APPENDIXES

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APPENDIX A: LAWS AND REGULATIONS

Many procedural and substantive requirements of federal and applicable state and local laws and regulations affect refuge and park establishment, management, and development. The following list identifies the key federal laws and policies that were considered during the planning process or that could affect future refuge and park management.

American Indian Religious Freedom Act (1978): Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

Americans with Disabilities Act (1992): Prohibits discrimination in public accommodations and services.

Antiquities Act (1906): Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Archeological and Historic Preservation Act (1974): Directs the preservation of historic and archaeological data in Federal construction projects.

Archeological Resources Protection Act (1979) as amended: Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

Architectural Barriers Act (1968): Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

Bald and Golden Eagle Protection Act (1940): The Act prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions.

Clean Air Act of 1977, as amended: The primary objective of this act is to establish federal standards for various pollutants from both stationary and mobile sources and to provide for the regulation of polluting emissions via state implementation plants. In addition, and of special interest for National Wildlife Refuges, some amendments are designed to prevent significant deterioration in certain areas where air quality exceeds national standards, and to provide for improved air quality in areas which do not meet Federal standards ("non-attainment" areas). Federal facilities are required to comply with air quality standards to the same extent as nongovernmental entities (42 U.S.C. 7418).

Clean Water Act (1977): Requires consultation with the Corps of Engineers (404 permits) for major wetland modifications.

Emergency Wetlands Resources Act (1986): The purpose of the act is "to promote the conservation of migratory waterfowl and to offset or prevent the serious loss of wetlands by the acquisition of wetlands and other essential habitat, and for other purposes."

Endangered Species Act (1973): Requires all federal agencies to carry out programs for the conservation of endangered and threatened species.

Executive Order No. 11593, "Protection and Enhancement of the Cultural Environment" (1971): If the Fish and Wildlife Service or the Park Service proposes any development activities that would affect the archeological or historical sites, the agencies will consult with federal and state historic preservation officers to comply with section 106 of the National Historic Preservation Act of 1966, as amended.

Executive Order 11987, "Exotic Organisms" (1977): Requires federal agencies, to the extent permitted by law, to restrict the introduction of exotic species into the natural ecosystems on lands and waters owned or leased by the United States; to encourage states, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the United States; to restrict the importation and introduction of exotic species into any natural U.S. ecosystems as a result of activities they undertake, fund, or authorize; and to restrict the use of federal funds, programs, or authorities to export native species for introduction into ecosystems outside the U.S. where they do not occur naturally.

Executive Order 11988, "Floodplain Management" (1977): Requires each federal agency shall provide leadership and take action to reduce the risk of flood loss and minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

Executive Order 11990, "Protection of Wetlands" (1977): Directs all federal agencies to avoid, if possible, adverse impacts to wetlands and to preserve and enhance the natural and beneficial values of wetlands. Each agency shall avoid undertaking or assisting in

wetland construction projects unless the head of the agency determines that there is no practicable alternative to such construction and that the proposed action includes measures to minimize harm. Also, agencies shall provide opportunity for early public review of proposals for construction in wetlands, including those projects not requiring an EIS.

Executive Order 12898, "Environmental Justice" (1994): Provides minority and low-income populations an opportunity to comment on the development and design of reclamation activities. Federal agencies shall make achieving environmental justice part of their missions by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.

Executive Order 13007, "Indian Sacred Sites" (1996): Directs federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

Executive Order 13084, "Consultation and Coordination with Indian Tribal Governments" (1998): The United States has a unique legal relationship with Indian tribal governments as set forth in the Constitution of the United States, treaties, statutes, executive orders, and court decisions. Since the formation of the Union, the United States has recognized Indian tribes as domestic dependent nations under its protection. In treaties, our Nation has guaranteed the right of Indian tribes to self-government. As domestic dependent nations, Indian tribes exercise inherent sovereign powers over their members and territory. The United States continues to work with Indian tribes on a government-to-government basis to address issues concerning Indian tribal self-government, trust resources, and Indian tribal treaty and other rights.

Executive Order 13112, "Invasive Species" (1999): Directs federal agencies to prevent the introduction of invasive species, control and monitor invasive species, and restore native species and habitats that have been invaded.

Federal Aid in Wildlife Restoration Act of September 2, 1937, as amended: This act, commonly referred to as the Pittman-Robertson Act, provides to states for game and non-game wildlife restoration work. Funds from an excise tax on sporting arms and ammunition are appropriated to the Secretary of the Interior annually and apportioned to States on a formula basis for approved land acquisition, research, development and management projects and hunter safety programs.

Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species; and an interdisciplinary approach with the cooperation of other Federal and State agencies.

Food Security Act of 1985 (Title XII, Public Law 99-198, 99 Stat. 1354; December 23, 1985), as amended: Authorizes acquisition of easements in real property for a term of not less than 50 years for conservation, recreation, and wildlife purposes.

Land and Water Conservation Fund Act (1965): Uses the receipts from the sale of surplus Federal land, outer continental shelf oil and gas sales, and other sources for land acquisition under several authorities.

Migratory Bird Conservation Act (1929): Establishes procedures for acquisition by purchase, rental, or gift of areas approved by the Migratory Bird Conservation Commission.

Migratory Bird Treaty Act (1918): Designates the protection of migratory birds as a Federal responsibility. This Act enables the setting of seasons, and other regulations including the closing of areas, Federal or nonfederal, to the hunting of migratory birds.

National Environmental Policy Act (1969): Requires all Federal agencies to examine the impacts upon the environment that their actions might have, to incorporate the best available environmental information, and the use of public participation in the planning and implementation of all actions. All Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documentation to facilitate sound environmental decision making. NEPA requires the disclosure of the environmental impacts of any major Federal action that affects in a significant way the quality of the human environment.

National Historic Preservation Act (1966) as amended: Establishes as policy that the Federal Government is to provide leadership in the preservation of the nation's prehistoric and historic resources.

Native American Graves Protection and Repatriation Act (1990): Requires Federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

LAWS AFFECTING THE NATIONAL ELK REFUGE ONLY

Executive Order 12996, "Management and General Public Use of the National Wildlife Refuge System" (1996): Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the System.

Fish and Wildlife Coordination Act of March 10, 1934, as amended: This act authorizes the Secretary of the Interior to assist Federal, State and other agencies in development, protection, rearing and stocking fish and wildlife on Federal lands, and to study effects of pollution on fish and wildlife. The Act also requires consultation with the Fish and Wildlife Service and the wildlife agency of any State wherein the waters of any stream or other water body are proposed to be impounded, diverted, channelized or otherwise controlled or modified by any Federal agency, or any private agency under Federal permit or license, with a view to preventing loss of, or damage to, wildlife resources in connection with such water resource projects. The Act further authorizes Federal water resource agencies to acquire lands or interests in connection with water use projects specifically for mitigation and enhancement of fish and wildlife.

Fish and Wildlife Act (1956): Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Fish and Wildlife Coordination Act (1958): Allows the Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 (Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, or environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

National Wildlife Refuge System Improvement Act of 1997: Sets the mission and administrative policy for all refuges in the National Wildlife Refuge System. Clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, or environmental education and interpretation); establishes a formal process for determining compatibility; establishes the responsibilities of the Secretary of the Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

Refuge Recreation Act (1962): Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

Rehabilitation Act (1973): Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the Federal government to ensure that anybody can participate in any program.

Refuge Revenue Sharing Act of 1935, as amended: Provides for payments to counties in lieu of taxes, using revenues derived from the sale of products from refuges. Public Law 88-523 (1964) revised this Act and required that all revenues received from refuge products, such as animals, timber and minerals, or from leases or other privileges, be deposited in a special Treasury account and net receipts distributed to counties for public schools and roads. Payments to counties were established as: (1) on acquired land, the greatest amount calculated on the basis of 75 cents per acre, three-fourths of 1% of the appraised value, or 25% of the net receipts produced from the land; and (2) on land withdrawn from the public domain, 25% of net receipts and basic payments under Public Law 94-565 (31 U.S.C. 1601- 1607, 90 Stat. 2662), payment in lieu of taxes on public lands.

Statute 293 (1912): Establishes the National Elk Refuge as a winter game (elk) reserve.

37 Statute 847 (1913): Sets aside the National Elk Refuge for the establishment and maintenance of a winter elk refuge in the State of Wyoming.

Executive Order 3596 (1921): Establishes all lands within the boundaries of the National Elk Refuge as a refuge and breeding ground for birds.

Executive Order 3741 (1922): Sets aside the National Elk Refuge for the use of the Secretary of [the Interior] as a refuge and breeding grounds for birds."

Statute 1246 (1927): Institutes another National Elk Refuge purpose for grazing of, and as a refuge for, American elk and other big game animals.

LAWS AFFECTING GRAND TETON NATIONAL PARK ONLY

National Park Service Organic Act (39 Stat. 535, 16 USC 1 et seq., as amended) (1916): Established the National Park Service, and states its basic mission: "To conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

45 Stat. 1314 (1929): Established Grand Teton National Park creating a 96,000-acre park that included the Teton Range and eight glacial lakes at the base of the peaks.

Presidential Proclamation Number 2578, 57 Stat. 731 (1943): Established Jackson Hole National Monument, which combined Teton National Forest acreage, other federal properties including Jackson Lake and a 35,000-acre donation by John D. Rockefeller. The Rockefeller lands continued to be privately held until December 16, 1949.

Public Law 81-787, 64 Stat. 849 (1950): Grand Teton National Park was enlarged to its present size by including the lands within Jackson Hole National Monument.

Public Law 92-404 (1972): Established John D. Rockefeller, Jr., Memorial Parkway for the purpose of commemorating the many significant contributions to the cause of conservation in the United States, which have been made by John D. Rockefeller, Jr., and to provide both a symbolic and desirable physical connection between the world's first national park, Yellowstone, and Grand Teton National Park.

Redwoods Act (1978): States "the promotion and regulation of the various areas of the National Park System be consistent with and founded in the purpose established . . . to the common benefit of all the people of the United States, and that authorization of activities be construed and the protection, management, and administration of these areas be conducted in light of the high public value and integrity of the National Park System and not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress."

112 Statute 3501, 16 USC 5936 (1998): Requires the Secretary of the Interior to use the results of scientific study when making decisions about park management. Additionally, when making a decision that "may cause a significant adverse effect on a park resource," the administrative record must reflect how the manager considered the resource studies.

APPENDIX B: FERTILITY CONTROL

Fertility control would be used to lower calf production and herd growth in the short term under Alternative 2, thus limiting increases in mortality as the feeding program is phased out.

Wildlife fertility control can take the form of permanent surgical sterilization or reversible biochemical contraception. Surgical sterilization is typically performed on farms or game ranches where loss of genetic variation is not a concern. Biochemical contraception has been practiced in zoos for over thirty years. However, it is only within the last 15 years that biochemical contraception has been applied to wild populations. Most of the research has been in horses and white-tailed deer, as well as smaller species that have been considered pests, such as rats and Canada geese. The field of wildlife contraception is still young and all wildlife contraception programs are considered experimental. There are no contraceptive drugs available for commercial use (Fagerstone et al. 2002). Nevertheless, the field is advancing rapidly and it has become apparent that, for some wildlife populations under some circumstances, wildlife contraception is a viable management tool.

Species of animals that have been considered for wildlife contraception programs have been those species for whom lethal control has been ineffective (coyotes, eastern white-tailed deer), or species who inhabit areas where lethal control is undesirable or unsafe (national parks and urban areas). In addition, growing numbers of the public enjoy wildlife for aesthetic, non-consumptive uses and a growing number of people are concerned with humane treatment of all animals. Many of these people, although they may not be opposed to all forms of lethal control, support management policies that are perceived to benefit wildlife itself and are not just beneficial for humans (Gill and Miller 1997). Other members of the public are strongly opposed to wildlife contraception, perceiving it as a threat to hunting or fearful that it will have unforeseen consequences on the genetic composition of wildlife populations. Acceptance or rejection of wildlife contraception programs often relates to larger world views, such as spiritual beliefs, beliefs about safety and security, beliefs about appropriate human intervention with the environment, and beliefs about individual freedom of choice (Fagerstone et al. 2002).

Reducing overabundant wildlife populations can be accomplished by capture and relocation of animals, or by killing animals, either through agency culling or public hunt programs. Capture and relocation is not appropriate for the Jackson bison herd due to brucellosis infection. Hunting has been effective in many situations, but less so for other situations and for certain herd segments. Wildlife contraception can reduce recruitment of animals into the population, slowing or stabilizing the growth of populations, but it does not remove animals from the population (Bomford 1990; Garrott 1991, 1995). The PZP Contraceptive Research Team (2001) cautions that contraception is not a good way to reduce wildlife populations rapidly. Animals in long-lived species die off slowly and the results of contraception can often be confounded by increased adult survival due to elimination of the energetic costs of breeding, gestation, and lactation (Garrott 1995). Wildlife contraception should be viewed as a long-term commitment and not a quick fix for problems that were years in the making.

When considering the biological feasibility of a wildlife contraception program, a number of factors must be taken into consideration including the extent to which the population is "open" or "closed" to immigration, the number in the population, sex ratios, age structure, estimated rate of increase, mortality rate, adult survival rate, age at which animals reproduce, and the estimated number of animals that will need treatment (Dolbeer 1998). Population models that compared the relative efficiency of wildlife contraception to lethal control measures predicted relative efficiencies of sterilization versus removal based on adult survival rate and the age at which animals reproduced (Dolbeer 1998). In general, these models indicated that wildlife contraception is much more effective in short-lived species that reproduce at an early age, have large litter or clutch sizes, and low survival rates (e.g., rats, brown-headed cowbirds). Conversely, longer-lived species that reproduce at 2-4 years of age and have small litter or clutch sizes can be managed more effectively with lethal control than with reproductive control (Fagerstone et al. 2002). If the public prefers non-lethal population control regardless of efficiency, then people would have to support the length of time necessary to achieve wildlife population goals and the economic costs that would be incurred.

Gender Considerations

Fertility control of male bison or elk could be accomplished through surgical or biochemical means. Surgical castrations and vasectomies would be permanent, whereas biochemical contraception would be reversible. All of these methods are successful but could have impacts on the genetics, social structure, and dominance hierarchy of the herd (Shelley and Anderson 1989). Bison are polygamous, with a small number of males doing most of the breeding. Biochemical or surgical castration could influence the social structure of the herd by reducing aggression in dominant bulls and allowing normally subordinate males to achieve an unusual degree of reproductive success. This situation could artificially alter natural selection to favor "less fit" individuals (pers. comm. B. Russell, U. of WY, as cited in Shelly and Anderson 1989). In addition, reproduction likely would not be effectively reduced. In contrast, surgical or biochemical vasectomies could allow dominant bulls to retain their status, for a time, but as the breeding season continues and females repeatedly come into estrous due to unproductive coupling with infertile bulls, the dominant bulls would grow exhausted and less dominant males would eventually breed with the females. Again, this could be selecting for "less fit" individuals and reproduction likely would not be effectively reduced.

Most of the males would have to be contracepted or sterilized in order to significantly reduce reproduction and to reduce transmission of brucellosis, which is primarily transmitted through aborted fetuses, placentas, parturient fluids or post parturient uterine discharge (Rhyan and Drew 2002). Surgical castrations and vasectomies would permanently remove males from the gene pool, while biochemical sterilization would preserve treated individuals genetic contribution for the future. Biochemical sterilization allows for greater management flexibility if environmental conditions change. In the event of a large die off due to disease or winter-kill, biochemical treatment could be withdrawn and the herd allowed to recover. However, the impact of removing most of the male genes, either permanently or temporarily, on the genetic variation of the herd would be difficult to measure (Shelley and Anderson 1989).

As the number of sterilized males in the population increases, the likelihood that females will not conceive during their first estrous cycles also increases. This situation has the potential to disrupt seasonal reproductive cycles, potentially shifting the birthing period to later in the summer or fall and greatly reducing a calf's chance of surviving the following winter (Garrott and Siniff 1992, Garrott et al. 1998). In addition, dominant males would likely experience increased mortality due to a prolonged breeding season and a depletion of their bioenergetic reserves (pers. comm. B. Smith, Biologist, National Elk Refuge, 2002).

Surgical sterilization of female bison would also permanently remove these individuals from the gene pool, but behavioral changes would not likely affect the social structure or dominance hierarchy of the herd. As with males, biochemical sterilization would be reversible and would preserve treated individuals' genetic contributions for the future (Shelley and Anderson 1989). Some forms of biochemical sterilization result in females continuing to experience estrous cycles for 3 to 8 months beyond the normal breeding season (Plotka et al. 1977, Haigh and Hudson 1993, McShea et al. 1997, Garrot et al. 1998, Heilmann et al. 1998). This does not appear to negatively affect female survival as reproduction itself has energetic costs associated with it (McShea 1997, Heilmann et al. 1998). However, as mentioned above, males that continue to compete for the right to breed with females beyond the normal breeding season may experience increased vulnerability to human harvest and higher overwinter mortality due to greater depletion of body reserves, although this has not been demonstrated in the wild (Heilmann et al. 1998).

For the above reasons, contraceptive measures potentially applicable to adult female elk and bison are considered here.

Permanent Sterilization

Female bison could be sterilized by removal of the ovaries through a vaginal or flank approach. The animals would need to be chemically immobilized. The surgeries could be performed using carfentanil, a drug that (1) is easy to prepare, (2) is a complete anesthesia (the animal is not aware of what is happening), and (3) has an antagonist (pers. comm. T. Roffe, Veterinarian, U. S. Geological Survey, 2003). The drug's drawback is that it is extremely lethal to humans if not used carefully.

Removal of the ovaries through the left flank could be accomplished without restraint equipment. The animals would have to be immobilized with carfentanil. This technique is a more major operation and has a greater chance of infection or other complications than if animals are physically restrained and local anesthetics used (Shelley and Anderson 1989). It is safer for the staff performing the procedures

and less stressful for the animals because they are unaware of what is happening. However, more time is required to perform each surgery than if restraint equipment is used (T. Roffe, Veterinarian, U. S. Geological Survey, pers. comm., 2003).

Biochemical Wildlife Contraception

Much of the following material was obtained from Rhyan and Drew (2002) with the senior author's permission. Because not all of their paper is included and because other material was added, quotations are used to designate paragraphs that were obtained from Rhyan and Drew's paper.

> "Over the past three decades, a variety of permanent and temporary contraceptive agents have been developed and tested in various wildlife populations, most notably wild horses and white-tailed deer (*Odocoileus virginianus*). This work has recently been summarized (Fagerstone et al. 2002; Kirkpatrick and Rutberg 2001; Kreeger 1997). While most contraceptive agents have had measured success in preventing pregnancy, problems have been associated with each method and thus far no contraceptive has gained widespread use in wildlife management. Most contraceptives for mammals could be grouped into the following categories: hormonal implants, immunocontraceptive vaccines, and a miscellaneous category that includes intrauterine devices, GnRH agonists, GnRH toxins, and engineered viruses. In this chapter we will discuss the various contraceptive strategies, their assets and problems, and their potential relevance to wildlife disease management, particularly in regard to brucellosis in Greater Yellowstone Area bison."

Hormonal Implants

Rhyan and Drew (2002) provided an overview of the application of hormonal implants. They concluded that "Widespread use of hormonal contraception in wildlife, however, has not been practiced and is not likely to achieve acceptance due to three main concerns. A minor concern is the need for minor surgery to install some of the larger implants necessary to achieve several years of contraception. More prominent are the concerns over effects on nontarget [species], i.e. scavengers or predators that might consume the carcasses of contracepted animals, and concerns over potential side effects in the treated animals. The use of hormonal implants in the Greater Yellowstone Area, where endangered populations of wolves, grizzly bears, and lynx exist, is not likely to achieve public acceptance due the nontarget concerns." Although progress on hormonal contraception should be monitored, it is not being considered for use in bison at this time.

Immunocontraceptive Vaccines

Because immunocontraceptive vaccines are showing promise for use in bison, Rhyan and Drew's (2002) entire section on the subject is included below, with the exception of the last two paragraphs that are not included because they dealt with immunocontraceptive vaccines that appear to have low probabilities of being used.

> "Of the contraceptive treatments, immunocontraceptive vaccines have recently received the most investigation in wildlife. They have successfully produced temporary sterility in horses, deer, elk, coyotes, seals, rodents, and several exotic species. The mechanism of action of immunocontraceptive vaccines is the production of a limited, temporary, humoral, immune response (antibody production) in an animal to proteins or peptides involved in the reproductive process. These protein or peptide targets include zona pellucida (ZP), sperm proteins, human chorionic gonadotropin (hCG), and gonadotropin releasing hormone (GnRH).
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> "The most widely investigated immunocontraceptive vaccines in wildlife are those that produce the development of antibodies to zona pellucida, the outer glycoprotein coating of the ovum, or its various subunits. Because it is a large molecule, when mixed and injected with a potent adjuvant (a substance that when mixed with an antigen enhances antigenicity and results in a superior immune response), ZP is immunogenic. Antibodies developed by the host against the injected vaccine ZP then cross-react with the host's own ZP, thereby preventing sperm penetration of the ova. Additionally, there is some experimental evidence suggesting that if fertilization does occur, the immune response may inhibit maturation of the corpus luteum (Miller et al. 2000b). Most investigators have utilized porcine zona pellucida (PZP) in the vaccines. Because high anti-

> body titers are required to produce sterility, PZP has usually been injected with Freund's complete adjuvant (FCA) initially followed by booster vaccinations with incomplete Freund's (FIA). Alternatively, PZP in FIA or in a modified FCA has sometimes been used in captive ungulates to avoid the development of positive tuberculosis skin tests sometimes associated with the use of FCA (Kirkpatrick et al. 1996).
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> "Extensive trials have been conducted using various formulations of PZP in horses (Kirkpatrick et al. 1990; Turner et al. 1997), elk (Garrott et al. 1998), white-tailed deer (Turner et al. 1996; Miller et al. 2001), and various exotic or zoo animals (Kirkpatrick et al. 1995; Kirkpatrick et al. 1996). Investigators have routinely demonstrated efficacy of PZP vaccines in the various species. Benefits of this approach include its effectiveness or efficacy in many species and the fact that much work has been done with PZP vaccines. On the list of zoo animals that have been successfully contracepted with PZP are numerous bovids including bison (Kirkpatrick et al. 1996). In fact, while much of the ungulate work with PZP has been directed toward white-tailed deer, the vaccine appears as effective in bovids as in cervidae (J. Kirkpatrick, Biologist, Science and Conservation Center, pers. comm., 2002)."

PZP vaccines can be delivered remotely via a 1.0 cc dart, making them more practical for wild populations than techniques that require handling of the animals (J. Kirkpatrick, Biologist, Science and Conservation Center 2002, pers. comm.). However, the need to vaccinate more than once the first season, and annually in subsequent seasons, requires that animals be marked and greatly increases the time and labor involved in conducting such a program (McShea et al. 1997). It is preferable that the animals are vaccinated immediately prior to the breeding season, but PZP is safe to use during pregnancy (J. Kirkpatrick, Biologist, Science and Conservation Center 2002, pers. comm.). It does not cause abortion or interfere with delivery of a normal calf. In addition, PZP is safe for nontarget species such as predators and scavengers that may consume the treated animal. Because it is a protein that is broken down in the body, PZP does not enter the food chain (Fagerstone et al. 2002). The cost of PZP is approximately $20/dose and the darts cost approximately $1.50 (J. Kirkpatrick, Biologist, Science and Conservation Center, pers. comm., 2003). The major expense would be the labor costs and that would depend on how many animals would need to be vaccinated.

> "Problems with PZP vaccines include the fact that most formulations have required one or more booster vaccinations and have only produced short-term sterility unless boostered annually. Additionally, the necessity of using Freund's complete adjuvant (FCA) has relegated the vaccine to an experimental status. FCA is often used experimentally because it dramatically enhances antibody production to an antigen, causes occasional granulomas or abscesses at the injection site. The Food and Drug Administration, the agency that has regulatory authority over immunocontraceptive vaccines, does not approve vaccines with FCA for widespread use."

Because of concerns about the safety of FCA, huntable animals must be ear-tagged with a "Do Not Consume" notice (Fagerston et al. 2002). Although PZP can be delivered via dart, making it more practical for free-roaming animal populations, the necessity of capturing the animal to attach an ear-tag totally negates the advantage of this delivery method for the Jackson bison and elk herds. The St. Louis Zoo Wildlife Contraception Advisory Group (2002) cautions that PZP may cause permanent sterility in artiodactyls (hoofed mammals) if used for more than 3 consecutive years. In any case, the length of time that an animal remains infertile can be highly variable (Miller et al. 2000, HYPERLINK www.stlzoo.org/images/CAGrecs2002.htm).

> "Recent advances, however may help solve these problems. Turner and co-workers (2001) using PZP in FCA and polymer microspheres for sustained release obtained one year of sterility in horses with a single injection. The same workers are currently experimenting with injection of polymer pellets containing the vaccine for release at different time intervals (Turner et al. 2002). Brown and coworkers (1997) produced at least six years sterility in wild gray seals (*Halichoerus grypus*) using a single injection of a PZP/FCA vaccine with liposomes and more recently demonstrated the vaccine's efficacy for three years in fallow deer (*Dama dama*) following a single injection (Fraker et al. 2002). In an ongoing study, Miller and co-workers have produced from one to two years' sterility in white-tailed

deer with a single injection of PZP utilizing an alternate adjuvant (Miller, pers. comm.).

"A remaining difficulty with the use of PZP in ungulates is that, in some species, vaccinated animals, although sterile, continue to experience estrous cycles. Female white-tailed deer vaccinated with PZP have continued to exhibit sexual activity into February (Miller et al. 2000b). PZP vaccinated elk also experience a prolonged breeding season (Heilmann et al. 1997). This continuous estrous cycling results in increased activity during early winter at a time when conservation of calories is important. Additionally, it could increase the spread of venereally transmitted diseases if present and, at least in the case of deer in populated areas, may contribute to increased collisions with automobiles. Prolonging the breeding season of bison in the Greater Yellowstone Area may be deleterious to winter survival of dominant bulls and vaccinated cows due to increased activity in fall and early winter. It is not known whether or not PZP-vaccinated bison would experience a prolonged breeding season.

"An interesting related question, especially relevant when considering contraceptive use in a national park setting, concerns what is considered "natural" behavior. All agree that reproductive activity is natural. The question that arises is as follows. Is it more "natural" for an animal to experience multiple estrous cycles or not to experience one at all? In fact, defensible arguments can be made on both sides of the issue, as there are probably individual animals in most herds that, due to health-related conditions (cystic ovaries, advanced age, persistent corpora lutea, malnutrition, etc.), experience either situation.

"Another immunocontraceptive vaccine that has been experimentally shown to produce temporary sterility in several species is one that produces immunity to the hormone Gonadotropin releasing hormone (GnRH). GnRH is a small peptide produced and secreted by the hypothalamus of the brain that stimulates the pituitary gonadotroph cells to release follicle stimulating hormone (FSH) and luteinizing hormone (LH). Follicle stimulating hormone and LH regulate normal functioning of the ovaries and testes. The chemical structure of GnRH is homologous between species. The peptide is normally recognized as "self" by the host's immune system. This, plus the hormone's small molecular weight render it, by itself, a poor immunogen. In other words, if injected alone or even with an adjuvant, GnRH would not stimulate sufficient antibody production by the host animal for a contraceptive effect. However, GnRH can be made more immunogenic by conjugating it to a large foreign protein such as ovalbumin, or keyhole limpet hemocyanin from shellfish. When this modified GnRH is injected into a host animal with a potent adjuvant, high antibody titers usually result rendering the host sterile. The mechanism of action in a GnRH-immunized animal is that the animal's antibody developed against the foreign protein and simultaneously against GnRH binds to the animal's GnRH causing it to be ineffective as a regulating hormone (Fig. 1). Without functional GnRH, the animal is unable to produce FSH and LH, and hormone and gamete production by the ovaries and testes is prevented. Thus, GnRH vaccine can effectively contracept females or males.

"Early trials with GnRH vaccines have had mixed outcomes. However, in recent years, a GnRH vaccine has successfully produced sterility in Norway rats (Miller et al. 1997) and white-tailed deer (Miller et al. 2000a). In an ongoing study in female white-tailed deer, a single injection of GnRH vaccine has produced sterility for one to two years (Miller, pers. comm.). Preliminary results of trials in bison show antibody production and contraception in the majority of animals receiving a single dose of the vaccine."

Additionally, the GnRH vaccine uses an adjuvant other than FCA. Animals experimentally vaccinated with GnRH and this adjuvant have been approved by the Food and Drug Administration for human consumption after one recent research project (L. Miller, pers. comm., 2003, U. S. Department of Agriculture). However, it has not yet been approved for human consumption in all instances. GnRH vaccines may be safe if delivered during the last 100 to 120 days of pregnancy in bison and during the last 80 to 90 days of pregnancy in elk. However, GnRH has not been tested on elk and only a small study has been carried out on bison. Additional research would have to be performed on elk to definitely determine if

GnRH can be administered during late pregnancy (J. Rhyan, Veterinarian, pers. comm., USDA 2003). Another benefit of GnRH is that it suppresses reproductive behavior, inhibiting females from recycling and extending the breeding season. GnRH vaccines are also safe for nontarget species, such as predators and scavengers because it is a peptide that breaks down in the digestive tract and does not enter the food chain (Fagerstone et al. 2002). However, GnRH vaccines are currently available only in injectible form, requiring that animals be captured in order to be treated (Fagerstone et al. 2002). The possibility exists that a dart for remote delivery could be developed, but this technique has not as yet been tested (J. Rhyan, Veterinarian, USDA, 2003).

Miscellaneous Contraceptive Approaches

> "Remaining in the armamentarium of potential contraceptive treatments for bison and elk are several approaches that have not been thoroughly investigated in any wildlife species. One of these approaches currently being investigated is that of GnRH agonists. Agonists are synthesized compounds, structurally similar to the original hormone, but much more potent in their action. Several GnRH agonist analogs have been produced that are 15 to 200 times more active than naturally occurring GnRH (Conn and Crowley, 1991). Continuous administration of these agonists results in desensitization of the pituitary gonadotroph cells, suppression of gonadotropin production, and loss of gonadal function. When administration of the agonist stops, however, normal gonadotropin production and fertility returns. Continuous administration of these agonists has been achieved by use of osmotic minipumps (Becker and Katz, 1995), and more recently by use of slow release, subdermal, matrix implants. GnRH agonists have been shown to inhibit ovulation in female cattle (Herschler and Vickery, 1981), sheep (McNeilly and Fraser, 1987), and horses (Montovan et al. 1990). Recent work has shown one of the agonists, leuprolide, administered in a subdermal implant, to be effective in suppressing LH secretion and pregnancy for one breeding season in captive elk (Baker et al. 2002). Negative side effects were not noted in these studies."

Leuprolide is safe for nontarget species, such as predators and scavengers, because it is a neuropeptide that is broken down in the digestive system and does not enter the food chain (Baker et al. 2002). Although female elk treated with leuprolide did engage in sexual behavior early in the breeding season, they did not experience recurrent estrous cycles (Baker et al. 2002). Leuprolide is currently being tested on female elk at Rocky Mountain National Park, but at this time the only way to deliver the implant is through handling the animals. It must also be delivered prior to the breeding season when the animals are not pregnant (M. Wild, Veterinarian, RMNP 2003 pers. comm.). The St. Louis Zoo Wildlife Contraception Advisory Group (2002) cautions that GnRH agonists may cause abortion if administered to pregnant artiodactyls (hoofed mammals).

> "Another novel approach currently being investigated is that of coupling a GnRH analog to a toxin. This allows delivery of the toxin directly to the gonadotropin secreting cells in the anterior pituitary. The toxic subunit then enters the targeted cells resulting in their death and subsequent cessation of gonadotropin production. Preliminary studies have shown a GnRH-toxin conjugate will suppress LH secretion up to 6 months in captive mule deer (Baker et al. 1999). This approach theoretically could result in permanent sterilization of the treated animal; however, no long term studies have been conducted to evaluate duration of effect."

Other contraceptive approaches that were described by Rhyan and Drew (2002) include genetically engineered viruses that express contraceptive molecules and mechanical barriers and intrauterine devices (IUDs), such as silastic vaginal implants. If these approaches become available for use in bison, it will be well into the future.

Comparison Summary of Wildlife Contraception Techniques

There has been much discussion within the field of wildlife contraception concerning the "perfect" wildlife contraceptive. Recognizing that what is perfect for one wildlife situation may not be perfect for another situation, the Bison and Elk Management Plan and Environmental Impact Statement will focus on those contraceptive techniques that are currently available, and would most likely be of benefit in preventing pregnancy in the Jackson bison herd. These are surgical sterilization, immunocontraception (PZP and GnRH), and leuprolide (a GnRH agonist).

An ideal wildlife contraceptive method for elk and bison would possess the following characteristics:

- Be species specific, so that there would be no inadvertent contraception of non-target species
- Would not affect non-target species, such as predators and scavengers, that consume treated bison or elk
- Could be delivered remotely (preferably orally), with no handling of animals
- Would be reversible
- Would require only one shot and would last for more than one breeding season
- Would be safe for use in all stages of pregnancy, causing no abortions
- Would have no significant health side effects
- Would be highly effective >80%
- Would have minimal effects on individual and social behavior
- Would not cause females to experience repeated estrous cycles
- Would be safe for humans to administer and to consume the meat of treated animals
- Would be inexpensive to administer

Currently there are no wildlife contraceptive methods that meet all of these criteria (Turner and Kirkpatrick 1991, Garrott 1995, Fagerstone et al. 2002).

Most contraceptive techniques work in a variety of species, although if a drug is being delivered via injection, dart, or biobullet, this is not a concern. However if an oral contraceptive is developed, it would have to be species specific or some method would have to be devised to prevent non-target species from consuming it.

Surgical sterilization, immunocontraception using PZP or GnRH, and Leuprolide, a GnRH agonist, are safe for predators and scavengers to consume.

The USDA National Wildlife Research Center continues to work on developing effective and safe oral contraceptives. However, these will probably not be available for at least five years (pers. comm., J. Rhyan, Veterinarian, USDA 2003). PZP can be delivered via a dart, but the need to tag huntable animals with a "Do Not Consume" ear-tag requires handling of the animal. GnRH has not yet been delivered by dart, but it is likely that one could be developed soon (pers. comm., J. Rhyan, Veterinarian, USDA, 2003). Surgical sterilization and leuprolide require handling the animals. Delivery of leuprolide via a dart is currently being tested but the results of that test will not be available for at least a year (pers. comm. M. Wild, Veterinarian, NPS, 2003).

PZP, GnRH and leuprolide would be reversible, although there is some concern about PZP becoming permanent after 3 consecutive years (St. Louis Zoo Contraception Advisory Group 2002). Surgical sterilization is permanent.

GnRH requires one shot the first year and lasts 1 to 2 years without a booster (Fagerstone et al. 2002). PZP requires 2 shots the first year and possibly booster shots in subsequent years (pers. comm., J. Kirkpatrick 2002), but Miller and Fagerstone (2000) found that PZP can last 1-4 years in white-tailed deer without boosting in subsequent years. Leuprolide requires one injectible implant and lasts 1 year (Baker et al. 2002).

Only PZP is safe in all stages of pregnancy.

No significant health side effects are known for surgical sterilization, PZP, GnRH, and leuprolide.

Surgical sterilization was 100% effective at preventing pregnancy in horses (Eagle et al. 1993). Leuprolide was 100% effective in preventing pregnancy in elk (Baker et al. 2002). PZP achieved 89% reduction in fertility in white-tailed deer (Miller et al. 1999) and GnRH achieved 86% reduction in fertility of white-tailed deer (Miller et al. 2000).

Having minimal effects on individual and social behavior may be an impossible standard since breeding is a social behavior. Eliminating breeding will eliminate estrous and mating behaviors (at least for some contraceptives), female-young bonds, and associated behaviors (Garrott 1995). In addition, surgical and biochemical sterilization of males can effect the social structure and dominance hierarchy in the herd (Shelley and Anderson 1989).

PZP causes repeated estrous cycling beyond the normal breeding season.

Handling large animals, such as elk and bison, always involves some risks to animals and humans. In addition the drugs used to immobilize animals are dangerous. FCA, the adjuvant that is used with PZP, has not been approved by the FDA for use in animals that may be consumed by humans. Surgically sterilized animals, GnRH, and leuprolide are

safe for use in animals that may be consumed by humans.

Since all four methods of contraception currently under consideration require handling the animals, the contraception program would be labor intensive, requiring a lot of time and a number of staff in addition to the cost of the drugs. PZP also requires two shots the first year and a booster every year thereafter, requiring that treated animals be relocated and vaccinated repeatedly. Therefore, contraception of the Jackson bison herd would not be inexpensive. However, if a dart delivery system for GnRH and leuprolide is developed soon, and if safe adjuvants for PZP and GnRH are approved by the FDA soon, handling of animals would not be necessary for those techniques and that would greatly reduce the time and costs of a contraceptive program.

Potential Application of Contraception in Disease Control

> "Objections have been raised to permanent sterilization, however, because it would result in the permanent removal of those animals from the gene pool and the creation of a new "unnatural" class of animals, i.e. permanently sterile bison."

Genetic concerns about permanent sterilization would also apply to test and cull and to regulated harvest, both of which result in the permanent removal of animals from the gene pool. The permanent removal of animals from the gene pool through permanent sterilization should not be of concern if the population never dips below an effective population size of 400 bison.

"Another alternative is that of reversible contraception. Conceivably this could be used in infected animals, possibly in conjunction with vaccination and/or sustained-release antibiotics, to greatly reduce transmission while not permanently removing the animals from the gene pool.

"Research in the area of wildlife contraception has been largely aimed at developing techniques to control or reduce populations of wildlife that are considered a nuisance or are not native and cannot be controlled by hunting or other conventional means. Examples of target populations in which contraceptive research is ongoing include feral horses, urban deer, feral swine, brown tree snakes (*Boiga irregularis*), prairie dogs (*Cynomys ludovicianus*), and urban Canada geese (*Branta canadensis*). Contraceptive applications for these situations would ideally be remotely delivered to a large proportion of the population."

"An obstacle to fertility control implementation is that considerable research needs to be conducted in bison. Though contraceptive techniques have been developed for other species and preliminary work in bison is promising, further bison trials are needed.

"In conclusion, numerous contraceptive strategies have been and are being developed for various species of wildlife. They offer a means of temporarily preventing pregnancy and parturition."

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APPENDIX C: PLANT AND ANIMAL SPECIES FOUND IN JACKSON HOLE

PLANT SPECIES

An asterisk indicates a nonnative species.

Alfalfa	*Medicago sativa*
Ballhead waterleaf	*Hydrophyllum capitatum*
Bearberry honeysuckle	*Lonicera involucrata*
Bentgrasses	*Agrostis* spp.
Big sagebrush	*Artemisia tridentata*
Birch	*Betula* spp.
Bitterbrush	*Pursia tridentata*
Bluegrasses	*Poa* spp.
Blue Spruce	*Picea pungens*
Brome snakeweed	*Gutierrezia sarothrae*
Buffaloberry	*Shepherdia canadensis*
Bulrushes	*Scripus* spp.
Hard-stemmed bulrush	*Scripus acutus*
Canada goldenrod	*Solidago canadensis*
Cattails	*Typha latifolia*
Chokecherry	*Prunus virginiana*
Columbian monkshood	*Aconitum columbianum*
Creeping foxtail	*Alopecurus arundinaceus*
Crested wheatgrass*	*Agropyron cristatum*
Douglas fir	*Pseudotsuga menziesii*
Douglas rabbitbrush	*Chrysothamnus viscidiflorus*
Engelmann spruce	*Picea engelmannii*
Fern-leaved lovage	*Ligusticum filicinem*
Foxtail barley	*Hordeum jubatum*
Fringed sage	*Artemesia frigida*
Golde-naster	*Heterotheca villosa*
Great basin wildrye*	*Elymus cinereus*
Green rabbitbrush	*Chrysothammus viscidiflous*
Horsetails	*Equisetum* spp.
Horsetail (common)	*Equisetum arvense*
Idaho fescue	*Festuca idahoensis*
Intermediate wheatgrass*	*Elytrigia intermedia*
June grass	*Kieleria macrantha*
Kentucky bluegrass*	*Poa pratensis*
Licorice root	*Glycorrhiza lepidota*
Limber pine	*Pinus flexilisand*
Lodgepole pine	*Pinus contorta*
Meadow foxtail	*Alopecurus aequalis*
Mountain alder	*Alnus incana*
Mountain bluebells	*Mertensia ciliata*
Mountain timothy	*Phleum alpinum*
Muhly	*Muhlenbergia glomerata, M. montana*
Narrowleaf cottonwood	*Populus angustifolia*
Needlegrasses	*Stipa* spp.
Pinegrass	*Calamagrostis rubescens*
Pondweed	*Potamogeton species*
Quaking aspen	*Populus tremuloides*
Red-osier dogwood	*Cornus stolonjfera*
Redtop	*Agrostis stolonj/era*
Reedgrasses	*Calamagrostis species*
Bluejoint reedgrass	*Calamagrostis canadensis*
Reed canarygrass	*Phalaris arundinacea*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Rushes	*Juncus species*
Shrubby cinquefoil	*Pentaphylloides floribunda*
Sedges	*Carex* spp.
Beaked sedge	*Carex utriculata*
Inflated sedge	*Carex vesixaria*
Small-winged sedge	*Carex microptera*
Water sedge	*Carex aquatilis*
Serviceberry	*Amelanchier alnifolia*
Silverberry	*Eleagnus commutata*
Silver sagebrush	*Artemesia cana*
Silvery Lupine	*Lupinus argenteus*
Smooth brome*	*Bromus inermis*
Snakeweed	*Gutierrezia sarothrae*
Snowberry	*Synphoricarpos oreophilus*
Sub-alpine fir	*Abies bifolia*
Tall mountain larkspur	*Delphimiym occidentale*
Thread-leaved sandwort	*Arenaria congesta*
Three-tipped sagebrush	*Artemisia tripartita*
Tufted hairgrass	*Deschampsia cespitosa*
Western Springbeauty	*Claytonia lanceolata*
Western rayless cone-flower	*Rudbeckia occidentalis*
Watercress	*Rorippa* spp.
Wheatgrasses	*Elymus* spp.
Western wheatgrass	*Elymus smithii*
Whitebark pine	*Pinus albicaulis*
Wild rose	*Rosa* spp.
Willows	*Salix* spp.
Bebb's willow	*Salix bebbiana*
Booth's willow	*Salix boothii*
Drummond's willow	*Salix drummongii*
Sandbar willow	*Salix exigua*
Wolf willow	*Salix wolfii*
Yellow willow	*Salix lutea*
Geyer's willow	*Salix geyeriana*
Plane leaf willow	*Salix planifolia*
Yellow salsify	*Tragopogon dubius*

ANIMAL SPECIES

Insectivora

Soricidae

Masked shrew	*Sorex cinereus*
Dusky or montane shrew	*Sorex monticolus*
Dwarf shrew	*Sorex nanus*
Water shrew	*Sorex palustris*
Merriam's shrew	*Sorex merriami*
Vagrant shrew	*Sorex vagrans*

Chiroptera

Verspertilionidae

Little brown myotis	*Myotis lucifugus*
Long-legged myotis	*Myotis volans*
Long-eared myotis	*Myotis evotis*
Small-footed myotis	*Myotis ciliolabrum*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Plecotus townsendii*

Lagomorpha

Ochotonidae

Pika	*Ochotona princeps*

Leporidae

Nuttall's cottontail	*Sylvilagus nutalli*
Snowshoe hare	*Lepus americanus*

Rodentia

Sciuridae

Least chipmunk	*Tamias minimus*
Yellow-pine chipmunk	*Tamias amoenus*
Uinta chipmunk	*Tamias umbrinus*
Yellow-bellied marmot	*Marmota flaviventris*
Uinta ground squirrel	*Spermophilus armatus*
Golden-mantled ground squirrel	*Spermophilus lateralis*
Red squirrel (pine squirrel, chickaree)	*Tamiasciurus hudsonicus*
Northern flying squirrel	*Glaucomys sabrinus*

Geomyidae

Northern pocket gopher	*Thomomys talpoides*

Castoridae

Beaver	*Castor canadensis*

Cricetidae

Deer mouse	*Peromyscus maniculatus*
Bushy tailed woodrat	*Neotoma cinerea*

Arvicolinae (subfamily)

Southern red-backed vole	*Clethrionomys gapperi*
Heather vole	*Phenacomys intermedius*
Meadow vole	*Microtus pennsylvanicus*
Montane vole	*Microtus montanus*
Long-tailed vole	*Microtus longicaudus*
Sagebrush vole	*Lemmiscus curtatus*
Water vole	*Microtus richardsoni*
Richardson's vole	*Microtus richardsoni*
Muskrat	*Ondatra zibethicus*

Murinae (subfamily)

Norway rat	*Rattus norvegicus*
House mouse	*Mus musculus*

Dipodidae

Western jumping mouse	*Zapus princeps*

Erethizontidae

Porcupine	*Erethizon dorsatum*

Carnivora

Canidae

Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*

Ursidae

Black bear	*Ursus americanus*
Grizzly bear	*Ursus arctos*

Procyonidae

Raccoon	*Procyon lotor*

Mustelidae

American marten	*Martes americana*
Fisher	*Martes pennanti*
Ermine (short-tailed weasel)	*Mustela erminea*
Least weasel	*Mustela nivulis*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Wolverine	*Gulo gulo*
Badger	*Taxidea taxus*
Western spotted skunk	*Spilogale gracilis*
Striped skunk	*Mephitis mephitis*
Northern river otter	*Lutra canadensis*

Felidae

Mountain lion	*Puma concolor*
Lynx	*Lynx lynx*
Bobcat	*Lynx rufus*

Artiodactyla

Cervidae

Elk (Wapiti)	*Cervus elaphus*
Mule deer	*Odocoileus hemionus*
White-tailed deer	*Odocoileus virgianus*
Moose	*Alces alces*
Pronghorn	*Antilocarpa americana*

Bovidae

Bison (American buffalo)	*Bison bison*
Mountain goat	*Oreamnos americanus*
Mountain sheep (bighorn sheep)	*Ovis canadensis*

REPRESENTATIVE BIRD SPECIES OF JACKSON HOLE

Hummingbirds

Calliope hummingbird	*Stellula calliope*
Broad-tailed hummingbird	*Selasphorus platycercus*
Rufous hummingbird	*Selasphorus platycercus*

Perching Birds

Western wood-pewee	*Contopus sordidulus*
Willow flycatcher	*Empidonax trailii*
Least flycatcher	*Empidonax minimus*
Dusky flycatcher	*Empidonax oberholseri*
Cordilleran flycatcher	*Empidonax occidentalis*
Western kingbird	*Tyrannus verticalis*
Eastern kingbird	*Tyrannus tyrannus*
Tree swallow	*Tachycineta thalassina*
Violet-green swallow	*Tachycineta thalassina*
Black-capped chickadee	*Poecile atricapilla*
Mountain chickadee	*Poecile gambile*
House wren	*Troglodytes aedon*
Western bluebird	*Sialia mexicana*
Mountain bluebird	*Sialia currucoides*
Veery	*Catharus fuscescens*
Swainson's thrush	*Catharus ustulatus*
Hermit thrush	*Catharus guttatu)*
American robin	*Turdus migratorius*
Gray catbird	*Dumetella carolinensis*
Cedar waxwing	*Bombycilla cedrorum*
European starling	*Sturnus vulgaris*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermivora celat*
Yellow warbler	*Dendroica petechia*
American redstart	*Setophaga ruticilla*
Northern waterthrush	*Seiurus noveboracensis*
MacGillivray's warbler	*Oporornis tolmiei*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler	*Wilsonia pusilla*
Yellow-breasted chat	*Icteria virens*
Western tanager	*Piranga ludoviciana*
Black-headed grosbeak	*Pheucticus melanocephalus*
Lazuli bunting	*Passerina amoena*
Chipping sparrow	*Spizella passerina*
Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospiza lincolnii*
White-crowned sparrow	*Zonotrichia leucophrys*
Dark-eyed junco	*Junco hyemalis*
Brewer's blackbird	*Euphagus cyanocephalus*
Brown-headed cowbird	*Molothrus ater*
Bullock's oriole	*Icterus bullockii*
American goldfinch	*Carduelis tristis*
Western meadowlark	*Sturnella neglecta*
Vesper sparrow	*Pooecetes gramineus*
Savannah sparrow	*Passerculus sandwichensis*
Red-winged blackbird	*Agelaius phoeniceus*
Yellow-headed blackbird	*Xanthocephalus xantho-cephalus*
Brewer's sparrow	*Spizella breweri*
Black-billed magpie	*Pica hudsonia*
Common raven	*Corvus corax*
Common crow	*Corvusbrachyrhynchos*

Woodpeckers

Lewis' woodpecker	*Melanerpes lewis*
Red-naped sapsucker	*Sphyrapicus nuchalis*
Williamson's sapsucker	*Sphyrapicus thyroideus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*

Gallinaceous Birds

Blue grouse	*Dendragapus obscurus*
Ruffed grouse	*Bonasa umbellus*
Sage grouse	*Centrocercus urophasianus*

Waterfowl

Trumpeter swan	*Cygnus buccinator*
Tundra swan	*Cygnus columbianus*
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Green-winged teal	*Anas crecca*
Gadwall	*Anas strepera*
American widgeon	*Anas americana*
Common Golden-eye	*Bucephala clangula*
Barrow's golden-eye	*Bucephala islandica*
Common merganser	*Mergus merganser*
Ringed-neck duck	*Aythya collaris*
Cinnamon teal	*Anas cyanoptera*

Shorebirds

Black-necked stilt	*Himantopus mexicanus*
American avocet	*Recurvirostra americana*
Semipalmated plover	*Charadrius semipalmatus*
Mountain plover	*Eupoda montana*
Killdeer	*Charadrius vociferus*
Long-billed curlew	*Numenius americanus*
Common snipe	*Capella gallinago*
Willet	*Catoptrophorus semipalmatus*
Western sandpiper	*Ereubetes mauri*

Rails and Coots

Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
Yellow rail	*Coturnicops noveboracensis*
American coot	*Fulica americana*

Cranes

Sandhill crane	*Grus canadensis*

Bitterns and Herons

Great blue heron	*Ardea herodias*
American bittern	*Botaurus lentiginosus*

Black-crowned night heron	*Nycticorax nycticorax*
Snowy egret	*Leucophoyx thula*
Cattle egret	*Bubulcus ibis*

Raptors

Bald eagle	*Haliaeetus leucocephalus*
Golden eagle	*Aquila chrysaetos*
Peregrine falcon	*Falco peregrinus*
American kestral	*Falco sparverius*
Osprey	*Pandion haliaetus*
Red-tailed hawk	*Buteo jamaicensis*
Northern harrier	*Circus cyaneus*

Owls

Great grey owl	*Strix nebulosa*
Great-horned owl	*Bubo virginianus*
Burrowing owl	*Athene cunicularia*
Western screech owl	*Otus kennicottii*
Barn owl	*Tyto alba*

Seabirds

White pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*
Eared grebe	*Podiceps caspicus*

Gulls and Terns

Franklin's gull	*Larus pipixcan*
Bonaparte's gull	*Larus philadelphia*
Caspian tern	*Sterna caspia*
Black tern	*Chlidonias niger*

APPENDIX D: COMPATIBILITY DETERMINATION FOR BISON HUNTING PROGRAMS

Draft

Use: Bison Hunting Program for the General Public and a Bison reduction Program for Tribal Members

Refuge Name: National Elk Refuge, Teton County, Wyoming

Refuge Purposes and Establishing Authority:

"...the establishment of a winter game (elk) reserve..." Stat. 293, dated Aug. 10, 1912

"For the establishment and maintenance of a winter elk refuge in the State of Wyoming..." 37 Stat. 847, dated March 4, 1913

"...all lands that now are or may hereafter be included within the boundaries of...the Elk Refuge, Wyoming,...are hereby further reserved and set apart for the use of the Department of [Interior] as refuges and breeding grounds for birds" Executive Order 3596, dated Dec. 22, 1921

"...for the use of the Secretary of [the Interior] as a refuge and breeding grounds for birds..." Executive Order 3741, dated September 20, 1922

"...for grazing of, and as a refuge for, American elk and other big game animals..." Stat. 1246, dated Feb. 25, 1927

"...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." Fish and Wildlife Act of 1956

"...suitable for – (1) incidental fish and wildlife-oriented recreational development. (2) the protection of natural resources. (3) the conservation of endangered species or threatened species..." 16 USC 460k-1 (Refuge Recreation Act of 1962)

National Wildlife Refuge System Mission:

"...to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats, of the United States for the benefit of present and future generations of Americans." Pub. Law 105-57, Oct 9, 1997

Description of Use:

Implementation of a bison hunting program for the general public licensed by Wyoming Game and Fish Department and a bison reduction program for Native American tribes historically associated with the Jackson Hole area. Both the hunt and the reduction program are being instituted for the purpose of removing surplus bison as determined in the Bison and Elk Management Plan/EIS.

General Public Hunt - Hunters will be required to meet all State of Wyoming requirements for the hunting of bison, including rifle caliber, wearing of hunter orange clothing, reporting of kills, and providing biological samples for disease testing and genetic analyses.

Hunters must show evidence of having passed a state sponsored and approved hunter safety course.

Hunters will be provided instructional materials on identification of sex and age of bison in the field to enhance selection of the type of animal that their permit specifies.

Bison hunting for the general public will occur on the refuge at approximately the same time that elk hunting for the general public is occurring.

The National Elk Refuge program will be highly managed. Members of the general public wishing to hunt on the refuge must have a valid State of Wyoming Bison Hunting License, and a valid Hunter Safety Card (or certification) or a current Hunter Safety Instructor Card issued by a state. While hunting on the refuge, individuals must also possess a Wyoming Conservation Stamp.

Hunt dates, bag limits, hunter quotas, and any adjustments to Refuge Hunt Zones will be determined on an annual basis, in consultation with Wyoming Game and Fish Department.

Bison Reduction by Tribes - Bison will be available to tribal members from July until the end of the elk hunting season. Native American tribal members may harvest no more than five bison unless the Wyoming Game and Fish Department requests that more animals be made available due to insufficient harvest.

Tribal hunters will observe all the usual regulations regarding bison hunting including rifle caliber, wearing of hunter orange clothing, reporting of kills, and providing biological samples for disease testing and genetic analyses.

All special National Elk Refuge regulations governing personal conduct during elk hunting shall apply to both the general public hunters and tribal members.

The National Elk Refuge Manager has the authority to close hunting seasons to prevent resource (soil and vegetation) damage during inclement weather or to insure public safety.

Availability of Resources:

It is anticipated that annual planning and execution of the proposed bison hunting and reduction programs will require approximately 95 staff-days of work, spread among the Refuge Manager, Biological, Visitor Services and Law Enforcement staff and cost approximately $26,000 to operate. Refuge resources are expected to be augmented by the services and volunteers and partnership with Wyoming Game and Fish Department personnel.

Anticipated Impacts:

Impacts on U. S. Fish and Wildlife Service lands, waters or interests will be limited to permitting hunters and tribal members to access closed areas of the refuge to pursue, harvest and remove bison. An annual elk hunting program has been conducted on the National Elk Refuge for over 50 years. The general public bison hunt is anticipated to largely occur concurrently with elk hunting to limit disturbance to other wildlife to the same period of time.

The bison hunting and reduction programs have minimal potential impacts on refuge wildlife, but significant beneficial impacts on the soil and flora of the refuge. See Bison and Elk Management Plan/EIS. Hunting has a positive impact on habitats by controlling ungulate grazing and browsing pressure by reducing the number of bison that forage on the refuge in the winter.

Direct negative impacts of the hunting program on most wildlife will be minimal because hunting occurs in the fall when breeding and nesting seasons are over. Most neotropical birds have migrated to their wintering grounds. Any disturbance impacts on most predators and scavengers including threatened and endangered species will be far outweighed by the increase in food in the form of gut piles and carcass remains. Migrating bald eagles and other raptors, in particular, benefit from this food source (Griffin 2002, pers. comm.). Grizzly bears and wolves could benefit from this food source in the future if these species begin to occur on the refuge with greater frequency.

Implementing a general public hunt and a bison reduction program on the refuge will affect bison movements, distribution, and behavior once bison understand that traditionally safe areas are no longer safe. Bison will move away from hunt areas to non-hunt areas on the refuge and in the park. Bison hunting in the northern end of the refuge may encourage bison to move south, possibly into the town of Jackson. If they move to private

lands, the Wyoming Game and Fish Department would have the prerogative to haze or destroy them because of safety or damage concerns. Hunting will also increase agitation, nervousness and energetic expenditures associated with fleeing from hunters and the sounds of weapons firing and possibly lowers nutrition because bison will stop foraging while being displaced from these areas (Smith 2003, pers. comm.).

The refuge is bordered by public lands to the north and east, i. e. Grand Teton National Park and Bridger Teton National Forest. Fencing on the western and southern boundaries of the refuge is designed to prevent ungulates from moving onto private lands and crossing Highway 89. Bison will continue to be able to move freely between the refuge and adjacent public lands.

Public Review and Comment:

This draft Compatibility Determination will be presented for public review and comment in conjunction with the public comment period for the Draft Bison and Elk Management Plan/EIS in the spring of 2005.

Compatibility Determination:

Using sound professional judgment (603 FW 2.6U., and 2.11A), place an "X" in appropriate space to indicate whether the use would or would not materially interfere with or detract from the National Wildlife Refuge System Mission or the Purposes of the National Elk Refuge.

___ Use is Not Compatible

X Use is Compatible

Stipulations Necessary to Ensure Compatibility:

The following stipulations would allow the bison hunting and reduction programs to be compatible from the standpoint of direct and short-term effects on the ability of the USFWS to fulfill the NWRS mission and the purposes of the refuge:

Weapons will be limited to rifles. No archery or handguns will be allowed.

Justification:

Jackson Hole has the second largest free-ranging bison herd in the United States and the largest herd within the National Wildlife Refuge System. The current Jackson bison herd is more than 400 animals above the Wyoming Game and Fish Department's objective, and the Wyoming Game and Fish Department conducts a sport hunt for bison on Bridger-Teton National Forest in an effort to reduce herd numbers. Because few bison move outside the boundaries of the refuge and the park, the Wyoming Game and Fish Department has had difficulty in achieving its bison herd objective. The bison hunt and reduction programs on the refuge would assist the state in achieving this objective.

The National Elk Refuge, Grand Teton National Park, and Wyoming Game and Fish Department jointly manage the Jackson bison herd. The herd currently numbers approximately 800 animals and increases at a rate of 14%–15% annually, largely because of low winter mortality. The herd winters on the refuge and consumes pelleted alfalfa hay. Winter range for bison is limited due to human occupation of winter range that is now cattle ranchlands and subdivisions. Therefore, the size of the bison herd must be controlled to prevent habitat damage and to reduce the potential for disease transmission.

Annual censuses of the bison herd are conducted each summer to determine calf production, and each winter to determine population size, age and sex composition, and recruitment. Two independent evaluations of the bison herd's population genetics have established that a herd of 400 bison is sufficiently large to insure that the herd's genetic diversity will be protected (Shell and Anderson 1989, Berger 1996). The herd would be allowed to range from approximately 450 to 500 bison post-hunt.

Annual censuses of bison and elk are conducted on the National Elk Refuge each winter. Almost every winter that 7,000 or more elk (plus varying numbers of bison, mule deer and moose) have wintered on the refuge, forage supplies have been depleted and supplemental feeding has been necessary (NER Files). Clearly, the refuge

capacity to support large ungulates is being exceeded. This jeopardizes the long-term health of plant communities and their ability to support a diverse fauna. It also places elk, bison and other species at risk of increased susceptibility to disease.

Forage utilization survey's conducted each spring on the NER, indicate that use of herbaceous forage on the southern half of the refuge has consistently exceeded 50% in recent years. In the McBride management unit, where the bison spend much of their 6 months on the Refuge, forage utilization rates have averaged more than 70% during the past 15 years (NER Files). Changes in plant communities have also occurred, particularly in the cottonwood habitats along upper Flat Creek and in the sagebrush community in Long Hollow. Excessive browsing by elk and bison has prevented regeneration in aspen and cottonwood habitats. Willow, serviceberry, chokecherry, currant and other shrubs are also heavily browsed and declining in vigor, particularly on the southern half of the refuge (Smith, Cole, and Dobkin 2004a). In addition, nonnative invasive plant species are increasing in NER grassland habitats and reducing the carrying capacity for herbivores. As a result, a concerted effort has been made in recent years to reduce the size of the wintering elk herd. Likewise, the size of the bison herd must be controlled to reduce negative effects on Refuge plant communities and other wildlife species that use these habitats.

The Jackson bison herd is infected with brucellosis and may pose some level of risk of infection to livestock. As a result, surplus bison can not be trapped and relocated to other areas outside of Jackson Hole. Brucellosis and other contagious bovine diseases are far more likely to spread and be maintained in a herd under the crowded conditions experienced on the National Elk Refuge in the winter. Bovine tuberculosis, in particular, could cause extensive losses in Jackson bison, threaten the health and welfare of area cattle, elk and other wildlife, and pose a significant human health risk, should this disease infect the bison herd. Lower numbers of bison combined with fewer years of feeding may reduce the risk of disease transmission among bison and from bison to cattle, other wildlife, and humans.

Hunting is a form of wildlife-dependent recreation and is considered to be a priority use of the National Wildlife Refuge System (Refuge Improvement Act 1997). As stated above, hunting helps control ungulate populations, and provides scientific data for surveillance of the bison populations for brucellosis and other diseases.

Literature Cited and Personal Communications

Berger, J.
1996 "Scenarios Involving Genetics and Population Size of Bison in Jackson Hole." On file at Grand Teton National Park, Moose, WY.

Griffin, J., Refuge Operations Specialist, U. S. Fish and Wildlife Service, Jackson, WY
2002 Personal communication regarding bald eagles on the National Elk Refuge.

National Elk Refuge Files
1990–2004 Annual Censuses of Bison and Elk. National Elk Refuge, Jackson, WY.

1990–2004 Forage Utilization Reports. National Elk Refuge, Jackson, WY.

Shelley, K. J. and S. H. Anderson.
1989 "A Summary on Genetics and Sterilization in a Free Ranging Herd of Bison near Jackson, Wyoming." Wyoming Cooperative Fishery and Wildlife Research Unit Report for the Wyoming Game and Fish Department. Cheyenne, WY.

Smith B. L., Wildlife Biologist, U. S. Fish and Wildlife Service, Jackson, WY
2003 Personal communication regarding wildlife and hunting on the National Elk Refuge.

Smith, B. L., E. K. Cole, and D. S. Dobkin
2004 *Imperfect Pasture: The National Elk Refuge.* Jackson, WY: Grand Teton National Park Natural History Association.

Compatibility Determination

Mandatory Re-Evaluation Date (provide month and year for "allowed" uses only):

___ Mandatory 15-year Re-Evaluation Date (for priority public uses)

___ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

___ Categorical Exclusion without Environmental Action Statement

___ Categorical Exclusion and Environmental Action Statement

___ Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

Determination

Prepared by Refuge Manager: _____ _____
(Signature) (Date)

Concurrence

Regional Chief, National Wildlife Refuge System: _____ _____
(Signature) (Date)

APPENDIX E: COMPATIBILITY DETERMINATION FOR THE ELK HUNTING PROGRAM

Draft

Use: Elk Hunting Program

Refuge Name: National Elk Refuge, Teton County, Wyoming

Refuge Purposes and Establishing Authority:

"...the establishment of a winter game (elk) reserve..." Stat. 293, dated Aug. 10, 1912

"For the establishment and maintenance of a winter elk refuge in the State of Wyoming..." 37 Stat. 847, dated March 4, 1913

"...all lands that now are or may hereafter be included within the boundaries of...the Elk Refuge, Wyoming,...are hereby further reserved and set apart for the use of the Department of [Interior] as refuges and breeding grounds for birds" Executive Order 3596, dated Dec. 22, 1921

"...for the use of the Secretary of [the Interior] as a refuge and breeding grounds for birds..." Executive Order 3741, dated September 20, 1922

"...for grazing of, and as a refuge for, American elk and other big game animals..." Stat. 1246, dated Feb. 25, 1927

"...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." Fish and Wildlife Act of 1956

"...suitable for – (1) incidental fish and wildlife-oriented recreational development. (2) the protection of natural resources. (3) the conservation of endangered species or threatened species..." 16 USC 460k-1 (Refuge Recreation Act of 1962)

National Wildlife Refuge System Mission:

"...to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats, of the United States for the benefit of present and future generations of Americans." Pub. Law 105-57, Oct.9, 1997

Description of Use:

The Refuge will administer an elk hunting program for youth and members of the general public.

A maximum of 70 hunter/participants would be allowed on the refuge at one time. There will be two hunts per year (one for youth and one for the general public). The youth hunt will last for 1 weekend, including a Saturday and Sunday. Youth hunters will be accompanied by an experienced non-hunting adult. General public hunts will be scheduled in accordance with Wyoming Game and Fish regulations.

Hunters will be required to meet all State of Wyoming requirements for the hunting of elk, including rifle caliber, wearing of hunter orange clothing, reporting of kills, and providing biological samples for disease testing and genetic analyses.

The National Elk Refuge hunt program will be highly managed. A Refuge Hunting Permit is required, which is obtained by participation in a weekly public drawing. Individuals wishing to draw for a Refuge Hunting Permit must be present at the drawing, possess a valid State of Wyoming Elk Hunting License, and a valid Hunter

Safety Card (or certification) or a current Hunter Safety Instructor Card issued by a state. While hunting on the refuge, individuals must also possess a Wyoming Conservation Stamp and a Wyoming Elk Feedground Special Management Permit.

Hunt dates, bag limits, hunter quotas, and any adjustments to Refuge Hunt Zones will be determined on an annual basis, in consultation with the Wyoming Game and Fish Department.

Availability of Resources:

It is anticipated that annual planning and execution of the proposed hunting program will require approximately 105 staff-days of work, spread among the Refuge Manager, Biological, Visitor Services and Law Enforcement staff and cost approximately $26,000 to operate. Refuge resources are expected to be augmented by the services and volunteers and partnership with Wyoming Game and Fish Department personnel.

Anticipated Impacts:

Impacts on U. S. Fish and Wildlife Service lands, waters or interests will be limited to permitting hunters to access closed areas of the refuge to pursue, harvest and remove elk. An annual elk hunting program has been conducted on the National Elk Refuge for over 50 years.

Hunting on the refuge does affect elk movements, distribution and behavior. Many elk move quickly through hunt areas to non-hunt areas on the refuge and in the park, sometimes traveling through the hunt areas during the night. Hunting also increases agitation, nervousness and energetic expenditures associated with running from hunters and the sounds of weapons firing and possibly lowers nutrition because elk will stop foraging while running from these areas (Smith 2003 pers. comm.). Changing the areas where hunting is allowed from one year to the next may increase these impacts as elk have to learn where the safe zones are every year.

Woody riparian vegetation in the northern half of the refuge benefits from hunting because elk quickly move through that area in the fall and therefore do not heavily browse aspen, willow and cottonwood habitats. However, it is browsed heavily later in the year after hunting ends and when snow depth does not prevent foraging in that area (Cole 2004 pers. comm.).

The hunt zone in the northern section of the refuge represents approximately 15,000 acres of transitional range that is lightly used because elk move quickly through to the safe zones on the southern section of the refuge, compounding already heavy grazing pressure on approximately 10,000 acres of native grasslands, wet meadows, and cultivated fields. In most years, by the time hunting season is over, snow prevents elk from returning to the northern section of the refuge to forage. Therefore grasses on the northern section of the National Elk Refuge get little use except in the spring when the elk are moving back into the park and the national forest, or in winters with below average snow accumulation.

Direct negative impacts of the hunting program on other wildlife will be minimal because hunting occurs in the fall when breeding and nesting seasons are over. Most neotropical birds have migrated to their wintering grounds. Any disturbance impacts on most predators and scavengers will be far outweighed by the increase in food in the form of gut piles and carcass remains. Migrating bald eagles and other raptors, in particular, benefit from this food source (Griffin 2002 pers. comm.). Grizzly bears and wolves could benefit from this food source in the future if these species begin to occur on the refuge with greater frequency.

The refuge is bordered by public lands to the north and east, i. e. Grand Teton National Park and Bridger-Teton National Forest. Fencing on the western and southern boundaries of the refuge is designed to prevent elk from moving onto private lands and crossing Highway 89. Elk will continue to be able to move freely between the refuge and adjacent public lands.

To date all harvested elk that have been tested on the National Elk Refuge have tested negative for chronic wasting disease. The percentage of hunter-killed elk that have been tested is unknown due to many hunters choosing not to participate in the testing program. Under the Region 6 Chronic Wasting Disease Policy, it will be necessary to continue surveillance of the refuge herds for occurrence and prevalence of chronic wasting disease. Hunter-harvested deer and elk will provide data for this surveillance requirement.

Jackson Hole has the largest wintering elk herd in North America. The current Jackson elk herd is more than 2,000 animals above the Wyoming Game and Fish Department's objective, and the Wyoming Game and Fish Department has taken aggressive action in recent years to reduce the herd through sport hunting. The hunt program on the refuge is helping the state achieve its elk herd objective goals.

Public Review And Comment:

This draft Compatibility Determination will be presented for public review and comment in conjunction with the public comment period for the Draft Bison and Elk Management Plan/EIS in the spring of 2005.

Compatibility Determination:

Using sound professional judgment (603 FW 2.6U., and 2.11A), place an "X" in appropriate space to indicate whether the use would or would not materially interfere with or detract from the National Wildlife Refuge System Mission or the Purposes of the National Elk Refuge.

__ Use is Not Compatible

X Use is Compatible

Stipulations Necessary to Ensure Compatibility:

The following stipulations would allow the elk hunting program to be compatible from the standpoint of direct and short-term effects on the ability of the USFWS to fulfill the NWRS mission and the purposes of the refuge:

Weapons will be limited to rifles. No archery or handguns will be allowed.

Justification:

Hunting is a form of wildlife-dependent recreation and is considered to be a priority use of the National Wildlife Refuge System (Refuge Improvement Act 1997). Hunting helps control ungulate populations, and provides scientific data for surveillance of refuge elk populations for chronic wasting disease.

Personal Communications

Cole, E. K., Wildlife Biologist, U.S. Fish and Wildlife Service, Jackson, WY
2004 Personal communication regarding elk and habitat on the National Elk Refuge.

Griffin, J., Refuge Operations Specialist, U. S. Fish and Wildlife Service, Jackson, WY
2002 Personal communication regarding bald eagles on the National Elk Refuge.

Smith B. S., Wildlife Biologist, U. S. Fish and Wildlife Service, Jackson, WY
2003 Personal communication regarding elk and hunting on the National Elk Refuge.

Compatibility Determination

Mandatory Re-Evaluation Date (provide month and year for "allowed" uses only):

___ Mandatory 15-year Re-Evaluation Date (for priority public uses)

___ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

___ Categorical Exclusion without Environmental Action Statement

___ Categorical Exclusion and Environmental Action Statement

___ Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

Determination

Prepared by
Refuge Manager _____ _____
(Signature) (Date)

Concurrence

Regional Chief,
National Wildlife
Refuge System: _____ _____
(Signature) (Date)

APPENDIX F: COMPATIBILITY DETERMINATION FOR PUBLIC USE ON THE SOUTHERN PART OF THE REFUGE

Draft

Use: Wildlife Viewing and Photography on the Southern Part of the Refuge

Refuge Name: National Elk Refuge, Teton County, Wyoming

Refuge Purposes and Establishing Authority:

"...the establishment of a winter game (elk) reserve..." Stat. 293, dated Aug. 10, 1912

"For the establishment and maintenance of a winter elk refuge in the State of Wyoming..." 37 Stat. 847, dated March 4, 1913

"...all lands that now are or may hereafter be included within the boundaries of...the Elk Refuge, Wyoming,...are hereby further reserved and set apart for the use of the Department of [Interior] as refuges and breeding grounds for birds" Executive Order 3596, dated Dec. 22, 1921

"...for the use of the Secretary of [the Interior] as a refuge and breeding grounds for birds..." Executive Order 3741, dated September 20, 1922

"...for grazing of, and as a refuge for, American elk and other big game animals..." Stat. 1246, dated Feb. 25, 1927

"...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." Fish and Wildlife Act of 1956

"...suitable for – (1) incidental fish and wildlife-oriented recreational development. (2) the protection of natural resources. (3) the conservation of endangered species or threatened species..." 16 USC 460k-1 (Refuge Recreation Act of 1962)

National Wildlife Refuge System Mission:

"...to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats, of the United States for the benefit of present and future generations of Americans." Pub. Law 105-57, Oct.9, 1997

Description of Use:

The Refuge will administer a public use program on the southern part of the National Elk Refuge that is now closed to hunting. This zone would continue to be closed to hunting, but the public will be allowed to access this area for the purpose of viewing and photographing wildlife for a period of time during the autumn. Hunters would not be allowed to access areas of the refuge outside of the hunt zone on days when they hold permits for hunting.

Availability of Resources:

It is anticipated that annual planning and execution of the proposed hunting program will require approximately 10 staff-days of work, spread among the Refuge Manager, Biological, Visitor Services and Law Enforcement staff and cost approximately $2,500 to operate.

Anticipated Impacts:

Impacts on U. S. Fish and Wildlife Service lands, waters or interests will be limited to permitting the public to access a formerly closed area of the refuge to view and photograph wildlife.

Wildlife viewers and photographers on the refuge will affect elk movements, distribution and behavior. Many elk that avoid hunters by foraging in the southern section of the refuge during the hunt season may run into the hunt area and may be shot by sportsmen. The presence of wildlife viewers will increase agitation, nervousness and energetic expenditures associated with being displaced by people and would possibly lower nutrition because elk may stop foraging while leaving this area (Smith 2003, pers. comm.). Changing the areas from a formerly people-free zone to an area where elk may encounter numerous people may increase these impacts as elk would have no refuge from people for a period of time each year.

A larger number of elk would likely be harvested as a result of opening this area to the public.

Ethical issues may arise if hunters arrange for friends to walk within the wildlife viewing area specifically for the purpose of running elk or bison into the hunt zone to be killed by waiting riflemen (Brock 2004, pers. comm.).

Grazing pressure in the Nowlin area and in parts of the marsh may be alleviated somewhat by keeping elk out of these areas for 2 weeks to a month each year (Cole 2004, pers. comm.).

Increased access by the public to areas that are usually closed would increase the dispersal of nonnative invasive plant species.

Bald eagles, other raptors, trumpeter swans and other migrating waterfowl would likely be disturbed by wildlife viewers and photographers approaching too closely to resting areas (DeLong 2002). This may have energetic costs associated with heightened alertness, nervousness, interrupted feeding, and repeatedly taking flight. Some birds may seek out other areas to rest or hunt.

If bison are present in the southern part of the refuge, wildlife viewers on foot may be endangered, as bison are not as likely to flee and may even charge people who approach too closely. If a bison hunt is initiated in the northern section of the refuge, bison are likely to seek the safety of the no-hunting zone with increasing frequency.

Stray bullets from hunters shooting at elk running into the no-hunting zone may endanger wildlife viewers and photographers that are walking near the hunt-zone boundary.

Public Review And Comment:

This draft Compatibility Determination will be presented for public review and comment in conjunction with the public comment period for the Draft Bison and Elk Management Plan/EIS in the spring of 2005.

Compatibility Determination:

Using sound professional judgment (603 FW 2.6U., and 2.11A), place an "X" in appropriate space to indicate whether the use would or would not materially interfere with or detract from the National Wildlife Refuge System Mission or the Purposes of the National Elk Refuge.

__ Use is Not Compatible

X Use is Compatible

Stipulations Necessary to Ensure Compatibility:

The following stipulations would allow the wildlife viewing program to be compatible from the standpoint of direct and short-term effects on the ability of the USFWS to fulfill the NWRS mission and the purposes of the refuge:

Dogs would not be allowed in the interior of the southern part of the refuge. Dogs on leash would only be allowed on Refuge Road as they are currently.

Bicycles would not be allowed in the interior of the southern part of the refuge. Bicycles would only be allowed on Refuge Road as they are currently.

Viewing of wildlife would only be allowed during daylight hours.

Justification:

Wildlife viewing and photography are forms of wildlife-dependent recreation and are considered to be a priority use of the National Wildlife Refuge System (Refuge Improvement Act 1997).

Literature Cited and Personal Communications

DeLong, A. K.
2002 "Managing Visitor Use and Disturbance of Waterbirds — A Literature Review of Impacts and Mitigation Measures." Prepared for Stillwater National Wildlife Refuge Complex. Appendix L in the *Stillwater National Wildlife Refuge Complex Final Environmental Impact Statement for the Comprehensive Conservation Plan and Boundary Revision.* Vol. 2. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon.

Brock, S., Deputy Manager, National Elk Refuge U.S. Fish and Wildlife Service, Jackson, WY
2004 Personal communication regarding elk and hunting on the National Elk Refuge.

Cole, E. K., Wildlife Biologist, U.S. Fish and Wildlife Service, Jackson, WY
2004 Personal communication regarding elk and habitat on the National Elk Refuge.

Smith B. S., Wildlife Biologist, U. S. Fish and Wildlife Service, Jackson, WY
2003 Personal communication regarding wildlife and hunting on the National Elk Refuge.

Compatibility Determination

Mandatory Re-Evaluation Date (provide month and year for "allowed" uses only):

___ Mandatory 15-year Re-Evaluation Date (for priority public uses)

___ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

___ Categorical Exclusion without Environmental Action Statement

___ Categorical Exclusion and Environmental Action Statement

___ Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

Determination

Prepared by Refuge Manager: _____ _____
(Signature) (Date)

Concurrence

Regional Chief, National Wildlife Refuge System: _____ _____
(Signature) (Date)

APPENDIX G: COMPATIBILITY DETERMINATION FOR ELK VACCINATION USING STRAIN 19

Draft

Use: Vaccination of Calf and Cow Elk Using Strain 19 by the Wyoming Game and Fish Department

Refuge Name: National Elk Refuge, Teton County, Wyoming

Refuge Purpose(s) and Establishing and Acquisition Authority(ies):

"...the establishment of a winter game (elk) reserve..." 37 Stat. 293, dated Aug. 10, 1912

"For the establishment and maintenance of a winter elk refuge in the State of Wyoming..." 37 Stat. 847, dated March 4, 1913

"... all lands that now are or may hereafter be included within the boundaries of ...the Elk Refuge, Wyoming, ...are hereby further reserved and set apart for the use of the Department of [Interior] as refuges and breeding grounds for birds" Executive Order 3596, dated Dec. 22, 1921

"...for the use of the Secretary of [the Interior] as a refuge and breeding grounds for birds..." Executive Order 3741, dated September 20, 1922

"...for grazing of, and as a refuge for, American elk and other big game animals..." 44 Stat. 1246, dated Feb. 25, 1927

"...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." (Fish and Wildlife Act of 1956)

"...suitable for— (1) incidental fish and wildlife-oriented recreational development. (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..." 16 USC 460k-1 (Refuge Recreation Act of 1962)

National Wildlife Refuge System Mission:

The Refuge System Mission is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:

The Wyoming Game and Fish Department (WGFD) would conduct a brucellosis vaccination program for elk on the NER. As part of the program, they would administer Strain 19 vaccine to elk calves and cows early in the feeding season before extensive exposure to field strain *Brucella abortus* occurs. Each year the vaccination program would be conducted in two phases: acclimation and vaccination. Implementation of vaccination would begin soon after winter feeding is initiated in the winter in those years when the refuge feeds. Vaccination procedures would be carried out as described below.

Feeding Operations. In those years when feeding operations are carried out on the refuge, the NER would continue to conduct supplemental feeding as they have in the past, with the following exceptions. To facilitate the vaccination operation, feedlines would be spaced somewhat further apart than currently practiced. Feedlines would be spaced up to 50 yards apart to provide a maximum shooting range of 25-30 yards when the vaccination team drives the over-the-snow vehicle between feedlines. If any adjustments to the feeding protocol are

needed to increase the successful vaccination of calves and cows, the USFWS and WGFD would work together to determine the best course of action. No significant changes to feeding operations would be undertaken. Adjustments would not be made that would adversely affect the elk. Long hay would not be used.

WGFD's vaccination program on the NER would not affect the USFWS decisions, in cooperation with the WGFD, in a given winter related to (1) when to begin winter feeding, (2) how long feeding is conducted (number of days in a given winter), or (3) whether feeding is carried out or not carried out in a given winter.

Vehicle. The WGFD would use a tracked over-the-snow vehicle (LMC 1500 Beartrac or equivalent) to follow feed trucks during feeding operations to acclimate elk and to provide a vehicle from which to administer the vaccine. The WGFD owns one Beartrac vehicle. If WGFD rents a second oversnow vehicle or secures access to another oversnow vehicle, then two teams would vaccinate elk. The WGFD and USFWS would work together in determining the best vehicle to use. The vehicle combination that disrupts feeding operations the least, disturbs elk the least, and provides the most effective platform to shoot from would be used.

Acclimation. Elk would be allowed to become accustomed to normal winter feeding operations. This would also allow calves to fully participate in the feeding program as they usually require a week to become accustomed to the feeding equipment and routine.

Beginning soon after the onset of supplemental feeding, WGFD technicians would begin to acclimate elk to the presence of the Beartrac vehicle, the two-person team (one to drive the vehicle and one to vaccinate), the report of an air-gun, and other sounds and actions associated with vaccination. Guns (vaccine and paintball) would be dry-fired at varying velocities to acclimate elk to the report of the gun as the support vehicle passes along the feedlines. Devices that sound similar to the vaccination equipment might be used during initiation of the acclimation period.

At the beginning of the acclimation period, acclimation activities would be carried out while feed trucks are dispensing pellets. Ideally, acclimation activities would be performed at two feeding sites each day. As the animals become accustomed to the presence of the support vehicle, two-person team, and the vaccination guns, the vehicles would spend progressively longer amounts of time in the vicinity of the feedlines and closer to the elk. Detailed notes on elk behavior would be recorded during the acclimation process. The acclimation period could require from several hours up to several weeks. Due to the unknown response of elk, the duration of the acclimation period cannot be predicted at this time. The determination of when to cease the acclimation period and begin vaccinating would be somewhat subjective, but would require elk to remain within 50–75 feet of the support vehicle as it passes along a feedline and occasionally comes to a stop.

Vaccination of Elk. Vaccination would begin when the WGFD determines that elk are sufficiently acclimated to the two-person team, additional vehicle, and discharge of firearms and that elk would remain within 50–75 feet of vehicle holding the two-person team. The protocol for vaccination would mimic that for acclimation of elk except that (1) an air-powered biobullet gun would be used to ballistically inject biobullet containing approximately 5.3×10^9 colony-forming units of freeze-dried Strain 19 vaccine, and (2) an air-powered paintball gun would be used to mark each vaccinated animal with an oil-based paint to ensure that it is not vaccinated more than once.

The support vehicle would continue to be operated the same way it was operated during the acclimation period, which includes occasional stops. Ideally, two vaccination teams would be used so that vaccination could be carried out at two or more feeding sites each day. Vaccination would target juvenile elk at each of the four feeding sites, but would also include adult female elk. Adult cow elk would also be vaccinated to more quickly increase the number of animals in the population that are vaccinated with Strain 19.

During the first few winters of the program, an attempt would be made to vaccinate at least 80% of elk calves, and possibly as many as 50% or more of the adult female elk. This means that approximately 1,200 calves and 2,000 cows (or, a total of about 3,200 elk) would have to be vaccinated each year. The time required to complete vaccination in a given winter cannot be predicted due to the unknown response of elk on the NER. In 2002, the average vaccination time on state feedgrounds was 20 calves per hour (range: 7–57).

Timing and Duration of the Use. The vaccination program would be conducted simultaneous with winter feeding activities that generally begin in January or February and continue through April.

Location of the Use. Vaccination of elk would be carried out in the same locations that winter feeding is conducted on the NER, which encompass three habitat types: cultivated fields, grasslands, and sagebrush. Plant communities within these habitat types are described in the environmental assessment. Any changes in elk or bison behavior resulting from vaccination activities or adjustments in winter feeding to accommodate vaccination could also potentially affect vegetation in other habitat types such as riparian and deciduous woodlands (e.g., willow, aspen, and cottonwood) and wet meadows that are found near feeding sites. Riparian and deciduous woodland habitat is currently in a degraded condition due to decades of overbrowsing by elk and more recently by bison.

Besides elk, bison are the only other wildlife species that feed at feedlines. Other wildlife species that can be found in or near feeding areas include coyotes, bald eagles, golden eagles, common ravens, common crows, and black-billed magpies. These species scavenge on elk and bison carcasses. Occasionally, gray wolves visit the NER and have been observed to kill elk.

Typical bird species that nest in riparian and deciduous woodland habitats are Lincoln's sparrows, MacGillivray's warblers, orange-crowned warblers, black- headed grosbeaks, and lazuli buntings. Wet meadows and associated wetlands are important for trumpeter swans, Canada geese, mallards, green-winged teal, gadwalls, American widgeons, common and Barrow's goldeneyes, common mergansers, greater sandhill cranes, and a variety of shorebirds and other birds.

Reason for the Use. The WGFD's purpose in vaccinating elk against brucellosis is to increase coverage and protection of feedground elk in northwestern Wyoming. The WGFD vaccination program currently is carried out annually on 21 WGFD feedgrounds in northwestern Wyoming and since 2002 has been conducted on the NER. The WGFD believes that vaccinating elk on the NER will enhance immunity and reduce the risk of transmission of brucellosis by reducing abortions caused by brucellosis. Elk overwintering on the NER cannot be vaccinated outside of the NER at this time.

Availability of Resources:

It is estimated that costs to administer the WGFD interim elk vaccination program would mostly be salaries and that it would increase the cost of the winter feeding program by about 3%, or $2,100. Additional staff time would be spent communicating with WGFD Project Biologists and staff in Cheyenne to ensure close coordination and to work out any disputes, writing and filing out forms related to special use permitting, administering records, monitoring vaccination activities and ensuring that agreed-upon protocol is followed and that stipulations are being met, monitoring elk/bison responses, working with media (in cooperation with WGFD), and providing briefings and updates to regional and Washington offices. Not included in these expenses are the cost of preparing the environmental assessment, compatibility determination, biological assessment, and any costs that would be needed for travel to Cheyenne, Wyoming to meet with WGFD staff.

Anticipated Impacts of the Use:

The following assessment of impacts only addresses the direct and indirect effects of the vaccination program.

Habitat

Although slight alterations may be made to feeding operations to accommodate the vaccination program (e.g., increasing the distance between feedlines), none of the changes would affect cultivated fields, grasslands, and sagebrush habitat where alfalfa pellets would be distributed and where vaccination procedures are conducted. At a maximum, negligible, unmeasurable changes would occur to these habitats.

If vaccination activities cause elk to move away from feedlines more than what they would do in the absence of vaccination, a negligible to minor increase in browsing by elk could take place on the days that elk are disturbed. However, by the end of the feeding season, these potential impacts would be diminished because elk likely consume all or nearly all accessible woody shoots in the vicinity of feedgrounds by the end of the winter feeding season. The condition of woody vegetation close to feedgrounds is already in degraded condition (Anderson 2002, Cole 2002, Dobkin, Singer, and Platts 2002).

Elk Population

Behavior and Social Interactions. Although it is possible that vaccination activities would result in no noticeable changes in elk behavior or interactions, it is more likely that vaccination activities would have at least some affect on elk behavior. However, major recurring or long-lasting impacts would not be anticipated because a stipulation of this compatibility determination is that changes would be made immediately to the vaccination program to avoid this level of impact.

Elk response to an additional vehicle and the activities associated with vaccination (e.g., starting and stopping of the vaccination vehicle, firing air guns) could vary on a daily basis, from negligible effects to elk leaving the vicinity of the feeding area where vaccination is taking place. Negligible and minor level effects would include animals flinching after being hit by a biobullet or paintball or in response to other activities associated with vaccination, a small numbers of animals rushing away from the feedline soon followed by a return to the feedline, and minor scuffling among elk. These types of effects would be expected to be normal and regular occurrences during the vaccination period.

Occasionally, major, short-duration effects could result from the presence or stopping and starting of the oversnow vaccination vehicle, changes in the vaccination vehicle relative to the feed trucks (e.g., increased distance between the two), human movements, the firing of air guns, being hit with a biobullet or paintball, and the sight of one or more elk being slightly alarmed in response to these stimuli. Major effects include the movement of large numbers or all animals away from a particular feeding area, escalated aggression among elk that leads to fighting resulting in serious injury or death, and aggressive interactions between elk and bison (B. Smith, Wildl. Biologist, NER, pers. comm., 2002). Increased aggression could occur if elk from one part of a feedline quickly move away and then converge on another part of the feedline already occupied by elk.

It is not anticipated that the additional time would be added to the process of dispensing alfalfa pellets. This is because substantial increases in the amount of time it takes to dispense alfalfa pellets could result in increased aggression among elk and increased aggression could escalate to major, short-duration effects such as fighting among some elk. Such fighting could potentially lead to injuries or death.

Effects of Brucellosis in Elk. Strain 19 would provide some level of protection against brucellosis-induced abortion and infection in elk (Thorne et al. 1981, Herriges et al. 1989, Roffe et al. 2002) and could potentially result in a negligible to minor reduction in seroprevalence of brucellosis in NER elk. This decrease in prevalence would add to the moderate (low end of moderate range) decrease expected in refuge elk in the long term because: (1) the population would be reduced to 4,000–5,000 elk on the refuge after 15 years, resulting in much lower density; (2) habitat improvements would increase distribution and further lower feedground density; and (3) there would be lower transmission potential in years when feeding does not occur (5 out of 10 years). The impact on seroprevalence of the entire Jackson elk herd would also be negligible to minor because only 45% of the herd would be on the refuge. However, Roffe (2004) indicates that Strain 19 has low efficacy and is unlikely to eradicate brucellosis in Greater Yellowstone elk. It is also possible that other factors influencing seroprevalence could result in an increase in seroprevalence during this time (B. Smith, Wildl. Biologist, NER, pers. comm., 2002). The Vaccination Environmental Assessment (2002) provides details on research conducted on Strain 19, but a summation of implications to the NER are as follows:

> Assuming that (1) 80% of calves are successfully vaccinated, (2) none of the calves have had previous exposure to *Brucella* organisms, and (3) a 25% efficacy with respect to protection against abortion, Strain 19 may result in 20% of NER calves being protected against abortion related to brucellosis. If 50% of the calves are successfully vaccinated, this would result in an estimated 13% of the calves being protected against infection and abortion. In 1989–1991, 45% of NER calves were hit by Strain 19 biobullets.
>
> Assuming that (1) 50% of all NER cows are successfully vaccinated, (2) 73% of adult cow elk had not been previously exposed to *Brucella* organisms (assuming that 27% of the cows are already infected, based on the 10-year average 27% seroprevalence rate) and (3) a 25%–30% efficacy with respect to protection against infection and abortion, Strain 19 may result in 9%–11% of NER cows being protected against infection and abortion related to brucellosis. If only 25% of the cows are vaccinated, this

would result in an estimated 5%–6% of the cows being protected against infection and abortion. In 1989–1991, 4% of NER cows were hit by Strain 19 biobullets.

There are a number of assumptions listed in the Vaccination Environmental Assessment (2002) with respect to assumption '3' in both paragraphs above, and if these assumptions are not met, efficacy of Strain 19 in field conditions may be higher or lower than clinically measured efficacy.

Even if the vaccination program resulted in measurably lower levels of seroprevalence of brucellosis in NER elk, this must be considered in the context of how vaccination-induced reductions in seroprevalence relate to the mission of the NWRS. Brucellosis is not a problem biologically to elk overwintering on the NER (Smith and Robbins 1994). Brucellosis in elk is primarily of concern because of potential for transmission of brucellosis from elk to livestock (Smith and Robbins 1994, Smith 2001, Ragan 2002, Thorne et al. 2002). While brucellosis may not be a biologically significant problem to elk wintering on the NER, the high prevalence of brucellosis in NER elk is an indicator that the conditions experienced by these elk are optimum for the transmission of other, more pathogenic diseases (Smith 2001). As such, reducing the seroprevalence of brucellosis in elk through vaccination, without addressing factors that cause elevated levels of brucellosis, does not necessarily contribute to the mission of the NWRS mission because it does not address the underlying problems that allow the disease to flourish. These underlying problems were investigated in a problem analysis that was conducted by the BEMP EIS interagency working group (DeLong 2001).

Mortality, Calf Production, and Numbers of Elk. It is possible that the incidence of gorings by bull elk or bison could increase slightly above the current level. Although not anticipated, it is possible that a small number of fatalities could result from disturbances described in the previous section and from elk cows and calves being hit with biobullet. Of the 2,272 elk that were vaccinated during 1989–1991, only 2–5 (less than 0.2%) may have died due to complications associated with biobullet vaccination (Wilbrecht 1989). It is not anticipated that the administration of Strain 19 would make elk more susceptible to predation or other causes of mortality, aside from factors described above. Therefore, any increases in mortality would be minimal.

Assuming that 100% of calves and cows have been vaccinated by the third year of the vaccination program and that Strain 19 is 25% effective in calves vaccinated on the NER, it is estimated that up to 10 additional calves would be recruited into the February population that year and up to 34 fewer abortions would occur that year (see the environmental assessment for details on how the estimates were calculated and for assumptions). If fewer than 100% of the calves are vaccinated, proportionally fewer calves would be recruited into the February population. Thorne et al. (1978) and Herriges et al. (1989) reported that 50%–70% of cow elk infected with brucellosis loose their first calf. After aborting the first calf, calf production is not affected appreciably (Thorne et al. 2002). This means that the effects of vaccinating elk on the NER 2003–2005, in terms of impacts on calf production, would occur during 2005–2007, assuming that female elk are first bred at age 2-1/2 and capable of producing their first calf at 3 years of age (Smith and Robbins 1994). An additional 10 calves being recruited into the February population each year would have negligible effects on the population (e.g., less than a 0.1% increase each year).

Other Wildlife Species

The following assessment of potential effects on other wildlife species is done as a group, except for potential disturbance effects on bison, because potential habitat and biosafety effects are similar among groups of species.

Disturbance to Bison. Vaccination procedures, including the use of an additional vehicle, firing air guns, and the effects this has on elk could result in behavior changes in bison, ranging from negligible to major, short-duration impacts. When calf and cow elk are being vaccinated on feedlines that are also occupied by bison, bison could become startled by the starting and stopping of the vaccination vehicle, report of the air gun, reactions of elk to these factors or to being hit with a biobullet or paintball, or other movements and sounds. It is anticipated that, in most instances, bison that are disturbed would immediately resume feeding. However, it is possible that on occasion the disturbance might elicit a flight response in bison, especially during the acclimation period. The most severe response would be for small to large numbers of bison to leave a feeding area temporarily or it is possible that they may move to another feeding area (B. Smith, Wildl. Biologist, NER, pers. comm., 2002).

During the last several years, bison on the NER have been approached with a Thoikol (oversnow vehicle) and, because some bison have been shot with tranquilizer guns, many bison now appear to associate the Thoikol with danger. In many cases, the approach of a Thoikol elicits a flight response in bison (B. Smith, Wildl. Biologist, NER, pers. comm., 2002). This may make it difficult for similar oversnow vehicles, such as the one used by WGFD in vaccination activities, to approach feeding areas occupied by bison without having bison run away. Because bison reaction to the oversnow vaccination vehicle could elicit a response in elk, this could add to the acclimation period on one or two feeding areas.

Effects due to Habitat Alterations. Because implementation of the vaccination program would likely not result in any measurable or noticeable changes to habitat conditions (see discussion on habitat impacts, above), no changes in population levels, densities, productivity, or other parameters of ungulate, bird, predator, and scavenger species would be anticipated due to possibly slight alterations to habitat conditions.

Effects due to Changes in Elk and Bison Distribution and Mortality. Because vaccination would have negligible lasting effects on elk and bison distribution — the vaccination program would be changed before this happened — any changes in distribution would not be large enough to result in anything more than negligible effects on wildlife species that could be affected by changes in distribution.

As noted in the Elk Population section, vaccination activities and possible adjustments to winter feeding operations could potentially cause elk and/or bison to move from one feeding area to adjoining habitat (temporarily) or to another feeding area. However, changes would be made to the vaccination program to minimize the extent to which any such disturbances recur. Furthermore, NER staff would immediately move a portion of the animals from the feeding area that gained animals to the feeding area that lost animals (i.e., any changes in distribution would be temporary).

The negligible to minor increase in mortality, due to such things as gorings by bull elk and bison and mortality caused by complications resulting from biobullets, would add to the food base of scavengers such as coyotes, bald and golden eagles, common ravens, common crows, and black-billed magpies. Because the mortality rate on the NER is relatively low (e.g., an average of about 1½%), even a slight increase in elk carcasses would noticeably add to the food base of scavengers. Conversely, the number of aborted fetuses would decline, but this would be a negligible impact. No lasting measurable effects would be anticipated due to potential changes in the mortality rate of elk on the NER.

Likewise, the anticipated negligible increases in calf recruitment and population growth would have no measurable effect on the food base of wolves, grizzly bears, and mountain lions in other parts of the Jackson elk herd unit.

Safety of Strain 19 in Wildlife other than Elk. Roffe and Olsen (2002:53) noted that "Despite the fact that S19 has been widely used in bison, very little research has been done on biosafety of this vaccine in bison and non-targeted wildlife species. Nevertheless, S19 vaccine was used extensively in calves and there were no widespread reports of adverse effects from commercial bison producers." Cook and Rhyan (2002:63) noted that "No clinical trials have been conducted specifically examining the safety of S19 in non-target wildlife. However, field experience suggests that S19 is safe in many species of non-target wildlife" (Vaccination EA 2002).

Threatened, Endangered, and Sensitive Species

The effects of the vaccination program on the most likely threatened and endangered species to be affected (e.g., gray wolves and grizzly bears) have already been described (see the previous section, Other Wildlife Species). The vaccination program would have negligible, if any, effects on threatened, endangered, and sensitive species as a consequence of temporary changes in elk and bison distributions, negligible changes in calf recruitment and mortality rates. No adverse effects of using Strain 19 to vaccinate elk, bison, and cattle on wolves or grizzly bears or other threatened species have been reported.

Wildlife-Dependent Recreational Opportunities on the NER Associated with Elk

The vaccination of elk would not begin until well after the close of the hunting season for elk on the NER. Therefore, any temporary shifts in distribution resulting from vaccination activities would not affect hunting opportunities. Effects of the vaccine program on calf production and recruitment could have negligible, if any,

effects on NER hunting opportunities. Likewise, viewing opportunities during most of the year would not be measurably affected.

If vaccination activities do not result in elk vacating the Nowlin feeding area, potential effects on NER sleigh rides would be nonexistent to minor, except that (1) vaccination activities at the Nowlin feeding area could provide morning sleigh ride participants an opportunity to be educated about brucellosis in the Greater Yellowstone area and WGFD's brucellosis management program and, conversely, (2) large numbers of calves and cows marked with paint could detract from the viewing experience and photographic opportunities for some people, especially since elk are viewed and photographed at close range from sleighs.

If large numbers or all elk using the Nowlin feeding area vacate the area due to vaccination activities or adjustments to feeding protocol, sleigh ride operations would stop for the day. This would reduce viewing opportunities for people visiting Jackson Hole on that particular day, would result in fewer opportunities for the NER to educate visitors about elk and wildlife conservation. Assuming that an average of 225 visitors ride the sleighs each day (J. Griffin, Refuge Operations Specialist, NER, pers. comm., 2002), each day that the sleigh rides are not in operation means that an estimated 225 fewer visitors would have the chance to ride the sleighs, view elk at close range, and to be educated about elk and wildlife conservation. Furthermore, each day that the sleigh rides are not operated results in a loss of an estimated $3,000 to the sleigh rider operator, NER, and the National Museum of Wildlife Art, including an estimated $1,800 loss to the sleigh ride operator. These costs are not recoverable. During the last five years, an average of 24,367 people participated in sleigh rides each winter. If elk are disturbed on feeding areas due to vaccination procedures to the extent that they leave the area, changes would be made to vaccination procedures to ensure it does not continue. Therefore, impacts on sleigh ride operations due to the vaccination program would be minor. However, sleigh rides may not be feasible from the contractor's point of view if the refuge is only feeding in above average and severe winters (estimated to occur every 4–5 out of 10 years). If the sleigh ride concession were not in operation, the vaccination program would not have any impacts on visitors or the sleigh ride operator's finances.

If elk are alarmed on the Nowlin feeding area, due to vaccination activities, while horse-drawn sleighs are in the vicinity of the elk, horses could panic in turn, which is a safety issue for visitors.

Cumulative Effects. The vaccination program would not contribute or add measurably to the degradation of habitat or disease risks caused by related programs such as winter feeding on the NER. Therefore, the cumulative effects of the vaccination would be negligible.

Public Review and Comment:

Public review of the draft compatibility determination will coincide with public review of the Bison and Elk Management Plan/EIS, and a summary of related comments and how they were addressed will be included in this section of the final compatibility determination.

Compatibility Determination:

Using sound professional judgment (603 FW 2.6U., and 2.11A), place an "X" in appropriate space to indicate whether the use would or would not materially interfere with or detract from the National Wildlife Refuge System Mission or the Purposes of the National Elk Refuge.

__ Use is Not Compatible

X Use is Compatible

Stipulations Necessary to Ensure Compatibility:

The following stipulations would allow the vaccination program to be compatible from the standpoint of direct and short-term effects on the ability of the USFWS to fulfill the NWRS mission and the purposes of the refuge.

- Elk vaccination teams will monitor and record response to vaccination procedures daily. Likewise, feed truck drivers will monitor elk behavior as is standard protocol at the NER. Observations of both groups will be used to make adjustments to avoid major adverse effects on elk, other wildlife, and opportunities for wildlife-dependent recreation.

- After a few days of acclimation, if elk repeatedly rush away from feedlines each time the airgun is fired, even if they return shortly, changes to vaccination procedures would be required to remedy this problem. Occasional reactions of elk resulting in them rushing away from the feedline would be acceptable.
- If, while vaccination activities are occurring, elk leave a feeding area and do not return until the next day or move to another feeding area, changes would be made to vaccination procedures to avoid recurrence of this response. If attempts to correct the problem do not prevent elk from leaving feeding areas, the vaccination program would be discontinued at the feeding sites where this is occurring.
- If, while vaccination activities are occurring, interactions between elk or between elk and bison increase above interactions of past years, and if interactions lead to injuries or death, changes would be made to vaccination procedures to avoid recurrence of this response. If attempts to correct the problem do not prevent further serious injuries or death, the vaccination program would be discontinued.
- Winter feeding operations would not be altered to any measurable degree to accommodate the vaccination program, as the feeding program has evolved over the last 30 years to minimize adverse interactions among elk. This includes no significant increases in the amount of time spent dispensing pellets. Changes in the way alfalfa pellets are dispensed could result in increased interactions, which could lead to injuries and death of elk.
- The decision to initiate winter feeding would not be influenced by the vaccination program. If the criteria on which the decision is made (USFWS and WGFD 1974) dictate that feeding is not needed in a given year, feeding would not be initiated for the purpose of allowing vaccination to occur.
- Hay would not be used.

Justification:

Vaccination of elk with Strain 19 was determined to be compatible for the following reasons. The potential effects of the vaccination program would result in negligible to minor direct and indirect effects on elk and other wildlife and opportunities for wildlife-dependent recreation. Any effects of the vaccination program (both beneficial and adverse) would be so slight that they would not be measurable, assuming adherence to the stipulations identified above. Therefore, while it would not contribute to the accomplishment of refuge purposes or the mission of the NWRS, vaccinating elk on the NER would not hinder their accomplishment.

Although vaccination of elk, under current technologies, can only be effectively undertaken when elk are concentrated through a winter feeding program (Thorne and Kreeger 2002, WGFD 2002), implementation of a vaccination program would not have any influence on the continuation of winter feeding. Therefore, although winter feeding is a prerequisite of the vaccination program and although winter feeding has resulted in adverse impacts to wildlife habitat (Anderson 2002; Cole 2002; Dobkin, Singer, and Platts 2002; Smith, Cole, and Dobkin 2004b) and disease prevalence and risk (Thorne et al. 1978, 1997; Smith 2001) on the NER, continuing the vaccination program would not be responsible, in whole or in part, for perpetuating these effects because (1) winter feeding would continue to be carried out in above average and severe winters (estimated to occur 4–5 out of 10 years) regardless of whether vaccination occurs, and (2) the vaccination program would not worsen, to any measurable degree, any of the adverse effects associated with winter feeding.

USFWS policy requires that compatibility be based on "sound professional judgment," meaning that determinations must be consistent with "sound fish and wildlife management." However, in making compatibility determinations, the consideration of sound professional judgment and consistency with sound wildlife management is narrowly limited to the determination of whether a vaccination program would or would not "materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge" (16 USC 668ee). The determination of compatibility in this document is consistent with sound wildlife management, as is demonstrated in the analysis of impacts in this compatibility determination and the environmental assessment.

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Compatibility Determination

Mandatory Re-Evaluation Date (provide month and year for "allowed" uses only):

___ Mandatory 15-year Re-Evaluation Date (for priority public uses)

___ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

___ Categorical Exclusion without Environmental Action Statement

___ Categorical Exclusion and Environmental Action Statement

___ Environmental Assessment and Finding of No Significant Impact

_X_ Environmental Impact Statement and Record of Decision

Determination

Prepared by Refuge Manager: _____ _____
(Signature) (Date)

Concurrence

Regional Chief, National Wildlife Refuge System: _____ _____
(Signature) (Date)

GLOSSARY

Above-average Winter – In above-average winters snow depths would make it more difficult for elk to acquire sufficient food resources to survive on their own. Suitable habitat in years when snows were above average would decline to an estimated 20,000 acres, most of which would be in the Gros Ventre River basin and an estimated 2,600 acres on the refuge. The winter of 1982 was designated as above average (Hobbs et al. 2003). See glossary definition of an average winter.

Adaptive Management – The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from research and the period evaluation of management actions and the conditions they produce to either reinforce the viability of objectives, strategies, and actions prescribed in a plan or to modify strategies and actions in order to more effectively accomplish management objectives.

Affected Environment – A description of the existing environment that may be affected by the proposed action (40 CFR 1502.15)

Alluvial – Of and/or relating to clay, sand, or other sediment that is gradually deposited by moving water.

Alternatives – Different means of accomplishing refuge and park purposes and goals and contributing to the Refuge System and National Park Service missions (USFWS 2000:602 FW 1.5).

Animal unit month (AUM) – The forage base required to sustain a cow and her calf for one month.

Anthropogenic – Pertaining to humans.

Antibody – An immunoprotein that is produced by lymphoid cells, in response to a foreign substance (antigen), with which it specifically reacts.

Antigen – A foreign substance, usually a protein or polysaccharide, that upon introduction into a vertebrate animal, stimulates an immune response.

Average Winter – In average years snow depths would not prevent elk from acquiring sufficient food resources to survive on their own. During an average winter, an estimated 51,000 acres in the Jackson elk herd unit area would likely be suitable as elk winter habitat (Wockner, pers. comm. 2002). Most of this acreage would be in the Gros Ventre River basin, with about 8,500 acres on the refuge, as well as in the Buffalo Valley area. The winter of 1996 was designated as average, based on rankings of snow-water equivalent measurements taken over a 50-year period at the Hunter-Talbot hayfields in Grand Teton National Park (Farnes et al. 1999; Hobbs et al. 2003). Snow crusting that decreases access to forage would make model predictions about winter conditions more similar to predictions for severe winters.

Baseline Conditions – Conditions that have resulted from the current management program up through the signing of a record of decision. These conditions assume (1) the elk herd is being maintained at 11,029, (2) the number of elk that winter on the NER fluctuates between 5,000 and 7,500, (3) the bison herd numbers 800-1,000, (4) information on wildlife populations, habitats and socio-economic factors are averaged from the past 5-20 years.

Biobullet – A single dose, biodegradable projectile comprised of an outer methylcellulose casing containing a solid, semi-solid, or liquid product (usually a vaccine or chemical contraceptive), propelled by a compressed-air gun.

Biological Opinion – Document stating the opinion of the Fish and Wildlife Service or the National Park Service on whether or not a Federal action is likely to jeopardize the continued existence of listed species, or result in the destruction or adverse modification of critical habitat.

Brucellosis – Infection with or disease caused by the *Brucella abortus* bacteria. Also known as Bangs disease, undulant fever, and contagious abortion.

Candidate Species – Plant and animal taxa for which the FWS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.

Carrying Capacity – The maximum number of organisms that can be supported in a given area or habitat.

Chytrid Disease – *Batrachochytrium dendrobatidis* is a pathogenic fungus that infects amphibians. Chytrid fungi are typically found in the water or soil and several types are known to parasitize plants and insects. Recent outbreaks (since 1993) of chytridiomycosis among amphibians are the first known outbreaks in vertebrates. The exact mechanism of the disease is unknown but it appears to attack keratin, a fibrous protein that forms a protective layer in animal skin. This disease could be at least partially responsible for worldwide declines in amphibians.

Climax Community – A final stage of a plant succession, in which vegetation reaches a state of equilibrium with the environment. The community is self-perpetuating, except that changes may occur very slowly and over a time-scale that is extensive compared with the rapid and dramatic changes during the early stages of succession.

Coliform – Of, pertaining to, or resembling the colon bacillus (*Escherichia coli*), which are found normally in all vertebrate intestinal tracts and are occasionally virulent, causing infantile diarrhea.

Compatible Use – A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge (USFWS Manual 603 FW 3.6).

Conservation Easement – A legal document that provides specific land-use rights to a secondary party. A perpetual conservation easement usually grants conservation and management rights to a party in perpetuity.

Cultural Resource Inventory – A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4.

Cumulative Effects – Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonable foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Demographic – Referring to the intrinsic factors that contribute to a population's growth or decline: birth, death, immigration, and emigration. The sex ratio of the breeding population and the age structure (the proportion of the population found in each age class) are also considered demographic factors because they contribute to birth and death rates.

Disease Reservoir – A place in nature where a disease normally lives or is always found in significant numbers.

Ecosystem – An ecological system; the interaction of living organisms and the nonliving environment producing an exchange of materials between the living and nonliving.

Ecosystem Management – Management of an ecosystem that includes all ecological, social, and economic components which make up the whole of the system.

Effective Population Size – A measure of population size based on members that effectively contribute genes to subsequent generations (Berger 1996).

Effects, Impacts – Effects, impacts, and consequences, as used in an environmental impact statement, are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agencies believe that the effect will be beneficial. Effects may be direct, indirect, or cumulative.

Direct effects — Those effects caused by the action and occur at the same time and place.

Indirect effects — Those effects caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Cumulative effects — Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonable foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Emergent Wetland – Wetlands with rooted plants that have most of their vegetative (non-root) parts above water.

Endangered Species – Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register. [16 USC 1532(6)]

Endemic Species – A species only found in a particular area or region.

Environment – The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

Environmental Analysis – An analysis of alternative actions and their predictable short-term and long-term environmental effects, incorporating physical, biological, economic, and social considerations.

Environmental Assessment (EA) – A concise public document, prepared in compliance with NEPA, that briefly discusses the purposes and need for an action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

Environmental Consequences – Environmental effects of project alternatives, including the proposed action, any adverse environmental effects which cannot be avoided, the relationship between short-term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented (40 CFR 1502.16).

Environmental Health – Abiotic composition, structure, and functioning of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment.

Environmental Impact Statement – A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Exotic Species – Any introduced plant, animal or protist species that is not native to the area and may be considered a nuisance.

Feedground – An area where a herd of elk are given feed during the winter months.

Forage Production – The amount of forage produced in a given year by a particular species of plant or by vegetation in an area as a whole.

Forage Utilization – The proportion of the current year's forage production that is consumed or destroyed by grazing animals. May refer to a single species of forage or to the vegetation as a whole.

Genetic Variability – The amount of genetic difference among individuals in a population, measured by the number of genes in the population that are polymorphic (having more than one allele), the number of alleles for each polymorphic gene, and the number of genes per individual that are polymorphic.

Genotype – The genetic constitution, latent or expressed, of an organism, as distinguished from its physical appearance (its phenotype). The sum total of all the genes present in an individual.

Goal – Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (USFWS 2000:620 FW 1.5).

Habitat – The environment in which a plant or animal lives (includes vegetation, soil, water, and other factors).

Habitat Effectiveness – The extent to which suitable habitat provides is usable by a given species of wildlife or wildlife community with respect to human activity. Habitat effectiveness can be reduced by human activity and disturbance (e.g., resulting from hiking, driving, hunting, and other forms of recreation).

Healthy Habitat – The composition and structure of habitat approximating historical conditions (e.g., conditions that were present prior to substantial human related changes to the landscape), based on the definition of environmental health and biotic integrity (USFWS 2001:601 FW 3.6.B-D).

Healthy Population – Conservation of healthy populations of fish and wildlife means the maintenance of fish and wildlife resources and their habitats in a condition that ensures stable and continuing natural populations and species mix of plants and animals in relation to their ecosystem; minimizes the likelihood of irreversible or long-term adverse effects upon such populations and species; and ensures the maximum practicable diversity of options for the future (50 CFR 100.4).

Herbaceous Forage – Non-woody plants; includes grasses, wildflowers, and sedges and rushes (grass-like plants).

Herd Integrity – The genetic integrity of the herd or population; i.e., the state in which heterozygosity, fitness, and viability are maintained.

Hydrology – The science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere. The distribution and cycling of water in an area.

Immunocontraception – The induction of contraception by injecting an animal with a compound that produces an immune response that precludes pregnancy.

Immunocontraceptive – A contraceptive agent that causes an animal to produce antibodies against some protein or peptide involved in reproduction. The antibodies hinder or prevent some aspect of the reproductive process.

Impairment – As used in NPS *Management Policies*, "impairment" means an adverse impact on one or more park resources or values that interferes with the integrity of the park's resources or values, or the opportunities that otherwise would exist for the enjoyment of them, by the present or a future generation. Impairment may occur from visitor activities, NPS activities in managing a park, or activities undertaken by concessioners, contractors, and others operating in a park. As used here, the impairment of park resources and values has the same meaning as the phrase "derogation of the values and purposes for which these various areas have been established," as used in the General Authorities Act.

Irretrievable – A term that applies to the loss of production, harvest, and consumptive or nonconsumptive use of natural resources. For example, recreation experiences are lost irretrievably when an area is closed to human use. The loss is irretrievable, but the action is not irreversible. Reopening the area would allow a resumption of the experience.

Irreversible – A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

Issue – Any unsettled matter that requires a management decision; e.g., an agency initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (USFWS 2000:602 FW 1.5).

Jackson Hole Area – The approximate geographic area south of Yellowstone National Park that includes Jackson Hole; the east side of the Teton Range; the stream and river drainages that flow into Jackson Hole, including the Pacific Creek, Buffalo Fork, Spread Creek, Hoback River, Flat Creek, and Mosquito Creek drainages; and the lower Hoback River drainage west of Granite Creek.

Jeopardy Opinion – The opinion of the USFWS that an action would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing reproduction, numbers or distribution of that species (CFR 402.02).

Lead Agency – The agency or agencies responsible for preparing the environmental impact statement (40 CFR 1508.18).

Listed Species – Any species of fish, wildlife or plant, which has been determined to be endangered or threatened under section 4 of the Endangered Species Act.

Loam – Loose-textured soil consisting of a mixture of sand, clay, and organic matter.

Loess – A pale, yellowish silt or clay forming finely powered, usually wind-borne deposits.

Management Plan – A document that provides direction and guidance for accomplishing management goals and establishing purposes, and for contributing to the fulfillment of agency missions. The heart of a management is comprised of goals, objectives, and strategies.

Mesic – Applied to an environment that is neither extremely wet (hydric) or extremely dry (xeric).

Mitigation – Planning actions taken to avoid an impact altogether, to minimize the degree or magnitude of an impact, to reduce the impact over time, to rectify the impact, or to compensate for the impact (40 CFR 1508.20).

Monitoring – A process of collecting information to evaluate if an objective and/or anticipated or assumed results of a management plan are being realized (effectiveness monitoring) or if implementation is proceeding as planned (implementation monitoring).

National Environmental Policy Act of 1969 (NEPA) – A law that requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and utilize public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements and prepare appropriate NEPA documents to facilitate better environmental decision making. NEPA requires Federal agencies to review and comment on Federal agency environmental plans/documents when the agency has jurisdiction by law or special expertise with respect to any environmental impacts involved (42 U.S.C. 4321-4327) (40 CFR 1500-1508).

National Wildlife Refuge System Mission – The mission of the System is to administer a national network of

lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

No-Action Alternative – The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management (40 CFR 1502.14(d)). Alternative 1 is the No-Action Alternative in this planning process.

Non-endemic Infectious Disease – A disease that is not native to a particular area and that is caused by a microbial agent capable of invasion, growth, and replication within a host animal.

Objective – A concise statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies, monitoring refuge and park accomplishments, and evaluating the success of the strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (USFWS 2000:602 FW 1.5).

Pathogen – A disease-producing microorganism.

Pathogenic – Capable of producing disease.

Prevalence (of a disease) – The number of cases of a disease that are present in a population at one point in time, usually expressed as a percentage of the total population of animals.

Proposed Action – A plan that contains sufficient details about the intended actions to be taken, or that will result, to allow alternatives to be developed and its environmental impacts analyzed (40 CFR 1508.23).

Record of Decision (ROD) – A concise public record of decision prepared by a federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

Recruitment – Number of animals surviving and being added to a breeding population at a certain point in time.

Residual Forage – Grasses, forbs, and other herbs that remain standing from one growing season to the next, and sometimes beyond. Generally, the above ground portion of herbaceous vegetation dies after the growing season, and if left undisturbed can remain upright for a period of time. Strong wind, heavy cover, and grazing can reduce the amount of residual vegetation remaining from one season to the next.

Riparian Area – A geographic area containing an aquatic ecosystem and the adjacent upland areas that directly affects it. This includes floodplain, and associated woodland, rangeland, or other related upland areas. Pertaining to the banks of streams, lakes, wetlands, or tidewater.

Riparian Zone – Terrestrial areas where the vegetation complex and micro-climate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs, and wet meadows.

Scope – The range of actions, alternatives, and impacts to be considered in an environmental impact statement (40 CFR 1508.2.5).

Scoping – An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

Sensitive Species – Those plant or animal species for which population viability is a concern as evidenced by a significant current or potential downward trend in population numbers, distribution, density, or habitat capability.

Seral – A phase in the sequential development of a climax community.

Seroprevalence – The proportion of individuals in a population that show positive results on serological examination.

Severe Winter – For modeling purposes, a severe winter is defined as one in which the snow-water equivalent over a large part of the analysis area would be 6 inches or, the threshold at which elk would be unable to acquire sufficient food resources to survive on their own (Hobbs et al. 2003). In a severe winter suitable habitat would decline to an estimated 12,000 acres, with less than 700 acres on the refuge. For reference purposes, the winter of 1997 was designated as se-

vere, based on rankings of snow-water equivalent measurements at the Hunter-Talbot hayfields in Grand Teton National Park (Farnes et al. 1999; Hobbs et al. 2003). Because some portions of the snow data set only went back to 1980, 1997 was used as "the most severe on record" (Hobbs et al. 2003). Snow crusting that decreases access to forage would likely intensify winter severity.

Shoulder Season – Period of time between two busy tourist seasons. In Jackson Hole, fall and spring are shoulder seasons between the busy summer season, when many tourists come to the area to view wildlife and scenery, hike, and raft rivers and the busy winter season when tourists come to downhill ski.

Snow-water Equivalents – Refers to the water content of snow, per unit volume of snow.

Stakeholder – Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Native American tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in planning issues and those who do or do not realize that the agencies' decisions may affect them.

Strain – An intraspecific group of organisms, possessing only one or a few distinctive traits, usually genetically homozygous for those traits, and maintained as an artificial breeding group by humans.

Strain 19 – The strain of *Brucella abortus* bacteria currently used to vaccinate cattle against brucellosis.

Strategy – A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (USFWS 2000:602 FW 1.5).

Subirrigated – Irrigated from beneath.

Succession – A gradual change from one community to another, characterized by a progressive change in species structure, an increase in biomass and organic matter, and a gradual balance between community production and community respiration.

Test and Cull – A procedure that involves capture, handling, and testing a group of cattle or bison for brucellosis, tuberculosis, or other communicable diseases, identifying the positive testers, and removing them from the herd.

Transitional Range – Range used by ungulates as they move from their summer range to their winter range and vice versus in the spring.

Threatened Species – A plant or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.

Undulant Fever – A disease in humans caused by *Brucella*.

Vaccine – A suspension of killed or attenuated microorganisms that, when introduced into the body, stimulates an immune response against that microorganism.

Vector – An organism that carries pathogens from one host to another.

Viable Population – A population of sufficient size and genetic variability that it maintains its vigor and its potential for evolutionary adaptation.

Vision Statement – A concise statement of the desired future condition of the planning unit, based primarily on the agency's mission, specific establishing purposes, and other relevant mandates (USFWS Manual 602 FW 1.5).

Zona Pellucida (ZP) – The outer membrane of a mammalian egg.

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BEA	Bureau of Economic Analysis, U.S. Department of Commerce
BLM	Bureau of Land Management, U.S. Department of the Interior
CEQ	Council on Environmental Quality
FHWA	Federal Highway Administration
GTNP	Grand Teton National Park
GYIBC	Greater Yellowstone Interagency Brucellosis Committee
MFWP	Montana Fish, Wildlife and Parks
NAS	National Academy of Sciences
NER	National Elk Refuge
NPS	National Park Service, U.S. Department of the Interior
NRCS	Natural Resources Conservation Service, U.S. Department of Agriculture
PNWRS	Pacific Northwest Research Station, Forest Service, U.S. Department of Agriculture
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service, U.S. Department of the Interior
USFS	U.S. Forest Service, U.S. Department of Agriculture
USIECR	U.S. Institute for Environmental Conflict Resolution
WDEQ	Wyoming Department of Environmental Quality
WDOT	Wyoming Department of Transportation
WGFC	Wyoming Game and Fish Commission
WGFD	Wyoming Game and Fish Department

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