September 29, 2006

Technical Analysis of the 12-month Finding by the USFWS Regarding Wyoming's Petition to Delist the Northern Rocky Mountain Distinct Population Segment of Gray Wolf (71 FR 43410, August 1, 2006) By the Wyoming Game and Fish Department

Summary of Findings

We completed a detailed review of the aforementioned 12-month finding by the USFWS (attachment). The Service has stated, "The only substantive disagreements between the Service and Wyoming are: (1) Whether there is any emergency or urgency to delist wolves in Wyoming and (2) if Wyoming's regulatory framework is adequate to maintain the wolf population above its numerical and distribution recovery levels in Wyoming should the ESA protections be removed." Most of the Service's arguments in the 12-month finding are based on unrealistic assumptions, misinterpretation of data, misrepresentation of the Wyoming Wolf Management Plan under Wyoming Statutes, and hypothetical examples that are infeasible or highly unrealistic. The Service's 12-month finding also ignored many points Wyoming raised in its 6 April, 2006 letter commenting on the preliminary notice of rule making (71 FR 6634; 2/8/06). The Service's opinion that the Wyoming Wolf Management plan cannot be implemented under Wyoming Statute continues to be a principal area of disagreement. In addition, the Service has rejected both its and Wyoming's earlier definitions of a wolf pack in favor of a new procedure based on a recently completed analysis that assigns discrete probabilities of a breeding pair to each pack size. However, the new procedure is functionally equivalent to Wyoming's pack definition when applied to the pack size data collected in Wyoming.

Urgency of the Petitioned Action

The Service stated, "The Wyoming Petition argued that delisting was urgent and a priority because of alleged impacts to big game populations, economic impacts, introducing wolves into unnatural and fragmented habitats, and livestock depredation. Wyoming presented this information with the overall perspective that the number of wolves exceeded recovery goals and that the wolf population and its impacts were larger than those analyzed in the Service's 1994 Environmental Impact Statement (EIS) on wolf

reintroduction (Service [USFWS] 1994)." The Service further stated, "The Wyoming Petition did not reveal any issues that were not previously anticipated or predicted in the 1994 EIS, nor does there currently appear to be any emergency regarding wolves or wolf management in Wyoming" (71 FR 43414).

In presenting its arguments and assertions, the Service has made several incorrect or misleading assumptions and conclusions summarized in bulleted form below:

- The Service stated, "The Wyoming segment of the wolf population was stable or slightly decreased in 2005, so the rates of predation on wild ungulates and livestock did not increase (Service et al. 2006)" (71 FR 43414).

  Response: The wolves predominantly outside Yellowstone and Teton National Parks and the Rockefeller Parkway (collectively "the National Park Units") comprise the segment of the wolf population that causes the greatest impacts to State resources. This segment of the population continues to increase in excess of 20% per year on average, and along with it, livestock depredations, livestock control actions, and impacts to big game populations are also increasing (refer to comment 8 in the attached analysis). The portion of the wolf population predominantly outside the National Park Units in 2005 was 51% higher than in 2004 and has exhibited rapid growth since 1999. The numbers of wolves removed in control actions have also increased rapidly since 1999. The number of cattle depredated by wolves has increased annually, though it decreased somewhat in 2005 as a result of very intensive control actions. Furthermore, preliminary data from the 2006 mid-year count indicate at least 309 wolves in 31 packs, including at least 24 potential breeding pairs are now present in Wyoming. This represents an all-time high count since the introduction program began in 1995, and is 23% higher than the 2005 count and 14% higher than the previous record count in 2004.

- The Service stated, "The potential impact of wolf predation … was *relatively accurately* forecast in the EIS … (71 FR 43414)" and "Surprisingly, the rate of confirmed livestock depredations *per* 100 wolves … is actually lower than the EIS predicted …" (71 FR 43415).

  Response: The Service is attempting to reinterpret the original EIS predictions as if they had been expressed as a rate *per* 100 wolves, rather than the total impacts of *a recovered population* of approximately 100 wolves. In no place does the 1994 EIS state or infer that its impact predictions were a rate *per* 100 wolves (refer to comment 8 in the attached analysis). If this were the case, the 1994 EIS would have violated NEPA, which requires that federal agencies must thoroughly analyze reasonable, foreseeable impacts and must prepare a supplemental EIS if new data indicate the impact predictions have been substantially exceeded [40 CFR 1502.16, 1508.8, and 1502.9(c)]. If the Service were allowed to predict and analyze impacts on a "per unit" basis, then the BLM should be able to analyze impacts of natural gas development on a "per well" basis without identifying a "reasonable development scenario." Likewise, the Forest Service should be able to analyze impacts of timber

harvest on a "per timber sale" basis without specifying the total area to be logged. Such an interpretation is not only preposterous it violates NEPA requirements. NEPA (the CEQ Regulations) expressly states, "Significance [of an impact] cannot be avoided by terming an action temporary or by breaking it down into small component parts" (40 CFR 1508.27) In reality, the 1994 EIS had stipulated that its predictions were *long term* and were based on a recovered population of 100 wolves and 10 packs. The impacts predicted in the 1994 EIS have been radically exceeded and this is clearly evident from the following statistics based on Wyoming and GYA wolf data (also refer to comments 3.b and 8 in the attached analysis):

- The wolf population in the GYA in 2005 (325+) was at least 3.3 times the original EIS prediction for a recovered population.
- The number of breeding pairs of wolves in the GYA in 2005 (20+) was at least 2.0 times the original EIS prediction and the number of breeding pairs in 2004 (31+) was at least 3.1 times the original EIS prediction.
- In 2005, the wolf population in Wyoming outside YNP (≥134 wolves) exceeded the recovery criteria for the entire GYA and continues to increase rapidly. By mid-year 2006, it had reached at least 166 wolves (USFWS weekly recovery report, 9/15-9/22).
- The estimated annual predation rate (22 ungulates per wolf) is 1.8 times the annual predation rate (12 ungulates per wolf) predicted in the 1994 EIS.
- The estimated number of ungulates taken by 325 wolves in a year (7,150) is 6.0 times the original EIS prediction.
- The percent of the northern Yellowstone elk harvest during the 1980s currently taken by wolves (50%) is 6.3 times the original estimate of 8% projected in the 1994 EIS.
- The actual decline in the northern Yellowstone elk herd (≥50%) is 1.7 times the *maximum* decline (30%) originally forecast in the 1994 EIS.
- The actual decline in cow harvest in the northern Yellowstone elk herd (89%) is 3.3 times the 27% decline originally forecast in the 1994 EIS.
- The actual decline in bull harvest in the northern Yellowstone elk herd is 75%, whereas the 1994 EIS predicted bull harvests would be "unaffected."
- The 1994 EIS predicted that presence of wolves would result in a 5-10% increase in annual visitation to YNP. On this basis, the EIS forecast wolves in the GYA would generate $20 million in revenue to the states of Idaho, Montana, and Wyoming. However, annual Park visitation remained essentially unchanged after wolf introduction, and has decreased 2.6% since the wolf population reached recovery goals in 2000 (Comment 4 in the attached analysis). The economic surveys (Duffield 1992 and Duffield et al. 2006) did not determine whether expenditures for wolves represent an actual increase in tourism revenue, or merely a redistribution of existing tourism revenues. Since Park visitation did not increase as originally forecast, the Service cannot legitimately conclude presence of wolves has had any appreciable effect on net tourism revenues.
- Since wolf introduction, average ratios of calf elk to cow elk have been greatly depressed in the northern Yellowstone elk herd and in the Wyoming elk herds impacted by wolves. In the northern Yellowstone elk herd and in the Sunlight unit of the Clarks Fork herd, calf:cow rations have been suppressed to

unprecedented levels below 15 calves per 100. The impact of wolves on calf recruitment was not addressed by the 1994 EIS.

- The 1994 EIS provided assurances that the USFWS would coordinate with the States to develop criteria for determining if wolf predation is excessively impacting big game herds, to develop methods for alleviating excessive impacts, and to "integrate wolf management into state big game management" (refer to comment 3.d in the attached analysis). Despite research findings in Idaho and the GYA, and monitoring evidence in Wyoming that indicate wolf predation is having an impact on ungulate populations that will reduce hunter opportunity if the current impact levels persist, the Service continues to rigidly deny wolf predation is a problem.

- The Service's inference that predation by grizzly bears may be a primary factor in explaining low calf:cow ratios is not supported by bear population data. During the 4-year period before the ratio of wolves to elk became consequential (1998-2001), the average minimum population estimate of grizzlies in the GYA was 349 and the average calf:cow ratio in the northern Yellowstone elk herd was 27:100. During the most recent 4-year period (2002-2005), the average minimum bear population increased by just 16% (to 406), yet the average calf:cow ratio decreased by 52% (to 13:100). A 16% increase in predation rate attributed to bears is at most, 3-4 additional calves killed per 100 cows and does not explain a reduction of 14 calves per 100 cows. Furthermore, the calf ratio recovered to 24:100 in 2006 *despite* presence of bears, but the higher calf:cow ratio coincided with a 40% decline in the wolf population on the northern range.

- The Service questioned some of Wyoming's elk herd comparisons (e.g., Wiggins Fork) on the basis too few wolves would have been preying on those elk to explain the reduction in calf:cow ratios. Petitioners remind the Service that its estimates of wolf populations are <u>minimums</u> and that wolves outside YNP are monitored less intensively compared to wolves inside the Park. Segments of the Wiggins Fork Herd also spend a substantial portion of the year outside the herd unit boundaries and are preyed on by additional wolves (Refer to comment 3.a.iii in the attached analysis).

- The Service postulated that deliberate elk reduction programs could explain low calf recruitment. Petitioners remind the Service that elk reduction programs actually *increase* calf:cow ratios measured in winter due to the disproportionate harvest of adult cows compared to calves. Furthermore, calf survival (recruitment) in the northern Yellowstone elk herd was density dependent based on data collected through the early 1990s (Singer et al. 1997). Therefore, calf recruitment should actually *increase* as the elk population density is decreased through deliberate elk reduction programs. (Refer to comment 3.a.iv in the attached analysis).

- The Service continues to cite the Vucetich et al. (2005) as evidence that elk predation by wolves is entirely or predominantly compensatory, while harvest by hunters may be "super-additive." Petitioners have demonstrated beyond any reasonable doubt that the Vucetich et al. conclusions are untenable and that Vucetich's analysis and

treatment of data were substantially flawed. (Refer to Comment 3.c in the attached analysis).

- The Service contends wolves can live in developed areas and around human activities *yet* the Service also describes unsuitable wolf habitat as areas with development, livestock grazing and human uses. The Service provides no resolution of those opposing characterizations. The 1994 EIS did not address whether wolves and wolf predation are ecologically compatible within big game winter ranges that have been constricted, fragmented and otherwise altered by land uses in valley bottoms, around the outer fringes of the GYA, or within elk feedgrounds. Wolf presence can be ecologically compatible in the GYA only to the extent that the distribution and numbers of wolves are controlled and maintained at approximately the levels originally predicted by the 1994 EIS –100 wolves and 10 breeding pairs. Petitioners believe the Service has a permanent, legal obligation to manage wolves at the levels on which the wolf recovery program was originally predicated, the levels described by the impact analysis in the 1994 EIS. (Refer to comments 5 and 6 in the attached analysis).

- The Service disputes whether wolves pose a threat to the depressed moose population in the GYA. However, numerous studies have documented that wolves sustained by an abundant primary prey base will continue to suppress moose populations at low levels (Gasaway et al. 1992; Boert et al. 1996; Ballard et al. 1997). (Refer to comment 7 in the attached analysis).

- Analyses of "long term" impacts provided in the 1994 EIS were deceptively conservative based on low estimates of a recovered wolf population in each recovery area (100 wolves and 10 breeding pairs). The 1994 EIS also did not analyze the impacts of introducing wolves into a highly altered ecosystem. Therefore, the 1994 EIS violated provisions of NEPA, which required the Service to prepare a detailed analysis of reasonable, foreseeable impacts (CEQ Regulations at 40 CFR 1502.16 and 1508.8). The Service is also in violation of the requirement at 40 CFR 1502.9(c) to prepare a supplemental impact statement if the original impact predictions were in error. (Refer to comment 8 in the attached analysis).

<u>The Adequacy of Wyoming's Regulatory Framework</u>

The Service continues to dispute whether Wyoming's Wolf Management Plan can be implemented under State Law. In addition, the Service is proposing a midstream change of its concept for monitoring breeding pairs to require the actual size of each wolf pack be documented rather than counting the number of packs exceeding a specific size. The Service has repeated most of its original criticisms of the Wyoming Wolf Management Plan as they pertain to vulnerability of wolves under "predatory animal" status, the ability of the Wyoming Game and Fish Department to quickly respond if the number of packs outside the National Parks is reduced to 7 or less, the perceived risks of managing for a minimum number of packs, the Service's perception that the status of wolves could change every 90 days, and possible problems with the State's definition of a pack as 5

wolves traveling together if that definition were applied outside the winter period. Finally, the Service alleges 4 "critical conditions" have changed since the original peer reviews of Wyoming's Wolf Management Plan were done, and those reviews are no longer relevant.

The Service's arguments against the adequacy of Wyoming's regulatory framework are largely based on misconstructions of Wyoming's Wolf Management Plan and the Service's assumption the plan cannot be implemented under State law. In addition, the Service relies on several infeasible or highly unrealistic examples of how wolf management under the State's Plan might reduce the population below recovery objectives. The Service has also selectively used data and references that appear to support its case, while ignoring other data and the preponderance of evidence that argue against the Service's position, (e.g., Petitioners' comments on the preliminary notice of rule making at 77 FR 6633 – WGFD letter dated 6 February, 2006).

- The Service now believes the peer reviews of Wyoming's Wolf Management Plan are no longer relevant because 4 critical conditions have allegedly changed since the original peer reviews were done (Refer to Comments 11 and 21 in the attached analysis):
  - (1) Peer reviewers assumed in error that the Wyoming Wolf Management Plan could be implemented under Wyoming Statute. Response: Peer reviewers' assumption was correct and is supported by O'Donnell (2003). Petitioners maintain the Wyoming Wolf Management Plan is consistent with, and can be implemented under Wyoming Statute. (Refer to comments 11 and 12 in the attached analysis).
  - (2) The "dramatic" decline of the YNP wolf population in 2005 raises doubts whether Wyoming's share of the recovered wolf population could be maintained under the Wyoming Plan and Wyoming Statutes. Response: The Service's hypothetical example is based on an assumption Wyoming could have wiped out all wolves outside YNP prior to the 2005 breeding season. This scenario is not permissible under Wyoming's Wolf Management Plan. A minimum of 7 packs of 5 or more wolves will be maintained outside YNP irrespective of the number of wolves inside the Park. In 2005, a worst-case scenario (7 packs of exactly 5 wolves each outside YNP) would have maintained 11 breeding pairs and 153 wolves in Wyoming. The 2005 scenario serves to verify the adequacy of Wyoming's plan under a worst-case scenario (Refer to comments 11 and 14 in the attached analysis).
  - Pursuant to the Oregon and Vermont court rulings, peer reviewers were not asked whether Wyoming's Wolf Management Plan would maintain a recovered wolf population throughout a "significant portion" of the suitable habitats within the species' range. Response: The Service has expressly defined "significant portion" as being 10 breeding pairs and 100 wolves in each recovery area. So long as those criteria are met, the distribution requirement of a "significant portion of the species range" will be achieved. Nothing in the Wyoming Wolf Management Plan precludes wolves from occupying any portion of the NW WY Wolf Management Area, which encompasses all of the suitable habitats in

Wyoming. The 7 or more packs of wolves within the NW WY Wolf DAU can potentially occupy any area throughout the DAU and that distribution will dynamically shift over time. The interpretation of "significant portion" under the ESA is an inherently discretionary, legal question that would not have been an appropriate biological question to pose to the peer reviewers. (Refer to comment 11 in the attached analysis). In any event, the Oregon and Vermont court decisions recognized the Service's failure to analyze wolf habitat over wide swaths of the U.S. Nothing more than this point can be inferred from the Oregon and Vermont decisions.

- The Service has a new definition of pack size and the existing Wyoming definition would not maintain the Wyoming segment of the wolf population above recovery levels. Response: The Wyoming definition (5 or more wolves traveling together) is functionally equivalent to the Service's new procedure, which is based on discrete probabilities of a breeding pair applied to each pack size. The Wyoming definition is adequate and more practical to use in the field. This issue will be addressed in greater detail. (Refer to comments 11 and 19 in the attached analysis).

- The Service continues to allege that wolves will be excessively vulnerable to human-caused mortality within portions of the NW WY Wolf DAU where they are classified as predatory animals, and that this vulnerability could rapidly drive the population below recovery goals before the WGFD could react and reclassify wolves as "trophy game." Response: The only evidence the Service provides in support of this, is a laundry list of possible ways wolves could be taken as "predatory animals" and a historic context that is no longer relevant to the current situation. The Service has greatly exaggerated the possible effectiveness of the methods they list and the public's ability to actually use those methods within the NW WY Wolf DAU. Under the Wyoming Wolf Management Plan, wolves would be swiftly classified as trophy game throughout the NW Wyoming Wolf DAU should the number of packs be reduced to 7 or fewer. Emergency rules providing for change in predatory status or expansion of the DAU can be effective under Wyoming law within a matter of days. Wolf packs in this population would be monitored at least quarterly and at least 1 wolf in each pack will be fitted with a radio telemetry transmitter. Therefore, any change in status of the wolf population will be quickly detected. The Service did not address Petitioners' rebuttal of the same assertion in 71 FR 6634 (comment 18, letter dated 6 April, 2006). (Refer to comment 13 in the attached analysis).

- The Service continues to allege that the State's management authority over wolves could be revoked within 90 days as the population flips back and forth between "predatory animal" and "trophy game" status. Response: this scenario is not permissible under the Wyoming Wolf Management Plan. Once wolves are classified as "trophy game" throughout the NW WY Wolf DAU, they can be classified back to "predatory animal" only after the conditions that led to the decline have changed sufficiently that a recovered population can be sustained with the trophy game classification reduced to a smaller portion of the DAU. (Refer to comments 15 and 18 in the attached analysis).

- The Service alleges that the WGFD would have limited ability to prevent further declines in the wolf population should the number of breeding pairs outside the National Park Units decline below 7. The Service believes lethal removal of problem wolves would likely continue, and could drive the population even lower. "Attempting to manage a wolf population that is constantly at minimum levels would *likely* result in the population falling below recovery levels due to factors beyond WGFD's control." Response: The Service's statement is conjectural and unfounded. A variety of nonlethal management options are available to alleviate depredation problems. Furthermore, the population will not be "constantly maintained at minimum levels" because the management status cannot be changed back to "predatory animal" until and unless the factors that originally led to the decline have changed or otherwise been addressed. Thus, if a change to "trophy game" status should be necessary throughout the NW WY Wolf DAU, this status will be long-term assuring the WGD greater regulation of human-caused mortality factors (Refer to comment 16 in the attached analysis).

- The Service alleges that the portion of Wyoming's pack definition that allows a pack of 10 or more wolves with 2 breeding females to be counted as 2 packs is inconsistent with the Service's definition of a breeding pair. Response: To date, wolf packs with multiple breeding females have not been documented in Wyoming outside YNP. Based on Ausband's probabilities, counting 1 pack of 10 or more wolves as 2 breeding pairs (2 packs) will produce a maximum estimated difference of only 0.12 breeding pairs if 5 other packs of exactly 5 wolves each are maintained. This is a highly improbable, worst-case scenario and the difference in probability of a breeding pair is inconsequential. (Refer to comment 17 in the attached analysis).

- The Service is proposing to change its basic concept for monitoring the number of breeding pairs. The previous method described in 71 FR 6633 (2/6/06) would require states to document 15 packs of a minimum size (5 or 6 wolves traveling together). This equates to 12-15 breeding pairs. Wyoming would document at least 7 packs of 5 or more wolves outside the National Park Units. The Service's new method referenced in 71 FR 43410 (8/1/06) and described in a Powerpoint presentation by Ausband (2006), would require the States to document the actual sizes of all packs of 4 or more wolves, and to then apply discrete probabilities to estimate the number of breeding pairs. The new method involves much more intensive monitoring, but is functionally equivalent to counting the number of packs of 5 or more wolves. Wyoming has constructed a revised regression model using data from 1999 through 2005. The revised regression predicts the probability of a breeding pair in packs of 5 or more wolves is about 88-89%. Applying Ausband's probabilities to the same data indicates the overall probability of a breeding pair in packs of 5 or more wolves would be 85%. In either case, defining a pack as 5 or more wolves assures more than 10 breeding pairs would be present in 15 packs. Even if we apply Ausband's probabilities to a highly improbable, worst-case scenario (YNP breeding pairs + 7 packs of exactly 5 wolves each outside YNP), more than 10 breeding pairs would have been maintained in all years since the population achieved recovery goals,

including 2005. The 2005 data serve to verify that Wyoming's definition of a wolf pack (5 wolves traveling together) is adequate to assure the Wyoming segment of the wolf population will be sustained above recovery goals. The Service's proposed new procedure is needlessly complex, requires substantially more intensive monitoring, and in practical terms, would not significantly improve the already high degree of assurance that 15 or more packs of 5 or more wolves would include at least 10 breeding pairs in each recovery area. The likelihood that all 15 packs would be exactly 5 or 6 wolves is far too remote to consider a realistic possibility. (Refer to Comment 19 in the attached analysis).

- The Service has postulated several hypothetical examples to illustrate situations in which Wyoming's pair definition might fail to assure at least 10 breeding pairs are maintained in the State. These examples are based on misconstructions of the Wyoming Wolf Management Plan and infeasible assumptions. For example, the Service presumes Wyoming could wipe out all wolves outside the National Park Units and that the "predatory animal" and "trophy game" classifications could be potentially change every 90 days. Neither assumption is feasible under the Wyoming Wolf Management Plan. Petitioners constructed worst-case examples that illustrate Wyoming's pack definition and Management Plan would sustain more than 10 breeding pairs under any realistic scenario. (Refer to Comments 19 and 20 in the attached analysis).

- The Service cites the 2005 data as evidence Wyoming might not have maintained 10 breeding pairs under the Wyoming Wolf Management Plan and the Wyoming Pack Definition. Response: The fewest breeding pairs that would have been maintained in Wyoming in 2005, assuming Wyoming sustained the smallest number and size of packs theoretically possible under Wyoming's wolf management plan, would have been 11. (Refer to Comments 19 and 22 in the attached analysis).

Technical Analysis of the 12-Month Finding by the USFWS Regarding Wyoming's Petition to Delist the Northern Rocky Mountain Distinct Population Segment of Gray Wolf (71 FR 43410, August 1, 2006)

1. RE: Incorrect distributional recovery criteria (71 FR 43412). The Service states, "At the end of 2000, the NRM population first met its numerical and distributional recovery goal of a minimum of 30 'breeding pairs' [an adult male and an adult female wolf that have produced at least 2 pups that survived until December 31 of the year of their birth, during the previous breeding season] and over 300 wolves well-distributed among Montana, Idaho, and Wyoming (68 FR 15804, April 1 2003; Service et al. 2001)."

   The wolf recovery criteria, as they were defined in 2000, did not mention distribution among the 3 states. Petitioners have repeatedly cautioned the Service's quote of 68 FR 15804 is inaccurate and does not describe the biological criteria the Service actually defined for recovery and delisting (also see WY Petition page 34 and WY comments on 71 FR 6633, dated 6 April, 2006). The specific recovery criteria are stated on page 15817 of 68 FR: "Thirty breeding pairs of wolves [defined as an adult male and an adult female that raise at least 2 pups until December 31 of the year of their birth], comprising some 300+ individuals in a metapopulation with some genetic exchange between subpopulations, for three successive years." The three recovery areas or "subpopulations" are, "Central Idaho," "Northwestern Montana," and "Greater Yellowstone" (refer to page 15845 and elsewhere in 68 FR). The reference to state distributions as a recovery criterion first appeared in 70 FR 1288, based on an inaccurate quote of 68 FR 15804.

   All 3 States are part of the "Greater Yellowstone" recovery area. The other 2 recovery areas in Montana and Idaho do not include any portion of Wyoming. The biological criteria for distribution of a recovered wolf population pertain to the recovery areas and not to the States. In no place does 68 FR 15804 suggest or imply the metapopulation of wolves must be "well-distributed among Montana, Idaho, and Wyoming." Only the actual biological criteria are relevant to the Service's decision to list or delist wolves.

2) RE: Distributional recovery criteria (71 FR 43412). The Service further states, "While absolute equitable distribution is not necessary, a well-distributed population with no one state maintaining a disproportionately low number of packs or number of individual wolves is needed for recovery in a significant portion of its range." As discussed above, this statement is not consistent with the actual biological recovery criteria. The distributional recovery goals pertain to the 3 subpopulations or recovery areas, not to the 3 states.

3) RE: Urgency of petitioned actions (71 FR 43414). The Service states, "The Wyoming Petition did not reveal any issues that were not previously anticipated or predicted in the 1994 EIS, nor does there currently appear to be any emergency

regarding wolves or wolf management in Wyoming …" In its attempt to rebut Wyoming's case for urgent action, the Service has made several highly inaccurate statements and assertions. These are addressed individually:

a. Predation effects on calf recruitment. "The Wyoming Petition presented data indicating that nearly all Wyoming elk herds still exceeded State management objectives, but that herds in areas with wolves had lower cow/calf ratios than herds in areas without wolves. The petitioner, however, did not address numerous other significant differences between these elk herds." (71 FR 43414).

   i. "All elk herds being preyed on by wolves are also being preyed on by grizzly bears (Barber et al. 2005). Elk herds that are living in areas without wolves have fewer large predators interacting with them." (71 FR 43414).

      Response: The Service failed to address Petitioners' rebuttal of the Service's contention that predation by grizzly bears rather than by wolves is causing suppressed calf ratios (WY comments 8 and 9 on 71 FR 6633, letter dated 6 April, 2006). In a radio interview by Bowhunter Magazine earlier this year, Mr. Ed Bangs indicated black bears and grizzly bears killed 58-60 of the 100 calves that died in a radio tagging study. He also stated, "This is consistent throughout North America. If you look at what eats young calves or fawns, its gonna (*sic*) be bears … but that doesn't mean that the number of elk is regulated by the number of bears." Mr. Bang's statement acknowledges bear predation, especially of very young animals, is largely compensatory to other sources of mortality. If bears did not kill elk calves, other predators or other environmental factors would. In addition, Petitioners believe the mortality estimates derived from a tagging study are biased high due to handling and marking effects that influence [increase] predation rates. This effect has been well documented by other research. (Refer to WGFD comments on 71 FR 6633, comment 9 of latter dated 6 April, 2006).

      Mortality of neonatal elk calves is naturally high, regardless of the location and the specific sources of mortality that operate on a herd. Significant predators of elk in Wyoming outside the GYA include black bears, coyotes, and mountain lions. Singer et al. (1997) analyzed mortality of elk calves in the Northern Yellowstone Herd from 1987-1991, prior to wolf introduction. During their 4-year study, they documented only a single predator-caused mortality during winter (Singer et al. 1997:17). However, since wolves were introduced, predation of elk, especially of elk calves, has become a significant source of mortality throughout the biological year, especially in winter (White and Garrott 2005).

      Singer et al. (1997:17) concluded summer survival of calves was density dependent and winter survival was highly density dependent (i.e., both were negatively correlated with population size). Given this relationship, summer and especially winter survival should be higher when population levels are

well below carrying capacity. Since 2002, the winter count of the Northern Yellowstone elk herd has ranged from 8,000-12,000 and averaged 9,766. This is much lower than historic levels and well within the carrying capacity of the herd. At lower populations, calf survival would normally be higher. However, despite the lower elk populations and presumably the reduction or elimination of density-dependent effects, the calf:cow ratio in the Northern Yellowstone Herd has been depressed to unprecedented low levels, averaging only 13:100 from 2002-2005. The ratio rebounded to 24:100 in 2006, but this coincided with a significant reduction in the northern range wolf population. In a press release dated 8 April, 2006, P.J. White, biologist for Yellowstone National Park, stated, "The increase in recruitment this year probably reflects less predation by wolves … An apparent disease outbreak reduced wolf numbers on the northern range by 40% during summer, 2005."

The sharp decline in calf recruitment became evident after the ratio of wolves to elk had increased to a consequential level by winter, 2001 (White and Garrott 2005). During the preceding 10 years, the average winter elk count was 14,712 (range: 11,700-19,000) and the average calf:cow ratio was 30:100. The Service postulated changes in environmental/climatic conditions and an increase in bear predation of neonatal calves are the reasons behind depressed calf:cow ratios in the Northern Yellowstone Elk Herd. The Petitioners purpose in comparing elk herds from other regions of Wyoming to the elk herds in the wolf recovery areas was to demonstrate that, under similar climatic conditions (including drought), cow:calf ratios in most herds remained at or near historic averages. Climatic factors, including drought, therefore, do not explain the differences in calf recruitment.

During the 4-year period from 1998-2001, the average, minimum population estimate of grizzly bears in the GYA was 349 (range = 339-361) (Haroldson and Frey 2005). During the 4-year period from 2002-2005, the average, minimum population was 406 (range = 361-416). Thus, the grizzly bear population was only 16% higher after the wolf:elk ratio became consequential in 2001. However, the calf:cow ratios during those 2 periods decreased from an average of 27:100 (range = 22-34) to an average of 13:100 (range = 12-14).

From 2003-2005, bears killed 38% of radio-tagged, neonatal calves. If we presume predation of elk calves by bears increased in proportion to the bear population, then predation attributed to bears during the period prior to the radio-tagging study would have been about 33% of the calf crop at birth. Lemke (2003) determined 70% of cows harvested during the late hunt in the northern Yellowstone elk herd were pregnant. Assuming a maximum of 70 calves are born per 100 cows, the difference in the number of calves that survive as a result of the difference in bear predation rates would be only 3-4 calves per 100 cows. Thus, a 16% increase in bears and the predation rate attributed to bears cannot explain a greater than 50% reduction (14 calves per 100 cows) in calf survival. Moreover, the calf ratio recovered to 24:100 in

2006 in spite of the bear population, but this increase coincided with a significant wolf mortality event on the northern range. At lower elk populations, population vital rates (survival and recruitment) are much less sensitive to weather covariates (White and Garrott 2005, Lubow et al. 2002), so changes in climatic conditions are not a reasonable explanation for a major change in calf:cow ratios, especially in elk herds that migrate between [moister] high elevation ranges in summer and [milder] low elevation ranges in winter.

The preponderance of evidence strongly indicates fall/winter predation by wolves is the major factor explaining the decrease in calf recruitment in the Northern Yellowstone Elk Herd. Calf:cow ratios of 15:100 and lower measured in winter are not adequate to sustain an elk herd. Chronically low calf recruitment results in an aging [top heavy age structure] population, which usually precedes a rapid population decline. This appears to be happening in the Northern Yellowstone Elk Herd. The average age of cows harvested during the late season elk hunt in 2005 was the oldest on record – 8.2 years. As cohorts of prime age females pass into reproductive senescence, and are not replaced, the population will decline even further.

Although many elk herds impacted by wolves in Wyoming are currently at or above their population objectives, the unprecedented low calf ratios are a serious concern in terms of sustaining these populations and the public recreation they support. White and Garrott (2005:953) concluded wolf predation in the Northern Yellowstone Elk Herd is additive and will likely have a relatively stronger influence on the population dynamics of Northern Yellowstone elk in coming years.

ii. "Elk herds with wolves typically summer in remote areas at high elevation, without access to as much agricultural forage, *possibly*, making them more susceptible to severe winter or summer drought." (71 FR 43414).

Response: The Service's statement is speculative and incorrect. All the major elk herds without wolves in Wyoming also summer in high elevations, in comparatively remote mountain environments, and migrate to lower elevations or feedgrounds in winter. Such herds include the North and South Bighorn, Medicine Lodge, Snowy Range, Sierra Madre, Laramie Peak, Shirley Mountain, Green Mountian, South Wind River, Pinedale, Piney, Afton, and West Green River elk herds. Elk that migrate between remote, high elevations in summer and lower elevations in winter are less vulnerable to effects of severe winters and summer drought. That is why migration behavior evolved. During summer, forage is more dependably available at the higher elevations even in drought cycles. In fact, the highest meadows are least impacted by drought because soil moisture is dependably replenished by snowmelt and frequent summer rains. During winter, conditions are milder at lower elevations and forage is dependably available on feed grounds or

remnant native winter ranges. In Wyoming, few elk are tolerated within agricultural areas and this aspect is not substantially different between herds with and without wolves.

iii. "Some of Wyoming's comparisons made between elk herds with and without wolves seemed questionable; for example, the Wiggins Fork herd with an objective of 7,000 elk and the largest decrease in cow/calf ratios of any herd, was only being preyed upon by one small wolf pack. It is highly unlikely that one pack of approximately 10 wolves could have any measurable impact on overall herd size or calf ratios among 7,000 elk." (71 FR 43414).

Response: The population objective of the Wiggins Fork Elk Herd is a range of 6,000-7,000. The population estimate in 2005 was 6,273. The Service's estimate of wolves in this herd unit, as elsewhere in the GYA recovery area, is a minimum number – refer to Table 4 entitled, "Northern Rocky Mountain minimum fall wolf population and breeding pairs …" and to pages 85 and 86 in the Service's 2005 Interagency Recovery Report, which state, "… at least 118 wolves … occupied YNP" and "… at least 134 wolves inhabited western Wyoming outside YNP in 2005" (USFWS et al. 2006). Wolves are also monitored less intensively outside the National Parks. The Service cannot deny many of the wolves that are not part of a radio-collared pack, are not included in the total estimate of the wolf population. Thus, the Service's estimates of wolf numbers at any given time are very conservative and likely significantly underestimate the number of wolves and/or packs in any given area. The exact number of wolves preying on the Wiggins Fork Elk Herd is unknown, but is undoubtedly greater than the Service's estimate.

Significant segments of the Wiggins Fork Elk Herd also migrate outside the existing herd unit boundaries (based on radio-telemetry data collected since 1992), where they are exposed to predation by additional packs of wolves through at least early to mid October. The segment that winters on Spring Mountain (1,500-2,500 elk) north of Hwy 26-287 is subject to year-round wolf predation and has the lowest calf:cow ratios (avg. = 20:100 from 2000-2005). Those elk calve in the Dunoir Valley, and then spend summer through mid-fall in the upper Buffalo Fork and South Fork river drainages, the Thorofare and YNP. By contrast, the segment of the Wiggins Fork Herd that winters south of Hwy 26-287 (South Dubois) has much higher calf:cow ratios (avg. = 40:100 from 2000-2005), and has been exposed to considerably less wolf predation. Recruitment in the south Dubois segment since 2000 is comparable (declined by just 7%) to recruitment during 1992-1999 before wolf densities became consequential. However, recruitment in the Dunoir/Spring Mountain segment has declined by 40% between the 2 periods.

iv. "In addition, Wyoming and Montana (North Yellowstone elk herd) initiated deliberate elk herd reduction programs (cow elk hunts in winter) in the GYA to bring the herd size down to habitat management objectives and to alleviate

landowner complaints about excessive elk competition with livestock for forage and crop damage (Hamlin 2005; Vucetich et al. 2005; White and Garrott 2006). Identifying wolf predation as the only, or primary, cause of differences in herd size or calf recruitment is misleading." (71 FR 43414).

Response: Wolf predation is unequivocally the primary cause of differences in calf recruitment. Ultimately, as a direct consequence of wolf predation, hunting opportunity must be reduced. This equates to an enormous loss of public recreation opportunity and income in order to maintain elk numbers at population objectives.

Under normal circumstances, if fall/winter predation of elk calves is minimal, elk reduction programs actually *increase* calf:cow ratios measured after the hunting season. This happens because hunters exhibit a strong preference for harvesting adult cows during antlerless hunting seasons. Since a larger proportion of the adult cows are harvested, the post-hunt ratio of calves to cows should be higher compared to ratios measured during years in which fewer cows are harvested. However, substantially lower calf:cow ratios have been documented in herds impacted by wolves. The preponderance of evidence clearly demonstrates wolf predation is the primary cause of differences in calf recruitment. White and Garrott (2005) stated, "We expected recruitment by northern Yellowstone elk to be significantly lower and less variable following wolf recovery owing to the high selection of elk calves by wolves (41% of kills during 1995-2002). Recruitment estimates during 1998-2004 continued to show marked temporal variation (CV=41%) but decreased after wolves reached high densities and the ratio of wolves to elk increased on the northern range." Differences in calf recruitment among elk herds with and without wolves in Wyoming are consistent with White and Garrott's conclusions, and with observations YNP biologist, P.J. White stated in official Park news releases (e.g., YNP news release dated 8 April, 2006).

b. Predation forecasts by the 1994 EIS. "The potential impact of wolf predation to decrease some elk herds and reduce hunter harvest for cow elk was *relatively accurately* forecast in the [1994] EIS …" (71 FR 43414).

Response 1: "*Relatively accurately*" is an oxymoron. The 1994 EIS based all projections of wolf impacts in the GYA upon the premise of "A recovered wolf population of 100 wolves (10 packs) …" (USFWS 1994:Chapt. IV, page 2). The USFWS states, "A recovered wolf population of 100 wolves (10 packs) would kill about 1,200 wild ungulates at a predation rate of 12 ungulates/wolf/year …" and "*Conclusions* – A recovered wolf population (about 100 wolves) is predicted to kill about 1,200 wild ungulates (primarily elk, deer, moose, and bison in the Yellowstone area" (USFWS 1994:Ch IV, pp 2-3).

These projections were not intended to represent the impacts *per 100 wolves*, as the Service now suggests, but rather, the impacts *of a recovered population of 100 wolves*. The wolf population at equilibrium was projected to fluctuate between 50 and 120 (White et al. 2005:35). The most current, minimum population estimate in the GYA is 325 wolves in 46 packs (USFWS et al. 2005). This number is 225% higher than the original EIS prediction of a recovered wolf population. In addition, the original predation rate per wolf was substantially underestimated. The current consumption rate is 22 ungulates per wolf per year, 92% of which are elk (White et al. 2005:35-36). At the current wolf population and predation rate, 325 wolves kill a *minimum* of 7,150 ungulates annually. Accordingly, the number of ungulates killed each year is 500% higher than the original EIS prediction.

Response 2: The Service summarized 2 modeling studies (Boyce and Gaillard 1992; Mack and Singer 1992) that forecast reductions in ungulate populations ranging from 0-30% (USFWS 1994:Ch IV, p2), the Service's actual predictions of the impact of wolf predation on wild ungulates are stated below:

"*Conclusions* – A recovered wolf population (about 100 wolves) is predicted to kill about 1,200 wild ungulates (primarily elk, deer, moose and bison) each year, representing about 1% of the estimated 95,000 elk, deer, moose, and bison in the Yellowstone area (USFWS 1994:Ch IV, p3)." [Petitioners stipulate this prediction is based on 100 wolves and an average kill rate of 12 ungulates/wolf/year]. The Service also stated, "a recovered wolf population (about 100 wolves) in the Yellowstone Area may reduce hunter harvests of antlerless ungulates (female and young) for some ungulate herds. Computer models predicted the high antlerless harvests for the northern range elk herd may be reduced as much as 27% from about 994 antlerless elk/year to 714 antlerless elk/year. The antlered (male) elk harvest would likely be unaffected" … "In the Yellowstone area, hunters annually harvest 14,314 elk, deer, moose, and bison. A recovered wolf population would kill about 1,200 ungulates/year, representing 8% of the average hunter harvest during the 1980s" (USFWS 1994:Ch IV, p4).

The Service's original predictions were highly inaccurate.

– The recovered wolf population (325) is currently 3.3 times higher than the 1994 EIS prediction for a recovered population long term [i.e., at equilibrium];
– The current estimated predation rate (approximately 22 ungulates/wolf/year) is 1.8 times the 1994 EIS prediction;
– The total ungulate kill based on 22 ungulates/wolf/year and 325 wolves is 6.0 times the 1994 EIS prediction;
– The Northern Yellowstone Elk Herd has declined more than 50% since wolves were introduced in 1995 (White et al. 2005:35). This is 1.7 times the maximum decline predicted by models.
– The 1994 EIS predicted average annual cow harvest in the northern Yellowstone elk herd would decline 27%, from 994 to 714 (USFWS:3). Since 2002, the average annual cow harvest has been 491 (Hamlin 2006), which represents a decline of 51%. In 2006 only 114 cows were harvested, representing a decline of 89%, or 3.3 times the decline forecast in the 1994 EIS;

– The original EIS predicted the antlered elk harvests would *likely* be unaffected (USFWS 1994:4). This prediction was irrational because the sustainable bull harvest is a function of male calf recruitment into the population, which depends on the number of cows in the population and the calf:cow ratio (put another way, bulls come from cows). If the elk population should decline by up to 30%, it follows that the sustainable bull harvest would also decline by a similar amount in order to maintain a satisfactory ratio of bulls to cows. Similarly, if the calf:cow ratio declines, recruitment of bulls into the population will also decline. The annual bull harvest in the northern Yellowstone elk herd actually decreased from an average of 810 pre-wolf to an average of 327 post-wolf, and was only 206 in 2005-06 (Hamlin 2006). These changes represent decreases in the bull harvest of 60% and 75%, respectively.
– The original EIS predicted a recovered wolf population would kill about 1,200 wild ungulates/year, representing 8% of the average hunter harvest during the 1980s. The current offtake of ungulates (22 per wolf per year), applied to the current minimum estimate of wolves (325) is 7,150. This is 50% of the 14,314 ungulates per year harvested during the 1980s, or 6.3 times the original EIS projection.
– Unprecedented, low calf ratios have been documented in Wyoming elk herds most heavily impacted by wolf predation (Wyoming Petition:Table 2, page 6). Recruitment rates of less than 15 calves per 100 cows, measured in early winter, will not sustain elk populations and harvest opportunity. The 1994 EIS did not address or even mention the potential effect of wolf predation in suppressing calf recruitment. Based on wolf behavior elsewhere, this effect should have been reasonably foreseeable and therefore subject to analysis by the NEPA document. As incoming cohorts (year classes) of female elk are severely reduced or lost, population level effects may be delayed somewhat because the older cohorts continue to survive for a period of years. However the reduction of several successive age cohorts eventually causes a rapid population decline as older females pass into reproductive senescence and die. Population recovery following loss or reduction of several successive age cohorts will be protracted and is unlikely unless calf recruitment recovers to pre-wolf levels.

Response 3: The original 1994 EIS did not analyze or even identify the principal mechanism by which wolf predation is impacting elk herds – fall/winter/spring predation of calves and loss of recruitment to the population. Based on White and Garrott (2005), the composition of 608 elk killed by wolves during winters of 1995-2002 was 41% calves, 39% adult females, and 20% adult males. Given a ratio of about 20 calves per 100 cows and a similar bull:cow ratio (northern Yellowstone elk herd), it is evident wolves are selecting calves at an overall rate of about 3 times their occurrence in the Northern Yellowstone population. The focus of wolf predation on young animals is well documented in other regions. This effect was reasonably foreseeable at the time the EIS was prepared and should have been considered in the impact projections.

c. Validity of wolf predation study referenced by the Service. The Service states, "Some studies indicated wolves were having minor impacts on elk herds in comparison to other factors (Vucetich et al. 2005) while others suggested wolf predation was a significant factor (White and Garrott 200[5])" (71 FR 43414).

Response: The Service failed to address Petitioners' critique of the Vucetich et al. (2005) data and its interpretation [refer to Wyoming Petition, pages 8-10]. In the Vucetich et al. (2005:3) analysis, hunter harvest of cow elk was posited to have a "super-additive" effect upon the population's growth rate: "Our analysis suggests that human harvest *may* have been super-additive. That is, for every one percent increase in harvest rate, the population growth rate declines by more than one percent (i.e., 1.55 …)" (Vucetich et al. 2005:6). This assertion is untenable and because the authors' models depend upon it, we believe their use/interpretation of the data was highly flawed. When limitations of the data set are not recognized or understood, even sophisticated statistical methods can and often do lead to absurd conclusions. The authors stated, "The apparent super-additivity of the harvest may be explained by the fact that most elk (70%) taken in the harvest were pregnant." However, the 1.5-fold "super-additivity" effect is easily disproved based on late season calf ratios.

The maximum possible impact of cow harvest upon a population's growth rate is determined from the average decrease in surviving cows and surviving calves at time "t+1" (the subsequent year) as a result of removing a cow at time "t." For example, if we assume each cow that is not harvested from the population has on average, a 90% chance of surviving until the end of the biological year (i.e., the beginning of the next calving season), and we assume the average number of female calves alive at the end of each biological year is 10 per 100 of the cows alive at the beginning of the hunting season, then harvesting an "average" cow has the effect of removing 0.9 cows from the population at t+1 and 0.1 female calves that would have been recruited as yearlings into the population, or a total effect of removing 1 female elk. In this scenario, increasing the female harvest rate by 1% will reduce the population growth rate by 1% (1% less of the population is left at the end of the biological year compared to the end of the prior biological year). On average, the effect of each percent change in cow harvest is multiplied by the ratio of cows alive at the beginning of the hunting season to the number of cows and yearling female calves alive at the beginning of the subsequent biological year (we assume summer mortality of cows is minimal).

The maximum potential effect of cow harvest can be estimated based on late season [winter] calf:cow ratios documented in the northern Yellowstone elk herd. For these simulations, we assumed there is no natural mortality of cows and no mortality of calves after the late winter classifications are done. Under these assumptions the impact of cow harvest is actually overestimated because:

1) Non-hunting mortality of adult cows, and mortality of calves after the classifications will reduce the actual effect of harvesting a cow; and

2) The ratio of calves present in the population at the time of the late season classifications, to the number of cows alive at the beginning of the hunting season, indicates the rate of potential recruitment loss per cow harvested. However, the late season calf:cow ratio is higher than this and is an overestimate of recruitment loss due to the disproportionate harvest of cows during the hunting season.

We simulated the potential growth rate of the cow segment based on the above assumptions, using average calf:cow ratios from the following 3 periods – overall (1986-2006), pre-wolf (1986-2005) and post-wolf (2000-2006). The 3 calf:cow ratios were 28:100 (pre-wolf), 22:100 (overall) and 18:100 (post-wolf). We assumed the female calf:cow ratio was half the total calf:cow ratio. The simulations were run for 5 generations to compare the changes in growth rate based on an increase of 1% applied to the average harvest rates of cows pre-wolf (10%) and post-wolf (4%). Results are summarized in the following table:

female calf:cow ratio	High Harvest Rate		**Difference (%)**	Low Harvest Rate		**Difference (%)**
	10%	(+1%) 11%		4%	(+1%) 5%	
	Growth Rate			Growth Rate		
.14	2.60%	1.46%	**1.14%**	9.44%	8.30%	**1.14%**
.12	0.80%	-0.32%	**1.12%**	7.52%	6.40%	**1.12%**
.09	-1.90%	-2.99%	**1.09%**	4.64%	3.55%	**1.09%**

Based on these simulations, the maximum potential effect a unit change in the cow harvest rate can have on the population's growth rate is the unit plus the recruitment increment attributed to that unit (i.e., 1.00 + 0.14, 0.12, or 0.09). The maximum recruitment increment is the average late season ratio of female calves to cows. Since the ratio of bulls:cows generally remains within a limited range, and the proportion of bulls is comparatively small, the growth rate of the female segment is indicative of the overall population growth rate.

In order to realize the super-additive effect of 1.55% posited by Vucetich et al. (2005), the late season ratio of female calves to cows would need to be at least 55:100, requiring a total calf:cow ratio exceeding 100:100. These ratios would be even higher to compensate for natural mortality of adult cows and late season calf mortality. The highest late winter calf:cow ratio (both sexes of calves) recorded in the northern Yellowstone Herd was 44:100 in 1992. Late winter ratios approaching 100:100, for that matter anything over 60-70:100, are unattainable in a wild elk herd. These implications conclusively demonstrate the data interpretation by Vucetich et al. (2005) was flawed. The Wyoming Petition suggested 3 likely reasons for this (pages 9-10): 1) the authors' regressions failed to account for the "releaser" effect of unconstrained population growth in a largely vacant environment after the long-term culling operations were terminated in 1968; 2) the authors' regressions failed to account for the effect of increasing

survey efficiency in explaining a portion of the population's apparent growth; and 3) frequent predation attempts on herds of elk by wolves throughout the winter period (only 1 in 5 attempts are successful) could impact the condition of many animals, potentially leading to decreases in population vital rates (birth, survival) that the authors did not attribute to wolves.

d. Excessive Predation of Ungulates (Elk) by Wolves. Both the 1987 recovery plan and the 1994 EIS provided assurances that excessive predation of ungulates by wolves would be addressed through management actions: The recovery plan included the following assurances: "Criteria should be developed with State wildlife agencies for determining when wolf predation may constitute a problem with ungulate populations/management objectives. Before a problem is considered to exist in wolf-ungulate relationships, the ungulate populations must be declining and evidence must be provided indicating wolves are primarily responsible for the decline" (USFWS 1987:26); "Wolf management must, out of necessity, be closely coordinated with State big game management objectives" (USFWS 1987:27); [and] "… Assure that big game and secondary prey populations are maintained at population levels adequate to maintain ten breeding pairs of wolves in each recovery area. This goal must also be integrated with State management goals for ungulate management/hunter harvest rates. These uses/demands should not be viewed as mutually exclusive." (USFWS 1987:28). The 1994 EIS additionally made the following assurance: "For ungulate herds where the primary management objective is to sustain higher big game populations to maximize hunter harvest, wolf recovery could reduce the number of animals available for harvest on a sustained basis. However, this alternative allows for relocation of wolves in circumstances where wolf predation causes significant reductions in ungulate populations." (USFWS 1994:Ch IV, p21). [Petitioners stipulate nearly all ungulate herds in the GYA are managed to maximize hunter harvest].

Response: The USFWS has not sincerely coordinated with the states to determine if wolf predation is excessively impacting big game herds and hunter harvest opportunity. Although the Service indicated loss of hunter harvest opportunity would be an important consideration, the Service only discussed one conceptual approach for identifying excessive predation – that is, a "*significant*" reduction in ungulate populations. However, suppressed calf recruitment also impacts harvest opportunity, potentially to an even greater degree than a reduction in the population. The EIS predicted a 27% reduction of antlerless harvest in the northern Yellowstone herd (USFWS 1994:Ch IV, p4), which the Service apparently does not consider "significant." The States consider such a loss of recreation opportunity to be highly significant. In addition, the Service's original predictions severely underestimated the actual impact of wolves on ungulate populations, annual recruitment, and hunter harvest (discussed in Comment 3.b.). In describing its basis for determining if wolves might be causing excessive impacts, the Service transferred burden of proof to the States while retaining ultimate veto discretion. And, the Service's suggested remedy for dealing with

excessive wolf predation, capturing and relocating wolves, is completely infeasible because nearly all potentially suitable habitats are saturated.

Petitioners provided credible studies and other evidence demonstrating wolf predation has greatly exceeded the original EIS predictions and is having unacceptable impacts on elk populations (Wyoming Petition, pages 3-14; WGFD comments 8 and 9, letter dated 23/6/06; White and Garrott 2005; Hamlin 2006; White et al. 2005). In the face of mounting evidence to the contrary, the Service dogmatically persists in its assertion that predation by wolves is not a significant factor impacting big game populations. However, the Service itself provides no substantive proof or documentation of this, instead relying upon theoretical explanations and rationalizations. (The apparent effects *could be* related to bear predation, to drought, to hunter harvests, to habitat issues, etc.). This "burden of proof" game places state resources squarely at risk, while minimizing accountability and liability for the Service. The Service need only continue to question and rationalize away the impacts until they become so excessive and costly to the States, they are indisputable. Even then, we question whether the Service might acknowledge wolves are responsible (e.g., the example of the northern Yellowstone herd). The Service assumes far too much discretionary authority without an appropriate measure of accountability. The Service has not coordinated with the States to "integrate wolf management into state big game management objectives," nor has the Service developed specific criteria, in consultation with the States, to determine when/whether wolf predation is causing excessive impacts to ungulate herds. Institutionally, culturally, and philosophically, the Service is ill equipped to impose numerical and distributional caps on the recovery of a potentially injurious and deleterious species within a highly altered ecosystem. Yet, such caps are absolutely essential to successfully and responsibly manage wolves in the GYA and elsewhere in the contiguous U.S.

e. Wolf impacts on harvest by hunters. The Service states, "The Wyoming Petition also asserted that wolf predation reduced the number of elk that needed to be killed by hunters each year to [manage herds at objective] … This is consistent with the predictions of the 1994 EIS …" (71 FR 43414.

Response: The reduction in cow harvests needed to manage elk herds at objective has greatly exceeded (by a factor of 3.3 times) the reduction originally forecast in the 1994 EIS for the northern Yellowstone herd (refer to comment 3.b).

f. Livestock depredations. The Service states, "Surprisingly, the rate of confirmed livestock depredations per 100 wolves (average of 14 cattle and 29 sheep killed for every 100 wolves in the GYA from 1995-2005) is actually lower than the EIS predicted (on average 100 wolves in the GYA were predicted to kill 19 cattle and 68 sheep annually) …"

Response: The predictions of livestock depredation, and all other forecasts in the 1994 EIS, were based on *a recovered population of 100 wolves and 10 packs*. This context is made crystal clear throughout the EIS and is reaffirmed in White

et al. (2005:37) and by the Service's own admission in 71 FR 43425: "… the wolf population has expanded its distribution and numbers far beyond, and more quickly than, earlier predictions …" The livestock depredation forecast was not a rate *per 100 wolves*, as the Service now attempts to rationalize. The original EIS projected *long term* livestock depredations by a recovered wolf population in the GYA would total 19 (range 1-33) cattle and 68 sheep (range 17-110) annually (USFWS 1994:Ch IV, pp 9-10) based on a population of 100 wolves. Since 2003, when the GYA wolf population reached and exceeded 300, wolves have killed an average of 69 (range 45-100) cattle and 81 (range 53-99) sheep (USFWS et al. 2006). These figures include only confirmed livestock depredations. The maximum number of sheep killed in a single year was 117 in 2001. The average and maximum numbers of cattle being depredated exceed the original EIS projections by 263% and 203%, respectively. The average and maximum numbers of sheep depredated exceed the original EIS projections by 19% and 6% respectively. Sheep depredations are likely lower only because numbers of sheep and sheep allotments have declined in the GYA wolf recovery area. This livestock depredation issue is addressed in greater detail by comment 8.

4. RE: Economic impact of wolves (71 FR 43414). The Service states, "Additionally, the Wyoming Petition only discussed the negative impact of wolf predation on select aspects of the economy (big game hunting and livestock depredation), not the entire economic effects of wolf restoration. The EIS analyzed the full range of costs and benefits of wolf reintroduction and concluded that the presence of wolves in YNP would generate many times more economic benefits than costs. A recent economic study in YNP indicated that the presence of wolves was currently generating over $20 million per year in economic activity in Montana, Idaho and Wyoming, similar to that forecasted ($23 million in 1992) in the EIS (Duffield et al. 2006)." [Petitioners stipulate that "generating $20 million in economic activity" does not mean an additional $20 million flows into the economy].

   The Wyoming Petition (pages 10-12) identified biases in the original survey method used to assess "economic benefits" of wolves in the 1994 EIS (based in part on Duffield 1992). The USFWS had forecast wolves in Yellowstone national park would result in "… an estimated 10.4% increase in visitation from residents of Montana, Idaho, and Wyoming, and an increase of 4.8% from out of region residents" (USFWS 1994:Ch IV, pp 16-17). However, the EIS also stated, "It should be noted that the standard errors on the estimates of percentage changes in visitation are quite large, and in all cases a 95% confidence interval on these estimates includes zero [change]." The Wyoming petition summarized data from the National Park Service, indicating park visitation since wolves were introduced (1995-2004, avg. = 2,974,060 visitors per year) changed by less than 2 tenths of a percent compared to the period prior to wolf introduction (1990-1994, avg. = 2,969,470). After the wolf population reached recovery goals in 2000, visitation averaged 2,892,289 from 2000-2004, representing a 2.6% decrease from the pre-wolf visitation level. In 2005, visitation was just 2,835,649, a 4.5% decrease from the pre-wolf visitation level.

With respect to the survey by Duffield (1992), the EIS cautioned, "It should be pointed out however that for a majority of respondents the presence of wolves would not change their visitation patterns." This is a key admission, because it indicates the presence of wolves might not actually increase revenue, but merely redistribute the existing revenue expenditures (i.e., someone might purchase a T-shirt bearing a wolf image instead of a bison image, someone might sign up for a wolf-watching tour instead of a general wildlife tour, someone might indicate wolves factored into a decision to visit the Park when they would have visited the park anyway). The original survey did not establish whether expenditures for wolves were additional expenditures above and beyond some baseline level, or whether wolf-related expenditures replaced expenditures for other purchases or services. (i.e., "additive" versus "compensatory" spending). The Duffield et al. (2006) survey results were summarized in an abstract that stated, "The study *replicates* a survey and economic analysis undertaken 15 years earlier (in June 1991) that was the basis for the projected economic impacts described in the 1993 and 1994 wolf recovery Environmental Impact Statements." This being the case, Petitioners believe the current survey has the same flaws and biases found in the original survey. Irrespective, it is untenable to believe wolves are responsible for *adding* $20-23 million to the economy, when the original EIS predictions were based on a 5-10% increase in Park visitation that never materialized. Visitation has actually declined by 2-4% in recent years compared to the 5 years before wolf introduction. Petitioners see no evidence that the presence of wolves has appreciably *increased* revenue inflow to the economies of Wyoming, Idaho, and Montana. Rather, the purported "economic value" of wolves is based on a very slight redistribution of the existing tourism revenue and overall tourism is actually down.

In addition, the Service overestimated the alleged economic gain resulting from presence of wolves compared to the economic losses attributed to reduced elk hunting opportunities. The Service states, "Wolf predation on ungulates (primarily elk) has a cost to some segments of society (some types of big game hunters), but those costs are far outweighed (*over 10-fold*) by the positive economic benefits to GYA States …" (71 FR 43414). The economic analysis in the 1994 EIS, sought to minimize the economic impact attributed to lost hunting opportunity. The 1994 EIS states, "… reduced hunter harvest of elk, mule deer, and moose in the Yellowstone area due to wolf recovery could result in losses on the order of $187,000 to $465,000 per year. Additionally, an estimated $207,000 to $414,000 in hunter expenditures would be lost to the 3-state region." (USFWS 1994:Ch IV, p15). The Service's estimates were based in part, on an assumed 27% reduction of cow harvest and no change in bull harvest in the northern Yellowstone elk herd. However, by 2005-06, the total cow and bull harvests had actually decreased by 89% and 75%, respectively.

The Wyoming Game and Fish Department estimated the potential loss of economic return to the State as a result of wolf predation could reach $9.1 million *based on the 1994 EIS assumption that predation would total just 12 ungulates per wolf per year* (Wyoming Petition: Appendix I, page 65). The original predation estimate has been greatly exceeded (now 22 ungulates per wolf per year), indicating the Department's earlier estimate of the economic impact was very conservative. The Wyoming figure

also did not consider economic losses in the Montana or Idaho portions of the GYA, nor did it consider uncompensated livestock losses or the very substantial costs of managing wolves, which the States will have to bear. Thus, the loss of economic return to States in the GYA will greatly exceed even the hypothetical gains from visitor expenditures forecast in the 1994 EIS.

5. RE: Wolf Habitat Suitability (71 FR 43414). The Service states, "The Wyoming Petition proposed that wolves were introduced into unnatural and fragmented landscapes and wolves were living in altered or marginally suitable habitats because of other human uses of the land. Suitable wolf habitat in North America can be simply characterized by moderate rates of human-caused mortality (due to low road density, forest cover, regulation of wolf killing by humans), adequate wild ungulates and seasonal or low livestock density … Wolves are habitat generalists and live in landscapes altered by humans throughout the world …Wolves listed under the ESA have lived in areas where human activities occur for decades … Wolf presence and human activity do not have to be mutually exclusive." (71 FR 43414).

   Response: The Service has not addressed the fundamental issue originally raised by the Wyoming Petition. Petitioners stated, "… the original FEIS failed, except on the most superficial level, to analyze the issues involved with attempting to manage wolves within altered or marginally suitable landscapes."

   The 1994 EIS did not analyze the suitability of GYA habitats to support an ecologically functioning wolf population as part of a natural predator-prey system. In fact, the EIS did not analyze any aspect of the suitability of habitats within the wolf recovery areas. Relevant portions of the "Alternatives (Chapter I), "Affected Environment" (Chapter II) and "Environmental Consequences" (Chapter III) merely discussed the comparative remoteness of the region and the abundance of prey. Habitat suitability was a tacit premise of the entire EIS process, as the issue was not addressed in any detail. Consequently, the EIS never answered the most fundamental question of all – was it biologically appropriate to introduce wolves into the highly altered GYA? This question needed to be addressed in substantial detail in order to establish compliance with 50 CFR 17.81(a) and to conduct a meaningful assessment of the impacts of wolf recovery.

   The 1987 Wolf Recovery Plan offered ambiguous and inconsistent interpretations of what may constitute suitable wolf habitat. Statements from the plan included: "The key components of wolf habitat are fairly simple: (1) a sufficient, year-round prey base of ungulates (big game) and alternate prey; (2) suitable and somewhat secluded denning and rendezvous sites; and (3) sufficient space with minimal exposure to humans." (USFWS 1987:6). "A few places, mostly the National Parks and other wild areas, still exist in the Northern Rocky Mountains where wolves can survive" (USFWS 1987:7). "Basic criteria that should be used in selection of recovery areas include: (1) presence of an adequate natural prey base on a year round basis; (2) a minimum contiguous area of 3,000 square miles, or a lesser area if adjacent available land[s] that could support wolves exceed 3,000 square miles in the aggregate; (3) no

more than 10% private lan[d], excepting railroad grant land; (4) *if possible*, absence of livestock grazing or little possibility for conflict; and (5) sufficient isolation to protect ten breeding pairs."

Elsewhere, the Service states that the management plan should: "establish management zones … Management Zone 1 … should contain key habitat components in sufficient abundance and distribution on an annual basis to sustain ten breeding pairs of wolves. It should generally be an area greater than 3,000 contiguous square miles with less than 10% private land … and less than 20% subject to livestock grazing." (USFWS 1987:23). [Petitioners stipulate Management Zone 1 corresponds to the National Parks and contiguous wilderness, which meet the criteria of >3,000 mi^2, ≥10 breeding pairs, and less than 20% subject to livestock grazing]. "Management Zone II … should be established as a buffer zone between Zone I and Zone III. It should contain *some* key habitat components but probably not in sufficient abundance and distribution to sustain a viable wolf population … Zone II boundaries may be changed according to demonstrated wolf population and habitat needs, provided the change does not bring wolves into conflict with livestock areas/allotments." [Petitioners stipulate Management Zone II corresponds to that portion of the Northwest Wyoming Wolf Management Area lying outside the national parks and contiguous wilderness]. "Management Zone III … contains established human activities such as domestic livestock use or other human activities or developments in sufficient degree to render wolf presence undesirable." [Petitioners stipulate Management Zone III corresponds to the balance of Wyoming outside the Northwest Wyoming Wolf Management Area].

The Service also states, "Unsuitable habitat also is important in determining the boundaries of our DPS … non-forested rangeland and croplands associated with intensive agricultural use (prairie and high desert) would preclude wolf pack establishment and persistence. This is due to chronic conflict with livestock and pets, local cultural intolerance of large predators, and wolf behavioral characteristics that make them extremely vulnerable to human-caused mortality in open landscapes" … "We included all of Wyoming, Montana, and Idaho in the NRM wolf DPS … We recognize that this includes large swaths of unsuitable habitat in eastern Wyoming and Montana." [71 FR 6642, February 8, 2006].

Thus, the Service has clearly acknowledged the potential for conflict with human development (exposure to humans) is a key consideration in defining suitable wolf habitat. Yet the Service also contends areas with comparatively high levels of human activity/development can be suitable habitat for wolves (71 FR 43414). These highly equivocal characterizations enable the Service to arbitrarily define its own range of standards for suitable wolf habitat. In fact, the Service has never established how much development or potential conflict would cause an area to be considered unsuitable wolf habitat. Although wolves can occupy developed areas, the economic and social costs of conflict management burgeon to unacceptable levels. In practical terms, those costs render such developed areas unsuitable habitat.

A much more crucial aspect of the habitat suitability issue was never addressed by the 1994 EIS or the 1987 Recovery Plan. This issue concerns whether wolves can fulfill a natural, ecological function, without being intensively managed, in such a highly altered ecosystem. The original EIS predictions of the anticipated rate of ungulate predations and the projected decline in northern Yellowstone elk resulting from a "recovered wolf population" have all been greatly exceeded (comment 3.b.), and calf recruitment has declined to unprecedented low levels in several elk herds impacted by wolf predation. All of these unanticipated conditions point to an imbalanced, predator-prey ecology and the need to intensively manage wolves, along with their prey, in this human-altered landscape. There are several reasons for this.

The Service asserted wolf populations have lived in landscapes altered by humans in other regions of the country (71 FR 43414), however the wolves in the GYA are not comparable to wolves elsewhere in the U.S., for example, in the Midwest. The ungulate prey base in the GYA undergoes distinct annual migrations onto extremely limited winter ranges and feed grounds that exist at lower elevations within a constricted interface between marginally suitable and unsuitable wolf habitat. The habitat suitability discussions in the 1987 Recovery Plan only addressed, on a gross scale, the overall abundance of ungulate populations and comparative remoteness of the entire GYA (most of which is summer range). However, throughout the "winter period" [defined as 1 November through 15 May (Singer et al. 1997:16)], nearly all ungulates in the GYA are forced to congregate within limited crucial winter ranges and feed grounds comprising less than 15% of the NW WY Wolf Management Area. Much of the available winter range is constrained to the very fringe of the GYA and is impacted and fragmented by agricultural activities and residential developments. For example, the National Elk Refuge comprises just 25% of the winter range that historically existed in Jackson Hole (USFWS 2005).

Fragmented winter ranges and feed grounds concentrate elk at abnormally high densities and afford few options for animals to disperse or relocate in response to wolf predation, or to winter in naturally dispersed groups over a larger area. In addition, development and incompatible land uses have blocked migrations of elk that historically wintered in more outlying, open basins, forcing those elk to also concentrate on remnant winter ranges and feed grounds within the primary areas occupied by wolves. Predation by wolves on feed grounds is <u>not</u> a natural ecological process (WY Petition: page 13). The same comment pertains to wolf predation within fragmented native winter ranges. The estimated annual predation rate (22 ungulates per wolf) greatly exceeds the original EIS prediction of 12 ungulates per wolf per year (White et al. 2005:36), further attesting GYA elk are abnormally vulnerable to wolf predation. Predation rates in the GYA substantially exceed predation rates documented elsewhere in more naturally functioning ecosystems – e.g., 4.6 ungulate kills per wolf per 100 days in NW Alaska (Ballard et al. 1997). The Service's original estimate of predation during winter was just 1 elk per wolf per 34 days (USFWS 1987:Appendix 3, page 55), or 5.8 elk per wolf per winter (1 November to 15 May).

For 6½ months of each biological year, elk are forced to occupy restricted areas of fragmented winter ranges and feed grounds, and the wolves follow their prey base onto those unnatural areas. While it's true the vast ungulate summer ranges of the GYA are largely remote, undeveloped areas consistent with the Service's criteria for suitable wolf habitat, the same cannot be said of the available winter ranges occupied during fully half of each annual cycle. A credible analysis of habitat suitability needed to consider winter and summer habitats separately, because the present-day circumstances and threats in each are vastly different. The Service did not examine the ecological status of wolf predation on feed grounds and on remnant native winter ranges, and did not objectively evaluate whether it was reasonable to expect wolf predation in such highly altered environments would be consistent with the equilibrium state predicted by the original 1994 EIS (approximately 100 wolves in 10 packs).

The following statement from the 1994 EIS illustrates the ideological precept under which wolf recovery was originally envisioned and carried out: "The restoration of a viable wolf population in the Yellowstone area would increase the maintenance and enhancement of long-term productivity of the environment by restoring the ecosystem to near pre-colonial natural conditions." (USFWS 1994:ChIV, p20). This notion is implausible. In order to restore the GYA ecosystem to "near pre-colonial natural conditions," nearly all human habitation and uses of the surrounding national forests and private lands would need to be eliminated. Fundamentally, the 1994 EIS did not objectively analyze the problems and issues associated with wolf introduction. Nor did it recognize the need to intensively manage the numbers and distribution of wolves within a highly altered and fragmented ecosystem.

6. RE: Feedground and Wnter Range Issues (71 FR 4314-4315). The Service attempts to refute Petitioners assertion that wolf recovery is incompatible with elk management in areas with feedgrounds. The Service concludes by stating, "Disease issues, not wolf predation, will *likely* continue to be the most serious issue facing winter feeding of high numbers of elk, but wolves have added to the complexity of managing wintering elk on feedgrounds (Jimenez and Stevenson 2003, 2004; Jimenez et al. 2005).

   The Service's response is conjectural and begs the question. The 3 major issues raised by the Wyoming Petition (page 13) were: (1) wolf predation on feedgrounds is not natural (i.e., not a natural ecological process); (2) wolf predation on feedgrounds creates numerous costly management issues; and (3) The 1994 EIS never analyzed or even once mentioned wolf compatibility with feedground operations and fragmented winter ranges. These issues should have been [and continue to be] very significant considerations in establishing whether large portions of the GYA are actually suitable habitat for wolves. For detailed discussions, refer to the previous comment.

7. RE: Unacceptable Impacts to GYA Moose Populations (71 FR 4315). The Service attempts to refute Petitioners assertion that wolf predation is a significant concern with respect to the State's depressed moose population. The Service concludes by

stating, "Wolves occasionally kill moose, but the effect of wolf predation on overall moose population status is unclear. It is *unlikely*, however to have been the most important factor to date.

The Service's response is conjectural and begs the question. Petitioners acknowledged wolves were not the most important factor affecting moose populations *up to the time a recovered wolf population became established*. However, opportunistic predation of moose by an abundant wolf population sustained by other more abundant prey can further depress a low-density moose population. This effect (the impact of an abundant predator population upon a depressed, secondary prey species) has been well documented elsewhere (Gasaway et al. 1992; Boert et al. 1996; Ballard et al. 1997).

8. RE: Premise of EIS predictions and failure to comply with NEPA requirements (71 FR 43415). The Service states, "Surprisingly, the rate of confirmed livestock depredations *per* 100 wolves (average of 14 cattle and 29 sheep killed for every 100 wolves in the GYA from 1995-2005) is actually lower than the EIS predicted (on average 100 wolves in the GYA were predicted to kill 19 cattle and 68 sheep annually) (Service [USFWS] 1996; Service [USFWS] et al. 2006). In 2005, the number of livestock depredations in Wyoming decreased, despite an increasing wolf population near livestock outside of the GYA Park Units. This may be a result of the aggressive [Petitioners note very expensive] control of problem wolves and the high level of removal of problem wolves by the Service in Wyoming outside the GYA Units … No information presented in the Wyoming Petition suggested there was any greater urgency or priority regarding wolf management issues than was anticipated in the 1994 EIS or than currently exists in Montana or Idaho."

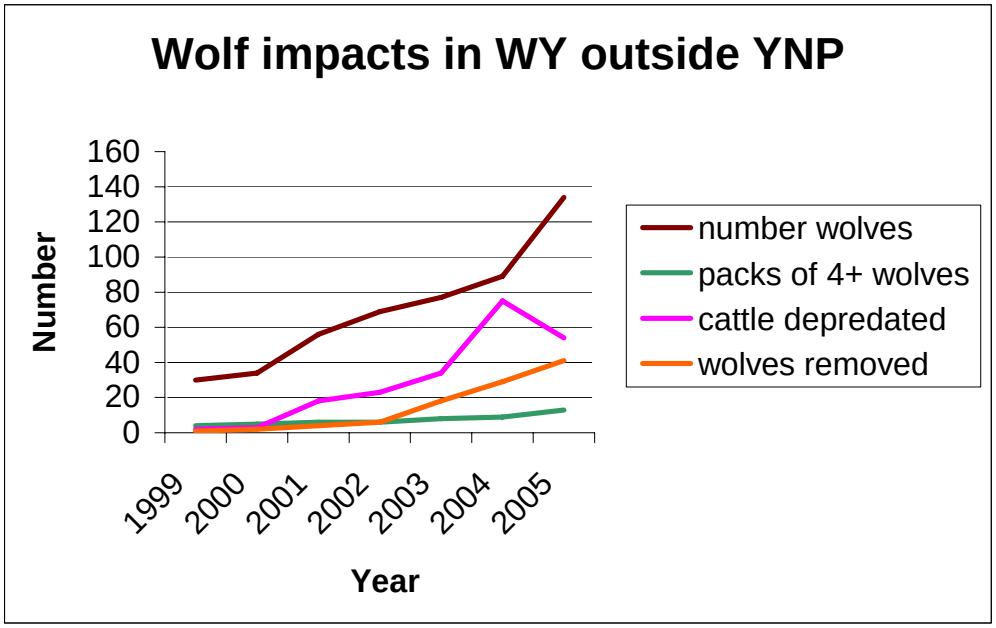
   The Service has misrepresented the original forecasts of the 1994 EIS. Absolutely nowhere in the EIS were predictions based on impacts *per 100 wolves*. The phrase, "per 100 wolves" does not appear anywhere in the EIS. The Service's premise for all impact analyses is stated early in the "Environmental Consequences" section: "*The Yellowstone Area* – The following analysis focuses on the effects of a recovered wolf population (10 packs, about 100 wolves) …" (USFWS 1994:Ch IV, p2). The Service's actual prediction of livestock depredation was, "Application of this equation to comparable data from Alberta, Minnesota, and northwestern Montana results in estimates of about 19 cattle (range 3-32) and 30 sheep (range 17-48) killed or injured by (100) wolves per year in the Yellowstone primary analysis area" (USFWS 1994:Ch IV, p9) and "*Conclusions* … Depredation rates, **long term**, are expected to be within the range of those experienced in other areas of North America and are estimated to average 19 cattle and calves (range 1-32) per year … Depredations on sheep are estimated to average 68 sheep and lambs (range 17-110)." (USFWS 1994:Ch IV, p10). [Petitioners note the predictions in this section of the 1994 EIS were discrepant].

The interjection of the number (100) in parentheses before "wolves" was to affirm the number of wolves in a recovered wolf population and this was unequivocally stipulated in several other sections throughout the EIS. The EIS clearly indicated **"long-term"** depredation rates were based on the number of livestock depredated per year in a recovered wolf population, not the number depredated per 100 wolves as the Service now contends. The Service had envisioned a recovered wolf population would consist of 100+ wolves. White et al. (2005:37) also interpreted that the Service's long-term depredation predictions were based on a recovered wolf population (100+ wolves) that was not envisioned to continue growing substantially beyond 100+ wolves. The minimum and maximum projections for a recovered population were 83-129 wolves from 2000-2002 (USFWS 1994:Ch II, p8, Table 2-1). Petitioners note the GYA wolf population in 2002 was a minimum of 271 (USFWS et al. 2006), which at that time already exceeded the EIS prediction by 110%.

Petitioners believe it was reasonable to foresee the GYA wolf population would rapidly and significantly exceed the Service's original basis for its impact assessments. In 71 FR 43425, the Service directly admits. "… the wolf population has expanded its distribution and numbers far beyond, and more quickly than, earlier predictions (Service 1994; Service et al. 2006)." Accordingly, the impact analyses in the 1994 EIS were substantially deficient and violated CEQ regulations at 40 CFR 1502.16 and 1508.8. In addition, 40 CFR 1502.9(c) states, "Agencies shall prepare supplements to either draft or final environmental impact statements if …there are significant new circumstances or information relevant to the environmental concerns and bearing on the proposed action or its impacts." We question why the Service did not prepare a supplemental EIS to address wolf populations and impacts that greatly exceeded EIS predictions by 2002. We also question why the Service's analysis of easonable foreseeable impacts was not based on the "foreseeable future" timeframe of 30 years, defined in 71 FR 43417.

The Service's own statements point to the urgency of the petitioned action: "In 2005, the number of livestock depredations in Wyoming decreased, despite an increasing wolf population near livestock outside of the GYA Park Units. This may be a result of the aggressive agency control of problem wolves and the high level of problem wolf removal by the Service in Wyoming outside of the GYA Park Units." (71 FR 43415). The Service has admitted the wolf population in Wyoming outside the GYA Park Units is continuing to increase and "aggressive agency control" is necessary to alleviate the resulting livestock depredations. When wolves are delisted, the costs and responsibilities of agency control actions will be transferred to the States.

The current wolf population and average annual livestock (cattle) depredations are 225% and 263% higher than the original EIS predictions, respectively. In fact, the numbers of wolves in WY outside YNP in 2005 (134+), exceeded the recovery criteria originally established for the entire GYA. The wolf population, livestock depredations and control actions in Wyoming outside the National Park Units continue to increase (see chart below). Further delays in delisting will result in even higher wolf populations in areas occupied by livestock, more severe impacts on ungulate populations, and greater management costs borne by the States upon delisting.



	1999	2000	2001	2002	2003	2004	2005
Number of Wolves	30 +	34 +	56 +	69 +	77 +	89 +	134 +
Packs of ≥4 Wolves	4 +	5 +	6 +	6 +	8 +	9 +	13 +
Confirmed Cattle Depredations	2	3	18	23	34	75	54
Wolves Removed	1	2	4	6	18	29	41

9. RE: Establishment of a NRM DPS (71 FR 43415). Petitioners agree with the Service's proposal to establish a NRM DPS comprised of the entire states of Wyoming, Idaho, and Montana, plus the eastern thirds of Washington and Oregon and northcentral Utah, as discussed in 71 FR 6643 (2/8/06).

10. RE: Justification for removing the gray wolf in the NRM DPS from the list of endangered and threatened wildlife. Petitioners agree generally with the Service's analyses of threats from habitat issues, overutilization, disease or predation, or other natural or manmade factors, except Petitioners do not agree with the portions of those analyses, which allege the Wyoming Wolf Management Plan and State Statutes may not be adequate regulatory mechanisms. Petitioners do not agree with the Service's analysis of the adequacy or inadequacy of existing regulatory mechanisms, which alleges the Wyoming Wolf Management Plan and State Statutes are not adequate regulatory mechanisms [Refer to 68 FR 15804 (4/1/03) and 71 FR 43410 (8/1/06)]. This issue is addressed in much greater detail in comments 11-19 that follow.

11. RE: Peer review of the Wyoming Gray Wolf Management Plan. The Service states, "In general, most reviewers believed the coordinated implementation of all three State plans would be adequate to maintain 30 breeding pairs in the NRM … [However] Four critical conditions have changed since the fall of 2003 and the peer review of the State plans. These four conditions support the Service's decision to not approve Wyoming's regulatory framework … (1) Our review of the State law questioned whether commitments made in the Plan could actually be implemented under the law; (2) the wolf population in YNP (most reviewers believed YNP would carry the bulk of Wyoming's share of the wolf population) declined rapidly and dramatically by spring 2005; (3) in 2005, the Federal District Court in Oregon and Vermont ruled on a 2003 Service rule to establish two large DPSs … Those court rulings emphasized the distribution of the wolf population in historical and still suitable habitat was a critical component of determining if recovery had been achieved. Peer reviewers were not asked whether Wyoming's plan would maintain wolf pack distribution in suitable habitat outside of YNP; (4) in recent consultation with Montana, Idaho, Wyoming, the Nez Perce Tribe, Yellowstone National Park, and the University of Wyoming, the Service recognized that the relationship between wolf pack size in winter and breeding pairs was not a linear regression as argued in the Wyoming Petition. The Service … established a method of estimating wolf population status that is scientifically sound and consistent with the Service's wolf breeding pair standard … However, the definition of a wolf pack in Wyoming law and the Plan is not consistent with this analysis and the method in the Wyoming definition of a wolf pack would not allow the Wyoming Segment of the wolf population to be maintained above recovery levels."

    Responses:

    (1) Compatibility of Wyoming Wolf Plan and State law: Petitioners have previously submitted a detailed analysis outlining the reasons why Wyoming's Wolf Management Plan (WGFD 2003) is consistent with and supported by Wyoming Law at W.S. 23-1-304 and related statutes – refer to Wyoming Petition (pages 48-54) and O'Donnell (2003). The Service did not respond to Petitioners' specific rationale on this matter. Petitioners stand by their original analysis and resubmit it in response to this issue.

(2) The YNP wolf population declined dramatically in 2005, suggesting YNP may not "carry the bulk of Wyoming's share of the wolf population": Petitioners previously addressed this issue in the Wyoming Comments on 71 FR 6633 – refer to comments 3 and 16, WGFD letter dated 6 April, 2006). The Service did not consider the Petitioners' data and explanation. The only expectation in the Wyoming Plan is that YNP would maintain 8 or more wolf packs. The single-year "decline" in 2005 was an isolated, episodic event caused by a suspected outbreak of canine parvovirus or distemper. Despite this event, YNP maintained 11 packs of 5 or more wolves and 7 breeding pairs in 2005. There were 13 packs of 5 or more wolves in Wyoming outside YNP. At least 9 of the 13 packs qualified as breeding pairs and the breeding status of 3 packs was unknown. Even if a theoretical minimum [under Wyoming's Plan] of just 7 packs of 5 or more wolves had existed outside YNP midwinter, and we assumed based on Ausband's probabilities (Ausband 2006) that just 56% of those packs had a breeding pair, there would still have been 4 breeding pairs outside the Park to complement the 7 known breeding pairs inside the Park. If we applied the .56 probability to all 11 packs in the park plus 7 packs outside the park (18 packs of 5 or more), the predicted number of breeding pairs would be 10.0, which is the Service's criterion for a recovered population. Furthermore, the protocol for emergency re-listing is a failure to achieve recovery criteria (10 breeding pairs) for 2 consecutive years in any one recovery area (71 FR 6660).

Petitioners had also noted in comment 3 of the 6 April letter, that the pack infrastructure still existed in YNP to have 14-16 successful breeding pairs in 2006. According to the most current (2006), mid-year wolf population estimates (USFWS weekly wolf recovery report dated 9/15-9/22), Yellowstone National Park has at least 14 wolf packs including 12 potential breeding pairs (consult report at http://westerngraywolf.fws.gov/). This sudden and substantial recovery further attests the parvovirus/distemper outbreak was a short-lived (1-year) episodic event as Petitioners had predicted. In addition, 17 packs including 13-16 with pups have been documented in Wyoming outside YNP. There are also 4 additional, suspected packs.

To summarize, the sudden decline in the YNP wolf population in 2005 serves to illustrate a "worst-case" scenario, and the results actually substantiate rather than refute the adequacy of Wyoming's wolf management plan.

(3) Peer reviewers were not asked whether Wyoming's wolf management plan would maintain wolf pack distribution in suitable habitat outside of YNP. The adequacy of wolf distribution throughout the NRM is addressed by the Service's own recovery criteria, the most recent iteration being: "a minimum of 30 breeding pairs (an adult male and an adult female wolf that have produced at least 2 pups that survived until December 31 of the year of their birth, during the previous breeding season) and over 300 wolves well distributed among Montana, Idaho, and Wyoming" (71 FR 43412, 8/1/06). The Service recently made the following findings (71 FR 6645, 2/8/06): "We determined that the current wolf population is

a three segment metapopulation and that the overall area used by the NRM wolf population has not significantly expanded since the population achieved recovery in 2002. This indicates there is probably limited suitable habitat for the population to expand significantly beyond its current borders … Roughly … 87% of [suitable habitat in Montana, Idaho, and Wyoming] is within the area we describe as the area currently occupied by the NRM wolf population …We believe the remaining roughly 13% of theoretically suitable wolf habitat that is unoccupied is primarily outside the NRM wolf population area, is unimportant to maintaining the recovered wolf population, and thus is not a significant portion of the NRM wolf DPS. The requirement that Montana, Idaho, and Wyoming each maintain at least 10 breeding pairs and 100 wolves in mid-winter insures that the recovered wolf population will be maintained throughout a significant portion of its range in the NRM wolf DPS into the foreseeable future." (Also see 71 FR 43419-43420, 8/1/06). In addition, the Service has stated, "Since 2001, all suitable areas for wolves have been filled with resident packs, and consequently most wolves that repeatedly depredate on livestock are now removed from the population (Service et al. 2006)" (71 FR 43425, 8/1/06).

The Service has conceded that wolves currently occupy all potentially suitable wolf habitats in Wyoming. The 13% of potentially suitable habitat that is not occupied is primarily outside the NRM wolf population area and is also outside the Northwest Wyoming Wolf Management Area identified by the Wyoming Wolf Management Plan. The Service further conceded that the original recovery criteria of 10 breeding pairs and 100 wolves in Wyoming and each of the other 2 states/recovery areas is sufficient to maintain a recovered wolf population throughout a significant portion of the suitable wolf habitat in the NRM DPS. Thus, the Service's own interpretation of what constitutes "significant portion of the species' range, pursuant to the Oregon and Vermont District Court rulings, is 10 breeding pairs in each recovery area. The question that was posed to the peer reviewers was exactly that – would Wyoming's plan be sufficient to assure 10 breeding pairs are maintained in Wyoming. The response by peer reviewers fulfills the Service's criteria for maintaining a recovered wolf population throughout a "significant portion" of the species' range.

We also caution the Service against interchanging concepts of "distribution" and "density" in its representation of "significant portion of the species' range." The Wyoming wolf management plan commits to manage for at least 7 packs of 5 or more wolves within Wyoming predominantly outside the National Park Units. Those packs will be maintained within the portions of the Northwest Wyoming Wolf Management Area that encompass all of the remaining suitable wolf habitats in Wyoming outside the National Park Units. The initial classification of wolves as "predatory animal" outside the wilderness areas contiguous to the National Park Units *might possibly* affect the density of packs, however it will not eliminate wolves from this area, in part, because there are no Wyoming wolf packs with ranges entirely within the wilderness areas (USFWS 2006:Fig 3). Therefore, maintaining at least 7 packs within Wyoming outside the National Park

Units will necessitate that most of the packs have ranges outside the wilderness areas. It is unlikely future wolf packs will have ranges entirely within the wilderness because, as the Service acknowledges, "Many of the wilderness areas … are rarely used by wolves because of their high elevation, deep snow, and low ungulate productivity" (71 FR 43427; 8/1/06).

There is no specific management action or requirement in the Wyoming Plan that would exclude wolves from any portion of suitable habitats within the NW Wyoming Wolf Management Area. Over time, the 7+ packs in Wyoming outside the National Park Units will persist in various locations throughout the Wyoming Wolf DAU and those locations will occasionally change depending on control actions, public and agency take of wolves, competition among packs, and dispersal of wolves to form new packs. However, a sufficient number and distribution of wolves will be sustained in Wyoming to meet the Service's criteria of a recovered wolf population (10 breeding pairs and 100 wolves), which the Service itself has determined would comprise a "significant portion" of the species' range. If the interpretation of "significant portion" were based on wolf packs existing everywhere wolf packs *can* or *might* exist, then recovery would need to be based on a completely unregulated wolf population. This would remove all management flexibility from the States and quite obviously would have significant, long-term impacts upon livestock and ungulate populations. A completely unregulated wolf population is clearly not the intent of the Service's own recovery criteria. Finally, the interpretation of "significant portion of a species' range" under the ESA [Sections 3.(6) and 3.(20)], is an inherently legal and qualitative decision. As such, this would not have been an appropriate biological question to pose to peer reviewers, who would have widely differing *personal philosophies* of what constitutes "significant portion." The Service's interpretation of "significant portion" with respect to the NRM DPS is stated in 71 FR 5545.

(4) Wyoming definition of wolf pack size. The Service now contends that Wyoming's definition of wolf pack size, which is based on 5 or more wolves traveling together, is inconsistent with a more recent analysis of pack size that estimated a pack of exactly 5 wolves has a 56% chance of having a breeding pair (71 FR 43416). The Service also contends that the procedure used by Wyoming to define a minimum pack size as a surrogate for the number of breeding pairs, was "mathematically incorrect" (71 FR 43429; 8/1/06). Both of these statements are inaccurate and will be addressed in detail by comment 19.

12. RE: Adequacy of Regulatory Mechanisms – Wyoming Wolf Management Plan. The Service bases its analysis of the adequacy of Wyoming's regulatory mechanisms upon the Service's own interpretation of Wyoming Statutes (W.S. 23-1-304 and related statutes). Petitioners will respond based on the content and provisions of the Wyoming Wolf Management Plan, which the State Attorney General has previously found to be fully consistent with Wyoming Statutes (O'Donnell 2003). Petitioners have previously explained why the Service's interpretation is incorrect [refer to pages

45-54 in the Wyoming Petition and to comments 1, 13, and 17 in the State's 6 April, 2006 letter commenting on 71 FR 6633]. The Service has made the following erroneous statements:

a. "Wolves in other parts of Wyoming could only be classified as trophy game only when populations dipped below 7 packs outside of the National Park/Wilderness units and there were fewer than 15 packs in Wyoming."

Response: The Wyoming Wolf Management Plan provides, "If the number of packs falls to [emphasis added] 7 or below outside of YNP, GTNP, and the Parkway, the Commission shall adopt rules and regulations to classify the gray wolf as a trophy game animal with an area of the State the Commission determines necessary outside of wilderness areas contiguous to the Parks and Parkway to ensure 7 packs of gray wolves are maintained in this State, primarily outside YNP, GTNP, and the Parkway (WGFD 2003: Fig. 3) … This new area will be the Northwest Wyoming Wolf Data Analysis Unit (DAU) and will consist of 3 wolf Management Units (WMU)" (WGFD 2003:10). The DAU is the balance of the NW Wyoming Wolf Management Area outside the National Park Units and encompasses the remaining, suitable wolf habitats in Wyoming. This area has been reviewed and endorsed by the Wyoming Game and Fish Commission.

b. "The State law requires that when there are 7 or more wolf packs in Wyoming 'primarily' … outside of National Park/Wilderness areas or there are 15 or more wolf packs anywhere in Wyoming, all wolves in Wyoming outside of the National Park/Wilderness units would be classified as predatory animals."

Response: The Wyoming Wolf Management Plan provides, "A change back to predatory animal status will occur in all or part of the DAU only if the Commission determines circumstances have changed sufficiently that 7 packs can be maintained outside the National Parks and Parkway with a smaller DAU" [in which wolves are classified as "trophy game"] (WGFD 2003:11).

13. RE: Vulnerability of wolves under predatory animal status. The Service asserts, "When wolves are classified as a "predatory animal" they are under the jurisdiction of the Wyoming Department of Agriculture and may be taken by anyone, anywhere, at any time, without limit, and by any means (including shoot-on-sight; baiting; possible limited use of poisons; bounties and wolf-killing contests; locating and killing pups in dens including use of explosives and gas cartridges; trapping; snaring; aerial gunning; and use of other mechanical vehicles to locate or chase wolves down)"

Response: The Service's speculative list of ways in which wolves could be taken under "predatory animal" status vastly exaggerates the public's actual ability to use those methods, their legality and potential effectiveness within the NW WY Wolf Management Area. These issues were originally addressed by the Wyoming Petition (pages 51-52) and again in detail by State's comments on 71 FR 6633 (see comment

18, letter dated 6 April, 2006). The Service, however, did not respond to the points Wyoming raised.

W.S. 23-3-103(a) [the predatory animal statute] does not and cannot authorize methods of take that are illegal or otherwise prohibited within specific federal jurisdictions. As Petitioners noted in their comments on 71 FR 6633 (see comment 18, WY letter dated 4/6/06), Forest Service regulations impose substantial constraints on baiting throughout the portion of the Grizzly Bear Occupancy Area which encompasses most of the NW WY Wolf DAU. As well, W.S. 23-2-303(d) and 23-3-304 (b) impose substantial constraints on use of bait for trapping, including trapping of predatory animals. Poisons of any type would be excluded from, or subject to extremely rigid controls on USFS lands and their use on BLM and private lands is restricted by USDA/APHIS regulations. Exposed poison baits and carcasses are not legal anywhere due to the potential taking of non-target, protected species.

Aerial gunning by the public requires a permit from the WY Dept. of Agriculture, which can only be issued for the protection of livestock or domestic animals, human health and safety (W.S. 11-6-105 and 50 CFR 19.11-32). Any pilot accepting payment from a client to hunt predatory animals from an aircraft, in addition to needing a Dept. of Agriculture permit, would need a commercial pilot's license from the FAA. Aerial gunning within most of the NW WY Wolf DAU, if attempted, could only be done effectively from a helicopter due to mountainous terrain, forested habitat, and frequently hazardous weather conditions. Aerial gunning from a helicopter is cost-prohibitive and impractical for most private individuals, especially given the amount of flying time typically required to be successful. In addition, aerial gunning over private lands requires the permission of the landowner. This would further constrain the practicality of aerial hunting at most lower elevations in occupied wolf habitat.

Using mechanical vehicles to hunt or chase down wolves would also be ineffective due to the steep terrain, vegetation, limited road/trail access, and in winter, deep snow conditions. Most of the NW WY Wolf DAU is not accessible by snow machine in winter due to rugged terrain, steep slopes and brushy or forested habitat. In addition, many areas of National Forest, including elk winter ranges and feedgrounds, are closed to human access and subject to travel restrictions throughout the winter. Wolf dens are typically located in remote areas of National Forest or wilderness where they are difficult for the public to find and access. It is unlikely members of the public will find a significant number of dens that they can access. Use of explosives is prohibited on National Forest and BLM lands. "Hunting contests" are notoriously ineffective means of killing predatory animals. It is unlikely a party in Wyoming would have sufficient interest or resources to post and sustain a wolf bounty large enough to encourage long-term, intensive wolf hunting or trapping resulting in a significant impact to the wolf population. Even if a bounty were offered, the remote terrain and other constraints on methods of take within the NW WY Wolf Management Area would still limit success.

Contrary to the Service's assertion, Wyoming Statutes do not place predatory animals "under the jurisdiction of the Wyoming Department of Agriculture." In reality, the Department of Agriculture and the Animal Damage Management Board (ADMB) are granted certain specific authorities for programs to fund or implement control of predatory animals, mitigate damage caused by predatory animals, and formulate damage management prevention policy. W.S. 11-6-304 states, "Nothing in this article shall preempt the Wyoming game and fish commission authority to manage wildlife or determine damage pursuant to any provision in title 23." "'Wildlife' means all wild mammals, birds, fish, amphibians, reptiles, crustaceans, and mollusks, and wild bison designated by the Wyoming game and fish commission and the Wyoming livestock board within Wyoming" [W.S. 23-1-101(a)(xiii)].

The Wyoming Game and Fish Act establishes that all wildlife in Wyoming are the property of the State. The purpose of the Act and the policy of the state are to provide an adequate and flexible system for control, propagation, management, protection and regulation of all Wyoming wildlife (W.S. 23-1-103). Under powers and duties of the Commission (W.S. 23-1-302), the Commission's management authorities over "wildlife," including "predatory animals," are "(vi) to direct the capture of any of the wildlife of Wyoming in localities where species are abundant and to transport and distribute any wildlife as in the judgment of the commission is for the best interests of Wyoming;" "(viii) to authorize the chief game warden or his designee to kill any wildlife in Wyoming when in the judgment of the commission the killing is necessary or when the animals or birds are doing substantial damage to property;" "(x) to enter into cooperative agreements with educational institutions and other agencies to promote wildlife research;" "(xi) to enter into cooperative agreements with federal agencies, corporations, associations, individuals, and landowners for the development of state control of wildlife management and demonstration projects;" "(xiii) to grant licenses for scientific or educational purposes to capture, take, or ship out of Wyoming, under the supervision of the commission, such wildlife or nests or eggs of nonpredacious birds as the commission may deem proper;" and "(xxix) after the date gray wolves are removed from the list of experimental nonessential population, endangered species or threatened species as provided by W.S. 23-1-108, to classify gray wolves as predatory or trophy game animals in accordance with W.S. 23-1-304, and to regulate the number of gray wolves which may be taken under a license issued under this act."

The Service has repeatedly expressed confidence that the WY Game & Fish Department would capably manage a recovered wolf population under "trophy game" status (e.g., 71 FR 4340; 8/1/06). On the other hand, the Service expresses distrust that possible actions by the WY Department of Agriculture could potentially jeopardize a recovered wolf population under "predatory animal" status. However, the Department of Agriculture is well acquainted that excessive take of gray wolves may result in relisting, which would remove the State's authority to manage wolves. Similarly, reclassifying wolves to "trophy game" would remove the Department of Agriculture and ADMB authorities to exercise specific control actions. Neither of these outcomes is in the State's or the Agriculture Department's interest. We

anticipate close coordination would take place between the State Department of Agriculture, the ADMB, and the Game and Fish Department with respect to any control actions that may remove wolves under "predatory animal" status, in order to assure the State does not risk potential relisting of the species. Coordination between the WY Department of Agriculture, the Animal Damage Management Board and the Game and Fish Department is statutorily required for activities of the ADMB generally [W.S. 11-6-303(a)(ii) and (c)], aerial hunting permits and activities (W.S. 11-6-105), duties and responsibilities of the ADMB [W.S. 11-6-304(a)], and WGFD funding of predator management (W.S. 11-6-307). The Service's apparent concern that activities of the Department of Agriculture may jeopardize wolves under "predatory animal" status is an unrealistic exaggeration of potential risk.

The Service states further, "Wolves are very susceptible to unregulated human-caused mortality, which would be the situation if they were to be delisted as predatory animals. Wolves are unlike coyotes in that wolf behavior and reproductive biology results in wolves being extirpated in the face of extensive human-caused mortality. These types and levels of take would most likely prevent wolf packs from persisting in areas where they are classified as predatory animals" (71 FR 43428; 8/1/06). The Service also stated, "Wolves are very susceptible to human-caused mortality, especially in open habitats such as those that occur in the western United States (Bangs et al. 2004)" (71 FR 43423; 8/1/06). [and] "Wolves do not appear particularly wary of people or human activity, and that makes them very vulnerable to human-caused mortality (Mech and Boitani 2003)" (71 FR 43423; 8/1/06).

Ironically, in its characterization of wolf threats to humans, the Service stated, "Algonquin Provincial park, Ontario (Pimlott 1970), Prince Albert National Park, Saskatchewan, Jasper National Park, Alberta, Riding Mountain National Park, Manitoba (Carbyn 1974, 1980), and Isle Royale National Park, Michigan (Peterson 1979), all documented that, far from being a threat to humans, healthy, wild wolves actually avoid humans" (USFWS 1987:8). Thus, the Service's own statements contradict the Service's contention that wolves are vulnerable to human-caused mortality because they are not particularly wary of people or human activity. Mech's (1990) characterization of his experiences with wolves also portrays the species as being generally wary and flighty around humans (USFWS 1994:Appendix 15, pages 61-63).

Petitioners previously addressed the Service's unfounded assertion, "it is likely that predatory animal status … would quickly reduce wolf packs outside the Park to minimum levels" (71 FR 6655; 2/8/06 and 71 FR) and "methods and levels of take would *most likely* prevent wolf packs from persisting in areas of Wyoming where they are classified as predatory, even in otherwise suitable habitat" (71 FR 43428; 8/1/06). Refer to Wyoming Petition (pages 50-52) and to Wyoming comments on 71 FR 6633 (comments 17, 18 – letter dated 6 April, 2006). The Service failed to address the specific points raised by petitioners.

Petitioners make the following points: The types of "open habitats" of the western United States in which wolves are susceptible to human-caused mortality (71 FR 6650 and 71 FR 43423) are predominantly outside the exterior boundaries of the NW Wyoming Wolf Management Area (WGFD 2003:Fig 3, page 12). Such habitats include highly accessible intermountain basins, desert, shrublands, grasslands, and isolated mountain ranges, densely roaded areas with low to moderate topographic relief, farm and ranch lands, and populated urban areas. The Service identified "open landscapes" as "non-forested rangeland and cropland associated with intensive agricultural use (prairie and high desert)" 71 FR 6642 (2/8/06). The NW Wyoming Wolf DAU is predominantly a remote, rugged mountainous environment, much of it is forested, and road densities are extremely low to nonexistent (refer to Wyoming Petition, Appendix III – GIS overlay of Road Networks in Wyoming). Human access, especially by any type of motorized vehicle, is extremely limited. These very characteristics originally formed the Service's basis for selecting the GYA as a suitable wolf recovery area. Specifically, the Service stated, "A few places, mostly National Parks and other wild areas, still exist in the Northern Rocky Mountains where wolves can survive" (USFWS 1987:7).

Furthermore, the eradication campaigns that historically extirpated wolves from the NRM included massive-scale poisoning by use of exposed baits and carcasses, now prohibited, and large-scale, government-sponsored trapping, hunting and poisoning programs. Wyoming would not sponsor government control programs of a scale that risks potential relisting and loss of State management authority. In addition, Forest Service rules applicable to occupied grizzly bear habitats preclude baiting for most of the year on most Forest Service lands within the NW Wyoming Wolf DAU (bait is considered "refuse" and therefore prohibited). Consequently, the limited means available for taking wolves on public lands will include mainly hunting on foot, trapping without bait, and to a minimal extent, hunting from a vehicle or snow machine on a small number of roads and trails. These methods are not efficient or effective enough to extirpate a wolf population. A few wolves will be taken by other methods to the extent they wander onto private lands, but those opportunities would also be comparatively minimal. Once wolves are subjected to some hunting or trapping pressure, they will become increasingly conditioned to avoid humans.

Because of the remoteness and mountainous topography, vegetation characteristics, limited access, and differences in permissible methods of take and wolf control programs between historic and modern times, a more restrictive management classification is not necessary to sustain the wolf population above recovery levels within the NW WY Wolf DAU. The Service stated, "Human-caused mortality would have to remove 34 percent or more of the wolf population annually before population growth would cease (Fuller et al. 2003)" (71 FR 43425). It is highly improbable that human-caused mortality could reach this level in the NW WY WMA, even under "predatory animal" management status. Nonetheless, the WY Wolf Management Plan provides a safety net that would reclassify wolves to "trophy game" throughout the NW WY WMU should the number of wolf packs predominantly outside the National Park Units decline to 7 or below (WGFD 2003:10-11). Wolves would not

then be reclassified back to "predatory animal" within this area unless the Wyoming Game and Fish Commission determines the factors that originally led to the decline have changed sufficiently that 7 packs can be maintained. It is this safety net that establishes an adequate regulatory mechanism, providing a "high degree of certainty" that Wyoming's share of a recovered wolf population will be sustained.

14. Service's hypothetical example of wolf management under the WY Wolf Management Plan. The Service states, "The above restrictions present the very real possibility that Wyoming would not be able to maintain its share of a recovered wolf population. For example, in 2004, the YNP wolf population (171 wolves in 16 confirmed breeding pairs) would have triggered predatory status outside the National Parks/Wilderness areas and allowed for *possible* elimination of all wolf packs outside YNP (89 wolves in 8 breeding pairs) (Service et al. 2005). In 2005, disease and other factors caused a natural reduction of the YNP wolf population to 118 wolves in 7 breeding pairs (Service et al. 2006) … However, if all wolves outside the National Parks/Wilderness areas had been eliminated in 2004 or early 2005, the Wyoming segment of the NRM wolf population would have fallen 3 breeding pairs below the 10 breeding pair recovery level by the end of 2005 (Service et al. 2006).

    Response: The Wyoming Wolf Management Plan does not allow this imaginary scenario to take place. The Plan commits to manage at all times, for a minimum of 7 packs with ranges predominantly outside the National Park Units, irrespective of the number of wolves in the Park Units (WGFD 2003:10). In no case could or would the State permit "the elimination of all wolf packs" outside the National Park Units. A "worst case," but highly improbable scenario would reduce the number of wolves outside the National Park Units to exactly 7 packs of exactly 5 wolves each. Applying Ausband's 56% probability of a breeding pair within a pack of exactly 5 wolves (Ausband 2006), 4 of the packs outside the park would be counted as a breeding pair. The number of breeding pairs inside the park in 2005 was 7, so the State total would have been 11 breeding pairs. Even if the number of packs outside the park had been reduced to 6 packs of exactly 5 wolves each, the predicted total number of breeding pairs would have been 10, which still meets the State's recovery criterion. And, if this should actually happen (a reduction to or below 7 packs), the management status would be changed to "trophy game" and would remain so until the factors causing the decline had changed.

15. Service interpretation of State management authority. The Service states, "While the WGFD would have authority to manage wolves when they are classified as trophy game, that authority would end if the number of packs increased to 15 in the State or if there were 7 packs primarily outside the National Park/Wilderness units (even if there were fewer than 15 packs in the State). In essence, as soon as WGFD met their management objective, their management authority would be removed by State law within a maximum of 90 days … We believe the real potential for flipping back and forth between predatory animal status and trophy game status would result in a program that would be nearly impossible to administer and enforce because of widespread confusion about changing wolf status."

Response: The Service's interpretation is a misrepresentation of wolf management under the Wyoming Plan and Wyoming State Law. *Presuming* the number of packs with ranges primarily outside the National Park Units should actually drop *to* 7 or fewer, and then recover to 7 *or more*, wolves would be reclassified back to predatory animal status *only if* the factors originally causing the decline had changed such that *at least* 7 packs can be maintained predominantly outside the National Park Units. This interpretation was determined fully consistent with State law (O'Donnell 2003). The total number of packs in the State will have no bearing on this determination. In addition, there will be no "widespread confusion" about changing wolf status, because the WGFD will provide the official count of wolf packs and Wyoming's Plan does not allow "flipping" back and forth between predator and trophy game status.

16. RE: Management options if the number of packs should fall to 7 or below. The Service states, "Additionally, despite assurances that WGFD would regulate human-caused mortality if wolf populations fell below minimum levels, WGFD likely would still control problem wolves and their efforts at regulating human-caused mortality under those circumstances, particularly with the likely public confusion over the status of the wolf, do not seem likely to be highly effective. In other words, whenever wolf populations would become low enough that WGFD would have the legal authority to regulate some forms of wolf mortality, WGFD would have a limited ability to prevent further declines in the population. Attempting to manage a wolf population that is constantly maintained at minimum levels would likely result in the wolf population falling below recovery levels due to factors beyond WGFD's control."

    Response: The Service's concern is speculative and unfounded. As stated in the previous comment, there will be no public confusion over the status of wolves. In the event wolf populations should fall to or below recovery levels (7 packs with ranges predominantly outside the National Park Units), a variety of nonlethal depredation control techniques can be employed. Such methods include hazing, use of deterrent devices, compensation of landowners or lessees for livestock losses, and relocation of problem wolves (since the density of the wolf population would be low, opportunities would exist to relocate problem wolves to more remote, vacant territories in suitable habitat). The WGFD has frequently captured and relocated problem grizzly bears to deal with bear-caused depredations in the past. Assuming excessive mortality reduced the wolf population to 7 packs under predatory animal status, the reclassification back to trophy game status would be long-term or permanent, enabling the Department to more closely regulate mortality factors. However, we do not anticipate the wolf population will be reduced below 7 packs under predatory animal status.

17. RE: Pack Definition – multiple breeding pairs per pack and recovery implications. The Service states, "The Wyoming State law and management plan also allows a pack of 10 or more [wolves] with 2 or 3 breeding females to be counted as 2 or 3 packs, respectively."

Response: In practical terms, the Service's concern is unjustified and may even be self-defeating. Petitioners reiterate a pack with multiple breeding females has not been documented outside the National Park Units to date and the expected incidence would be extremely low. Furthermore, it is unlikely the State would institute the intensity of monitoring needed to actually document multiple breeding females in a pack. The logic behind monitoring based on pack numbers is to avoid actually having to document breeding pairs. This issue was previously addressed by Petitioners comments on 71 FR 6633 (refer to comment 11, WGFD letter dated 6 April, 2006).

The purpose of a pack definition is to provide a surrogate for estimating the number of breeding pairs, which is the Service's actual basis for determining a recovered population. If multiple breeding females should be documented within a pack, then that pack has a 100% probability of containing at least 1 "breeding pair" (assuming the "alpha male" mates with more than 1 female in the pack). However, the estimate of breeding pairs in all packs is expressed as the probability of a breeding pair times the number of packs. In our highly improbable, worst case example, 7 packs of exactly 5 wolves would have 4 breeding pairs (3.92 to be exact) based on Ausband's (2006) probability. If the population contains 5 packs of 5 wolves each, and 1 additional pack with 2 breeding females documented, then 1 pack has a 100% probability of at least 1 breeding pair. The other 5 packs each have a 56% probability of having a breeding pair or 2.8 breeding pairs in all. The sum of 2.8 estimated breeding pairs plus at least 1 documented breeding pair is 3.8 or just 0.12 less than the number predicted based on 7 packs of exactly 5 wolves each. The difference is inconsequential. Furthermore, the existence of a large pack with multiple breeding females will often precede break-up and dispersal to form multiple packs in successive years.

The Service can manufacture any number of farfetched, "what if" scenarios based upon extreme interpretations of Wyoming's regulatory mechanisms, however these highly unlikely examples have little bearing on the "*sufficient* certainty," "*minimal* uncertainty," or "*high level* of certainty" principals variously described in the Service's "Policy for Evaluation of Conservation Efforts When Making Listing Decisions" (68 FR 15100; 3/28/03).

18. RE: Pack definition; 90-day evaluations of population status. The Service states, "The Wyoming definition of a pack and the 90-day evaluation of population status is inconsistent with wolf biology and how the Service has, and will, measure wolf population recovery … Wolf packs only breed and produce young once a year (April), so a wolf population can only increase once a year. If a pack's breeding adults are killed between February and April, the pack will not produce young for at least another year. If pups are killed, no more will be produced for another year."

    Response: The Service's rationale is counterintuitive. If packs were only monitored once during winter, assuming the Service's concern about excessive mortality should

be realized, then the only opportunity to reclassify the management status of wolves would be the winter following the year in which the mortality events happened. By monitoring wolves quarterly (in conjunction with the requirement to report all take of wolves), the State will be able to detect sooner whether the number of packs of 5 or more wolves should actually decline to 7 or fewer. The fact that wolves only reproduce once a year is irrelevant. Under the Service's monitoring plan, if human-caused mortality reduced the number of packs to the threshold level at some time after the winter survey, this would not be detected until the following winter period, raising the possibility that the number of packs might be reduced even further below the minimum threshold before the State could take any action. Given that the State will conduct surveys every 90 days, at least 1 survey will be done during December-March, which corresponds to the end of the biological year and minimum population levels for wolves.

The Service's rationale apparently presumes the State might document a sufficient number of packs with 5 or more wolves after pups are born in the spring (when the wolf population is at its maximum for the year) and on this basis, classify wolves as predatory animals. Then, at some point before the final quarterly survey of the year, the number of packs of 5 or more wolves might be reduced below the recovery threshold necessitating classification back to trophy game status. We remind the Service that this scenario is not permissible under the Wyoming Wolf Management Plan. If the number of packs had been below the minimum threshold prior to the breeding season (e.g., during the winter survey), wolves would have been classified as trophy game and that classification could not be modified unless and until circumstances changed sufficiently to maintain 7 or more packs under predatory animal status. Thus, once wolves are classified as trophy game, a simple increase in the number of packs does not automatically trigger a change back to predatory animal status. The Wyoming Wolf Management Plan does not allow the "see-saw" or "flip-flop" effect which the Service seems to envision.

19. RE: Pack Definition – number of wolves traveling together. For several years, the Service has conceded pack size can be used as a surrogate in monitoring to estimate the number of breeding pairs of wolves. In fact, this approach was the basis of the monitoring protocol adopted by all 3 states in their respective wolf management plans. The purpose of using pack size is to reduce the costs and burdens associated with physically documenting breeding pairs. Since the number of wolf packs that exceed a specific size is *highly correlated* with the number of breeding pairs, pack size can be used as a reliable predictor of breeding pairs. By including a reasonable buffer between the number of packs exceeding a specific size and the 10 breeding pairs that must be present in a recovered wolf subpopulation, monitoring packs can be a very dependable way to document whether the subpopulation continues to meet the Service's recovery criteria. The Service originally advocated the criterion for documenting a recovered wolf subpopulation should be 15 packs of at least 6 wolves traveling together in winter (Williams 2004). Petitioners conducted an analysis, based on Wyoming data, that demonstrated the probability of a breeding pair in packs of 5 or more wolves traveling together is statistically the same probability as in packs

of 6 or more wolves traveling together (Wyoming Petition, pages 54-55 and 81-84). In FR 71 6655 (2/8/06), the Service stated, "Our current data support the concept that 15 packs of 5 or more wolves traveling together in winter is equivalent to about 12-15 breeding pairs … There is no statistical difference between using either five or six wolves traveling together in winter to develop a biological equivalent definition of a pack to the current definition of a breeding pair."

Now, the Service seeks to reject not only Wyoming's analysis, but the Service's original position stating, "[a]t the current time, biological monitoring and analysis indicate that this pack size [6 wolves traveling together] is expected to include at least one breeding pair" (Williams 2004) (71 FR 43428). The Service is changing its interpretation based upon an analysis recently completed by a University of Montana graduate student, which has yet to undergo peer-review (Ausband 2006).

Response: Ausband's analysis may yield some useful information regarding discrete probabilities of a breeding pair within specific pack sizes, however, its use in estimating breeding pairs is functionally equivalent to the Wyoming definition of a pack and its correlation with breeding pairs when applied to Wyoming data. Furthermore, the Service's repeated changes in the recovery criteria and monitoring protocol are not supported by any real biological necessity, but present a moving target to the states that is highly inappropriate.

The Service made the following statements, "… in recent consultation with Montana, Idaho, Wyoming, the Nez Perce Tribe, Yellowstone National Park, and the University of Montana, the Service recognized the relationship between wolf pack size in winter and breeding pairs was not a linear regression as argued in the Wyoming Petition" (71 FR 43416) [and] "Other important developments … include … an 'improved' method of estimating wolf population status that demonstrated that earlier attempts to correlate pack size in winter with the probability of being a breeding pair were 'mathematically incorrect' and are clearly inconsistent with both the Service's previous and current breeding pair standards." (71 FR 43429).

The Service's statement that the method used by the Wyoming Petition was "mathematically incorrect" is itself incorrect. Linear regression is a mathematical operation, like addition or multiplication, which is applied to a cluster of data points in a 2-dimensional field. The procedure can be applied to any such cluster of data points and the purpose is to define the line that best fits the cluster by minimizing the sum of the squares of the vertical deviations of data points from the line. So long as the regression procedure was correctly applied to the data set, a trivial operation, the regression itself was "mathematically correct."

If the regression demonstrates a high degree of linearity (i.e., the points defined by the concomitant variables tend to line up), then the 2 variables are closely correlated. The interpretation of what that correlation means and how useful it is depends upon the characteristics of the variables themselves and the assumptions inherent in the regression. These are logical rather than mathematical questions.

The Ausband (2006) procedure addressed a fundamentally different question than the analysis done by Wyoming. Contrary to the Service's statements, the Wyoming Petition did not postulate the relationship between pack size and the probability of a breeding pair is linear. This "straw man" has been concocted by the Service to argue against Wyoming's analysis and pack definition. The Wyoming analysis only postulated that the relationship between the number of packs of 5 or more wolves and the number of breeding pairs is linear. The Wyoming analysis demonstrated that, *given the distribution of pack sizes and data collection through 2003*, the number of breeding pairs in 15 packs of 5 or more wolves is expected to be approximately 14, with a range of 12-15. The Ausband analysis, on the other hand, sought to identify the specific probabilities that a breeding pair is present in each discrete pack size, based on pack size and breeding pair data collected through 2005. In effect, the Wyoming analysis modeled the system as it actually existed through 2003, and made the assumption that, with a reasonable margin of safety, the results of that modeling exercise can be applied to the future. The Ausband procedure, when applied to packs of 5 or more wolves in the Wyoming dataset, is functionally equivalent to the results of the Wyoming analysis. Petitioners note the Ausband analysis included data from 2005, in which a suspected outbreak of parvovirus and/or distemper caused an abnormally high rate of reproductive failures. Whether the contribution of the 2005 data are representative in the system at equilibrium is unknown, however their inclusion adds a degree of conservatism.

Thus, the fundamental issues to be addressed are whether the assumptions inherent in the Wyoming analysis are *reasonable* given the purpose of the analysis, and whether the results can be *reasonably* applied to the future. No statistical procedure, including that done by Ausband, rigidly meets all statistical assumptions. For this reason, inferences developed from statistical results must be tempered based upon the purpose of the analysis, the inherent characteristics of the data, and other logical considerations.

Ausband (2006) postulates 2 basic criticisms of the Wyoming analysis:
(1) Two "measures of population growth" were regressed against one another, which would violate the assumption that the 2 variables are independent of one another; and
(2) Since the sampling units are the years, and since the years the data series tend to follow the sequence of years (packs and breeding pairs tend to increase in successive years), there could be a serial correlation.

Criticism (1) – The two measures of population growth are not independent. Ausband's observation is made after the fact rather than before the fact. Either of these measures could have increased in a non-linear, or highly variable fashion as the population grew. However, it is apparent from the regression that both breeding pairs and numbers of packs tended to increase and were very closely correlated as the population grew. This was actually the point of the regression. We wanted to determine whether the proportion of packs of 5 or more wolves with breeding pairs

was reasonably constant or linearly predictable in a series of samples. If the proportion changed markedly from year to year, or if it varied in a non-linear fashion as the population increased, then the correlation would have been much weaker, possibly indicating the proportion of packs of 5 or more wolves with breeding pairs is too variable to be a good predictor of the number of breeding pairs. Ausband is partially correct in stating that the number of packs of 5 or more wolves and the number of breeding pairs are not *completely* independent variables – they would always be at least somewhat correlated in a growing population, even if the relationship between packs and pairs is weak. For this reason, we need to be careful about accepting the regression results unless the correlation is very tight – it is. Regression, applied in this manner, can be a useful *mathematical* tool to *approximate* the relationship between packs and breeding pairs over a series of yearly sampling units, *provided* the correlation is extremely tight and the data are representative. The regression demonstrates that the proportion of packs of 5 or more wolves with breeding pairs is expected to remain constant or within a reasonably tight range, and this is what we needed to know in order to use packs of 5 or more wolves as a surrogate for breeding pairs.

Criticism (2): Potential for serial correlation. A "serial correlation" exists if the data values being regressed change primarily as a function of the sequence of sample units. Since the sample units were "years" and the population, breeding pairs, and packs generally increased as a function of increasing years, there is the possibility of "serial correlation," which is essentially what we addressed in our response to the first criticism. However, if the annual ratios of breeding pairs to packs of 5 or more wolves had not been reasonably constant or linearly predictable over time, the correlation would have been much weaker. The extremely tight correlation indicates the ratio of breeding pairs to packs is linearly predictable and therefore the number of packs of 5 or more wolves is a reliable predictor of breeding pairs. Petitioners' original regression equation for packs of 5 or more wolves was:

$$BP = 1.06(Packs \geq 5) - 1.85$$
$$r = 0.98$$

We took another look at the Wyoming regression using data taken from the 1999-2005 wolf recovery annual reports (Table 1). This period initiates the year before recovery criteria were first achieved, and includes all years since.

Table 1. Wolf pairs and packs from 1996-2005, Wyoming data.

Year	Total Wolves in Wyoming	Total Pairs	No. Packs ≥5	Pairs in Packs ≥ 5	No. Packs = 4	Pairs in Packs = 4	No. Packs = 5	Pairs in Packs = 5	No. Packs = 6	Pairs in Packs = 6
1996	40	4								
1997	86	9								
1998	112	6								

Table 1 (continued).

Year	Total Wolves in Wyoming	Total Pairs	No. Packs ≥5	Pairs in Packs ≥ 5	No. Packs = 4	Pairs in Packs = 4	No. Packs = 5	Pairs in Packs = 5	No. Packs = 6	Pairs in Packs = 6
1999	107	7	10	7	1	0	1	1	1	1
2000	153	12	12	11	2	0	1	1	2	1
2001	189	13	15	13 + 2 unk	0	0	0	0	3	2 + 1 unk
2002	217	18	17	17	2	1	0	0	0	0
2003	234	18	18	17	2	1	1	0	1	1
2004	272	25	22	22	3	3	2	1	1	1
2005	252	16	24	16 + 2 unk	2	0	4	2	3	1 + 2unk
Totals			118	103+	12	5	9	5	11	7+

Annual data are summarized below (Table 2) for packs of 5 or more wolves in which the presence or absence of a breeding pair (2 or more pups along with at least 2 adults) could be affirmatively documented:

Table 2. Proportions of packs of 5 or more wolves with breeding pairs (data from packs of known breeding status only).

	1999	2000	2001	2002	2003	2004	2005	Totals
No Packs ≥5 with presence or absence of BP documented	10	12	13	17	18	22	22	114
No. BP	7	11	13	17	17	21	16	100
Proportion of packs with breeding pairs	0.70	0.92	1.00	1.00	0.94	0.95	0.73	0.88

The following regression equation describes the relationship between the number of packs of 5 or more wolves and the number of breeding pairs in packs of 5 or more wolves, where presence/absence of a breeding pair was affirmatively documented:

$$BP = 0.86(Packs \geq 5) + 0.49$$
$$r = 0.90$$

Based on this relationship, 15 packs of 5 or more wolves are expected to have 13.4 breeding pairs. The slight reduction (0.7 pack) from the number predicted by Petitioners' original regressions may be due to the inclusion of data from 2005, a year with a low proportion of successful breeding pairs. The average annual proportion of packs of 5 or more wolves with breeding pairs is 0.88, range = 0.70-1.00. The "y" intercept of the regression is close to zero, therefore the predicted ratio of breeding

pairs to the number of packs of 5 or more wolves is relatively constant (0.88-0.89) throughout the probable range of wolf pack numbers (15-30).

In order to apply Ausband's logistic regressions to predict the numbers of breeding pairs, several assumptions must be made. Chief among these are that the relationship between pack size and the probability of a breeding pair can be accurately described by a logistic function, that the relationship is a smooth curve, and that the data obtained during the period of population growth are representative of the system in the future. We compared Ausband's predicted probabilities against the actual proportions of breeding pairs in the Wyoming data set from 1999-2005 (Table 3, Fig. 1):

Table 3. Breeding pair proportions in relation to pack size based on actual data and Ausband's probabilities.

	Pack Size													
	4	5	6	7	8	9	10	11	12	13	14	15	≥16	Totals
1999														
Packs	1	1	1		2	2		1		2			1	11
BP	0	1	0*		2	2		0*		1*			1	7
2000														
Packs	2	1	2	2			1			3			3	14
BP	0	1	2	1			1			3			3	11
2001														
Packs			3		2	2	2	1	1		1		3	15
BP			2-3		2	2	2	1	1		1		2-3	13-15
2002														
Packs	2			2		2	4	1	2		2	1	3	19
BP	1			2		2	4	1	2		2	1	3	18
2003														
Packs	2	1	1	4	2		2		1			2	5	20
BP	1	0	1	4	2		2		1			2	5	18
2004														
Packs	3	2	1	2	4	4		2	2	1	1	1	2	25
BP	3	1*	1	2	4	4		2	2	1	1	1	2	24
2005														
Packs	2	4	3	2	3	3	3	2			1	2	1	26
BP	0	2	1-3	0	2	3	3	1-2			1	2	1	16-19
Total Packs	12	9	11	12	13	13	12	7	6	6	5	6	18	130
Total BPs	5	5	7-10	9	12	13	12	5-6	6	5	5	6	17-18	107-112
Proportion Packs with BPs	0.42	0.56	0.64-0.91	0.75	0.92	1.00	1.00	0.71-0.86	1.00	0.83	1.00	1.00	0.94-1.00	
Ausband's Proportion	0.46	0.56	0.65	0.73	0.80	0.85	0.90	0.93	0.95	0.97	0.98	0.98	0.99	

* An asterisk indicates 1 additional pack had ≥2 pups, but was not counted as a breeding pair because only 1 adult was documented.

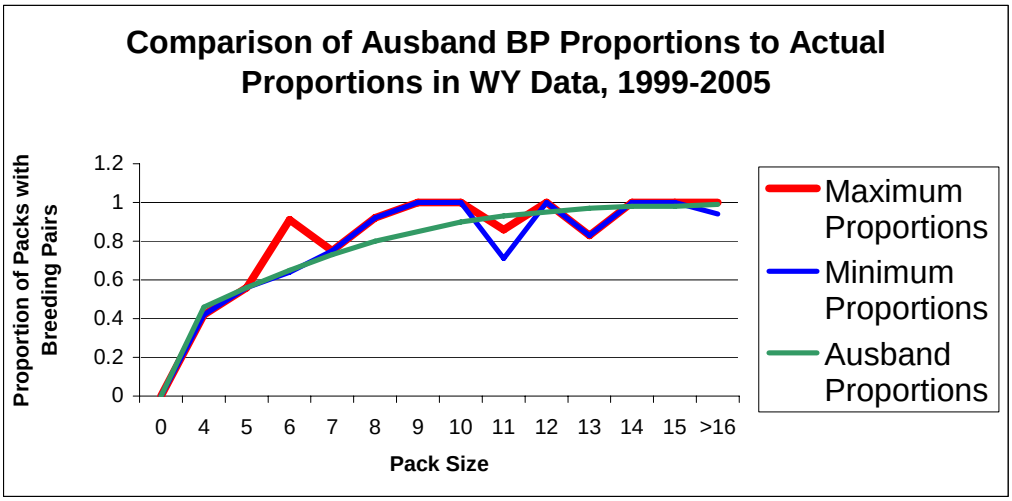


Fig. 1. Comparison of Ausband's logistic relationship between breeding pair proportions and pack size against actual Wyoming data.

In 2001 and 2005 of the Wyoming data, presence or absence of breeding pairs was not documented in several packs of wolves that were included in the data. Ausband apparently treated these packs as packs without breeding pairs rather than excluding them from the data set as he should have done. Had these packs been excluded, the probabilities at the lower end of Ausband's logistic regressions may have been substantially higher than his estimates (refer to "maximum proportions" in Fig. 1). Several of Ausband's estimated probabilities were affected by his treatment of the data, and to some degree, may also be artifacts of the curve fitting process. A logistic curve is prone to especially large sampling errors at the lower end, where the proportions increase very rapidly (i.e., slight errors in curve fitting can translate to very large errors in estimated probabilities within this portion of the curve). The degree to which a segment of the regression curve can be "bent" to fit to actual data points is restricted by the overall weighting effect of all data points, which impacts the position and shape of the curve. In other words, the shape of a regression curve is comparatively rigid and is an imperfect fit to the data. This is a particular problem with all forms of curvilinear regressions and opens the door for significant errors when curves such as those defined by logistic regression are fit to data clusters.

Having established that the Wyoming analysis and the Ausband approach are both imperfect approximations, Petitioners submit the 2 approaches are nearly identical when they are applied to answer the original question: Can the number of packs of 5 or more wolves be used as a surrogate to predict the number of breeding pairs?

Petitioners' revised regression based on 1999-2005 data predicts 15 packs of 5 or more wolves are expected to have 13.4 breeding pairs. We can also apply Ausband's probabilities to the same data set to predict the number of breeding pairs in packs of 5 or more wolves (Table 4).

Table 4. Proportion of packs of 5 or more wolves with breeding pairs estimated using Ausband's probabilities and Wyoming data, 1999-2005

	Pack Size												
Year	5	6	7	8	9	10	11	12	13	14	15	≥16	Tot.
1999	1	1		2	2		1		2			1	10
2000	2	2	2			1			3			3	13
2001		3		2	2	2	1	1		1		3	15
2002			2		2	4	1	2		2	1	3	17
2003	1	1	4	2		2		1			2	5	18
2004	2	1	2	4	4	0	2	2	1	1	1	2	22
2005	4	3	2	3	3	2	2			1	2	1	23
Totals	**9**	**11**	**12**	**13**	**13**	**12**	**7**	**6**	**6**	**5**	**6**	**18**	**118**
Proportion of Total Packs	.0763	.0932	.1017	.1102	.1102	.1017	.0593	.0508	.0508	.0424	.0508	.1525	1.000
Ausband's BP Probabilities for Pack Size	0.56	0.65	0.73	0.80	0.85	0.90	0.93	0.95	0.97	0.98	0.98	0.99	
Partial Probabilities	.0427	.0606	.0742	.0882	.0937	.0915	.0551	.0483	.0493	.0416	.0498	.1510	
Total Probability = Σ partial probabilities based on proportions of packs of each size.													**0.85**

By applying Ausband's probabilities to the actual distribution of pack sizes in the Wyoming data from 1999-2005, we estimate the overall probability of a breeding pair in packs of 5 or more wolves is 0.85 (Petitioners believe this may be somewhat conservative due the impact of Ausband's apparent assumptions regarding packs with unknown breeding status, discussed earlier. In addition, packs of 4 wolves are not included in either calculation). On this basis, 15 packs of 5 or more wolves are expected to include 12.8 breeding pairs or 0.6 fewer breeding pairs than predicted by the Petitioners' regression equation. We did the same analysis for packs of 6 or more wolves, based on Ausband's probabilities, and determined the overall probability of a breeding pair is expected to be 0.87, which is not substantially different than the probability for packs of 5 or more wolves.

Implications of a revised pack definition: It is paramount to restate the original purpose of a breeding pair definition was to establish a *pragmatic* and *practical* means of verifying that a recovered wolf population is sustained each year, and to reduce the monitoring burden and costs associated with actually documenting the number of breeding pairs. The Service now is apparently proposing to abandon the minimum size definition of "pack" in favor of discrete probabilities applied to each pack size to estimate the numbers of breeding pairs. Petitioners assert this approach is excessively complex, costly, and unnecessary.

The Petitioners' approach inherently assumes that the pack size distributions in the data set from 1999-2005 are within reason, representative of the future distributions of pack sizes. However, since the relationship between pack size and probability of a

breeding pair is logistic (Ausband 2006), the actual predicted proportions of breeding pairs based on Ausband's probabilities are not overly sensitive to distributional changes for packs sizes ≥5. This lends further support for using the number of packs of 5 or more wolves as a surrogate to predict the number of breeding pairs. The annual and overall distributions of pack sizes ≥5 from the 1999-2005 Wyoming data are summarized in Table 5:

Table 5. Annual distribution of pack sizes and predicted proportions of packs of 5 or more wolves that have a breeding pair based on Ausband's probabilities.

Year	Pack Size Distributions (% of total)												Avg. Pack Size ≥5	**Ausband BP proportion (%)**
	5	6	7	8	9	10	11	12	13	14	15	≥16		
1999	10.0	10.0		20.0	20.0		10.0		20.0			10.0	9.8	**84**
2000	8.3	16.7	16.7			8.3			25.0			25.0	12.3	**82**
2001		20.0		13.3	13.3	13.3	6.7	6.7		6.7		20.0	12.0	**86**
2002			11.8		11.8	23.5	5.9	11.8		11.8	5.9	17.6	11.9	**91**
2003	5.6	5.6	22.2	11.1		11.1		5.6			11.1	27.8	11.4	**86**
2004	9.1	4.5	9.1	18.2	18.2		9.1	9.1	4.5	4.5	4.5	9.1	10.4	**84**
2005	16.7	12.5	8.3	12.5	12.5	12.5	8.3			4.2	8.3	4.2	9.0	**79**
Overall	7.6	9.3	10.2	11.0	11.0	10.2	5.9	5.1	5.1	4.2	5.1	15.3	10.8	**84**

As the reader can readily see, the total range in annual proportions of packs predicted to have a breeding pair based on Ausband's method was only 12% (79%-91%) for packs of 5 or more wolves. This lends further support to Petitioners' case for using the minimum pack size definition as a reliable surrogate to estimate the numbers of breeding pairs.

Of course, the best way to demonstrate the dependability of Wyoming's pack size definition is to compare the numbers of breeding pairs estimated using it and Ausband's method, against the actual numbers of breeding pairs documented in the dataset annually since the NRM wolf population first achieved recovery objectives in 2000 (Table 6). The Service may criticize this approach by suggesting human-caused mortality after delisting could potentially reduce sizes of wolf packs outside the National Park Units. To counter this criticism, we also applied Ausband's method to 2 highly improbable, "worst case" scenarios that assume no more than 7 packs exist outside YNP in each year of the data set, and all packs outside YNP are exactly 5 wolves each (Table 7). Since there is little potential for human-caused mortality of wolves inside the National Park Units, we assumed the numbers and size distributions of packs inside the National Park Units would remain unaltered. Even if some packs occasionally wander outside the Parks, their vulnerability will be low within the rugged terrain and during the comparatively brief periods those wolves may be exposed to human-caused mortality.

Table 6. Comparison of breeding pairs predicted using the Ausband probabilities and the revised Wyoming regression against actual breeding pairs documented since the GYA wolf population achieved recovery criteria in 2000, Wyoming data.

Year	Total No. of packs of ≥ 4 wolves	Total No. of packs of ≥ 5 wolves	Actual number of breeding pairs (BPs) documented	Breeding Pairs predicted from sum of Ausband's Probabilities for packs ≥4	Breeding Pairs predicted from revised Wyoming Regression for packs ≥5
2000	14	12	12	11.0	10.9
2001	15	15	13+ (2 unk)	12.9	13.6
2002	19	17	18	16.4	15.4
2003	20	18	16	16.3	16.3
2004	25	22	25	19.9	20
2005	26	24	16+ (2 unk)	20.0	21.8

Table 7. Worst case analysis of the number of breeding pairs of wolves in Wyoming, assuming actual pack sizes or breeding pairs in YNP, and no more than 7 packs of exactly 5 wolves each outside YNP.

Year	Worst Case One: Ausband probabilities applied to packs of ≥4 wolves documented inside YNP plus no more than 7 packs of exactly 5 wolves each outside YNP			Worst Case Two: Actual BPs documented inside YNP + Ausband probabilities applied to no more than 7 packs of exactly 5 wolves each outside YNP.		
	Total 4+ Packs inside YNP	Assumed packs of 5 outside YNP	Total estimated BPs	Actual BPs documented inside YNP	Assumed packs of 5 outside YNP	Total estimated BPs
2000	9	4	10.0	7	4	9.2
2001	9	6	11.4	8+	6	11.4+
2002	13	6	14.6	12	6	15.4
2003	12	6	13.9	11	6	14.4
2004	16	7	17.1	16	7	19.9
2005	13	7	13.7	7	7	10.9
2006	13 (prelim)	7	14.9	12 (prelim)	7	15.9

Summary: Petitioners' analysis demonstrates the numbers of breeding pairs predicted based on packs of 5 or more wolves (the Wyoming regression) and Ausband's probabilities are approximately the same. Both methods yielded results that approximated or were more conservative than the actual number of breeding pairs except in 2005, when an abnormal number of reproductive failures took place (Table

6). Two versions of a highly improbable, worst case scenario demonstrate the number of breeding pairs will be maintained at or above recovery objectives if the number of packs predominantly outside YNP should be reduced to 7 packs of exactly 5 wolves – the minimum threshold theoretically permissible under the Wyoming Wolf Management Plan. Even if the number of packs outside the Park should fall to 5 or 6 packs of exactly 5 wolves, it is likely the recovery criterion of at least 10 breeding pairs would continue to be met. (In the 2000-2003 data, we assumed the numbers of packs with 5 or more wolves were the packs with exactly 5 wolves. This resulted in fewer than 7 packs in WY outside YNP during those earlier years).

The Service's new proposed method of estimating the number of breeding pairs, based on the Ausband (2006) probabilities, would require that all the wolves in each pack must be documented to receive the appropriate credit for breeding pairs. This requires much more intensive monitoring, since packs are often incompletely counted in forested, partially forested or shrubby cover and broken terrain. As it is currently conceived, the new method also does not provide any "buffer" between the predicted numbers of breeding pairs and the minimum of 10 breeding pairs required by the recovery criteria. As in all statistical procedures, the Ausband probabilities are associated with a degree of uncertainty or confidence intervals that have not been specified. In addition, confidence intervals surrounding each discrete probability are variable, adding greatly to the complexity of applying multiple probabilities to multiple pack sizes. If Ausband's probabilities were applied to a distribution of pack sizes and the resulting estimate were exactly 10 or even 11 breeding pairs, there is a substantial chance that the actual number of breeding pairs could be less than or greater than 10. Accordingly, applying Ausband's probabilities to estimate breeding pairs does not provide "a high degree of certainty" that recovery criteria will continue to be met, unless the necessary "buffer" is incorporated into recovery criteria.

The Wyoming method is much simpler than Ausband's method in that it only requires a minimum of 5 wolves must be detected and counted in order to include the pack in the total pack tally. As is the case now, most packs will continue to have more than 5 wolves and the size distribution of wolf packs in the National Park Units will remain predominantly unaffected by human-caused mortality. Petitioners do not believe the distribution of pack sizes outside the National Park Units will be substantially altered by human-caused mortality. However a worst-case analysis based on Ausband's probabilities indicates that recovery criteria will continue to be met even if all packs outside the Parks should be reduced to exactly 5 wolves. The Wyoming method of monitoring wolf packs based on minimum pack size will require substantially less intensive surveys. It is an adequate and practical means of documenting that recovery criteria continue to be met. And, it provides a liberal "buffer" between the 13.4 breeding pairs estimated based on a minimum of 15 packs, and the 10 breeding pairs that must be sustained in a recovered population.

20. Purported "examples" of failures of the Wyoming pack definition (71 FR 429): The Service states, "consider the following examples. First, in 1999 and 2005, pup production and survival declined significantly … Because few pups survived, five

wolves traveling together in winter would not have equated to an adult male and female with 2 pups on December 31. Second, from 2002 to 2005, mange infested some packs in Montana causing them to not survive in winter. In this situation, if five wolves traveling together in summer or fall were known to have mange, it would have been incorrect to rely on them as a breeding pair since they would be unlikely to survive until December 31. Third, at the end of 2005, there were 16 breeding pairs in Wyoming under the current Service definition … But, under Wyoming's definition, even if it were used in mid-winter, there would have been 24 packs counted as breeding pairs, an overestimate of 50 percent. If Wyoming had been managing for 15 "packs" as they define them, there could have been fewer than 10 actual "breeding pairs" in Wyoming.

Response: The Wyoming Wolf Management Plan does not count the wolves inside the National Park Units in determining how many packs will be maintained outside the National Park Units. The plan simply commits to maintain at least 7 packs of 5 or more wolves each outside the National Park Units. The packs and pack size distribution inside the National Park Units are not expected to be affected, and will always serve to complement the 7 or more packs sustained outside the National Park Units. Data from 1999 are not relevant to the Service's examples because the NRM wolf population was still increasing to the recovery threshold and only 8 breeding pairs were present in the GYA (7 in WY) based on the Service's definition. One cannot assume the GYA population at that time would have been representative of a "recovered" wolf population. Petitioners have demonstrated that a highly improbable, worst case scenario, in which Wyoming managed for 7 packs of exactly 5 wolves each outside the National Park Units, would still have met the Service's recovery criteria from 2000 through 2006 (the 2000 example presumed there were only 4 packs of 5 wolves and not 7 packs outside YNP). Even the 2005 "worst case" example, in which there were only 7 breeding pairs inside YNP, demonstrated at least 11 breeding pairs would have been present in Wyoming. During that year, there were 11 packs of 5 or more wolves inside YNP, so the statewide total would have been at least 18 packs of 5 or more under Wyoming management.

The original Wyoming regression (Wyoming Petition, page 54) was defined based on pack data from 1996 through 2003. The maximum number of packs of 5 or more wolves in any one year in that dataset was only 17. The Service observed that the Wyoming regression may predict 24 packs in 2005 would equate to 24 (23.7) breeding pairs when only 16 breeding pairs were present. In the Service's view, this 50% "overestimate" would suggest the Wyoming regression is extremely inaccurate. However, we direct the Service to the confidence interval cone, which becomes extremely wide if the regression is applied to a number of packs that is significantly outside the data range used to define the regression equation (see figures in Appendix IV of the Wyoming Petition). The accuracy of the regression begins to break down substantially at 18-20 packs and higher. This is because slight deviations in the slope of the regression equation, while unimportant within the regression data range, can manifest substantial errors when applied outside that range. At 24 packs, an estimate of $\pm$8 breeding pairs is not unreasonable. As well, there may be other factors at play,

for example density-dependent effects at higher ranges of pack numbers. Or, 2005 may have been an extremely atypical year (an "episodic event") as suggested in the Wyoming response to 71 FR 6633 (comments 3 and 16, letter dated 6 April, 2006)

The revised Wyoming regression (based on 1999-2005 data) predicts 24 packs would have 21.8 breeding pairs, which is 36% above the actual number documented. Even Ausband's probabilities applied to the wolf population in that year overestimated the number of breeding pairs by 25%. The Wyoming regression provides a reasonable estimate and cushion of safety when the total population is 15 packs of $\geq$5 wolves each, which is the number on which minimal achievement of Wyoming's recovery criteria depends. At higher wolf populations, there is an even greater margin of safety and it's irrelevant whether the precision of the regression is as tight. The cone of precision in our original regression is narrow in the range of 8-16 packs, where it needs to be narrow.

None of the Service's examples illustrates a legitimate concern or fatal issue associated with using packs of 5 or more wolves to estimate the number of breeding pairs in Wyoming. So long as 7 packs of 5 or more wolves are maintained in Wyoming outside the National Park Units to complement the actual numbers of packs and breeding pairs inside the Parks, Wyoming's definition of pack size will provide a "high degree of certainty" that Wyoming will continue to sustain a recovered wolf population into the foreseeable future, defined as "30 years."

21. Peer Reviews (71 FR 43429): The Service states, "Eleven [peer] reviews were completed. While Wyoming's Plan was thought to be the most extreme in terms of wolf control and minimizing wolf numbers and distribution, some reviewers thought it was adequate *primarily* because they assumed in error that Wyoming's definition of a pack was equivalent to the Service's current breeding pair standard (Ausband 2006), thought that YNP was likely to carry most of Wyoming's share of the wolf population, and assumed that the commitments in the Plan could be implemented under State law. As noted above, the Service now views these three assumptions as unrealistic. Other important developments since these peer reviews include recent Federal District court rulings in Oregon and Vermont emphasizing the importance of suitable habitat in calculating the significant portion of the range occupied by wolves prior to changing the listing status, the decline of wolves in YNP, and an improved method of estimating wolf population status that demonstrated that earlier attempts to correlate pack size in winter with the probability of being a breeding pair were mathematically incorrect and clearly inconsistent with both the Service's previous and current breeding pair standards."

    Responses:
    i. Peer reviews that were completed in November 2003 could not have assumed anything about a breeding pair standard that was not developed until 2006.
    ii. When applied to Wyoming data, the Service's "revised" method of estimating breeding pairs (Ausband 2006) is functionally equivalent to Wyoming's method based on the pack definition of 5 or more wolves traveling together. However,

the Ausband method is unnecessarily complex and costly. (Refer to Comment 18).

iii. YNP need not carry more than 6 breeding pairs of wolves (e.g., 8-10 packs ranging from 4-12 wolves) in order for Wyoming to sustain its share of the recovered wolf population. Under Wyoming's management plan, a highly improbable worst-case scenario would leave 7 packs of exactly 5 wolves each outside the National Park Units. This would equate to 4 breeding pairs based on Ausband's probabilities. The fewest breeding pairs documented inside YNP since the wolf population first reached the recovery criteria in 2000 was 7. The fewest number of packs was 9. (Refer to comments 14 and 18-20).

iv. The assumption by peer reviewers that commitments in the Wyoming Wolf Management Plan could be implemented under Wyoming Law was correct, not incorrect.

v. Nothing in the Wyoming Wolf Management Plan precludes wolves from occupying any area of the NW Wyoming Wolf Management Area. All suitable wolf habitat in Wyoming is within the NW WY Wolf Management Area. (Refer to comment 5).

vi. The decline of wolves in YNP in 2005 did not jeopardize the recovered population and would not have jeopardized the population if wolves were being managed by the State. (Refer to Comments 18, 19, and 22).

22. RE: Implications of the 2005 experience in YNP (71 FR 43429). The Service repeatedly cites low reproductive success in YNP in 2005 as a case in which State management of wolves might not have sustained the population at or above recovery levels in Wyoming. The Service states, "The potential success of the current Wyoming law and Wolf plan to maintain its share of wolves in the NRM is *greatly* dependent on YNP having at least *eight breeding pairs*. However, recent experience tells us this is an unrealistic expectation. In 2005, wolf numbers substantially declined in YNP ([USFWS] et al. 2006) … In 2005, if each group of 5 or more wolves had been counted as a pack as Wyoming law defines a pack, there would have been a total of 24 "packs" in Wyoming, 11 inside YNP, and 13 outside YNP. It is likely that predatory animal status, if it had been implemented, would have quickly reduced or eliminated the number and size of wolf packs outside YNP going into summer and fall of 2005. The Wyoming segment of the wolf population would most likely have fallen below 10 breeding pairs (to only the 7 breeding pairs in YNP), and the distribution of wolf packs in suitable habitat in Wyoming outside the National Park/Wilderness units would have been significantly reduced. This could have occurred because the State definition of five wolves traveling together as constituting a pack would have prevented the WGFD Commission from enlarging the area designated as trophy game even though there could have been only 7 breeding pairs in the State."

Response: The success of the Wyoming wolf management plan is not dependent on maintaining 8 breeding pairs in YNP. The Plan assumes 8 or more packs will be maintained in YNP to complement the 7 or more packs maintained outside the Park. Success of the Plan can be assured with as few as 6 breeding pairs inside YNP,

because, under a worst-case scenario, there would be at least 4 breeding pairs outside the park in midwinter. (Refer to Comment 19). The Service greatly exaggerates vulnerability of wolves under "predatory animal" status outside YNP (Refer to Comment 13). Under the State plan, the status of wolves within the NW WY Wolf DAU would change from "predatory animal" to "trophy" status as soon as the number of packs of 5 or more wolves outside the Parks declined to 7 (Refer to Comment 12). Therefore, it would not have been possible for the number of breeding pairs in the State to decline to just the 7 present in YNP. Under a highly improbable, worst-case analysis, the number of breeding pairs in Wyoming could not have fallen below 11 in 2005 (Refer to Comment 18).

Furthermore, the wolf population in Wyoming, both inside and outside YNP, grew substantially in 2006 (USFWS weekly wolf recovery report dated 9/15-9/22). As of midyear, there are at least 309 wolves in 31 packs, including at least 24 potential breeding pairs in Wyoming. This represents an all-time high count since the introduction program began in 1995, and is 23% higher than the 2005 count and 14% higher than the previous record count in 2004.

Literature Cited:

Ausband, D. 2006. Probability of a breeding pair based upon group size (1996-2005). Meeting notes, Interagency Wolf Working Group, University of Montana, Missoula, Montana June 27, 2006. 8pp.

Ballard, W.B., L.A. Ayres, P.R. Krausman, D.J. Reed, and S.G. Fancy. Ecology of wolves in relation to a migratory caribou herd in northwest Alaska. Wildl. Monogr. 135:1-47.

Bangs, E., J. Fontaine, T. Meier, M. Jimenez, C. Niemeyer, D. Smith, C. Mack, V. Asher, L. Handegard, M. Collinge, R. Krischke, C. Sime, D. Moody, S. Nadeau. 2004. Submitted. Restoration and conflict management of the gray wolf in Montana, Idaho, and Wyoming. Trans. 69th N. Am. Wildl. Nat. Res. Conf., Seattle, WA.

Boert JE, R.D., P. Valkenburg, and M.E. McNay. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. J. Wildl. Manage. 60(3):474-489.

Carbyn, L.N. 1974. Wolf predation and behavioral interactions with elk and other ungulates in an area of high prey diversity. Can. Wildl. Serv. Rept. 233pp.

Carbyn, L.N. 1980. Ecology and management of wolves in Riding Mountain National Park, Manitoba, Can. Wildl. Serv. Rept. 184pp.

Duffield, J. 1992. An economic analysis of wolf recovery in Yellowstone: Park visitor attitudes and values. Pages 2-35 to 2-87 in J.D. Varley and W.G. Brewster, eds. Wolves for Yellowstone? A report to the United States Congress, Volume 4, Research and Analysis. NPS, Yellowstone National Park, WY.

Duffield, J.W., D.A. Patterson, C.J. Neher, and G. Plumb. 2006. Wolves and People in Yellowstone (*abstract only*). 18th Ann. N. Am. Wolf Conf. 1p.

Fuller, T.K., L.D. Mech, and J.F. Cochrane. 2003. Wolf population dynamics. Pages 161-191 in L.D. Mech and L. Boitani (eds). Wolves: Behavior, Ecology, and Conservation. Univ. Chicago Press, Chicago, Ill. 448pp.

Gasaway, W.C., R.D. Boert JE, D.V. Grangaard, D.G. Kelleyhouse, R.O. Stephenson, and D.G. Larsen. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. Wildl. Monogr. 120:1-57.

Haroldson, M.A. and K. Frey. 2005. Grizzly Bear Mortalities. Pages 25-30 in C.C. Schwartz, M.A. Haroldson, and K. West (eds). Yellowstone grizzly bear investigations: Annual report of the Interagency Grizzly Bear Study Team, 2005. U.S. Geological Survey, Bozeman, MT. 90pp.

Jimenez, M. D., and J. Stevenson. 2003. Wolf-elk interactions on state-managed feed grounds in Wyoming. 2002 progress report. USFWS, 190 N First St., Lander WY 82520. 11 pp.

Jimenez, M. D., and J. Stevenson. 2004. Wolf-elk interactions on state-managed feed grounds in Wyoming. 2003 progress report. USFWS, PO Box 2645, Jackson, WY 83001. 13 pp

Jimenez, M.D., S.P.Woodruff, S. Cain, and S. Dewey. 2005. Wolf-elk interactions on winter range and state-managed feed grounds in Wyoming. 2005 progress report. USFWS, P.O. Box 2645, Jackson, WY 83001. 12 pp.

Lemke, T.O. 2003. Gardiner Late Elk Hunt Annual Report, 2003. Montana Fish, Wildlife and Parks, Livingston, MT.

Lubow, B.C., F.J. Singer, T.L. Johnson, and D.C. Bowden. 2002. Dynamics of interacting elk populations within and adjacent to Rocky Mountain National Park. Pages 3-23 in F.J. Singer and L.C. Zeigenfuss, compilers. Ecological evaluation of the abundance and effects of elk herbivory in Rocky Mountain National Park, Colorado, 1994-1999. Open File Report 02-208, United States Geological Survey, Fort Collins, CO.

Mech, L.D. 1990. Who's afraid of the big bad wolf? Audubon 92(2):82-85, March 1990.

Mech, L.D. and L. Boitani (eds). 2003. Wolf conservation and recovery. Pages 317-340 in Wolves: Behavior, Ecology, and Conservation. Univ. Chicago Press, Chicago. 448pp.

Messier, F. 1994. Ungulate population models with predation: A case study with North American moose. Ecology 75:478-488.

Nowak, R.M. 1995. Another look at wolf taxonomy. Pages 375-397 in L.D. Carbyn, S.H. Fritts, and D.R. Seip (eds). Ecology and conservation of wolves in a changing world. Canadian Circumpolar Institute, Occasional Publication No. 35. Edmonton, Alberta. 642pp.

O'Donnell, M.R. (Chief Deputy Attorney General). 2003. Legal opinion on Wyoming law [W.S. 23-1-304] regarding the classification of gray wolves as trophy game animals. Letter to Director Brent Manning dated 22 May, 2003. State of Wyoming, Office of the Attorney General, Cheyenne. 4pp.

Peterson, R.O. 1979. The role of wolf predation in a moose population decline. Pages 329-333 in R.M. Linn (ed). Proc. 1st Conf. Sci. Res. Natl. Parks, New Orleans, 1976. U.S. Natl. Park Serv. Proc. Ser. No. 5. Vol. 1.

Pimlott, D.H., J.A. Shannon, and G.B. Kolenosky. 1969. The ecology of the timber wolf in Algonquin Provincial Park. Ontario Dept. Lands and Forests. 92pp.

Singer, F.J., A. Harting, K.K. Symonds, and M.B. Coughenour. 1997. Density dependence, compensation, and environmental effects on elk calf mortality in Yellowstone National Park. J. Wildl. Manage. 61(1):12-25.

USFWS. 2005. National Elk Refuge history: A legacy of wildlife conservation. U.S. Fish and Wildlife Service, National Elk Refuge, Jackson, WY. www.fws.gov/nationalelkrefuge/Documents/RefugeHistory.pdf

USFWS. 2006. Gray wolf biology questions and answers. U.S. Fish and Wildlife Service, Region 3, Fort Snelling, Minnesota. www.fws.gov/midwest/wolf/biology/qandas.htm

Vucetich, J.A., D.W. Smith, and D.R. Stahler. 2005. Influence of harvest, climate, and wolf predation on Yellowstone elk, 1961-2004. Oikos 111:259-270.

WGFD. 2002. Annual Report 2002. Wyoming Game and Fish Department, Cheyenne. 119pp.

WGFD. 2003. Final Wyoming Gray Wolf Management Plan. Wyoming Game and Fish Department, Cheyenne. 40pp.

Williams, S. 1994. Letter to Terry Cleveland dated 1/13/04. U.S. Fish and Wildlife Service, Washington, D.C. 3pp.

Wyoming Governor's Office and Wyoming Game and Fish Commission. 2005. Petition to revise the listed status of the gray wolf (*Canis lupus*) by establishing the Northern Rocky Mountain distinct population segment and to concurrently remove the gray wolf in the Northern Rocky Mountain Distinct Population Segment from the list of Endangered and Threatened Species. Wyoming Game and Fish Commission, Cheyenne. 89pp.

White, P.J., D.W. Smith, J.W. Duffield, M. Jimenez, T. McEneaney, and G. Plumb. 2005. Yellowstone Science 13(1):34-43.

White, P.J. and R.A. Garrott. 2005. Northern Yellowstone elk after wolf restoration. Wildl. Soc. Bull. 33:942-955.