

# Feral Horse (*Equus caballus*) Management Plan for South Central Wyoming

Zachary R. Gauthier

April 30, 2019



(Image Source: Pilot Butte Wild Horses)

---

A paper submitted in partial fulfillment of the requirements for the degree of Bachelor of Science  
in Fisheries and Wildlife – Wildlife Concentration at Paul Smith's College.

---

## Table of Contents

Introduction.....	2
Executive Summary.....	3
Natural History.....	4
Social Structure.....	4
Reproduction and Survivorship.....	5
Habitat.....	6
Diet.....	7
Disease.....	8
Conservation Issues.....	9
Economic.....	9
Legal and Regulatory.....	10
Ecological.....	11
Sociocultural.....	11
Statement of Need.....	12
Management.....	13
Goal.....	13
Objectives.....	13
Actions.....	13
Conclusion.....	17
Literature Cited.....	19
Appendix.....	21
Feral Horse Survey.....	21
Poster.....	22

## **Introduction**

The modern horse was first domesticated over 6,000 years ago in the Eurasian Steep known today as Ukraine and Kazakhstan and have been selectively bred ever since. The majority of horse breeds today including feral horse of the western United States can be traced back to two major lineages. The Arabian which is still a breed today which was thought to originate from in the Arabian Peninsula and the now extinct Turkoman from the Eurasian steppe (Price 2017). Extensive studies have been done with fossilized ancient horse remains but at this point, they are all theoretical. We do know that a species genetically similar to the modern horse was in North America 10,000 years ago before there extinction (Kirkpatrick et al. 2010). Feral horses were later reintroduced by European explorers in the 15th century primarily in present-day Mexico (Garrott et al. 1991). During the 17th and 18th centuries, the horse populations spread to larger numbers due to Native American use of the horse and in many cases established into a feral population. Their numbers were then only increased by western expansion of the United States Government, and it was not until the early 1900s did their populations become an issue (Garrott et al. 1991). The effects of feral horse of the western rangeland went widely unstudied until the pass of the Wild and Free Roaming Horse and Burro act of 1971, which gave management of the feral horses to the federal government with the Bureau of Land Management (BLM) currently overseeing their protection (Garrott et al. 1991)(Beever et al. 2000).

## **Executive Summary**

Feral horses are found through our western rangelands in the thousands tho they are not truly “Wild Horses” they are technically feral and were introduced into the western landscape by Spanish conquistadors in the 1500s. In Southcentral Wyoming, there are currently 3,403 adult feral horses within 3,008,875 acres of federal Bureau of Land Management (BLM) which exceeds the appropriate management level (AML) is 1,521-2,104 adults. Feral horse overpopulation is a large strain on the BLM's budget and a political and social hot topic as there

is both support for more horses to be on the range and support for them to be removed. To date, feral horses are federally protected by The Wild and Free-Roaming Horses and Burros Act of 1971 and are managed by the BLM. Feral horses have the potential to double their herd sizes every four years resulting in unchecked populations being able to overpopulate and degrade delicate rangeland ecosystem and utilizing resources crucial for native wildlife. Currently, feral horses are managed by rounding up the excess population via helicopter and removing them from the range to which they are then adopted out or held in captivity in the BLM's care. This management technique works but is time-consuming, expensive and redundant. To more adequately manage feral horses in south central Wyoming an animal roundup will be performed to have a population that is within the AML from which the immunocontraceptive Porcine Zona Pellucida (PZP) will be utilized to lower fecundity to a level that will prevent overpopulation. With this management option, PZP darting will have to be done on an annual basis but will be a much cheaper and socially acceptable option than today's. Once feral horse populations in South Central Wyoming are properly managed the result will be healthier multiple use rangelands for both wildlife, ranchers and recreationist to enjoy.

## Natural History

### *Social Structure*

Feral Horses live in social units that we often call herds, harems or bands. These groups consist of one lead stallion several mares across all age groups and then young stallions (McDonnell et al. 1995). Some herds do have more than one stallion in these cases mares tend to be more defensive over their foals as stallions may kill offspring that is not theirs (Cameron et al. 2003). Bachelor herds are groups of young stallions that live together before they have a herd of their own. It has been shown that when bachelor stallions are in



Figure 1: Shows two stallions fighting, they fight by rearing up and striking there opponent with the front feet and or

these herds they have a lower testosterone level than when in a traditional herd. Bachelor stallions may become lead stallions if they fight a stallion and take over his herd, he may start a herd of his own by attracting females from another herd (McDonnell et al. 1995). Once a stallion transitions to a lead stallion his testosterone levels rise and his behavior changes. At this time they will now spend much less time grazing and resting and will spend the majority of their time roaming around there herd. Fighting and running off competitive stallions and are much more aggressive (McDonnell et al. 1995)

### *Reproduction and Survivorship*

Breeding tends to occur in the spring when mares are most fertile but can happen any time of year as mares and stallions are fertile all year round.

Females have an 11 month gestation period resulting in most foaling occurring in early spring. They typically give birth to one young a year with a 5%

chance of twins. Females have been observed both with young while pregnant showing evidence that they often breed year to year (Wolfe 1980). Feral horses are large long-lived species with an average lifespan of 20-25 years. They are reproductively fertile by 3 years until death with some 2-year-olds being observed with young (Seal 1983). Survivorship of foals averages around 72% and only rises as you move into other age classes. The majority of mortality are recorded in the >15 age class and survivorship of males tends to be slightly higher (Garrott 1990).

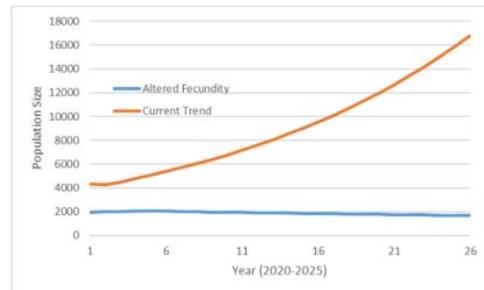


Figure 2. Left illustrates both unmanaged, and proposed management for the next 26 years

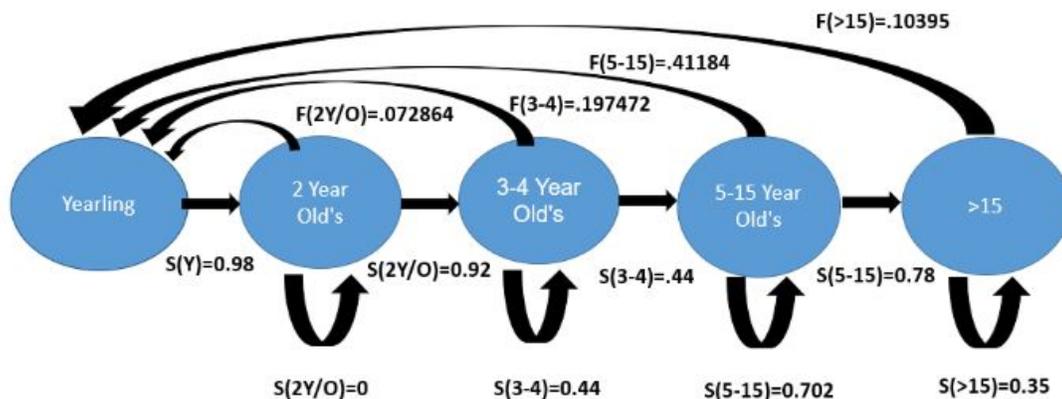


Figure 3. A life history model showing survivability of age classes, fecundity and proportion that move into the next age class. Numbers for this model were taken from a conglomerate of studies used for this management plan. This shows that the 5-15 age class has both the greatest survivorship but also fecundity resulting in rapid population growth.

### Habitat

Feral horse (*Equus caballus*) habitat selection is most often determined by water availability and vegetation cover. Across the US feral horse populations, the greatest limiting factor is water with horses most commonly found on sagebrush steppe or desert areas (Crane et al, 1997). In south-central Wyoming, water is not considered to be a limiting factor on the landscape and has a diverse variety of vegetation both native and standing crops. Thus their populations within this part of Wyoming are not isolated or limited. (Crane et al, 1997). In non-limiting areas such as south-central Wyoming, food type is the greatest influence on habitat selection. It has been found that they spend the most time in sagebrush-grass type habitat over all others, especially during the fall and winter. Saltbrush-winterfat grasslands were highly utilized in late spring and early summer when water is a limiting factor. Large numbers of horses, cattle, and wildlife all congregate at the water. During these times antelope often will not water with horses or livestock (Miller 1983). Ridges are the most utilized form of cover for feral horses. They are utilized for protection from the wind and also key to winter survival due to high winds blowing snow of ridge tops and exposing vegetation (Miller 1983). When looking at available habitat classes compared to their availability it is shown that riparian zones such as streamsidess and bog/meadow habitats are of great importance. This is likely due to the increase of vegetation and

standing crop found there (Crane et al, 1997). Wyoming feral horse habitat is in good shape when not overgrazed by a combination of wildlife, livestock and feral horses, with riparian zones and ridges for travel and suitable microhabitat is crucial.

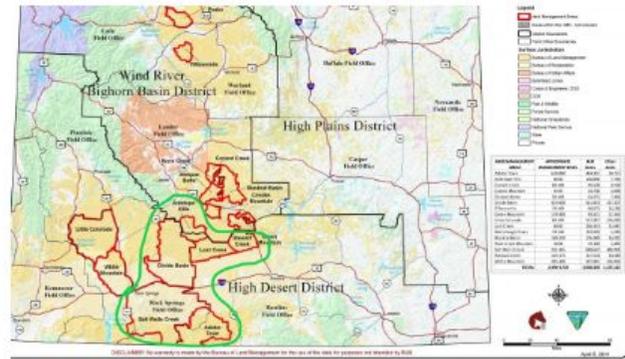


Figure 4. Left shows feral horse and burro populations across the Western United States

Figure 5. Above shows Feral horse populations in Wyoming all red figures are HMAs all the ones within the green outline are in the proposed management plan.

## Diet

Primarily horses are grazers that are most in competition with domestic cattle (Bovidae) that graze on public land via grazing permits from the Bureau of Land Management (BLM) with some competition among Antelope (*Antilocapra americana*) and Elk (*Cervus canadensis*) (Miller 1983). Feral horses spend most of their diurnal hours feeding compared to that of the afternoon idling and no significant difference between traveling times (Crane et al. 1997). When looking at wildlife and livestock dietary overlap it is important to do so while looking at seasonal trends as this determines when wildlife and livestock are foraging and what they are seeking out. When looking at drier areas of south-central Wyoming. The red desert Wheatgrass (*Agropyron* spp.) and Needlegrass (*Stipa* spp.) accounted for 37% and 46% respectively. It is also some of the largest forage value for elk cattle and sheep but not antelope (Olsen et al, 1997). In areas of

south-central Wyoming where water is not as limited both Wheatgrass and Needlegrass are of high forage value but also with the addition of sedges (*Carex* spp.). This could be largely due to the excess riparian vegetation zones (Crane et al. 1997). Feral horse most often will select areas for food over water especially during winter and other cold temperature months suggesting that food is most often the limiting factor in feral horse dispersal is quality forage over water, but during summer months horses do stay within 4.8 km of a water source and during time of drought will become aggressive for water (Miller 1983). Domestic cattle can more easily be removed from the range than feral horses. Therefore the best management practices to be utilized after horse populations are brought back down to an appropriate level is to ensure range health by strictly monitoring range conditions and slowing the feral horse population growth to ensure healthy range conditions.

### *Disease*

When the Bureau of Land Management rounds up feral horses they are tested for a multitude of common equine diseases including Equine infectious anemia, Eastern and Western equine encephalomyelitis, Tetanus, Equine influenza, Equine herpesvirus, West Nile virus, Strangles, and Rabies (Anderson 2015). Today the majority of these diseases are more prevalent in domestic horses than feral populations. They are also susceptible to clubfoot and other skeletal deformities that often lead to death. As well as a multitude of parasitic worms that are common among livestock and often are transmitted from grazers to other grazers.

Despite it being incredibly rare in the United States, today Equine Infectious Anemia (EIA) is one of the most feared diseases in the equine world. First discovered in the 1930s, it hit record highs during the '60s and '70s with 10,371 known cases in 1975 alone. Today all horses that cross state lines must have a negative Coggins test. This is a blood test that screens for multiple diseases including EIA (Cordes 2014). Most common vectors for EIA are biting blood sucking insects most common being horse flies (*Tabanidae*) that carry the disease on mouth parts from horse to horse (Cordes 2014). Today most cases of EIA can be traced back to a man, typically from the use of needles and other veterinary medical supplies. When horses do test positive for

EIA euthanasia is the most common treatment. EIA is a particularly nasty virus and it has the ability to spread because of its high ability to mutate. As the disease is passed from vector to vector the disease often gets more severe and infectious (Cordes 2014). Controlling the virus is done by preventing the spread and euthanizing infected horses. All infections must be reported to the United States Department of Agriculture (USDA), there is no vaccine to date because of the virus's ability to mutate.

Once the equid is infected by the virus acute signs of the disease typically consist of a fever which is often associated with other causes and often occurs within 2-3 weeks of the infection. If the equid survived the acute bout and enters into the clinical phase in which more symptoms typically occur such as fever, petechial hemorrhages, depression, weight loss, dependent edema and anemia (USDA). There is a final stage of infection in which called inapparent carriers that results in a positive Coggins test but no symptoms shown, the less developed the disease is in the equid the more infectious the horse's blood is with inapparent carriers. It would take nearly 1 in 6 million horse fly bites to result in a successful transmission (USDA).

## **Conservation Issues**

### *Economic*

When analyzing the economic factors feral horses have on the western rangelands the negative values far out weight the positive. Feral horses like most nonnative species cost both the federal government and private businesses a significant amount of money. Horse based tourism is an up incoming form of vacationing often overlooked that has the potential to cover some of the costs of managing feral horses. Black Hills Wild Horse Sanctuary in South Dakota raises up to half of there operating money through the 20,000 people that visit them annually (Notzke 2016). Feral horses off the east coast attract tens of thousands of people to watch them be rounded up. An auction to sell the excess population in which the proceeds of this event help maintain the herd and fund the local fire department (Notzke 2016). Wild horse benefits include recreational viewing, other nonconsumptive uses and their value to foster homes after their capture and

adoption. Negative costs associated with feral horses are the loss of forage on the landscape for both livestock and more profitable wildlife, management costs, running public foster homes and negative externalities such as unwanted feral horses grazing of private land (Bastain 1999). The cost in the 1980s to round up and capture horses was \$165 per head coupled with a \$2.25/ day to keep them in holding facilities. This resulted in 92 million taxpayer dollars being spent on wild horse management between 1980 and 1988 (Bastain 1999).

### *Legal and Regulatory*

The BLM is the primary agency that oversees the health and management of the wild horse population with assistance from the US Forest Service. The BLM's mission is "to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations" and are responsible to uphold this on 264 million acres (Glover 2001). As previously mentioned the Act of 1971 charges the BLM with the care of wild horses on federal land as Congress stated that "Congress finds and declares that wild free-roaming horses and burros are living symbols of the historic and pioneer spirit of the West; that they contribute to the diversity of life forms within the Nation and enrich the lives of the American people; and that these horses and burros are fast disappearing from the American scene. It is the policy of Congress that wild free-roaming horses and burros shall be protected from capture, branding, harassment, or death; and to accomplish this they are to be considered in the area where presently found, as an integral part of the natural system of the public lands"(Glover 2001). The BLM manages federal land with a multiple use approach so that everyone has the ability to utilize the land. Therefore they must manage feral horse while also attempting to meet the needs of ranchers, miners, hunters and other recreationists (Beever 2000). As a result of the Act of 1971 being implemented there have been more than 40 lawsuits in federal district courts, ranging from feral horse advocates claiming they are not managed properly and the "Adopt a Horse" program is simply to send the rounded up horses to slaughter to ranchers not getting proper access for grazing permits (Glover 2001).

### *Ecological*

Feral Horses share the range with a number of other species in the Divide Basin Herd Management Area (HMA) including Elk, (*Cervus canadensis*) Mule and Whitetail Deer (*Cervidae*), Pronghorn (*Antilocapra americana*) and domestic grazing animals. Not only do they share the range but they also have some dietary overlaps that have the potential to result in not enough forage available (Mcinnis et al. 1987). Before the Act of 1971, there was relatively unrestricted removal that often left horse populations at relatively low sizes, but with the average annual population growth at 20 %, if left unmanaged feral horses have the ability to more than double in 4 years (Mcinnis et al). Water is also a limiting factor for all wildlife found on the range and unlike forage, there is always overlap. As horses are large herd oriented animals they have the ability to exploit seasonal water relatively quickly, and they have also been shown to damage riparian zones which overall decrease species diversity of both plants and animals (Beever 2001).

### *Sociocultural*

Management decisions have been strongly influenced by public opinion and perception of this matter. For example, scientifically they are a non-native feral animal but are most often referred to as wild horses. This altered name often helps them seem less harmful to the health of the range and is even more present when discussed by the media. Other less threatening names for them utilized are mustangs, mavericks, and stallions. In Australia news reports often report of damage done to horses than by them (Beever 2001). In the Divide Basin HMA as of November 2017, the total population was estimated at 791 with the Appropriate Management Level (AML) being 415-600 adult horses. This was after a roundup was performed in October of the same year and the last time the HMA was at the AML was in 2015 (BLM 2018). This is a repeating trend across almost all HMA exceeding their AML by over 100%. There are a number of feral horse advocate groups that fight for the horse's existence on the range. Their largest argument is that the BLM

manages for cattle grazing instead of feral horses in 2001 there were 530,000 grazing cattle to that of 23,214 wild horses in Nevada alone (Glover 2001). Indigenous peoples opinions must also be understood as feral horses were partly spread across North America by Native Americans, and feral horses largely shaped Native American Culture (Bhattacharyya et al. 2014). The greatest problem today that we face in managing feral horse populations is not necessarily how to limit their numbers on the range but how to do it in a way that is both financially viable, publicly accepted and ethical (Beever 2000).

## **Statement of Need**

Human dimensions in feral horse management across the globe are the more difficult part of successful management. They are often not managed like most other ungulate species because of the legislation that protects them and the notion that they are a national treasure (Nimmo et al 2007) Feral horse management options are limited often require constant observation and implementation. The chosen management option must also be weighed in regards to its cost, effectiveness and social acceptability (Nimmo et al 2007). Overgrazing effects both soil density and important soil surface characteristics. These changes in the soil often result in an increased amount of soil erosion from decreases infiltration rates and decreased plant diversity (Davies et al. 2014). Riparian zones are at even greater risk for degradation by feral horses both because they are sought after by them and tend to be less adaptable to heavy grazing. Wildlife species that use riparian zones for nesting, hiding, and feeding are also negatively impacted (Boyd et al. 2017) Feral horse induced rangeland vegetation shifts in sagebrush steppes have been found to negatively alter grassland birds found three including Greater-sage grouse (*Centrocercus urophasianus*) by reducing grass abundance and composition and structure of the ecosystem. The number of unpalatable forbes to sage grouse and domestic cattle also increases by feral horse grazing (Beever et al 2011). There are many negative implications of feral horse grazing on federal rangelands that must be addressed for proper management and by achieving the goal within this management plan healthier multi-use federal land can be achieved.

## **Management**

### *Goal*

Lower wild horse populations within south central Wyoming to an appropriate management level (1,980 individuals) while maintaining genetic diversity and healthy multiple use rangelands within three years.

### *Objectives*

1. Increase public awareness of feral horse overpopulation and holding cost in south central Wyoming by 20% within one year.
2. Increase adoption numbers so all 1,423 horses removed will be homed by private citizens within one year.
3. Remove excess horses (1,423) to lower the population to the AML for the combined HMAs within 3 months after objectives 1-3 are complete. (See Table A. for number of individuals removed within there age class)
4. Reduce population growth indefinitely, to keep populations within the AML done indefinitely after objectives 1-4 are complete.

### *Actions*

1.1. Public forums to better understand current public perception with expert speakers to educate the dangers of overpopulation (Farnworth et al 2014). With a focus at events that are popular among Feral Horse advocates.

1.2. Educational pamphlets in areas where wild horse populations are higher and where tourism is received for Feral horse viewing. (Farnworth et al 2014).

1.3. No action, proceed with management plan with no consideration of public opinion.

Final Course of Action 1: Combination of both a and b to educate the public on the dangers of overgrazing and rangeland degradation, along with information on just how overpopulated the HMAs are. Public education may be difficult as often times Feral horse activist are not residents within or near the HMAs. To broadly spread literature, surveys and hold public forums would be too expensive and unachievable. This will be lessened by having biologist present at heard roundups to answer questions and inform protesters once objective 3 is implemented.

Assessment Protocol 1: Two surveys (Appendix A) will be administered one before action 1 is implemented and one after to measure public perception change. Unless after the first survey there is over 80% awareness of feral horse overpopulation. Not only will residents of south central Wyoming be surveyed but public land users of the HMAs as well. To be able to better spread the message to feral horse advocates, educational literature will be on display at locations such as humane societies and other animal rights organizations. Surveys will be sent out to all households within the HMAs and all hunters that applied for tags within the HMAs

2.1 Increase the number of adoption events across the country and combine them with equine related events such as rodeos, horse shows and fairs (Turner 2012).

2.2. Implement incentives to encourage adaptations such as tax brakes, free shipping, training programs (Hauser 2019). Some of these incentives are currently in use but could be utilized more what the implementation of action 1.

2.3. Change legislation so that meat buyers would be able to purchase them for slaughter (Nuñez et al 2016). This is an unlikely option as to date there have been multiple lawsuits regarding the unethical treatment of captive held feral horses (Glover 2001).

2.4. No action, horses will continue to be held in federal holding facilities at a cost of \$2.25 per head per day (Bastain 1999).

Final Course of Action 2: Implement both a and b to help increase adoptions and help ensure they go to good homes by continuing the background checks and paperwork to successfully adopt out horses. Difficulties with this objective will be that currently there are already over 50,000 feral horses held in captivity that are still waiting for a home.

Assessment Protocol 2: To ensure all individuals removed from the range are adopted out preemptive advertising will be done to raise interest before the horses are even removed if all horses are not swiftly adopted out then increasing advertisements and adoption events will take place. If all 1423 horses cannot be adopted than long term holding facilities that are privately funded or legislation changes may be sought after to take the strain off of the BLM budget to house feral horses.

3.1. Perform a lethal cull that will result in 1,423 horses being removed from the range, with this option will result in no need for objective 2 (Nuñez et al 2016). This option is not socially acceptable and would come with a large amount of backlash from the public. It would also require legislative change to become a viable option.

3.2. Round up herds utilizing helicopters to guide them into funnel traps from across the management area and remove 1,423 individuals from across age classes while maintaining natural sex ratio. This is very similar to how the BLM currently removes excess horses some public pushback is anticipated (Glover 2001). Experts in the field will be on site to help inform and answer any questions from activists at trap sites.

3.3. No action, allow horses populations to exed until they reach their carrying capacity and die on the range of natural causes. (Danvir 2018)

Table B. Shows the number of individuals per age class both before and after gather the far right column is the newly reduced total population.

<b>Yearlings</b>	900	400
<b>2Y/O</b>	1361.2	750
<b>3Y/O-4Y/O</b>	1157.02	650
<b>5-15 Y/O</b>	544.48	150
<b>16+ Y/O</b>	340.3	30
<b>Total</b>	4303	1980

Final Course of Action 3: Action b will be implemented to remove excess populations both initially and if additional roundups are needed in the future. Action b comes with the least negative stigma requires no change in legislation and will still bring the population down to the AML.

Assessment Protocol 3: Accurate aerial counts are crucial both before and after the roundup ensuring the proper number of individuals are removed. If more animals are to be removed or released to keep the population within the AML range (Seal et al 1983). A citizen Science program will also be helpful in measuring range health, habitat use and population counts and condition.

4.1. Porcine Zona Pellucida (PZP) will be used as a contraceptive to slow population growth to one that will not exceed the AML (Kirkpatrick et al 1990). This has been shown to be effective for sterilization in horses but will require annual treatment of mares. (Grey et al 2010).

4.2. Permanent sterilization of select individuals to slow population growth to one that will not exceed the AML (Danvir 2018). Once a mare is sterilized they will never have the ability to produce offspring this could potentially limited genetic diversity resulting in unhealthy herds. Will be higher utilized in stallions than mares.

4.3. No action, allow horses populations to exed until they reach their carrying capacity and die on the range of natural causes and causing severe overgrazing and range degradation (Danvir 2018).

Final Course of Action 4: A combination of a and b will be used to limit population growth to a manageable level, PZP darting (Table B for altered fecundity numbers) will be done with a combination of BLM technicians and a citizen science program with supervision from biologists or veterinarians. Permanent sterilization will also be used to but not in excess to ensure genetic diversity.

Table B. Depicts the unaltered (middle row) and altered fecundity numbers that will be achieved through PZP darting.

<i>F(y)</i>	<i>F(2Y/O)</i>	<i>F(3-4Y/O)</i>	<i>F(5-15)</i>	<i>F(16+)</i>
0	0.072864	0.197472	0.41184	0.10395
0	0.072864	0.129518	0.288288	0.08085

Assessment Protocol 4: Annual aerial population counts will be utilized to get accurate population numbers to ensure the AML range is being met (Seal et al 1986). Population counts will also be gathered using data collected from the PZP darting program. If there are populations that exceeded more individuals than the HMAs can manage then the excess will be sterilized or removed from the range. The citizen science program will be a helpful tool in gaining support from the feral horse advocates with the new management plan. Spring is key for surveying birth rates and will be crucial data in interpreting weather immunocontraception is slowing the growth rate enough or too much. This data will help determine the darting intensity for that breeding season.

## Conclusion

Lowering and keeping Feral horse populations within AML is no small feat but is necessary for healthy multiple use rangelands. Like in many cases in wildlife management the hardest part may not be managing the horses but instead managing the public. The presence of Feral horses on our western landscape will always be there unless The The Wild Free-Roaming Horses and Burros Act of 1971 is repealed, therefore our best management practices must be utilized to slow feral horse populations to that of a manageable level. By doing this with annual PZP vaccinations and public outreach and education we may be able to appease both sides of the “Wild horse”

debate and have healthy rangelands with horses and not have to spend millions of dollars to hold the excess Feral horses in captivity.

---

Acknowledgments: I would like to thank Dr. Ross Conover, Dr. Jorie Favreau, Melinda Bard and my peers in Fisheries and Wildlife 470-Wildlife Management. Also my friends family and, Cletus for all there help and support.

---

## Literature Cited

- Bastian, C. T., L. W. V. Tassell, A. C. Cotton, and M. A. Smith. 1999. Opportunity Costs Related to Feral Horses: A Wyoming Case Study. *Journal of Range Management* 52:104.
- Beever, E. A., and C. L. Aldridge. 2011. Influences of Free-Roaming Equids on Sagebrush Ecosystems, with a Focus on Greater Sage-Grouse. *Greater Sage-Grouse Ecology and Conservation of a Landscape Species and Its Habitats* 272–290.
- Beever, E.A., P.F. Brussard 2000. Charismatic megafauna or exotic pest? Interactions between popular perceptions of feral horses (*Equus caballus*) and their management and research. In *Proceedings of the Vertebrate Pest Conference* 19:19.
- Bhattacharyya, J., and B. M. Larson. 2014. The Need for Indigenous Voices in Discourse about Introduced Species: Insights from a Controversy over Wild Horses. *Environmental Values* 23:663–684.
- Boyd, C., K. Davies, and G. Collins. 2017. Impacts of Feral Horse Use on Herbaceous Riparian Vegetation Within a Sagebrush Steppe Ecosystem. *Rangeland Ecology & Management* 70:411–417.
- Cameron, E. Z., W. L. Linklater., K. J. Stafford., and E. O. Minot. 2003. Social grouping and maternal behaviour in feral horses (*Equus caballus*): the influence of males on maternal protectiveness. *Behavioral Ecology and Sociobiology*, 53:2, 92-101.
- Crane, K. K., M. A. Smith, and D. Reynolds. 1997. Habitat Selection Patterns of Feral Horses in Southcentral Wyoming. *Journal of Range Management* 50:374.
- Davies, K. W., G. Collins, and C. S. Boyd. 2014. Effects of feral free-roaming horses on semi-arid rangeland ecosystems: an example from the sagebrush steppe. *Ecosphere* 5.
- Feller, J. M. 1995. Til the Cows Come Home: The Fatal Flaw in the Clinton Administration's Public Lands Grazing Policy. *Environmental. Law*, 25:703.
- Garrott, R. A., D. B. Siniff, and L. L. Eberhardt. 1991. Growth Rates of Feral Horse Populations. *The Journal of Wildlife Management* 55:641.
- Garrott, R. A., and L. Taylor. 1990. Dynamics of a Feral Horse Population in Montana. *The Journal of Wildlife Management* 54:603.
- Glover, K.H. 2001 *Managing Wild Horses on Public Lands: Congressional Action and Agency*

Response N.C. L. Rev. 79:4:8

- Gray, M. E., D. S. Thain, E. Z. Cameron, and L. A. Miller. 2010. Multi-year fertility reduction in free-roaming feral horses with single-injection immunocontraceptive formulations. *Wildlife Research* 37:475.
- Jakus, P. M. 2018. A Review of Economic Studies Relating to the Bureau of Land Management's Wild Horse and Burro Program. *Human–Wildlife Interactions*, 12:1:8.
- Kirkpatrick, J. F., and P. M. Fazio. 2010. Wild Horses as Native North American Wildlife. Animal Welfare Institute. <<https://www.awionline.org/content/wild-horses-native-north-american-wildlife>> Accessed 16 Apr 2019.
- Mcdonnell, S. M., and S. C. Murray. 1995. Bachelor and Harem Stallion Behavior and Endocrinology. *Biology of Reproduction* 52:577–590.
- Mcinnis, M. L., and M. Vavra. 1987. Dietary Relationships among Feral Horses, Cattle, and Pronghorn in Southeastern Oregon. *Journal of Range Management* 40:60.
- Miller, R. 1983. Seasonal Movements and Home Ranges of Feral Horse Bands in Wyoming's Red Desert. *Journal of Range Management* 36:199.
- Notzke, C. 2014. Wild horse-based tourism as wildlife tourism: the wild horse as the other. *Current Issues in Tourism* 19:1235–1259.
- Nimmo, D. G., and K. K. Miller. 2007. Ecological and human dimensions of management of feral horses in Australia: a review. *Wildlife Research* 34:408.
- Olsen, F. W., and R. M. Hansen. 1977. Food Relations of Wild Free-Roaming Horses to Livestock and Big Game, Red Desert, Wyoming. *Journal of Range Management* 30:17.
- Programs: Wild Horse and Burro: Herd Management: Herd Management Areas: Wyoming: Divide Basin HMA. 2017. Wild Horse and Burro | BUREAU OF LAND MANAGEMENT. <<https://www.blm.gov/programs/wild-horse-and-burro/herd-management/herd-management-areas/wyoming/divide-basin>> Accessed 14 Feb 2019.
- Scasta, J. D., J. L. Beck, and C. J. Angwin. 2016. Meta-Analysis of Diet Composition and Potential Conflict of Wild Horses with Livestock and Wild Ungulates on Western Rangelands of North America. *Rangeland Ecology & Management* 69:310–318.
- Seal, U. S., and E. D. Plotka. 1983. Age-Specific Pregnancy Rates in Feral Horses. *The Journal of Wildlife Management* 47:422.

Turner, J. W., and J. F. Kirkpatrick. 1986. Hormones and reproduction in feral horses. *Journal of Equine Veterinary Science* 6:250–258.

## **Appendix**

### *A. Feral Horse Survey*

#### Feral Horse Survey for WY Residents and Landusers

1. What is your primary use of public rangelands of South central Wyoming?
  - a. Ranching/grazing rights
  - b. Hunting
  - c. Hiking
  - d. Wildlife viewing
  - e. None
2. At what frequency do you encounter Feral Horse interactions on federal rangelands in South central Wyoming?
  - a. Very often
  - b. Often
  - c. Rarely
  - d. Never
3. How are you affected by feral horse populations in South central Wyoming?
  - a. Yes, negatively
  - b. Yes, positively
  - c. No
4. Indicate your perspective on the following statement: *There are too many Feral horses in South central Wyoming?*
  - a. Strongly Agree
  - b. Agree
  - c. Unsure
  - d. Disagree
  - e. Strongly Disagree
5. How many Feral Horses do you believe the federal government has being held in captivity?
  - a. 0
  - b. 1000
  - c. 25000
  - d. 50000
  - e. 100000
6. Are you aware all of the above Horses are available for adoption?
  - a. Yes
  - b. No

7. Have you ever adopted a Feral Horse from the BLMs (Bureau of Land Management) Adopt a Horse program?
  - a. Yes
  - b. No
  
8. Are you aware that you can adopt up to four Feral Horses a year and receive 1,000 dollars per horse for doing so?
  - a. Yes
  - b. No
  
9. Would you be interested in adopting a Feral Horse from the BLMs adopt a horse program?
  - a. Yes
  - b. No

Comments:

---

---

---

---

---

---

---

---

This survey will be administered to both residents and landusers of the affected HMAs it is not intended for anyone else and will be used to gage the opinions and knowledge of people that may encounter feral horses on a regular basis.

Appendix B.

## Feral Horse (*Equus caballus*) Management Plan for South Central Wyoming

Zachary R. Gauthier, zgauthier@paulsmiths.edu

### Executive Summary

Feral Horses (i.e., Wild Horses, or Mustangs) were introduced in the 1500s by European explorers and currently have unsustainably high population densities across Western rangelands. Feral horses are federally protected by the Wild and Free-Roaming Horses and Burros Act of 1971 and are managed by the Bureau of Land Management (BLM). This management plan improve rangeland conditions by lowering feral horse numbers in South Central Wyoming. An initial gather will be performed to bring the population within the Appropriate Management Level (AML) from which the immunocontraceptive Porcine Zona Pellucida (PZP) usage will reduce fecundity to prevent overpopulation. Properly managed Feral horse populations in South Central Wyoming will enhance rangelands for multiple uses including wildlife, ranching, and recreationists

### Conservation Issues

- Currently, adult feral horse population exceeds the AML
- Populations have the potential to double every 4 years
- Feral horse range consists of 3,008,875 acres of BLM land shared with Ranchers and Wildlife
- Severe overgrazing resulted in degraded rangeland conditions and damaged riparian zones

### Goal/Objectives

**Goal**  
Lower wild horse populations within South central Wyoming to an appropriate management level (1980 individuals) while maintaining genetic diversity and healthy multiple use rangelands within three years.

**Objectives**

1. Increase public awareness of feral horse overpopulation 20% within one year
2. Increase adoption numbers of captive horses to 80%
3. Remove excess horses (1,423) within 3 months
4. Reduce fecundity to keep populations within the AML

Figure 2. Map of Wyoming split into its herding management areas, the green figure is encompassing all HMAs this plan manages

### History

- Live in harems commonly known as herds consisting of a lead stallion, multiple mares and their young (1)
- Bachelor stallions live in herds together until a herd of their own is established (1)
- Mares give birth to one young a year and are typically breed in the spring with an 11 month gestation period
- Commonly found in sagebrush steppes (2)
- Utilize ridges for both cover and grazing areas in the winter (3)
- Diet consists of primarily Wheatgrass (*Triticum spp.*) and Needlegrass (*Stipa spp.*) and a variety of sedges from riparian zones when available (4)

Figure 1. This diagram depicts life stages with the respected fecundity (F) and survivorship (S) data

### Actions

- 1.1 Public forums to educate the negative implications of overpopulation (4)
- 1.2 Distribute educational pamphlets in areas where wild horse populations are a popular tourist attraction(4)
- 2.1 Increase the number of adoptions in the US (5)
- 2.2 Implement incentives to encourage adoptions (6)
- 3.1 Conduct helicopter gatherers to remove 1,423 individuals
- 4.1 Porcine Zona Pellucida (PZP) will be used as a contraceptive to reduce population growth to one that will not exceed the AML (7)
- 4.2 Permanent sterilization of select individuals to reduce population growth to one that will not exceed the AML (8)

Figure 4. Right is a herd of feral horses on a sagebrush steppe habitat in South central Wyoming

### Conclusion

Reducing and maintaining Feral horse populations within the AML requires a great deal of planning and foresight but is necessary for healthy multiple use rangelands. Managing such a popular species presents challenges related to public support. The presence of Feral horses on our western landscape is inevitable as a result of The Wild Free-Roaming Horses and Burros Act of 1971. It is because of this our best management practices must be utilized to slow feral horse populations to that of a manageable level. By doing this with annual PZP darting healthier multiple use rangelands for both Wildlife, Ranchers and Recreationist to enjoy can be achieved.

Poster illustrating and describing current conservation issues regarding feral horse overpopulation in south central Wyoming.