Montana (bottom) together with (C and F) the ratio of pre- to post-delisting annual kills. Bars are proportional in height to annual losses of sheep (dark green) and cattle (light green) in each unit. Montana data are presented by Recovery Area.

The spatial patterns in Figure 3 show where the greatest increases in mortality have occurred, along with the magnitude of those increases. In Idaho, increases were least where kills to control depredation were highest pre-delisting. By contrast, over 6-times as many wolves are being killed each year in far northern Idaho, and between 3-4-times more in the wilderness areas of central Idaho. In Montana increases have been greatest in the northwest (a 3-fold increase), although indexed mortality rates are currently highest in the Yellowstone recovery area. Again, almost all of the spatially-explicit differences in increased levels of mortality have been driven by sport hunting, but concentrated in Idaho where pre-delisting mortality had been lowest as an artifact of fewer losses of livestock.

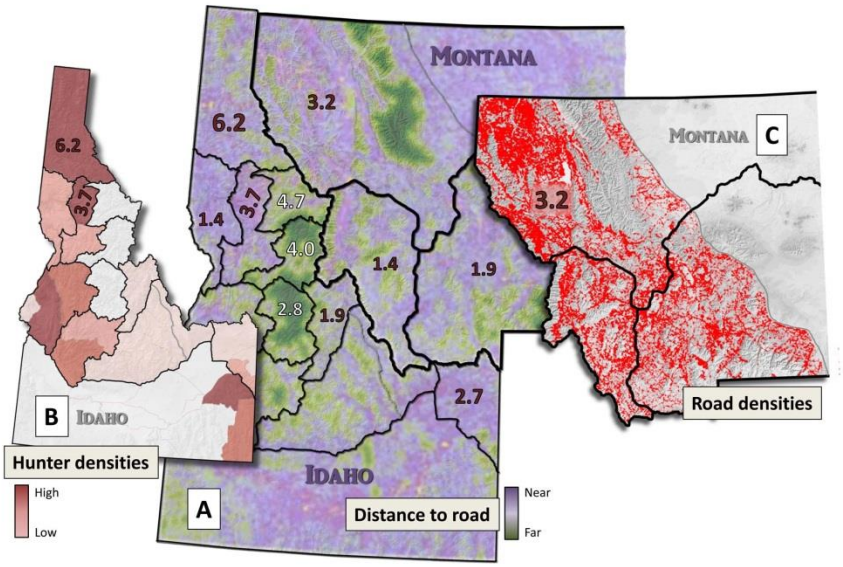

Figure 4. Relations between increases in wolf mortality and either (A and C) road access/densities or (B) hunter densities.

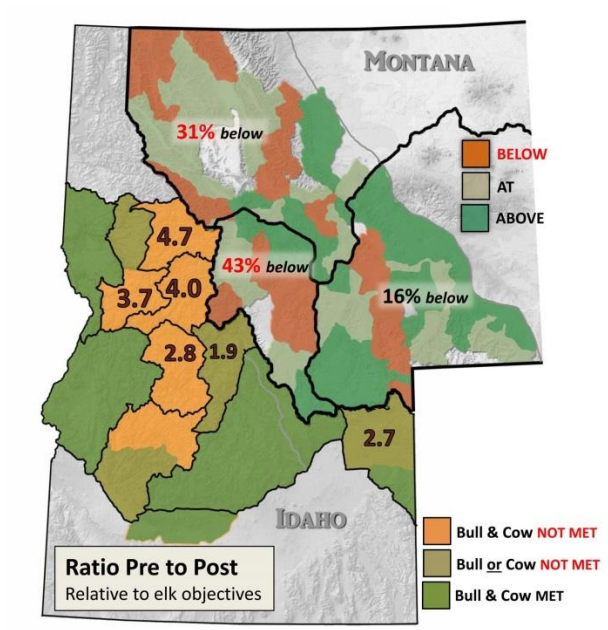

Figure 5. Ratios of pre- to post-delisting levels of wolf mortality relative to the local status of elk populations relative to management goals. The percent of total wolf recovery areas below target is shown in red for Montana.

Figures 4 and 5 provide some degree of explanation for spatial patterns of increase in human-caused wolf mortality in Idaho and Montana. In both states, increases in wolf deaths are partly associated with road access, but especially so in Montana. In Idaho, hunter densities, as such, provide the most direct correlation with the dramatic increase in wolf deaths in northern Idaho, but clearly facilitated by relative ease of access. Subsidiary to the effects of sheer numbers of well-distributed hunters, increases in wolf kills in the remote of areas of central Idaho were apparently driven by the political imperative to meet elk management objectives. Taken together, dramatic increases in wolf kills post-delisting were clearly driven by unleashing thousands of sport hunters provisioned with a near unlimited number of hunting licenses (>15,000-20,000 in Montana alone), aided and abetted by road access, amplified by the concerted promotion of wolf-killing in wilderness areas under the auspices of "predator control) plans, all playing out against a pre-existing background of depredation control concentrated in areas of greatest livestock losses.

As a bottom line, it is clear that Montana and Idaho unapologetically embarked upon a post-delisting wolf-killing program that was deliberately designed to reduce wolf populations in service, first, of controlling depredation; second, increasing elk and deer populations; and, third, offering essentially unlimited sport hunting opportunities playing out in a spatially ad hoc manner. There is no evidence that these two states were managing to achieve any other "values" or to achieve even a loose approximation of ecological function driven by wolf predation. Wyoming and Montana have both made clear that these are the planned outcomes for grizzly bears as well, barring a more closely circumscribed approach to sport-hunting.

Conclusion: Given prima facie evidence as well as the existing track-record of wolf and grizzly bear management, there is no basis for trusting the states of Wyoming, Montana, and Idaho with management of Yellowstone's grizzly bears in the absence of conservative legally-binding direction enforceable through on-going federal oversight and citizen-initiated litigation. Rather than being an apologist for the obvious deficiencies of state wildlife management, the Service needs to critically evaluate the short-comings of the states and make realistic provisions for ensuring the long-term security of, not only Yellowstone's grizzly bears, but also the national public trust should delisting occur. As is, the Service gives the impression of a functionary being driven by the whips of political masters in regional state government rather than an impartial and conscientious arbiter of the public trust.

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