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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 plans. 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 an-

nually 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.

ADDITIONAL LAWS ONLY AFFECTING THE NATIONAL ELK REFUGE

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.

Native American Policy (1994): The purpose of the Native American policy is to articulate the general principles that will guide the U.S. Fish and Wildlife Service's government-to-government relationship with Native American governments in the conservation of fish and wildlife resources. The policy does not suggest recognition of tribal authority that does not exist, nor is the policy used to arbitrate differences in opinion between governmental agencies or judicial findings.

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.

ADDITIONAL LAWS ONLY AFFECTING GRAND TETON NATIONAL PARK

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 win-

ter (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. L. 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).

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).

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 ex-

pense 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 boosted 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](http://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). Miller, Rhyan, and Drew (2004) found that GnRH vaccine effectively prevented pregnancy in bison for at least one year. 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).

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.

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

ANIMAL SPECIES

InsectivoraSoricidae

<i>Sorex cinereus</i>	Masked shrew
<i>Sorex merriami</i>	Merriam's shrew
<i>Sorex monticolus</i>	Dusky or montane shrew
<i>Sorex nanus</i>	Dwarf shrew
<i>Sorex palustris</i>	Water shrew
<i>Sorex vagrans</i>	Vagrant shrew

ChiropteraVespertilionidae

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

LagomorphaOchotonidae

<i>Ochotona princeps</i>	Pika
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Leporidae

<i>Lepus americanus</i>	Snowshoe hare
<i>Sylvilagus nuttalli</i>	Nuttall's cottontail

RodentiaSciuridae

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

Geomyidae

<i>Thomomys talpoides</i>	Northern pocket gopher
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Castoridae

<i>Castor canadensis</i>	Beaver
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Cricetidae

<i>Neotoma cinerea</i>	Bushy tailed woodrat
<i>Peromyscus maniculatus</i>	Deer mouse

Arvicolinae (subfamily)

<i>Clethrionomys gapperi</i>	Southern red-backed vole
<i>Lemmiscus curtatus</i>	Sagebrush vole
<i>Microtus longicaudus</i>	Long-tailed vole
<i>Microtus montanus</i>	Montane vole
<i>Microtus pennsylvanicus</i>	Meadow vole

Microtus richardsoni

Water vole

Microtus richardsoni

Richardson's vole

Ondatra zibethicus

Muskrat

Phenacomys intermedius

Heather vole

Murinae (subfamily)*Mus musculus*

House mouse

Rattus norvegicus

Norway rat

Dipodidae*Zapus princeps*

Western jumping mouse

Erethizontidae*Erethizon dorsatum*

Porcupine

CarnivoraCanidae*Canis latrans*

Coyote

Canis lupus

Gray wolf

Vulpes vulpes

Red fox

Ursidae*Ursus americanus*

Black bear

Ursus arctos

Grizzly bear

Procyonidae*Procyon lotor*

Raccoon

Mustelidae*Gulo gulo*

Wolverine

Lutra canadensis

Northern river otter

Martes americana

American marten

Martes pennanti Fisher || *Mephitis mephitis* | Striped skunk |
Mustela erminea	Ermine (short-tailed weasel)
Mustela frenata	Long-tailed weasel
Mustela nivulis	Least weasel
Mustela vison	Mink
Spilogale gracilis	Western spotted skunk
Taxidea taxus	Badger
Felidae*Lynx lynx*

Lynx

Lynx rufus

Bobcat

Puma concolor

Mountain lion

ArtiodactylaCervidae*Alces alces*

Moose

Antilocarpa americana

Pronghorn

Cervus elaphus

Elk (Wapiti)

Odocoileus hemionus

Mule deer

Odocoileus virginianus

White-tailed deer

Bovidae*Bison bison*

Bison (American buffalo)

Oreamnos americanus

Mountain goat

Ovis canadensis

Mountain sheep (bighorn sheep)

REPRESENTATIVE BIRD SPECIES OF JACKSON HOLE

Hummingbirds

<i>Selasphorus platycercus</i>	Broad-tailed hummingbird
<i>Selasphorus platycercus</i>	Rufous hummingbird
<i>Stellula calliope</i>	Calliope hummingbird

Perching Birds

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

<i>Vermivora celat</i>	Orange-crowned warbler
<i>Vireo gilvus</i>	Warbling vireo
<i>Wilsonia pusilla</i>	Wilson's warbler
<i>Xanthocephalus xanthocephalus</i>	Yellow-headed blackbird
<i>Zonotrichia leucophrys</i>	White-crowned sparrow

Woodpeckers

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

Gallinaceous Birds

<i>Bonasa umbellus</i>	Ruffed grouse
<i>Centrocercus urophasianus</i>	Sage grouse
<i>Dendragapus obscurus</i>	Blue grouse

Waterfowl

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

Shorebirds

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

Rails and Coots

<i>Coturnicops noveboracensis</i>	Yellow rail
<i>Fulica americana</i>	American coot
<i>Porzana carolina</i>	Sora
<i>Rallus limicola</i>	Virginia rail

Cranes

<i>Grus canadensis</i>	Sandhill crane
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Bitterns and Herons

<i>Ardea herodias</i>	Great blue heron
<i>Botaurus lentiginosus</i>	American bittern
<i>Bubulcus ibis</i>	Cattle egret
<i>Leucophoyx thula</i>	Snowy egret
<i>Nycticorax nycticorax</i>	Black-crowned night heron

Raptors

<i>Aquila chrysaetos</i>	Golden eagle
<i>Buteo jamaicensis</i>	Red-tailed hawk
<i>Circus cyaneus</i>	Northern harrier
<i>Falco peregrinus</i>	Peregrine falcon
<i>Falco sparverius</i>	American kestrel
<i>Haliaeetus leucocephalus</i>	Bald eagle
<i>Pandion haliaetus</i>	Osprey

Owls

<i>Athene cunicularia</i>	Burrowing owl
<i>Bubo virginianus</i>	Great-horned owl
<i>Otus kennicottii</i>	Western screech owl
<i>Strix nebulosa</i>	Great grey owl
<i>Tyto alba</i>	Barn owl

Seabirds

<i>Pelecanus erythrorhynchos</i>	White pelican
<i>Phalacrocorax auritus</i>	Double-crested cormorant
<i>Podiceps caspicus</i>	Eared grebe

Gulls and Terns

<i>Chlidonias niger</i>	Black tern
<i>Larus philadelphia</i>	Bonaparte's gull
<i>Larus pipixcan</i>	Franklin's gull
<i>Sterna caspia</i>	Caspian tern

APPENDIX D: COMPATIBILITY DETERMINATION FOR BISON HUNTING

Use: Bison Hunting

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:

The mission of the National Wildlife Refuge 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, of the United States for the benefit of present and future generations of Americans” (National Wildlife Refuge System Administration Act of 1966, as amended [16 USC 668dd–668ee]).

Additionally, the National Wildlife Refuge System Act specifically addresses wildlife-dependent recreation:

“compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System and the purposes of many refuges, and which generally fosters refuge management and through which the American public can develop an appreciation for fish and wildlife.” 16 USC 668dd(a)(3)(B).

“when the Secretary determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated, subject to such restriction or regulations as may be necessary, reasonable, and appropriate.” 16 USC 668dd(a)(3)(D).

“the terms ‘wildlife-dependent recreation’ and ‘wildlife-dependent recreational use’ mean a use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.” 16 USC 668ee (2).

Description of Use:

The National Elk Refuge will administer a bison hunting program for the general public licensed by the Wyoming Game and Fish Department (WGFD) and could potentially allow for a small ceremonial event for Native American tribes historically associated with the Jackson Hole area. Both the hunt and the ceremonial event are being instituted for the purpose of removing surplus bison as determined in the *Final Bison and Elk*

Management Plan and Environmental Impact Statement (Final Plan/EIS). Under the Preferred Alternative in the Final Plan/EIS the bison herd will be adaptively managed based on habitat and population monitoring, and the U.S. Fish and Wildlife Service (USFWS) and the National Park Service (NPS) will recommend a population objective of approximately 500 animals for the Jackson bison herd. WGFD sets the objective levels for the herd through a public review process that requires approval by the Wyoming Game and Fish Commission.

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 WGFD.

Ceremonial Event by Tribes. The refuge manager would potentially allow for the removal of up to five bison annually on the National Elk Refuge by Native American tribes for ceremonial purposes.

All special National Elk Refuge regulations governing personal conduct during elk hunting shall also apply to 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 WGFD personnel.

Anticipated Impacts:

Impacts on National Elk Refuge lands, waters or interests will be limited to permitting hunters to access closed areas of the refuge to pursue, harvest and remove bison based on fair-chase principles. 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 occur concurrently with elk hunting to limit disturbance to other wildlife to the same period of time. The program will require no facility development or conversion of habitat areas to administrative use.

The bison hunt will likely have minimal impacts to other refuge wildlife and significant beneficial impacts on the soil and flora of the refuge (Final Plan/EIS). Hunting can benefit habitats by reducing the number of bison that forage on the refuge in the winter, thus controlling ungulate grazing and browsing pressure.

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 or 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, pers. comm. 2002). 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 public hunt on the refuge will likely affect bison movements, distribution, and behavior once bison understand that traditionally safe areas are no longer safe. Bison will likely 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 although this is unlikely. If they move to private lands, WGFD will have the prerogative to haze or destroy them because of safety or damage concerns. Hunting may also increase agitation, nervousness, and energetic expenditures associated with fleeing from hunters and the sounds of weapons firing, possibly lowering nutrition because bison will stop foraging while being displaced from these areas (Smith, pers. comm. 2003).

The National Elk 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 their winter range on the National Elk Refuge and their summer range on Grand Teton National Park and their limited use of private lands and adjacent forest land.

Public Review and Comment:

The draft compatibility determination for bison hunting was presented for public review and comment in conjunction with the public comment period for the Draft Plan/EIS, beginning on July 21, 2005. The comment period closed on November 7, 2005.

At three public hearings, and throughout the comment period for the Draft Plan/EIS, substantial public input was received regarding the provisions in the Proposed Action to provide a hunting program and ceremonial event for bison at the National Elk Refuge.

Only one comment specifically addressed the draft compatibility determinations, and the commenter expressed the view that the compatibility determinations were inadequate, premature and suggested a predetermined outcome of the EIS process.

With respect to public comments, a large number of individuals and some conservation groups expressed concern that the population objective of 450–500 (Draft Plan/EIS) is at the low end of what is considered to be a genetically viable population. The public overwhelmingly desires that the bison herd be managed like other big game species and not be reduced to the lowest genetically viable population. Several studies indicate this number to be about 400 (Berger 1996; Gross and Wang 2005). The Preferred Alternative in the Final Plan/EIS was modified to state that the bison herd would be adaptively managed based on habitat monitoring, and that the lead agencies will recommend a population objective of approximately 500 animals. WGFD sets the objective levels for the herd through a public review process, and the Wyoming Game and Fish Commission must approve.

Overall, most agencies, conservation groups, and Native American tribes that submitted comments support the reduction of the bison herd through hunting. Letters were received from WGFD, the Shoshone-Bannock Tribes, the Town of Jackson, and numerous conservation and sportsmen groups. The Shoshone-Bannock Tribes oppose limiting the small ceremonial event to five animals annually, while WGFD opposes the ceremonial event by Native Americans. As stated above, most people support reducing the herd as long as the herd is not reduced to the minimum for a genetically viable population. Two animal rights stakeholder groups and a few individuals voiced their opposition to the bison hunt. In addition to issues of whether a hunt based on “fair-chase” principles can be implemented, they raised concerns about whether visitors to Grand Teton National Park would have fewer opportunities to view bison, and they were generally opposed to hunting and how that affects a person’s overall experience.

A 2004 study by Loomis and Koontz and a 2005 study by Koontz and Hoag analyzed visitor preferences for different management alternatives and actions, including bison hunting, across three geographic areas — Teton County, the State of Wyoming, and the rest of the United States. The study found a strong correlation between stakeholder viewpoints and preferred management actions. Assessment about the dynamic of hunting on an individual bison or the bison herd found it would unlikely change the impact of summer visitor experiences in Grand Teton National Park. Loomis and Koontz (2004) found that having a hunting program on the National Elk Refuge would not lead to a change in visitors coming to Grand Teton National Park unless there were major changes in numbers of animals.

In the professional judgment of the undersigned, none of the issues received during the comment period warrants changing the proposal for allowing a public bison hunt on the National Elk Refuge. The proposal to allow for a small ceremonial event by Native Americans was modified as potentially allowing for the removal of five

bison for ceremonial purposes. Hunting is clearly an appropriate use of the National Wildlife Refuge System by law and policy. The costs of the program are mostly salaries of personnel expended over the course of a fiscal year and are not excessive compared to many refuge programs. Hunting is an effective tool for ungulate population management that provides a wholesome outdoor recreational experience. In accordance with the U.S. Fish and Wildlife Service's Compatibility Policy (2000), seeking public comment during the comment period on the Draft Plan/EIS is appropriate and recommended.

Compatibility Determination:

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

Use is Not Compatible

Use is Compatible

Stipulations Necessary to Ensure Compatibility:

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

- Weapons will be limited to rifles. No archery or handguns will be allowed.
- The bison hunt must be detailed in an approved hunting plan prior to implementation.

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 numbers over 1,000 animals, more than 500 animals above the recommended population objective of 500 animals. WGFD conducts a sport hunt for bison in 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 USFWS, NPS, and WGFD jointly manage the Jackson bison herd. The herd increases at a rate of 10%–14% 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. Several evaluations of the bison herd's population genetics have established that a herd of 400 bison is likely large enough to ensure that the herd's genetic diversity will be protected (Shelley and Anderson 1989; Berger 1996; Gross and Wang 2005). The recommended herd objective would be approximately 500 bison.

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 (USFWS 1990–2004). The refuge capacity to support large ungulates is being exceeded, and considerable degradation is occurring to woody vegetation on the refuge from bison and elk. This jeopardizes the long-term health of plant communities and their ability to support a diverse fauna. It also places elk and bison at risk of increased susceptibility to disease.

Forage utilization surveys conducted each spring on the refuge indicate that the 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 six months on the refuge, forage utilization rates have averaged more than 70% during the past 15 years (USFWS 1990–2004). Changes in plant communities have also oc-

curred, 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 2004). In addition, nonnative invasive plant species are increasing in National Elk Refuge 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 cannot be trapped and relocated to other areas outside 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.

The use of fertility control was considered in the Draft Plan/EIS but was not selected as the Preferred Alternative in the Final Plan/EIS. 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.

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
 Environmental Impact Statement and Record of Decision

Determination

**Prepared by
Refuge Manager:**


 (Signature) _____ (Date)

11-3-06

Concurrence

**Regional Chief,
National Wildlife
Refuge System:**


 (Signature) _____ (Date)

11/9/06

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APPENDIX E: COMPATIBILITY DETERMINATION FOR ELK HUNTING

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. . . .” Refuge Recreation Act of 1962 (16 USC 460k-1).

National Wildlife Refuge System Mission:

The mission of the National Wildlife Refuge 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, of the United States for the benefit of present and future generations of Americans” (National Wildlife Refuge System Administration Act of 1966, as amended [16 USC 668dd–668ee]).

Additionally, the National Wildlife Refuge System Act specifically addresses wildlife-dependent recreation:

“compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System and the purposes of many refuges, and which generally fosters refuge management and through which the American public can develop an appreciation for fish and wildlife.” 16 USC 668dd(a)(3)(B)

“when the Secretary determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated, subject to such restriction or regulations as may be necessary, reasonable, and appropriate.” 16 USC 668dd(a)(3)(D)

“the terms ‘wildlife-dependent recreation’ and ‘wildlife-dependent recreational use’ mean a use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.” 16 USC 668ee(2).

Description of Use:

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

A maximum of 70 hunters/participants will 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, such as rifle caliber, wearing of hunter orange clothing, reporting of kills, or other stipulations.

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 (WGFD). Some changes to the existing hunt zones may occur in an effort to move elk out of traditional safe zones in the southern portion of the refuge and increase harvest efficiency.

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 National Elk 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 WGFD personnel.

Anticipated Impacts:

Impacts on National Elk Refuge 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. Elk would likely spend more time during the fall utilizing available habitat on the northern portion of the refuge. Many elk move quickly through hunt areas in the northern zone 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, pers. comm. 2003). 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. A beneficial effect to this would be increasing harvest efficiency of certain segments of the Jackson elk herd that arrive on the refuge earlier in the fall and thus reducing the number of elk wintering on the refuge.

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, pers. comm. 2004).

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, pers. comm. 2002). 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 approximately 2,000 animals above the WGF’s objective, and WGF 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:

The draft compatibility determination for elk hunting was presented for public review and comment in conjunction with the public comment period for the *Draft Bison and Elk Management Plan / Environmental Impact Statement (Draft Plan/EIS)*, beginning on July 21, 2005. The comment period closed on November 7, 2005.

At three public hearings, and throughout the comment period for the Draft Plan/EIS, substantial public input was received regarding the provisions in the Proposed Action to continue the elk hunting program at the National Elk Refuge.

Only one comment specifically addressed the draft compatibility determinations, and the commenter expressed the view that the compatibility determinations were inadequate, premature and suggested a predetermined outcome of the EIS process.

Many comments were received by conservation groups, other agencies, and the general public in support of continuation of the elk hunt on the National Elk Refuge. Two stakeholder groups plus a few members of the general public voiced their opposition to elk hunting. Many commenters expressed a desire for more access for hunting and maximum opportunity for hunting.

In the professional judgment of the undersigned, none of the issues received during the comment period warrants changing the proposal for continuation of the elk hunting program on the National Elk Refuge. Hunting is clearly an appropriate use of the National Wildlife Refuge System by law and policy. The costs of the program are mostly salaries of personnel expended over the course of a fiscal year and are not excessive compared to many refuge programs. Hunting is an effective tool for ungulate population management that provides a wholesome outdoor recreational experience. In accordance with the USFWS “Compatibility Policy” (2000), seeking public comment during the comment period on the Draft Plan/EIS is appropriate and recommended.

Compatibility Determination:

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

___ Use is Not Compatible

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 mission of the National Wildlife Refuge system 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 has been a successful program for over 50 years on the National Elk Refuge as part of the overall management of the entire Jackson elk herd. It helps control ungulate populations, reduces mortality by starvation, and provides scientific data for surveillance of refuge elk populations for chronic wasting disease.

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
- Environmental Impact Statement and Record of Decision

Determination

**Prepared by
Refuge Manager**

_____ 11-3-06
 (Signature) (Date)

Concurrence

**Regional Chief,
National Wildlife
Refuge System:**

_____ 11/9/06
 (Signature) (Date)

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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)

Allele – Either of a pair of genes located at the same position on both members of a pair of chromosomes and conveying characters that are inherited in accordance with Mendelian law. (*Webster's New World Dictionary of American English*, 3rd College ed., 1988).

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 2000b, 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, Heydon, and Hansen 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 11,000, (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 Diversity – The variety of living organisms, including the genetic differences among them, and communities and ecosystems in which they occur (USFWS 2001: 601 FW 3).

Biological Integrity – For the National Wildlife Refuge System, biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities (USFWS 2001: 601 FW 3).

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 re-

lated 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 (16 USC 1532(6)) as being in danger of extinction throughout all or a significant portion of its range, and published in the *Federal Register*.

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. Specifically for the National Wildlife Refuge System, composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions (USFWS 2001: 601 FW 3).

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.

Genetic Viability – Retention of genetic differences among individuals in a population at a level that allows the populations to persist with limited inbreeding and associated deleterious effects.

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 2000b, 602 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.

Heterozygosity – The proportion of individuals with more than one version of the same gene on a chromosome locus. Also, the tendency to possess two versions of the same gene on a locus, as opposed to the same version (homozygosity).

Heterozygote – A plant or animal having two different alleles at a single locus on a chromosome, and hence not breeding true to type for a particular genetic characteristic.

Historic Conditions – For the National Wildlife Refuge System, the composition, structure, and functioning of ecosystems resulting from natural processes that were present prior to substantial human-related changes to the landscape (USFWS 2001: 601 FW 3).

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 non-renewable 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 2000b, 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 USC 4321-27; 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.

Native – With respect to a particular ecosystem, a species that occurred historically in that ecosystem (USFWS 2001: 601 FW 3).

Natural Diversity – For the U.S. Fish and Wildlife Service, the number and relative abundance of indigenous species that would occur without human interference (USFWS 1992: 701 FW 1).

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 2000b, 602 FW 1.5).

Pathogen – A disease-producing microorganism.

Pathogenic – Capable of producing disease.

Preferred Alternative – The preferred alternative can be the proposed action as found in the draft NEPA document, the no-action alternative, another alternative, or a combination of actions or alternatives discussed in the draft NEPA document.

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.

Refuge – A designated area of land or water, or an interest in land or water, within the National Wildlife Refuge System.

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 severe, based on rankings of snow-water equivalent measurements at

the Hunter-Talbot hayfields in Grand Teton National Park (Farnes, Heydon, and Hansen 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 2000b, 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 *Bruceella*.

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
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
WYDOT	Wyoming Department of Transportation
WGFC	Wyoming Game and Fish Commission
WGFD	Wyoming Game and Fish Department

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