

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
BILLINGS FIELD OFFICE

ENVIRONMENTAL ASSESSMENT

PRYOR MOUNTAIN WILD HORSE RANGE

**FY2004: FERTILITY CONTROL ON
AGE-SPECIFIC WILD HORSE MARES**

Under Direction of the BLM National Research Field Trials
on Wild Horse Fertility Control
Summer 2004

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TABLE OF CONTENTS

	<u>Page</u>
I. <u>Introduction</u>	4
II. <u>General Area, Population Description and Background Data</u>	5
A. Location	
B. Population Demographics and Genetic Viability	
Herd Census Activity	
Herd Social Structure	
Herd Age Structure and Sex Ratio	
Mare Foaling Rates and Foal Survival	
Herd Natural Mortality	
Herd Genetic Viability	
III. <u>Proposed Management Action</u>	8
Compassionate-Use of Fertility Control on Yearling Mares, Two-year Old Mares and Mares 14 Years of Age and Older	
A. Purpose	
B. Need	
C. Objectives	
D. Proposed Fertility Control Agent	
E. Vaccine Quality and Remote-Delivery Protocol	
F. Permission and Criteria for Vaccine Use	
G. Conformance with Fertility Control Field Trial Plan	
H. Authority for Proposed Action	
I. Conformance with Existing Land Use Plans	
IV. <u>Alternative Management Actions</u>	12
A. Use of Fertility Control on All Ages of Wild Mares	
B. No Action Alternative: No Use of Fertility Control on Wild Mares	
V. <u>Affected Environment , Environmental Impacts and Mitigation Measures</u>	14
A. Affected Environment	
B. Environmental Impacts and Mitigation Measures	
1) Pryor Mountain Wild Horse Herd	
2) Wilderness Study Areas (WSA)	
3) Visual Resources, Recreation, and Hunting	
4) Areas of Critical Environmental Concern (ACEC)	
5) Livestock Grazing and Trailing	
6) Vegetation	
7) Terrestrial Wildlife	
8) Waste, Hazardous or Solid	

VI. <u>Consultation and Coordination</u>	18
A. List of Preparers	
B. Individuals, Groups, and Agencies Consulted	
VII. <u>Fonsi</u>	19
VIII. <u>References Cited</u>	20

- i. Figures
- ii. Appendices

LIST OF FIGURES

- Figure 1 – Age Structure and Sex Ratio PMWHR Spring 2004
- Figure 2 - Mare Pregnancy Results PMWHR Spring 2004
- Figure 3 – Mare Interchange Activity PMWHR 1998-2003 (2 years of age and older)
- Figure 4 - Mare Interchange Activity PMWHR 1998-2003 (yearlings and older)
- Figure 5 - Harem Interchanging Mares Losing Foals PMWHR 1999-2003
- Figure 6 – Ages of Interchanging Mares PMWHR 1998-2003
- Figure 7 – Herd and Foal Crop Sex Ratio PMWHR 1971-2003
- Figure 8 - Annual Foaling Rate PMWHR 1996-2003
- Figure 9 – Age Class Foaling Rates PMWHR 1996-2003
- Figure 10 - Population Numbers PMWHR 1971-2003
- Figure 11 - Foaling Periods PMWHR 1996-2003
- Figure 12 – Annual Foal Production by Age Class of Mares PMWHR 1996-2003
- Figure 13 – Rate of Increase in Herd Size PMWHR 1971-2003
- Figure 14 – Annual Foal Crop Survival PMWHR 1996-2003
- Figure 15 – Total Foal Production PMWHR 1996-2003
- Figure 16 – Recorded Mortality PMWHR 1996-2003
- Figure 17 – Foal Siring by Harem Stallions PMWHR 1996-2003
- Figure 18 – Foal Numbers by Harem Stallions PMWHR 1996-2003

LIST OF APPENDICES

- Appendix 1 - 2003 Pryor Mountain Wild Horse Survey (as of Oct 31, 2003)
(indicating age-specific fertility control mares)
- Appendix 2 - 2004 Protocol for the Treatment of Wild Horses on the PMWHR with a Porcine Zona Pellucida (PZP) Contraceptive Vaccine
- Appendix 3 - Distribution List of Public Reviewers for EA, April 2004

I. INTRODUCTION

With passage of the Wild, Free-Roaming Horse and Burro Act of 1971, Congress found that: “Wild horses are living symbols of the pioneer spirit of the West”. In addition, the Secretary of the Interior was ordered to “manage wild free-roaming horses and burros in a manner that is designed to achieve and maintain a thriving natural ecological balance on the public lands”. Since passage of the Act through present day, the Bureau of Land Management (BLM), Billings Field Office (BiFO), has endeavored to meet the requirements of the Act. The procedures and policies implemented to accomplish this mandate have been constantly evolving over the years.

Throughout this period, BLM experience has grown, and the knowledge of the effects of current and past management on wild horses and burros has increased. Long-term research efforts have resulted in viable alternatives to removal-only procedures in controlling herd size. Program goals have expanded beyond simply establishing “thriving natural ecological balance” (setting appropriate management levels) for individual herds, to include achieving and maintaining genetically-viable and self-sustaining populations of healthy animals.

The BLM continues to pursue research in support of the Wild Horse and Burro Program. A final draft of Wild Horse and Burro Strategic Research Plan was reviewed and supported by the National Wild Horse and Burro Advisory Board in August 2002, and the BLM Director’s Science Advisory Board in January 2003. Within this strategy, continuing research on fertility control has been identified as a high priority.

The initiation of fertility control treatment of mares in the Pryors began with the 2001 gather. During this activity five yearlings and one 2-year old female received a single-dose (primer) of PZP contraceptive vaccine. The intent was to prepare these mares to receive a single booster of PZP vaccine, allowing one year of infertility and an opportunity to fully mature before becoming pregnant. Additional fertility control, under the national field trial research protocol, occurred in the summer of 2002. Participation was assessed and determined by EA# MT-010-02-22 (available at <http://www.mt.blm.gov/bifo/whb/doc2.html> or by contacting BiFO) and a Decision Record dated June 14, 2002. The BLM continued with research-based fertility control efforts on the PMWHR in 2003 under EA# MT-010-03-14 and a Decision Record signed June 19, 2003.

The BLM is required to prepare a separate EA for public review and comments prior to proceeding with fertility control on additional mares. As such, this document outlines relevant information about the Pryor Mountain wild horse herd and presents alternatives for the application of additional fertility control within the herd. It also addresses the methods and procedures to be used in implementing this action, and assesses the environmental impacts of such action on the Pryor Mountain Wild Horse Range (PMWHR).

Public comments to the EA, must be submitted in writing, contain original signatures and be postmarked by May 10, 2004 which allows for a 30-day comment period.

The proposed fertility control implementation is scheduled to begin no earlier than July 1, 2004 and will continue until all mares have received a booster vaccine conferring one year of

infertility. Any subsequent fertility control efforts, involving animals not identified in this EA, will be covered by additional NEPA documents.

II. GENERAL AREA , POPULATION DESCRIPTION and BACKGROUND DATA

A. LOCATION: The Pryor Mountain Wild Horse Range (PMWHR) is located in the southeastern portion of Carbon County, Montana and extends into the northern portion of Big Horn County, Wyoming (maps available at <http://www.mt.blm.gov/bifo/whb/information.html> or by contacting BiFO). The range is approximately 13 miles north of Lovell, Wyoming. The PMWHR was created in 1968 by order of the Secretary of the Interior, Stewart L. Udall. This designation was the first of its kind in the United States, and directs that management of the wild horses be within a balanced program, which considers all public values without impairment to the productivity of the land. Henceforth this area has been administered for the protection and management of wild horses, wildlife, and watershed, archeological, recreational, and scenic values. The order also states that the BLM will manage the range in a manner compatible with the Bighorn Canyon National Recreational area, which is adjacent to East Pryor Mountain.

The PMWHR encompasses about 38,000 acres and includes BLM, National Park Service (Bighorn Canyon/Dryhead), Custer National Forest (lower Lost Water Canyon), and private lands (Krueger). Natural topographical barriers (westside - Crooked Creek; eastside - Bighorn Canyon), as well as man-made barrier fence lines to the north and south, restrict the majority of horses to available range. Otherwise the Pryor herd freely roams throughout the range, largely unrestricted by internal fences.

The wild horses are seasonally migratory and winter in the lower and mid-elevations where typical snow-depths range from 0-25 cm. The mid-elevation ridges and plateaus are nearly always snow-free because of wind and exposure to winter sunshine. The horses typically do not spend the winter in the subalpine meadows where snow-depths may exceed 1 m for several months. During other times of the year, and especially in summer, horse distribution seems to be restricted to the upper elevations within easy access of forage and nearby water reservoirs. Additional background information can be found at <http://www.mt.blm.gov/bifo/whb/information.html> or by contacting BiFO.

B. POPULATION DEMOGRAPHICS and GENETIC VIABILITY:

Specific details regarding the appropriate management level (AML) for the herd, colonial Spanish phenotype, population color balance, demographics, genetic viability, and reproductive fitness were addressed within EA# MT-010-01-44, MT-010-02-22 and MT-010-03-14. These documents are available at <http://www.mt.blm.gov/bifo/whb/doc2.html> or by contacting BiFO. The reader is encouraged to review these documents for additional herd descriptive information. Updated information for consideration in the current EA is presented below.

a) Herd Census Activity: The Pryor Mountain wild horse population comprises a harem band

social structure with associated bachelor groups. Individual horses can be recognized by coat color and scars, facial and leg markings, and group association and are tracked annually using a CD-ROM wild horse management database (WHIMS) developed by BRD-USGS researchers (Appendix 1). Within the last decade, population census and monitoring has comprised a combination of aerial census (a maximum of twice annually) and year-round ground surveys by BLM employees, student interns, and public volunteers. The composition of harems and dominant stallions is fluid in nature, and therefore this information is tracked on an on-going basis primarily from May through November of each year.

Since 1996, the herd has averaged 167 total horses. Current estimates place the population at 22 yearlings and 139 adults as of October 31, 2003 (Figure 1; Appendix 1). Based on Spring 2004 mare pregnancy results (Figure 2), a minimum of ~30 foals are expected this year. The impacts of winter (2003-2004) mortality and 2004 foal births on the herd will be determined by field personnel this field season.

b) Herd Social Structure: According to available data (BLM monitoring, Hall, 1972; Garrott and Taylor, 1990; Singer et al, 2000), the number of harems within the PMWHR changes due to population demographics and has increased from 18 to 34 in the last decade. This increase has been correlated with a decreasing number of average mares per harem and an overall increase in the number of male horses on the range. In addition, the population is characterized by having one the highest rates of mare interchange between harem stallions recorded for wild horse herds. An average of 50% of all mares interchange between harems each year (Figures 3 and 4). Sometimes foals are abandoned or injured and subsequently die because of this activity (Figure 5). Furthermore, a high rate of interchange activity between harems appears to be the "norm" for yearling and especially two-year old mares (Figure 6). This interchange activity has resulted in a fairly fluid or unstable social structure and one where the stallions seem to be the dominant decision-makers on the range.

c) Herd Age Structure/Sex Ratio: A typical age structure for a wild ungulate herd would be pyramidal in shape with the majority of animals in the youngest age categories. This has historically been (Perkins *et al*, 1979), and currently is (Figure 1), the structure for the PMWHR herd. There is a tendency for some age groups to be under-represented and either age selective management or mortality has contributed to this condition. The maximum age of horses on the range appears restricted, with limited numbers of horses older than 15-16 years. It is probable that environmental conditions such as severe winters have contributed to this pattern.

The herd has experienced wide variations in sex ratio (Figure 7) over the years. Wide variation has especially been seen in the foal crop during the last decade. Researchers (Singer *et al*, 2000) have indicated that an emphasis on the production of male foals suggests females may be in overall better condition. The result has been a herd sex ratio slightly in favor of males.

d) Mare Foaling Rates and Foal Survival: Current estimates of herd foaling success are indicative of a healthy and productive wild horse population. Research efforts characterize the herd as having a moderate foaling rate of ~52% (Figure 8), with noted variation among age classes of mares (Figure 9). Long-term trends in foal production indicate an annual birth of 33

foals with an average of 26 surviving foals (Figure 10). Foaling takes place primarily in the months of May-June (Figure 11) although some variation is present each year. Mares aged 3-13 years appear to primarily contribute to foal production (Figures 9 and 12), and, in general, yearling conception is limited in this herd. Harem stallions are primarily 5-15 years of age (Figure 17).

Annual rates of population increase have varied tremendously (Figure 13) in this herd. More recently (1996-2003), foal survival has been impacted as much as 30% by mountain lion and black bear predation as well as mare interchange related foal injuries and foal abandonment (Figures 14 and 16). This level of foal loss has not been recorded pre-1996. The recent increase in foaling by 3 year olds in 2000 and 2001 (Figures 12 and 15) may have been a population response to this reduced foal survival in 1999 and 2000 (Figure 14). Previous fertility control treatment has resulted in no foals being produced by three-year olds in 2003 (Figure 12).

e) Herd Natural Mortality: Data from earlier research studies (see 2001 Gather Plan, MT-010-1-44) have been used to define patterns of natural mortality (due to predators, disease, and environmental exposure) within the Pryor Mountain wild horse herd. These data have been compared to known deaths and carcass retrieval information from more recent studies (Figure 16), as well as age-class related survival estimated from tracking known individuals on the range. There appears to be relatively limited mortality across most age classes, with more deaths occurring among younger and older horses (Figure 16). It also appears that females are more susceptible to a shorter lifespan, perhaps as a result of energy expenditure over years of foal production.

f) Herd Genetic Viability: According to recent studies by Cothran (2002) and Cothran and Singer (2000), current levels of genetic diversity within the Pryor Mountain herd appear to have limited vulnerability to inbreeding depression. In fact, genetic variation is relatively high for a wild horse population and well above the mean for domestic breeds. The impact of inbreeding is apparently much less than would be expected in a horse population of its current size. Since inevitable loss of genetic variation could reduce long-term adaptability and survivability of the herd, it is important to continue to regularly track herd diversity.

A primary concern is that the current level of herd genetic variation is based on high allelic diversity within the herd. Over 50% of this material is considered rare and present at low frequency levels. These alleles are at a relatively high risk of being lost, especially at low population sizes (<200 animals). Due to the relatively long generation time of horses (~10 year span) and the long reproductive life span of individual horses, maintenance of genetic variability within the population is not yet at a critical level. There are, however, several alternative management strategies, which can be used to promote genetic conservation within the herd (BLM Wild Horse and Burro Population Viability Forum Recommendations, 1999).

From a management standpoint, increasing population size is not always an effective method of conserving herd genetic health. For example, if management suggests setting a conservation goal for maintaining 90% of existing diversity over the next 200 year period, then Gross (2000a) has demonstrated that the Pryor herd size would need to be increased to levels far beyond that which

the Pryor range could sustain (see 2001 Gather Plan, MT-010-1-44). However, other alternatives do exist and these management concepts and impacts have been modeled for the Pryor herd and subsequently published in peer-reviewed journals by Gross (2000b). Any management action that serves to delay the age of first reproduction for mares (by removing or contracepting young mares) would reduce the number of lifetime matings for those animals. This would act to reduce the total loss of genetic material from the herd (genetic drift), and serve to conserve genetic variation over time. Also, any management activity which serves to increase male participation in breeding (a herd sex ratio slightly in favor of males resulting in more, smaller harems) will promote genetic diversity within the herd. Observational monitoring has noted both an increase in harem numbers as well as relatively uniform foal contribution by individual stallions since 1996 (Figures 17 and 18).

III. PROPOSED MANAGEMENT ACTION:

Compassionate-Use of Fertility Control on Yearling Mares, Two-year Old Mares and Mares 14 Years of Age and Older

A. PURPOSE: Under this alternative, all yearling and two-year old mares, as well as those 14 years and older (as of April 1, 2004), currently on the range, would receive contraception. In support of **compassionate-use*** of fertility control, BLM is recommending that all 10 yearling and 4 two-year old mares (Figure 1; Appendix 1) within the Pryor herd receive primer and booster doses (or just booster doses) of immunocontraceptive Porcine Zona Pellucida (PZP) vaccine. The vaccine would induce one year of infertility, allowing the mares to mature in a healthier condition, before becoming pregnant and producing and supporting a foal. Contracepting younger mares also affords advantages to herd genetic diversity and this has been researched and evaluated for the Pryor herd (Gross, 2000a,b). Individual contracepted mares would have their genetic contributions delayed but not removed from the herd.

Compassionate-use of fertility control would undoubtedly benefit older mares as well. This has been clearly demonstrated for older mares on Assateague Island National Seashore (Turner and Kirkpatrick, 2002). Most mares on the Pryors start producing by age three and then steadily produce foals either every year or every other year. Generally foal production ceases by the 16th year on the Pryors (Figures 9, 12 and 15). Most mares do not live much beyond this age (Figures 1 and 16). Contraception would permit older mares a year or more of existence on the range in better physical condition. As all of these mares have already made genetic contributions to the herd (data on file at BiFO), there would be minimal impact to the genetic diversity of the herd by reducing their lifetime contribution by an estimated one foal per mare.

Therefore, the Billings Field Manager proposes to apply fertility control to age-specific younger and older wild horse mares, under a compassionate-use application, in order to achieve and maintain a healthy and genetically viable Pryor Mountain wild horse population.

*** Compassionate-use is defined as “the use of a tool (or in this case a fertility control agent) to improve the quality of life of another (in this case a younger or older wild mare).”**

B. NEED: In the last 8 years (1996-2003), BLM monitoring has shown that a total of 6 two-year old mares and 30 three-year old mares have produced foals (Figure 15). Their contribution to annual production has averaged <1 foal per year from the two-year old age class, and ~4 foals per year from the three-year old mares (Figure 12). The largest annual contribution from three-year old mares was in 2000 and presumably in response to notably increased foal mortality the year before. In several cases, the energetic demands of gestation and/or lactation had deleterious impacts on these mares. Since 1996, several young mares have lost their foals. In fewer cases, both mare and foal died. Young mares have also suffered serious injuries presumably during a prolonged or difficult labor. All young mares have been in poor body condition post-foaling (1-2 condition factor, out of a possible 5), in stark contrast to young mares that were naturally delayed in foal production. Several of these mares have taken 1-2 years to improve their condition. Several of these mares and one foal were removed from the range during scheduled gathers, for adoption purposes, due to concerns about survivability on the range.

Currently there are 7 mares, 14 years of age and older (Figure 1; Appendix 1), on the range. Spring 2004 pregnancy data (Figure 2) indicate that 5 of these mares will probably foal in 2004. The pregnancy status for the other 2 mares is undetermined at this time. Monitoring has indicated that since 1996, these older age classes of mares have produced an average of 2 foals per year (Figure 12). It is likely that the older pregnant mares will not naturally conceive in 2004 nor produce a foal in 2005. The application of a one-year agent would delay pregnancies in 2005 as well. This would allow these mares at least 2 years of recovery post-foaling, providing some opportunity for improvement in physical condition and health. By 2006, most of these mares would be old enough to succumb to natural mortality.

C. OBJECTIVES: The objectives of this proposed action are to:

- 1) implement the compassionate-use of a one-year fertility control agent to 14 young mares and 7 older mares on the PMWHR;
- 2) specifically provide fertility control primers and boosters (at least one month apart) to 10 yearling mares born in 2003 (Appendix 1);
- 3) specifically provide fertility control boosters to 4 two-year old mares (Appendix 1);
- 4) specifically provide a fertility control primer and booster (at least one month apart) to 1 fourteen year-old mare and boosters only to 3 fifteen-year old mares, 2 sixteen-year old mares and 1-eighteen year-old mare (Appendix 1);
- 5) conduct safe, successful and minimally-intrusive remote-delivery of fertility control vaccine in the field (Appendix 2);
- 6) support recommendations within the Wild Horse and Burro Strategic Research Plan and conduct monitoring under research protocol within the BLM National Wild Horse Fertility Control Field Trial program including impacts on herd foaling rates, foaling seasonality, herd genetic viability, and individual mare body condition, fitness and behavior.

Fertility control provided in the summer of 2004 would impact 2005 pregnancies only. Impacts of the proposed action on herd demographics including size, age structure and sex ratio, over time, have been evaluated. The numbers, age, and sex of animals for the proposed action are supported by recent research on genetic viability of the herd (Gross, 2000a,b). The Proposed management action has also been evaluated using WinEquus (Wild Horse Population Model

Version 1.4; April 2, 2002) developed by Dr. Stephen Jenkins, Associate Professor, University of Nevada, Reno and available at <http://unr.edu/homepage/jenkins>. Details on all completed research efforts have been made available to the public on an on-going basis and parameters and output for specific population modeling runs are on file at the Billings Field Office (BiFO).

D. PROPOSED FERTILITY CONTROL AGENT: At this time, all published research indicates that the Immunocontraceptive Porcine Zona Pellucida (PZP) vaccine meets BLM requirements for an ideal contraceptive agent including criteria for safety and efficacy (Appendix 2). When injected, PZP vaccine acts as an antigen and causes the mare's immune system to produce antibodies. These antibodies then bind to eggs in the mare's ovaries and effectively block sperm binding and fertilization (ZooMontana, 2000). The vaccine is relatively inexpensive (\$20 per dose), can be remotely administered in the field, and requires a single annual booster dose to confer infertility for one breeding season. Extensive research has demonstrated that contraceptive efficacy is 90% for mares treated twice in the first year and annually thereafter (Turner and Kirkpatrick, 2002). Research has also shown that contracepted mares clearly show improvements in body condition and may actually live longer (Turner and Kirkpatrick, 2002). From a mare physiological standpoint, PZP contraception appears to be temporary (Kirkpatrick and Turner, 2002), does not appear to cause out-of-season births (Kirkpatrick and Turner, 2003), and has no ill effects on ovarian function if contraception is not repeated for more than 5 consecutive years on a given mare.

If mares are already pregnant, research has shown that PZP vaccine will not affect normal development of the fetus, hormone health of the mare or behavioral responses to stallions (see EA# MT-010-02-22, Appendix 6). Recent behavioral studies with the Assateague Island and Shackleford Banks wild horses (Powell, 1999; Rogers, 2001) have shown that contracepted and non-contracepted mares had virtually identical activity budgets, associated in a similar manner with the harem stallion and showed no increase in harem exchange behavior or change in their social status during the study. All mares affected by the proposed action would continue to be monitored for body condition and aspects of social behavior. The latter would be compared to existing baseline data and control studies (Anderson, 1998; Jenson, 2000; Harty, 2000; Meredith, 2001, BRD/USGS, 2003).

E. VACCINE QUALITY and REMOTE-DELIVERY PROTOCOL: All PZP vaccine used on mares within the PMWHR would be provided by the Science and Conservation Lab (SCC), ZooMontana and subjected to quality control testing (see EA# MT-010-02-22, Appendix 7). All documented aspects of PZP vaccine provision, mare selection, vaccine remote-delivery, dart recovery, record keeping, veterinary emergencies, and media relations would be strictly adhered to by all participants in the proposed action (Appendix 2). This protocol shall serve as the Standard Operating Procedures (SOPs) for this proposed management action. Implementation of the SOPs would take into consideration all safety concerns, individual animal health and condition, seasonal distribution of the horses, as well as local weather and environmental considerations.

Due to known summer horse distribution during the months of July, August and September (see EA# MT-010-02-22, Appendix 8), it is anticipated that most darting activity would take place in

the upper elevations of the PMWHR. Minimal darting activity is also expected on the National Park Service (NPS) portion, Bighorn Canyon National Recreation Area, of the horse range and within upper elevation Custer National Forest lands (USFS) outside of the designated horse range. Permission was sought and has been granted by responsible management agencies to dart in these other areas, as necessary.

F. PERMISSION and CRITERIA for VACCINE USE: The Humane Society of the United States (HSUS) has made the PZP vaccine available to the BLM under the Investigational New Animal Drug exemption (INAD #8857) filed with the federal Food and Drug Administration (FDA) (see EA# MT-010-02-22, Appendix 9). As a condition of using the PZP vaccine, the HSUS expects the BLM to follow the Draft Criteria for Immunocontraceptive Use in Wild Horse Herds recommended by the Wild Horse and Burro National Advisory Board in August 1999 (see EA# MT-010-02-22, Appendix 10). BiFO, in its management of the PMWHR, is in full compliance with all pertaining criteria.

G. CONFORMANCE with NATIONAL RESEARCH: The BLM has developed a long-term research strategy for the Wild Horse and Burro Program. A final draft of the Strategic Research Plan was reviewed and supported by the National Wild Horse and Burro Advisory Board in August 2002, and the BLM Director's Science Advisory Board in January 2003. Within this strategy, continuing research on fertility control is identified as a high priority and directions are provided in the National Wild Horse Fertility Control Field Trial Plan (FCFTP) (Singer and Coates-Markle, 2002). The implementation of additional fertility control field trials, under this research protocol, began in the summer 2002.

The proposed action would adhere to all guidance and research protocol set by the oversight documents. The intent of this research is to answer those remaining questions and concerns about fertility control using PZP that are best answered on free-ranging populations in the wild. The plan details protocols for injections, experimental design, and research methods that will be employed to evaluate effects of PZP on free-ranging animals. The research focuses on the effects of immunocontraceptive treatment on seasonality of foaling, any possible compensatory reproduction of mares post-treatment, duration of estrus cycles, population growth rates, and harem behavior. The behavior and fertility of the treated mares will be studied both during the treatment phase, and for a minimum of two years post-treatment to assure that a return to normal fertility occurs. The first annual report detailing 2003 field efforts (BRD/USGS, 2003) is on file at BiFO.

H. AUTHORITY for PROPOSED ACTION: The Wild Free-Roaming Horse and Burro Act of 1971 (Public Law 92-195) as amended, Section 3(b)(1), states that the Secretaries of the Interior and Agriculture shall "determine appropriate management levels of wild free-roaming horses and burros on areas of public lands; and determine whether appropriate management levels should be achieved by the removal or destruction of excess animals, or other options (such as sterilization or natural controls on population levels)." The authority may also be found at Title 43 of the Code of Federal Regulations (CFR-4700, Protection, Management and Control of Wild and Free-Roaming Horses and Burros).

With implementation of the proposed action, age-specific wild horse mares would be contracepted under a compassionate approach for a one-year period in accord with 43 CFR 4700.0-6 which identifies that [...wild horses]" shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat," and with Public Law (PL) 92-195 Sec 3 (b) (2) which identifies the need to maintain appropriate management levels of wild horses within their herd management area (HMA).

I. CONFORMANCE with EXISTING LAND USE PLANS: The Billings Resource Management Plan Final EIS (Sept.1984), Record of Decision, has been reviewed and the proposed action is in conformance with objectives of managing a balance between a healthy and viable population of wild horses and improvements in range condition, wildlife habitat, and watershed condition. The Pryor Mountain Wild Horse Range Herd Management Plan (BLM-MT-PT-84-019-4321/June 1984), provides the authority to manage the horse herd at an established Appropriate Management Level (AML) and make management decisions on the basis of animal type, conformation, color, age, sex, location and free-roaming behavior. The plan directs that management of wild horses be within a balanced program that considers all public values without impairment to the productivity to the land.

BLM is still developing a revision of the PMWHR Herd Management Plan based on extensive research in areas of herd demographics, genetics and population control, ecosystem health, range condition and trend and updated ecological site inventories. A summary of these efforts was provided in the FY2001 EA and Gather Plan MT-010-01-44. The herd plan revision is presently on hold pending completion of the NRCS Ecological Site Inventory for the horse range. This document is nearing completion. At a result, BiFO expects to have a revision document available for public review within 2005.

IV. ALTERNATIVE MANAGEMENT ACTIONS: The following represents a reasonable range of alternatives based on the issues and goals identified through public scoping efforts and results of multi-agency, multi-institutional research efforts on fertility control and herd genetic viability.

A. Use of Fertility Control on All Ages of Wild Mares

Under this alternative, all breeding-aged mares, currently on the range, would receive contraception. Mares would need to be gathered and brought into Britton Springs for primer and booster shots, or the vaccine could be remotely-delivered in the field. Research studies on east-coast barrier island populations indicate that, for population growth control purposes, at least 80% of all breeding aged mares must receive annual vaccine boosters for each year of desired infertility. This level of mare infertility may also be required to achieve zero population growth within the Pryor herd.

This alternative was considered but eliminated from further analysis due to unacceptable impacts on the population at this time. Currently, it is not a PMWHR management goal to control population growth rates by fertility control. The intent of the proposed management action is the compassionate-use of fertility control and to support research on the effects of infertility

treatment on foaling seasonality, duration of estrus, population growth rates, mare and harem behavior, and possible compensatory reproduction. Further analysis of these issues, as well as the increasing impacts of predation and other natural mortality on the herd, is needed prior to further consideration of this alternative.

B. No Action Alternative: No Use of Fertility Control on Wild Mares

Under this alternative, no mares would receive fertility control for compassionate reasons. Neither PZP immunocontraceptive vaccine primers nor boosters would be given to any yearling, two-year old or mares 14 years of age and older. These mares would be allowed to conceive naturally and potentially be subjected to the physiological constraints of foal production at either an early or late age. A total of 21 mares would be affected with a maximum potential for 7-8 foals in 2006 (based on an average 52% herd foaling rate and 70% foal survival). Given that the yearling and older age classes of mares produce less than the herd average (Figures 9 and 15), live foal production from these age classes would likely be less than this estimate.

This alternative was considered but eliminated from further analysis because of unacceptable impacts on the future body condition and fitness of the 2004 yearling, two-year old and mares 14 years of age and older. Given the probability that no more than 10% of the 10 yearlings may conceive in 2004 and produce a foal in 2005, fertility control would prevent these mares from conceiving again in 2005. This would allow at least a year of recovery following foal production in these young mares. The remaining 90% of the yearling age class would probably not conceive in 2004, and due to fertility control, conception would be delayed until 2006 when they are 3 years of age. This delay in conception would allow these mares the opportunity to fully mature before becoming pregnant and in all likelihood improve primiparous (first time foaling) mare and foal condition and survival.

Spring 2004 pregnancy data indicate that at least one two-year old mare is going to produce a foal this year (Figure 2). It is likely that up to 50% of this age class may conceive in 2004 and produce foals in 2005 as 3-year olds. Fertility control in 2004 would not impact existing pregnancies, but would prevent conception in 2005. This would allow at least a year of recovery following foal production in these young mares. Within the remaining half of this age class then, fertility control in summer 2004 would delay pregnancy until 2006 (as 4-year olds). Once again, this delay in conception would allow these mares the opportunity to fully mature before becoming pregnant and in all likelihood improve primiparous mare and foal condition and survival.

Spring pregnancy data (Figure 2) indicates that 5 of the 7 older mares will foal in 2004. In all likelihood, these mares will not conceive in 2004 but may again in 2005. Fertility control would prevent the pregnancies in 2005 and reduce foal production in these age classes by an estimated 2 foals in 2006. By 2006, all of these mares would be at least 16 years old with their physical condition showing the demands of lifetime foal production. Death generally occurs shortly thereafter. A very few Pryor mares have survived 3-4 years past their last foaling year, and generally in very poor physical condition. Fertility control may allow these older mares improved fitness and condition in later life.

V. AFFECTED ENVIRONMENT, ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES:

A. AFFECTED ENVIRONMENT: : The purpose of this section is to provide the reader and decision-makers with a listing of the resource values which are known to occur within the Pryor Mountain Wild Horse Range. Detailed descriptions and discussions of these resource values can be found in the Affected Environment, Environmental Impacts and Mitigation Measures section of the EAs for the FY2001, FY2002 and FY2003 PMWHR management decisions (MT-010-1-44, MT-010-02-22 and MT-010-03-14 respectively). These documents are available at <http://www.mt.blm.gov/bifo/whb/doc2.html> or by contacting BiFO. The reader is encouraged to review these documents. Updated information for consideration in the current EA is presented below.

Table 1. Summary of Critical Elements & Other Resources of Concern within The Human Environment.

Element	Present	Not Present	Element	Present	Not Present
Sensitive, Threatened or Endangered Plant Species	X		Range and Watershed Condition	X	
Cultural and Paleontological Resources	X		Native American Religious Concerns	X	
Wilderness Study Area	X		Sensitive, Threatened or Endangered Wildlife Species	X	
Water Quality (surface or ground water)	X		Fisheries Habitat	X	
Visual Resources Recreation, and Hunting	X		Areas of Critical Environmental Concern (ACECs)	X	
Climate and Air Quality	X		Wetlands and Riparian Areas	X	
Hazardous Waste	X		Livestock Grazing and Trailing	X	
Pryor Mountain Wild Horses	X		Vegetation	X	

Soils	X		Terrestrial Wildlife	X	
Social Economic Concerns	X		Forestry/Timber	X	

The following resources of concern, although present, were determined not to be affected or impacted by the proposed action and will not be discussed further in this EA: Climate and Air Quality; Cultural and Paleontological Resources; Threatened, Endangered, Candidate, or Sensitive Wildlife Species; Sensitive, Threatened or Endangered Plant Species; Range and Watershed Condition; Soils; Water Quality (Surface or Ground Water); Native American Concerns; Social Economic Concerns; Forestry/Timber; Fisheries Habitat; Wetlands and Riparian Areas; Livestock Grazing and Trailing. The remaining resources (**in bold**) will be evaluated for potential impacts and mitigation measures.

B. ENVIRONMENTAL IMPACTS and MITIGATION MEASURES: Resources impacted by the proposed action: **Compassionate-Use of Fertility Control on Yearling Mares, Two-year Old Mares and Mares 14 Years of Age and Older** will be evaluated for direct, indirect and cumulative consequences. Mitigation measures will be provided as needed. No irretrievable or irreversible impacts to any resource value are anticipated (with the exception of a possible 21 wild mares which may be successfully contracepted for one year only) with implementation of the proposed action.

1) Pryor Mountain Wild Horse Herd: The proposed action incorporates proven Standard Operating Procedures (SOPs) which have been developed over time (Appendix 2). These SOPs represent the “best methods” for ensuring quality results, minimizing risks and reducing impacts associated with this activity. All activity would be carried out according to current BLM, HSUS and ZooMontana policy with the intent of conducting as safe and humane an operation as possible. In addition, the proposed action would also adhere to all guidance and research protocol set by the BLM National Wild Horse Fertility Control Field Trial program (FCFTP). Protocol have been specifically developed for remote-delivery techniques of fertility control vaccine. If conditions warrant, and animal health or welfare is in jeopardy at any time, remote-darting would be delayed or halted.

Impacts to the wild horses take the form of direct and indirect impacts and may occur on either the individual or the population as a whole. Direct individual impacts are those impacts which occur to individual horses and are immediately associated with implementation of the proposed action. These impacts include stress associated with the remote-darting activity for delivery of the fertility control vaccine. The intensity of these impacts vary by individual, and are indicated by behaviors ranging from nervous agitation to physical distress. There are no indications that these direct impacts persist beyond a short time following the stress event. There would be an additional impact to individual animals at the isolated injection site following receipt of the dart and vaccine. These impacts (granulomas, abscesses) are monitored on a regular basis under research protocol set by the FCFTP and have been discussed at length in reviewing previous

treatment efforts with the Pryor horses (BRD/USGS, 2003). Mortality and/or permanent injury of individuals from this impact is unlikely.

In order to mitigate the impacts of the proposed fertility control, all vaccine would be controlled, handled and administered by a lead researcher in fertility control, Dr. Jay Kirkpatrick, ZooMontana, or a trained, certified and experienced associate. Dr. Kirkpatrick has been responsible for the remote-delivery of PZP vaccine on various east-coast barrier island wild horse populations for over 16 years. In addition, knowledgeable and experienced BLM personnel would be on-site, during all phases of the operation. These BLM employees would be responsible for the accurate identification of individual age-specific mares. A contract veterinarian would be on-call, at all times during the operation. Possible veterinary emergencies have been discussed in detail within the SOPs. Observers are welcome, but in order to decrease additional stress and disruption to the animals and the operation, would be asked to remain a safe distance from the animals during all phases of darting (see Appendix 2).

Indirect individual impacts are those impacts which occur to individual horses after the initial stress event, and may develop as a result of the application of fertility control vaccine. Some of these impacts have yet to be noted and documented for wild horses in the scientific literature but may include increased social disorder among the horses and/or a prolonged foaling season. The proposed action may also result in an opportunity for increased fitness and body condition in a maximum of 21 younger and older mares prior to or immediately following foaling. Other potential physiological impacts of the PZP vaccine were discussed under the specifics of the proposed action. All mares subjected to fertility control would continue to be monitored for aspects of social behavior, body condition and foaling under the guidance and research protocol set by the FCFTP. Behavioral data would be compared to existing baseline data and control studies on the Pryors (Feist, 1971; Anderson, 1998; Jenson, 2000; Harty, 2000; Meredith, 2001; BRD/USGS, 2003).

Population-wide direct impacts are immediate effects which would occur during or immediately following implementation of the proposed action. Direct population-wide impacts might consist of a heightened awareness of human presence. This is likely to be temporary in nature but may persist for several days following the darting activity. Repeat remote-darting activity in 2003 did not appear to cause additional horse/harem sensitivity or stress beyond monitored levels in 2002 (BRD/USGS, 2003).

Population-wide indirect impacts would not appear immediately as a tangible effect and are more difficult to quantify. These are primarily associated with the use of fertility control drugs and reductions in short term fecundity in treated wild mares. A total of 21 mares would be affected with a maximum potential loss of 7-8 foals in 2006 (based on an average 52% herd foaling rate and 70% foal survival). Given that the yearling and older age classes of mares produce less than the herd average (Figures 9 and 15), live foal production from these age classes would likely be less than this estimate.

This one-time effect of age-specific fertility control is not expected to have a significant impact on average herd size, sex ratio or age structure over time. This proposed action (in combination

with previous fertility control and removal actions) has been evaluated using WinEquus (Wild Horse Population Model Version 1.4; April 2, 2002). Parameters and output for specific population modeling runs are on file at the Billings Field Office (BiFO). Modeling efforts forecast that the cumulative impacts of management actions on population dynamics are not expected to reduce herd growth rates below a sustainable level. In addition, available research indicates that delaying the age to first reproduction for younger mares would result in positive genetic benefits to the herd over time. As all of the proposed older mares have already made genetic contributions to the herd (data on file at BiFO), there would be minimal impact to the genetic diversity of the herd by reducing lifetime contribution by an estimated one foal per mare. Thus no cumulative impacts to the long-term viability of the herd are expected with the proposed action.

2) Wilderness Study Areas (WSA): Impacts and mitigation measures pertaining to the proposed actions have been previously addressed in the Affected Environment, Environmental Impacts and Mitigation Measures section of the EA and Gather Plan for the FY2001 PMWHR Gather and Selective Removal (MT-010-1-44) and the EA for the Humane-Use of Fertility Control on Select Young Wild Horse Mares (MT-010-02-22). These documents are available at <http://www.mt.blm.gov/bifo/whb/doc2.html> or by contacting BiFO. The reader is encouraged to review these documents.

3) Visual Resources, Public Recreation and Hunting: Impacts and mitigation measures pertaining to the proposed action have been previously addressed in the Affected Environment, Environmental Impacts and Mitigation Measures section of the EAs for the FY2001 (MT-010-1-44), FY2002 (MT-010-02-22) and FY2003 (MT-010-03-14) PMWHR management decisions. These documents are available at <http://www.mt.blm.gov/bifo/whb/doc2.html> or by contacting BiFO. The reader is encouraged to review these documents.

Updates on remote-darting activity will be made available upon request. The public and/or media are encouraged to contact BiFO (405-896-5013) with questions.

4) Areas of Critical Environmental Concern (ACEC): The East Pryor Mountains (including the PMWHR) were designated ACEC in March 1999. The area is to be managed per VRM Class II objectives. Most horse access and darting activities are likely to happen on foot within reasonable hiking distances of wilderness roads. Therefore any impacts would be considered as temporary disturbances and no irretrievable, irreversible, or cumulative impacts to any identified ACEC values are anticipated with implementation of the proposed action.

5) Vegetation: Adverse impacts to vegetation with implementation of the proposed action would include slight surface disturbance and trampling of native vegetation, to some extent, during the darting process. Most horse access and darting activities are likely to happen on foot within reasonable hiking distances of wilderness roads. Therefore any impacts would be considered as temporary disturbances and no irretrievable, irreversible, or cumulative impacts to vegetation are anticipated with implementation of the proposed action.

6) Terrestrial Wildlife: Under the proposed actions, the potential exists for a temporary

displacement of wildlife from disturbance associated with the darting activity. These impacts would be temporary and none would persist beyond a few hours of the darting procedure. No impact to avian species would be expected.

During field activities, the decision to dart a horse would ultimately rest with the designated darter. The accessibility of the horse at a particular point in time and location would trigger the decision-making process. The gun would remain unloaded until the horse has been selected and it is safe to proceed. The presence of wildlife in the vicinity would also be taken into consideration. The Dan Inject dart-gun would not be used at ranges in excess of 30 meters. No attempts would be made when wildlife are lingering within a 30 m radius of the target animal. No attempts would be made in high wind.

7) Waste, Hazardous or Solid: Syringes, darts, needles, vaccine containers, etc. used in the administration of the immunocontraceptive vaccine are considered regulated medical waste. Regulated medical waste must be placed in leak proof containers that are contained in a red plastic bag labelled medical waste. Medical waste must be handled and transported separately from other waste to an approved disposal facility. The amount of regulated waste that would be generated by the proposed action would be minimal and not result in any threat to the environment.

VI. CONSULTATION AND COORDINATION: Through the process of public scoping for the Pryor Mountain Wild Horse Range Herd Plan Revision, which has included two public meetings as well as the submission and summary of significant written comments, BLM has received and reviewed input regarding herd genetic viability as well as population control techniques. Several mailings went out to the public during this period in order to seek additional input on several other issues being considered in the plan revision. All relevant input was considered in the development of this EA. Previous and on-going extensive research on wild horse fertility control has also been considered. In addition, the results of several research studies on Pryor wild horse population genetics and viability were given detailed consideration. It is significant that these studies involved co-operative efforts with state and federal agencies and academic institutions. Results of previous research efforts as well as the current EA have been mailed to a Pryor Mountain mailing distribution list totaling over 500 individuals and groups (Appendix 3).

A. List Of Preparers:

Linda Coates-Markle, Wild Horse and Burro Specialist, Montana/Dakotas.

B. Individuals, Groups and Agencies Consulted: A letter with notification about the availability of the Fertility Control EA has been distributed to members of the general public, special interest groups, intra- and interagency personnel, and researchers at several different institutions (see Appendix 3) for review and comment. A press release was issued in the local and state media informing the public that the Fertility Control EA has been prepared and is available for review. Copies of the EA are available at the Billings Field Office, BLM, P.O.Box 36800, Billings, MT or by calling 406-896-5013. Comments to the EA may be submitted to the same address.

VII. FONSI: The environment assessment, analyzing the environmental effects of the proposed action, has been reviewed. With the implementation of the attached mitigation measures, there is a finding of no significant impact on the human environment and an Environmental Impact Statement (EIS) is not required. Implementation of the Proposed Action will not result in unnecessary or undue degradation of the Public Lands. In addition, the Proposed Action is in conformance with the appropriate and approved land use and herd management plans.

SIGNATURE OF PREPARER: _____

Date Signed: _____

SIGNATURE OF ENVIRONMENTAL REVIEWER: _____

Date Signed: _____

SIGNATURE OF AUTHORIZED OFFICIAL: _____

Date Signed: _____

VIII. REFERENCES CITED:

Anderson, Erin (1998) Circadian Rhythms and the Effects of Age and Sex on Activity Budgets of Feral Horses in the Pryor Mountain Wild Horse Range. Internship Paper, Dept. of Wildlife, Fish and Conservation Ecology, UC Davis. 8pp.

BLM Wild Horse and Burro Population Viability Forum (2000) Summary Recommendations of PVA Forum April 1999, Ft. Collins, CO. Resource Notes 35: 4 pp.

BLM, BiFO (June 2001) Environmental Assessment and Gather Plan, Pryor Mountain Wild Horse Range, FY2001 Wild Horse Population Gather and Selective Removal. EA#MT-010-1-44

BLM, BiFO (April 2002) Environmental Assessment, Pryor Mountain Wild Horse Range, FY02 Humane-Use of Fertility Control on Select Young Wild Horse Mares. EA#MT-010-02-22

BLM, BiFO (April 2003) Environmental Assessment, Pryor Mountain Wild Horse Range, FY03 Fertility Control on Select Young Wild Horse Mares; Selective Removal of Young Wild Horse Stallions. EA#MT-010-03-14

BRD/USGS (2003) Annual Report on Wild Horse Research and Field Activities. U.S. Geological Survey, Biological Resources Division, U.S. Dept. of Interior, Fort Collins, Co.

Cothran, E.G. (2002) Genetic Analysis of the Pryor Mountain Wild Horse Herd, MT. Report to BLM under CESU Cooperative Agreement No. JSA001013, Task Order No. 4.

Cothran, E.G. and F. Singer (2000) Analysis of Genetic Variation in the PMWH Herd. pp 91-104. (in) Singer, F.J. and K.A. Schoenecker, compilers (2000) Managers' Summary - Ecological Studies of the Pryor Mountain Wild Horse Range, 1992-1997. U.S. Geological Survey, Midcontinent Ecological Science Center, Ft. Collins, CO. 131 pp.

Feist, J. D. (1971) Behavior of Feral Horses in the Pryor Mountain Wild Horse Range. Masters Thesis, University of Michigan, Ann Arbor. 129 pp.

Garrott, R. and L. Taylor (1990) Dynamics of a Feral Horse Population. J.Wildl. Mgt. 54: 603-612.

Gross, J.E. (2000a) Genetic and Demographic Consequences of Removals and Contraception on Wild Horses in the PMWHR. pp 105-120. (in) Singer, F.J. and K.A. Schoenecker, compilers (2000) Managers' Summary - Ecological Studies of the Pryor Mountain Wild Horse Range, 1992-1997. U.S. Geological Survey, Midcontinent Ecological Science Center, Ft. Collins, CO. 131 pp.

Gross, J.E. (2000b) Genetic and Demographic Consequences of Removals and Contraception on Wild Horses in the PMWHR. pp 105-120. (in) Singer, F.J. and K.A. Schoenecker, compilers (2000) Managers' Summary - Ecological Studies of the Pryor Mountain Wild Horse Range, 1992-1997. U.S. Geological Survey, Midcontinent Ecological Science Center, Ft. Collins, CO. 131 pp.

- Hall, R. (1972) Wild Horse: Biology and Alternatives for Management, Pryor Mountain Wild Horse Range. Bureau of Land Management, Billings, MT. 116 pp.
- Harty, C. (2000) Pryor Mountain Wild Horse Range: Pre-immunocontraceptive Research, Summer 2000. Internship Paper, Dept. of Fish and Wildlife, Oregon State University, Corvallis, OR., 51 pp.
- Jenson, H. (2000) Social Structure and Activity Patterns among Selected Pryor Mountain Wild Horses. Internship Paper, Dept. of Animal Sciences, Utah State University, Logan, Utah. 86 pp.
- Kirkpatrick, J.F. and A. Turner. (2002) Reversibility of Action and Safety during Pregnancy in Wild Horses Immunized against Porcine Zona Pellucida. *Journal of Reproduction (Suppl. 60)*: 197-202.
- Kirkpatrick, J.F. and A. Turner (2003) Absence of Effects From Immunocontraception on Seasonal Birth Patterns and Foal Survival Among Barrier Island Wild Horses. *Journal of Applied Animal Welfare Science* 6(4): 301-308.
- Meredith, J. (2001) Baseline Daily Social Behavioral Patterns for Selected Pryor Mountain Wild Horses. Internship Progress Report, Dept. of Wildlife Biology, University of Montana, MT 6 pp.
- Perkins, A., Gevers, E., Turner, J.W. Jr., and J. Kirkpatrick (1979) Age Characteristics of Feral Horses in Montana. pp 51-58. (In) Denniston, R.H., Symposium on the Ecology and Behavior of Wild and Feral Equids, University of Wyoming, WY.
- Powell, D.M. (1999) Preliminary Evaluation of Porcine Zona Pellucida (PZP) Immunocontraception for Behavioral Effects in Feral Horses (*Equus caballus*). *Journal of Applied Animal Welfare Science* 2(4): 321-335.
- Rogers, J.E. (2001) The Effects of an Immunocontraceptive on the Social Behavior of Female Feral Horses (*Equus caballus*). BA thesis, Princeton University, N.J.
- Singer, F.J. and Coates-Markle, L.C. (2002) Treatment of Wild Horse Mares with the Immunocontraceptive Porcine Zonae Pullicida Vaccine; Effects on Populations and Behavior. Wild Horse Fertility Control Field Trial Plan. BLM, BRD-USGS, NREC of CSU, and SCC.
- Singer, F.J. and K.A. Schoenecker, compilers (2000) Managers' Summary - Ecological Studies of the Pryor Mountain Wild Horse Range, 1992-1997. U.S. Geological Survey, Midcontinent Ecological Science Center, Ft. Collins, CO. 131 pp.
- Singer, F.J., Zeigenfuss, L., Coates-Markle, L. and Rev. F. Schwieger (2000) A Demographic Analysis, Group Dynamics, and Genetic Effective Number in the PMWH Population, 1992-1997. pp 73-89. (in) Singer, F.J. and K.A. Schoenecker, compilers (2000) Managers' Summary - Ecological Studies of the Pryor Mountain Wild Horse Range, 1992-1997. U.S. Geological Survey, Midcontinent Ecological Science Center, Ft. Collins, CO. 131 pp.

Turner, A. and J.F. Kirkpatrick (2002) Effects of Immunocontraception on Population, Longevity and Condition in Wild Mares (Equus caballus). Journal of Reproduction (Suppl. 60): 187-195.

ZooMontana (2000) Wildlife Fertility Control: Fact and Fancy. ZooMontana Science and Conservation Biology Program, Billings, MT.