United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Fillmore Field Office
95 East 500 North
Fillmore, UT 84631-3513

IN REPLY REFER TO:

4720 (UTW02000)

October 5, 2020

Dear Reader:

The Decision Record for the Confusion HMA Wild Horse Gather Plan Environmental Assessment (EA) (DOI-BLM-UT-W020-2018-015-EA) and Finding of No Significant Impact are available for review on-line at the ePlanning website located at eplanning.blm.doi.net. Hard copies are available from the Fillmore Field Office at the above address.

The EA analyzes the Bureau of Land Management (BLM) Fillmore Field Office's proposal to implement a 10-year wild horse gather plan for the Confusion Herd Management Area (HMA). The purpose of the project is to achieve a thriving natural ecological balance by achieving and maintaining wild horse appropriate management levels (AML) of 70 – 115 wild horses, improve and maintain sustainable rangelands, and maintain a healthy wild horse population within the Confusion HMA. The proposal includes gathering and removing excess wild horses and the application of population growth suppression via surgical sterilization methods.

The Finding of No Significant Impact documents BLM's determination that the proposed action will not result in "significant environmental impacts," and the Decision Record approves implementation of the proposed action of the Confusion HMA Wild Horse Gather Plan EA.

If you have any questions or need additional information, please contact the Fillmore Field Office at (435) 743-3100. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1-800-877-8339 to leave a message or question with the above individual. The FIRS is available 24 hours a day, seven days a week. Replies are provided during normal business hours.

Sincerely,

Michael D. Gates
Acting District Manager
West Desert District

BLM

U.S. Department of the Interior
Bureau of Land Management

Decision Record

DOI-BLM-UT-W020-2018-015-EA

October 2020

Confusion HMA
Wild Horse Gather Plan

Location: Millard and Juab counties, Utah

Estimated Total Agency Cost Associated with Developing and Producing this Document: $49,000

U.S. Department of the Interior
Bureau of Land Management
West Desert District
Fillmore Field Office
95 East 500 North
Fillmore, Utah 84631

NATIONAL SYSTEM OF PUBLIC LANDS

Decision Record

Confusion Herd Management Area Wild Horse Gather Plan

DOI-BLM-UT-W020-2018-015-EA

Juab and Millard Counties, Utah

The Bureau of Land Management (BLM) Fillmore Field Office (FFO) has completed the Confusion HMA Wild Horse Gather Plan Environmental Assessment (EA), serialized as DOI-BLM-UT-W020-2018-015-EA, and a corresponding Finding of No Significant Impacts (FONSI). These and other supporting documents are included on BLM's National Environmental Policy Act (NEPA) ePlanning site at: https://go.usa.gov/xvdwn.

The EA analyzes and discloses the potential site-specific environmental effects of the proposed action and alternatives to the proposed action. The BLM used an interdisciplinary approach to balance proposed actions with different resource values and ensure compliance with all applicable laws, regulations, and policies, in accordance with NEPA.

INTRODUCTION

The Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971 and the Federal Land Policy and Management Act (FLPMA) of 1976 mandate that BLM manage wild horses so as to preserve and maintain a "thriving natural ecological balance" (TNEB) and multiple use relationships on public lands and also protect rangeland resources from deterioration associated with wild horse overpopulation.

The appropriate management level (AML) is the number of wild horses that can be sustained within a designated HMA so as to achieve a TNEB on the range. BLM removes excess horses from the range after it first makes two determinations: (1) that an overpopulation of wild horses exists in a given area, and (2) that removal of excess horses is necessary to achieve a TNEB. BLM has discretion in how it will achieve HMA management objectives.

The Confusion HMA comprises of about 235,005 acres of public and other land located in Millard and Juab counties, Utah. The HMA includes the Confusion Range, Granite and Middle Mountains, and the Coyote Knolls topographic features. These ranges are made up of long, narrow, and steep ridges with large flats areas around the Coyote Knolls. Elevation varies from 7200 feet to 4420 feet. Precipitation averages 4-6 inches at lower elevations to 6-8 inches at the highest elevations. Temperatures also vary, from 0- and -10-degrees Fahrenheit in winter to between 100 and 105 degrees Fahrenheit in summer.

BLM established the Confusion HMA AML at 70-115 wild horses in the October/1987 House Range Resource Area Resource Management Plan/Record of Decision (House Range RMP/ROD)

following an in-depth analysis of habitat suitability and resource monitoring and population inventory data, with public involvement. The estimated population of wild horses in the Confusion HMA in March 1, 2020, was approximately 551. This number is based on an aerial survey population inventory using the Simultaneous Double Count Method conducted in November of 2017, historical knowledge of the area, a 20% population increase for the year 2018, and a 20% population increase for 2019. By the fall of 2020, the population is projected to grow another 20%, to approximately 661 wild horses. The estimated population of 661 is about 9.4 times over the AML lower limit and approximately 5.7 times over the AML upper limit.

The scope of this decision does not include a re-evaluation of AML or any other amendment to the management decisions reflected in the House Range RMP/ROD.

SUMMARY OF ALTERNATIVES

The BLM FFO prepared the Confusion HMA EA to analyze the proposed action and alternatives to gather and remove excess wild horses within and outside the Confusion HMA to bring the wild horse population towards the lower end of the AML range, and, for some alternatives, implementing population growth suppression measures over time. BLM may employ multi-year population growth suppression efforts as stated in Alternatives A, C, or D and conduct maintenance gathers as necessary, according to ongoing monitoring efforts and population surveys, to maintain AML as stated in Alternatives A-D.

Alternative A: Gather and Remove Excess Wild Horses to achieve low AML with sex ratio adjustments.

This alternative would gather and remove excess wild horses from within and outside the Confusion HMA to achieve low AML. The estimated population is approximately 661 horses. At current numbers, approximately 591 wild horses would be removed from the HMA over multiple gathers and additional horses would be gathered for the purpose of adjusting the sex ratio to a 60/40% male/female sex ratio. Sex ratio adjustment reduces the annual growth rate by reducing the number of breeding mares in the herd. Selective removal criteria for the HMA include: (1) First Priority: Age Class - Five Years and Younger; (2) Second Priority: Age Class - Six to Fifteen Years Old; (3) Third Priority: Age Class Sixteen Years and Older. Any horses released back to the HMA would be selected to maintain a diverse age structure, herd characteristics and body type (conformation). Every effort would be made to release horses to the same general area from which they were gathered. Once AML is achieved and the sex ratio adjusted; it is anticipated that it would be 5 to 7 years before a maintenance gather would be needed.

Alternative B: Removal only of Excess Wild Horses to low AML; No Population Growth Suppression Measures.

Alternative B is similar to Alternative A and would gather and remove excess wild horses from within and outside the Confusion HMA to achieve AML with additional maintenance gathers for 10 years after the initial gather. However, population growth suppression measures would not be applied and no changes to the herds' sex ratios would be made. Under this alternative it is anticipated that maintenance gathers would need to occur within five years following the achievement of low AML.

Alternative C: Selective Removal of Excess Wild Horses to low AML, and implementation of Population Growth Control using Population Growth Suppression Vaccines and Intra-Uterine Devices (IUDs).

This action alternative would include an initial effort to gather approximately 93% of the wild horses in and around the HMA. Of the gathered horses, approximately 481 would be removed from the range. Gathered mares would be returned to the range after being treated with population growth suppression measures PZP-22 (or most current formulation), GonaCon-Equine, and/or IUDs. The number of mares receiving PZP-22 (or most current formulation) or GonaCon-Equine is dependent on how many mares can be gathered beyond the low AML to allow for a post-gather population within AML. Initially, up to 15 mares may receive IUDs. A soft, flexible, Y-shaped silicone IUD would be used. If the IUDs show to be effective in the wild mares after two years of observation additional mares may receive IUDs. Any mare that receives an IUD will be documented and photos taken for field identification. The mares would be observed at appropriate times of the year to see if/when the mare has another foal. It is expected that the IUD will eventually fall out. Horses may be gathered over a period of ten years from the date of the initial gather operation for PZP/GonaCon-Equine booster treatments and insertion of IUDs, as necessary. The combination of PZP/GonaCon-Equine and IUDs should lower the population growth rate within the HMA.

After achieving low AML and administering population growth suppression measures, additional removals may be necessary to maintain the population within AML. The target removal numbers for these maintenance removals would be adjusted accordingly based on current population inventories for the HMA. The principal management goal for the HMA would be to maintain a population of 70 wild horses, which is the low end of AML.

Alternative D, Proposed Action: Gather and removal of excess wild horses to low AML, implementing population growth control by establishing non-reproducing components.

Alternative D would gather and remove excess horses to low AML in the same fashion as Alternatives A and C. Alternative D would not adjust sex ratios or apply fertility control vaccines and IUDs. Alternative D would establish a non-reproducing component wherein mares would be sterilized. As in Alternatives A, B, and C, maintenance gathers following achievement of low AML would occur when monitoring shows the need. Under Alternative D, BLM's management objective is to maintain the herd population within AML, once low AML is achieved, and with

introduction of the non-reproducing component, it is expected that the need for maintenance gathers would be less frequent than the other action alternatives.

Mares younger than the age of 5 would not be returned to the Confusion HMA. Potential methods for sterilizing mares include those mentioned in EA Appendix H and F. For any method using surgery or extensive animal handling, a veterinarian will ensure use of appropriate sedation, anesthesia, analgesics and antibiotics. Pregnant mares will not be treated. BLM will track and monitor the sterilized mares to help ensure that a minimum of 50% of the mares on the range are fertile as illustrated by Table 1 in section 2.2.4 of the EA. The herd would continue to receive occasional genetic influence from horses crossing over from nearby HMAs. Hair samples will be pulled for genetic monitoring. If genetic monitoring efforts show a need to increase observed heterozygosity levels then BLM FFO would augment the genetic diversity in the herd by introducing fertile adults from other HMAs.

If Alternative D is selected one or more of the sterilization procedures discussed in detail in Appendix H and F of the EA would be conducted. Treated mares will be freeze marked for identification purposes. The surgical procedure will take place at a private veterinarian's facility to provide for individual care and post operation observation and recovery. Treated mares will remain at the veterinarian's facility until the veterinarian is confident they are healed enough to be released. As the surgery would be conducted at a private facility, general public observation of the surgical procedure would not be allowed. However; BLM FFO acknowledges the public's interest in wild horse welfare and will request that the contracted veterinarian allow observation by an unaffiliated, licensed and practicing veterinarian. BLM is responsible for creating a safe environment for both the horses and the veterinarian, including, but not limited to, keeping the horses' and veterinarian's stress levels to a minimum. Limiting public observations to an unaffiliated, licensed, and practicing veterinarian will increase the likelihood that surgeries and recovery are safe and successful.

All horses subject to sterilization will be at minimum a body score 3 (see Appendix L of the EA); however, BLM FFO will prioritize treatment to horses with body scores 4s and 5s, thus increasing the likelihood of a faster and easier recovery from sterilization procedures

Alternative E: No Action

Under the No Action Alternative, no gather or removal of excess horses would occur and no management actions would be undertaken to address the overpopulation of wild horses.

Management Actions Common to Alternatives A-D

See Section 2.3 of the EA for the management actions common to Alternatives A-D. This includes, but is not limited to, the option to release a small number of neutered stallions to the HMA. At no time would there be more than 10 neutered stallions on the range. Neutered

stallions would not be used to take the place of fertile mares and thus will not affect the overall population growth of the herd.

DECISION

Based on my review and consideration of the EA and FONSI, it is my decision to select and implement the Proposed Action (Alternative D) as described in Section 2.2.4 of the EA. This decision is necessary to achieve and maintain a TNEB and multiple use relationship within the Confusion HMA. Due to the behavior of the Confusion wild horses and the inability to safely water trap and approach the horses as discussed in Chapters 2.4.1, 2.4.11, and 4 of the EA, it is appropriate to consider the use of methods and techniques other than fertility vaccines for long-term population growth suppression, and I have determined that sterilization is the minimum feasible level of management possible for the Confusion HMA. The other action alternatives will require more handling, treatments, and/or more frequent gather and removal of wild horses to maintain AML, thereby increasing the stress and chance of injury to the horses.

It is also my decision to select ovariectomy via colpotomy as the method for spaying mares. The surgical outcomes that were reported from management use of ovariectomy (spaying) via colpotomy of the feral horses at the Sheldon NWR (Collins and Kasbohm 2017) are strong evidence that this method can be used by BLM in wild horse management, with an acceptable level of safety for people and treated horses. Also, behavioral observations from Collins and Kasbohm (2017) demonstrated that ovariectomized (spayed) mares were always observed with other feral horses. This result indicates that spayed mares continued to have social relationships with other feral horses in the Sheldon NWR. Collins and Kasbohm (2017) definitively showed that feral horse herd growth rates decreased in proportion to the fraction of mares in the herd that were spayed. For this reason, and based on my review and consideration of the analysis contained in Chapter 4 and Appendices F and H of the EA, the surgical method of ovariectomy via colpotomy for spaying mares is the method of choice.

Based on my review and consideration of the EA the practice of neutering stallions via gelding is a safe and common practice and has been successfully done by BLM for many years. Gelding is the method of choice for sterilizing the stallions.

In summary, implementation of this decision will include the following:

- Achieve HMA population levels at the lower end of the AML range by removing excess horses and implementing population growth suppression via surgical sterilization. After achieving low AML additional maintenance gathers may be conducted to maintain the populations within AML.
- In the long term, maintain the wild horse populations within the Confusion HMA at a level within the established AML.
- Reduce negative impacts to rangeland resources from an overpopulation of wild horses and

promote the improvement of wild horse habitat within the Confusion HMA. This will ensure that significant progress towards attainment of heathy rangelands occurs and also ensure healthy populations of wild horses are maintained in a TNEB for generations.

This decision is effective immediately pursuant to 43 C.F.R. § 4770.3(c).

COMPLIANCE AND MONITORING

As described in EA Section 2.3 and 5.0, FFO personnel will collect and maintain data during gather and removal operations. Population inventories will continue to be conducted on the HMA in accordance with the WFRHBA and BLM policy. Vegetation monitoring studies (rangeland health, trend and utilization) will continue to be conducted in conjunction with livestock, wildlife, and wild horse use.

MANAGEMENT AND GATHER DESIGN FEATURES

The gathers and population growth suppression will be accomplished using the design features and standard operating procedures detailed in the EA Sections 2.2, 2.3, and Appendices B, F, and H.

RATIONALE

As discussed in the EA, excess wild horses are present within and outside the Confusion HMA and need to be removed to restore a TNEB within a multiple use mandate. The estimated population for the Confusion HMA is 661. The estimated population is over 9 times the upper AML for the Confusion HMA. An additional 20% population increase after the foaling season of 2020 was added to the estimated population as discussed in the EA Section 1.1. Analysis of ongoing monitoring data indicates that wild horses are degrading rangeland health through heavy utilization levels, trailing, and trampling of riparian areas. Furthermore, the past drought cycles coupled with overuse by overpopulated wild horses have reduced forage availability for wild horses particularly in the lower elevations. The perennial key forage species have exhibited minimal growth and perennial grasses have not recovered in many locations.

Excess wild horses are competing heavily with native wildlife including mule deer, and pronghorn, which also depend on these areas for forage and water. In order to allow for recovery and upward trends in rangeland health, protect wildlife habitat, ensure long term health and success of wild horses and prevent widespread starvation and death of individual animals due to lack of forage during future seasons, gathers must be conducted to remove excess wild horses.

The gathers are necessary to remove excess wild horses and to bring the wild horse population back to within the established AML range in order to achieve and maintain a TNEB between wild horses and other multiple uses as required under Section 1333(a) of the WFRHBA and Section 302(b) of the FLPMA. The gathers are needed to not only remove excess wild horses, but also to

implement population growth suppression, and ultimately achieve and maintain population levels within AML for the HMA.

Nationwide, off-range corral and off-range pasture holding space for excess wild horses removed from the range is limited. In order to facilitate gathers and make progress toward management objectives, numerous BLM districts throughout the West have implemented phased gather operations in which a portion of the excess wild horses are removed during the initial gather along with implementation of population controls, with additional excess wild horses to be removed during follow-up gather(s) to achieve and maintain the AML goals. The approach authorized in this Decision is consistent with Instruction Memorandum 2019-004, *Issuance of Wild Horse and Burro Gather Decisions.* The Confusion HMA gathers will bring the population to within AML and population growth suppression via surgical sterilization will slow and control the growth of the population over time. Based on ongoing monitoring and real-time circumstances, maintenance gathers will be conducted for up to ten years following the initial gather, as appropriate, to continue implementing population growth suppression and to maintain AML.

This Decision is in conformance with the BLM's House Range RMP/ROD. The House Range RMP/ROD identifies the Confusion HMA as being suitable for wild horses and reflects BLM's decision to maintain horse numbers in the HMA within AML through "periodic removals."

Leaving excess wild horses on the range under the No Action Alternative does not comply with the WFRHBA or applicable regulations and Bureau policy, nor will it comply with the House Range RMP/ROD. The No Action Alternative will allow continued deterioration of rangeland resources, including vegetative, soil and riparian resources, and could potentially result in the irreversible loss of native vegetative communities. Wild horses will continue to relocate in increasing numbers to areas outside the HMA boundaries due to competition for forage and space within the HMA, adversely impacting public land resources not designated for wild horse management. The No Action Alternative also increases the likelihood of emergency conditions occurring, which is expected to lead to the death or suffering of individual animals or to an emergency gather in order to prevent suffering or death due to insufficient forage or water.

It is BLM FFO's desire to manage the Confusion HMA wild horses at the minimum feasible level necessary to attain the objectives identified in approved land use plan. Without population suppression the FFO would need to remove wild horses from the range every 3 to 5 years to maintain AML. For these reasons, it is my decision that Alternative D, using ovariectomy via colpotomy and gelding as sterilization methods, is the better approach for the herd.

PUBLIC INVOLVEMENT

Notification of the proposed action was listed in ePlanning on October 23, 2018. BLM offered a 30-day comment period (6/26/2020 - 7/25/2020) on the Preliminary Confusion HMA Wild Horse Management and Gather Plan EA. Additional comments were received through email until

7/27/2020 due to the press release stating comments were due by July 27. The EA information was provided on the project's ePlanning webpage and announced through Press Releases/Distribution Lists (Media and Wild Horse Advocates). Additional public outreach information is contained in the EA in Section 8.

Using letters, emails, and the ePlanning website, 16 entities submitted comments to the FFO as follows:

- 5 advocacy groups (The Cloud Foundation (TCF), The American Wild Horse Campaign (AWHC) and Animal Welfare Institute (AWI) combined, Return to Freedom Wild Horse Conservation (RTF), and Wild Horse Education (WHE)) and Utah Farm Bureau
- 7 individuals one of which was an unknown submitter
- Local and State governments (Iron County, Beaver County, Public Lands Policy Coordinating Office (PLPCO)).

Comments were not received after July 27, 2020. BLM considered all comments received. The comments contained approximately 53 overlapping issues/concerns. Many of the comments were addressed or answered by referring to sections within the EA. Other comments were outside the scope of the EA. Many of the comments expressed opinions against gather and removal management activities and advocated that BLM instead implement a PZP darting program without any gathers. Some of the comments were in favor of gathering and removing wild horses down to the low AML of 70 horses and implementing some form of population suppression. All comments were considered, and substantive comments were addressed in the Comment Report of the EA. Several changes were made from the Preliminary EA to the Final EA in response to substantive comments and public involvement. Due to the low number of submissions comments which stated personal opinion or general support/opposition to the proposed management activities but were not substantive or were otherwise outside of the scope of the EA are included in the Comment Report and in the case file at the FFO.

As required by 43 C.F.R. § 4740.1(b), a public hearing was held in Cedar City, Utah on November 14, 2019, and will be held in subsequent years to discuss the use of helicopters and motorized vehicles in the management of Utah BLM's wild horses and burros. This meeting will be advertised in papers and radio stations statewide. Similar meetings have been held annually in Utah since the passage of FLPMA in 1976. Comments received on the preliminary EA at those public meetings were considered and, if applicable, were addressed in management actions, NEPA documents, and decision documents using the most current direction from the National Wild Horse and Burro Program.

AUTHORITY

The authority for this Decision is contained in Section 1333(a) of the WFRHBA, Section 302(b) of FLPMA, and regulations at 43 C.F.R. Part 4700.

PLAN CONFORMANCE AND CONSISTENCY

Plan conformance discussions are contained in the EA at Section 1.3.

APPEAL PROVISIONS

If you wish to appeal this decision, it may be appealed to the Interior Board of Land Appeals, Office of the Secretary, in accordance with 43 C.F.R. Part 4. Instructions for filing an appeal are contained on the attached Form 1842-1 (Appendix A).

Public notification of this decision will be considered to have occurred on the date of signature reflected below. If you wish to appeal, your appeal must be filed with the BLM FFO at the following address within 30 days of the date of signature:

Michael D. Gates, Acting District Manager
BLM, Fillmore Field Office
95 East 500 North
Fillmore, Utah 84631

BLM will not accept electronic filing of notice of appeals. If a statement of reasons for the appeal is not included with the notice of appeal, it must be filed with the Interior Board of Land Appeals, Office of Hearings and Appeals, U.S. Department of the Interior, 801 North Quincy St., Suite 300, Arlington, VA 22203, within 30 days after the notice of appeal is filed with the BLM FFO.

If you wish to file a petition for stay of the decision pending your appeal pursuant to regulation at 43 C.F.R. § 4.21, the petition for stay must accompany your notice of appeal. If you request a stay, you have the burden of proof to demonstrate that a stay should be granted. A petition for a stay is required to show sufficient justification based on the following standards:

1. The relative harm to the parties if the stay is granted or denied.
2. The likelihood of the appellants success on the merits.
3. The likelihood of immediate and irreparable harm if the stay is not granted.
4. Whether the public interest favors granting the stay.

If a petition for stay is submitted with the notice of appeal, a copy of the notice of appeal and petition for stay must be served on each party named in the decision from which the appeal is taken, and with the Interior Board of Land Appeals at the same time it is filed with the BLM FFO.

A copy of the notice of appeal, any statement of reasons, and all pertinent documents must be served on each adverse party named in the decision from which the appeal is taken and on the

Office of the Regional Solicitor, U.S. Department of the Interior, 6201 Federal Building, 125 South State Street, Salt Lake City, Utah 84138-1180, not later than 15 days after filing the document with the Authorized Officer and/or Interior Board of Land Appeals.

Michael D. Gates
Acting District Manager
West Desert District

October 5, 2020
Date

Attachment
Form 1842-1 - Appeals
Environmental Assessment DOI-BLM-UT-W020-2018-015-EA
Finding of No Significant Impact (DOI-BLM-UT-W020-2018-015-EA)

U.S. Department of the Interior
Bureau of Land Management

Finding of No Significant Impact

DOI-BLM-UT-W020-2018-015-EA

October 2020

Confusion HMA
Wild Horse Gather Plan

Location: Millard and Juab counties, Utah

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NATIONAL SYSTEM OF PUBLIC LANDS

BLM

INTRODUCTION

The Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971 and the Federal Land Policy and Management Act (FLPMA) of 1976 mandate that BLM manage wild horses so as to preserve and maintain a "thriving natural ecological balance" (TNEB) and multiple use relationships on public lands and also protect rangeland resources from deterioration associated with wild horse overpopulation.

The appropriate management level (AML) is the number of wild horses that can be sustained within a designated HMA so as to achieve a TNEB on the range. The AML for the Confusion Herd Management Area (HMA) is 70 to 115 wild horses. The AML was established in the October/1987 House Range Resource Area Resource Management Plan and Record of Decision (House Range RMP/ROD) following an in-depth analysis of habitat suitability and resource monitoring and population inventory data, with public involvement.

The Bureau of Land Management (BLM) has conducted an environmental analysis included in the Confusion HMA Wild Horse Gather Plan Environmental Assessment (DOI-BLM-UT-W020-2018-015-EA) to analyze the gather and removal of excess wild horses within and outside the Confusion HMA to bring the population of the HMA low AML of 70 wild horses, and implement population growth suppression by sterilization (ovariectomy via colpotomy, as selected in the Decision Record (DR)). For up to ten years following the initial gather, further population growth suppression and maintenance gathers will be conducted to maintain AML, as appropriate.

The estimated population of wild horses in the Confusion HMA in March 1, 2020 was approximately 551. This number is based on an aerial survey population inventory using the Simultaneous Double Count Method conducted in November of 2017, historical knowledge of the area, a 20% population increase for the year 2018, and a 20% population increase for 2019. By the fall of 2020, the population is projected to grow another 20%, to approximately 661 wild horses. This population is about 9.4 times over the AML lower limit and approximately 5.7 times over the AML upper limit.

FINDING OF NO SIGNIFICANT IMPACT

Based upon a review of the EA and the supporting documents, I have determined that Alternative D, as adopted in the DR, does not constitute a major federal action and that would significantly affect the quality of the human environment, individually or cumulatively with other actions in the Confusion HMA. No environmental effects would occur that meet the definition of significance in context or intensity as defined by the Council of Environmental Quality (CEQ) in 40 CFR 1508.27, nor do the environmental effects exceed those described in the House Range RMP/ROD. Therefore, an environmental impact statement is not needed. This finding is based on the context and intensity of the project as identified in the EA and described below.

Context: The project is a site-specific action on BLM administered public land and does not in and of itself have international, national, regional, or statewide importance. The gathers and implementation of population growth suppression will occur in the Confusion HMA located in

Millard and Juab counties, Utah. The Confusion HMA comprises of about 235,005 acres of public and other land. The HMA includes the Confusion Range, Granite and Middle Mountains, and the Coyote Knolls topographic features. These ranges are made up of long, narrow, and steep ridges with large flats areas around the Coyote Knolls. Elevation varies from 7200 feet to 4420 feet. Precipitation averages 4-6 inches at lower elevations to 6-8 inches at the highest elevations. Temperatures also vary, from 0- and -10-degrees Fahrenheit in winter to between 100 and 105 degrees Fahrenheit in summer. It is estimated that by time a gather will occur there will be approximately 591 excess wild horse in and around the HMA. Given the limited and site-specific context of Alternative D, the significance of the action depends on the effects in the project area and immediate locale. As demonstrated below, the intensity of Alternative D's impacts is minimal. Consequently, the context and intensity of the proposed action do not rise to the level of significance as defined by the CEQ.

Intensity: The following discussion is organized around the Ten Significance Criteria described in 40 CFR 1508.27 and incorporated into resources and issues considered (includes supplemental authorities Appendix 1 H-1790-1) and supplemental Instruction Memorandum, Acts, Regulations and Executive Orders. The following have been considered in evaluating intensity for this proposal.

Impacts may be both beneficial and adverse: The EA described both the beneficial and adverse impacts of the alternatives including Alternative D, Proposed Action, on resources and issues. The beneficial effects of the proposed action include maintaining a thriving natural ecological balance and multiple use relationship consistent with other resource needs. Gathers will benefit the health of the rangeland by decreasing the removal of vegetation by wild horses. A wild horse population within AML will benefit riparian and soils resources, as well. A decrease in competition for forage will benefit native wildlife species and have some limited benefit for permitted livestock grazing, allowing for continued multiple use and sustained yield. A decrease in wild horse numbers will improve rangeland health conditions by limiting impacts associated with an overpopulation of wild horses. Wild horses will experience short term impacts when gathered and removed from the range and by having population growth suppression via sterilization administered. Design Features and Standard Operating Procedures (see Alternative D, Proposed Action and appendices of the referenced EA) will be implemented to reduce impacts to wild horses during the gathers.

None of the environmental impacts disclosed above and discussed in detail in the EA would have a significant impact on the human environment.

The degree to which the selected alternative will affect public health or safety: Alternative D as adopted in the DR will have minimal effects on public health or safety. Wild horse gather operations involve some level of inherent risk due to both the nature of working with wild animals and risks associated with normal helicopter operations. Risks are highest near the trap-site area. The gathers will be conducted in accordance with the specifications and procedures outlined in the EA, Appendix B, and CAWP ensuring compliance with all health and safety regulations and requirements. For the surgeries associated with this project, BLM will encourage the contracted veterinarian performing the procedure to allow a third-party observer as discussed in Section 2.2.4 of the EA. This approach would minimize safety risk to the public observers,

horses, handlers, and the veterinarian performing the procedures.

Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farm lands, wetlands, wilderness or wilderness study areas (WSA), wild and scenic rivers, or ecologically critical areas: The project area is not proximate to any park lands, wild and scenic rivers, ecologically critical areas, or WSAs. The gathers and population growth suppression will have no effect to significant cultural resources. The capture and temporary holding locations will be located on an area of existing disturbance. The possibility of finding intact cultural resources in these areas is minimal to non-existent. If an existing disturbed area cannot be located for the capture and temporary holding areas, a cultural resource inventory will take place prior to the gather. If cultural resources are located during this inventory, the capture area will be moved to another location which does not contain cultural resources.

The degree to which the effects on the quality of the human environment are likely to be highly controversial: Controversy in this context means disagreement about the nature of the effects, not expressions of opposition to the proposed action or preference among the alternatives. The effects that would occur from implementation of gathers are well known and understood. No anticipated effects have been identified that are scientifically controversial. Comments received during the public comment period for the EA provided no scientific evidence contradicting or casting doubt on the reasonableness of the authorized officer's conclusion, based on exiting literature, that the effects are not likely to be highly controversial. Some comments expressed concern that the sterilization methods used in Alternative D, as adopted in the DR, are disputed by the National Academy of Sciences, in the findings and recommendations of its report, "Using Science to Improve the BLM Wild Horse and Burro Program: A Way Forward." It is the opinion of the authorized officer that nothing in this report establishes that the scientific community is in dispute about the proposed action nor is the proposed action controversial in the scientific community.

The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks: Alternative D's possible effects on the human environment are not highly uncertain or involve unique or unknown risks. Helicopter-drive trapping as well as bait/water and horseback-drive trapping are not new methods of capturing wild horses and have been successfully completed for decades. There are no uncertain or unknown risks to the human environment associated with these capture methods.

The act of gathering wild horses and using population growth suppression by sterilization via surgical spaying is not the first of its kind, neither are the effects highly uncertain or involve unique or unknown risks. While the surgical spaying of wild mares has not previously been used by BLM; spaying by ovariectomy via colpotomy was successfully used for management purposes in feral horses in the Sheldon National Wildlife Refuge. Data and observations of the impacts of the procedure on the mares and herd at the Sheldon NWR coupled with existing research relating to the procedure's impact on domestic mares supports BLM's conclusion that the effects are not highly uncertain or involve unique or unknown risks. The neutering of wild stallions (typically by gelding) has been used by BLM since the passage of the 1971 Wild Free-Roaming Horses and Burros Act and its effects and risks are well understood. The anticipated

effects of gelding on studs and ovariectomy via colpotomy on the mare, and behavioral effects of gelded studs and ovariectomized mares returned to the range are disclosed an analyzed in Chapter 4 of the EA and in EA appendices F and H.

The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration: Alternative D will not establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration. Any future projects within the area or in the surrounding areas will be analyzed on their own merits with the appropriate level of NEPA documentation, independent of the actions currently selected.

Whether the action is related to other actions with individually insignificant but cumulatively significant impacts - which include connected actions regardless of land ownership: Alternative D is not related to other actions with individually insignificant but cumulatively significant impacts within the project area. The interdisciplinary team evaluated the possible actions in context of past, present and reasonably foreseeable actions. Significant cumulative effects are not predicted.

The degree to which the action may adversely affect districts, sites, highways, structures, other objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources: Alternative D would not adversely affect significant scientific, cultural, or historic resources. The capture locations will be located on an area of existing disturbance. The possibility of finding intact cultural or historic resources in these areas is minimal to non-existent. If an existing disturbed area cannot be located for the capture locations, an appropriate and reasonable cultural and historic resource identification effort will take place prior to the gather. If cultural or historic resources are located during the identification effort, the capture location or temporary holding will be located so as to avoid or mitigate adverse effects to cultural and historic resources.

The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973, or the degree to which the action may adversely affect: 1) a proposed to he listed endangered or threatened species or its habitat, or 2) a species on BLM's sensitive species list: No portions of the Confusion HMA are within sage-grouse Priority Habitat Management Areas. There are no known federally listed ESA threatened, endangered, or candidate species known to occur within or reasonably near the proposed action.

Whether the action threatens a violation of a federal, state, local, or tribal law, regulation or policy imposed for the protection of the environment, where non-federal requirements are consistent with federal requirements: Alternative D will not violate or threaten to violate any Federal, State, or local law or requirement imposed for the protection of the environment. Applicable laws and regulations were considered in the EA. State, local and tribal interests were presented with the opportunity to participate in the environmental analysis process.

Michael D. Gates
Acting District Manager
West Desert District

October 5, 2020
Date

BLM

U.S. Department of the Interior
Bureau of Land Management

Final Environmental Assessment
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Confusion HMA
Wild Horse Gather Plan

Location: Millard and Juab counties, Utah

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NATIONAL SYSTEM OF PUBLIC LANDS

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1.0 Introduction

This Environmental Assessment (EA) has been prepared to disclose and analyze environmental effects of the Bureau of Land Management (BLM) Fillmore Field Office's (FFO) Proposed Action, which consists of achieving and maintaining a herd population within the appropriate management level (AML) by gathering and removing excess wild horses from the Confusion Herd Management Area (HMA) and conducting fertility control management, and alternatives to the Proposed Action. The Proposed Action would achieve management objectives through gather and removal of excess horses within and near the Confusion HMA, implementation of population control measures by establishing a non-reproducing component, and follow-up gathers over 10 years from the date of the initial gather operation to achieve and maintain appropriate management levels (AML).

This EA is a site-specific analysis of the potential impacts that could result with the implementation of the Proposed Action or alternatives to the Proposed Action. Preparation of an EA assists the BLM authorized officer to determine whether to prepare an Environmental Impact Statement (EIS) if significant impacts could result, or a Finding of No Significant Impact (FONSI) if no significant impacts are expected.

This document is tiered to:

- ❒ House Range Resource Area Final Environmental Impact Statement and Proposed Resource Management Plan (House Range RMP/EIS), 1986.

Should a determination be made that the implementation of the Proposed Action or action alternative would not result in significant environmental impacts or significant environmental impacts beyond those already addressed in the House Range RMP/EIS a FONSI will be prepared to document that determination, and a Decision Record issued providing the rationale for approving the chosen alternative.

1.1 Background

Since the passage of the Wild Free-Roaming Horses and Burros Act (WFRHBA) of 1971, BLM has refined its understanding of how to manage wild horse population levels. By law, BLM is required to control any overpopulation, by removing excess animals, once a determination has been made that excess animals are present and removal is necessary. Program goals have always been to establish and maintain a "thriving natural ecological balance" (TNEB), which requires identifying the AML for individual herds. The AML is defined as the number of wild horses that can be sustained within a designated HMA which achieves and maintains a TNEB in keeping with the multiple-use management concept for the area.[1] In the past two decades, goals have also explicitly included the application of contraceptive treatments to reduce total population growth rates in the short-term and increase the time between gathers necessary to remove excess animals. Other management efforts include improving the accuracy of population inventories and

1 The Interior Board of Land Appeals (IBLA) defined the goal for managing wild horse (or burro) populations in a thriving natural ecological balance as follows: "As the court stated in Dahl vs. Clark, supra at 594, the 'benchmark test' for determining the suitable number of wild horses on the public range is 'thriving natural ecological balance.' In the words of the conference committee which adopted this standard: 'The goal of WH&B management should be to maintain a thriving ecological balance (TNEB) between WH&B populations, wildlife, livestock and vegetation, and to protect the range from the deterioration associated with overpopulation of wild horses and burros.'"

collecting genetic baseline data to support genetic health assessments.

At the national level, annual gather removals are based on national priorities (such as risks to public safety, wild horse health, and resource protection) and budget for gather operations. The national program also needs to consider the costs and budget constraints involving long-term care of excess un-adopted wild horses that have been moved to off range pastures so long as Congressional appropriations bills prohibit the euthanization or sale without limitation of excess unadopted wild horses removed from the range.[2]

Population controls, such as the use of chemical fertility control or permanent sterilization, help control the population of wild horses in HMAs and bring down the number of excess wild horses in the long-term. If used as the sole approach to controlling population numbers, population controls would not allow the BLM to achieve population objectives. However, in conjunction with other techniques (e.g., removals of excess animals and adoption/sale), it provides a valuable tool in a larger, more adaptive approach to wild horse management.

Confusion HMA

The Confusion HMA comprises of about 235,005 acres of public and other land. The HMA is located in Juab and Millard Counties, approximately 30 miles north from Garrison, Utah. The HMA encompasses a portion of the Confusion Mountain Range and has many large, rugged hills. Water sources are limited in the HMA but the sources that are available are very large. See Appendix D.

The AML for wild horses within the HMA is 70-115. The AML was established in the House Range RMP/Record of Decision (ROD) following an in-depth analysis of habitat suitability and resource monitoring and population inventory data, with public involvement. The AML upper limit is the maximum number of wild horses that can populate the HMA while maintaining a TNEB and multiple use relationship on the public lands in the area. Establishing AML as a population range allows for the periodic removal of excess animals (toward the low end) and subsequent population growth (toward the high end) between removals.

The Confusion horses are highly attuned to their environment. During the course of past management activities, BLM has experienced the horses running away long before BLM resource specialists are even within sight. When startled, the horses run to the hills and they have been observed traveling up to ten miles before stopping. Many of the Confusion horses are similar to each other in appearance making identification of individuals difficult if not in close proximity. Due to the terrain and behavior of the Confusion horses BLM expects multiple gathers will be needed to achieve a population within AML.

2 The WHBA allows the Secretary to "destroy[ ] in the most humane and cost efficient manner possible" old, sick, lame, or unadoptable horses. 16 U.S.C. § 1333(b)(2)(A), (C). However, BLM has not destroyed excess unadoptable horses since January 1982, when a former BLM director issued a moratorium on the destruction of excess unadoptable horses. Additionally, Congress has prohibited the use of appropriated funds for the purpose of euthanizing unadoptable horses between 1987 and 2004, again in 2010, and each year since then. See, e.g., 2019 Further Consolidated Appropriations Act, Pub. L. No. 116-94, 133 Stat. 2747 (2019).

The March 2020 estimated population of wild horses in the Confusion HMA was approximately 551. This number is based on an aerial survey population inventory using the Simultaneous Double Count Method conducted in November of 2017, historical knowledge of the area, a 20% population increase for the year 2018, and a 20% population increase for 2019. By the fall of 2020, the population is projected to grow another 20%, to approximately 661 wild horses. The fall of 2020 population estimate is about 9.4 times over the AML lower limit and approximately 5.7 times over the AML upper limit. The HMA was last gathered in September 2010. At that time, 162 wild horses were gathered and removed from the HMA. Approximately 157 horses remained in the HMA after the gather.

Based upon all information available at this time, the BLM has determined that excess wild horses exist within and outside the Confusion HMA and need to be removed. This includes horses in the Partoun/Deep Creek Mountains area west of the Confusion HMA. This determination is based on the following factors including, but not limited to:

- ❒ A November 2017 population inventory estimate of 299 wild horses inside and outside the Confusion HMA (see Appendix E) with an upper confidence limit (UCL) of 333 horses in and out of the HMA. This inventory was conducted in one day to avoid recounting horses over a two-day period (these horses are known for moving long distances when disturbed). Due to time constraints the transects were spaced at approximately 1.5 miles and a couple of areas where horses are known to move between the Confusion and Conger HMAs were not included in the inventory. The UCL is used in this EA as the base starting population to account for horses missed due to the large transect spacing. Since the 2017, inventory did not include the areas between the two HMAs and based on historical knowledge of the area, an additional 50 horses were added to account for animals within those areas excluded. As of March 2020, taking into consideration the population growth in 2018 and 2019, the overall population is approximately 551 wild horses (based on a 20% population increase each year), 481 horses in excess of the AML lower limit.
- ❒ Use by wild horses is exceeding the available forage allocated by over 4 times based on allocations established for wild horse use in the House Range RMP/ROD.
- ❒ Utilization monitoring completed in years 2011 through 2017 documents increased utilization by wild horses on key forage species across the Confusion HMA.
- ❒ Wild horses are increasingly found in areas outside the Confusion HMA not normally used.
- ❒ An Allotment Evaluation completed in December of 2016 of the Thousand Peaks Allotment indicated that a need for a reduction in livestock Animal Unit Months (AUMs) was warranted. In 2018, The Fillmore Field Office issued a decision which reduced livestock AUMs by 34% based on monitoring data from the allotment. The Thousand Peaks Allotment largely overlaps with the Confusion HMA, consisting of 78% of BLM-managed lands within the HMA boundaries.
- ❒ A rangeland health assessment completed in July 2001 indicated wild horse overpopulation was contributing to the following standard not being met: Riparian Areas - rangeland health assessment (see section 9.0) states that three springs (Miller North 1, 2 & 3) in close proximity to each other are heavily used by horses. A rangeland health assessment completed in 2012 showed the riparian areas met standards but included a side note stating the need for control of horse use. This was after three wild horse gathers that occurred in 2002, 2004 and 2010 in which a total of 413 horses were removed from the Confusion HMA.

1.2 Purpose and Need

The purpose of the Proposed Action is to restore a TNEB and multiple use relationship on the public lands consistent with the provisions of the WFRHBA, to remove excess wild horses from within and outside the Confusion HMA, and to manage wild horses to achieve and maintain established AML ranges for the HMA. Additionally, the purpose of the Proposed Action is to reduce the wild horse population growth rate in order to prevent undue or unnecessary degradation of the public lands by protecting rangeland resources from deterioration associated with an overpopulation excess wild horses within and outside the Confusion HMA.

The need for the Proposed Action is to remain consistent with the House Range RMP/ROD, comply with the WFRHBA, protect rangeland resources, and to prevent unnecessary or undue degradation of the public lands associated with excess populations of wild horses within the Confusion HMA and use of rangeland resources by wild horses outside the HMA boundaries.

1.3 Land Use Plan Conformance and Consistency with Other Authorities

The Federal Land Policy and Management Act of 1976 (FLPMA) requires that an action under consideration be in conformance with the applicable BLM land use plan(s), and be consistent with other federal, state, and local laws and policies to the maximum extent possible.

The action alternatives are in conformance with the House Range RMP/ROD.

The action alternatives are consistent with all applicable BLM policies and regulations implementing the WFRHBA at Title 43 Code of Federal Regulations (43 CFR) 4700. The action alternatives are also consistent with the WFRHBA, which mandates, among other things, that the Bureau "prevent the range from deterioration associated with overpopulation," and "remove excess horses in order to preserve and maintain a TNEB and multiple use relationships in that area." Additionally, 43 CFR 4700.0-6 (a) states "Wild horses shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat (emphasis added)."

Other relevant authorities with which the action alternatives are consistent include, but are not limited to:

- ❒ **WFRHBA §1333(b)(1). Powers and duties of Secretary**
  The Secretary shall maintain a current inventory of wild free-roaming horses and burros on given areas of the public lands. The purpose of such inventory shall be to: make determinations as to whether and where an overpopulation exists and whether action should be taken to remove excess animals; determine appropriate management levels of wild free-roaming horses and burros on these areas of the 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).

- ❒ **43 CFR 4710.3-1 Herd management areas.**
  Herd management areas shall be established for the maintenance of wild horse and burro herds. In delineating each herd management area, the authorized officer shall consider the AML for the herd, the habitat requirements of the animals, the relationships with other uses of the public and adjacent private lands, and the constraints contained in 4710.4. The

authorized officer shall prepare a herd management area plan, which may cover one or more herd management areas.

- ❒ **43 CFR 4710.4 Constraints on management.**
  Management of wild horses and burros shall be undertaken with limiting the animals' distribution to herd areas. Management shall be at the minimum feasible level necessary to attain the objectives identified in approved land use plans and herd management area plans.

- ❒ **43 CFR 4720.1 Removal of excess animals from public lands.**
  Upon examination of current information and a determination by the authorized officer that an excess of wild horses or burros exists, the authorized officer shall remove the excess animals immediately.

- ❒ **43 CFR 4740.1 Use of motor vehicles or aircraft.**
  (a) Motor vehicles and aircraft may be used by the authorized officer in all phases of the administration of the Act, except that no motor vehicle or aircraft, other than helicopters, shall be used for the purpose of herding or chasing wild horses or burros for capture or destruction. All such use shall be conducted in a humane manner.
  (b) Before using helicopters or motor vehicles in the management of wild horses or burros, the authorized officer shall conduct a public hearing in the area where such use is to be made.

1.4 Decision to be Made

The authorized officer will determine whether to implement management actions to achieve management objectives of maintaining the Confusion HMA wild horse population within the established AML and protect the range from deterioration resulting from excess wild horse population. The authorized officer's decision is limited to the need to remove excess wild horses and to implement fertility control and/or sex ratio adjustments to achieve and maintain population size within AML. Any decision would not adjust AML or livestock use, including forage allocations, as these were set through previous decisions reflected in the House Range RMP/ROD.

1.5 Scoping and Identification of Issues

Consultation and coordination with BLM, State Historic Preservation Office (SHPO), the Utah Division of Wildlife Resources (UDWR), US Fish & Wildlife Service (USFWS), Native American Indian tribes, Utah School and Institutional Trust Lands Administration (SITLA), Millard/Juab Counties, and routine business contacts with livestock operators and others, has underscored the need for the BLM to maintain wild horse populations within the AML.

The following issues were identified as a result of consultation/coordination and internal scoping relative to the BLM's management of wild horses in the Confusion HMA planning area:

1. Impacts to individual wild horses and the herd. Measurement indicators for this issue include:

   - Expected impacts to individual wild horses from handling stress
   - Expected impacts to herd social structure
   - Expected effectiveness of proposed fertility control application
   - Potential effects on genetic diversity

- Potential impacts on animal health and condition

2. A need to implement different or additional population control methods to maintain population size within AML over the long-term. Measurement indicators for the issue include:

- Projected population size and annual growth rate (WinEquus population modeling)
- Projected gather frequency
- Projected number of excess animals to be removed and placed in the adoption, sale, and off-range corral and off-range pasture holding pipelines over the next 10 years

3. Impacts to vegetation/soils, riparian/wetland, and cultural resources (*as applicable*). Measurement indicators for this issue include:

- Expected forage utilization.
- Potential impacts to vegetation/soils and riparian/wetland resources.

2.0 Proposed Action and Alternatives

2.1 Introduction

This section of the EA describes the Proposed Action and alternatives, including any that were considered but eliminated from detailed analysis. Five alternatives are considered in detail:

- **Alternative A:** Gather and Remove Excess Wild Horses to achieve low AML with sex ratio adjustments.
- **Alternative B:** Removal only of Excess Wild Horses to low AML; No Population Growth Suppression Measures.
- **Alternative C:** Selective Removal of Excess Wild Horses to low AML, and implementation of Population Growth Control using Population Growth Suppression Vaccines and Intra-Uterine Devices (IUDs).
- **Alternative D, Proposed Action:** Gather and removal of excess wild horses to low AML, implementing population growth control by establishing non-reproducing components.
- **Alternative E:** No Action

Alternatives A-D were developed to respond to the identified resource issues and the Purpose and Need to differing degrees. Alternatives A-D would all guide management over a period of 10 years, beginning at the time of the initial gather. Tracking collars and tags may be used as part of monitoring efforts for Alternatives A-D. Tracking collars would not be used on stallions. These collars and tags are currently being used in the nearby Conger and Frisco HMAs and are analyzed in chapter 4 of this EA.

Alternative E, No Action, would not achieve the identified Purpose and Need. However, it is analyzed in this EA to provide a basis for comparison with the other action alternatives, and to assess the effects of not conducting a gather at this time. The No Action Alternative is inconsistent with the WFRHBA and the House Range RMP/ROD which requires the BLM to manage the population within AML.

2.2 Description of Alternatives Considered in Detail

2.2.1 Alternative A: Gather and Remove Excess Wild Horses to achieve low AML with sex ratio adjustments.

This alternative would gather and remove excess wild horses from within and outside the Confusion HMA to achieve low AML. The current estimated population is approximately 661 horses. At current numbers, approximately 591 wild horses would be removed from the Confusion HMA over multiple gathers and additional horses would be gathered for the purpose of adjusting the sex ratio to a 60/40% male/female sex ratio (the current sex ration is expected to be approximately 50/50 based on field observation). Sex ratio adjustment reduces the annual growth rate by reducing the number of breeding mares in the herd. Selective removal criteria for the Confusion HMA include: (1) First Priority: Age Class - Five Years and Younger; (2) Second Priority: Age Class - Six to Fifteen Years Old; (3) Third Priority: Age Class Sixteen Years and Older. Any horses released back to the Confusion HMA would be selected to maintain a diverse age structure, herd characteristics and body type (conformation). Every effort would be made to release horses to the same general area from which they were gathered. Once AML is achieved and the sex ratio adjusted; it is anticipated that it would be 5 to 7 years before a maintenance gather would be needed.

2.2.2 Alternative B: Removal only of Excess Wild Horses to low AML; No Population Growth Suppression Measures.

Alternative B is similar to Alternative A and would gather and remove excess wild horses from within and outside the Confusion HMA to achieve AML with additional maintenance gathers for 10 years after the initial gather. Population suppression measures would not be applied and no changes to the herd's sex ratios would be made. Under this alternative, it is anticipated that maintenance gathers would need to occur within five years following the achievement of low AML.

2.2.3 Alternative C: Selective Removal of Excess Wild Horses to low AML, and implementation of Population Growth Control using Population Growth Suppression Vaccines and Intra-Uterine Devices (IUDs).

Under Alternative C management actions would be similar to the Alternative A with the exception that all mares returning to the Confusion HMA would be treated with population growth suppression vaccine (i.e., Porcine Zona Pellucida (PZP) vaccine (ZonaStat); PZP vaccine pellets (PZP-22); GonaCon-Equine) and/or intrauterine devices (IUDs), and no sex ratio adjustments would occur.

This action would gather approximately 93% of the existing wild horses and return periodically to gather excess wild horses to maintain AML and administer or booster population control measures to the other gathered horses over a period of ten years from the date of the initial gather operation. After the initial gather, the target removal number would be adjusted accordingly based off population inventories for the Confusion HMA and the resulting projection of excess animals. The principal management goal for the Confusion HMA would be to maintain the herd within AML (70 – 115 horses).

Selective removal procedures would prioritize removal of younger excess wild horses after achieving AML within the Confusion HMA and allow older less adoptable wild horses to be released back to the HMA.

If gather efficiencies during the initial gather do not allow enough horses to be captured to reach low AML, BLM would subsequently return to the Confusion HMA to remove excess horses above low AML and would conduct follow-up gathers over a 10 year period to remove any additional wild horses necessary to achieve and maintain the low range of AML as well as to allow BLM to gather a sufficient number of wild horses so as to implement the population control component of the this action (vaccines and/ or IUDs) for wild mares remaining in the Confusion HMA.

If gather efficiencies of the initial gather exceed the target removal number of horses necessary to bring the population to low AML during the initial gather, this would allow the BLM to begin implementing the population control components (fertility control vaccines, IUDs) of this alternative with the initial gather. In this scenario, horses treated with fertility control measures would be released back into the Confusion HMA and post-gather population numbers would not fall below low AML. Population inventories and routine resource/habitat monitoring would be completed between gather cycles to document current population levels, growth rates, and areas of continued resource concern (horse concentrations, riparian impacts, over-utilization, etc.) prior to any follow-up gather. The subsequent maintenance gather activities would be conducted in a manner consistent with those described for the initial gather and could be conducted during the period of November through February which is identified as the period of maximum effectiveness for fertility control vaccine application. Funding limitations and competing priorities might impact the timing of maintenance gather and population control components of this action.

The procedures to be followed for implementing fertility control vaccines are detailed in Appendix C. Vaccine-treated mares would receive freeze marks and uniquely numbered RFID chips for the purpose of identifying the treated animals and tracking their treatment history. At the AML level established for the Confusion HMA and based on known seasonal movements of the horses within the HMA (BLM, unpublished data), sufficient genetic exchange should occur to maintain the genetic health of the population. All horses identified to remain in the Confusion HMA population would be selected to maintain a diverse age structure, herd characteristics and body type (conformation).

The long-term goal of using fertility control vaccines and/ or IUDs is to reduce female fertility. This may reduce or eliminate the need for gathers and removals (NRC 2013). The BLM would return to the Confusion HMA as needed to re-apply fertility control vaccines and/ or IUDs and initiate new treatments to maintain contraceptive effectiveness in controlling population growth rates. The combination of initial doses and follow-up booster doses should lower the population growth rate within the HMA. Once the herd size in the project area is at AML and population growth seems to be stabilized at a low rate, BLM could make a determination as to the required frequency of new mare treatments and mare re-treatments with fertility control vaccine and/ or IUDs, to maintain the number of horses within AML.

If PZP-22 vaccine is used, treated mares would be treated with that form of porcine zona

pellucida (PZP) fertility control vaccine, then released back to the Confusion HMA. If PZP ZonaStat vaccine or GonaCon-Equine is used, treated mares would need to be held for a minimum of thirty days after the first treatment to administer a booster shot to increase efficacy and treatment longevity. Mares previously treated with fertility control vaccines may receive booster doses at later dates.

Up through the present time (August 2020), BLM has not used IUDs to control fertility as a wild horse and burro fertility control method on the range. The BLM has supported and continues to support research into the development and testing of effective and safe IUDs for use in wild horse mares (Baldrighi et al. 2017, Holyoak et al. 2019). However, existing literature on the use of IUDs in domestic horses allows for inferences about expected effects of IUDs in wild horses.

Under this alternative IUDs may be placed into some mares while fertility control vaccines are used on mares not receiving IUDs. Initially up to 15 mares may have IUDs implanted. A Y-shaped silicone IUD would be used. This IUD has been shown to be effective over 18 months in an ongoing field situation where natural breeding behavior occurs. If the IUDs appear to be effective for management purposes in the wild mares after two years of opportunistic observation additional mares may receive IUDs. Any mare that receives an IUD will be documented and photos taken for field identification. The mares would be observed at appropriate times of the year to see if/when the mare has another foal. It is expected that most IUDs will eventually fall out. If the Y-shaped silicone IUDs prove ineffective BLM may try another IUD or switch to just using fertility control vaccines.

Reference in this text to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favoring by the Department of the Interior.

Horse Identification
The treated mares would be individually marked and/or be individually recognizable without error. During past treatments in nearby HMAs, mares have been freeze branded on the hip and the neck. Such brands help in the identification of the horses. During any future gathers, new brands would be put on mares released back to the Confusion HMA. Color, leg and face markings, and any other unique markings or scars could potentially identify some mares without a brand. Once each horse is positively identified, their information would be compiled into a database along with photographs. Individual identification information (notes about freeze brands, photographs and unique characteristics) would be compiled into books or put onto an electronic device that can be taken to the field. Individual numbers are assigned to each herd/band member based on these unique characteristics. Unique numbers would be assigned to all mares and documented on the Data Sheets. A filly under 18 months would be tracked on her mother's Data Sheet. A filly over 18 months of age would receive her own number and Data Sheet. Information about probable maternal kinship would be tracked or followed through Data Sheet notes.

2.2.4 Alternative D, Proposed Action: Gather and removal of excess wild horses to low AML and population growth control by establishing a non-reproducing component.

Alternative D would gather and remove excess horses to low AML in the same fashion as

Alternatives A and C. Alternative D would not adjust sex ratios or apply fertility control vaccines and IUDs. Alternative D would establish a non-reproducing component wherein mares would be sterilized. As in Alternatives A, B, and C, maintenance gathers following achievement of low AML would occur when monitoring shows the need. Under Alternative D, BLM's management objective is to maintain the herd population within AML, once low AML is achieved, and with introduction of the non-reproducing component, it is expected that the need for maintenance gathers over time would be less frequent than the other action alternatives.

Under Alternative D, no gathered mares younger than the age of 5 would be returned to the Confusion HMA, and one or more of the sterilization procedures discussed in detail in Appendix H and F would be conducted on a selection of mares to be returned to the HMA. All mares considered for sterilization would be 5 years old and older and would have already had the opportunity to reproduce and add to the genetic diversity of the herd. Alternative D does not contemplate treatment of pregnant mares. At no time would more than 50% of the mares on the range after the total population is within AML be sterile. Treated mares will be freeze marked for identification purposes.

Table 1 below gives an example of how Alternative D could be implemented via at least three gathers and the sterilization of mares over a period of ten years. Table 1 is for illustrative purposes only and represents only one example of how Alternative D could be implemented over time based on several factors outside the control of BLM FFO such as the national gather schedule, permission to operate in military restricted airspace, weather, funding, and corral space for removed from the Confusion HMA. For example, if the gather efficiency is higher than 75% or if a second gather occurs sooner than Table 1 reflects, AML may be achieved sooner than contemplated in Table 1 and BLM would then focus on gathering to monitor and release treated mares, as needed to meet management objectives. Table 1 reflects BLM's intention to track and monitor the sterilized mares to help ensure that a minimum of 50% of the mares on the range are fertile.

For any sterilization method using surgery or extensive animal handling, a veterinarian will ensure use of appropriate sedation, anesthesia, analgesics and antibiotics. The surgical procedure will take place at a private veterinarian's facility thus giving the horses the best possible care and post operation welfare observation and recovery. Treated mares will remain at the veterinarian's facility for welfare monitoring and until the veterinarian is confident they are healed enough to be released. As the surgery would be conducted at a private facility, general public observation of the surgical procedure will not be allowed. However; BLM FFO acknowledges the public's interest in wild horse welfare and will request that the contracted veterinarian allow observation by an unaffiliated, licensed and practicing veterinarian. BLM is responsible for creating a safe environment for both the horses and the veterinarian, including, but not limited to, keeping the horses' and veterinarian's stress levels to a minimum. Limiting public observations to an unaffiliated, licensed, and practicing veterinarian will increase the likelihood that surgeries and recovery are safe and successful.

All horses subject to sterilization will be at minimum a body score 3 (see Appendix L, Body Condition Score Chart); however, BLM FFO will prioritize treatment to horses with body scores 4s and 5s, thus increasing the likelihood of a faster and easier recovery from sterilization procedures.

Once the population of the herd is within AML, more than 50% of the herd would still be able to reproduce, and the herd would continue to receive occasional genetic influence from horses crossing over from nearby HMAs. Hair samples would be collected for genetic monitoring. If genetic monitoring efforts show a need to increase observed heterozygosity levels then BLM FFO would augment the genetic diversity in the herd by introducing fertile adults from other HMAs.

Table 1: Ten-Year Plan Example

EXAMPLE: Ten-Year Confusion HMA Population/Gather Plan Implementation											
Year	Gather	Pop Increase %	Pop #	Horses Gathered*	Treated Mares Gathered	Treated Mares	Returned Mares	Returned Studs	Total Removed	Post Gather Pop	HMA Pop Studs/Mares
1	1		661	496		17	17		479	182	82/100
2		20%	219							219	101/118
3		20%	262							262	123/139
4	2	15%	302	226	13		13	25		113	48/65
5		15%	130							130	56/74
6		15%	150							150	67/83
7		15%	173							173	78/95
8		15%	198							198	90/108
9	3	15%	228	171	12	1	13	12		82	33/49
10		12%	92							92	36/54

*This table assumes a 75% gather success rate due to the skittish and elusive nature of the Confusion horses and the geographically challenging terrain

2.2.5 Alternative E: No Action

Under the No Action Alternative, no gather or removal of excess horses would occur, and no management actions would be undertaken to address the wild horse overpopulation and associated range degradation at this time. The No Action Alternative does not comply with the WFRHBA of 1971, regulations, or House Range RMP/ROD and does not meet the purpose and need for action in this EA. It is included as a basis for comparison with the Proposed Action.

2.3 Management Actions Common to Alternatives A-D

- The initial Confusion HMA gather is expected to occur no earlier than November 2020, subject to BLM Headquarters Office approval. Several factors such as animal condition, herd health, weather conditions, logistics, or other considerations could result in adjustments in the schedule. Multiple gathers may occur within a ten-year time frame after the initial gather to achieve and maintain a horse population within AML.
- Gather operations will involve areas beyond the Confusion HMA boundaries as displayed by the 2017 wild horse distribution map in Appendix D.
- Gather operations would be conducted in accordance with the Standard Operating Procedures (SOPs) (Appendix B) described in the National Wild Horse and Burro Gather Contract.

- Trap sites and temporary holding facilities will be located in previously used sites or other disturbed areas whenever possible. Undisturbed areas identified as potential trap sites or holding facilities would be inventoried for cultural resources. If cultural resources are encountered, these locations would not be utilized unless they could be modified to avoid impacts to cultural resources.
- Decisions to humanely euthanize animals in field situations will be made in conformance with BLM policy (Washington Office Instruction Memorandum 2015-070). Current policy reference: http://www.blm.gov/policy/im-2015-070
- A small number of humanely neutered stallion horses may be returned to the Confusion HMA. At no time would there be more than 10 neutered stallions on the range. Neutered stallions would not be used to take the place of fertile mares in the herd and thus will not affect the overall population growth of the herd. Neutering stallions is discussed in detail in Appendix H.
- Data including sex and age distribution, condition class information (using the Henneke rating system, see Appendix L), color, size and other information will also be recorded during gather operations, along with the disposition of that animal (removed or released).
- During the initial gather operation, hair samples would be collected on about 25-50 animals from the Confusion HMA to assess the genetic diversity of the herd. Thereafter, samples would be collected during gathers as needed to determine whether the herd is maintaining acceptable genetic diversity (avoiding inbreeding depression). In the event that genetic monitoring indicates relatively low levels of observed heterozygosity (a measure of genetic diversity), additional wild horses could be introduced into Confusion HMA to further increase gene flow into the herd.
- Excess animals would be transported to a BLM off-range corral wild horse facility where they will be prepared (freeze-marked, vaccinated and de-wormed) for adoption, sale (with limitations), or off-range pastures (ORP).
- A BLM contract Veterinarian, Animal and Plant Health Inspection Service (APHIS) Veterinarian or other licensed Veterinarian would be on site as the gather is started and then as needed for the duration of the gather to examine animals and make recommendations to the BLM for the care and treatment of wild horses, and ensure humane treatment. Additionally, animals transported to the BLM Delta Wild Horse Facility or Axtell contract facility are inspected by facility staff and the BLM contract Veterinarian, to observe health and ensure the animals have been cared for humanely.
- Noxious weed monitoring at gather sites and temporary holding corrals would be conducted in the spring and summer following the initial gather by BLM. Treatment would be provided, if necessary, following guidance from the Noxious Weed Control EA# J-010-099-015EA. Mitigation measures would be followed to eliminate the spread of noxious/invasive weeds.
- Monitoring of rangeland forage condition and utilization, water availability, aerial population surveys and animal health would continue.
- A comprehensive post-gather aerial population inventory would occur within 12 months following the completion of the initial gather operation. The inventory would be planned to include the Confusion HMA and adjacent areas outside HMA boundaries.

Helicopter

If the local conditions require a helicopter drive-trap operation, the BLM will use a contractor or in-house gather team to perform the gather activities in cooperation with BLM and other appropriate staff. The contractor would be required to conduct all helicopter operations in a safe manner and in compliance with Federal Aviation Administration (FAA) regulations 14 CFR § 91.119 and BLM IM No. 2010-164.

Helicopter drive trapping involves use of a helicopter to herd wild horses into a temporary trap. The Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers (CAWP, Appendix I) would be implemented to ensure that the gather is conducted in a safe and humane manner, and to minimize potential impacts or injury to the wild horses. Traps would be set in an area with high probability of access by horses using the topography, if possible, to assist with capturing excess wild horses residing within the area. Traps consist of a large catch pen with several connected holding corrals, jute-covered wings, and a loading chute. The jute-covered wings are made of material, not wire, to avoid injury to the horses. The wings form an alley way used to guide the horses into the trap. Trap locations are changed during the gather to reduce the distance that the animals must travel. A helicopter is used to locate and herd wild horses to the trap location. The pilot uses a pressure and release system while guiding them to the trap site, allowing them to travel at their own pace. As the herd approaches the trap the pilot applies pressure and a prada horse is released guiding the wild horses into the trap. Once horses are gathered, they are removed from the trap and transported to a temporary holding facility where they are sorted.

If helicopter drive-trapping operations are needed to capture the targeted animals, BLM would assure that an APHIS veterinarian or contracted licensed veterinarian is on-site during the gather to examine animals and make recommendations to BLM for care and treatment of wild horses. BLM staff would be present during gather operations at all times to observe animal condition, ensure humane treatment of wild horses, and ensure contract requirements are met.

Bait/Water Trapping

Bait and/or water trapping may be used if circumstances require it or best fits the management action to be taken. Bait and/or water trapping generally require a longer window of time for success than helicopter drive trapping. Although the trap would be set in a high probability area for capturing excess wild horses residing within the area, and at the most effective time periods, time is required for the horses to acclimate to the trap and/or decide to access the water/bait.

Trapping involves setting up portable panels around an existing water source or in an active wild horse area, or around a pre-set water or bait source. The portable panels would be set up to allow wild horses to go freely in and out of the corral until they have adjusted to it. When the wild horses fully adapt to the corral, it is fitted with a gate system. The acclimation of the horses creates a low stress trapping method. During this acclimation period the horses would experience some stress due to the panels being setup and perceived access restriction to the water/bait source.

When actively trapping wild horses, the trap would be staffed or checked daily by either BLM personnel or authorized contractor staff. Horses would be either removed immediately or fed and

watered for up to several days prior to transport to a holding facility. Existing roads would be used to access the trap sites.

Gathering excess horses using bait/water trapping could occur at any time of the year and traps would remain in place until the target number of animals are removed. Generally, bait/water trapping is most effective when a specific resource is limited, such as water during the summer months. For example, in some areas, a group of wild horses may congregate at a given watering site during the summer because few perennial water resources are available nearby. Under those circumstances, water trapping could be a useful means of reducing the number of horses at a given location, which can also relieve the resource pressure caused by too many horses. As bait and/or water trapping is a low stress approach to gathering wild horses, such trapping can continue into the foaling season without harming the mares or foals in general. However, due to the elusive, and flighty nature of the Confusion HMA wild horses and the large size of the water sources, bait/water trapping is anticipated to be minimally successful.

Gather Related Temporary Holding Facilities (Corrals)

Wild horses that are gathered would be transported from the gather sites to a temporary holding corral in goose-neck trailers. At the temporary holding corral, wild horses would be sorted into different pens based on sex. The horses would be aged and provided good quality hay and water. Mares and their un-weaned foals would be kept in pens together. At the temporary holding facility, a veterinarian, when present, would provide recommendations to the BLM regarding care and treatment of the recently captured wild horses. Any animals affected by a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club foot, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA).

Transport, Off-range Corrals, and Adoption Preparation

All gathered wild horses would be removed and transported to BLM holding facilities where they would be inspected by facility staff and if needed a contract veterinarian to observe health and ensure the animals are being humanely cared for.

Those wild horses that are removed from the range and are identified to not return to the range would be transported to the receiving off-range corrals (ORC) in a goose-neck stock trailer or straight-deck semi-tractor trailers. Trucks and trailers used to haul the wild horses would be inspected prior to use to ensure wild horses can be safely transported. Wild horses would be segregated by age and sex when possible and loaded into separate compartments. Mares and their un-weaned foals may be shipped together. Transportation of recently captured wild horses is limited to a maximum of 10 hours.

Upon arrival, recently captured wild horses are off-loaded by compartment and placed in holding pens where they are provided good quality hay and water. Most wild horses begin to eat and drink immediately and adjust rapidly to their new situation. At the off-range corral, a veterinarian provides recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses. Wild horses in very thin condition or animals with injuries are sorted and placed in hospital pens, fed separately, and/or treated for their injuries.

After recently captured wild horses have transitioned to their new environment, they are prepared for adoption, sale, or transport to Off-Range pastures. Preparation involves freeze-marking the animals with a unique identification number, vaccination against common diseases, castration, microchipping and de-worming. At ORC facilities, a minimum of 700 square feet of space is provided per animal.

Adoption

Adoption applicants are required to have at least a 400 square foot corral with panels that are at least six feet tall. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the horse for one year and inspects the horse and facilities during this period. After one year, the applicant may take title to the horse, at which point the horse becomes the property of the applicant. Adoptions are conducted in accordance with 43 CFR Subpart 4750.

Sale with Limitations

Buyers must fill out an application and be pre-approved before they may buy a wild horse. A sale-eligible wild horse is any animal that is more than 10 years old or has been offered unsuccessfully for adoption at least three times. The application also specifies that buyers cannot sell the horse to slaughter buyers or anyone who would sell the animals to a commercial processing plant. Sales of wild horses are conducted in accordance with the 1971 WFRHBA and congressional limitations.

Off-Range Pastures

When shipping wild horses for adoption, sale, or Off-Range Pastures (ORPs) the animals may be transported for up to a maximum of 24 hours. Immediately prior to transportation, and after every 24 hours of transportation, animals are offloaded and provided a minimum of 8 hours on-the-ground rest. During the rest period, each animal is provided access to unlimited amounts of clean water and two pounds of good quality hay per 100 pounds of body weight with adequate space to allow all animals to eat at one time.

Mares and sterilized stallions (geldings) are segregated into separate pastures. Although the animals are placed in ORP, they remain available for adoption or sale to qualified individuals; and foals born to pregnant mares in ORP are gathered and weaned when they reach about 8-12 months of age and are also made available for adoption. The ORP contracts specify the care that wild horses must receive to ensure they remain healthy and well-cared for. Handling by humans is minimized to the extent possible although regular on-the-ground observation by the ORP contractor and periodic counts of the wild horses to ascertain their well-being and safety are conducted by BLM personnel and/or veterinarians.

Euthanasia or Sale without Limitations

Under the WFRHBA, healthy excess wild horses can be euthanized or sold without limitation if there is no adoption demand for the animals. However, while euthanasia and sale without limitation are allowed under the statute, these activities have not been permitted under Congressional appropriations for over a decade. If Congress were to lift the current

appropriations restrictions, then it is possible that excess horses removed from the Confusion HMA over the next 10 years could potentially be euthanized or sold without limitation consistent with the provisions of the WFRHBA.

Any old, sick, or lame horses unable to maintain an acceptable body condition (greater than or equal to a Henneke BCS of 3) or with serious physical defects would be humanely euthanized either before gather activities begin or during the gather operations. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Washington Office Instruction Memorandum (WO IM) 2015-070 or most current edition). Conditions requiring humane euthanasia occur infrequently and are described in more detail in Washington Office Instruction Memorandum 2009-041.

Monitoring

Monitoring of the rangeland and wild horses will continue throughout the ten-year duration of this plan. Rangeland monitoring may include but is not limited to: utilization, trend, and rangeland health monitoring. Wild horse monitoring may include but is not limited to: population inventory flights, population growth rates, distribution on the land, water availability, and overall horse health. FFO employees will continue to assess the needs of the land and the horses and adjust management actions as appropriate and in accord with applicable law and policy.

Public Viewing Opportunities

Opportunities for public observation of the gather activities on public lands would be provided, when and where feasible, and would be consistent with WO IM No. 2013-058 and the Visitation Protocol and Ground Rules for Helicopter WH&B Gathers. This protocol is intended to establish observation locations that reduce safety risks to the public during helicopter gathers (see Appendix B). Due to the nature of bait and water trapping operations, public viewing opportunities may only be provided at holding corrals.

2.4 Alternatives Considered but Eliminated from Detailed Analysis

2.4.1 Use of Bait and/or Water Trapping Only

It would not be timely, cost-effective or practical to use bait and/or water trapping as the only gather method to remove the excess horses located within the Confusion HMA in order to achieve AML without risking increased degradation to the rangelands. Two water sources supply the horses with reliable drinking water, Coyote Spring on the east side of the Confusion HMA and the salt marshes on the west side. These water sources are large and cover several acres each making it impractical to attempt water trapping. With the Confusion HMA covering over 235,000 acres the use of bait traps would be time consuming and inefficient. Due to the elusive, and flighty nature of the Confusion HMA wild horses, bait/water trapping is anticipated to be minimally successful. The exclusive use of bait and/or water traps are not consistent with the purpose and need. As a result, this alternative was dismissed from detailed analysis.

2.4.2 Remove or Reduce Livestock within the Confusion HMA

This alternative was not considered in detail because it is inconsistent with previous decisions allocating forage for livestock use. Such an action would not be in conformance with the existing House Range RMP, would be contrary to the BLM's multiple-use mission as outlined in FLPMA, and would also be inconsistent with the WFRHBA.

Furthermore, simply re-allocating livestock AUMs to accommodate an increase wild horse numbers would not achieve a TNEB nor would it eliminate the need for wild horse removal at some point in the future. There is a carrying capacity issue on all desert rangeland. If the carrying capacity is exceeded, ungulate removal is necessary, regardless of species, or rangeland health issues will follow.

BLM currently puts the burden of destocking on the livestock seasonally, in compliance with the Taylor Grazing Act and the WFRHBA. Livestock can be confined to specific pastures, limited periods of use, and specific seasons-of-use to minimize impacts to vegetation during the critical growing season and to riparian zones during the summer months. Wild horses on the other hand are present year-round and their impacts to rangeland resources cannot be controlled through establishment of a grazing system. Thus, impacts from wild horses can only be addressed by limiting their numbers to a level that does not adversely impact rangeland resources and other multiple uses. BLM policy is that at appropriate levels, conservatively stocked livestock grazing and appropriate levels of wild horses can be sustained and allow for healthy range conditions.

Livestock grazing can only be reduced or eliminated following the process outlined in the regulations found at 43 CFR Part 4100 under the authority of the Taylor Grazing Act. Removal or reduction of livestock is beyond the scope of the decision to be made. Furthermore, these changes cannot be made through a wild horse gather decision.

2.4.3 Gather the Confusion HMA to the AML Upper Limit

Under this Alternative, a gather (or gathers) would be conducted to remove enough wild horses to achieve the upper AML of 115 wild horses. A post-gather population size at the upper range of the AML would result in AML being exceeded following the next foaling season. This would be unacceptable for several reasons.

As discussed above, the AML represents the optimum number of wild horses which results in a TNEB and avoids a deterioration of the range. The Interior Board of Land Appeals has explained that "[p]roper range management dictates removal of horses before the herd size causes damage to the rangeland. Thus, the optimum number of horses is somewhere below the number that would cause resource damage" Animal Protection Institute, 118 IBLA 63, 75 (1991). The upper level of the AML established for the Confusion HMA represents the maximum population for which TNEB would be maintained. The lower level represents the number of animals to remain in the Confusion HMA immediately following a wild horse gather to allow for a periodic gather cycle and to prevent the population from exceeding the established AML between gathers. Gathering only to the upper range of AML would result in the need to follow up with another gather by the next year and could result in continued overutilization and damage to the rangeland. The frequency of gathers necessary under this alternative would increase stress to wild horses, as individuals and as an entire herd. For these reasons, this alternative was eliminated from further consideration.

2.4.4 Fertility Control Treatment Only (No Removal)

Population modeling was completed to analyze the potential impacts associated with conducting gathers about every 3 years over the next 10-year period to treat captured mares with fertility control. Under this alternative, no excess wild horses would be removed. While the average population growth rate would be reduced, AML would not be achieved and the damage to the range associated with excess wild horses would continue. This alternative would not meet the Purpose and Need for the Action and was dismissed from further study.

2.4.5 Tubal Ligation or Laser Ablation of the Oviduct Papilla

Tubal ligation or laser ablation of the oviduct papilla are new sterilization methods, but the BLM is aware of only one published study that tested tubal ligation in domestic mares (McCue et al. 2000) and no studies of laser ablation in mares. The safety and effectiveness of these procedures is largely unknown for domestic or wild horses.

The BLM received a proposal to study these techniques in 2015, and in 2016 considered conducting research at the Oregon Wild Horse and Burro Corral Facility that would have included novel studies of mare sterilization via tubal ligation and via laser ablation of the oviduct papilla (BLM 2016). Tubal ligation and laser ablation were promising in principle but had not been tested. Neither method has been proven elsewhere to be effective in wild or feral mares. However, partners withdrew from the BLM-funded study that would have examined the safety and efficacy of those procedures in Oregon, and the study proposed to have taken place in 2016 did not take place. BLM FFO was unable to find sufficient information to analyze these methods in detail at this time, however, these methods may become available as further studies are conducted. It is for that reason these sterilization methods are mentioned here but are dismissed from further study at this time.

2.4.6 Control of Wild Horse Numbers by Natural Means

This alternative would use natural means, such as natural predation and weather, to control the wild horse population. This alternative was eliminated from further consideration because it would be contrary to the WFRHBA which requires the BLM to manage the range to prevent deterioration associated with an overpopulation of wild horses. The alternative of using natural controls to achieve a desirable AML has not been shown to be feasible in the past. The National Academies of Sciences report (2013) concluded that allowing wild horse herds to grow without restraint would lead to substantial ecological damage. Wild horse populations in the Confusion HMA are not substantially regulated by predators, as evidenced by the 20% average annual increase in the wild horse population. In addition, wild horses are a long-lived species with documented adult and foal survival rates often exceeding 90% (Ransom et al. 2016) and are not a self-regulating species. This alternative would allow for a steady increase in the wild horse populations which would continue to exceed the carrying capacity of the range and would cause increasing damage to the rangelands until severe range degradation or natural conditions that occur periodically – such as blizzards or extreme drought – cause a catastrophic mortality of wild horses in the Confusion HMA.

2.4.7 Raising the AML for Wild Horses

This alternative was not brought forward for detailed analysis because it was outside of the scope of the purpose and need of this project. Monitoring data collected within the Confusion HMA

does not indicate that an increase in AML is warranted at this time. On the contrary, such monitoring data confirms the need to remove excess wild horses above AML to reverse downward trends and promote improvement of rangeland health. Given the resource degradation occurring with the current overpopulation of wild horses, it is necessary to bring the population back to AML first so the agency can collect data that would help inform whether the range could support additional horses above AML while still ensuring a TNEB. Because the AML was established in the House Range RMP as a land use planning decision, adjustment to the AML can only occur through a land use plan amendment. This gather decision is therefore not an appropriate mechanism for adjusting AML.

2.4.8 Designation of the Confusion HMA to be Managed Principally for Wild Horses

Designation of all HMAs, as "Wild Horse and Burro Ranges" was proposed through public comments conducted during the development of multiple NEPA documents pertaining to gathering of wild horses across the country. This action under 43 CFR 4710.3-2 would require amendment of the land use plan, which would be outside the scope of this EA. Only the BLM Director or Assistant Director (as per BLM Manual 1203: Delegation of Authority), may establish a Wild Horse and Burro Range after a full assessment of the impact on other resources through the land-use planning process. Wild Horse and Burro Range is not an "exclusive" designation. Designation would not necessarily exclude livestock use; therefore, levels of livestock grazing permitted could remain the same.

2.4.9 Use of Alternative Capture Techniques Instead of Helicopter Capture

An alternative using capture methods other than helicopters to gather excess wild horses has been suggested by some members of the public. As no specific alternative methods were suggested, the BLM identified chemical immobilization, net gunning, and wrangler/horseback drive trapping as potential methods for gathering wild horses. Net gunning techniques normally used to capture big game animals also rely on helicopters. Chemical immobilization is a very specialized technique and strictly regulated. Currently the BLM does not have sufficient expertise to implement either of these methods and it would be impractical to use given the size of the project area, access limitations, and difficulties in approachability of the wild horses.
Use of wrangler on horseback drive-trapping to remove excess wild horses can be effective on a small scale. However, given the number of excess wild horses to be removed from the Confusion HMA, access limitations, and difficulties in approaching the wild horses, this technique would be ineffective and impractical. Horseback drive-trapping is also very labor intensive and can be very dangerous to the domestic horses and the wranglers used to herd the wild horses. Domestic horses can easily be injured while covering rough terrain and the wrangler could be injured if he/she falls off. For these reasons, this alternative was eliminated from further consideration.

2.4.10 Implement a Tiered Removal of Wild Horses

Under the view set forth in some comments during public commenting for wild horse gathers nationwide, a tiered removal of wild horses from the range is mandated by the WFRHBA. [3] Specifically, this alternative would involve a tiered gather approach, whereby BLM would first identify and remove old, sick, or lame animals to euthanize those animals on the range prior to

[3] The view that the WFRHBA requires a tiered removal process has been litigated and rejected by Federal courts. See *In Defense of Animals v. Salazar*, 675 F. Supp. 2d 89, 97-98 (D.D.C. 2009); *In Defense of Animals v. United States DOI*, 909 F. Supp. 2d 1178, 1190-1191 (E.D. Cal. 2012), aff'd 751 F.3d 1054, 1064-1065 (9th Cir. 2014).

gather. Second, BLM would identify and remove wild horses for which adoption demand exists, e.g., younger wild horses or wild horses with unusual and interesting markings. Under the WFRHBA section 1333(b)(2)(iv)(C), BLM would then sell or destroy any additional excess wild horses for which adoption demand does not exist in the most humane and cost effective manner possible, although euthanasia and sale without limitations are currently limited by Congressional appropriations.

This proposed alternative could be viable in situations where the project area is contained, the area is readily accessible and wild horses are clearly visible, and where the number of wild horses to be removed is so small that a targeted approach to removal can be implemented. However, under the conditions present within the gather area and the significant number of excess wild horses both inside and outside of the Confusion HMA, this proposed alternative is impractical, if not impossible, as well as less humane for a variety of reasons.

First, BLM does euthanize old, sick, or lame animals on the range when such animals have been identified. This occurs on an on-going basis and is not limited to wild horse gathers. During a gather, if old, sick or lame animals are found and it is clear that an animal's condition requires the animal to be put down, that animal is separated from the rest of the group that is being herded so that it can be euthanized on the range. However, wild horses that meet the criteria for humane destruction because they are old, sick or lame usually cannot be identified as such until they have been gathered and examined up close, e.g., so as to determine whether the wild horses have lost all their teeth or are club footed. Old, sick, and lame wild horses meeting the criteria for humane euthanasia are also only a small fraction of the total number of wild horses to be gathered.

Due to the size of the gather area, access limitations associated with topographic and terrain features and the challenges of approaching wild horses close enough to make an individualized determination of whether a wild horse is old, sick or lame, it would be virtually impossible to conduct a phased culling of such wild horses on the range without actually gathering and examining the wild horses. Similarly, rounding up and removing wild horses for which an adoption demand exists, before gathering any other excess wild horses, would be both impractical and much more disruptive and traumatic for the animals. Recent gathers have had success in adopting out approximately 30% of excess wild horses removed from the range on an annual basis. The size of the gather area, terrain challenges, difficulties of approaching the wild horses close enough to determine age and whether they have characteristics (such as color or markings) that make them more adoptable, the impracticalities inherent in attempting to separate the small number of adoptable wild horses from the rest of the herd, and the impacts to the wild horses from the closer contact necessary, makes such phased removal a much less desirable method for gathering excess wild horses. This approach would create a significantly higher level of disruption for the wild horses on the range and would also make it much more difficult to gather the remaining excess wild horses.

Making a determination of excess as to a specific wild horse under this alternative, and then successfully gathering that individual wild horse would be impractical to implement (if not impossible) due to the size of the gather area, terrain challenges and difficulties approaching the wild horses close enough to make an individualized determination. This tiered approach would also be extremely disruptive to the wild horses due to repeated culling and gather activities over a short period of time. Gathering excess wild horses under this alternative would greatly increase

the potential stress placed on the animals due to repeated attempts to capture specific animals and not others in the band. This in turn would increase the potential for injury, separation of mare/foal pairs, and possible mortality.

This alternative would be impractical to implement (if not impossible), would be cost-prohibitive, and would be unlikely to result in the successful removal of excess wild horses. This approach would also be less humane and more disruptive and traumatic for the wild horses. This alternative was therefore eliminated from any further consideration.

2.4.11 Darting Wild Horses using the Wildlife Protection Management darting system or darting guns.

To the best of BLM's knowledge at this time, there is no published information documenting that the Wildlife Protection Management darting system has effectively delivered a large number of fertility control vaccines in a herd of free-roaming, feral horses. This usefulness of this system as an effective means of delivering fertility control for population growth suppression on western rangelands remains untested and consequently unproven. At this time, it is not clear whether the system is able to read RFID chips that have been injected below the mane into the nuchal ligament on the left side of the neck. The system is also not capable of the initial placement of RFID chips in horses' nuchal ligaments; at this time, that must be done by hand injection, after the animal has been captured. Chip placement in the horse nuchal ligament is a more typical location than placement in the pectoral region. However, if the system is reconfigured in such a way that it could read chips that are in the nuchal ligament, then it is possible that such a system could, conceivably, be used to provide booster doses of GonaCon-Equine. It is BLM's understanding that the cooling system in the invention is currently designed such that it would have more successful storage and delivery of GonaCon-Equine than PZP vaccine. This or a similar remote-darting system could be considered for use in future BLM wild horse and burro herd management actions (such management decisions would be subject to NEPA compliance).

The Confusion horses are very attuned to their environment and do not allow people near enough to dart them with guns. Typically, these horses are running away long before they are even within sight. Water sources in the Confusion HMA are very large (too large to set up panels for safe water trapping) and can be accessed from many spots making waiting at a water source very ineffective. BLM's expectation is that the horses will not be approachable because they will simply move to a different spot out of range, or not come into water if they sense a person near. Confusion horses are also very similar to each other in appearance making identification of individuals very difficult without being very close. For these reasons darting with guns (i.e., pneumatic projectors) is eliminated from detailed analysis.

3.0 Affected Environment

This section of the EA briefly discusses the relevant components of the human environment which would be either affected or potentially affected by the alternatives (refer to Table 3).

3.1 General Description of the Affected Environment

Confusion HMA

The Confusion HMA encompasses 235,005 acres of public and private land, within Juab and Millard Counties, Utah, (Map 1). The HMA includes the Confusion Range, Granite and Middle Mountains, and the Coyote Knolls topographic features. These ranges are made up of long, narrow, and steep ridges with large flats areas around the Coyote Knolls. Elevation varies from 7200 feet to 4420 feet. Precipitation averages 4-6 inches at lower elevations to 6-8 inches at the highest elevations. Temperatures also vary, from 0- and -10-degrees Fahrenheit in winter to between 100 and 105 degrees Fahrenheit in summer.

Vegetation in the area is made up of three main vegetative types. Saltbush-grass type, black sage-grass type, and rabbit brush-grass type. There are a few juniper trees that occur on the tops of the low mountain ridges. Key species include indian ricegrass (*Oryzopsis hymenoides*), bottlebrush squirreltail (*Sitanion hystrix*), galletta (*Hilaria jamesii*), needleandthread (*Stipa comata*), sand dropseed (*Sporobolus cryptandrus*) and winterfat (*Ceratoides lanata*). Other forage species are listed in Table 2.

Table 2: Forage Species

Grasses	Forbs	Shrubs
Basin wildrye (*Elymus cinereus*)	Scarlet globemallow (*Sphaeralcea coccinea*)	Black sagebrush (*Artemisia nova*)
Muttongrass (*Poa fendleriana*)	Buckwheat (*Eriogonum*)	Shadscale (*Atriplex confertifolia*)
Western wheatgrass (*Agropyron smithii*)		Ephedra (*Ephedra nevadensis*)
Mountain brome (*Bromus carinatus*)		Big sagebrush (*Artemisia tridentate*)
Bluebunch wheatgrass (*Agropyron spicatum*)		Budsage (*Artemisia spinescens*)
Prairie junegrass (*Koeleria macrantha*)		

Permanent water sources are located along the west side of the Confusion HMA along the drainage bottom of Snake Valley. These waters originate as springs in what is known locally as the "Salt Marsh." Horses also water at Coyote Springs which is located on the east side of the Confusion HMA in Tule Valley. There is a distance of 24 miles between the two permanent water sources. Water is also available occasionally at the Hole-in-the-Wall Reservoir located near the north boundary of the Confusion HMA. During the winter months the horses will utilize the snow on the Middle and Granite Mountains.

3.2 Description of Affected Resources/Issues

Table 3 lists the elements of the human environment subject to requirements in statute, regulation, or executive order which must be considered.

Table 3: Supplemental Authorities (Critical Elements of the Human Environment)

Supplemental Authorities	Present	Affected	Rationale
ACECs	**YES**	**NO**	The Gandy Salt Marsh ACEC lies on the western perimeter of the Confusion Herd Management Area.

Supplemental Authorities	Present	Affected	Rationale
			Reduction of herd size will reduce any impacts by wild horses and should improve aquatic and riparian habitat at the marsh for least chub and Columbia spotted frog
Air Quality	**YES**	**NO**	The Proposed Action would have no effect on air quality.
Cultural Resources	**YES**	**NO**	To prevent any impacts to cultural resources, trap sites and temporary holding facilities would be located in previously disturbed areas. Cultural resource inventory and clearance would be required prior to using trap sites or holding facilities outside existing areas of disturbance. (Refer to SHPO Project No. U-10-BL-0259b required item 12)
Environmental Justice	**YES**	**NO**	Implementation of the Proposed Action would have no disproportionately high or adverse human health or environmental effects on minority and/or low-income populations.
Fish Habitat	**NO**	**NO**	Not present.
Floodplains	**NO**	**NO**	There are no floodplains that may be adversely impacted, and the Proposed Action follows Executive Order 11988 on Floodplain Management
Forest and Rangelands	**YES**	**YES**	No impact to Forestry. Rangelands and Rangeland Health discussed below in Section 3.2.2 and 4.2.2.
Livestock Grazing	**YES**	**YES**	Removal of excess horses would benefit the rangeland conditions and available forage, allowing livestock grazing to be permitted by the reduced competition for vegetation and water resources.
Migratory Birds	**YES**	**NO**	Given the low magnitude and short duration of the Proposed Action, no impacts to migratory birds are anticipated. Migratory birds would benefit from the reduction of herd numbers and anticipated improved range and riparian conditions.
Native American Religious Concerns	**YES**	**NO**	There are no known Native American Religious Concerns or Traditional Properties that will be impacted by the project. Letters were sent to the tribes May 25, 2018, notifying them of the project. A single response was received from the Hopi June 7, 2018 requesting additional consultation if there are any prehistoric sites that may be affected by the project. Impacts to cultural sites will be avoided by all project activities.
Noxious Weeds	**YES**	**NO**	To prevent the risk for spread, any noxious weeds or non-native invasive weeds would be avoided when establishing and accessing trap sites and holding facilities.
Prime or Unique Farmlands	**NO**	**NO**	Not present.
Riparian-Wetland Zones	**YES**	**YES**	Removal of excess horses would reduce the pressure on riparian areas and contribute to improved riparian condition
Sensitive Species	**YES**	**NO**	Given the low magnitude and short duration of the Proposed Action, no impacts to sensitive animal species

Supplemental Authorities	Present	Affected	Rationale
			are anticipated. Sensitive animal species would benefit from the reduction of herd numbers and the anticipated improved range and riparian conditions.
Soils	**YES**	**YES**	The removal of excess horses would contribute to the maintenance of sufficient vegetation and litter to protect soil from erosion.
T&E Species	**NO**	**NO**	There are no known federally listed fish or wildlife species within the proposed wild horse gather operation.
Vegetation Excluding Designated/Special Status Species	**YES**	**YES**	Removal of excess horses would benefit vegetation through reduced utilization levels of desirable forage species in high use areas.
Water Quality	**YES**	**NO**	There would be no impacts to water resources/quality.
Waste (Hazardous or Solid)	**NO**	**NO**	Not present.
Wild and Scenic Rivers	**NO**	**NO**	There are no Wild and Scenic Rivers within the proposed project location per PL111.11.
Wilderness and Wilderness Study Area	**YES**	**NO**	Placement of gather sites in previously disturbed areas and along existing roads would ensure no impacts to Wilderness Study Areas. If current protocol for gathers are followed, there would be no impacts to WSAs. A monitor will be assigned to this project.
Wildlife and Fish Excluding Designated/Special Status Species	**YES**	**NO**	General wildlife species, such as mule deer, antelope, mountain lion, coyote, rattle snakes, lizards and jack rabbits occur within the scope of the Proposed Action. Managing herd numbers will benefit wildlife overall by reducing competition and improving range and riparian conditions.
Wild Horses and Burros	**YES**	**YES**	The wild horse gather will reduce the amount of horses in the Confusion HMA and may apply population suppression techniques. Impacts to horses associated with gathers such as stress and possible injuries. Horses removed would be taken to off-range corrals and put into the adoption program.

The critical elements of soils, vegetation, and riparian-wetland zones are discussed in the Rangeland Health section. The existing situation (affected environment) relative to these resources is described below.

3.2.1 Livestock

The Thousand Peaks, Coyote Knolls, Gandy, Cowboy Pass, and Partoun Allotments overlap with the Confusion HMA. There is a total of 11 livestock operators who are currently authorized to graze livestock in these allotments annually. The operators are authorized to use 25,312 Animal Unit Months (AUMs) of forage each year. An AUM is the amount of forage needed to sustain one cow, five sheep, or five goats for a month. The allotments consist of various pastures grazed in rest-rotation and deferred rotation grazing systems. The season of use may vary by 1-2 weeks annually based upon forage availability, drought conditions, and other management criteria.

The BLM allocated forage for livestock use through the House Range RMP/ROD. AML for the Confusion herd was established as a population range 70 -115 in the House Range RMP/ROD. Adjustments in permitted use have been made through Allotment Management Plans as conditions have changed such as drought and class of livestock changes. In 2018, livestock AUMs in the Thousand Peaks Allotment were reduced from 18,597 to 12,289 after a 2016 allotment evaluation warranted the reduction. This was a 34% reduction in AUMs allocated for livestock.

Table 4a and 4b summarizes the permitted and actual livestock use information for the allotments in the Confusion HMA(s).

Table 4a: Livestock Use Information

Allotment	Total Allotment Acres	% of HMA in Allotment	Permittee	Livestock	Authorized Season of Use	Authorized Livestock AUMs (Preference Entire Allotment)	Suspended AUMs or AUMs in (Nonuse Entire Allotment)
Thousand Peaks	332,022	78%	1	2,000 Cattle	10/28 -- 05/25	12,289	
Coyote Knoll	49,434	9%	1 2 3	2,200 Sheep 11 Cattle 11 Cattle	11/01 – 04/30 05/01 – 10/05 05/01 – 10/05	2,330 57 57	
Gandy	52,515	5%	1 2	105 Cattle 488 Cattle	05/16 – 01/02 11/01 – 04/30	328 2,759	36 307
Cowboy Pass	41,059	4%	1 2 3	1,700 Sheep 840 Sheep 378 Sheep	11/01 – 04-30 11/01 – 04/30 11/01 -- 04/30	1,841 1,000 265	
Partoun	71,983	4%	1 2 3 4	2,350 Sheep 39 Cattle 289 Cattle 27 Cattle 26 Cattle	11/02 – 04/26 06/16 – 10/15 11/01 – 04/30 11/01 – 04/30 11/01 – 04-30	2,203 156 1,720 148 158	

Table 4b: Livestock Actual Use

Allotment	Years	Actual Livestock AUMs Used/Billed Each Year	Authorized Livestock AUMs
Thousand Peaks	2017-2019	12,289	See Table 4a
Coyote Knoll	2017-2019	2,444	See Table 4a
Gandy	2017-2019	3,087	See Table 4a
Cowboy Pass	2017-2019	3,106	See Table 4a
Partoun	2017-2019	4,385	See Table 4a

3.2.2 Rangeland Health

According to the US Drought Monitor the 2012, 2013, 2014, 2015, 2016, 2018, and 2020 springs all experienced moderate to extreme drought conditions during the critical growing season in Millard and Juab Counties; which includes the Confusion HMA. Drought and moderate to heavy utilization (see table 5 for utilization levels) has damaged the forage species. In 2018, permitted livestock AUMs in the Thousand Peaks Allotment, which makes up the majority of the Confusion HMA, were reduced by 34% after monitoring showed a decrease in rangeland health

conditions and key forage species. Use by wild horses is exceeding the available forage allocated by over 4 times based on allocations established for wild horse use in the House Range RMP. A rangeland health assessment completed in July 2001 indicated wild horse overpopulation was contributing to degradation in riparian areas, the estimated wild horse population was 134 at the time. A rangeland health assessment completed in 2012 showed the riparian areas met standards but included a side note stating the need to control wild horse use, the estimated wild horse population was 188 at the time. Three wild horse gather/removals occurred in 2002, 2004, and 2010 in which a total of 413 horses were removed from the Confusion HMA. These gathers occurred between the two rangeland health assessments of 2001 and 2012. 2010 was the last year a wild horse gather occurred in the Confusion HMA (see Table 6).

Table 5: Average % Utilization Levels

Confusion HMA Average % Utilization* Levels								
Allotment	Year	Indian Ricegrass	Galleta	Alkali Sacaton	Saltgrass	Budsage	Black sage	Winter Fat
Cowboy Pass								
	2016	24	6			3	41	19
	2015	21	4			22	30	42
	2013	25	6			26	44	37
	2012	27	3			34	44	53
Coyote Knolls								
	2015	34	6				35	
	2014	30	11			3	13	
	2012	31	37				40	
Gandy								
	2015	79	33					70
	2014	82	64					78
	2011	83	53					70
Partoun								
	2017	65	33	25	22	11		
	2015	39	18	3	3			
Thousand Peaks								
	2015	41	26	3				66
	2012	44	31				17	64
	2011	37	25				23	67

*Utilizations were read in the spring of each year. Utilization refers to the amount of plant material that has been removed by animals during the grazing period. It can be based on either individual plants, key species, or an assessment of the entire management unit.

3.2.3 Wild Horses

The Confusion HMA was formally designated as an HMA in the House Range RMP/ROD. The House Range RMP/ROD also established the Confusion HMA AML at 70-115 based on site vegetation inventory monitoring and data collection. The current wild horse population is approximately 5 – 9 times above the established AML range.

In September 2004, a removal of excess wild horses from the Confusion HMA was completed. 154 horses were gathered and removed. Following the gather, no horses were released leaving an estimated post-gather population of 114 animals (about 80 males and 34 females or a 70/30% male/female sex ratio).

The last and most recent removal of excess wild horses from the Confusion HMA was completed in September 2010 when 162 horses were gathered and removed. Following the gather, no horses were released leaving an estimated post-gather population of 157 animals.

The early 2020 estimated population of wild horses inside and outside of the Confusion HMA is based on a Simultaneous Double Observer aerial population survey (Griffin et al. 2020) completed in November 2017 with a 20% increase to account for the 2018 population increase and 2019 population increase. Another 20% was added for the fall of 2020 population estimate.

Forage utilization levels by wild horses on rangelands within the Confusion HMA increase as the population increases. The potential for loss of key forage species also increases as the amount of sustainable forage is depleted through higher levels of use. Drought events over the past ten years have shown the effects of limited resources for wild horses through body condition and range condition. Areas inside and outside the Confusion HMA are experiencing increased use on forage species and resources by wild horses as they expanded outside the HMAs.

Wild horses within the Confusion HMA are currently in thin to moderate body class conditions or a body condition score (BCS) class 3 – 5 on the Henneke BCS chart. The wild horses are very flighty horses and are easily startled. When startled they tend to run for several miles before stopping. These horses are difficult to find because they leave as soon as they hear vehicles approaching and they often can hear a vehicle up to two or three miles away (based on observation). Monitoring indicates that wild horses have moved and are residing outside the Confusion HMA boundaries.

Hair follicle samples have not previously been collected on the Confusion HMA, but samples will be collected as part of the initial gather in the action alternatives to establish baseline genetic diversity. Based on proximity to other nearby HMAs, and based on the current estimated herd size of this and other nearby HMAs, it is expected that the existing genetic diversity within Confusion HMA, as measured by observed heterozygosity, will prove to be relatively high.

Table 6: Wild Horse Gather History

HMA	Fiscal Year	Captured	Removed	Released	Died/Euthanized
Confusion	1995	39	39	1	0
Confusion	1997	93	83	10	0
Confusion	2002	93	93	1	0
Confusion	2004	158	148	10	1
Confusion	2010	162	162	0	0

4.0 Environmental Consequences

4.1 Introduction

This section of the EA documents the potential environmental impacts which would be expected with implementation of the action alternatives (Alternatives A-D), and the No Action Alternative. These include the direct impacts (those that result from the management actions) and indirect impacts (those that exist once the management action has occurred).

4.2 Potential Effects of Alternatives

4.2.1 Livestock

Impacts Common to Action Alternatives (A-D)

Livestock are permitted to graze within the Confusion HMA during the summer months and gather activities could result in direct short-term impacts by disturbing and dispersing the livestock present. Reduced competition between livestock and wild horses for the available forage and water would also result. Indirect impacts would include an increase in the quality and quantity of the available forage in the short-term. Over the longer-term, improved vegetation resources would lead to a TNEB.

Impacts of Alternative A – None that are not in common with other action alternatives.

Impacts of Alternative B – None that are not in common with other action alternatives.

Impacts of Alternative C – None that are not in common with other action alternatives.

Impacts of Alternative D – None that are not in common with other action alternatives.

Impacts of Alternative E (No Action)

Utilization by authorized livestock has been directly impacted due to the current overpopulation of wild horses, both within and outside the Confusion HMA. Livestock operators have been asked to voluntarily reduce AUMs due to the impacts of the wild horse overpopulation on range vegetation/forage conditions. In 2018, BLM reduced livestock AUMs from 18,597 to 12,289 after a 2016 allotment evaluation warranted the reduction to maintain and improve rangeland health. This was a 34% reduction in AUMs. The allotment evaluation was based on rangeland monitoring and climate data. The current wild horse population is 5 – 9 times above its forage allocation. Moderate to heavy utilization is occurring (see Table 5 in section 3.2.2). The indirect impacts of No Action would be continued damage to the range; continuing competition between livestock, wild horses, and wildlife for the available forage and water; ongoing reductions in quantity and quality of forage and water; and further hardship for the livestock operators who would continue to be unable to fully use the forage they are authorized to use in an effort to help slow the deterioration of the range. Livestock would not experience temporary disturbance and displacement due to gather activities.

4.2.2 Rangeland Health

Impacts Common to Action Alternatives (A-D)

Rangeland health is directly impacted by the levels of use experienced upon upland soils, riparian and wetland areas, desired plant species including native, threatened, endangered and

special status species. A reduction in the number of wild horses to within the AML on the Confusion HMA would allow increased recovery and maintenance of rangeland health. Over time, as population levels are managed at AML, rangeland health would continue to improve allowing for the TNEB of all uses present. Soil erosion would decrease as vegetation production increases and riparian areas would see less use.

Impacts of Alternative A – None that are not in common with other action alternatives.

Impacts of Alternative B – None that are not in common with other action alternatives.

Impacts of Alternative C – None that are not in common with other action alternatives.

Impacts of Alternative D – None that are not in common with other action alternatives.

Impacts of Alternative E (No Action)
Deterioration of rangeland health would continue, as wild horse population numbers would continue to increase with no action. Those areas where wild horses spend a majority of their time would suffer from continued loss of riparian vegetation, increased soil erosion with compaction, and removal of desired plant species from the range. Indirect impacts from no action would occur in areas not suitable for wild horses. These areas outside the Confusion HMA would experience increased levels of use by wild horses and may not be resilient enough to recover. Wild horses exist within the Confusion HMA because their basic needs of water, desirable vegetation, cover, and space are met. Areas outside the HMAs lack some, if not all, of these needs and would suffer from increased use.

4.2.3 Wild Horses

The action alternatives in this EA have impacts to wild horses that are common to each and are analyzed in the *Impacts Common to Alternatives A-D* portion of this section. All the action alternatives will remove excess wild horses down to the low AML as shown in Table 7. Table 7 summarizes the AML, population estimates, and estimated removal numbers for the Confusion HMA under the action alternatives.

Table 7: Summary of Wild Horse Population Information

HMA	Acres	AML Range	Current Pop.	Proposed Target Removal	Est'd Post Gather Pop. Size
Confusion	235,005	70 - 115	661	591*	70

*This number indicates what it would currently take to achieve low AML. Current Population listed is for the fall of 2020 and does include population growth in 2020. These numbers are subject to change and a 20% increase will be added if a gather does not happen before the 2021 population increase.

Impacts Common to Action Alternatives (A-D)
Over the past 35 years, various impacts to wild horses as a result of gather activities have been observed. Under the action alternatives, potential impacts to wild horses would be both direct and indirect, occurring to both individual horses and the population as a whole.

The BLM has been conducting wild horse gathers since the mid-1970s. During this time, methods and procedures have been identified and refined to minimize stress and impacts to wild

horses during gather implementation. The CAWP would be implemented to ensure a safe and humane gather occurs and would minimize potential stress and injury to wild horses.

In any given gather, gather-related mortality averages only about one half of one percent (0.5%), which is very low when handling wild animals. Approximately, another six-tenths of one percent (0.6%) of the captured animals, on average, are humanely euthanized due to pre-existing conditions and in accordance with BLM policy (GAO-09-77). Comparable rates were determined recently, by Scasta (2019). These data affirm that the use of helicopters and motorized vehicles has proven to be a safe, humane, effective, and practical means for the gather and removal of excess wild horses (and burros) from the public lands. The BLM also avoids gathering wild horses by helicopter during the 6 weeks prior to and following the expected peak of the foaling season (i.e., from March 1 through June 30).

Individual, direct impacts to wild horses include the handling stress associated with the roundup, capture, sorting, handling, and transportation of the animals. The intensity of these impacts varies by individual and is indicated by behaviors ranging from nervous agitation to physical distress. When being herded to trap site corrals by the helicopter, injuries sustained by wild horses may include bruises, scrapes, or cuts to feet, legs, face, or body from rocks, brush, or tree limbs. Rarely, wild horses will encounter barbed wire fences and will receive wire cuts. These injuries are very rarely fatal and are treated on-site until a veterinarian can examine the animal and determine if additional treatment is indicated.

Other injuries may occur after a horse has been captured and is either within the trap site corral, the temporary holding corral, during transport between facilities, or during sorting and handling. Occasionally, horses may sustain a spinal injury or a fractured limb but based on prior gather statistics, serious injuries requiring humane euthanasia occur in less than 1 horse per every 100 captured. Similar injuries could be sustained if wild horses were captured through bait and/or water trapping, as the animals still need to be sorted, aged, transported, and otherwise handled following their capture. These injuries can result from kicks and bites, or from collisions with corral panels or gates.

To minimize the potential for injuries from fighting, the animals are transported from the trap site to the temporary (or short-term) holding facility where they are sorted as quickly and safely as possible, then moved into large holding pens where they are provided with hay and water. On many gathers, no wild horses are injured or die. On some gathers, due to the temperament of the horses, they are not as calm and injures are more frequent. Overall, direct gather-related mortality averages less than 1%.

Indirect individual impacts are those which occur to individual wild horses after the initial event. These may include miscarriages in mares, increased social displacement, and conflict in studs. These impacts, like direct individual impacts, are known to occur intermittently during wild horse gather operations. An example of an indirect individual impact would be the brief 1-2-minute skirmish between older studs which ends when one stud retreats. Injuries typically involve a bite or kick with bruises which do not break the skin. Like direct individual impacts, the frequency of these impacts varies with the population and the individual. Observations following capture indicate the rate of miscarriage varies but can occur in about 1% to 5% of the captured mares, particularly if the mares are in very thin body condition or in poor health.

A few foals may be orphaned during a gather. This can occur if the mare rejects the foal, the foal becomes separated from its mother and cannot be matched up following sorting, the mare dies or must be humanely euthanized during the gather, the foal is ill or weak and needs immediate care that requires removal from the mother, or the mother does not produce enough milk to support the foal. On occasion, foals are gathered that were previously orphaned on the range (prior to the gather) because the mother rejected it or died. These foals are usually in poor condition. Every effort is made to provide appropriate care to orphan foals. Veterinarians may administer electrolyte solutions or orphan foals may be fed milk replacer as needed to support their nutritional needs. Orphan foals may be placed in a foster home to receive additional care. Despite these efforts, some orphan foals may die or be humanely euthanized as an act of mercy if the prognosis for survival is very poor.

Through the capture and sorting process, wild horses are examined for health, injury, and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM Euthanasia Policy IM-2015-070 is used as a guide to determine if animals meet the criteria and should be euthanized. Animals that are euthanized for non-gather related reasons include those with old injuries (broken or deformed limbs) that cause lameness or prevent the animal from being able to maintain an acceptable body condition (greater than or equal to BCS 3); old animals that have serious dental abnormalities or severely worn teeth and are not expected to maintain an acceptable body condition, and wild horses that have serious physical defects such as club feet, severe limb deformities, or sway back. Some of these conditions have a causal genetic component such that the animals should not be returned to the range; this prevents suffering and avoids amplifying the incidence of the deleterious gene in the wild population.

Wild horses not captured may be temporarily disturbed and moved into another area during the gather operation. Except for changes to herd demographics from removals, direct population impacts have proven to be temporary in nature with most, if not all, impacts disappearing within hours to several days of release. No observable effects associated with these impacts would be expected within one month of release, except for a heightened awareness of human presence.

It is not expected that genetic health would be adversely affected by the action alternatives. The current expectation is that this herd very likely contains high levels of genetic diversity at this time, based on the history of apparent genetic interchange with other nearby BLM-managed herds. More information about the genetic diversity in these populations will become available as a result of Alternatives A-D. Hair follicle samples have not previously been collected on the Confusion HMA, but samples will be collected as part of the initial gather in the action alternatives to establish baseline genetic diversity, which can be compared against future genetic monitoring results to determine any changes in variation over time. The AML range of 70 – 115 should provide for acceptable genetic diversity, especially since some movement of horses between the Confusion, Conger, and Swasey HMAs does occur. If at any time in the future the genetic diversity (as measured by observed heterozygosity) in the Confusion HMA is determined to be below suggested guidelines (BLM 2010), then a large number of other HMAs could be used as sources for fertile wild horses that could be transported into the Confusion HMA.

Because of history, context, and periodic introductions, wild horses that live in the Confusion

HMA herd are not a truly isolated population, and BLM is not required to manage them as if they were isolated or endemic. The National Academies of Sciences report to the BLM (2013) recommended that single HMAs should not be considered isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, connected by interchange of individuals and genes due to both natural and human-facilitated movements. In the specific case of the Confusion HMA, the ancestry of horses in this area is most likely to be of mixed origin from a number of domestic breeds commonly used in the region. These animals are most likely part of part of a larger metapopulation (NAS 2013) that has demographic and genetic connections with other BLM-managed herds in western Utah, eastern Nevada, and beyond.

Although genetic monitoring has yet been completed in the Confusion HMA, nearby herds that have had genetic monitoring sampled indicate relatively high levels of observed heterozygosity (which is a measure of genetic diversity) and low inbreeding coefficients (Cothran 2013, Cothran 2017). Those herds are likely also part of the larger metapopulation including Confusion HMA and have a background of mixed domestic breed heritage (Cothran 2013, Cothran 2017). There is a history of natural and intentional movements of animals between herds in this area. This background is very similar to that of many other herds managed by the BLM. The herd's similarity to other BLM-managed herds has also likely been increased by historical movements of breeding-aged, fertile horses from other HMAs. Over the time scale of wild horse generations, the wild horses breeding within Confusion HMA are a component of a larger genetic metapopulation. Decreases in the number of breeding animals at the Confusion HMA do not, of themselves threaten the genetic diversity of the larger population that the Confusion HMA is part of. Under the action alternatives in this EA, if genetic monitoring indicates that there is concern about levels of observed heterozygosity in Confusion HMA, then BLM can use wild horse introductions from other HMAs to augment genetic diversity there. It is expected that introductions reduce the risk of inbreeding-related health effects. Introducing fertile animals is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010).

By maintaining wild horse population size within the AML, there would be a lower density of wild horses across the Confusion HMA, reducing competition for resources and allowing the wild horses that remain to use their preferred habitat. Maintaining population size near the established AML would be expected to improve forage quantity and quality and promote healthy, self-sustaining populations of wild horses in a TNEB and multiple use relationship on the public lands in the area. Deterioration of the range associated with wild horse overpopulation would be reduced. Managing wild horse populations in balance with the available habitat and other multiple uses would lessen the potential for individual animals or the herd to be affected by drought and would avoid or minimize the need for emergency gathers. All this would reduce stress to the animals and increase the success of these herds over the long-term.

Transport, Off-Range Corrals (ORC), and Adoption (or Sale) Preparation

Wild horses removed from the range will be transported to the receiving ORC facility in straight deck semi-trailers or goose-neck stock trailers. Vehicles will be inspected prior to use to ensure wild horses can be safely transported and that the interior of the vehicle is in a sanitary condition. Wild horses are segregated by age and sex and loaded into separate compartments. A small number of mares may be shipped with foals. Transportation of recently captured wild horses is limited to a maximum of 10 hours. During transport, potential impacts to individual horses can

include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless wild horses are in extremely poor condition, it is rare for an animal to be seriously injured or die during transport.

Upon arrival at the ORC facility, recently captured wild horses are off-loaded by compartment and placed in holding pens where they are fed good quality hay and water. Most wild horses begin to eat and drink immediately and adjust rapidly to their new situation. At the ORC facility, a veterinarian examines each load of horses and provides recommendations to the BLM regarding care, treatment, and if necessary, euthanasia of the recently captured wild horses. Any animals affected by a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club feet, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA). Wild horses in very thin condition or animals with injuries are sorted and placed in hospital pens, fed separately, and/or treated for their injuries as indicated. Recently captured wild horses, generally mares, in very thin condition may have difficulty transitioning to feed. Some of these animals are in such poor condition that it is unlikely they would have survived if left on the range. Similarly, some mares may lose their pregnancies. Every effort is taken to help the mare make a quiet, low stress transition to captivity and domestic feed to minimize the risk of miscarriage or death.

After recently captured wild horses have transitioned to their new environment, they are prepared for adoption or sale. Preparation involves freeze-marking the animals with a unique identification number, drawing a blood sample to test for equine infections anemia, vaccination against common diseases, castration, and de-worming. During the preparation process, potential impacts to wild horses are similar to those that can occur during handling and transportation. Serious injuries and deaths from injuries during the preparation process are rare but can occur.

At ORC facilities, a minimum of 700 square feet is provided per animal. Mortality at ORC facilities averages approximately 5% per year (GAO-09-77, Page 51), and includes animals euthanized due to a pre-existing condition; animals in extremely poor condition; animals that are injured and would not recover; animals which are unable to transition to feed; and animals which are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations, and Off-Range Pastures (ORP)

Adoption applicants are required to have at least a 400 square foot corral with panels that are at least six feet tall for horses over 18 months of age. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the horse for one year and the horse and the facilities are inspected to assure the adopter is complying with the BLM's requirements. After one year, the adopter may take title to the horse, at which point the horse becomes the property of the adopter. Adoptions are conducted in accordance with 43 CFR 4750.

Potential buyers must fill out an application and be pre-approved before they may buy a wild horse. A sale-eligible wild horse is any animal that is more than 10 years old; or has been offered unsuccessfully for adoption three times. The application also specifies that all buyers are not to re-sell the animal to slaughter buyers or anyone who would sell the animal to a commercial processing plant. Sales of wild horses are conducted in accordance with Bureau policy.

Table 8 shows the adoption numbers nationwide from 2012 to 2019 and Table 9 shows the sale with limitation numbers from 2012 to 2019 to qualified individuals as reported on the BLM web site.

Table 8: Horses and Burros Adopted from years 2012 to 2019.

Fiscal Year	Horses	Burros	Total
2019	3,774	1,356	5,130
2018	2,459	699	3,158
2017	2,905	612	3,517
2016	2,440	472	2,912
2015	2,331	300	2,631
2014	1,789	346	2,135
2013	2,033	278	2,311
2012	2,232	351	2,583

Table 9: Horses and Burros Sold to Good Homes from years 2012 to 2019.

Fiscal Year	Horses	Burros	Total
2019	1,538	429	1,967
2018	1,201	250	1,451
2017	518	64	582
2016	179	32	211
2015	88	180	268
2014	23	64	87
2013	22	43	65
2012	320	82	402

Animals 5 years of age and older are transported to off-range pastures (ORP). The BLM has maintained ORPs in the Midwest for over 30 years.

Potential impacts to wild horses from transport to adoption, sale or ORP are similar to those previously described. One difference is that when shipping wild horses for adoption, sale or ORP, animals may be transported for a maximum of 24 hours. Immediately prior to transportation, and after every 18-24 hours of transportation, animals are offloaded and provided a minimum of 8 hours on-the-ground rest. During the rest period, each animal is provided access to unlimited amounts of clean water and 2 pounds of good quality hay per 100 pounds of body weight per horse per day with adequate bunk space to allow all animals to eat at one time. Most animals are not shipped more than 18 hours before they are rested. The rest period may be waived in situations where the travel time exceeds the 24-hour limit by just a few hours and the stress of offloading and reloading is likely to be greater than the stress involved in the additional period of uninterrupted travel.

ORPs are designed to provide excess wild horses with humane, life-long care in a natural setting off the public rangelands. There wild horses are maintained in grassland pastures large enough to allow free-roaming behavior and with the forage, water, and shelter necessary to sustain them

in good condition. About 36,500 wild horses, that are in excess of the existing adoption or sale demand, are currently located on private land pastures in the mid-west. Located in mid-west and western state of the United States, these ORPs are highly productive grasslands as compared to more arid western rangelands. The majority of these animals are older in age.

At ORP facilities, mares, and sterilized stallions (geldings) are segregated into separate pastures. Although the animals are placed in ORPs, they remain available for adoption or sale to qualified individuals. No reproduction occurs in the ORPs, but foals born to mares (that are pregnant when placed into the ORPs) are gathered and weaned when they reach about 8-12 months of age and are then shipped to ORC facilities where they are made available for adoption. Handling by humans is minimized to the extent possible although regular on-the-ground observation and weekly counts of the wild horses to ascertain their numbers, well-being, and safety are conducted. A very small percentage of the animals may be humanely euthanized if they are in very thin condition and are not expected to improve to a BCS of 3 or greater due to age or other factors. Natural mortality of wild horses in ORPs averages approximately 8% per year but can be higher or lower depending on the average age of the horses pastured there (GAO-09-77, Page 52). The savings to the American taxpayer which results from contracting for ORPs averages about $4.32 per horse per day as compared with maintaining the animals in ORC facilities. The average daily cost of an ORC is $6.37 versus an ORP is $2.05 per horses per day.

Neutered Stallions

Mature stallions may be neutered via gelding (castration) or surgical vasectomy (Appendix H). Removal of the testicles reduces testosterone levels, but stallions gelded after puberty are expected to retain stallion-like behaviors. Stallions that are returned to the Confusion HMA as neutered stallions will be mature when surgically sterilized. Neutered stallions will not be used to replace fertile mares in the Confusion HMA and since no more than 10 would be on the range at any given time during the duration of this EA the neutered stallions will not affect the population growth. Chemical vasectomy was identified as a promising method in the 2013 National Academies of Sciences report, but chemical vasectomy has since been identified as an unsuccessful method in horses (Scully 2015); the method is, therefore, not being considered for use under these alternatives.

Radio Collars and Tags

The impact of radio collars and tags is very minimal. From March 2015 through March 2016 researchers at the U.S. Geological Survey conducted a preliminary study on captive wild horses and burro jennies to determine proper fit and wear of radio collars (Schoenecker et al. 2020). The condition of wild horses wearing radio collars was compared to non-collared controls and documented with photographs. In addition, both collared individuals and controls were observed for 80 minutes each week for 14 weeks in order to quantify any impact of the collar on their behavior and health. At the end of the study period (March 2016) the collars were removed. Preliminary analyses indicate that mares had almost no impact in terms of rubbing or wear from radio collars, and behavior of collared and uncollared mares did not differ (Schoenecker et al. 2020). There was no impact of radio tags on behavior or wear, either. Tracking collars and tags are currently being used in horses in the nearby Conger and Frisco HMAs.

Monitoring

Monitoring of the rangeland and wild horses will continue throughout the ten-year duration of this plan. Rangeland monitoring may include but is not limited to: utilization, trend, and rangeland health monitoring. Wild horse monitoring may include but is not limited to: population inventory flights, population growth rates, distribution on the land, water availability, and overall horse health. FFO employees will continue to assess the needs of the land and the horses to inform implementation of the final gather plan as appropriate.

Results of Win Equus Population Modeling

The Alternatives were modeled using Version 1.40 of the Win Equus population model (Jenkins, 2002). The purpose of the modeling was to analyze and compare the effects of the Alternatives on population size, average population growth rate, and average removal number. See Appendix A for additional detail.

Health and Safety

Members of the public can inadvertently wander into areas that put them in the path of wild horses that are being herded or handled during the gather operations, creating the potential for injury to the wild horses or burros and to the BLM employees and contractors conducting the gather and/or handling the horses as well as to the public themselves. Because these horses are wild animals, there is always the potential for injury when individuals get too close or inadvertently get in the way of gather activities.

While helicopters are highly maneuverable and the pilots are very skilled in their operation, unknown and unexpected obstacles in their path can impact their ability to react in time to avoid members of the public in their path. These same unknown and unexpected obstacles can impact the wild horses or burros being herded by the helicopter in that they may not be able to react and can be potentially harmed or caused to flee which can lead to injury and additional stress. When the helicopter is working close to the ground, the rotor wash of the helicopter is a safety concern by potentially causing loose vegetation, dirt, and other objects to fly through the air which can strike or land on anyone in close proximity as well as cause decreased vision.

Fleeing horses can go through wire fences, traverse unstable terrain, and go through areas that they normally don't travel in order to get away, all of which can lead them to injure people by striking or trampling them if they are in the animal's path.

Disturbances in and around the gather and holding corral have the potential to injure the government and contractor staff who are trying to sort, move and care for the horses and burros by causing them to be kicked, struck, and possibly trampled by the animals trying to flee. Such disturbances also have the potential for similar harm to the public themselves.

Specific Impacts of Alternative A: Gather and Remove Excess Wild Horses to achieve low AML with sex ratio adjustments.

Implementation of Alternative A would occur after the 2020 foaling season and horses would be removed with the goal of returning the wild horse population size to within AML. Additional horses would be gathered released back to the Confusion HMA for the purpose of adjusting the sex ratio in the attempt to reach a 60/40% male to female ratio. If gather operations do not occur

until after the 2021 foaling season the numbers will increase. Studs would be selected for release to maintain a diverse age structure, herd characteristics, and conformation (body type).

For 10 years following the initial gather, implementation of this alternative will allow for maintenance of the population within the AML range once the low AML has been achieved. Maintenance of the population would be done through additional gathers. Once low AML is achieved it is anticipated that a maintenance gather will not be necessary for 5 to 7 years. Having the ability to keep the population within AML increases BLM's ability to have and maintain healthy rangeland and horses. Some captured wild horses would be released back to the range to achieve a post-gather sex ratio of 60% studs and 40% mares on the Confusion HMA. Under this alternative, band size would be expected to decrease, competition for mares would be expected to increase, recruitment age for reproduction among mares would be expected to decline, and size and number of bachelor bands would be expected to increase. These effects would be slight, as the proposed sex ratio is not an extreme departure from normal sex ratio ranges in the Confusion HMA.

Specific Impacts of Alternative B: Removal only of Excess Wild Horses to within AML range; No Population Growth Suppression Measures.

If Alternative B is implemented, over the ten-year period from the initial gather more horses overall would be removed due to the fact no population growth suppression measures would be applied. Maintenance gathers would need to occur every 3 to 5 years. A gate cut removal would be implemented rather than a selective removal (i.e., the gather would end when the number of excess wild horses which requires removal has been captured). Alternative B would not involve any fertility control methods; mares would not undergo the additional stress of receiving fertility control injections or freeze-marking and would foal at normal rates until the next gather is conducted. Adjusting the sex ratio would not occur. Smaller bachelor bands would be expected, with similar reproduction rates as currently being experienced within the herd, and individual mares would likely begin actively producing at a slightly older age.

Specific Impacts of Alternative C: Selective Removal of Excess Wild Horses to low AML, and implementation of Population Growth Control using Population Growth Suppression Vaccines and Intra-Uterine Devices (IUDs).

Impacts from this alternative would be similar to Alternative A, however fertility control vaccines and/ or IUDs would be applied to mares and the sex ratio adjustment would not occur. When gather efficiencies have been able to achieve horse numbers within the range of AML maintenance gathers to reapply fertility control and to remove adoptable wild horses would be conducted for the next 10 years following the initial gather. Most if not all mares selected for release back to the Confusion HMA after the gather would be treated with fertility control vaccines or IUDs. Mares treated with ZonaStat or GonaCon-Equine would have to be held at least 30 days following the initial treatment to apply a booster shot that should increase the efficacy of the drug and prolong its effects, while mare treated with PZP-22 could be returned to the range sooner. Handling may include freeze-marking and individual identification with RFID chip, for the purpose of identifying treated mares and identifying their treatment history. Appendix G contains the detailed analysis for the fertility control vaccines mention in this alternative.

Under this alternative the BLM would return to the Confusion HMA as needed to re-apply PZP-22, ZonaStat-H, GonaCon-Equine or other improved PZP vaccines that may become available in the future, IUDs, and initiate new treatments in order to maintain contraceptive effectiveness in controlling population growth rates. PZP-22, ZonaStat-H, and GonaCon-Equine effects are discussed in Appendix G. Both currently available forms of PZP can safely be reapplied as necessary to control the population growth rate. Even with repeated booster treatments of PZP, it is expected that most, if not all, mares would return to fertility, though some mares treated repeatedly may not (see *PZP Direct Effects* in Appendix G). Once the population is at AML and population growth seems to be stabilized, BLM could use population planning software (WinEquus II, currently in development by USGS Fort Collins Science Center) to determine the required frequency of re-treating mares with the fertility control vaccines. Some negative consequences of vaccination are possible.

GonaCon-Equine can be administered to either sex, but this analysis is limited to effects on females, except where inferences can be made to females, based on studies that have used the vaccine in males. The GonaCon-Equine vaccine is an EPA-approved pesticide (EPA, 2009a) that is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced in a USDA-APHIS laboratory. Its categorization as a pesticide is consistent with regulatory framework for controlling overpopulated vertebrate animals, and in no way is meant to convey that the vaccine is lethal; the intended effect of the vaccine is as a contraceptive. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate. Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, although the average duration of effect after booster doses has not yet been quantified. The expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine has not been quantified.

Expanding the use of population growth suppression (PGS) to slow population growth rates and reducing the number of animals removed from the range and sent to off-range pastures (ORPs) is a BLM priority. No finding of excess determination is required for BLM to pursue contraception in wild horses or wild burros. Contraception has been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used with other techniques, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013). All fertility control methods in wild animals are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton et al. 2015). Contraception by itself does not remove excess horses from an HMA's population, so if a wild horse population is in excess of AML, then contraception alone would result in some continuing environmental effects of horse overpopulation. Successful contraception reduces future reproduction. Limiting future population increases of horses could limit increases in environmental damage from higher densities of horses than currently exist. Horses are long-lived, potentially reaching 20 years of age or more in the wild and, if the population is above AML, treated horses returned to the Confusion HMA may continue exerting negative environmental effects, as described above, throughout their life span. In contrast, if horses above AML are removed when horses are gathered, that leads to an immediate decrease in the severity of ongoing detrimental environmental effects.

Successful contraception would be expected to reduce the effects of frequent horse gather

activities on the environment, as well as wild horse management costs to taxpayers. Bartholow (2007) concluded that the application of 2 or 3-year contraceptives to wild mares could reduce operational costs in a project area by 12-20%, or up to 30% in carefully planned population management programs. He also concluded that contraceptive treatment would likely reduce the number of horses that must be removed in total, with associated cost reductions in the number of adoptions and total holding costs. If applying contraception to horses requires capturing and handling horses, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but adoption and long-term holding costs would be lower. Selectively applying contraception to older animals and returning them to the Confusion HMA could reduce long-term holding costs for such horses, which are difficult to adopt, and could reduce the compensatory reproduction that often follows removals (Kirkpatrick and Turner 1991). On the other hand, selectively applying contraception to younger animals can slow the rate of genetic diversity loss – a process that tends to be slow in a long-lived animal with high levels of genetic diversity – and could reduce growth rates further by delaying the age of first parturition (Gross 2000). Although contraceptive treatments are associated with a number of potential physiological, behavioral, demographic, and genetic effects, detailed in Appendix G, those concerns do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013). This alternative reflects proposed management strategies that are consistent with the WFRHBA.

In addition to treating some mares with population growth suppression vaccines, BLM may also implant soft, flexible, Y-shaped silicone IUDs in up to 15 other mares. If the IUDs show to be effective in the wild mares after two years of observation, additional mares may receive IUDs. Any mare that receives an IUD will be documented and photos taken for field identification. The mares would be observed on occasion to see if/when the mare has another foal and for general health. It is expected that the IUD will eventually fall out. If the Y-shaped silicone IUDs prove ineffective the FFO may try another IUD or switch to just using one of the fertility control vaccines mentioned. A detailed analysis of IUDs is contained in Appendix G.

Specific Impacts of Alternative D: Gather and removal of excess wild horses to low AML and population growth control by establishing a non-reproducing component.

Gather impacts from this alternative would be similar to Alternative A, B, and C, however fertility control via sterilization would be applied and neither population grown suppression vaccines nor sex ratio adjustment would occur. No more than 50% of the mares remaining on the Confusion HMA at any time will be sterilized. Reproducing horses will remain in the Confusion HMA. The anticipated effects of the sterilization treatment are both physical and behavioral. For any method using surgery or requiring extensive animal handling, a veterinarian would ensure use of appropriate sedation, anesthesia, analgesics, and antibiotics. Physical effects would be due to post-surgical healing and the possibility for complications.

Due to the flightiness of the Confusion wild horses and the inability to safely water trap as discussed in Chapter 2.4.1 and 2.4.11 of this EA, sterilization represents a minimum feasible level of management possible for the Confusion HMA. The other action alternatives would likely result in more handling, treatments, and/or removal of wild horses to maintain AML increasing the stress and chance of injury to the horses. Under Alternative D, when gather

efficiencies have been able to achieve horse numbers within the range of AML and fertility control via sterilization has been performed; maintenance gathers to apply fertility control and to remove adoptable wild horses would be conducted for the next 10 years only if needed, as indicated by ongoing monitoring. The need for follow up gathers and spaying treatments will be determined based on wild horse population numbers exceeding the upper AML limit, but over the 10-year duration of Alternative D implementation the number of gathers, animals handled, and the number of animals needed to be removed is expected to be less than under the other action alternatives.

The BLM has an overriding interest in ensuring the safety of the horses that will undergo the sterilization procedure, and the contracted veterinarians and assistants performing or assisting with the procedures. The BLM also has an overriding interest in effectively and efficiently performing the sterilization procedure on the horses. It is for this reason that the surgery would be conducted at a private facility and that public observation of the surgical procedure would not be allowed. However, BLM FFO acknowledges the public's interest in wild horse welfare and will request that the contracted veterinarian allow observation by an unaffiliated, licensed and practicing veterinarian. BLM will not select the observing veterinarian. BLM is responsible for creating a safe environment for both the horses and the veterinarian, including, but not limited to, keeping the horses' and veterinarian's stress levels to a minimum. Limiting public observations to an unaffiliated, licensed, and practicing veterinarian will increase the likelihood that surgeries and recovery are safe and successful. Treated mares will remain at the veterinarian's facility for welfare monitoring until the veterinarian is confident they are healed enough to be released. This will give the horses the best post-operation care possible. The treated mares will be monitored each day by the veterinarian and staff after the procedures for their health and comfort until the veterinarian is confident they are healed enough to be returned to the range. If post-operation complications occur the veterinarian will advise BLM on the best options and with BLM permission carry out the prescribed treatment.

For detailed discussion of possible sterilization techniques and impacts see Appendix F and H.

Impacts of Alternative E: No Action

Under the No Action Alternative, there would be no active management to control the population size within the established AML at this time. Without gathers or any population growth suppression efforts, the wild horse populations would continue to grow at an average rate of 15% to 20% within the Confusion HMA and the population could grow to approximately 1000 on the Confusion HMA in four years' time.

Utilization by wild horses would continue to exceed the amount of forage allocated for their use. Competition between wildlife, livestock and wild horses for limited forage and water resources would continue. Damage to rangeland resources would continue or increase. Over time, the potential risks to the health of individual horses would increase, and the need for emergency removals to prevent their death from starvation or thirst would also increase. Over the long-term, the health and sustainability of the wild horse population is dependent upon achieving a TNEB and sustaining healthy rangelands. Allowing wild horses to die of dehydration or starvation would be inhumane and would be contrary to the WFRHBA which requires that excess wild horses be immediately removed. Allowing rangeland damage to continue to result

from wild horse overpopulation would also be contrary to the WFRHBA which requires the BLM to "protect the range from the deterioration associated with overpopulation," "remove excess animals from the range so as to achieve appropriate management levels," and "to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area."

4.3 Cumulative Effects for All Alternatives

The NEPA regulations define cumulative impacts as impacts on the environment that result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The cumulative impacts study area for the purposes of evaluating cumulative impacts is the Confusion HMA. According to the 1994 BLM *Guidelines for Assessing and Documenting Cumulative Impacts*, the cumulative analysis should be focused on those issues and resource values identified during scoping that are of major importance. Accordingly, the issues of major importance to be analyzed are maintaining rangeland health and maintaining AML.

4.3.1 Wild Horses

The 1987 House Range RMP/ROD designated the Confusion HMA for the long-term management of wild horses. The Confusion HMA established in 1976 and identified in the "West Desert Wild Horse Capture Plan" (1977) is nearly identical in size and shape to the original herd areas identified in 1971 after passage of the WFRHBA. Management of wild horses within the Confusion HMA today is guided by the House Range RMP. AML was established as a population range of 70 – 115 on the Confusion HMA in the House Range RMP ROD.

Congressional appropriations have historically and continue to prohibit the destruction of healthy animals that are removed or deemed to be excess. BLM policy is consistent with these appropriations provisions such that only sick, lame, or dangerous animals can be euthanized, and destruction is no longer used as a population control method. Nor does BLM sell excess wild horses for slaughter; rather BLM makes every effort to place excess wild horses with private citizens who can provide the animals with a good home.

While humane euthanasia and sale without limitation of healthy horses for which there is no adoption demand is authorized under the WFRHBA, Congress has prohibited the use of appropriated funds for this purpose.

Public interest in the welfare and management of wild horses continues to be very high. There are many different values pertaining to wild horse management from the public's perceptions. Some view wild horses as nuisance animals, while others strongly advocate management of wild horses as living symbols of the pioneer spirit.

Over the next 10-20-year period, reasonably foreseeable future actions include gathers about every 5 - 7 years once low AML is obtained to remove excess wild horses to manage population size within the established AML range. Small selective management removals could be conducted to maintain the AML within the Confusion HMA reducing the need for large gathers

thus reducing the amount of stress experienced by the wild horses. Neutered studs may continue to live on the range. The excess animals removed would be transported to ORC facilities where they would be prepared for adoption, sale (with limitations), or ORPs. A Herd Management Area Plan could also be completed which would establish short and long-term management and monitoring objectives for the herd and its habitat. Future wild horse management involving gathers, following the time frame of this EA, would be analyzed in appropriate environmental documents following site-specific planning with public involvement.

The cumulative effects associated with the capture and removal of excess wild horses includes gather-related mortality of less than 1% of the captured animals, about 5% per year associated with transportation, ORCs, adoption or sale with limitations and about 8% per year associated with ORPs. This compares with natural mortality on the range ranging from about 5-8% per year for foals (animals under age 1), about 5% per year for horses ages 1-15, and 5-100% for animals age 16 and older (Jenkins, 1996, Garrott and Taylor, 1990). In situations where forage and/or water are limited, mortality rates increase, with the greatest impact to young foals, nursing mares and older horses. Animals can experience lameness associated with trailing to/from water and forage, foals may be orphaned (left behind) if they cannot keep up with their mare, or animals may become too weak to travel. After suffering, often for an extended period, the animals may die. Before these conditions arise, the BLM generally removes the excess animals to prevent their suffering from dehydration or starvation.

Cumulative Effects of Alternative A

Adjustment in sex ratios to favor males should slow population growth and result in fewer gathers and less frequent disturbance to individual wild horses and the herd's social structure. However, return of wild horses back into the Confusion HMA could lead to decreased ability to effectively gather horses in the future as released horses learn to evade the helicopter.

Cumulative Effects of Alternative B

Gathering to low AML without any sex ratio adjustment to favor males or fertility control treatment on mares keeps the growth rate higher and causes the need to return to the Confusion HMA more frequently to maintain horses at the AML levels. This causes more repeated stress on the animals. This alternative would require the need to gather and remove horses every 3 to 5 years to maintain AML levels. The alternatives with some form of growth suppression would need gathers and removals every 5 to 7 years once low AML is obtained to maintain AML levels.

Cumulative Effects of Alternative C

Using fertility control vaccines and/or IUDs to treat mares should prolong the need to remove horses from the range. However, gathers to retreat mares would need to occur to stay current on the treatments needed to control the population.

Cumulative Effects of Alternative D (Proposed Action)

Impacts of this alternative are similar to the Alternatives A-C except that sterilization of mares would also be part of the herd continuing into the future. The sterile wild horses would not be able to reproduce thus eliminating the possibility for them to pass on their genes. As horses grow old and die over time it is expected that BLM FFO would have to spay additional mares to maintain AML, but at no time would more than 50% of the mares on the range be sterile.

Cumulative Effects of Alternative E (No Action)

Under the No Action Alternative, the wild horse population within the Confusion HMA area could exceed 1000 in four years. Movement outside the Confusion HMA would be expected as greater numbers of horses search for food and water for survival, thus impacting larger areas of public lands. Heavy to excessive utilization of the available forage would be expected and the water available for use could become increasingly limited. Eventually, ecological plant communities would be damaged to the extent that they are no longer sustainable, and the wild horse population would be expected to crash.

Emergency removals could be expected to prevent individual animals from suffering or death as a result of insufficient forage and/or water. These emergency removals could occur as early as 2020 with the current population levels and expected growth. During emergency conditions, competition for the available forage and water increases. This competition generally impacts the oldest and youngest horses as well as lactating mares first. These groups would experience substantial weight loss and diminished health, which could lead to their prolonged suffering and eventual death. If emergency actions are not taken, the overall population could be affected by severely skewed sex ratios towards stallions as they are generally the strongest and healthiest portion of the population. An altered age structure would also be expected.

4.3.2 Rangeland Health and Livestock

Through previous decisions, the BLM has allocated the available forage to wild horses, wildlife, and domestic livestock. Other decisions have resulted in adjustments to livestock numbers and seasons of use and for implementation of grazing systems and the associated range improvements to promote rangeland health.

While the present livestock grazing system and efforts to manage the wild horse population within AML has reduced past historic impacts, the current overpopulation of wild horses is continuing to contribute to areas of heavy vegetation utilization, trailing and trampling damage and is preventing the BLM from managing for rangeland health and a TNEB and multiple use relationship on the public lands in the area. Rangeland Health Assessments have been conducted within the Confusion HMA for the associated livestock grazing allotments. Portions of the complex have been monitored over the past several years due to problems with drought, vegetation condition and the combined use of wild horses and domestic livestock. Adjustments have been made from these evaluations to the permitted use by livestock by way of season of use, livestock numbers, and grazing systems through the allotment evaluation and permit renewal processes.

The action alternatives analyzed in this EA would result in the reduction in competition between wild horses and other users (i.e. native wildlife and domestic livestock) for the limited available forage and water resources. Direct improvements in soils and riparian condition would be expected in the short term and result in fewer multiple-use conflicts within and adjacent to the Confusion HMA.

Over the long-term, improving the range would further benefit all users and the resources they depend on for forage and water.

Under the No Action alternative, the current population of wild horses would continue to grow. Competition among wild horses, native wildlife and domestic livestock for limited resources would increase, and riparian conditions would continue to deteriorate. Over the long-term, the health of wild horses and native wildlife would be expected to suffer as rangeland productivity further declines.

Livestock grazing is expected to continue at similar stocking rates and utilization of the available vegetation (forage) would also be expected to continue at similar levels. Continuing to graze livestock in a manner consistent with grazing permit terms and conditions would be expected to achieve or make significant progress towards achieving/maintaining Rangeland Health Standards. There are not any future actions that would adversely affect vegetation within the Confusion HMA area currently being developed.

The other cumulative effects which would be expected when incrementally adding either of the action alternatives to the Confusion HMA would include continued improvement of upland vegetation conditions, which would in turn benefit permitted livestock, native wildlife, and wild horse population as forage (habitat) quality and quantity is improved over the current level. Benefits from a reduced wild horse population would include fewer animals competing for forage and water resources. Cumulatively, there should be more stable wild horse populations, healthier rangelands, healthier wild horses, and fewer multiple use conflicts in the area over the short and long-term. Over the next 10-20 years, continuing to manage wild horses within the established AML range would achieve a TNEB and multiple use relationship on public lands in the area.

Cumulative impacts would result in foregoing the opportunity to improve rangeland health and to properly manage wild horses in balance with the available forage and water and other multiple uses. Attainment of site-specific vegetation management objectives and Standards for Rangeland Health would not be achieved. AML would not be achieved and the opportunity to collect the scientific data necessary to re-evaluate AML levels, in relationship to rangeland health standards, would be foregone.

5.0 Monitoring and Mitigation Measures

The BLM Wild Horse Specialist assigned as lead for gather operations would be responsible for ensuring all personnel abide by the SOPs (Appendix B). In addition to new measures for genetic monitoring noted in this EA, ongoing monitoring of forage condition, utilization, water availability, aerial population surveys, and animal health would continue. Management actions over the life of this plan will be informed by information collected from the ongoing monitoring efforts.

6.0 List of Preparers

The following list identifies the interdisciplinary team member's area of responsibility:

Name	Title	Area of Responsibility
Trent Staheli	Wild Horse Specialist	Project Lead/Wild Horses
Paul Griffin	Research Coordinator	WH&B Program Research Coordination
Cassie Mellon	Hydrologist	Wetlands/Riparian Zones
Wesley	Archeologist	Cultural Resources, Native American Religious Concerns

Willoughby		
Teresa Frampton	Recreation Specialist	Areas of Critical Environmental Concern, Recreation, Wilderness/WSA, Visual Resources, Lands with Wilderness Characteristics
Trevor Riding	Rangeland Management Specialist	Livestock Grazing, Standards for Rangeland Health
Paul Caso	Rangeland Management Specialist	Soil, Riparian/Wetlands, Farmlands (Prime or Unique)
RB Probert	Weed Specialist	Invasive Species/Noxious Weeds
David Whitaker	Rangeland Management Specialist	Vegetation, Special Status Species

7.0 Consultation and Coordination

An annual single state-wide public hearing is held regarding the use of helicopters and motorized vehicles to capture wild horses (or burros) within the state of Utah. During the hearing, the public is given the opportunity to present new information and to voice any concerns or opinions regarding the use of these methods to capture wild horses (or burros). A hearing was held in the Cedar City BLM Office in Cedar City, Utah on Nov. 14, 2019. Primary issues discussed were: (1) how helicopters are used during gathers and their effects on wild horses, (2) appropriate management levels in HMAs and how they are establish and monitored, and (3) legal ability of BLM using motorized vehicles. General questions & answers were discussed.

8.0 Public Involvement

Notification of the Proposed Action was listed in ePlanning 10/23/2018. BLM offered a 30-day comment period (6/26/2020 - 7/25/2020) on the EA in ePlanning, but additional comments were received through email until 7/27/2020 due to the press release stating comments were due by July 27. The EA information was provided on the project's webpage on the BLM's NEPA Register and announced through Press Releases/Distribution Lists (Media and Wild Horse Advocates). Public outreach information is contained in the EA in Section 8. Using letters, emails, and the NEPA Register, 16 entities submitted comments to the FFO as follows:

- 5 advocacy groups (The Cloud Foundation (TCF), The American Wild Horse Campaign (AWHC) and Animal Welfare Institute (AWI) combined, Return to Freedom Wild Horse Conservation (RTF), and Wild Horse Education (WHE)) and Utah Farm Bureau
- 7 individuals, one of which was an unknown submitter
- Local and State governments (Iron County, Beaver County, Public Lands Policy Coordinating Office (PLPCO)).

AWHC and AWI submitted a comment letter together and AWHC also submitted a form letter written by AWHC and signed by approximately 4,545 individuals. The list of comments is included in the Comment Report (Appendix K). Similar comments were generally reviewed collectively. BLM considered all comments received. A couple of the comments resulted in BLM making a change to portions of the EA. When comments promoted a change in the EA,

such a change is noted in the Comment Report. Some of the comments were broad in scope and consisted mainly of personal opinion or non-substantive input not requiring a response; however, due to the low number of submissions those comments are included in the Comment Report. Only a couple commenters specifically discussed the conditions and wild horses in the Confusion HMA. Most of the comments were opposed to gather and removal of wild horses and proposed the implementation of some form of PZP use to control population growth. Several comments were in favor of the action of removing wild horses down to low AML of 70 horses and implementing some form of population growth suppression. The comments and responses shown in the Comment Report capture the range of content sent in by all commenters.

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10.0 Appendices

Appendix A – Win Equus Population Modeling Results
Appendix B – Standard Operating Procedures for Wild Horse Gathers
Appendix C – Standard Operating Procedures for Population-level Fertility Control Treatments
Appendix D – Maps

Appendix E – November 2017 Population Inventory Results
Appendix F – Ovariectomy Procedures
Appendix G – Fertility Control Review
Appendix H – Sterilization Review
Appendix J – Interdisciplinary Team Checklist
Appendix K – Comment Report
Appendix L – Body Condition Score Chart

Appendix A. Population Modeling

Confusion HMA 2018 Population Modeling

To complete the population modeling for the Confusion HMA 2018, version 1.40 of the WinEquus program, created June 26, 2018, was utilized.

Objectives of Population Modeling

Review of the data output for each of the simulations provided many use full comparisons of the possible outcomes for each alternative. Some of the questions that need to be answered through the modeling include:

- Do any of the Alternatives "crash" the population?
- What effect does Population growth suppression have on population growth rate?
- What effects do the different alternatives have on the average population size?
- What effects do the different alternatives have on the genetic health of the herd?

Population Data, Criteria, and Parameters utilized for Population Modeling
All simulations used the survival probabilities, foaling rates, and sex ratio at birth that was supplied with the Winn Equus population for the Garfield HMA.

Sex ratio at Birth:
42% Females
58% Males

The following percent effectiveness of Population growth suppression was utilized in the population modeling for Alternative I: Year 1: 94%

The following table displays the contraception parameters utilized in the population model for Proposed Alternative:

Contraception Criteria

Age	Percentages for Fertility Treatment
1	100%
2	100%
3	100%
4	100%

Age	Percentages for Fertility Treatment
5	100%
6	100%
7	100%
8	100%
9	100%
10-14	100%
15-19	100%
20+	100%

Population Modeling Criteria

The following summarizes the population modeling criteria that are common to the Proposed Action and all alternatives:

- Starting year: 2018
- Initial Gather Year: 2018
- Gather interval: regular interval of five years
- Gather for fertility treatment regardless of population size: Yes
- Continue to gather after reduction to treat females: Yes
- Sex ratio at birth: 58% males
- Percent of the population that can be gathered: 70%
- Minimum age for long term holding facility horses: Not Applicable (Gate Cut)
- Foals are included in the AML
- Simulations were run for 10 years with 100 trials each

The following table displays the population modeling parameters utilized in the model:

Population Modeling Parameters Modeling Parameter	Gather and Removal of Excess Wild Horses and Application of Population Growth Suppression	Gather and Removal of Excess Wild Horses without Population Growth Suppression.	No Action – Continue Existing Management. No Gather and Removal
Management by removal only	No	Yes	No
Threshold Population Size Following Gathers	70	70	N/A
Target Population Size Following gather	70	70	N/A
Gather for Population Growth Suppression regardless of population size	Yes	No	N/A
Gather continue after removals to treat additional females	Yes	Yes	N/A
Effectiveness of Population Growth Suppression: Year 1	94%	N/A	N/A

To summarize the results obtained by simulating the range of alternatives for the proposed Confusion HMA wild horse gather, the original questions can be addressed.

Do any of the Alternatives "crash" the population?

None of the alternatives indicate that a "crash" is likely to occur to the population. Minimum population levels and growth rates are all within reasonable levels, and adverse impacts to the population are not likely.

What effect does fertility control have on population growth rate?

The use of fertility control is expected to cause a slightly lower population growth rate than Alternative B (without the use of fertility control), which would involve gathers only, but would

modify the sex ratio of the herd. This would tend to indicate that the growth rate of the herd can be reduced by modifying the sex structure slightly, without the use of fertility control.

What effect do the different alternatives have on the average population size?

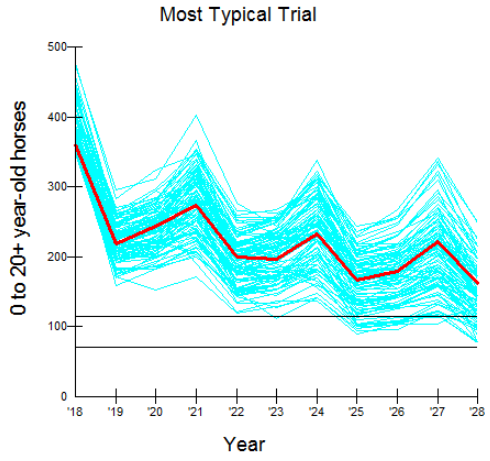
The level to which the population is gathered appears to have more of an influence to average population size than fertility control. As expected, Alternatives without growth suppression/ fertility control result in the highest average population.

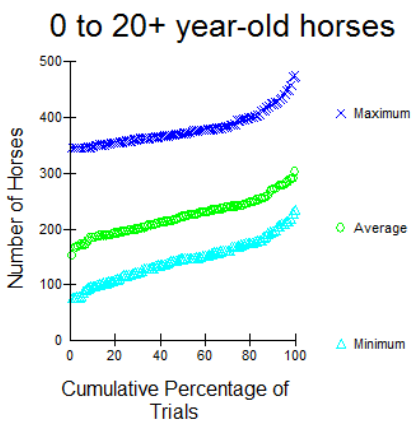
What effects do the different alternatives have on the genetic health of the herd?

The minimum population levels and growth rates are all within reasonable levels for each alternative; therefore, adverse impacts to the population are not likely to occur. Occasional immigration from nearby HMAs helps to increase genetic diversity of the Confusion horses. Moreover, if genetic diversity monitoring reveals that there are causes for concern about the levels of observed heterozygosity in the herd, BLM can introduce additional wild horses from a different HMA, to augment genetic diversity within the Confusion HMA.

Results - Gather and Removal of Excess Wild Horses and Application of Population Growth Suppression.

Population Size



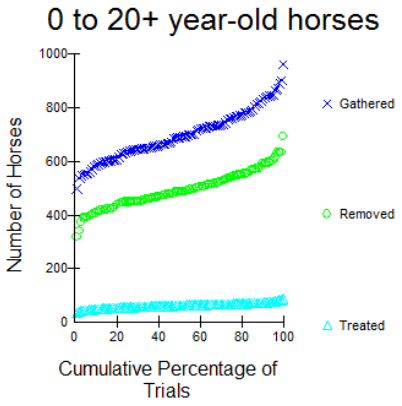


Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	77	152	346
10th Percentile	97	185	350
25th Percentile	118	197	359
Median Trial	148	222	373
75th Percentile	171	242	396
90th Percentile	197	271	426
Highest Trial	235	302	476

* 0 to 20+ year-old horses

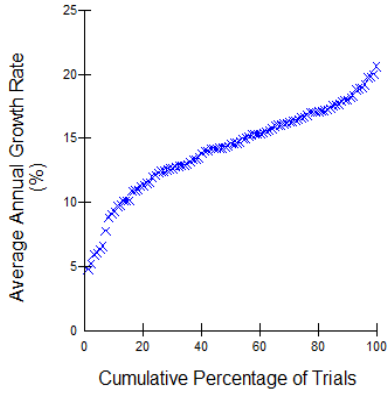
In 11 years and 100 trials, the lowest number 0 to 20+ year-old horses ever obtained was 77 and the highest was 476. In half the trials, the minimum population size in 11 years was less than 148 and the maximum was less than 373. The average population size across 11 years ranged from 152 to 302.



Totals in 11 Years*

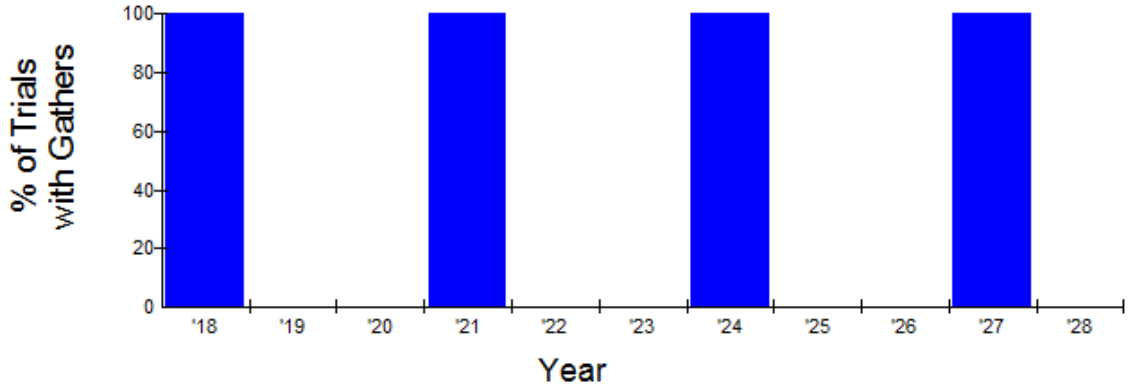
	Gathered	Removed	Treated
Lowest Trial	498	318	36
10th Percentile	588	410	48
25th Percentile	640	448	55
Median Trial	692	488	63
75th Percentile	764	542	68
90th Percentile	837	592	74
Highest Trial	963	692	87

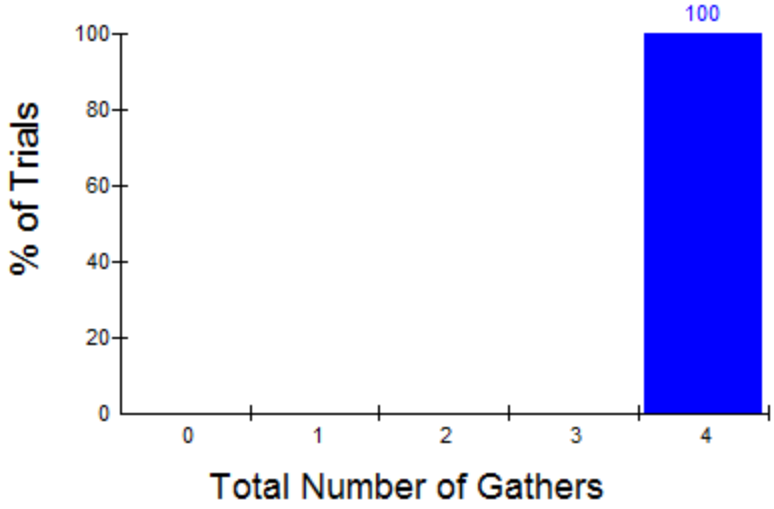
* 0 to 20+ year-old horses



Average Growth Rate in 10 Years

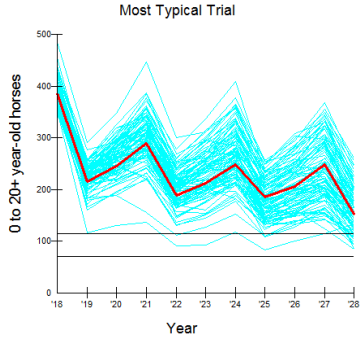
Lowest Trial	4.7
10th Percentile	9.5
25th Percentile	12.4
Median Trial	14.6
75th Percentile	16.8
90th Percentile	18.1
Highest Trial	20.6

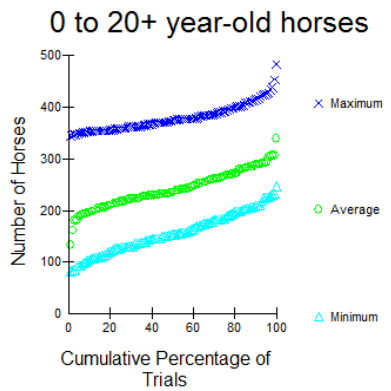




Results - Gather and Removal of Excess Wild Horses without Population Growth Suppression

Population Size



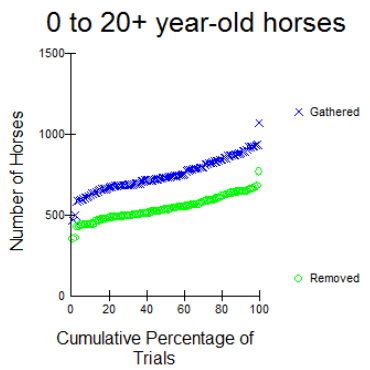


Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	83	133	345
10th Percentile	106	197	354
25th Percentile	128	217	360
Median Trial	154	236	376
75th Percentile	186	268	394
90th Percentile	210	289	416
Highest Trial	247	338	484

* 0 to 20+ year-old horses

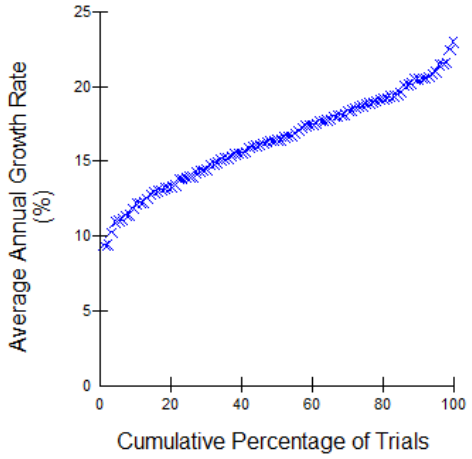
In 11 years and 100 trials, the lowest number 0 to 20+ year-old horses ever obtained was 83 and the highest was 484. In half the trials, the minimum population size in 11 years was less than 154 and the maximum was less than 376. The average population size across 11 years ranged from 133 to 338.



Totals in 11 Years*

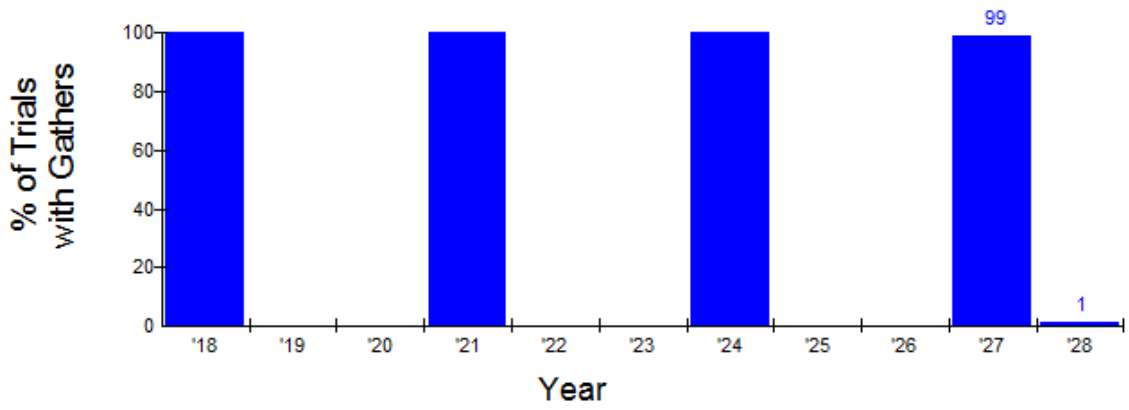
	Gathered	Removed
Lowest Trial	472	353
10th Percentile	632	446
25th Percentile	689	492
Median Trial	740	537
75th Percentile	834	596
90th Percentile	894	647
Highest Trial	1073	769

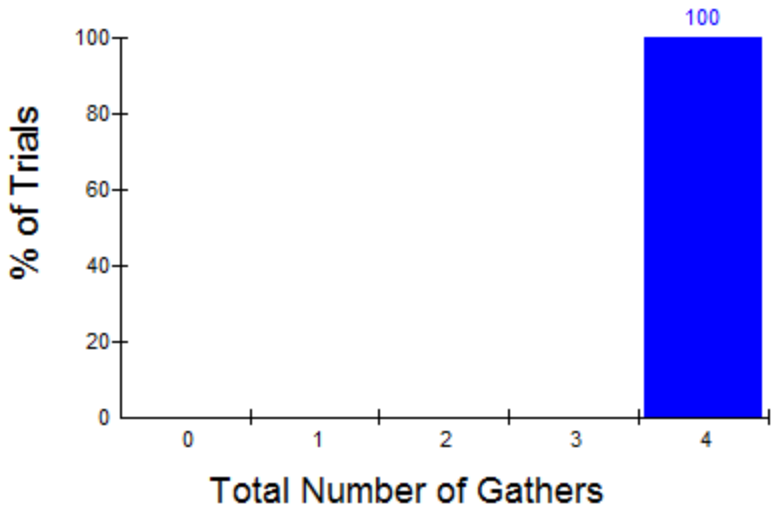
* 0 to 20+ year-old horses



Average Growth Rate in 10 Years

Lowest Trial	9.4
10th Percentile	12.2
25th Percentile	14.0
Median Trial	16.5
75th Percentile	18.9
90th Percentile	20.5
Highest Trial	23.0

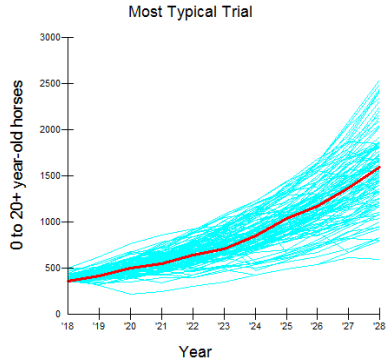




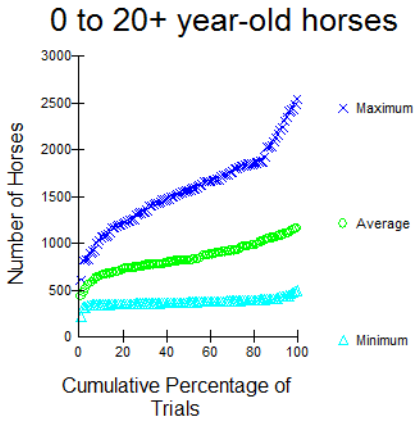
Results - No Action – No Gather, Removal or use of Population Growth Suppression

Results - No Action

Population Size



Population Sizes in 11 Years*

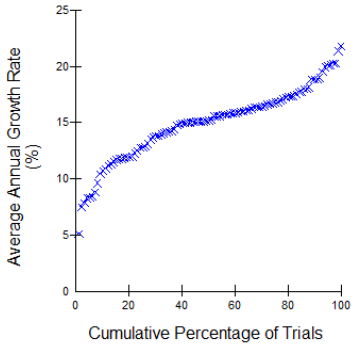


Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	217	432	614
10th Percentile	348	660	1076
25th Percentile	354	742	1287
Median Trial	372	821	1576
75th Percentile	390	963	1836
90th Percentile	411	1066	2152
Highest Trial	496	1158	2541

* 0 to 20+ year-old horses

In 11 years and 100 trials, the lowest number 0 to 20+ year-old horses ever obtained was 217 and the highest was 2541. In half the trials, the minimum population size in 11 years was less than 372 and the maximum was less than 1576. The average population size across 11 years ranged from 432 to 1158.

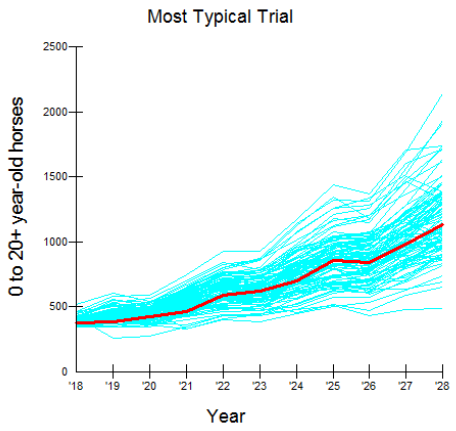


Average Growth Rate in 10 Years

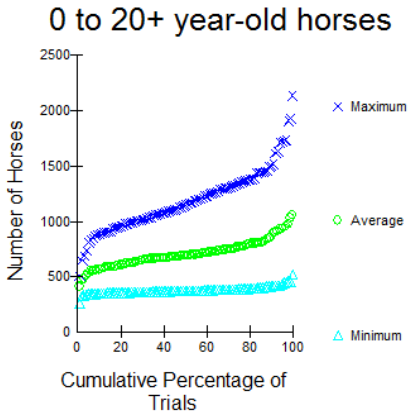
Lowest Trial	5.1
10th Percentile	10.8
25th Percentile	12.8
Median Trial	15.2
75th Percentile	16.8
90th Percentile	18.9
Highest Trial	21.8

Results - Alternative Considered but Not Analyzed: Population Growth Suppression Only.

Population Size



Population Sizes in 11 Years*

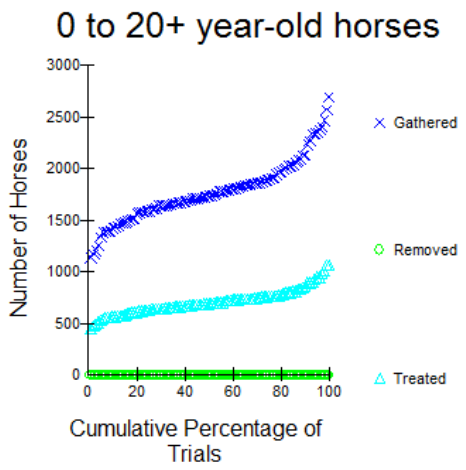


Population Sizes in 11 Years*

	Minimum	Average	Maximum
Lowest Trial	256	414	513
10th Percentile	351	566	894
25th Percentile	360	628	1000
Median Trial	374	693	1159
75th Percentile	389	772	1354
90th Percentile	416	876	1512
Highest Trial	520	1058	2136

* 0 to 20+ year-old horses

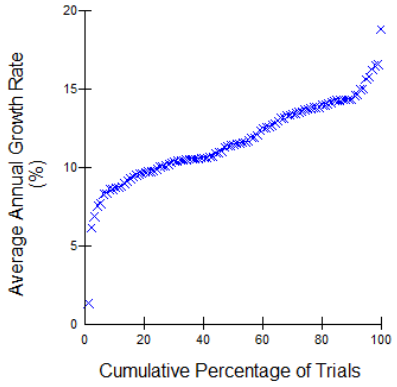
In 11 years and 100 trials, the lowest number 0 to 20+ year-old horses ever obtained was 256 and the highest was 2136. In half the trials, the minimum population size in 11 years was less than 374 and the maximum was less than 1159. The average population size across 11 years ranged from 414 to 1058.



Totals in 11 Years*

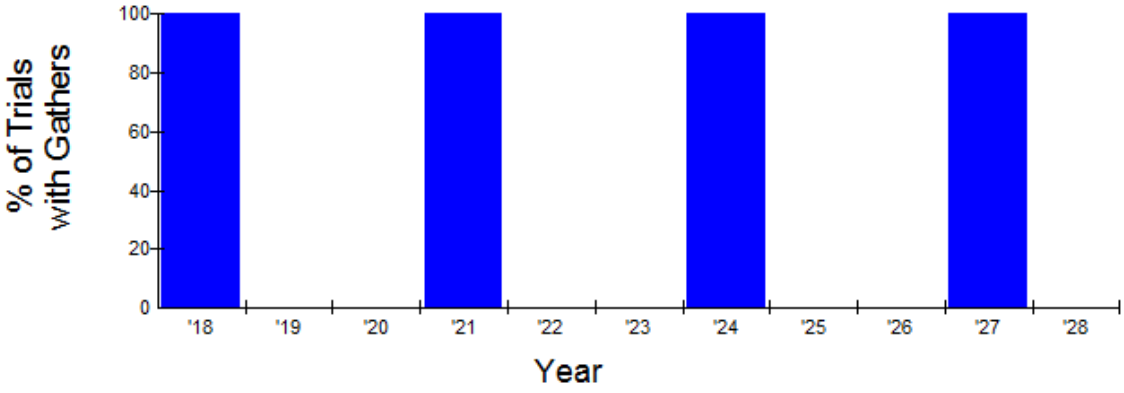
	Gathered	Removed	Treated
Lowest Trial	1139	0	447
10th Percentile	1430	0	565
25th Percentile	1602	0	632
Median Trial	1742	0	692
75th Percentile	1909	0	761
90th Percentile	2188	0	875
Highest Trial	2698	0	1067

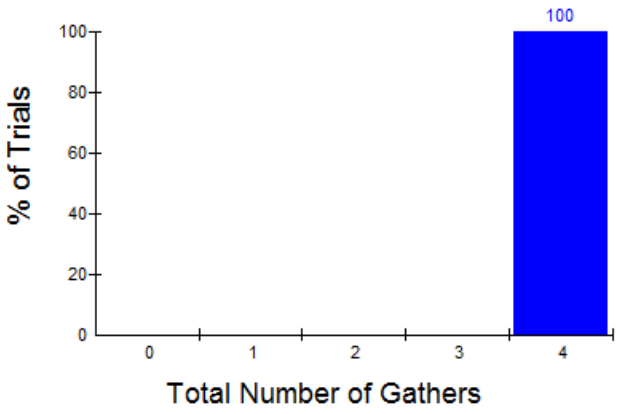
* 0 to 20+ year-old horses



Average Growth Rate in 10 Years

Lowest Trial	1.3
10th Percentile	8.7
25th Percentile	10.1
Median Trial	11.5
75th Percentile	13.8
90th Percentile	14.5
Highest Trial	18.8




100
100
80
60
40
20
0
% of Trials
0
1
2
3
4
Total Number of Gathers

Confusion Population Modeling

Files used Age - garage97.ain

Survival - garsurv.sin

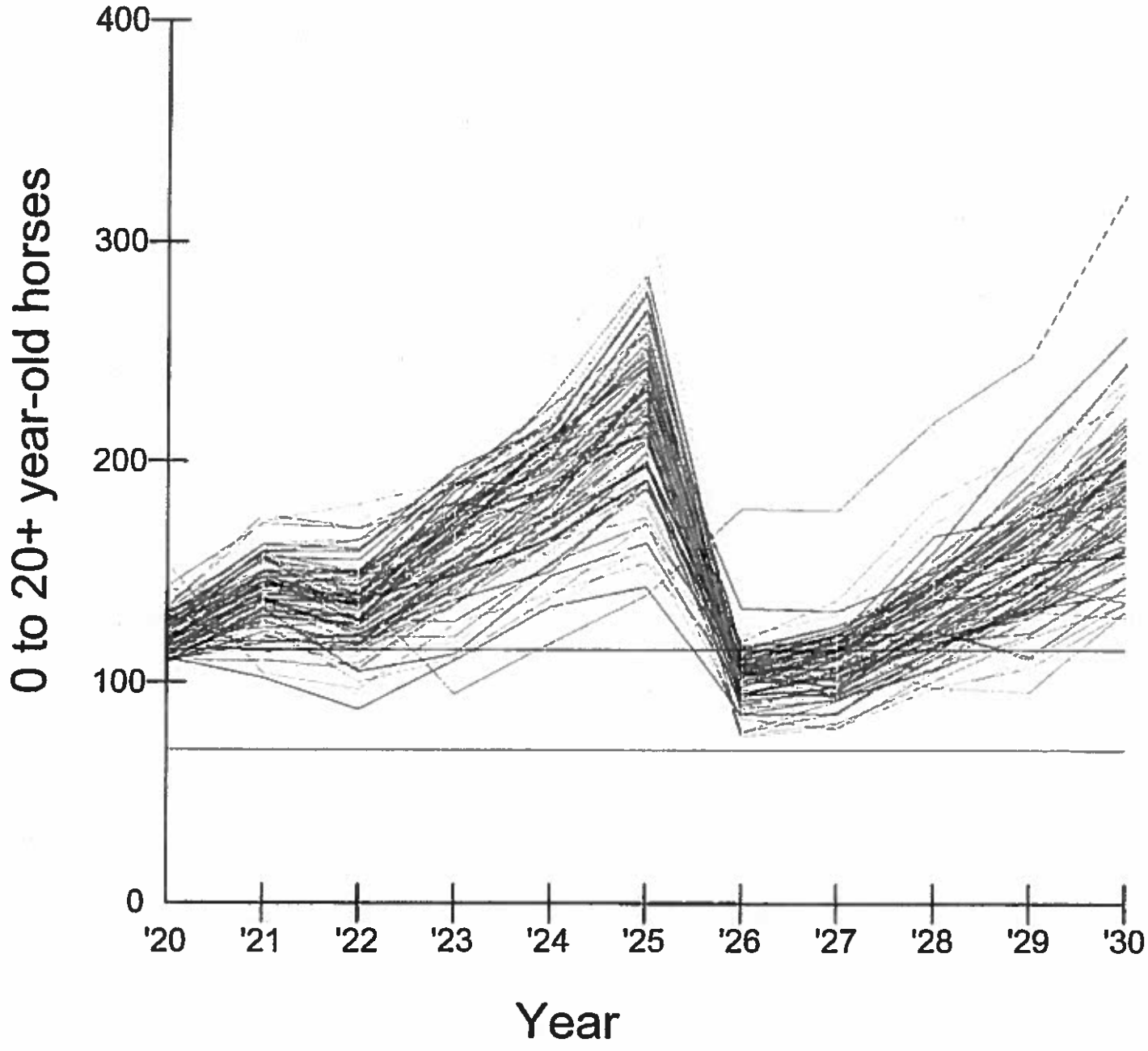
Foaling – garfoal.fin

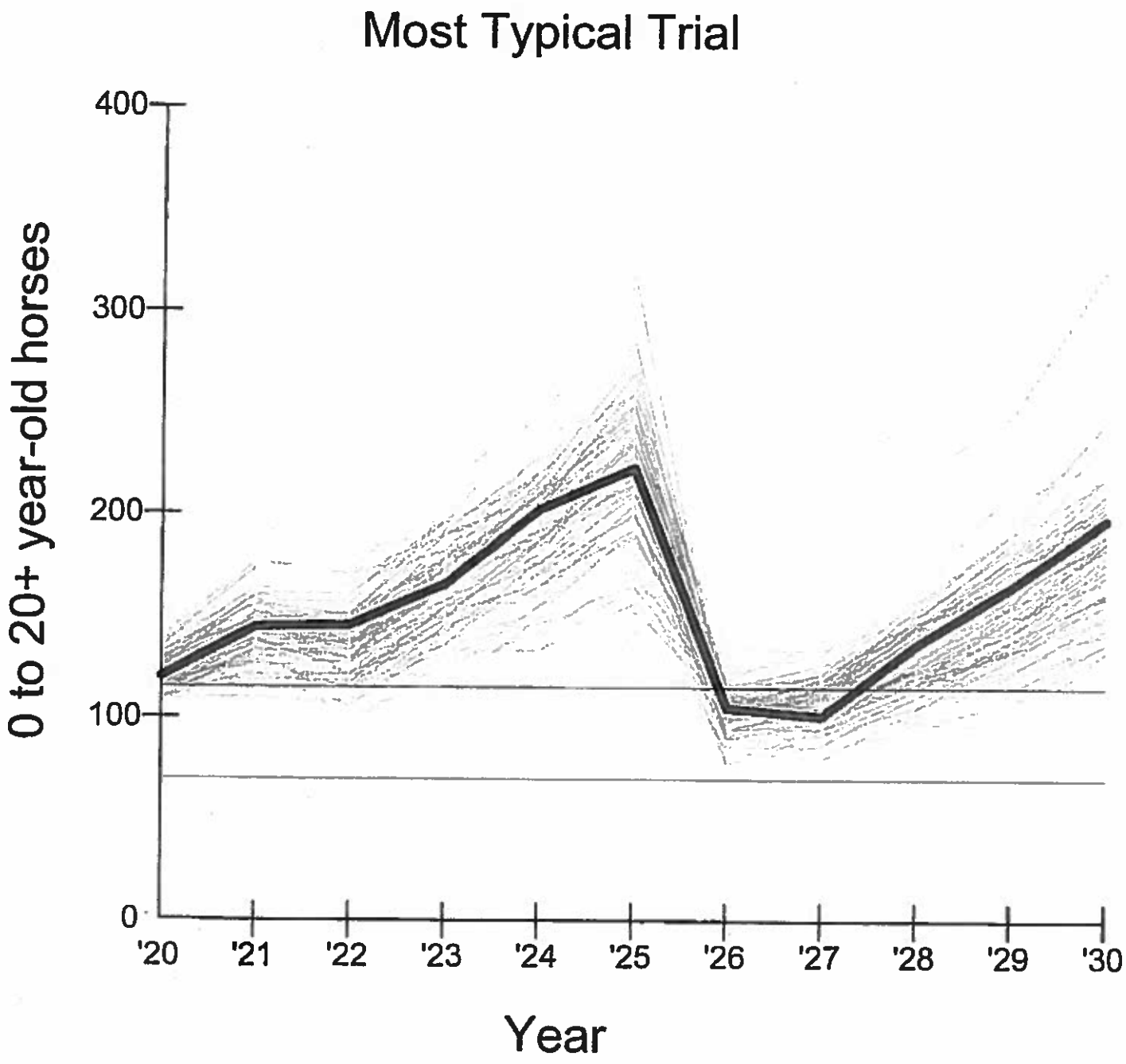
Removal - gate cut, all age ranges

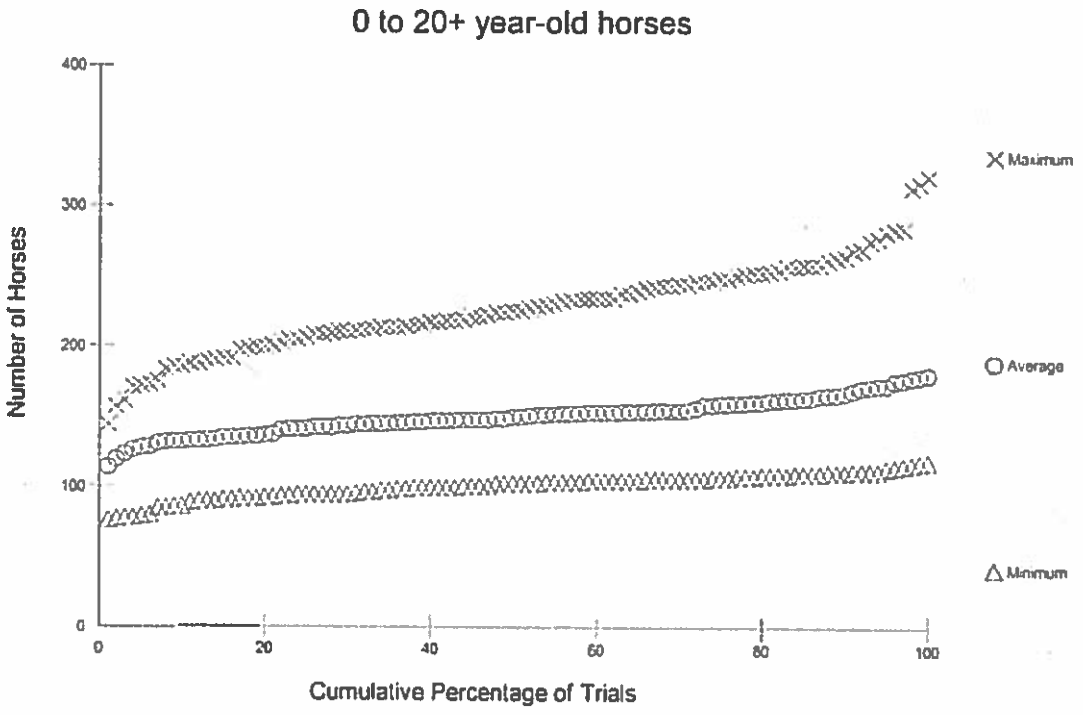
Contraception – all age ranges, all mares returned 100% efficacy for spay.

5 year gather interval, 80% gather of population

Population Size in 11 years: In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses, ever obtained was 76 and the highest was 322. In half the trials, the minimum population size in 11 tears was less than 103 and the maximum was less than 226. The average population size across 11 years ranged from 114 to 181.

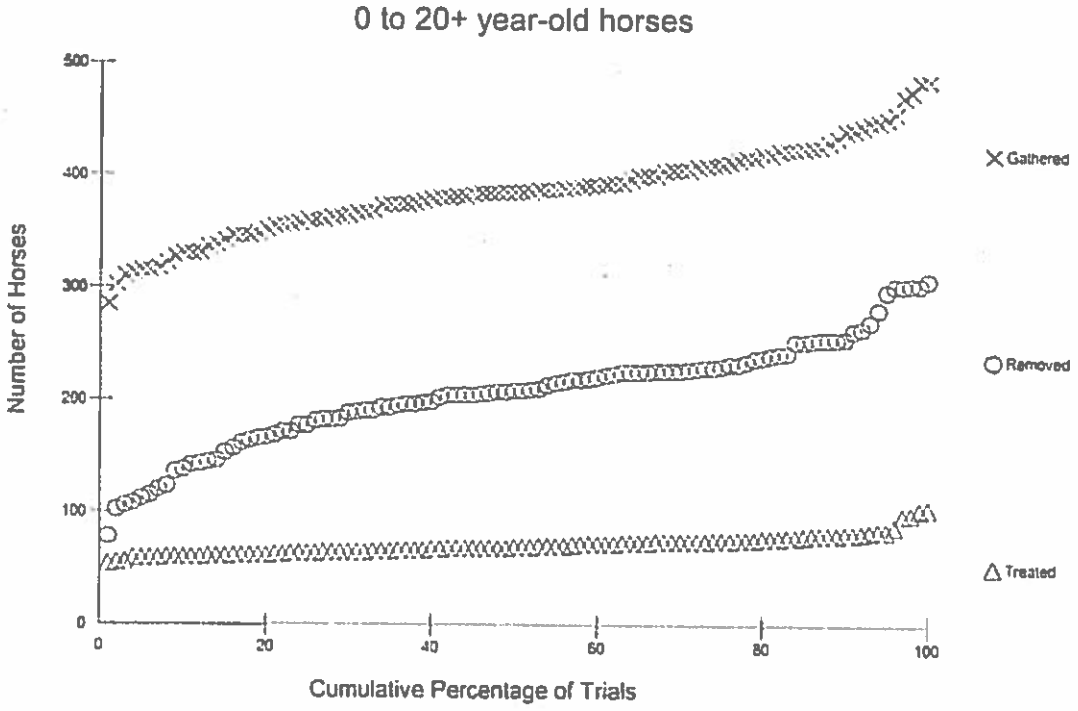

400
300
200
100
0
0 to 20+ year-old horses
'20
'21
'22
'23
'24
'25
'26
'27
'28
'29
'30
Year


Most Typical Trial
0 to 20+ year-old horses
400
300
200
100
0
'20
'21
'22
'23
'24
'25
'26
'27
'28
'29
'30
Year



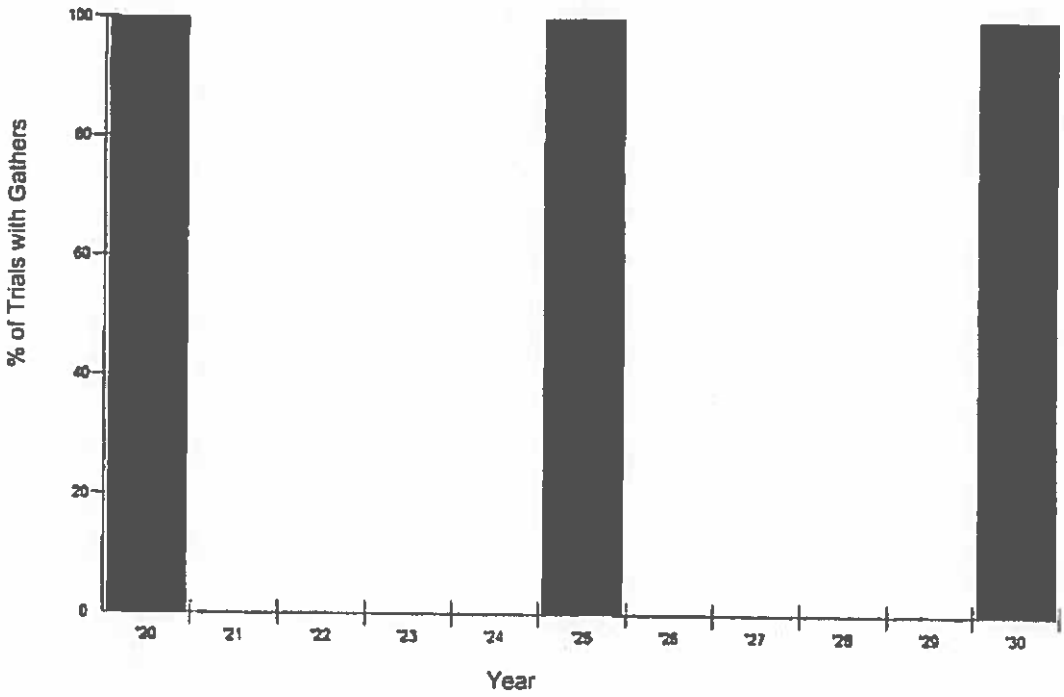
	Population Sizes in 11 Years*		
	Minimum	Average	Maximum
Lowest Trial	76	114	144
10th Percentile	88	133	187
25th Percentile	95	142	208
Median Trial	103	150	226
75th Percentile	107	160	249
90th Percentile	112	168	267
Highest Trial	119	181	322

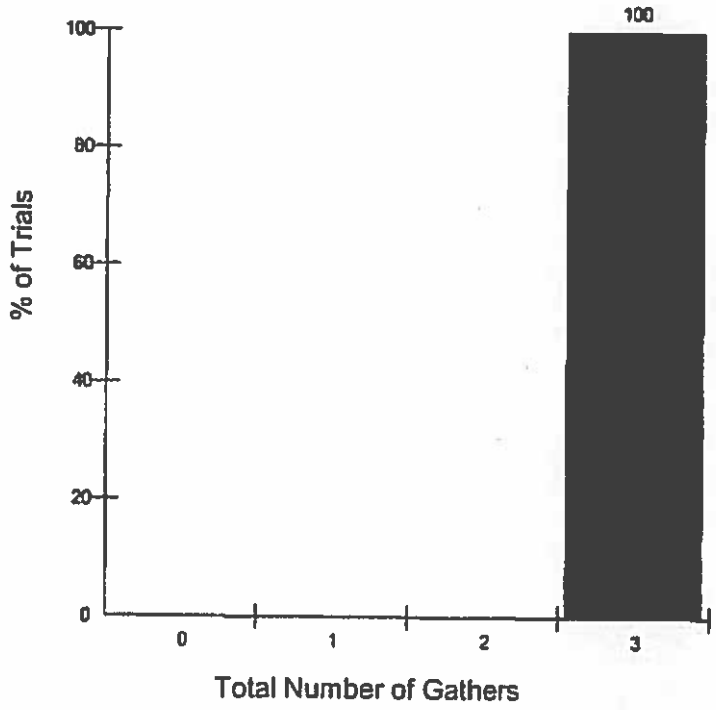
* 0 to 20+ year-old horses

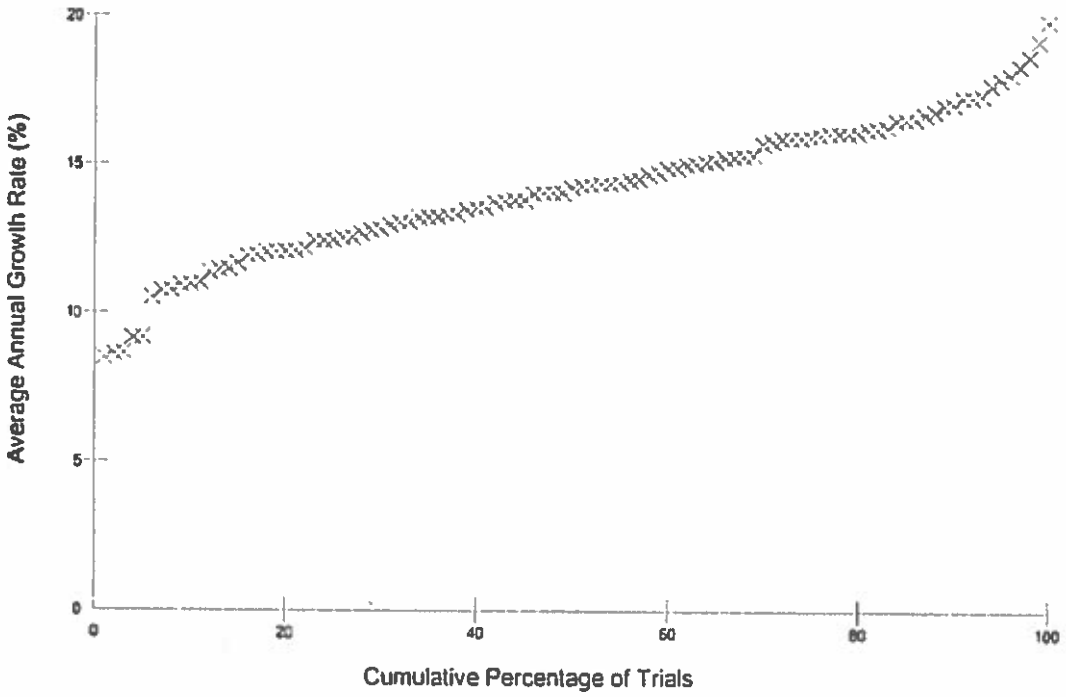


	Totals in 11 Years*		
	Gathered	Removed	Treated
Lowest Trial	285	78	54
10th Percentile	330	140	60
25th Percentile	361	180	64
Median Trial	386	209	70
75th Percentile	412	232	76
90th Percentile	442	259	82
Highest Trial	486	308	105

* 0 to 20+ year-old horses


% of Trials with Gathers
100
80
60
40
20
0
'20
'21
'22
'23
'24
'25
'26
'27
'28
'29
'30
Year


% of Trials
100
80
60
40
20
0
100
0
1
2
3
Total Number of Gathers



Average Growth Rate in 10 Years

Lowest Trial	8.5%
10th Percentile	11.0%
25th Percentile	12.5%
Median Trial	14.3%
75th Percentile	16.0%
90th Percentile	17.2%
Highest Trial	19.9%

Appendix B

Standard Operating Procedures for Wild Horse Gathers

Gathers are conducted by utilizing contractors from the Wild Horse Gathers-Western States Contract or BLM personnel. The following standard operating procedures (SOPs) for gathering and handling wild horses apply whether a contractor or BLM personnel conduct a gather. For helicopter gathers conducted by BLM personnel, gather operations would be conducted in conformance with the Wild Horse Aviation Management Handbook (January 2009).

Prior to any gathering operation, the BLM would provide for a pre-gather evaluation of existing conditions in the gather area(s). The evaluation would include animal conditions, prevailing temperatures, drought conditions, soil conditions, road conditions, and a topographic map with Wilderness boundaries, the location of fences, other physical barriers, and acceptable gather locations in relation to animal distribution. The evaluation would determine whether the proposed activities would necessitate the presence of a veterinarian during operations. If it is determined that a large number of animals may need to be euthanized or gather operations could be facilitated by a veterinarian, these services would be arranged before the gather would proceed. The contractor would be apprised of all conditions and would be given instructions regarding the gather and handling of animals to ensure their health and welfare is protected.

Gather sites and temporary holding sites would be located to reduce the likelihood of injury and stress to the animals, and to minimize potential damage to the natural resources of the area. These sites would be located on or near existing roads whenever possible.

The primary gather methods used in the performance of gather operations include:
1. Helicopter Drive Gathering. This gather method involves utilizing a helicopter to herd wild horses into a temporary gather site.

2. Helicopter Assisted Roping. This gather method involves utilizing a helicopter to herd wild horses to ropers.

3. Bait Trapping. This gather method involves utilizing bait (e.g., water or feed) to lure wild horses into a temporary gather site.

The following procedures and stipulations would be followed to ensure the welfare, safety and humane treatment of wild horses in accordance with the provisions of 43 CFR 4700.

A. Gather Methods used in the Performance of Gather Contract Operations
The primary concern of the contractor is the safe and humane handling of all animals gathered. All gather attempts shall incorporate the following:

1. All gather sites and holding facilities locations must be approved by the Contracting Officer's Representative (COR) and/or the Project Inspector (PI) prior to construction. The Contractor may also be required to change or move gather locations as determined by the COR/PI. All gather sites and holding facilities not located on public land must have prior written approval of the landowner.

2. The rate of movement and distance the animals travel shall not exceed limitations set by the COR who would consider terrain, physical barriers, access limitations, weather, extreme temperature (high and low), condition of the animals, urgency of the operation (animals facing drought, starvation, fire rehabilitation, etc.) and other factors. In consultation with the contractor the distance the animals travel would account for the different factors listed above and concerns with each HMA.

3. All gather sites, wings, and holding facilities shall be constructed, maintained and operated to handle the animals in a safe and humane manner and be in accordance with the following:

a. Gather sites and holding facilities shall be constructed of portable panels, the top of which shall not be less than 72 inches high for horses and 60 inches high for burros, and the bottom rail of which shall not be more than 12 inches from ground level. All gather sites and holding facilities shall be oval or round in design.

b. All loading chute sides shall be a minimum of 6 feet high and shall be fully covered, plywood, metal without holes larger than 2”x4”.

c. All runways shall be a minimum of 30 feet long and a minimum of 6 feet high for horses, and 5 feet high for burros, and shall be covered with plywood, burlap, plastic snow fence or like material a minimum of 1 foot to 5 feet above ground level for burros and 1 foot to 6 feet for horses. The location of the government furnished portable fly chute to restrain, age, or provide additional care for the animals shall be placed in the runway in a manner as instructed by or in concurrence with the COR/PI.

d. All crowding pens including the gates leading to the runways shall be covered with a material which prevents the animals from seeing out (plywood, burlap, plastic snow fence, etc.) and shall be covered a minimum of 1 foot to 5 feet above ground level for burros and 2 feet to 6 feet for horses.

e. All pens and runways used for the movement and handling of animals shall be connected with hinged self-locking or sliding gates.

4. No modification of existing fences would be made without authorization from the COR/PI. The Contractor shall be responsible for restoration of any fence modification which he has made.

5. When dust conditions occur within or adjacent to the gather site or holding facility, the Contractor shall be required to wet down the ground with water.

6. Alternate pens, within the holding facility shall be furnished by the Contractor to separate mares or jennies with small foals, sick and injured animals, estrays or other animals the COR determines need to be housed in a separate pen from the other animals. Animals shall be sorted as to age, number, size, temperament, sex, and condition when in the holding facility so as to minimize, to the extent possible, injury due to fighting and trampling. Under normal conditions, the government would require that animals be restrained for the purpose of determining an animal’s age, sex, or other necessary procedures. In these instances, a portable restraining chute may be necessary and would be provided by the government.

Alternate pens shall be furnished by the Contractor to hold animals if the specific gathering requires that animals be released back into the gather area(s). In areas requiring one or more satellite gather

site, and where a centralized holding facility is utilized, the contractor may be required to provide additional holding pens to segregate animals transported from remote locations so they may be returned to their traditional ranges. Either segregation or temporary marking and later segregation would be at the discretion of the COR.

7. The Contractor shall provide animals held in the gather sites and/or holding facilities with a continuous supply of fresh clean water at a minimum rate of 10 gallons per animal per day. Animals held for 10 hours or more in the gather site or holding facilities shall be provided good quality hay at the rate of not less than two pounds of hay per 100 pounds of estimated body weight per day. The contractor would supply certified weed free hay if required by State, County, and Federal regulation.

8. An animal that is held at a temporary holding facility through the night is defined as a horse/burro feed day. An animal that is held for only a portion of a day and is shipped or released does not constitute a feed day.

9. It is the responsibility of the Contractor to provide security to prevent loss, injury or death of gathered animals until delivery to final destination.

10. The Contractor shall restrain sick or injured animals if treatment is necessary. The COR/PI would determine if animals must be euthanized and provide for the destruction of such animals. The Contractor may be required to humanely euthanize animals in the field and to dispose of the carcasses as directed by the COR/PI.

11. Animals shall be transported to their final destination from temporary holding facilities as quickly as possible after gather unless prior approval is granted by the COR for unusual circumstances. Animals to be released back into the HMA following gather operations may be held up to 21 days or as directed by the COR. Animals shall not be held in gather sites and/or temporary holding facilities on days when there is no work being conducted except as specified by the COR. The Contractor shall schedule shipments of animals to arrive at final destination between 7:00 a.m. and 4:00 p.m. No shipments shall be scheduled to arrive at final destination on Sunday and Federal holidays; unless prior approval has been obtained by the COR. Animals shall not be allowed to remain standing on trucks while not in transport for a combined period of greater than three (3) hours in any 24 hour period. Animals that are to be released back into the gather area may need to be transported back to the original gather site. This determination would be at the discretion of the COR/PI or Field Office Wild Horse & Burro Specialist.

B. Gather Methods That May Be Used in the Performance of a Gather

1. Gather attempts may be accomplished by utilizing bait (feed, water, mineral licks) to lure animals into a temporary gather site. If this gather method is selected, the following applies:

a. Finger gates shall not be constructed of materials such as "T" posts, sharpened wouldows, etc., that may be injurious to animals.

b. All trigger and/or trip gate devices must be approved by the COR/PI prior to gather of animals.

c. Gather sites shall be checked a minimum of once every 10 hours.

2. Gather attempts may be accomplished by utilizing a helicopter to drive animals into a temporary gather site. If the contractor selects this method the following applies:

a. A minimum of two saddle-horses shall be immediately available at the gather site to accomplish roping if necessary. Roping shall be done as determined by the COR/PI. Under no circumstances shall animals be tied down for more than one half hour.

b. The contractor shall assure that foals shall not be left behind, and orphaned.

3. Gather attempts may be accomplished by utilizing a helicopter to drive animals to ropers. If the contractor, with the approval of the COR/PI, selects this method the following applies:

a. Under no circumstances shall animals be tied down for more than one hour.

b. The contractor shall assure that foals shall not be left behind, or orphaned.

c. The rate of movement and distance the animals travel shall not exceed limitations set by the COR/PI who would consider terrain, physical barriers, weather, condition of the animals and other factors.

C. Use of Motorized Equipment

1. All motorized equipment employed in the transportation of gathered animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals. The Contractor shall provide the COR/PI, if requested, with a current safety inspection (less than one year old) for all motorized equipment and tractor-trailers used to transport animals to final destination.

2. All motorized equipment, tractor-trailers, and stock trailers shall be in good repair, of adequate rated capacity, and operated so as to ensure that gathered animals are transported without undue risk or injury.

3. Only tractor-trailers or stock trailers with a covered top shall be allowed for transporting animals from gather site(s) to temporary holding facilities, and from temporary holding facilities to final destination(s). Sides or stock racks of all trailers used for transporting animals shall be a minimum height of 6 feet 6 inches from the floor. Single deck tractor-trailers 40 feet or longer shall have at least two (2) partition gates providing at least three (3) compartments within the trailer to separate animals. Tractor-trailers less than 40 feet shall have at least one partition gate providing at least two (2) compartments within the trailer to separate the animals. Compartments in all tractor-trailers shall be of equal size plus or minus 10 percent. Each partition shall be a minimum of 6 feet high and shall have a minimum 5 foot wide swinging gate. The use of double deck tractor-trailers is unacceptable and shall not be allowed.

4. All tractor-trailers used to transport animals to final destination(s) shall be equipped with at least one (1) door at the rear end of the trailer which is capable of sliding either horizontally or vertically. The rear door(s) of tractor-trailers and stock trailers must be capable of opening the full width of the trailer. Panels facing the inside of all trailers must be free of sharp edges or holes that could cause injury to the animals. The material facing the inside of all trailers must be strong enough so that the

animals cannot push their hooves through the side. Final approval of tractor-trailers and stock trailers used to transport animals shall be held by the COR/PI.

5. Floors of tractor-trailers, stock trailers and loading chutes shall be covered and maintained with wood shavings to prevent the animals from slipping as much as possible during transport.

6. Animals to be loaded and transported in any trailer shall be as directed by the COR/PI and may include limitations on numbers according to age, size, sex, temperament and animal condition. The following minimum square feet per animal shall be allowed in all trailers:

- 11 square feet per adult horse (1.4 linear foot in an 8 foot wide trailer);

- 8 square feet per adult burro (1.0 linear foot in an 8 foot wide trailer);

- 6 square feet per horse foal (0.75 linear feet in an 8 foot wide trailer);

- 4 square feet per burro foal (0.5 linear feet in an 8 foot wide trailer).

7. The COR/PI shall consider the condition and size of the animals, weather conditions, distance to be transported, or other factors when planning for the movement of gathered animals. The COR/PI shall provide for any brand and/or inspection services required for the gathered animals.

8. If the COR/PI determines that dust conditions are such that the animals could be endangered during transportation, the Contractor would be instructed to adjust speed.

D. Safety and Communications

1. The Contractor shall have the means to communicate with the COR/PI and all contractor personnel engaged in the gather of wild horses utilizing a VHF/FM Transceiver or VHF/FM portable Two-Way radio. If communications are ineffective the government would take steps necessary to protect the welfare of the animals.

2. The proper operation, service and maintenance of all contractor furnished property is the responsibility of the Contractor. The BLM reserves the right to remove from service any contractor personnel or contractor furnished equipment which, in the opinion of the contracting officer or COR/PI violate contract rules, are unsafe or otherwise unsatisfactory. In this event, the Contractor would be notified in writing to furnish replacement personnel or equipment within 48 hours of notification. All such replacements must be approved in advance of operation by the Contracting Officer or his/her representative.

3. The Contractor shall obtain the necessary FCC licenses for the radio system.

4. All accidents occurring during the performance of any task order shall be immediately reported to the COR/PI.

5. Should the contractor choose to utilize a helicopter the following would apply:

a. The Contractor must operate in compliance with Federal Aviation Regulations, Part 91. Pilots provided by the Contractor shall comply with the Contractor's Federal Aviation Certificates, applicable regulations of the State in which the gather is located.

b. Fueling operations shall not take place within 1,000 feet of animals.

E. Site Clearances

1. No personnel working at gather sites may excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage or otherwise alter or deface any archaeological resource located on public lands or Indian lands.

2. Prior to setting up a gather site or temporary holding facility, BLM would conduct all necessary clearances (archaeological, T&E, etc.). All proposed site(s) must be inspected by a government archaeologist. Once archaeological clearance has been obtained, the gather site or temporary holding facility may be set up. Said clearance shall be arranged for by the COR, PI, or other BLM employees.

3. Gather sites and temporary holding facilities would not be constructed on wetlands or riparian zones.

F. Animal Characteristics and Behavior

Releases of wild horses would be near available water when possible. If the area is new to them, a short-term adjustment period may be required while the wild horses become familiar with the new area.

G. Public Participation

Opportunities for public viewing (i.e. media, interested public) of gather operations would be made available to the extent possible; however, the primary considerations would be to protect the health, safety and welfare of the animals being gathered and the personnel involved. The public must adhere to guidance from the on-site BLM representative. It is BLM policy that the public would not be allowed to come into direct contact with wild horses being held in BLM facilities. Only authorized BLM personnel or contractors may enter the corrals or directly handle the animals. The general public may not enter the corrals or directly handle the animals at any time or for any reason during BLM operations.

H. Responsibility and Lines of Communication

- Contracting Officer's Representative/Project Inspector:

- Contracting Officer's Representative/Project Inspector:

The Contracting Officer’s Representatives (CORs) and the project inspectors (PIs) have the direct responsibility to ensure the Contractor’s compliance with the contract stipulations. The Field Managers for the Humboldt River and Tuscarora Field Offices would take an active role to ensure the appropriate lines of communication are established between the field, Field Office, District

Office, State Office, National Program Office, and BLM Holding Facility offices. All employees involved in the gathering operations would keep the best interests of the animals at the forefront at all times.

All publicity, formal public contact and inquiries would be handled through the Field Manager and District Public Affairs Officer. These individuals would be the primary contact and would coordinate with the COR/PI on any inquiries.

The COR would coordinate with the contractor and the BLM Corrals to ensure animals are being transported from the gather site in a safe and humane manner and are arriving in good condition. The contract specifications require humane treatment and care of the animals during removal operations. These specifications are designed to minimize the risk of injury and death during and after gather of the animals. The specifications would be vigorously enforced. Should the Contractor show negligence and/or not perform according to contract stipulations, he would be issued written instructions, stop work orders, or defaulted.

Appendix C

Standard Operating Procedures for Population-level Fertility Control Treatments

The following implementation and monitoring requirements are part of the Proposed Action Alternative and Alternative B which involves the use of PZP and GonaCon™:

Standard Operating Procedures for PZP Vaccine Treatments; One-Year Liquid Vaccine

The following implementation and monitoring requirements are part of the Proposed Action:

1. Fertility vaccine would be administered through darting by trained BLM personnel or collaborating partners only. For any darting operation, the designated personnel must have successfully completed a nationally recognized wildlife darting course and who have documented and successful experience darting wildlife under field conditions.
2. All jennies targeted for treatment will be clearly identifiable through photographs to enable darters and HMA managers to positively identify the animals during the project and at the time of removal during subsequent gathers. This will be accomplished by marking each individual with a freeze mark on the hip. Additionally, ear tags may be placed in an ear to assist in positively identifying individuals when they are long haired.
3. Only designated darters would prepare the emulsion. Vaccine-adjuvant emulsion would be loaded into darts at the darting site and delivered by means of a projector gun. Designated darters will follow safety guidance on EPA labeling for all adjuvants.
4. Delivery of the vaccine would be by intramuscular injection into the left or right hip/gluteal muscles while the jenny is standing still.
5. Safety for both humans and the burro is the foremost consideration in deciding to dart a jenny. The Dan Inject® gun would not be used at ranges in excess of 30 m while the Pneu-Dart® gun would not be used over 50 m, and no attempt would be taken when other persons are within a 30-m radius of the target animal.
6. No attempts would be taken in high wind (greater than 15 mph) or when the animal is standing at an angle where the dart could miss the hip/gluteal region and hit the rib cage. The ideal is when the dart would strike the skin of the horse at a perfect 90° angle.
7. If a loaded dart is not used within two hours of the time of loading, the contents would be transferred to a new dart before attempting another horse. If the dart is not used before the end of the day, it would be stored under refrigeration and the contents transferred to another dart the next day. Refrigerated darts would not be used in the field.
8. No more than two people should be present at the time of a darting. The second person is responsible for locating fired darts. The second person should also be responsible for identifying the horse and keeping onlookers at a safe distance.

9. To the extent possible, all darting would be carried out in a discrete manner. However, if darting is to be done within view of non-participants or members of the public, an explanation of the nature of the project would be carried out either immediately before or after the darting.
10. Attempts will be made to recover all darts. To the extent possible, all darts which are discharged and drop from the burro at the darting site would be recovered before another darting occurs. In exceptional situations, the site of a lost dart may be noted and marked, and recovery efforts made at a later time. All discharged darts would be examined after recovery in order to determine if the charge fired and the plunger fully expelled the vaccine. Personnel conducting darting operations should be equipped with a two-way radio or cell phone to provide a communications link with the Project Veterinarian for advice and/or assistance. In the event of a veterinary emergency, darting personnel would immediately contact the Project Veterinarian, providing all available information concerning the nature and location of the incident.
11. In the event that a dart strikes a bone or imbeds in soft tissue and does not dislodge, the darter would follow the affected horse until the dart falls out or the horse can no longer be found. The darter would be responsible for daily observation of the horse until the situation is resolved.

Monitoring and Tracking of Treatments

1. At a minimum, estimation of population growth rates using helicopter or fixed-wing surveys will be conducted before any subsequent gather. During these surveys it is not necessary to identify which foals were born to which jennies; only an estimate of population growth is needed (i.e. # of foals to # of adults).
2. Population growth rates of herds selected for intensive monitoring will be estimated every year post-treatment using helicopter or fixed-wing surveys. During these surveys it is not necessary to identify which foals were born to which jennies, only an estimate of population growth is needed (i.e. # of foals to # of adults). If, during routine HMA field monitoring (on-the-ground), data describing jenny to foal ratios can be collected, these data should also be shared with the NPO for possible analysis by the USGS.
3. An Application Data sheet will be used by field applicators to record all pertinent data relating to identification of the jenny (including photographs if jennies are not freeze-marked) and date of treatment. Each applicator will submit an Application Report and accompanying narrative and data sheets will be forwarded to the NPO (Reno, Nevada). A copy of the form and data sheets and any photos taken will be maintained at the field office.

Standard Operating Procedures for GonaCon Vaccine Treatments

Administering the GonaCon Vaccine by Hand-Injection

1. For initial and booster treatments, mares would ideally receive 2.0 ml of GonaCon-Equine. However, experience has demonstrated that only 1.8 ml of vaccine can typically be loaded into 2 cc darts, and this dose has proven successful. Calculations below reflect a 1.8 ml dose.

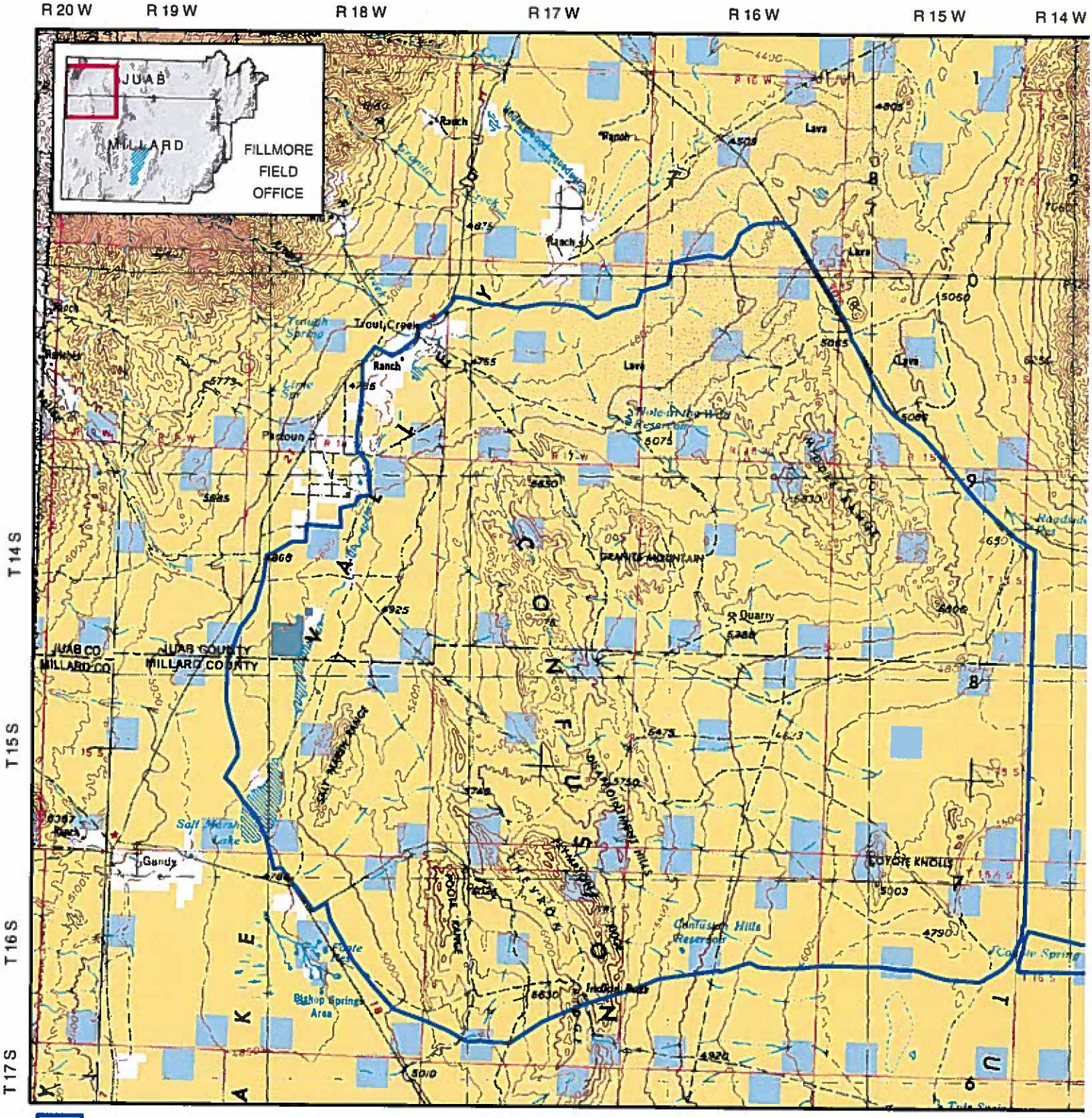
2. With each injection, the vaccine should be injected into the left or right hind quarters of the mare, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).
3. Darts should be weighed to the nearest hundredth gram by electronic scale when empty, when loaded with vaccine, and after discharge, to ensure that 90% (1.62 ml) of the vaccine has been injected. Animals receiving <50% should be darted with another full dose; those receiving >50% but <90% should receive a half dose (1 ml). All darts should be weighed to verify a combination of ≥1.62 ml has been administered. Therefore, every effort should be made to recover darts after they have fallen from animals.
4. A booster vaccine may be administered 90 or more days after the first injection to improve efficacy of the product over subsequent years.
5. Free ranging animals may be photographed using a telephoto lens and high quality digital receiver as a record of treated individuals, and the injection site can be recorded on data sheets to facilitate identification by animal markings and potential injection scars.
6. A tracking system would be maintained by NPO detailing the lot number(s) of the vaccine, quantity of vaccine issued, the quantity used, the date of vaccination, disposition of any unused vaccine, the date disposed, the number of treated mares by HMA, field office, and State along with the freeze-mark(s) applied by HMA and date.

Preparation of Darts for GonaCon Vaccine Remote Delivery:

1. The vaccine is distributed as preloaded doses (2 mL) in labeled syringes. Upon receipt, the vaccine should be kept refrigerated (4° C) until use. Do not freeze. The vaccine has a 6-month shelf-life from the time of production and the expiration date will be noted on each syringe that is provided. Important: label instructions must be followed for this product.
2. Although infrequent, dart injections can result in partial injections of the vaccine, and shots are missed. As a precaution, it is recommended that extra doses of the vaccine be ordered to accommodate failed delivery (~15 %). To determine the amount of vaccine delivered, the dart must be weighed before loading, and before and after delivery in the field.
3. For best results, darts with a gel barb should be used. (i.e. 2 cc Pneu-Dart brand darts configured with Slow-inject technology, 3.81 cm long 14 ga.tri-port needles, and gel collars positioned 1.27 cm ahead of the ferrule)
4. Wearing latex gloves, darts are numbered and filled with vaccine by attaching a loading needle (7.62 cm; provided by dart manufacturer) to the syringe containing vaccine and placing the needle into the cannula of the dart to the fullest depth possible. Slowly depress the syringe plunger and begin filling the dart. Periodically, tap the dart on a hard surface to dislodge air bubbles trapped within the vaccine. Due to the viscous nature of the fluid, air entrapment typically results in a maximum of approximately 1.8 ml of vaccine being loaded in the dart. The dart is filled to max once a small amount of the vaccine can be seen at the tri-ports.
5. Important! Do not load and refrigerate darts the night before application. When exposed to moisture and condensation, the edges of gel barbs soften, begin to dissolve, and will not hold the dart in the muscle tissue long enough for full injection of the vaccine. The dart needs to remain in the muscle tissue for a minimum of 1 minute to achieve dependable full injection. Sharp gel barbs are critical.
6. Darts (configured specifically as described above) can be loaded in the field and stored in a cooler prior to application. Darts loaded, but not used can be maintained in a cooler at about 4° C and used the next day, but do not store in a refrigerator or any other container likely to cause condensation.

BUREAU OF LAND MANAGEMENT
WEST DESERT DISTRICT

Map 1
Confusion HMA



hma_ut24fm

Land Status

- Bureau of Land Management (BLM)
- Indian Reservation (IR)
- Private
- State
- State Wildlife Reserve/Management Area

0 2.75 5.5
Miles

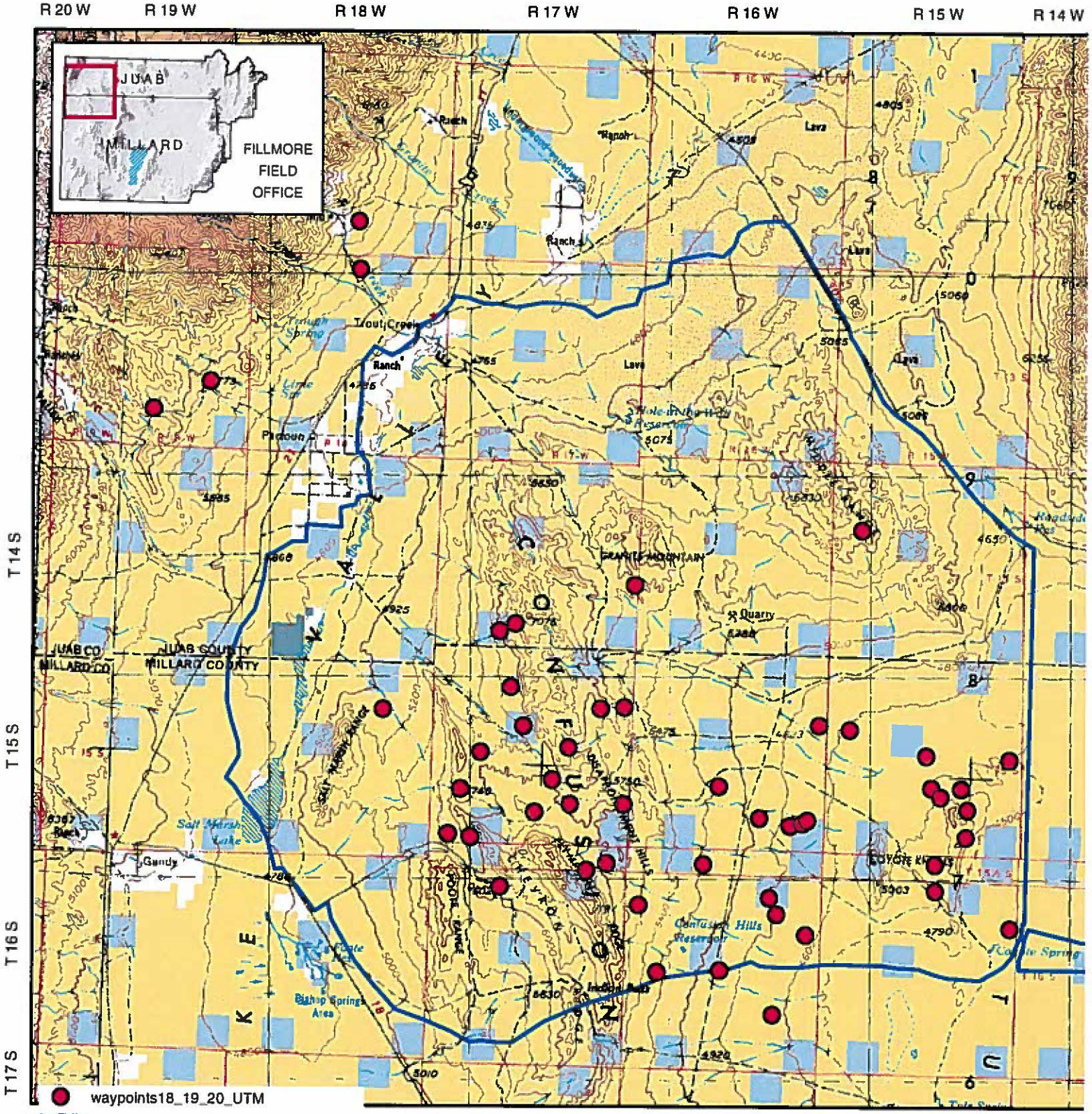
N

August 27, 2018

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

BUREAU OF LAND MANAGEMENT
WEST DESERT DISTRICT

Map 2
Nov. 2017 Wild Horse Distribution



waypoints18_19_20_UTM

hma_ut24fm

Land Status

- Bureau of Land Management (BLM)
- Indian Reservation (IR)
- Private
- State
- State Wildlife Reserve/Management Area

0 2.75 5.5
Miles

N

August 27, 2018

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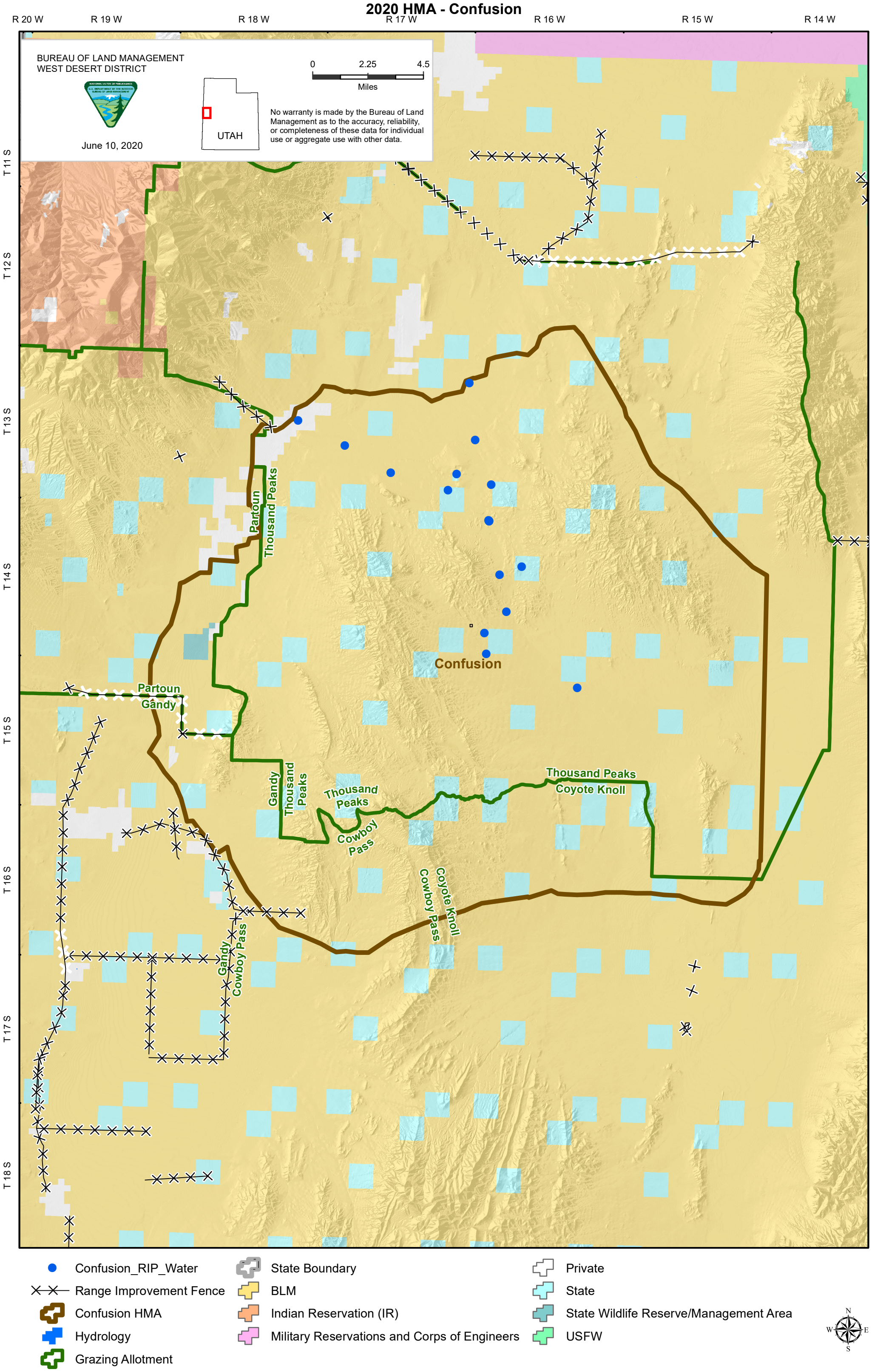
2020 HMA - Confusion



Appendix E
November 2017 Population Inventory Results

TABLE 1. Estimated abundance (Estimate) is for the number of horses in the surveyed areas at the time of survey. 90% confidence intervals are shown in terms of the lower limit (LCL) and upper limit (UCL). The coefficient of variation (CV) is a measure of precision; it is the standard error as a percentage of the estimated population. Number of horses seen (No. Seen) leads to the estimated percentage of horses that were present in the surveyed area, but that were not recorded by any observer (% Missed). The estimated number of horses associated with each HMA but located outside the HMA's boundaries (Est. No. Horses Outside HMA) is already included in the total estimate for that HMA.

Area	**Age Class**	**Estimate (No. Horses)**	LCL[a]	UCL	Std Err	CV	No. Horses Seen	% Missed	Estimated # of Groups	Estimated Group Size	Foals per 100 Adults	Est. No. Horses Outside HMA
Onaqui Mountain HMA	Total	455	445	474	11	2.4	445	2.2	43	10.6	11.5	35
	Foals	47	46	49	1.2	2.5	46					
	Adult	409	399	427	10.4	2.5	399					
Confusion HMA	Total	299	285	333	15.5	5.2	285	4.7	53	5.6	10.7	23
	Foals	29	28	32	1.9	6.6	28					
	Adult	270	257	302	14.3	5.3	257					

[a] The lower 90% confidence limit is based on bootstrap simulation results or the number of horses seen, whichever is higher.

U.S. Geological Survey
Fort Collins Science Center
2150 Centre Avenue, Building C
Fort Collins, Colorado 80526-8118

November 24, 2015

Dean Bolstad
Acting Division Chief,
Wild Horse and Burro Program
Bureau of Land Management, WO-260
20 M Street,
Washington, DC 20003

Dear Mr. Bolstad,

Attached please find a summary table and notes resulting from expert panel discussions on September 24, 2015, exploring several alternative methods for wild horse spaying. In addition to veterinary and equine experts, several USGS, BLM, USDA-APHIS, and Colorado State University staff also observed and contributed to discussions.

The materials reflect professional opinions about the current state of understanding of four spay methods currently used on domestic horses, as represented and discussed by panel members during and after the day-long meeting. These materials do not provide BLM with a recommendation, but hopefully provide useful information for BLM to consider.

Sincerely,

Z. H. B. 20 Nov 15

Zack Bowen
Branch Chief, Ecosystem Dynamics

Attachments.

Colorado State University

Sarah R.B. King, Ph.D.
Research Scientist
Coordinator of the Equid Red List Authority, IUCN

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Colorado State University, Fort Collins, CO 80523
Phone: (720) 587-9890; Fax: (970) 491-1965
Email: sarah.king@colostate.edu

November 24, 2014

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Sincerely,

Sarah R. B. King
Research Scientist, CSU

Attachments.

Assessment of spay techniques for mares in field conditions

Panel meeting held at USGS Fort Collins Science Center

September 24, 2015

Summary of panel expert responses on four potential spay methods

	Colpotomy	**Ventral midline**	**Flank incision**	**Flank laparoscopy**
Facilities needed	Squeeze chute with a kick panel and access to the perineum.	Squeeze chute, table fitted on a forklift.	Squeeze chute (may require access to both sides).	Squeeze chute (may require access to both sides), sling.
Equipment needed	Ecraseur, scalpel or bistury, blunt scissors, gauze sponges tied with umbilical tape.	Complete surgical pack, surgical drapes, gauze sponges.	Complete surgical pack, surgical drapes, gauze sponges.	Laparoscope, CO_2 for insufflation, surgical pack, surgical drapes, gauze sponges.
Equipment preparation	Ecraseur autoclaved or cold-sterilized in ortho-phthalaldehyde (OPA/28) >10 minutes then rinsed in sterile water, or use chlorhexidine for sterilization.	Autoclave or cold-sterilize instruments.	Autoclave or cold-sterilize instruments.	Prepare laparoscopic equipment – cleaned and cold-sterilized.
Sedation	IV injection to the jugular of xylazine + butorphanol + detomadine.	Horses are placed in dorsal recumbency following an induction dose of xylazine/ butophenol/diazepam and ketamine.	Local lidocaine infiltration of flank and IV butorphanol.	IV jugular catheter continuous sedation drip - 20 mg detomidine in 1 liter fluid for standing sedation.
Anesthetic /analgesic protocol	Horses remain standing under tranquilization: butorphanol + xylazine or detomidine . Add low dose ketamine as needed.	Anesthesia may be maintained by IV administration of triple drip (IV-ketamine, xylazine and guaifenesin 5%) or using inhalant anesthesia.	Horses remain standing under tranquilization: butorphanol + xylazine or detomidine. Injection of lidocaine in line or L-block (~100-200 ml) at incision site.	Horses remain standing under tranquilization: butorphanol + xylazine or detomidine. Epidural for analgesia of the reproductive tract, local anesthesia at portal sites.
Procedure	Administer antibiotic (Excede - ceftiofur) that lasts for 4	Administer antibiotic (Excede - ceftiofur) that lasts for 4	Administer antibiotic (Excede - ceftiofur) that lasts for 4	Administer antibiotic (Excede - ceftiofur) that lasts for 4

	Colpotomy	Ventral midline	Flank incision	Flank laparoscopy
	days. Wrap tail and tie up. Evacuate rectum/bowel, prep perineum. Make 1 cm incision in vaginal fornix. Expand incision via blunt dissection. Locate ovaries. Sterile 4x4 gauze soaked with 30 ml 2% lidocaine compressed over ovarian pedicle 3-5 minutes or lidocaine injected into pedicle. Remove ovaries via ecraseur. Repeat for other ovary through same incision.	days (or given 40 ml procaine penicillin and 10 ml flunixin meglumine post surgery). Surgical area is clipped and prepped with chlorhexidine scrub followed by chlorhexidine solution swabs. Incision into peritoneum made on ventral midline. Ovaries exteriorized through ventral midline incision. An emasculator is applied to the ovarian pedicle. #6 MSA used to ligate the ovarian stump proximal to the emasculator. The emasculator is removed and the ligated stump allowed to retract into the abdomen. Closure is accomplished in three layers, the outermost being a subcuticular layer using #6 MSA absorbable.	days. Surgical area is clipped and prepped with chlorhexidine scrub followed by chlorhexidine solution swabs. Line or L-block injections are administered. Wait until block has effect, then single incision in left flank through skin and fascia followed by blunt dissection into the peritoneum. 9-inch burdizzo (or emasculator) for removal of ovaries. Closure of the underlying layers of muscle and fascia such that only the skin requires suturing. Very bottom of the skin suture line is left open to prevent seroma formation.	days. Approach both flanks: surgical area is clipped and prepped with chlorhexidine scrub followed by chlorhexidine solution swabs. Make incision at flank. Insert cannula for instruments. Insufflate with CO_2. Lidocaine injected to ovary and pedicle. Ovary is removed through incision; incision may have to be enlarged to remove ovary. Suture incision. Repeat on other side.
Incision	5 cm in anterior vagina.	9-15 cm incision made just cranial to the udder.	10-15 cm in flank (on one or both sides).	One 1 cm incision and one 6-10 cm incision in the left flank, and three 1 cm incisions on the right side.
Standing or recumbent surgery?	Standing	Recumbent	Standing	Standing
Surgery time per	15-20 minutes	20-30 minutes	45 minutes	40-60 minutes

	Colpotomy	Ventral midline	Flank incision	Flank laparoscopy
horse				
Complications	1-2% seen within 2 days.	Infection of open wound; potential for evisceration; potential for injury upon recovering from anesthesia.	5% incisional complications under sterile conditions (more likely 10-20% under field conditions).	1-2% incisional complications (in sterile environment), 10% subcutaneous edema; puncturing a bowel; dropping ovaries in abdomen.
Recovery time (before release)	3 days	2-3 weeks	2-4 weeks	1-2 weeks
Contra-indications	Uterine infection/pyometra. Enlarged (>6 cm) ovary; pelvic or ovarian abnormalities. Heavy late gestation may prevent access to ovaries. Surgery may not be possible if the mare cannot be sufficiently sedated.	Very dirty animal; old/multiparous; any animal that is contraindicated for general anesthesia. Contraindicated in later term gestation due to risk of initiating labor and abdominal wall rupture during parturition. Pregnant mares in surgery have a 3x greater risk of pregnancy loss with general anesthesia.	Very dirty animal; any animal that is contraindicated for general anesthesia. Pregnant mares in surgery have a 3x greater risk of pregnancy loss with general anesthesia.	Dependent on technology; abnormal ovary.
Effect on pregnant/lactating mares	Late gestation may challenge access to ovaries. Pregnancy no issue following first ±70 days. No foal abandonment issues. No issues with lactation.	Late gestation may be challenging. May affect nursing (pain when the foal tries to nurse).	Unknown. May affect nursing (pain when the foal tries to nurse).	Unknown, but likely easily done.
Effect of breeding post-surgery	Vaginal incision usually healed by 7-10 days post-	Breeding may cause injury prior to recovery.	Breeding may cause injury to the incision line.	Breeding may cause injury to the incision line.

	Colpotomy	Ventral midline	Flank incision	Flank laparoscopy
	surgery. If open or <100 days pregnant administer long acting progesterone which should suppress receptivity/save pregnancy.			
Operator safety	Strapping the back of the mare helps prevent kicking, kickboard and tail tied dorsally aids operator safety. Short time with scalpel.	Animal fully anesthetized.	Operator protected due to small window of access on side of animal. Longer time with scalpel.	Operator protected when coming from the flank, but injuries can occur due to equipment and two people in a restricted space.
Cost per horse	$250-$300[1] Long-acting progesterone ($7/mare)	$350[2] includes all drugs and supplies. Plus long-acting progesterone ($7/mare).	$350[2] Includes all drugs and supplies. Plus long-acting progesterone ($7/mare).	$450-$500[3] Long-acting progesterone ($7/mare).
Pro of method	Fast healing and recovery, quick surgery, can be done on pregnant mares.	Low risk to operator, common surgery for companion animals.	Low risk to operator, common surgery.	Direct visualization, low morbidity, good public opinion.
Con of method[4]	Higher risk to operator, need for trained surgeons.	Risk of evisceration, risk of incision infection.	Risk of incision infection and pain.	Most expensive and time-consuming approach.

Notes:

[1] Colpotomy cost per mare: $100-1500 initial equipment cost (chain ecraseur Jorgensen J-37E $450 buy 2 or 3, replacement chain MidWest 350.01254.2 J37ED1 $95). Then $80-100/mare: OPA/28 4 gal $99.56 (estimate 50-80 mares: $2/mare), suture 2-0 monocryl 36/box $205 ($6/mare), #10 or #21 scalpel blade 100/$25.52 ($3/mare), Lidocaine 100ml $8 ($4/mare), Xylazine $1/100 mg ($4/mare), Butorphanol 10mg/ml 50 ml $250 ($5/mare), Detomadine $16/mare, Ceftiofur - excede 15 ml $30/mare. Once the ecraseur and scalpels have been purchased, the expense via colpotomy for each mare is the drugs, the lidocaine and gauze for the pedicles, and the sterilizing of the ecraseur.

[2] Ventral midline and flank incision – there will be a cost of drapes, gowns, sutures, etc., as for all abdominal surgeries, and a cost for the surgical equipment. Drug and other equipment cost will be as in [1].

[3] Laparoscopy equipment costs: $25,000 for camera, light core, light source, monitor, Thorston telepack, $5,000 – insufflator, $3,000 – microscope, $750 x 6 for hand instruments (need two sets): $40,000 total new, or could buy used. Likely need to replace 5 hand instruments per 100 mares. Drug and other equipment cost will be as in [1].

[4] It should be noted that all surgeries are associated with a risk of death. There are no published data available to assess the mortality risk of any spay surgery in wild horses, although preliminary data on domestic and wild equids were discussed by the panel.

Assessment of spay techniques for mares in field conditions

Panel meeting held at USGS Fort Collins Science Center
September 24, 2015

Transcript of Comments

Questions or topics are in **bold**.
The speaker is in *italics*. If the person introducing the topic made the comment it is indented with a bullet. If the speaker is not known the comment is indented with a hyphen. All attendees and invitees have been given the opportunity to edit this document. As these are notes taken from a discussion, what is written here may not capture the exact intended meaning of a given statement.

Attendees
In person: Zach Bowen (USGS), Jason Bruemmer (CSU), Doug Eckery (USDA/APHIS), Paul Griffin (BLM), Al Kane (USDA/APHIS), Sarah King (CSU), Joanna Ruffino (USGS), Kate Schoenecker (USGS).
By WebEx/Phone: Cheryl Asa (St. Louis Zoo), Gail Collins (NPS), Robert Cope, Jay D'Ewart (BLM), Bryan Fuell (BLM), Dean Hendrickson (CSU), Katrin Hinrichs (Texas A&M), Sue McDonnell (U. Penn.), Leon Pielstick (DVM), Patricia Sertich (U. Penn.), Mark Stetter (CSU), Regina Turner (U. Penn.), Julie Weikel (DVM).
Information provided after the panel: Paul Zancanella (DVM)

Introduction
Paul Griffin

- Purpose of the meeting is to discuss different procedures for spaying wild horse mares.
- We will discuss pros and cons of the various methods that could potentially be used for spaying wild horse mares.
- This is not a definitive decision making meeting for BLM, but to get the opinions of experts.

Background of study to be conducted by USGS/CSU
Sarah King

- Aim of the study is to look at the short-term impact of spaying on health and behavior of individual mares, specifically any effects on band fidelity, spatial ecology and population demography.
- Location: White Mountain HMA, Wyoming.
- We have proposed to spay 60% of adult mares (adult mares are 3 years old and older), which will probably be 36-48 mares, depending on the age structure, leaving 24-32 untreated controls plus juveniles and foals.

- We will collect 1 year of pre-treatment data, and then 3 years of post-treatment data.

Facilities at Rock Springs BLM Adoption Facility

Al Kane:

- It's a typical BLM facility.
- Two hydraulic squeeze chutes. Most facilities do not have a split tailgate. At Rock Springs, the door would need to be re-fitted to have a split tailgate that would allow access to perform a colpotomy. It's an open question about whether BLM would have the funding to get a new tailgate (that is split).
- Squeeze chutes give access to the left side and hindquarters of the animal. They are - padded and compress the animal front to back and side to side.
- For recumbent surgery the mare can be rolled out of the chute onto the ground; no access to a table.
- No hospital and no indoor facility.
- Transportation to and from the HMA: gooseneck, stock type trailer, or semi-trailers.

Zack Bowen:

- We will compile notes and comments and put them in a briefing paper. This will not be published. It will be a statement to BLM compiling information, not making a recommendation.
- Information will be compiled based on considerations that will be asked of each technique.

Kane: Today we will discuss some considerations for what technique may be most appropriate for this study, but another technique may be more appropriate in the future for spaying on a wider scale across HMAs. But it may be the same.

King: The method chosen by the BLM for this study should be the same as what is used in the future elsewhere, as this will have been the method we gathered data on.

Discussion of Colpotomy - *Leon Pielstick*

History:

- Leon is a veterinarian who has worked with the BLM since 1975, and has also been involved with the management of horses at Sheldon-Hart. At Sheldon he spayed horses which had been placed on a private pasture for the trial.
- Spayed mares in the field successfully: Out of 34 mares spayed, 31 were open, 3 were pregnant and successfully foaled. At Sheldon they used spaying as a management tool – they vasectomized males and spayed females that were considered unadoptable, then turned them back out to the range. The majority of such spayed mares were pregnant.
- He has spayed 188 mares by colpotomy, including 16 spayed at a wild horse sanctuary in California, 16 spayed as part of a PZP safety study in Oregon.

- Out of the 188 mares there were 2 fatalities: one bled to death internally due to a clotting abnormality, and one got sick, aborted her foal and died (anecdotal evidence indicated that she had a peritoneal infection). We can expect a 1-2% complication rate with colpotomy. For any given choice of spay method, the BLM must be prepared to accept some level of loss.
- 70-75% of mares are likely to be pregnant in late summer. Pregnant mares can still be sterilized by colpotomy because of the way the foal drops in the uterus: the ovaries are still at the top of the uterus so can be reached. At 7-8 months pregnant it gets harder to move the intestines to reach the ovaries, so it is more difficult to keep the intestine out of the ecraseur tool. The only mare that had an abortion was the mare that died.
- To do the surgery, give heavy sedation/analgesia (butorphenol + xylazine or detomidine + Dormosedan) and heavy analgesics (banamine + butorphenol); the surgery is performed with the mares standing. Banamine was added to eliminate mild post surgical colic which had occurred in a few of the mares the first year in which the procedures were done.
- Mares held off feed for 24 hours before surgery seemed to have good recovery after. Holding off feed means that fecal balls are reduced, which can resemble ovaries on palpation and thus take time to sort out, and reduces abdominal fill. Depending on the horse there was a little colic within the first few hours post surgery until Banamine was added to the procedure. Mares generally walked out of the chute and started to eat, some would raise their tail and act as if they were defecating, however in most you could not notice signs of discomfort.
- There was no squeeze chute at Sheldon, but the mares could be held at the back of the chute where there was an access window. Some mares needed additional sedation as they could not be squeezed. It should be possible to make any facility functional for this surgery.

Facilities:

- Needs a kick panel and an access window, so that there is access to the perineal area. Use a strap above the rump, to help prevent jumping and kicking. Most facilities can be made functional. At the BLM Burns facility, for example, there is enough room to slide in a 3 foot tall plywood kick panel.

Behavior:

- In the first group of 33 spayed mares with 10 intact mares and 2 stallions (on private land) – the group all stayed together as a herd.
- In another situation two groups of 8 spayed mares formed their own bachelorette band. They were new to the facility.
- In Sheldon it is assumed that they returned to their band.

Recovery time:

- The only complications were seen within two days of surgery. After 2 days there were no visual problems so they could be released to the range.

- It is typically recommended in domestic mares that they not be ridden for a month, but they seem okay after 2 days.
- The incision in the anterior vagina is not sutured; this heals rapidly (within days, cannot be identified easily on speculum examination). Evisceration through the vaginal incision is often brought up as a possible complication of colpotomy, but none of the panel participants had had this occur nor had heard of it actually occurring. In addition, being held off feed would reduce the chance of evisceration.
- Being held off of feed before-hand is important according to Pielstick, although others said it was less necessary.

Gail Collins - At Sheldon they had the opportunity to recapture spayed mares that were released (3yr, 5yr, 6yr later) to monitor progress.

- They were given a dose of antibiotic (Excede -- ceftiofur) that lasts for 4 days within the mare (single injection).

Procedure:

- Cold sterilize ecraseur. Give antibiotic.
- Wrap tail and tie up for procedure.
- Evacuate bowel, surgically scrub peritoneum and flush out vagina. Clean vagina with iodine. Others perform procedure without vaginal flush (vagina should be essentially sterile).
- Put on sterile sleeves, introduced hand into vagina, and make the incision in the anterior vagina.
- Mares have no nerve receptors in that area, so they only feel pressure/stretching. They show no outward sign of discomfort. Mares feel the pull on and compression of the ovarian pedicle, but lidocaine administered to the pedicle to minimizes this. This analgesic lasts a couple / few hours. The pain afterwards is similar to that of castration.
- Timeline: 15 minutes for the whole procedure. Speed is often necessary due to volume of horses. Can do 30-35 horses a day as it is not physically taxing.
- Controlling the level of dust is very important, but otherwise it is possible to keep the area 'field sterile'.
- Can make a portable chute for this procedure out of a hydraulic cattle chute; this would have an adequate tail gate.
- Mares walk out of the surgery.

Comments:

Julie Weikel served as an observer for Leon's procedure at Sheldon; wrote a review:

- Some mares would walk out from surgery and immediately want to eat (hunger pain worse than spay pain due to keeping them off food).
- Some (a few individuals) showed minor signs of colic for about a half hour, such as getting up and down repeatedly. These were collected so that they could be watched more closely for up to an hour, then turned out to join a bigger group with feed and

water. For these horses they did not use lidocaine, which might alleviate the colic symptoms. Leon now uses liodocaine in every spay.

Katrin Hinrichs: **Did you give any antibiotics before the procedure?**

- Antibiotics are given after sedation, so not as long before surgery as ideal. There isn't a large opportunity to give it long before surgery due to the circumstances of these being wild horses.

How is the Lidocaine injected in to the pedicle?

- Via needle, an assistant pumps the drug, but the surgeon guides the needle.
- Dr. Pielstick is trying to modify the ecraseur to also hold a needle, thereby reducing the overall risk of contamination (and needle stick); having the needle on the ecraseur would mean one less trip in and out of the abdomen.

Are the mares in pain after the drugs wear off? Are they observed at night?

Hinrichs: has seen mares in pain at night after the surgery; she now gives butorphanol for 24 h after surgery, or morphine + detomidine epidural at the time of surgery.

Pielstick: They are observed for several hours after. They seem fairly comfortable. Pain is at an acceptable level; the banamine helps.

- Domestic mares are given banamine and sent home.
- They seem more comfortable than castrated stallions.

Weikel: I walked pens every morning and evening at the gather observing behavior. Mares were mostly involved in social status behaviors.

Pielstick: Finished surgery at 4pm on a good day, so not a lot of light for observations after surgeries.

Regina Turner: **What is the effect of operator experience?**

- This is a practical technique. Leon taught 9 vets in Arizona when spaying 5 donkeys. Any vet who generally works with equine reproduction can pick it up, however there is a learning curve. On one donkey they had trouble getting the left ovary out, after they finally succeeded the donkey bled to death. They did a flank incision on two donkeys and this seemed better on that species.

Are there enough trained people?

- Plenty of vets would be interested in learning the technique. If there is a complication it can be used as a learning experience to avoid future complications. There were complications with the donkeys as multiple people were learning how to do it. The chance of complications increases with the number of times you go in and out of the animal.

Cheryl Asa: **Could we have more follow up on the AZ procedures?**

- Concerns about the Arizona project include the fact that one died, one lost a 50-70 day old fetus, and others had post-operative infections.

Pielstick: The burro that died had a left ovary with a membrane around it; there was no post mortem exam to discern exact cause of death. If a female has an unusual ovary it would be best to abort surgery and not proceed.

It seems as though the training contributed significantly to the mortality there?

- If there are unusual situations then generally complications arise, and this is used as a learning curve to create a better procedure.
- It is also worth noting that the number of learning surgeons entering the body cavity of those burros could have contributed to the one in five mortality rate for those burros. Dr. Asa noted that one of the major complications could have been the training itself.

Kane: **What are the contra-indications of this technique? Does the condition of the horse affect the procedure?**

- Generally body condition will affect the choice made to do the procedure. Best to pass on very old mares or mares in poor condition.
- Late gestation will increase the complication rate, but pregnancy will not be an issue in the first or second trimester.
- Surgeons should also pass on mares with pelvic abnormalities.
- 1-2% of mares could not be sedated heavily enough to do the procedure. 1cc of ketamine would help. If a mare fails to sedate the issue is that she moves, so the procedure is not done.

Of the big group of mares that you spayed, what percentage were pregnant? Which were checked before-hand?

- Of the first 33 mares that had the procedure, 3 were pregnant (about 60-70 days). All 3 foaled.
- The 16 spayed in CA were all open.
- At Sheldon 70-80% were pregnant - up to 7 or 8½ months gestation. Ovaries were easy to reach, but it was generally a little harder with the foal in the uterus.

Did it affect pregnant or lactating mares to keep them off feed?

Pielstick: They were only held off feed for 24 hours, and were given water. Mares were released with their foals. There were no abandonment issues.

Hinrichs: does not hold off of food and has not had an issue.

Pielstick: feels holding off food is important; the less abdominal fill, the better.

Hinrichs: **How long do you take to close the ecraseur?**

Pielstick: A few seconds.

Griffin: **Could we release into the wild and worry about potential breeding?**

Hinrichs: The result of ecraseur is a very clean pedicle, as she has had the opportunity to observe via flank incision during removal of ovaries with the ecraseur. Additionally, after 2 or 3 days you can barely see the incision in the vagina, but if she is mated at that time it could open up the incision.

- There is a chance they could be in heat, but if the procedure is in fall many will be pregnant.

- There is a concern that, if they are bred shortly after the procedure, the vaginal incision could be opened by the stallion's penis. This could result in peritonitis and death of the mare.

Patricia Sertich: Not necessary to hold off feed. Instead rely on careful palpation of the uterus and ovary. 32 years experience doing ovariectomy by colpotomy. The initial incision (<1cm) is made in the vaginal fornix with a no.10 scalpel and the incision is enlarged by blunt dissection. This method separates rather than transects the muscle fibers so the incision decreases in length when the vaginal muscles contract after the tranquilization wanes post-surgery. Three days post-op the incision edges are adhered, and healed after 7-10 days. If the mare is not pregnant or less than 60-80 days pregnant she will likely tolerate copulation by a stallion in 3-7 days due to the decrease in ovarian progesterone.

Hinrichs: They could be given an injection of a long-lasting progesterone (e.g. Altrenogest) to stop the mare tolerating stallion advances.

Asa: Estrus behavior is seen in pregnant mares, but in our study they did not not allow copulation.

Pielstick: could do a study to monitor how often mares show heat after spaying.

Sue McDonnell: Spayed mares can be receptive all year round. Typically can not even put them with geldings as they would be mounted. If given the opportunity a spayed mare would tolerate the sexual advance of an amorous gelding. If over 100 days pregnant at the time of ovariectomy, and don't immediately lose the pregnancy, the feto-placental unit has taken over from the ovary for progesterone to support the pregnancy, and without the ovary will likely suppress attractivity and receptivity.

Kane: **What are the long-term complications of spaying? What is the incidence of pyometras in spayed mares?**

Gail Collins: At Sheldon 85% of mares that had been spayed and released (plus 30 mares not spayed) were recaptured. The survival rate of spayed and non-spayed mares was not different.

Hinrichs: Breeding is not a problem if the incision is elsewhere than the vagina.

- There may be a long-term risk of vaginitis and pyometra in spayed mares if bred repeatedly after spaying. There is risk of penetration into the abdomen and peritonitis if mares are allowed to breed before the vaginal incision has healed.

Hinrichs: This is unlikely as the cervix will be open due to lack of progesterone (no ovaries).

Griffin: **How long should we keep mares in captivity?**

Collins: At Sheldon they kept them in for 7-8 days before release.

Hinrichs: Has just visited a lab that does a lumbosacral epidural on mares for oocyte recovery. This would eliminate the need for lidocaine and make sure the mare does not move during the procedure. May not be feasible in wild mares. The lumbosacral was given while the perineum was being prepared; done at the level of the tuber coxae. Lab she visited has used this on client mares over 300 times successfully.

Pielstick: It may be faster to just block the ovarian pedicle.

Discussion of ventral midline and flank incision approach - *Julie Weikel*

History

- Julie has spayed about 100,000 cows by either flank or vaginal approach. The vast majority of these were spayed by the vaginal approach, however several hundred were spayed through the flank at all stages of pregnancy. These experiences are the ones that inform our discussion about spaying mares as there are many similarities in the issues faced and potential consequences. The adult cattle spays were all performed as part of federal Brucellosis eradication efforts. Under the Brucellosis control program neither sexually intact nor pregnant animals could leave a quarantined premises, hence the need for both spays and C-sections, frequently in the same individual animals. Rarely were the conditions under which these surgeries occurred ideal in any way; cleanliness, weather, adequate manpower, etc. In other words, true field conditions. While Julie always tried to obtain follow-up information about complications and survival, she did not always get that feedback. Some of the problems in cattle might inform the discussion.
- In cows you cannot reach the ovary through the vagina when they are pregnant, so had to go through the flank.
- All the mares (domestic) Julie spayed were via a single flank approach, probably less than a dozen. They were all decades ago and were for either granulosa cell tumor removal or attempts to control "nymphomania." All were done in horses used to being handled and in a clinical environment.
- Entry for flank spays utilized a skin and fascia incision followed by blunt dissection that results in a "closure" of the underlying layers of muscle and fascia such that only the skin requires suturing. Only the very bottom of that skin suture line is left open. Julie came to this procedure as a result of dealing with seromas as a not uncommon sequence in fully closed suture lines. Seromas are not a serious post surgical complication, but in field situations where any secondary handling poses additional risk to the animal, they should be avoided if possible.
- In mares always used a 9 inch burdizzo rather than an ecraseur when doing flank incisions. Has never had a hemorrhage issue with castration using the burdizzo.
- P. 869 in Loesch and Rodgerson (2003) article is very thorough in regards to complications from any non-colpotomy approach in a horse.
- Always better to do surgery with a horse standing if possible – want to avoid lying horses down. Surgical vasectomies are done recumbent.
- Surgical recovery in a wild horse is already an extraordinary event (i.e., presenting unusual circumstances).

Conditions:

- Dust control is crucial (not completely sterile by any means).
- Heifer corrals mirror field conditions.
- Any surgery poses an issue for infection at the incision site.

Training:

- Julie has taught numerous vets to spay heifers. Only a small percentage are still spaying. All found it to be quite difficult. Adopting colpotomy for wild mares means that we need to find people who have gone through the steep learning curve. Some people can develop a good feel to correctly assess what tissue you have hold of, but it takes experience to learn.
- In the west, many dude ranches do not like cycling mares. Julie works with a veterinarian who spays these mares. Other vets with this experience are a potential for pool of people to choose from for the colpotomy method.
- While Julie has usually required 100 heifers to "train" a veterinarian to spay heifers, 100 mares may not be necessary to train an already accomplished equine surgeon to perform colpotomies. Training will vary with the individuals involved and hopefully could be accomplished with many fewer animals, maybe 5-10, with time to rest between surgeries for reflection during training.

Comments:

Hinrichs: Feels there is not such a problem with training veterinarians for equine ovariectomies via colpotomy. Did ovariectomies by colpotomy for PhD work – everyone wanted to learn the technique. Reproduction vets are best because they can tell if the ovary is covered by omentum, and recognize the anatomy better via palpation than surgeons. They are more familiar with the feel of it. Katrin has trained many veterinarians on ovariectomy via colpotomy, and they have been successful. They have conducted colpotomy on 22-30 year old mares with no complications. Reproductive specialists are used to palpating mares, so the colpotomy method is not difficult to teach.

Weikel: The biggest mistake is that trainees are too eager to jump right in and because the initial entrance into the abdomen is extremely important this causes an issue. During autopsies of spayed heifers the vaginal wall penetration site was difficult to find. This was observed in heifers only because she has never lost a mare.

Griffin: **Is there a minimum number of mares to use to teach people how to do the procedure?**

Hinrichs: 3-5 colpotomies should be done under supervision.

Weikel: People who were good had it after 1-2 animals. There are others who still wouldn't get it after 100. You need people with experience or competence.

- Dust control is critical – spray pens down every day, and re-spray during the day. In her opinion, field conditions make colpotomy an attractive option.

Kane: **Is there one incision or both flanks?**

- Single incision (left flank) and does the left ovary first. Dr. Weickel uses the burdizzo to access the second ovary, carrying the tool though the abdomen.

Chemical immobilization?

- Lidocaine and adequate sedation (butorphenol). Some mares respond differently – can't settle even when sedated. These are generally released without surgery.
- Sedation is an important variable.

Issues with flank incisions?

- It's an open wound. An external wound can become an abscess.

Recovery time? Or effects on pregnant mare?

- Cannot speak first hand on the flank approach in pregnant mares.
- In heifers Weikel would attempt vaginally or go in via flank. She would C-section (after 120 days pregnancy) therefore could see the ovary and proceed.

Turner: It will be harder to find people who are good at colpotomies. Some people prefer flank incisions, and more people are trained to do it. However flank incisions can take longer to heal and be more painful.

Weickel concurred that colpotomy appears less painful.

Kane: **Can anyone comment on the access to the ovaries on pregnant mares via flank incisions?**

[No response from the panel]

Kane: **Recovery time on flank incision?**

Weikel: There is a prolonged recovery time (2-3 weeks) due to the risk of abscesses developing after surgery.

Asa: Following up with data from the burro project: 2 were spayed via flank incision. These got infected and opened up within a week. They took a month to heal. These animals were closely monitored.

Turner: You will likely be able to find more veterinarians who are trained in and comfortable with flank incisions for ovariectomy. However, there are many complications in flank incisions even under sterile conditions. Most of these are related to healing of the incision line and discomfort. On the other hand, it will be hard to find people who are good at colpotomy. When untrained people perform colpotomies there is in an increased risk that things will go wrong and sometimes things can go very wrong.

Weikel: We need to be conscious of trained personnel who are good at colpotomy to teach others to do this procedure so they can take over if there are complications.

Hinrichs: has not had issues training people, however, she is very detailed in her training methods. She goes through every complication she has experienced with each new trainee. Reiterated that she prefers reproductive vets over surgeons.

Kane: **Safety of the people involved during the surgery?**

- Colpotomy – strapping the back of the mare helped stopped the mare from kicking, plus there is a kickboard and the tail is tied up.
- Flank incision – operator can be more protected. Small window of access. Weikel does not believe that this outweighs the consideration of the colpotomy.
- Hinrichs noted that the time with the scalpel in colpotomy is only a couple of seconds. This time is longer for flank incision, which means more opportunity for fractiousness and infection.

Ventral midline incision approach: *Jay D'Ewart*

Procedure

- 8 mares were spayed using the ventral midline approach at Rock Springs, WY. All survived. It was not a blind procedure. Done under anesthetic with the surgery similar to a dog or cat. Given three-layer sutures. After surgery the mare got up and wandered to the recovery pen. The mares were watched for 2-3 weeks at Rock Springs and then sent to long-term holding facilities.

Comments:

Kane: **Were the mares pregnant? How long after were they turned out?**

- Unsure if any mares were pregnant, but it is unlikely as they had been in holding for some time prior to surgery.
- These mares were never released to the range (they are in long-term holding somewhere).

Griffin: **How would this affect pregnant mares?**
Hinrichs: It would be difficult to access ovaries via ventral midline in a pregnant mare.
Kane: **How would this affect lactating mares?**
D'Ewart: Might be able to select mares that are close to weaning.
Weikel: It is likely to be more of a problem if the mare is still sore. In heifers there is soreness due to the calf poking around to nurse. The relationship between dam and foal could be compromised. Edema could affect lactation. Flank incision might also make some mares resistant to nursing.
Griffin: **With the ventral midline procedure is there a potential for evisceration?**
Weickel: Yes, definitely. This is a primary possible complication of this procedure, and it is an awful outcome.
Hinrichs: what is the incision size?
D'Ewart: 5 inches
[Referred to Loesch and Rodgerson (2003): 25-35 cm]
Weikel: depends on the size of the ovary and size of the operator's hand.
Doug Eckery: close to the mammary gland, so may affect nursing.

- Evisceration is a horrific consequence so we want to be careful of a method in which evisceration is a complication, as in ventral midline.

Hinrichs: Although evisceration is said to be a risk of colpotomy, she has not known of any evisceration post-colpotomy.
[Neither had people at U. Penn.]
Sertich: Domestic horses that have had a ventral midline incision are usually restricted to stall rest for one month, and then only hand walked for the second month. These horses are kept with very limited activity. No data on mares that had free access to exercise.
D'Ewart: Had a successful experience in Wyoming. After anesthesia the horses are turned out in a holding pen where they don't get a lot of exercise. No eviscerations. The vet thinks it is a very teachable procedure.

King: We will be sending the briefing statement to Paul Zancanella who conducts and advocates for the ventral midline approach. He can add comments.

Ventral midline procedure - Paul Zancanella (written comment submitted after the panel)

- Mares are restrained in a padded chute and administered an induction dose of xylazine and ketamine. Upon induction an indwelling catheter was installed in the jugular vein. Anesthesia was maintained using intravenous administration of triple drip (IV-ketamine, zylazine and Guiafensin 5%) to effect. Horses are placed in dorsal recumbency. Surgical area is clipped, pre-surgical preparation was done with chlorhex scrub followed by chorhex solution swabs. Seven-inch incisions were made just cranial to the udder. Ovaries are exteriorized through the incision. A serra emasculator is applied to the ovarian stump. Number 6 MSA is used to ligate the ovarian stump proximal to the emasculator. The emasculator is removed and the ligated stump allowed to retract into the abdomen.
- Closure is accomplished in three layers. The outermost being a subcuticular layer using #6 MSA absorbable. The surgical time, induction to completion, is twenty to thirty minutes.
- Mares all received 40 ml procaine penicillin and 10 ml flunixin meglumine post surgery.
- Mares are standing within thirty minutes of surgery and eating within two hours of surgery.
- In conclusion, a ventral midline ovariectomy is a viable field surgical procedure for fertility control in mares. The surgery is accomplished relatively easily with less risk and expense than other fertility control methods.
- The ventral midline can be performed with little or no modifications to the existing facilities.
- Postoperative pain is much less than colpotomy and is easily managed with intraoperative IV flunixin meglumine.
- Operator and assistants safety is much better than standing procedures.
- Some concerns expressed for mares being anesthetized is exaggerated or naïve. Equine practitioners anesthetize thousands of horses with minimal problems.
- Ventral midline surgeries are accomplished routinely on horses without complications.
- Having performed both the colpotomy and ventral midline I much prefer the ventral midline approach.

Kane: We need sedation and anesthetic protocols for the three incision approaches.
Griffin: **Is there something additional about lying horses down that is an issue?**
Weikel: There is a lot of weight on the tissues if on its back, pressure on the aorta (cardiovascular effects), and recovery issues; these are mentioned in the review article [Loesch and Rodgerson (2003)]. When a domestic horse that trusts you is recovering you can keep them calm and help them. With wild horses this is not an option. The goal is to get away from them (and get them

away from people) as soon as possible. They can sometimes run and buck/get acrobatic; level ground is a must for recovery.
[*Hinrichs* and *Turner* agree with not laying horses down for surgery if at all possible.]
Hinrichs: We always do ovariectomy surgery standing. Injectable sedation for ventral midline seems risky, as compared to gas anesthesia. People are moving away from abdominal incisions in humans; for example in women they are doing hysterectomy etc. via colpotomy and this is associated with less pain and much faster recovery.
Weikel: There is potential for adhesions to the ovary, for example due to a history of inflammation. Those are problematic. Leon will not take such ovaries out of mares. Individuals with these inflammations are high risk - heifers walked around with the hump in their back even if they lived. Would be skeptical if there are adhesions.
King: **Is this similar to cryptorchid stallions?**

- If a mare has an ovary left she will still cycle, even if one ovary is infertile. Generally in cryptorchids they do not have adhesions, so not really comparable.

Kane: **What are contra-indications for flank or midline methods?**
Weickel: No external surgical incisions should be done on any mare that is very dirty. Any mare that is especially dirty we need to ask why is she laying down and rolling a lot. Will she be doing this post-surgical procedure? How dirty are the field conditions? At Sheldon, the corral where the surgeries took place was clean, and not used at all for many months per year.
Sertich: Would avoid ventral midline incisions in late gestation in mares (in last month before parturition) as they may go into labor. Some mares have delivered foals after midline surgery for colic, but they were watched carefully. The concern is that there may be a breakdown of the abdominal wall during delivery.
Kane: **Is there an age effect for these approaches?**
Sertich: No specific numbers, but as mares get older they are more at risk for abdominal wall rupture.
Turner: Older/multiparous mares have an increased risk under general anesthesia because they may be at increased risk for catastrophic fracture during the recovery process. Also, many physical conditions would preclude the use of general anesthesia and subsequent recovery (e.g. neurologic horses, horses with heart conditions, etc.) Any of these conditions would be contraindications for general anesthesia and therefore the ventral midline approach. Mares would need to have a full physical examination prior to anesthesia, which is unlikely in the field.
Sertich: Mares that lactate year round every year probably have lower bone density, so are more at risk of catastrophic fractures during recovery from general anesthesia. These risks are inherent to the recovery process following general anesthesia (not the method of surgery chosen). But since the ventral midline approach can only be done under general anesthesia, these potential complications would be unavoidable with ventral midline (vs. other procedures that could be done standing).

Weikel: The Sheldon mares (colpotomy) spayed were skewed towards older mares. The recovery was the same as the mares that did not have the procedure, but all of these mares were done standing and did not have general anesthesia.
Hinrichs: 8 mares 21-30 years old were given ovariectomies by (standing) colpotomy without complication.
Kate Schoenecker: **How does an ovariectomy affect the fetus?**
Hinrichs: [will be sending the research paper cited to Joanna] Mares ovariectomized earlier than 50 days – all lost their fetus. At 50-70 days about half lost their pregnancy. >140 days none lost their foal. In her own research, took ovariectomized mares off progesterone after 100 days of gestation and then had no problem.
Sertich: When mares get abdominal surgery of any kind they are also administered progesterone/progestin before and for a few weeks after surgery to prevent pregnancy loss. There is less risk of losing a foal with a colpotomy. General anesthesia for a ventral midline incision requires that the horse is off its feed, which means more muscle trauma and more stress.
Turner: Pregnant mares in surgery have a 3x greater risk of pregnancy loss with general anesthesia.
Griffin: **Due to colpotomy sometimes early stage pregnancy can be lost. Can we give them long term progesterone injection to save the pregnancy?**
Hinrichs: It could be possible to keep ovariectomized mares pregnant by injecting progesterone. At <50 days of gestation won't find evidence of fetal loss. Pregnancies of 50-70 days might be helped by a long-lasting progesterone shot. Pregnancies over 70 days are likely to be maintained even without exogenous progesterone.
Kane: **What product would you recommend?**
Hinrichs: Not sure on commercial availability of certain products. BET had a long-lasting progesterone and long-acting altrenogest that was available. (Checked subsequent to the panel: 30-day altrenogest injection still available).
Kane: **Potential for a feed through on mares that die due to this procedure in the wild?**
Hinrichs: Main issue is if an animal were to eat the area of the mare where the progesterone is injected, but progesterone is a natural hormone and the consumer would just receive an oral dose. (Note added later: Altrenogest does have the potential for feed-through).
Kane: If gestational stage is <50 days, we should consider accepting fetal loss. If stage is 50-70 days, one could consider injecting a drug to maintain the pregnancy.
Hinrichs: **Does anyone know what time in gestation an abortion is visible?**
Kane: It is very difficult to find aborted fetuses, even in a stall. Most that are found are close to term (size of a beagle). There are behavioral signs preceding abortion. We want to avoid abortions to the extent possible.

- Beagle size is 150 or more days (5-6 months) gestation.

Collins: We rarely found aborted fetuses in corrals. Only a few times did we find beagle size fetuses.

How often is the fetus reabsorbed?

Sertich: It is thought to be expelled/passed out through the cervix and not found, rather than resorbed.
Weikel: When it's hormonal abortion we are less likely to see discharge from the mare. When it is infection one sees a messier discharge.
Kane: Horses are corralled for testing purposes and held for 30-90 days. We vary rarely see secondary complications in mares that abort a fetus. The complications with abortion of foals are minimal. The mares do not show signs of illness, pyometra, or founder. The mares are generally farther along when we see complications, if any.
Hinrichs: In Argentina the polo industry is aborting hundreds of male foals, then within a few weeks transferring another embryo to the same mare with no ill effects.

Discussion of Laparoscopy: *Dean Hendrickson*

Procedure:

- Done a lot in horses at CSU. Performed in domestic horses with standing sedation. Typically approach both flanks. Can do it through one flank but this takes more time. Typically it takes 40 mins to remove both ovaries (doesn't include time for preparing/sterilizing horses for surgery, which brings the total to 50-60 minutes per animal).
- Equipment needed is a laparoscopic tower, light source and monitor, camera box, CO_2 canister, insufflator, and one standard surgery pack per animal (scalpel, blades, clamps, etc.).

Recovery time:

- Some are sent home the same day or some stay over night. There is minimal postoperative care.
- Has done the surgery in a field setting (laparoscopic vasectomy of elephants in Africa). Can keep the animals/instruments clean and sterile enough with cold sterilization.
- Standing sedation may not be possible in a wild horse for this surgery.
- The effect on the fetus if the hormones are not maintained (at less than 50 days gestation) is that the mares will generally abort. It is most likely that there is the same level of risk as for other procedures.

Comments:

Hinrichs: **What is the sterilization time for the instruments?**

- About 20 minutes to sterilize between animals (would work better with 2 sets of instruments to avoid wasting time).

Jason Bruemmer: **If you were to do it from only one side does it affect your time of completion?**

- Yes, it can take up to an hour standing sedated in a squeeze chute if surgery is from one side.

Sertich: When we do ovariectomies by laparoscopy they allow 1 to 1.5 hours, which includes scrubbing the flanks. They make incisions from both sides to get both ovaries.

Collins: **How is sedation maintained?**

- IV jugular catheter, continuous sedation drip. More consistent than with a bolus.
- Have done epidural (caudal) which also works well, but not sure this will work for wild mares.
- With this procedure in elephants they are under general anesthetic and hung in a sling from a crane so there is access to the flanks. Not sure if this is possible for horses.

What is the size of the incision?

- Ovaries are removed through the flank. Incision size is dependent on the size of the ovary (just enough to pop the ovary through), normally 4-10 cm.
- In 2% of cases there is incisional drainage, and in 10% there is subcutaneous emphysema from the CO_2 insufflation.

How are they managed post operatively?

- 1 dose of antibiotics pre-op and 3-5 days of NSAID post-op.
- Kept in a pen for 1 week, and then normal work after 2 weeks. But would not have a problem waking the mares up and sending them off.

Is it possible to use the laparoscope vaginally?

- Yes, there have been two reports using it to aid in colpotomy.

King: **Have you ever carried out this procedure on a pregnant mare?**

- No.

Hinrichs: **What type of epidural do you use?**

- Caudal epidural as it reduces movement. But there is no flexibility in that method of sedation as if you put in too much it's hard to keep them standing, and too little means they aren't sufficiently sedated.
- 40 µg/kg detomidine is used. Lidocaine would require too much volume to be used as an epidural.

Do you use lidocaine on the ovary?

- Yes – injected into the ovarian pedicle (15 ml local anesthetic injected to the pedicle).Give an epidural for analgesia of the reproductive tract, rather than the flank.

Kane: **Can you comment on the ventral approach?**

- It makes laparoscopy more difficult. When dorsal it is harder to get to the ovaries and find them. Ovaries present better when standing from the flank.
- In the small animal world they put the animal head down tail up and tip them from side to side. It might be possible to roll horses one side to the other to get to the ovaries.

Kane: **What are the general equipment costs?**

- $25,000 for camera, light core, light source, monitor, Thorston telepacs (sp.?)
- $5,000 - insufflator
- $3,000 - microscope

- $750 x 6 for hand instruments
- $40,000 total new, or could buy used.
- You would need two sets of instruments to be efficient, so that one set could be cold sterilizing while the other was in use.

Kane: **Contra-indications for this method?**

- You are very dependent upon technology – if something breaks and you don't have a duplicate then you need to stop. It takes time to get used to the approach and do it.
- Worst-case complications would be puncturing a bowel. Withholding feed tends to reduce this risk.
- It is possible to drop ovaries in the abdomen. There is no proof that this is an issue but could be.

Durability of equipment?

- Not a huge worry – machinery is not that delicate. The monitor is most delicate - if kicked it could break the screen.

What do you recommend for pre-op?

- 12 hours off feed but not critical. The more comfortable you are with the tech the less you need to worry about feed – 3 hours would be fine. Time off food possibly upsets them. Elephants were never held off feed and they have similar digestive tracts.

Hinrichs: **How long does it take to learn the procedure?**

- With 3 days and 5 or 6 mares you can get someone up to speed. Doing it regularly helps. Has learned how to teach it well. Ovaries in a standing mare are easy to access. It is not difficult to do an ovariectomy.

Kane: **Can you guess what would happen in a pregnant mare?**

- Pregnant mares present ovaries well if standing. It could be easily done.

Do you have any ideas about slinging them under anesthesia in a chute?

- Can use the same concept as hoisting horses up and out of ditches. You can use this to keep them into position.
- You could potentially have two teams working on either side of the abdomen and cut your time shorter.

Hinrichs: **What is the infection rate?**

- It's about 1/10 less when the instruments go in and out of the body cavity through a cannula, rather than flank laparotomy where they go repeatedly in and out through an incision. Instead of 5 in 100 you'll get 1 in 100.
- We don't see them commonly in open flank procedure.

Kane: **How safe is this procedure for the operator?**

- Coming from the flank you can avoid the feet, but he has still ended up with bruises and a broken toe.
- The difficulty is the amount of equipment and two people puts you a little more at risk than standing flank ecraseur, but slightly safer than a colpotomy.

How do you feel about training on a large scale?

- He feels good about training people fully. Colpotomy is rough because you cannot see what you are doing. One could use the laparoscope to train colpotomy.
- Won't walk away from someone until comfortable that they could do it.

Hinrichs: When training students on colpotomy, the student will find the ovary and place it in the loop of the ecraseur, then she will put her hand in and make sure it's an ovary before anything is cut.

Griffin: **Can you comment on the approximate cost the procedure will be per animal?**

- CSU charge is $1400 to do mare ovariectomy at the hospital (including technician time).
- Could do it in the field for $250/ horse for procedure alone (not including salaries).
- Did ovariectomies on dude ranch mares in Durango – 11 horses in 3 days. The real cost was $450-$500 per horse.

What is the cost per colpotomy and ventral midline?

Collins: Colpotomy was $250-$300 per horse at Sheldon NWR.

- Ventral midline is approximately $350/horse at Rock Springs, WY.

Fragility of the equipment? Is the jostling of the wild mares going to be an issue for the equipment?

- Wise choice is per 100 mares look to replace 5 instruments (this is the rate with people who are not fiscally responsible for the equipment).
- More likely to break hand instruments than the scope.
- Laparoscopy is the most expensive approach, but there is direct visualization, low morbidity, and better public opinion.

Schoenecker: **Do you cold sterilize?**

- Yes. Clean with soap and then water, rinse with sterile water.

What happens with dust?

- Blowing dust is less of a problem as the instruments are solid. Has been able to brush dust off during elephant procedures.

Sertich: **Infection issues or seromas?**

- One does get some seromas but no big problems with them. 1-2% incisional complications, but those rates are for mares in a clean and controlled environment. Opening and draining generally fixes this.
- No long-term negative or infection rates. In a field setting there may be a 2-3 x higher risk, but this is still small and corrects on its own.

D' Ewart: **Is there a difference in laparoscopy vs just through the flank?**

- You can see what you are doing with lap.
- You can ligate the pedicle with two ($10) ligatures to cut sharply, rather than putting the ecraseur through with a flank incision.
- Two ligating loops is faster than the radiofrequency "Ligasure".

- There is a radio frequency device for cauterizing the ligated tissue, but it is expensive and finicky, and is just one more piece of equipment to worry about that may halt surgeries.

Bruemmer: **Can you use umbilical clamps?**

- Seems like you could. Thicker pedicle in the horse than cattle.

D'Ewart: **What is the infection rate difference in flank than scope?**

- 5% incisional infection for flank.
- 2% with laparoscopy.

Hinrichs: **Is the opening for the ovary a straight incision? How is it closed?**

- Incision of 5-10 cm modified grid. Close fascia and skin in continuous pattern.

D'Ewart: **How do you manage pain?**

- A lot of the pain comes from the flank incision. It is helpful to anesthetize the pedicle (with carbocaine).
- Since laparoscopy incision is smaller than with the flank laparotomy method, it is mildly less painful but not a huge difference.

Behavioral estrus post spaying: *Cheryl Asa*

History

- 10 ovariectomized mares and 10 anovulatory mares were put with stallions and monitored for 15 days in January. The study was published in 1980.
- Of the 20 mares all showed at least one day of weak estrus. One mare showed full estrus all 15 days. Most had at least some mounting and were accepting of a stallion to full copulation.
- Most notable is that there was nothing cyclic (it was on and off day to day).
- Considering our various studies, only when a mare had elevated progesterone (e.g., diestrus, pregnancy) was there an absence of estrus and copulation. The adrenal cortex produces sex steroids. Estrus was not shown in mares with adrenal cortical hormone production was blocked with dexamethasone, suggesting that it is adrenal sex steroids that support estrus in mares that are ovariectomized and during the non-breeding season.
- It would be interesting to know whether this represents what mares would do in a naturalistic circumstance.

Comments:

Weikel: **What was the relationship between stallion and exposure? And relationship to spay?**

- Mares and stallions were kept separate and introduced (several mares and a stallion in a paddock) and allowed to interact freely.

Weikel: The increase in breeding activity may have been because the mares were new to the stallion. In Asa's study, the stallions were not with the mares except during the study.

Collins: Didn't monitor for sexual behavior at Sheldon but did analyze band association. Spayed mares maintained their band associations, and were in mixed groups. They were not found in bachelorette bands, or as solitary animals.

Is there a more natural setting?

Asa: Horses stay together year round (unlike most animals), so behavioral estrus may be a mechanism for the band to stay together outside of the breeding season.

Collins: Mares that were not coming into estrus were not driven off or kicked out the band.

Hinrichs: **In an intact band full of intact mares what portion of those mares would not be pregnant?**

Collins: 45-50% recruitment in Sheldon.

Asa: Reviewed horse literature for the NAS report. It looked like there was a trend where mares on BLM range were reproducing about every other year.

Kane: varies from HMA to HMA. 60-75% of mares are coming up pregnant based on fecal testing or foaling. There is 75-80% pregnancy rate based on fecal testing or foaling, observed at Teddy Roosevelt NP.

Collins: Most foal deaths were within the first 2 months of life.

Griffin: If a foal survives to fall, then typically BLM would consider it part of the population. "Recruitment" is survival to nearly a year old.

King: **Any other observations of behavioral differences in mares post ovariectomy?**

Sertich: Teaser mares (stimulus mares for semen collection) are ovarectomized. They are sexually receptive to stallion advances every day for the rest of their lives. Sometimes ovariectomized mares are administered estrogen to encourage proceptivity, but most of the time they are not. Ovariectomy to prepare a stimulus mare is common in the horse breeding industry for semen collection to be used for artificial insemination.

Griffin: The main reason we are asking USGS to conduct this study is because this behavior is not well known, so part of the purpose of this study is to discover that.

Griffin: **An injection of progesterone would create more time for the mare to heal by making her less receptive to being bred?**

Hinrichs: Yes. A long-acting progesterone given at a concentration of 1-2 ng/ml could suffice. They should reject the stallion for about 7-10 days.

Kane: **Any concern about exogenous progesterone affecting post-operative uterine infection rates?**

Hinrichs- There could be concern, but because the cervix may open shortly thereafter, when the progesterone level falls, this should be self-limiting. Some contamination could occur during the procedure, but because of antibiotics the likelihood of infection would be low.

Collins: **If you are doing the surgery when is the injection being administered?**

Collins: At Sheldon we held animals for a week, and restricted the number of times they handled the animals.

Hinrichs: If you give injection at the time of ovariectomy it should last 7-10 days, which would be OK if the mares are released in 2-3 days. Otherwise would need to be given later for a later release, and it would be better not to handle the horses again.

Were the stallions held?

Collins: Depended on the studs (they were doing vasectomies). Some were turned out sooner than the mares, but not always.

Did the mares get back to the same harem group?

Collins: They were not released all at once and this was not monitored as some were adopted.

Griffin: **Is a week enough to heal?**

Weikel: Yes, the healing rate is very quick with colpotomy.

Hinrichs: To be safe maybe one should allow 2 weeks before the mare is repeatedly bred in the wild in order to avoid catastrophe. A stallion can rupture even an intact vagina. It takes a surgical incision 7-10 days to fully heal.

Risk is running through chute once or keeping them in captivity?

Weickel: Checking the BET website, there is a 30 day progestin injection, Altrenogest, that could also be given. Could it promote uterine infection?

Hinrichs: if the uterus was contaminated at surgery, but as noted before, this is unlikely.

King: **Could progesterone injections also be given to control animals** (to reduce any confounding effects of progesterone injection on comparisons of observed animal behavior)?

Hinrichs: This drug has been thoroughly tested in pregnant mares and shown not to be detrimental to the mare or foal.

Mare menopause approach: *Doug Eckery*

- The aim is to develop a vaccine. GonaCon and PZP are currently available and both have been shown to be effective, but for a limited time. PZP prevents fertilization; GonaCon prevents ovulation. A vaccine is only good as long as antibodies can be maintained. PZP, in particular, requires many booster shots. Follicles are constantly replenishing, so mares need a booster throughout their lifetime.
- The idea is to target something earlier in ovarian function. Successful reproduction in female mammals depends on an adequate supply of eggs that are found in primordial follicles. However, there is only a finite supply of eggs in the ovaries, that if destroyed would cause permanent sterilization. Every day a certain number of primordial follicles begins to grow, and only a very few ever reach the final stages of maturation and go to ovulation. The initiation of growth is a committed step and controlled largely by local growth factors. Oocyte-specific growth factors are involved in the early stages of follicular growth. A research team in New Zealand found that a certain group of infertile sheep had a mutation causing infertility. The research goal is to come up with a vaccine to mimic this mutation but for horses. If the primordial follicles do not mature then the animal is sterile. For sterility you need to deplete the ovaries of eggs by directly killing the eggs/primordial follicles or by

causing a mass activation of the primordial follicles (once growth is started it cannot be stopped).

- We are going to test vaccines against oocyte specific growth factors in horses. This will prevent follicular growth and ovulation in the short term, but hopefully will eventually deplete eggs leading to mare menopause, but this is a hypothesis.

Timeline:

- Start research in November by vaccinating mares against the growth factors. After 1 year will conduct a unilateral ovariectomy and look at the ovaries under the microscope. Throughout the year will conduct hormone testing. AMH levels will be measured, as this can be one index of follicular reserve. The project will run for 2 years. Also will track ovarian function through ultrasound and behavior through teasing.

Comments:

Kane: **When would you expect them to be sterile? Are you planning a fertility challenge?**

- We do not expect animals to continue to cycle. The follicles will not produce any steroids so behavior will be changed. Eventually we will conduct fertility testing. It is unknown how long it will take to deplete the ovaries. This is a test to see if the mechanism will work.
- Vaccine and booster will be 6 weeks apart. Next step is to develop a vaccine.

Kane: single shot vaccination is a lofty goal.

Schoenecker: **What happens if given to a pregnant mare and depletes her eggs?**

- The vaccine should have no effect on an existing pregnancy as it is not affecting the corpus luteum.
- The time frame of egg depletion would take longer than the term of a pregnancy, so therefore no effect on the pregnancy.

Kane: **What about the effect on the fetus?**

- Antibodies would probably not pass through the placenta to affect the foal, and probably not in the colostrum long enough to affect the foal's antibodies. But it is unknown whether there would be a long-term effect on the offspring.

A Review of Equine Standing Laparoscopic Ovariectomy

Monika Lee and Dean A. Hendrickson, DVM, MS

INTRODUCTION

Equine ovariectomies are performed for various reasons. The most common indications are to prepare a mount mare for semen collection, eliminate estrus behavior and colic signs associated with estrus,[1,2] sterilize the mare for registration purposes, and to prepare recipient mares for embryo transfer.[2] Other reasons are associated with removing pathologically abnormal ovaries in the form of granulosa–theca cell tumors.[2] Regardless of the reasons for performing the surgery, it has developed into a regularly requested procedure.

Different surgical approaches and amputation techniques have been developed to remove equine ovaries. Horses can be operated on while in a standing or dorsally recumbent position. The standing technique can be performed using sedation and local anesthesia,[3] whereas dorsally recumbent procedures require administration of general anesthesia.[2] General anesthesia has been shown to cause hypoxemia and hypoventilation that may necessitate a ventilator.[1] The surgery can be done as a ventral midline celiotomy, flank laparotomy, or colpotomy.[1,2] Colpotomy complications include unidentified and potentially fatal hemorrhage of the mesovarium caused by poor hemostasis, intestinal and mesenteric trauma, peritonitis, adhesions, and possibly death.[2] The flank approach is favorable because visibility is improved, but it is still difficult to exteriorize the ovary without making large incisions.[2] Consequently, standing laparoscopic ovariectomy has become a more common technique to remove ovaries in mares.

Advantages of laparoscopic techniques include the reduction of complications through full observation of the operative field, minimal invasiveness, a shortened convalescent time with fewer postsurgical complications,[1,2] and improved cosmetics after surgery.[1] It also allows for tension-free ligation of vessels in the mesovarium.[2] Concerns and limitations associated with laparoscopic techniques include the necessity and cost of specialized equipment, technical difficulty of the procedures and required training to conduct them, and the fact that a lack of familiarity with procedures can dramatically increase operating time.[2,3]

Performing laparoscopy in standing horses adds the advantage of avoiding the risk and expense of general anesthesia while providing easier access to the ovaries because of the location of the reproductive anatomy.[3] Limitations of standing procedures include horses with unsuitable temperaments for standing sedation surgery, the size of the horse, and the availability of appropriate facilities for restraint.[3]

MATERIALS AND METHODS

Patient Preparation

Feed but not water is withheld from the horses for 18 to 24 hours to reduce bulk in the peritoneal cavity and improve the working space. The use of prophylactic antibiotics is left to the surgeon's discretion; however, at most only perioperative antibiotics should be used. Preoperative nonsteroidal anti-inflammatory drugs should be given to reduce pain and inflammation associated with surgery. The horses are sedated, a catheter is placed, and surgical sedation can be obtained with intravenous boluses of detomidine, epidural detomidine (40 μg/kg brought to a total volume of 10–12 mL with sterile saline), or titrated to effect intravenous infusion of detomidine (20 mg/L liter saline or polyionic replacement fluids). Both flanks for bilateral ovariectomy, and the ipsilateral flank for unilateral ovariectomy, should be clipped and aseptically prepared for surgery. The surgical sites can be anesthetized with local anesthesia in either an inverted "L" block, a line block, or, as the authors prefer, individual portal blocks (Fig. 1). The first portal is placed at the level of the base of the tuber coxae, midway between the tuber coxae and the last rib. A 10- to 12-mm-diameter, 15- to 20-cm-long cannula with a blunt trocar is advanced through a 12-mm incision in the skin and external abdominal oblique fascia and the rest of the abdominal musculature into the peritoneal space. The trocar is then replaced by a laparoscope connected to a 300-watt xenon light source and laparoscopic camera, which is used to confirm penetration through the parietal peritoneum. Abdominal insufflation with carbon dioxide is to an intra-abdominal pressure of 8 to 12 mmHg initially. The second portal is made just cranial and 10 cm proximal to the first cannula, and the third portal is made 10 cm ventral to the first cannula[3] (Fig. 2).

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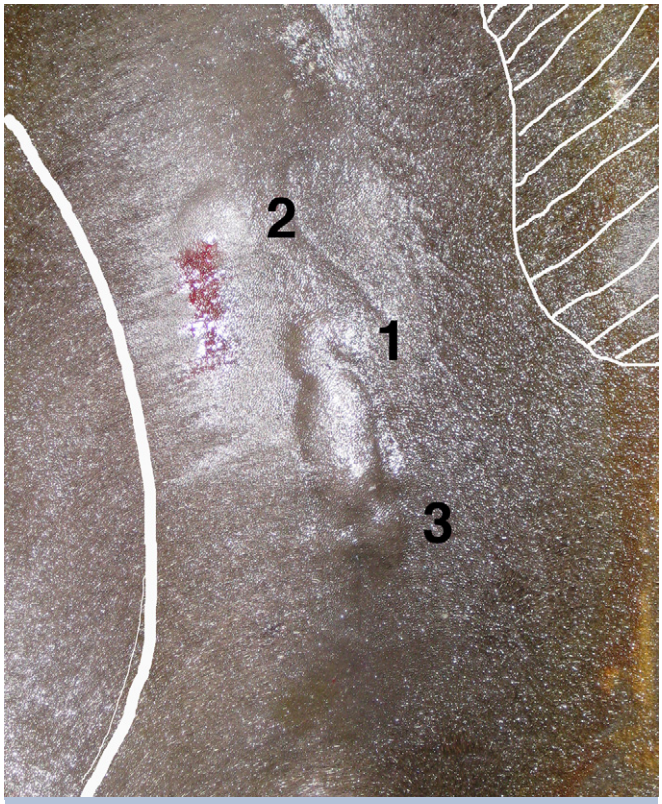

Figure 1. Photograph of left flank showing portal sites: 1, first portal; 2, second portal; 3, third portal. Note the local anesthetic between portals 1 and 3 to facilitate enlargement of portals for ovary removal. White line on left corresponds to last rib. White line with crosshatches on right corresponds to tuber coxae.

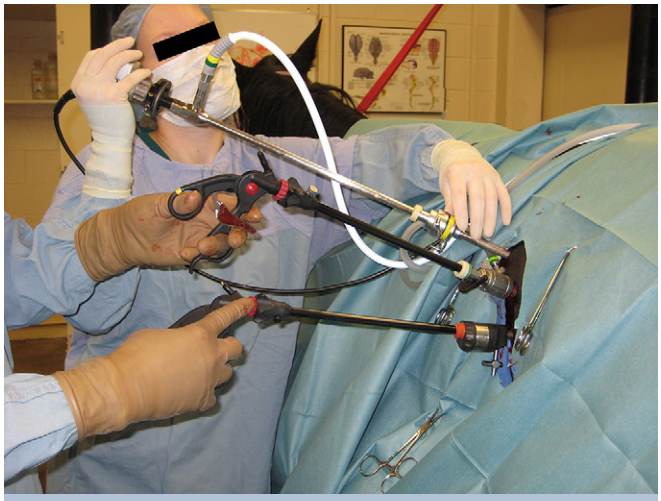

Figure 2. Portal placement in left flank.

Throughout the procedure, all laparoscopic instruments are inserted through the instrument portals as required. The mesovarium should be infiltrated with 10 to 15 mL 2% lidocaine before resection.[4] If a single ovary is removed, the ventral incision is enlarged for removal of the ovary. For bilateral ovariectomy, both are resected; the right ovary is passed under the descending colon to the left side of the abdomen and removal is via the left flank. Only the skin is closed in the small incisions using size 2–0 nylon in a cruciate or simple interrupted pattern. The external abdominal oblique muscle and fascia are closed in the single enlarged incision using size 0 polyglyconate (Maxon, Covidien) in a simple continuous pattern and size 2–0 nylon in the skin in a simple continuous pattern. The horses are generally kept in a stall for 1 week and a stall/run for 1 week, and then they are returned to work.

Various techniques have been used to amputate the ovary in standing laparoscopic ovariectomy. The main variations are the methods with which hemostasis is achieved. Reported methods include hand-tied ligating loops, pre-tied ligating loops, bipolar and monopolar electrosurgical forceps, ultrasonic cutting/coagulating devices, radiofrequency devices, surgical staples, and lasers. The ultimate objective in ovariectomy experiments is to find a method that facilitates the ovarian resection and removal with minimal hemorrhage and ovarian manipulation.[5]

Ligating Loops

Intracorporeal suturing in laparoscopic surgery requires extensive skill and practice. Consequently, other suture techniques have been developed to provide a simpler ligation technique using loop sutures. The most common suture combinations are size 2 or 3 polyglactin 910 (Vicryl, Ethicon) in a modified Roeder knot,[1] size 1 polyglyconate (Maxon, Covidien) using a 4-S modified Roeder knot,[3,6] or the pre-tied Endoloop (size 0 polyglactin 910 or polydioxinone, Ethicon Endosurgery). All of these knots are designed to slip while advancing but to lock into place when tightened. In the study by Shettko et al,[6] the combination of the 4-S modified Roeder knot, and size 1 Maxon was significantly stronger than all other suture and knot combinations tested.

The caudal pole of the ovary is sharply dissected to reduce the pedicle size (Fig. 3), and two ligating loops are placed on the ovarian pedicle (Fig. 4). The ovary is grasped with forceps through the ligature loop and then manipulated to tease the loop around the newly created ovarian pedicle. It is generally effective to twist the ovary through the loop. Once the pedicle is snared, the loop is tightened by advancing the knot pusher while pulling the tail end of the ligature. The knot pusher is then exchanged for scissors, and the tail of the ligature is cut and removed; this is repeated. The ovarian pedicle is then carefully transected with laparoscopic scissors between the ovary and ligature and checked for bleeding (Fig. 5). Specific equipment for this technique

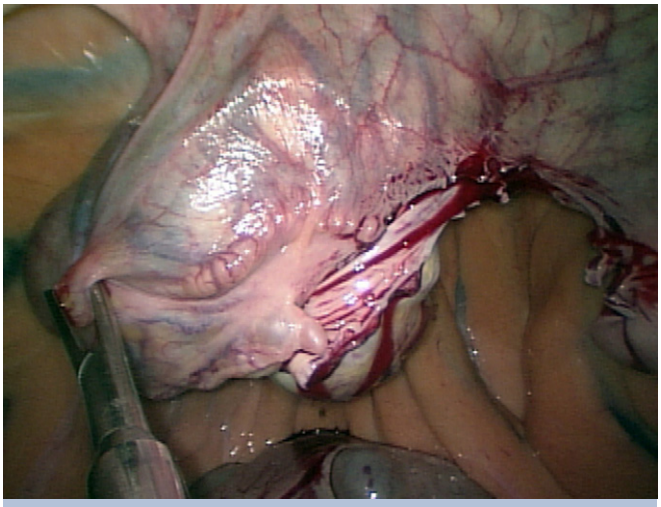

Figure 3. Photo showing dissection of the caudal pole of the left ovary.

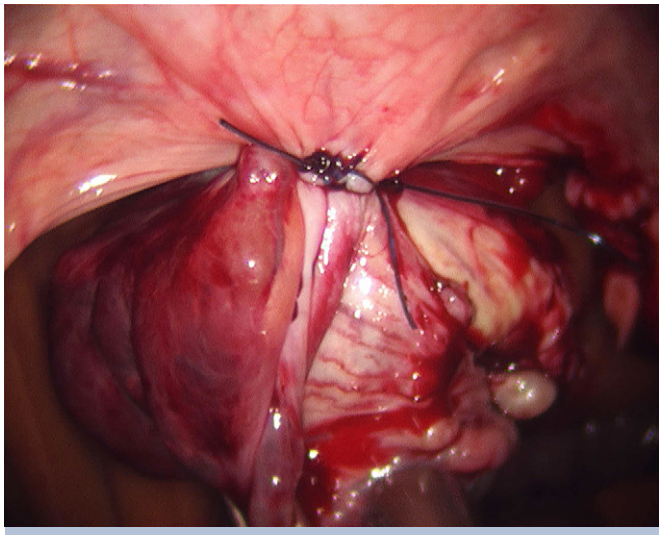

Figure 4. Photo showing two ligating loops on the left ovarian pedicle.

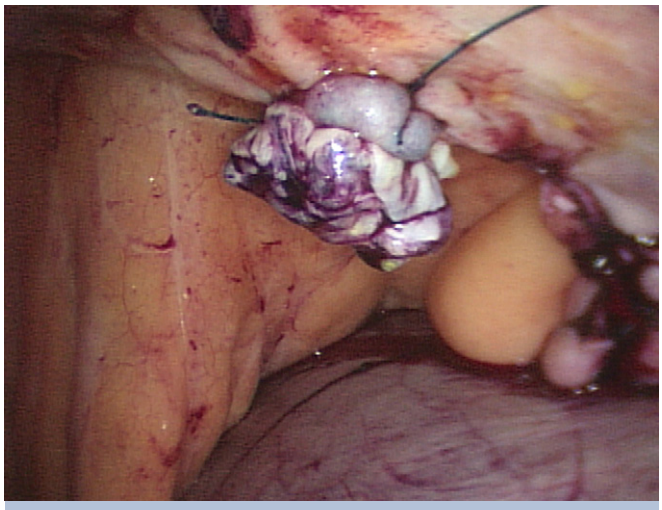

Figure 5. Photo showing transected stump after amputation of left ovary.

includes a knot pusher, a 5-mm reducer, a suture scissors, and a tissue scissors.

No major complications have been associated with this technique. In a few circumstances, incomplete hemostasis occurs, which is very easily resolved with an additional ligature or by placement of a ligating clip. Hemostasis also can be achieved without ovarian pedicle dissection, but it often results in reduced ligature security. Limits to this technique occur when the ovaries are larger than 15 to 18 cm in diameter, because it is difficult to control such a large loop in the abdomen.

Polyamide Tie-Rap

Another technique used to perform mesovarian ligation is through the use of a white-colored, commercially available polyamide tie-rap, more commonly known as a zip-tie.[7] The tie used is 500 mm long, 4.8 mm wide, and 1.2 mm thick. Sterilization of the tie-rap can be done using gas plasma sterilization, steam, ethylene oxide (which minimizes elongation of the material), and autoclave techniques. The tie is manually marked every 20 mm before initiation of the surgery to ensure that the tie-rap tightens adequately during surgery. The polyamide tie-rap is prepared by creating a loop and connecting it to a hooked metal bar. The metal bar tie-rap unit is inserted in the metal tube, and cervical forceps are inserted to grasp the ovary and provide tension on the mesovarium. Curved Metzenbaum scissors are inserted through the second portal and are used to slightly transect the mesovarium, on the caudal and cranial ends. The scissors are then removed, replaced by tie-rap unit, and the loop is set horizontally and under the ovary. The loop typically slides quite easily over the ovary due to the stiffness of the polyamide tie. With the traction from the cervical forceps on the ovary, the loop is positioned as high as possible on the pedicle and then tightened by pushing up on the buckle of the tie rap with the metal tube while pulling on the end of the tie-rap with the hooked metal bar. The tie-rap is tightened until the surgeon sees the buckle rest between marks 3 and 4. The metal bar is then removed and replaced by tissue forceps, which is used to completely tighten the loop. The cutter–sleeve unit is inserted to cut off the end of the tie rap, and the ovary is then completely transected from the mesovarium with laparoscopic scissors.

Few complications were noted in this report. Mesovarial hemorrhage can occur if the vessels are not entirely occluded, which is easily fixed with the application of a second

tie-rap proximal to the first. Two weeks after surgery, the tie-rap and mesovarial stump is partially encapsulated with yellowish fibrovascular tissue, at 4 weeks encapsulation is complete, and at 12 weeks, the stump is entirely encapsulated with organized fibrous tissue.

The polyamide tie is inexpensive and widely available at any hardware store. Because the polyamide polymer is a nylon monofilament material, it is biologically inert and noncapillary. Its melting point is 250°C, which is important to remember when sterilizing. The suture material is nonabsorbable and can elicit an inflammatory reaction but typically does not cause problems. The major advantage of using the polyamide tie-rap is that the loop to be placed around the ovary is rigid and is therefore easier to apply in comparison with a ligature. The 14-cm-diameter loop can be a limitation when it is insufficient to allow passage of a large ovary. Larger tie-raps are available, however, which minimize this problem.

Electrocoagulation

Bipolar cautery can be used to provide hemostasis of the ovarian pedicle.[2] This procedure involves the use of basic laparoscopic tools and bipolar forceps to provide hemostasis of the mesovarium. Bipolar cautery provides a safer environment than monopolar cautery, because there is a reduced likelihood of collateral damage from aberrant currents.

Laparoscopic grasping forceps are inserted through one instrument portal to provide traction on the ovary. The bipolar electrosurgical instrument is inserted through either the most cranial or the most dorsal instrument portal. Pedicle dissection is initiated when the electrosurgical forceps are placed across the cranial aspect of the mesovarium approximately 1 cm proximal to the ovary. The cranial mesovarium is coagulated until blanching and shrinkage are observed. The laparoscopic scissors then replace the atraumatic grasping forceps, and coagulation and transaction is repeated caudally until the ovary is only suspended by the tubal membrane, oviduct, and proper ligament of the ovary. The electrosurgical instrument is replaced with grasping forceps to grab the ovary. Laparoscopic scissors are used to transect the remaining mesovarium, which now lacks any major blood vessels. Once the ovary is transected, the mesovarium is observed for bleeding before laparoscope removal.

The advantages of electrosurgery are that it is less technically demanding than ligature placement; however, it does require more equipment to purchase and maintain. It can generally provide adequate hemostasis of the mesovarium and consequently a dry surgical field. However, it is generally limited to coagulating vessels of 3 mm in diameter or less. Thermal injury to bowel from stray currents can lead to perforation and subsequent life-threatening postoperative peritonitis. This can occur because of insulation failure in the active electrode, direct coupling, or capacitive coupling. These complications can be reduced by avoiding the use of high-power settings, energizing the active electrode only when it is in contact with the target tissue, keeping the active electrode in the field of view, not inserting metal cannulas through plastic devices, avoiding touching the active electrode to other metal instruments, and avoiding long activation of the active electrode. The standing position helps minimize injury because the ovary and mesovarium are located dorsal to abdominal viscera; however, distention of the bowel can cause problems, which emphasizes the importance of withholding feed before surgery.

Ultrasonic Cutting and Coagulating Devices

Ultrasonic energy is delivered to the ovarian pedicle to coagulate vessels and cut the tissue of the pedicle.[8,9] Standard laparoscopic instrumentation along with a device for providing the ultrasonic energy are required for this procedure. Two main devices are available, the Harmonic Scalpel (Ethicon Endosurgery) and the Autosonix (US Surgical, Covidien). The units consist of a generator, a foot pedal, and hand piece with a connecting cable, and a blade system. A transducer in the hand piece converts electrical energy from the generator into ultrasonic vibration, 55,000 Hz, which is transmitted along an extending rod to the active blade tip. This energy is sufficient to cause protein disorganization and denaturation, resulting in a sticky protein coagulum capable of sealing vessels up to 3 to 5 mm in diameter. The devices use multiple power settings to empower a blade system that allows a surgeon to control the balance between cutting and coagulation by varying power settings, changing blade configurations, and varying the grip force.

The ovary is stabilized by grasping the infundibulum with laparoscopic claw forceps while the shears are inserted. When using the Harmonic Scalpel (Ethicon Endosurgery), the coagulating shears transect the mesosalpinx, uterine tube, and proper ligament with a sharp blade and the number 5 setting while simultaneously coagulating blood vessels. The vertical part of the ovarian pedicle is transected using the blunt blade and number 3 setting, and the first cuts are made on the most cranial part. The shears are exchanged for laparoscopic scissors, and the remainder of the ovarian pedicle is separated into medial and lateral components by blunt dissection. The laparosonic coagulating shears are reintroduced into the craniodorsal portal, and the lateral aspect of ovarian pedicle is transected followed by the medial aspect.[8] A similar technique is performed using the Autosonix (US Surgical, Covidien) except that a single pair of shears is used[9] (Fig. 6).

The advantages of using an ultrasonic device are that it is simple to use and it is capable of grasping, coagulating, and cutting tissue simultaneously. It minimizes the number of

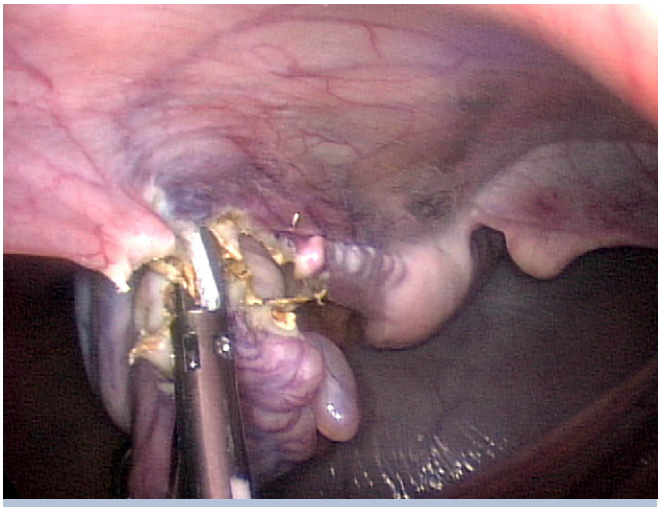

Figure 6. Intra-abdominal view of cauterization and amputation of the left ovary using the ultrasonic cutting/coagulating shears (Autosonix, US Surgical, Covidien).

Figure 7. Intraabdominal view of cauterization and amputation of the left ovary using a radiofrequency wand (LigaSure, Covidien).

instrument exchanges needed to complete the procedure, and the surgeon can control the balance of coagulation and cutting by varying the power setting, blade configuration, and tissue pressure. The shears are easy to use and achieve reasonable hemostasis of the ovarian pedicles. In the report by Alldredge and Hendrickson,[9] many of the pedicles required further treatment in the form of ligating clips for hemostasis. The shears can be used to offer further hemostasis. The equipment can be expensive, and the shears are designed to be single use.

Radiofrequency

Radiofrequency can be used to cauterize the ovarian pedicle.[10] The LigaSure (Covidien) device is a feedback-controlled bipolar vessel sealing device used to establish hemostasis. The feedback-controlled electrothermal scaler applies the precise amount of energy to produce a seal of the vessel walls in the form of partially denatured protein. The integrity of the seal is independent of a proximal thrombus and resists dislodgment because the seal is inside the vessel wall structure. Unlike electrocoagulation device, the LigaSure minimizes thermal spread to adjacent tissue and reduces sticking or charring at the seal sites.

The use of the LigaSure does not require the dissection of the mesovarium to create a smaller ovarian pedicle. The instrument is inserted through the appropriate portal and is positioned to begin from either the caudal or the cranial pole of the ovary. The Atlas wand incorporates a cutting blade so that the tissue can be coagulated and cut sequentially without changing instruments. This process is repeated until the ovary is removed, which takes approximately five to seven applications of the LigaSure (Fig. 7).

A technical problem of spark emittance has been reported with mechanical operation of the device when discharging it across tissue. This could be attributable in part to too much tissue forced into the instrument's jaws, or sterilizing and re-using a device designed for single use. The LigaSure is advantageous to use because it does not require dissection of the mesovarium, there is no likelihood of ligature slippage, and no foreign-body reaction occurs because of the suture material. The instrument is effective for vessels up to 7 mm in diameter, and the translucent appearance of the seal indicates a complete lack of blood flow to the cut edge of the pedicle. Although designed to be a single-use instrument, the wand can be sterilized for cost-effectiveness in a hydrogen peroxide/plasma sterilizer.

Endoscopic Stapling

Stapling devices have been part of equine surgery since the 1970s. Recently they have been adapted for endoscopic procedures. The endoscopic stapling devices generally require a 12- or 15-mm-diameter cannula. The Endo-GIA II (US Surgical, Covidien) stapling device is designed to seal ovarian vessels and transect the mesovarium all in a single application. It also is possible to use a disposable specimen pouch for removal of the ovaries from the abdomen.[5]

The mesovarium is dissected to isolate ovarian vessels, creating a pedicle capable of containment within the stapling device. The ovary is manipulated with grasping forceps to incorporate the entire pedicle into both arms of the stapler. The distal aspect of the stapler is typically the most common site of incomplete occlusion, which is

important to consider when performing this procedure. Once the pedicle is completely encased in both arms of the stapler, the blade within the stapler is advanced, causing release of the staples and subsequent severing of the pedicle. Any residual attachment of the pedicle that is not incised is transected using laparoscopic tissue scissors. It is critical that the transected pedicle be evaluated for bleeding before removal of the ovary. The detached ovary can then be placed in the EndoCatch II (US Surgical, Covidien) disposable specimen pouch, previously inserted into abdomen through the dorsal instrument portal. In the report reviewed, the right ovary was placed into the bag and then the left ovary directed toward the caudal aspect of the right abdomen by passing it between the bladder and the body of the uterus. To perform this step more carefully, the camera is moved to the left flank for better visualization and then moved to the right flank for removal. Once both ovaries are in the pouch, it is closed with a drawstring and pulled tightly against the flank. The right abdominal incision is then enlarged to pull the bag through the body wall, and all incisions are closed.

Bleeding from the pedicle can occur when the initial dissection is too close to the ovary. The advantages of using this technique are the simultaneous hemostasis of the ovarian vessels and transection of the ovary. The disadvantage is the cost of the staple cartridge and bag if used. The main advantages of using a laparoscopic stapling device technique compared with a suture are the shorter surgical time, that the ovary is resected from the mesovarium immediately without the need for transaction after individually ligating vessels, and that there is no risk of inadvertently cutting the suture or displacing the knot during amputation. The primary advantage of using the EndoCatch II device is the avoidance of losing the ovary during transfer to another grasping instrument, given there is sufficient space in the bag for both ovaries. The disadvantage associated with this technique is the increased surgical time needed to control bleeding when ovarian vessels are inadvertently transected, which can be corrected with electrocautery or laparoscopic clips.

CONCLUSIONS

The primary advantages of standing laparoscopic surgeries are excellent intraoperative visibility, secure hemostasis, reduced surgical and postoperative morbidity, decreased postoperative discomfort, rapid and uncomplicated healing, reduced quantity of medication needed, shorter postoperative management, and less expense than for ovariectomies performed under general anesthesia.[3]

There have been few reported significant complications associated with standing laparoscopic ovariectomy. Choosing the appropriate animals to undergo standing surgery under sedation is the most important first step. If the mare is not amenable to a standing surgical procedure performed in the stocks, it should be anesthetized. Bleeding from the pedicle can be managed immediately because the procedure allows direct visualization of the surgical site. It is possible to drop the ovary into the abdomen after amputation; it is generally considered important to find the ovary and remove it from the abdomen. In most cases, this can be done using laparoscopic instruments. In some cases, it requires an enlarged incision and identifying the ovary manually for removal.[2] Sometimes ovaries with large follicles are difficult to exteriorize and are incised and drained in the abdomen to decrease ovarian size and avoid slippage during removal.[7] Most mares are clinically normal immediately after surgery. The tension-free amputation is believed to be less painful than traditional techniques. There are reports of mares that have a slight decrease in appetite and increase in temperature for the first 12 hours postoperatively or that experience mild incisional edema and subcutaneous emphysema, which often resolves in 3 to 5 days.[1] Mares often show mild signs of colic and are given a single dose of flunixin meglumine, which has been shown to be useful.[2]

All of the reported techniques are useful in equine ovariectomy. Of the techniques discussed in this review, the ligating loop is the least expensive but requires the most skill. The LigaSure device requires the least skill and is similar in cost to the other techniques. The authors recommend using the ligating loops for normal-sized ovaries and the LigaSure device for ovaries larger than 15 to 18 cm. In a recent retrospective study evaluating the clients' perspective on standing laparoscopic ovariectomy, behavioral improvement was seen in 83% (19/23) of mares treated for behavior-related problems, aggression problems improved in 86% (12/14) of cases, general disagreeable demeanor improved in 81% (17/21), and excitability improved in 75% (12/16) of cases where these behaviors had been previously observed. Kicking and biting improved in 73% (8/11), problems in training improved in 72% (13/18), and frequent urination and problems with other horses improved in 64% (7/11 and 9/14, respectively) of cases.[11]

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Surgical Approaches to Ovariectomy in Mares

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KEY FACTS

- When performing ovariectomy by a colpotomy (vaginal) approach, proper positioning of the vaginal incision is necessary to prevent fatal complications.
- A colpotomy approach should not be used to remove ovaries larger than 8 to 10 cm in diameter; ovaries up to 15 cm in diameter can be removed safely through a flank approach; and larger ovaries should be removed through a celiotomy incision.
- Laparoscopic ovariectomy techniques allow optimal visualization and tension-free ligation to maximize hemostatic security.
- A wide variety of complications of differing severity (from mild to fatal) can follow any ovariectomy technique.

ABSTRACT: The preoperative considerations, surgical techniques, postoperative care, and complications associated with the surgical techniques available to perform unilateral or bilateral ovariectomy in horses are described. Standing techniques described include the colpotomy (vaginal), flank laparotomy, and laparoscopic approaches. Procedures that require general anesthesia, including flank laparotomy, ventral midline celiotomy, paramedian celiotomy, diagonal (oblique) paramedian celiotomy, and laparoscopic approaches, are also discussed. Complications following surgery can range from mild incisional swelling and pain to fatal intraabdominal hemorrhage or eventration. Careful consideration of the advantages and disadvantages of each procedure allow equine surgeons to select the most appropriate approach for each patient.

Equine ovariectomy is a commonly performed elective surgical procedure. Various surgical approaches are used for unilateral or bilateral ovariectomy. The surgical approaches described include vaginal or colpotomy, flank, diagonal or oblique paramedian, ventral midline, caudal paramedian, and numerous laparoscopic techniques. The decision as to which approach to use for a particular case depends on the following factors:

- Specific indications for ovariectomy
- Size of the affected ovary
- Surgeon's preference
- Financial constraints imposed by the client
- Temperament of the mare
- Equipment available
- Client expectations

An understanding of the benefits and disadvantages of all approaches can aid the clinician in selecting the appropriate surgical approach for each patient. This article reviews the surgical approaches used to perform unilateral and bilateral ovariectomy in mares.

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PREOPERATIVE CONSIDERATIONS

Special preoperative preparation of the mare should be instituted before performing ovariectomy. Food should be withheld for 12 to 24 hours before surgery to help decrease the amount of ingesta and gas within the gastrointestinal tract, thereby making it easier to exteriorize the ovary and suture the abdominal wall incision. Depending on patient positioning, laparoscopic techniques require that food be withheld for 12 to 48 hours prior to surgery[1,2] to improve visualization of intraabdominal structures and to decrease the likelihood of penetrating a viscus when the laparoscopic instruments are introduced into the abdomen.[3–7]

Abdominal palpation per rectum (with or without ultrasonographic evaluation) is useful in detecting abnormalities associated with the reproductive tract and should be performed in all mares presenting for ovariectomy regardless of the reason. Results of this evaluation may help dictate the necessary surgical approach based on the palpable size of the ovary to be removed. In addition, identifying pathology, such as adhesions or abscessation associated with the reproductive tract, may provide valuable information regarding the optimal surgical approach.

The rationale for and use of antibiotics to treat horses undergoing ovariectomy vary among surgeons. If antibiotics are used, they should be administered preoperatively to ensure that adequate systemic concentrations are present at the time of surgery. Administration of broad-spectrum antibiotics should be continued postoperatively if a break in aseptic technique occurred during the procedure. Tetanus prophylaxis should be administered routinely when performing ovariectomy.

SURGICAL PROCEDURES

Vaginal Approach (Colpotomy)

In 1903, Williams first described a vaginal approach, or colpotomy, using an ecraseur to ovariectomize mares.[8] The vaginal approach is now commonly used to perform a bilateral ovariectomy in normal mares, but unilateral removal of a suspected granulosa–theca cell tumor less than 8 to 10 cm in diameter can also be performed using this approach.[9,10] There are several advantages to the colpotomy technique, including the fact that it is performed as a standing procedure, minimal instrumentation is required, the procedure can be performed quickly, excellent cosmetic results can be expected, and the convalescent period following surgery is relatively short.

Ideally, mares should be in diestrus or anestrus because ovarian vasculature is believed to be minimized at these times.[11] Mares are restrained in standing stocks and sedated. Sedation is most commonly accomplished with an α_2-agonist and butorphanol to provide analgesia as well as profound sedation. Acepromazine can be administered for tranquilization as well. Administration of caudal epidural anesthesia is unnecessary but is recommended by some surgeons to help prevent the mare from straining during the procedure.[12,13] The tail is wrapped and secured away from the perineal region, and all manure should be evacuated from the rectum to prevent contamination of the external genitalia. Routine aseptic preparation of the external genitalia and perineal region is performed, and the vagina is lavaged with sterile saline or dilute povidone–iodine solution. In some mares, catheterization of a large urinary bladder may facilitate the procedure and may help reduce the risk of inadvertent injury during the procedure.[14–16]

The location of the initial incision in the cranial fornix of the vagina is very important. The incision must be placed in either a craniodorsal (at the 2- or 10-o'clock) or a cranioventral (at the 4- or 8-o'clock) position. Potential complications of a misplaced incision include entering the rectum if the incision is placed too dorsal, injuring the urethra or bladder if placed too ventral, and incising the caudal uterine branch of the urogenital artery if too medial or lateral (at the 3- or 9-o'clock position).[11,17,18] The incision should be started 3 to 5 cm caudal to the os cervix to avoid disruption of the cervical musculature.[12,14,16] Using a scalpel blade, scissors, or mosquito hemostat, a small 1- to 3-cm vaginal incision is sharply/bluntly created. This initial incision should penetrate the full thickness of the vagina and peritoneum to prevent the peritoneum from lifting away from the underlying tissues during blunt dissection. The incision is then bluntly enlarged digitally, and the peritoneum is perforated to allow the surgeon's hand to enter the abdomen. The ovary and associated mesovarium are isolated by direct manual palpation. Anesthesia of the mesovarium can be attempted using gauze sponges soaked with local anesthetic, which are held around the mesovarium for 30 seconds to 2 minutes. To prevent loss of the sponges within the abdomen, a long suture or strand of umbilical tape should be secured to the sponges.[13,16,19]

To transect the ovary from the mesovarium, a chain ecraseur is used to slowly crush and cut the mesovarium. The chain ecraseur should be carefully placed around the mesovarium, ensuring that bowel, intestinal mesentery, or a portion of the uterine horn is not encircled by the chain.[12,17,18] Once the chain is properly positioned, it is tightened slowly (over 1 to 4 minutes) using the ratchet system of the ecraseur. Hemostasis of the mesovarium depends on crushing the vascular structures and the resulting vasospasm. While the ecraseur is being tightened around the ovary, the ovary

should be held within the surgeon's hand to prevent losing it within the abdomen. The contralateral ovary may be removed via the same vaginal incision if a bilateral procedure is to be performed. The vaginal incision is left open to heal by second intention. Optionally, an episioplasty (Caslick's procedure) may be performed to complete the surgery in an effort to decrease the risk of ascending infection.[11]

Tie stall restriction for 2 to 7 days postoperatively has been advocated to prevent recumbency and reduce the risk of evisceration.[13,19,20] However, some authors suggest that this is unnecessary and report no adverse effects with routine stall confinement.[11,17] Exercise restriction is employed for 1 to 3 weeks following surgery, depending on the rate of healing of the vaginal incision. During this time, limited hand walking or small paddock turnout is important to reduce the potential formation of adhesions to the ovarian stump.[11,15,18] Light riding and a slow return to normal work are allowed after this time.

The primary disadvantage to the colpotomy approach is the lack of visualization.[21] By palpation alone, the ovary must be differentiated and isolated from the omentum, local mesentery, loops of intestine, and fecal balls within the small colon.[12,22] Hemorrhage from the mesovarium may be difficult to determine and control due to the lack of visualization with this approach.[13,21] Postoperative administration of broad-spectrum antibiotics may be indicated in mares undergoing a vaginal approach because it is difficult to adequately prepare the vagina for aseptic surgery. This approach is not recommended in mares that pool urine or in mares with vaginal, cervical, or uterine infections.[14,18,22] Ecraseur transection of large ovaries (larger than 8 to 10 cm in diameter) should not be attempted due to the size of vaginal incision needed to remove the ovary, the possibility of dropping the ovary within the abdomen, and the enlarged vascular supply associated with larger ovaries.[10,11,13,18,23] Even with adequate restraint and heavy sedation, this approach poses a risk to the surgeon due to positioning behind the mare.[12,22] Thus only tractable mares are good candidates for this procedure.

Flank Approach

The flank ovariectomy approach can be performed with the mare in the standing or recumbent position. To perform a standing flank laparotomy, the mare's temperament must be amenable to standing surgery. When performing a standing flank laparotomy, the mare is sedated, restrained in standing stocks, and the tail is wrapped and secured away from the surgical site (as described for the colpotomy procedure). For the recumbent technique, mares are placed in lateral recumbency so that the ovary to be removed is uppermost. The recumbent flank technique requires general anesthesia, resulting in a slightly greater cost to the client and potentially increased risk to the mare. The recumbent flank technique is generally only used for unilateral ovariectomy, as it offers easy access to only one ovary.[14]

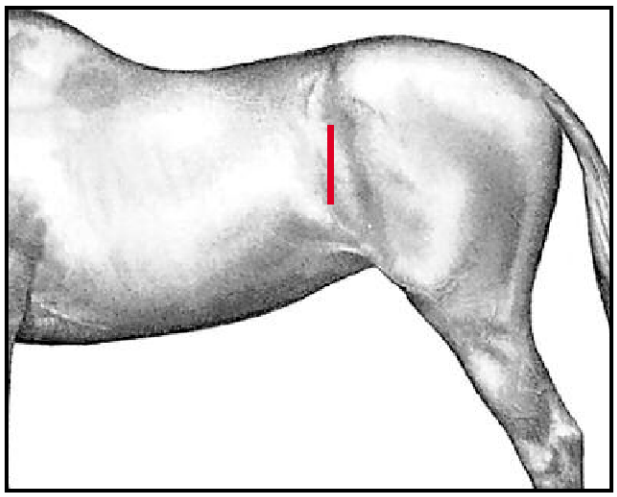

Figure 1—Position of paralumbar flank incision for ovariectomy between the 18th rib and tuber coxae. This incision position can be used in both standing and recumbent horses.

Compared with the colpotomy approach, both the standing and recumbent flank laparotomy approaches enable the surgeon to remove larger ovaries and give better exposure of the mesovarium, thus potentially providing superior hemostasis.[13,19,22] The ovary is normally situated beneath the paralumbar fossa. In horses, the limited size of the paralumbar fossa (compared with bovines) and the thickness of the body wall in the flank region may limit the ability to easily exteriorize large ovaries.[10,11,24] Ovaries up to 15 cm in diameter can be removed easily through a flank approach.[9,18,23] Bilateral ovariectomy typically requires a second incision through the opposite paralumbar fossa to remove the contralateral ovary. In the standing mare, bilateral ovariectomy can be achieved through a single flank incision, but the contralateral ovary must be excised blindly within the abdomen using a chain ecraseur.[12,14,19]

Regardless of positioning, the paralumbar fossa is clipped, aseptically prepared, and draped. Regional anesthesia in the form of an inverted L-block or local infiltration of the proposed incision site is required in standing mares.[11,12,24] The incision is started 5 cm ventral to the lumbar transverse processes between the 18th rib and the tuber coxae and is extended ventrally 10 to 15 cm as needed, depending on the size of the ovary to be

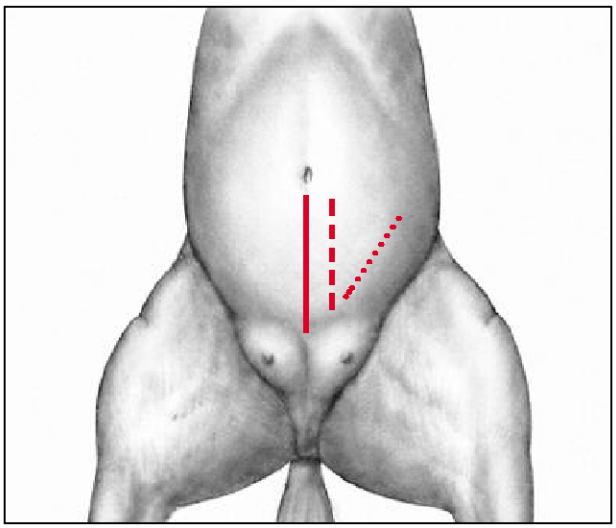

Figure 2—Position of traditional celiotomy incisions performed under general anesthesia with the horse in dorsal recumbency. *Solid red line* = ventral midline approach; *dashed line* = paramedian approach; *dotted line* = diagonal (oblique) paramedian approach.

removed (Figure 1). Following incision of the skin and subcutaneous tissues, a grid or modified grid approach may be used to incise the abdominal musculature. The grid approach creates a slightly smaller opening into the abdomen and should only be used for ovaries less than 10 cm in diameter; larger ovaries will necessitate use of the modified grid technique.[13,14,19] A grid approach involves separating the external abdominal oblique muscle along the direction of its fibers, whereas a modified grid technique involves incising this muscle along the line of the skin incision.[14] For both techniques, the internal abdominal oblique and transversus abdominis muscles are bluntly separated along the direction of their fibers or incised to expose the peritoneum. The peritoneum may be incised or bluntly perforated to allow access to the abdomen. The ovary is then identified and isolated. In standing mares, the mesovarium is anesthetized by topical administration of anesthetic, similar to that described for the colpotomy procedure, or by direct injection of anesthetic into the mesovarium, if visualization permits. The ovary may be transected within the abdomen or after exteriorization. Aspiration of cystic cavities within the ovary may reduce the overall ovarian size and facilitate exteriorization.[9,10,18] The means to achieve hemostasis and transection of the mesovarium depend on the ability to exteriorize or visualize the mesovarium through the flank incision. Possible choices include the use of a chain ecraseur, emasculator, surgical stapling device, or transfixing ligatures.[11,14,16,19,24] Following removal of the ovary, the mesovarium is observed for hemorrhage and oversewn if desired, when adequate visualization permits. Oversewing the mesovarium with 2-0 absorbable suture material may reduce possible intraabdominal adhesions of a segment of bowel to the transected mesovarium.[14,18] Closure of the laparotomy incision is routine.

Postoperative pain and discomfort may be observed in association with the flank incision. Incisional swelling and discharge may be noted 24 to 72 hours after surgery.[24,25] Incisions created in a more ventral position on the flank tend to develop more swelling and cause increased postoperative pain and discomfort.[24] Incisions in the flank have been associated with incisional discharge and partial dehiscence.[13,14,22] Occasionally, this approach results in a poor cosmetic outcome if scarring of the incision site occurs.[10-12] Exercise should be restricted to hand walking or turnout in a small paddock for 4 to 6 weeks following surgery, after which light riding and a slow return to normal work may be allowed, provided the incision has healed without complications.

Diagonal (Oblique) Paramedian Approach

The diagonal (oblique) paramedian approach has been reported to be superior to other approaches for ovariectomy, especially for the removal of ovaries up to 20 to 25 cm in diameter.[26,27] Because the incision is created so close to the intraabdominal position of the ovary, exteriorization through a diagonal paramedian incision generally results in less traction being placed on the mesovarium. In addition, the body wall is thinner at this location, as compared with other approaches, which allows greater flexibility in retracting the wound edges. Improved visualization of the ovary and mesovarium can often be achieved with this approach. Bilateral ovariectomy can be performed; however, two incisions are generally required. General anesthesia is necessary to perform an ovariectomy with this approach; therefore, the cost and risks associated with recumbency are also associated with this technique.

Perioperative preparation and care is similar to that for the previously described approaches. Following induction of general anesthesia, the mare is placed in dorsal recumbency. Slightly tilting the mare toward the side opposite the affected ovary helps minimize the tendency for bowel to protrude from the incision. Following routine aseptic preparation of the ventral abdomen, an incision is started approximately 5 to 10 cm cranial to the ipsilateral mammary gland and extended approximately 20 cm (or as needed, depending on the size of the affected ovary) cranially and laterally toward the fold of the flank[11,15,16] (Figure 2). The incision is extended through the underlying external rectus sheath,

parallel to the initial skin incision. The rectus abdominis, internal rectus sheath, and peritoneum are bluntly divided in the direction of their fibers or incised (depending on surgeon preference) to allow access to the abdomen.[13,18,26] The ovary is located and exteriorized. Local anesthesia of the mesovarium, either by topical application of anesthetic-soaked gauze sponges or direct injection of local anesthetic, may be used to diminish the pain response secondary to traction on the ovary.[16,28] Fluid within cystic cavities may be aspirated to reduce the size of the ovary and facilitate its removal from the abdomen.[16,23,27] Large suture material placed as stay sutures within the ovary and retraction on the incision edges may aid the surgeon in exteriorizing large ovaries. Overlapping transfixation ligatures of No. 2 absorbable suture material or application of a TA-90 stapler (US Surgical) may be used for hemostasis prior to transection of the mesovarium.[15,18,26,29] Ligatures should be tightened and staples should be applied to the mesovarium in a relaxed position; application under tension may result in failure to provide adequate hemostasis.[13,19,28] Following complete transection of the mesovarium, closure of the abdominal incision is routine. Due to the location of the incision on the ventrum, a good cosmetic outcome usually follows ovariectomy by the diagonal paramedian approach.[11]

Exercise restriction during the early postoperative period should consist of stall confinement with hand walking for the first 2 to 4 weeks following surgery.[11,27] After this time, small paddock turnout may be allowed for an additional 2 to 4 weeks of confinement,[11] the actual length of restriction depending on the individual patient's wound-healing progress. Return to a full exercise schedule and/or the allowance of natural service should not be allowed for at least 8 to 12 weeks postoperatively.[27] Mares may be bred by artificial insemination when the estrous cycle occurs following surgery.[15]

Ventral Midline Celiotomy Approach

A ventral midline celiotomy approach offers good exposure of the ovaries in the majority of mares.[14,15,28] The ventral midline incision can easily be extended as necessary, depending on the individual case, making it the technique of choice for removal of extremely large, tumorous ovaries.[13,19] The ventral midline approach is generally used to remove very large granulosa–theca cell tumors but can also be used to perform a bilateral ovariectomy.[11,15,16,23,25] A good cosmetic outcome is expected with this approach, provided no complications with incisional healing occur.

Perioperative preparation and care are similar to previously described approaches. For a ventral midline technique, general anesthesia is required and the mare is placed in dorsal recumbency. A caudal ventral midline linea incision is created, beginning at the mammary gland and extending cranially 25 to 35 cm as needed for adequate exposure[13,14,29] (Figure 2). The ovary is located by manual palpation and exteriorized. Local anesthesia of the mesovarium can be used if desired. Topical application of anesthetic-soaked gauze sponges or direct injection of the mesovarium with local anesthetic may decrease the pain response related to traction on the mesovarium.[16,28] Intraoperative hypotension believed to cause myopathies and neuropathies has been associated with excessive traction on the mesovarium, and these complications may be reduced by the application of local anesthetic.[28] Hemostasis and transection of the mesovarium are similar to what was described for the flank and diagonal paramedian approaches. Closure of the ventral midline incision is routine.

Postoperatively, care is similar to the other ovariectomy approaches. Stall confinement with hand walking should be enforced for the first 2 to 4 postoperative weeks, at which time sutures or staples used to close the ventral incision should be removed.[19] Small paddock turnout may be allowed after this, for an additional 2 to 4 weeks of confinement, after which light riding or pasture turnout may be allowed.[14] Full exercise should not be allowed for a minimum of 8 to 12 weeks after surgery, depending on the progress of incisional healing.[13,14]

Paramedian Approach

The paramedian approach can be used to remove large pathologic ovaries or to perform bilateral ovariectomy through one (contralateral ovary must be transected blindly) or two incisions.[18,19,23,25,28,30,31] The paramedian approach is similar to the ventral midline approach except for the location of the incision. The incision is made 4 to 8 cm lateral to midline and extends cranially from the level of the mammary gland for 25 to 35 cm or as needed for adequate exposure[16,19] (Figure 2). Methods to exteriorize the ovary and provide hemostasis of the mesovarium are similar to those described for other approaches. Postoperative care following a paramedian celiotomy is similar to the ventral midline and diagonal paramedian approaches.

Laparoscopic Techniques

In the past 10 years, laparoscopic ovariectomy techniques have been described for mares in the standing[3,4,32–34] and dorsally recumbent[2,4,5,21,34,35] positions. Laparoscopic techniques can greatly improve visualization of the ovary and mesovarium, potentially decrease postsurgical complications, and allow tension-free ligation of the vessels within the mesovarium.[2,3,21,32,33] How-

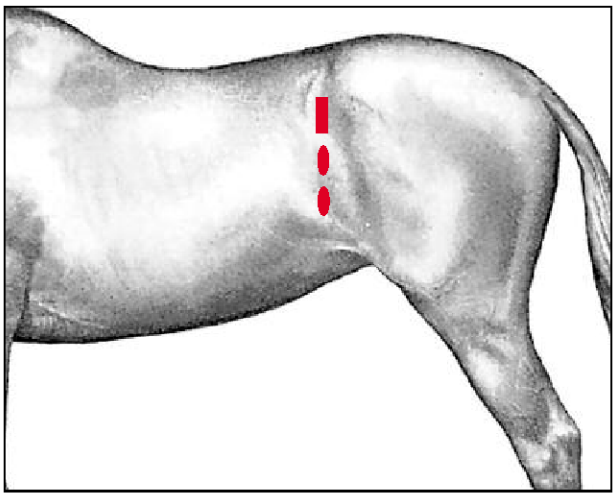

Figure 3—Position of the laparoscope *(rectangle)* and instrument portals *(ovals)* for laparoscopic ovariectomy in the standing horse. The laparoscope portal is positioned between the 18th rib and the tuber coxae, just dorsal to the crus of the internal abdominal oblique muscle. Instrument portals are created 4 to 8 cm ventral to the laparoscope portal.

ever, important considerations when performing equine laparoscopic ovariectomy include the requirement of specialized equipment, the technical difficulty of certain procedures, and the potential for anesthetic complications in horses placed in the Trendelenberg position.[4,21,33] Additionally, the use of laparoscopic equipment may be cost prohibitive in certain situations.[3,21]

Laparoscopic Ovariectomy in the Standing Mare

Laparoscopic ovariectomy in the standing mare avoids the need for general anesthesia, eliminates the cardiovascular derangements associated with the Trendelenberg position, and shortens the required preoperative fasting time (12 hours instead of 24 to 48 hours).[1,3,32] Mares are sedated using either xylazine hydrochloride or detomidine hydrochloride in combination with butorphanol tartrate. For bilateral ovariectomy, both paralumbar fossae are prepared for aseptic surgery and draped. The paralumbar fossa is desensitized using regional anesthesia or by direct infiltration of the proposed laparoscope and instrument portal sites.[4,5,36] The abdominal cavity can be insufflated with carbon dioxide through either a Verres-type needle inserted dorsally in the paralumbar fossa or a teat cannula inserted ventrally, as if performing abdominocentesis.[7,37] As an alternative (to avoid the potential complication of inadvertently insufflating the retroperitoneal space), the trocar–cannula can be inserted through the paralumbar fossa prior to insufflation of the abdominal cavity.[6,32,33,38]

A 15-mm skin incision is made at the dorsal border of the internal abdominal oblique muscle, and the sharp laparoscopic trocar–cannula is introduced into the abdominal cavity perpendicular to the paralumbar fossa[1,3,4,39] (Figure 3). The trocar is replaced by the laparoscope, and the caudal portion of the abdomen is examined to identify the ovary. The first instrument portal is made 4 to 8 cm ventral to the laparoscope portal, and a second instrument portal is made 4 to 8 cm ventral to the first[4] (Figure 3). Trocar–cannula units are passed through each instrument portal perpendicular to the flank musculature. Using a long spinal needle inserted separately through the flank musculature or a laparoscopic injection needle placed through a cannula, the mesovarium can be infiltrated with local anesthetic.[5,31,38] Hemostasis of the mesovarium can be achieved using suture ligatures, staples, laser energy, electrosurgical instrumentation, a vessel-sealing device, or a harmonic scalpel.[1,3,32,33,36,38–41] The ovary is transected using laparoscopic scissors distal to the site of ligation or coagulation. The ovary is removed by enlarging one of the instrument portals or by connecting the two instrument portals.[5,36] After removing the ovary, the abdomen is deflated through a laparoscopic cannula. The superficial abdominal fascia and skin at the portals are closed separately. The same procedure is then performed through the opposite paralumbar fossa to remove the contralateral ovary in bilateral procedures.

A hand-assisted laparoscopic ovariectomy technique in standing mares can be used to remove granulosa–theca cell tumors as well.[42] A standard flank approach is used, but the process of injecting local anesthetic into the mesovarium, application of a surgical stapling device, and transection of the mesovarium is performed intraabdominally with digital manipulation while using laparoscopic observation of the procedure.[42] After transecting the ovary from its mesovarium, the ovary is placed within a sterile plastic bag and sharply transected. Placing the ovary within the bag facilitates removal through a smaller incision and prevents abdominal and body wall contamination from the ovarian cystic fluid.[35,42] The standing, hand-assisted, laparoscopic ovariectomy technique is technically easy to perform, can be used for large pathologic ovaries (up to 30 cm in diameter), allows accurate placement of the staple line, and eliminates the potential risks and costs associated with general anesthesia.[42]

Laparoscopic Ovariectomy in the Anesthetized Mare

To perform unilateral or bilateral ovariectomy in an anesthetized mare using laparoscopy, the horse is anesthetized and positioned in dorsal recumbency, and the

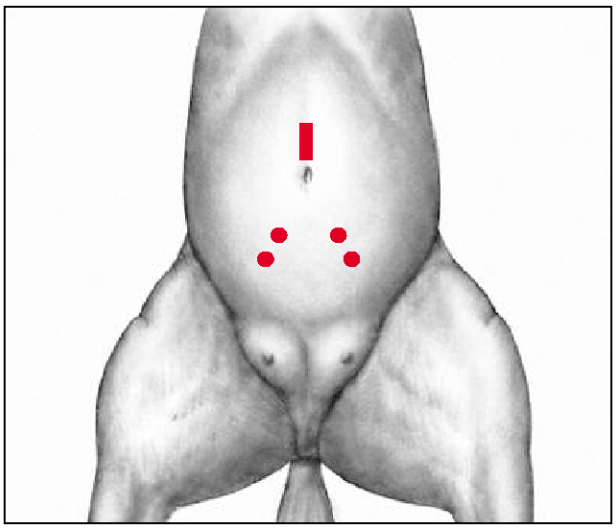

Figure 4—Position of the laparoscope and instrument portals for ovariectomy in the dorsally recumbent horse under general anesthesia. The laparoscope portal *(rectangle)* can be positioned just cranial to the umbilicus or just lateral to the umbilicus. Instrument portals *(dots)* are created between the laparoscope portal and the ipsilateral mammary gland.

tail is secured to the surgery table. The caudal abdomen is aseptically prepared and draped. To improve visualization of the caudal abdomen, a urinary catheter can be passed to decompress the urinary bladder.[35,43] A 10-mm skin incision is made just cranial or lateral to the umbilicus (Figure 4). The abdomen is insufflated with carbon dioxide through a teat cannula to a pressure of approximately 15 to 20 mm Hg.[2,4,39] A laparoscopic trocar–cannula unit is introduced into the abdomen, and the trocar is replaced with the laparoscope. In the recumbent technique, patient positioning becomes important for adequate visualization of the caudal abdomen. In routine dorsal recumbency, the female reproductive tract is obscured by intestinal viscera, so the surgical table must be elevated in such a way that the mare's head is lower than the hindquarters. For removing ovaries, an angle of inclination of approximately 30° from horizontal (Trendelenberg position) is generally required.[4,21] Two instrument portals (cranial and caudal) are created on both the left and right ventral abdomen (Figure 4). The cranial instrument portals are located midway between the ipsilateral mammary gland and the umbilicus. The caudal instrument portals are placed midway between the ipsilateral mammary gland and the cranial instrument portal.[35] After creating the four instrument portals, the ipsilateral uterine horn is elevated using a Chambers catheter (Jorgensen Laboratories) inserted through the contralateral caudal instrument portal. A knot push rod equipped with a modified Roeder knot or a commercial suture loop is inserted through the ipsilateral caudal instrument portal (left caudal instrument portal for removing a left ovary).[2] Sharp-toothed laparoscopic grasping forceps are passed through the cranial instrument portal on the same side as the suture loop. The jaws of the forceps are passed through the suture loop and used to grasp the ovary. The suture loop is passed over the ovary and tightened around the mesovarium. The mesovarium is then transected distal to the suture ligature.[21] The transected ovary is maintained in the jaws of the grasping forceps while the same series of steps are reversed to allow removal of the opposite ovary. The abdomen is deflated and the ovaries are removed by enlarging one of the cranial instrument portals. For the enlarged incision, the external fascia of the rectus abdominis, subcutaneous tissue, and skin are closed separately.[21] All remaining incisions are closed by simply apposing the skin.

Because most laparoscopic ovariectomy techniques can be accomplished through small incisions, the mare can be returned to exercise shortly after the procedure is performed. Postoperatively, mares should be confined to a stall for the first 24 hours followed by stall or small paddock confinement for 2 to 3 weeks before they are returned to unrestricted exercise.[33,35,38]

Laparoscopy can be used to remove large ovarian granulosa–theca cell tumors. One report described two mares that had a granulosa–theca cell tumor removed using a recumbent laparoscopic ovariectomy technique.[2] The mares were placed in Trendelenberg position, and the maximum diameter of the ovaries was estimated to be 20 cm in diameter.[2]

Complications that may occur following laparoscopic ovariectomy are similar to those seen with other approaches. Hemorrhage from the mesovarium has been reported following ligature slippage.[1,21] Subcutaneous emphysema may be observed postoperatively if the abdomen is not decompressed adequately prior to closure of the incisions.[32,43]

COMPLICATIONS

Although great advances have been made in the routine use of general anesthesia and surgical technique in horses, ovariectomy remains a procedure in which potential complications may occur, regardless of the approach used. In general, ovariectomy has been associated with greater postoperative morbidity and mortality than for other elective procedures.[10,13,15,22,25] Postoperative hemorrhage from the mesovarium can occur if hemostasis of the mesovarium fails.[3,22,23,44,45] Intraabdominal hemorrhage from branches of the ovarian artery is a serious and possibly fatal complication that

may go undetected at the time of surgery. Therefore, mares should be confined to a stall for the first 24 hours after surgery. Clinical signs associated with blood loss include tachycardia, pale mucous membranes, weakness or ataxia, weak thready pulse, and poor jugular distention.[13,18,22] Hemorrhage must be controlled, and initial medical therapy should be aimed at replacing the lost blood volume by intravenous administration of fluids and whole blood.

The vaginal approach also has the potential risk of inadvertently incising the caudal uterine branch of the urogenital artery when making the incision into the abdomen.[11,15] Care to avoid the 3- and 9-o'clock positions will help prevent this potentially fatal complication. Other potential complications reported when performing a vaginal approach include pain and discomfort; injuries to the cervix, bladder, or a segment of bowel; delayed vaginal healing; eventration of bowel, incisional site hematoma, or abscess; intraabdominal adhesions to the vagina; and chronic lumbar or bilateral hindlimb pain.[14,17,19,45]

Reported complications with the other celiotomy approaches vary depending on position. Intraoperative hypotension, myopathies, and neuropathies have been associated with traditional ovariectomy approaches performed under general anesthesia to remove granulosa–theca cell tumors.[13,22,25,45] Tension placed on the mesovarium during the process of exteriorizing an ovary is speculated to cause a decrease in arterial blood pressure and potentially lead to inadequate peripheral circulation.[25]

Cardiopulmonary derangements have been observed during laparoscopic procedures with horses placed in the Trendelenberg position.[21,32,39,46] This positioning exaggerates the force of abdominal insufflation and the weight of abdominal viscera on the diaphragm, decreasing the horse's ability to adequately ventilate without mechanical assistance and potentially compromising venous return to the heart.[21,32] Metabolic acid–base disturbances may also occur following prolonged abdominal insufflation with carbon dioxide, which diffuses easily into the systemic circulation.[39,46] As with traditional surgical approaches, myopathies and neuropathies can be a consequence of prolonged dorsal recumbency.[21] Therefore, proper anesthetic patient monitoring is required when performing laparoscopic ovariectomy with the mare in the dorsal recumbent position.

Regardless of whether the surgery is performed with the mare standing or recumbent, postoperative pain, anorexia, depression, incisional swelling, incisional infections, incisional dehiscence, eventration, peritonitis, intraabdominal adhesions, and death have been reported following ovariectomy in mares.[10,11,13,17,22,25,44,45] Incisional complications have been associated with ovariectomy techniques to remove granulosa–theca cell tumors.[25] A higher incidence of incisional complications have been observed with approaches through the paralumbar fossa.[14,24,47] This may be associated with the increased amount of dead space and possible muscle necrosis that may occur with the paralumbar approach.[47]

Proper aseptic techniques must be employed when performing ovariectomy procedures, or postoperative septic peritonitis may result.[12,24,25,44] This potential complication can be prevented by adhering to proper aseptic technique throughout the procedure and by the administration of perioperative antibiotics. Intraabdominal adhesions can develop after any abdominal procedure; however, the use of proper aseptic technique and ensuring minimal trauma to gastrointestinal serosal surfaces can help prevent formation of adhesions.[14,28]

Ovariectomized mares may continue to display signs of estrus after ovariectomy. It has been reported that 60% of ovariectomized mares will cease estrous behavior following surgery.[19] If previous hormonal therapy has been successful in altering the mare's behavior and/or performance favorably, then bilateral ovariectomy is likely to be successful at meeting the client's expectations. Prospective "jump" mares to be used for stallion collection should stand well during estrus as an intact mare; otherwise, the individual is not likely to be a good candidate for ovariectomy for this purpose.[48]

CONCLUSION

The equine surgeon presented with a mare requiring ovariectomy has numerous approaches available. The specific approach to be used should be chosen carefully to minimize traction on the pedicle yet allow adequate exposure and visualization of the ovarian pedicle for secure hemostasis. Standing techniques include colpotomy (vaginal), flank laparotomy, and laparoscopy. Traditional techniques that require general anesthesia are flank, paramedian, diagonal (oblique) paramedian, and ventral midline celiotomy approaches as well as laparoscopic procedures. Laparoscopic techniques are superior in providing visualization of the ovaries and tension-free ligation for maximal hemostatic security. However, laparoscopy requires specialized instrumentation and surgical knowledge, which may increase operative time, at least initially, until experience is gained. Each technique for equine ovariectomy has associated advantages and disadvantages, and as such, there is no single "proper" technique to be used for every case. When deciding which approach to use, clinicians should be intent on completing the procedure in the most efficient way, while at the same time minimizing patient discomfort and postoperative complications.

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ARTICLE #5 CE TEST

The article you have read qualifies for 1.5 contact hours of Continuing Education Credit from the Auburn University College of Veterinary Medicine. *Choose the best answer* to each of the following questions; then mark your answers on the postage-paid envelope inserted in *Compendium.*

1. Mares undergoing ovariectomy by colpotomy should be in what stage of the estrous cycle?
   a. immediately after ovulation
   b. diestrus or anestrus
   c. actively cycling
   d. pregnant
   e. seasonal transition

2. The initial vaginal incision for the colpotomy approach to ovariectomy should be in which position?
   a. directly dorsal
   b. on the medial wall
   c. on the lateral wall
   d. cranioventral or craniodorsal
   e. directly ventral

3. Oversewing the mesovarium following transection is recommended for which of the following reasons?
   a. decrease adhesion formation
   b. prevent eventration
   c. provide analgesia
   d. ensure adequate hemostasis
   e. complete sterilization

4. Which of the following is considered the main advantage to the ventral midline celiotomy approach to ovariectomy?
   a. little interference from abdominal viscera
   b. ease of performing a bilateral procedure
   c. optimal visualization of ovaries on short pedicles
   d. most tension-free ligation
   e. the ability to extend the incision as needed

5. Which of the following is generally not used for hemostasis when performing laparoscopic ovariectomy?
   a. suture ligatures
   b. staples
   c. chain ecraseur
   d. laser energy
   e. electrosurgical instrumentation

6. What is the main theory for why intraoperative hypotension is associated with traditional ovariectomy procedures performed under general anesthesia?
   a. Tension on the mesovarium decreases arterial blood pressure.
   b. Blood loss from the surgical incision causes hypovolemia.
   c. Hypoventilation causes decreased arterial oxygen content.
   d. Anesthetic agents cause decreased systemic blood pressure.
   e. Abdominal viscera interfere with venous return to the heart.

7. Which incision location has been associated with a higher incidence of complications?
   a. ventral midline
   b. paramedian
   c. laparoscopic
   d. flank
   e. diagonal paramedian

8. What percentage of mares stop showing estrous behavior following bilateral ovariectomy?
   a. 100%
   b. 60%
   c. 75%
   d. 50%
   e. 30%

9. Which of the following are advantages to laparoscopic ovariectomy approaches compared with the traditional celiotomy approaches?
   a. smaller incisions for access to the abdomen
   b. visualization of the ovary and mesovarium
   c. tension-free ligation of the mesovarium
   d. shorter, less complicated postoperative recovery
   e. all of the above

10. Which of the following is not a reported complication following equine ovariectomy?
    a. septic peritonitis
    b. eventration
    c. neurologic deficits
    d. hemorrhage
    e. hindlimb pain

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Original Article

How to perform ovariectomy through a colpotomy

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Keywords: horse; ovariectomy; colpotomy

Summary

Bilateral ovariectomy of mares is performed most commonly to eliminate or diminish unwanted behaviour, create a teaser mare, sterilise a mare so that it can be registered in its breed association, or produce a recipient mare for embryo transfer. A practical technique of bilateral ovariectomy that can be easily performed without the mare sedated and without a surgical facility is ovariectomy through a colpotomy. Ovariectomy through a colpotomy is less expensive than ovariectomy using other approaches because it is performed with the mare standing, can be performed quickly and the only specialised instrument required is a chain écraseur. Complications of ovariectomy performed through a colpotomy are uncommon when the mare is correctly prepared for the procedure and when proper precautions are taken during and after the procedure.

Both ovaries are sometimes removed from mares to eliminate the regular oestrous cycle, create a teaser mare, or produce a recipient mare for embryo transfer (Hooper *et al.* 1993). Surgical approaches described for bilateral ovariectomy of mares include celiotomy through one or both flanks, or through the vagina (Hooper *et al.* 1993; Palmer 1993; Pader *et al.* 2011). A practical technique of bilateral ovariectomy that can be performed easily without anaesthetising the mare and without a surgical facility is ovariectomy through a colpotomy, with the use of an écraseur. Ovariectomy performed with an écraseur through a colpotomy, although once performed commonly (Nichols 1988; Embertson 2009), is now performed rarely because of perceived dangers associated with the procedure and the increasingly widespread use of laparoscopy to remove ovaries. Ovariectomy through a colpotomy is relatively inexpensive because it is performed with the mare standing, can be performed quickly and the only specialised instrument required is an écraseur. Removing one or both ovaries through a colpotomy avoids scarring, which is common when ovariectomy is performed using other approaches.

Ovariectomy through a colpotomy is usually performed to spay mares because most neoplastic ovaries are too large to be removed through a vaginal celiotomy. A neoplastic ovary is usually removed using a ventral midline, or oblique paramedian celiotomy (Moll *et al.* 1987; Westermann *et al.* 2003). Neoplastic ovaries less than about 10 cm in diameter, however, can be removed through a colpotomy (Colbern 1993; Moll and Slone 1998). Complications of ovariectomy performed through a colpotomy are uncommon when the mare is prepared properly for the procedure and when the correct precautions are taken during and after the procedure (Nichols 1988; Moll and Slone 1998; Embertson 2009; Pader *et al.* 2011).

Preparation of the mare for the surgery

Feed should be withheld for 24 h if the surgeon is inexperienced to reduce the number of faecal balls in the small colon, in order that a faecal ball is not confused with an ovary during the procedure. Administering 4 L of liquid paraffin 12–24 h in advance of surgery decreases the likelihood of faecal balls being present in the small colon. The mare is restrained in an equine stock and sedated with detomidine HCl (0.002–0.022 mg/kg bwt i.v.) and butorphanol (0.002–0.022 mg/kg bwt i.v.) (Pleasant and McGrath 1998). Administration of detomidine HCl should precede administration of butorphanol to avoid opioid-induced excitement. Sedation can be maintained by administering sedatives i.v. by constant rate infusion. Drugs commonly administered by constant rate infusion include detomidine alone (0.02 mg/kg bwt/h, i.v.), or in combination with butorphanol (0.012 mg/kg bwt/h, i.v.), or morphine (0.05 mg/kg bwt/h, i.v.) (Doherty and Valverde 2006). To avoid inducing excitement when using butorphanol in combination with detomidine, a loading dose of detomidine (0.008 mg/kg bwt i.v.) should be administered initially before a loading dose of butorphanol (0.022 mg/kg bwt i.v.) is administered (Doherty and Valverde 2006).

The mare is administered antimicrobial therapy and an anti-inflammatory, analgesic drug such as phenylbutazone (2.2 mg/kg bwt i.v.) and the perineum, vestibule and vagina desensitised by infusing 2% mepivacaine HCL (1.8 mg/kg bwt) alone, or in combination with, 2 or 10% xylazine HCl (0.18 mg/kg bwt), into the epidural space. A mare can be ovariectomised safely through a colpotomy without receiving epidural anaesthesia (authors' observation), but epidural anaesthesia, in addition to desensitising the vestibule and at least a portion of the vagina, prevents the mare from defaecating during surgery.

The tail is bandaged with rolled gauze, elevated and secured to the overhead cross-bar of the stock. The faeces are removed manually and the mare's ovaries and uterus evaluated by palpation per rectum. Hair surrounding the perineum is clipped and the perineum scrubbed with an antiseptic soap. Irrigating the vagina with 1 L isotonic saline solution not only cleans the vagina and vestibule, it also induces pneumovagina, easing the introduction of a hand and arm into the vagina.

Preparation of the surgeon

Although the procedure can be performed with the surgeon and assistant wearing only sterile obstetrical sleeves, we prefer to wear sterile surgical gowns, the arms of which are

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covered with a sterile obstetrical sleeve to decrease friction between the arm and vagina. Sterile surgical gloves are donned over the hands of the obstetrical sleeves. The glove and sleeve on the surgeon's dominant arm are lubricated with sterile KY jelly to ease introducing the hand and arm into the vagina and into the abdomen after colpotomy.

Surgical procedure

A small pack of sterile gauze swabs, tethered to a sterile suture (e.g. umbilical tape) and saturated with local anaesthetic solution, such as mepivacaine HCl or lidocaine HCl, is introduced into the vagina with the surgeon's dominant arm (**Fig 1**). Pressing the pack to the fornix of the vagina for several minutes ensures that the mucosa at the fornix is desensitised. A stab incision is made with a No.10 or 15 scalpel blade, tethered to sterile strand of suture (e.g. umbilical tape), at the dorsolateral aspect of the fornix of the vagina, at the 10.30 or 13.30 h position, about 2 cm dorsolateral to the base of the cervix. This incision is cranial and dorsal to the vaginal branch of the internal pudendal artery (i.e. the vaginal artery) (Embertson 2009), which can usually be easily palpated when the vagina is distended with air (**Figs 2** and **3**). A right-handed surgeon can perform bilateral ovariectomy more easily through a colpotomy created on the right aspect of the vaginal fornix (i.e. the 13.30 h position), whereas a left-handed surgeon can perform bilateral ovariectomy more easily through a colpotomy created on the left aspect of the vaginal fornix (i.e. the 10.30 h position).

The blade is inserted through vaginal mucosa and submucosa and the stab incision is spread, first with the jaws of a haemostat and then with fingers, until an opening in the mucosa and submucosa is created that can accommodate the entire hand into the retroperitoneal space. Fascia and peritoneum are torn with a finger to create a hole into the abdominal cavity large enough to accommodate the hand and forearm of the surgeon. Trying to thrust a finger through the peritoneum, rather than tearing the peritoneum with a finger, is ineffective because this manoeuvre pushes the peritoneum away from the abdominal wall.

Fig 1: A pack of sterile gauze, tethered to a sterile suture and saturated with local anaesthetic solution, is introduced into the vagina.

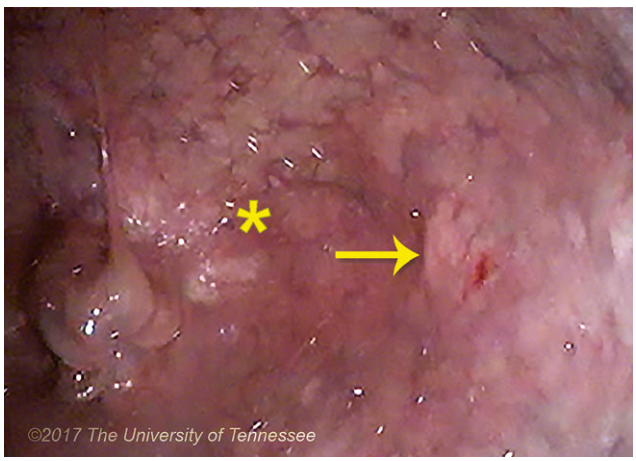

Fig 2: A stab incision is made with a No. 10 or 15 scalpel blade at the dorsolateral aspect of the fornix of the vagina, at the 10.30 or 13.30 h position, about 2 cm away from the base of the cervix and cranial and dorsal to the vaginal branch of the internal pudendal artery. *, site of incision; arrow, points to the vaginal branch of the internal pudendal artery.

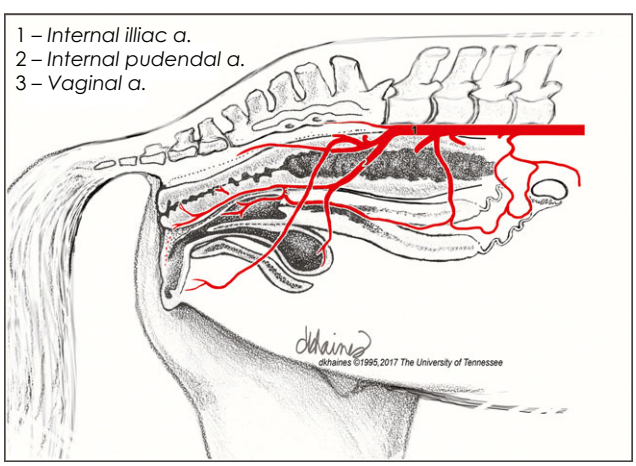

Fig 3: Schematic diagram showing the vaginal branch of the internal pudendal artery. 1, internal iliac artery; 2, internal pudendal artery; 3, vaginal artery.

The ovaries are identified and the pedicle of each ovary desensitised by pressing sterile gauze swabs, saturated with local anaesthetic solution, to each ovarian pedicle for several minutes (**Fig 4**). The gauze is tethered to a long, sterile suture (e.g. umbilical tape) to ensure that the gauze can be retrieved from the abdomen, if the gauze swabs are accidently dropped. The chain of the écraseur is secured over the dominant hand of the surgeon by placing four fingers through the loop of the chain of the écraseur and inserting the hand, the chain and the end of the écraseur through the colpotomy into the abdomen. The chain of the écraseur is positioned, with tension, against the surgeon's proximal row of phalanges as the end of the écraseur is introduced into the abdomen. The écraseur preferred by the authors is the Chassaignac écraseur[1] (**Fig 5**).

The left ovary should be removed first, if the colpotomy was created on the right side of the vagina, so that when

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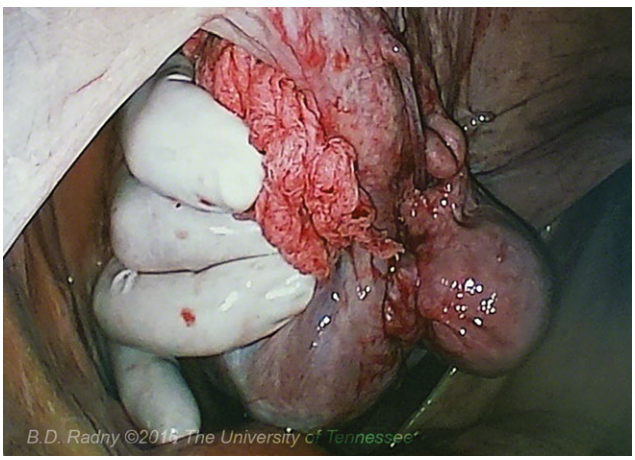

***Fig 4:** Ovaries are identified and the pedicle of each ovary is desensitised by pressing sterile gauze, saturated with local anaesthetic solution, to each ovarian pedicle.*

***Fig 5:** The écraseur preferred by the authors is the Chassaignac écraseur[1].*

the right ovary is removed, the pedicle of the left ovary is not disturbed by the arm of the surgeon. When removing the ovary on the side contralateral to the colpotomy, the surgeon should ensure that his, or her, hand and the écraseur have passed beneath the small colon to access the ovary, so that the ovary is not grasped through the mesocolon. Removing an ovary encased by mesocolon risks severing a colonic vein and artery and creates a hole in the mesocolon through which intestine can become entrapped.

With the chain of the écraseur secured against the proximal row of the surgeon's phalanges, the ovary is grasped and the chain is slipped over the hand to encircle the ovarian pedicle (**Fig 6**). The chain is tightened around the pedicle, being careful that the chain encircles no other structure, such as a loop of intestine. The surgeon, or preferably an assistant surgeon, slowly tightens the chain by using the ratchet on the end of the écraseur while the surgeon holds the ovary and ensures that the ovarian pedicle is not stretched during this part of the procedure. The chain is tightened, using the ratchet, until the pedicle is severed (**Fig 7**). Stretching the pedicle while the chain is tightened may cause the pedicle to recoil when the pedicle is severed, which, in turn, may result in excessive haemorrhage from the ovarian artery. The ovary is extracted through the colpotomy and the contralateral ovary is removed in a similar manner.

The palm of a hand is held beneath each pedicle at the end of the procedure to feel for bleeding from the pedicle (**Fig 8**). If, on rare occasion, the amount of blood emanating from a pedicle is alarming, a long forceps, such as a Knowles cervical forceps, can be inserted vaginally, through the

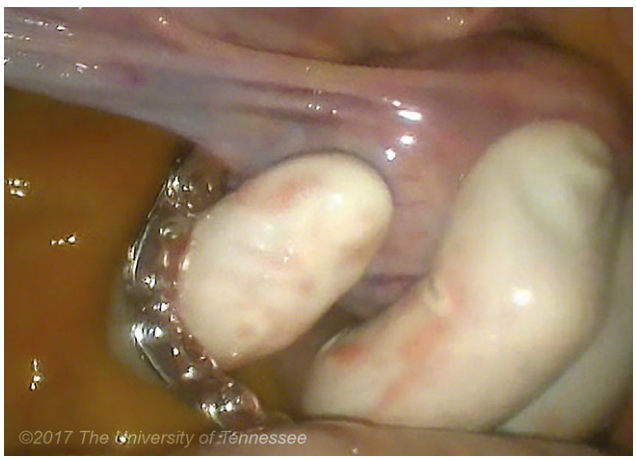

***Fig 6:** The chain of the écraseur is secured against the proximal row of the surgeon's phalanges, the ovary grasped, and the chain slipped over the hand to encircle the ovarian pedicle. This photograph was obtained through a laparoscope introduced into the abdominal cavity at the mare's flank, for the purpose of demonstrating ovariectomy through a colpotomy.*

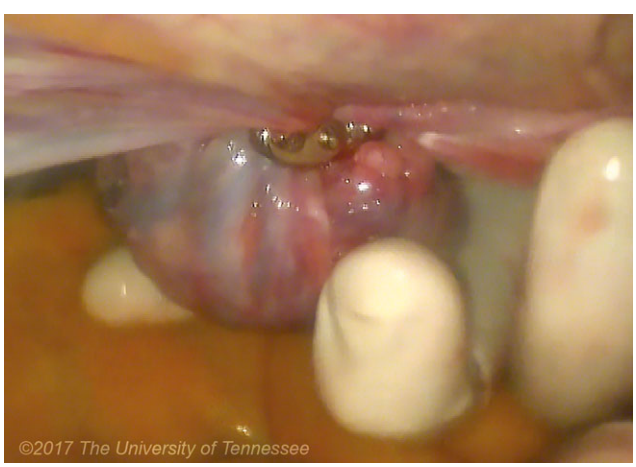

***Fig 7:** The chain is tightened, using the ratchet, until the pedicle is severed. This photograph was obtained through a laparoscope introduced into the abdominal cavity at the mare's flank, for the purpose of demonstrating ovariectomy through a colpotomy.*

colpotomy, applied to the pedicle and left in situ for 1 h or more to induce haemostasis. The colpotomy is usually left unsutured to heal by second intention because suturing the colpotomy is difficult and may induce vaginitis, causing the mare to strain.

The mare should receive a Caslick's vulvoplasty if its perineal conformation is poor, to prevent pneumovagina and subsequent contamination of the vestibule, vagina and abdomen. Antimicrobial and analgesic therapy is continued for 3–5 days after surgery. The mare should be cross-tied for 2–3 days to prevent it from becoming recumbent because rising from recumbency increases abdominal pressure which, in turn, increases the likelihood of evisceration (Embertson 2009). Within about 3 days, the colpotomy contracts to a diameter that accommodates only one finger (**Fig 9**). The hole is usually completely sealed from the abdomen within

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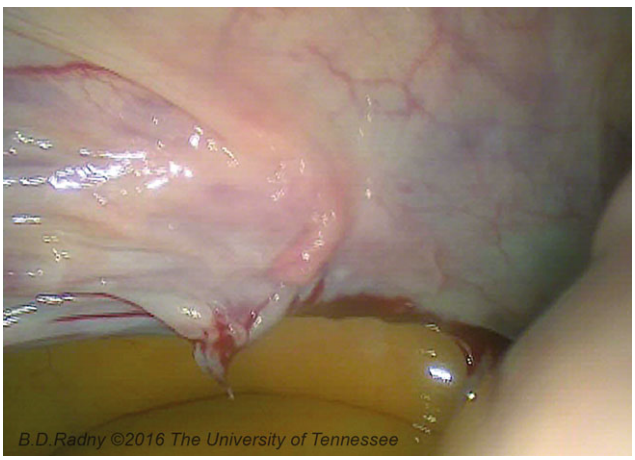

Fig 8: The palm of a hand is held beneath each pedicle at the end of the procedure to detect bleeding from the pedicle. This photograph was obtained through a laparoscope introduced into the abdominal cavity at the mare's flank, for the purpose of demonstrating ovariectomy through a colpotomy.

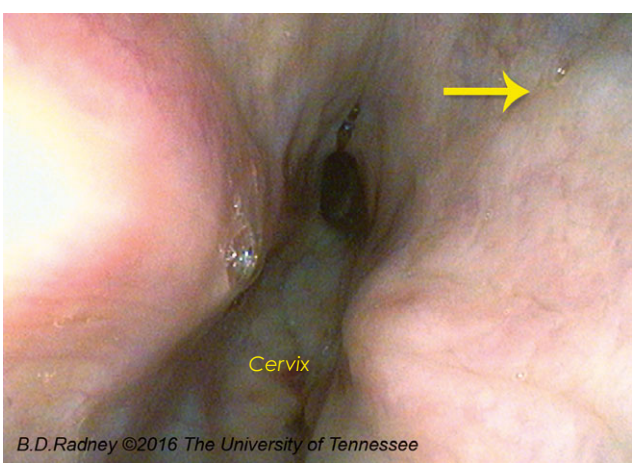

Fig 9: Endoscopic view of the fornix of the vagina 3 days after colpotomy. The colpotomy has contracted to a diameter smaller than that of one finger. The bulge in the vaginal wall (arrow) is the vaginal artery.

3 weeks (Moll and Slone 1998). The mare can be allowed unrestricted exercise after about 5 days (Nichols 1988; Colbern 1993; Moll and Slone 1998; Embertson 2009; Pader *et al.* 2011).

Discussion

The primary disadvantage of ovariectomy by colpotomy is that the ovarian pedicle is crushed and transected blindly, making detection of excessive intra-abdominal haemorrhage difficult. Because of this difficulty, the mare's haematocrit and serumal total protein should be determined before surgery and periodically after surgery to ensure that haemorrhage from the severed ovarian pedicles is not severe. Determining the magnitude of blood loss by monitoring the horse's haematocrit and total serumal solids during the first 6–24 h after ovariectomy, however, is difficult, because with severe blood loss, a decrease in total serumal protein is often not evident for 6 h and a decrease in haematocrit may not be evident for 12–24 h (Getman 2009).

Clinical signs associated with substantial blood loss include tachycardia, tachypnoea, a weak pulse, pale mucous membranes, prolonged capillary refill, cold extremities and weakness (Mudge 2014). If severe haemorrhage is suspected, the horse should receive fluid therapy and transfusion of blood from an acceptable donor should be considered. A complication of colpotomy itself is fatal haemorrhage caused by inadvertent perforation of the vaginal artery with a scalpel blade, but this artery is avoided if it is located by palpation before the fornix of the vagina is incised and if the incision is created at the proper location (Embertson 2009).

One of the authors (J.S.) has observed only two surgical complications after performing over 100 ovariectomies by colpotomy. One mare experienced severe haemorrhage, requiring multiple blood transfusions, but survived. The cause of severe haemorrhage was thought to result from transecting the ovarian pedicle while the pedicle was under tension. Another mare strained after surgery, presumably because of vaginitis induced by an unsuccessful attempt to suture the colpotomy. Straining gradually diminished over several days.

Persistence of unwanted behaviour is a complication of bilateral ovariectomy performed to eliminate or ameliorate that behaviour (Hooper *et al.* 1993; Kamm and Hendrickson 2007; Crabtree 2016). Success of ovariectomy in eliminating or ameliorating unwanted behaviour is likely if that behaviour occurs primarily during oestrus and if hormonal therapy has been shown to improve the mare's behaviour (Kamm and Hendrickson 2007). Ovariectomy is unlikely to resolve unwanted behaviour, if that behaviour is sexual behaviour that occurs during oestrus, because ovariectomy commonly results in continued display of sexual receptiveness with loss of normal cyclic activity (Hedberg *et al.* 2007).

Bilateral ovariectomy eliminates the production of oestrogen by eliminating the theca and granulosa cells of the ovarian follicles (Christensen 2011). Continued signs of oestrus displayed by ovariectomised mares is most likely due to absence of the corpora lutea, the primary source of progesterone, because progesterone is responsible for inhibiting the behavioural signs of oestrus (Watson and Hinrichs 1989).

Authors' declaration of interests

No conflicts of interest have been declared.

Ethical animal research

Not applicable.

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Authorship

The manuscript was written by both authors who also obtained the photographs.

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Manufacturer's address

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Thanks a lot!

Ovariectomy in the Mare: Presurgical, Surgical and Postsurgical Considerations

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Ovariectomy in the mare is frequently indicated for removal of a pathological ovary. Presurgical considerations are: (1) nature of ovarian abnormality, (2) size of ovary to be removed, (3) temperament and tractability, (4) economical considerations, and (5) physical condition of the mare. Surgical planning should include a consideration of: (1) experience of surgeon, (2) anesthesia, anesthesia equipment, and surgical facilities available, (3) availability of selected surgical instruments, (4) preparation of mare for surgery, (5) laparotomy approach, and (6) technique of ovariectomy. Postsurgical care may include by necessity the treatment of the following: (1) hemorrhage, (2) shock, (3) abdominal pain (colic), (4) hematoma, abscess, granuloma development with adhesions, (5) peritonitis, (6) dehiscence of laparotomy incision with occasional herniation or evisceration, and (7) behavioral change of operated mare.

Removal of 1 or both ovaries in the mare (to ovariectomize or spay) has been employed for surgical correction of various ovarian conditions. The most frequent indication for removal of a pathological ovary is granulosa cell tumor.[3,4,14,15] Additional ovarian tumors reported in the mare include melanoma, epithelioma, cystadenoma, adenocarcinoma, and teratoma.[15] Less common indications for ovariectomy are: (1) ovarian abscess and hematoma, (2) ovarian cysts, (3) nymphomania, and (4) prevention of estrus.[4,14,15,16,17]

In the majority of tumor cases, ovariectomy is performed unilaterally for removal of the neoplastic mass, and the tumor is usually granulosa cell type.[3,4,8,14,15,17,18,19,21,22] In this paper the discussion centers around the surgical correction of ovarian tumors, except where otherwise indicated.

Granulosa cell tumors are functional androgen producers, and clinical alterations seen are related to changes in estrus, colic, infertility, lameness, abnormal muscular development, changes in external genitalia, and personality.[3,4,8,9,17,18,19,23,24] This tumor predominantly affects 1 ovary, rarely if ever metastasizes in the mare, and occurs primarily in the young mare.[12,15,16,19] A consistent physical examination finding of granulosa cell tumors is a slow but progressive increase in size. Tumorous ovaries, exceeding 20 kg in weight, have been successfully removed in certain cases.[16] Once a presumptive diagnosis of ovarian tumor is made, ovariectomy is the preferred surgical approach.[21]

Ovarian abscesses and hematomas may accompany neoplastic involvement or occur as primary entities. Rough handling of ovaries by rectal palpation and drainage of ovarian cysts by percutaneous or vaginal centesis are probable causes.[15] Hematomas, abscesses, and cysts may fluctuate considerably in size due to seasonal variation and iatrogenic factors. Ovariectomy is an elective procedure for this group of abnormalities in virtually all instances.

Spaying a mare for correction of nymphomania has had variable and inconsistent results.[3,14,17] Based on clinical observations of nymphomaniac tendencies only during estrus and "normal" ovarian size, bilateral ovariectomy has been reported as a satisfactory means of surgical correction. Conversely, the nymphomaniac mare with marked abnormal behavior that is chronic and constant in nature has not generally been responsive to bilateral ovariectomy.[14,17] This type of mare should be considered extremely dangerous and hazardous to the surgeon, handlers, and animals that come in contact with her. Humane destruction is frequently the end result of this case and the advisability of surgical intervention (ovariectomy) should be questioned for economical as well as therapeutic reasons.[17]

Although the physical attitude, personality, and various other clinical manifestations of ovarian tumor may be altered by ovariectomy, sterility may persist for the life of the mare.[2,3]

Presurgical Considerations

Nature of Ovarian Abnormality — A history of infertility, abortion, alterations of estrus, nymphomania, "mounting" of other mares, personality changes, lameness, masculinity, overdevelopment of external genitalia, and ovarian enlargement contains clinical signs and physical findings consistent with ovarian tumors.

Rectal examination of such a mare may reveal an enlarged ovary, with the opposite ovary normal. Palpation of small, firm, and atrophied ovaries is a consistent finding in the classical form of nymphomania. If the history includes a previous attempt to "tap" an ovarian cyst, careful palpation per rectum may reveal adhesions, abscessation, or fluid-filled structures.

Radioimmunoassays can be performed on blood samples for analysis of hormone concentrations. Results of such analyses from mares with tumorous ovaries may correlate with clinical findings and responses to surgical removal. Function of a remaining ovary may be assessed by comparing hormone concentrations in blood samples collected pre- and postsurgical with those that are recognized to be normal. This type of test may aid the clinician in formulating hormonal treatment and predicting the prognosis of fertility for unilateral ovariectomize mares.[13,19,20,21]

Size of Ovary to be Removed — Accurate assess ment of ovarian dimensions by rectal palpation is no always possible. If the ovary is very large or the mar difficult to palpate, an estimation may be necessary Since this parameter is important in selecting the surgica approach, sedative agents or epidural anesthesia shoul be employed in the intractable mare. Inaccurate assess ment of ovarian size contributes to the following surgica errors: (1) inadequate surgical exposure (wron laparotomy approach), (2) unnecessary tissue traum promoting abscesses, hematomas, and seromas, (3) mis diagnosis of problem, and (4) inability to correct prob lem(s).

Temperament and Tractability of Mare — Thi parameter influences not only the method of anesthesi and surgical approach used, but is a trait that hopefull will be altered by surgery in certain cases.

With ovariectomy performed in the standing mar (flank approach or via colpotomy) under appropriat anesthesia, it is imperative that the mare's disposition b conducive to surgical incision and manipulation. Such a operation performed on a vicious or intractable mare wil consistently lead to disastrous results. Therefore, stand ing ovariectomies should be reserved for surgical case that are more than adequately manageable under thes circumstances.

Economical Considerations — Cost of surgery an anesthesia will not be a deciding factor in all cases When economic circumstances influence and com promise the surgical, anesthetic, and postsurgical phase of ovariectomy, the anticipated standard results will nc be achieved. The most inexpensive way to spay a mare i via colpotomy. Special instrumentation and a coopera tive mare are prerequisites for this procedure to be suc cessful. Conversely, the greatest cost of a similar opera tion would be ovariectomy through a midline laparotom under general anesthesia of an inhalation type. Cos should be a factor that is always considered but shoul never assume priority over the appropriate anestheti agent or surgical approach for a given case.

Physical Condition of the Mare — In a few in stances, physical condition of a mare may influence th surgeon's choice of anesthesia or laparotomy approach t be used. Generally, intravenous anesthesia will be dis carded in favor of a standing approach for the debilitate or crippled case. The presence of uterine, cervical, o vaginal infection eliminates the vaginal approach fror available laparotomy choices. Excessively fat an short-coupled mares may have inadequate room for sur gical exposure through a paralumbar incision. Chroni

TABLE 1

Anesthesia Chart for Selecting Type Compatible with Laparotomy Approach Chosen

Laparotomy Approach	Primary Anesthetic	Complementary Anesthetic
Vaginal	Caudal epidural 1-1.5 ml 2% lidocaine [a] per 100 # (45.6 kg) body weight	Topical application of gauze soaked in lidocaine applied to ovarian pedicle
Flank (local anesthesia)	Line infiltration Inverted L block (Local infiltration of lidocaine with syringe and needle)	Topical application as with vaginal approach
Flank (general anesthesia)	1. Glyceryl guaiacolate (GG) [b] with 5% dextrose and barbiturate [c] added. Used both as inducing agent and maintenance solution. 2. Short acting barbiturate (thiamylal sodium) [c] as inducing agent and 1% solution as a slow intravenous drip for maintenance. 3. Combinations of chloral hydrate-magnesium sulfate [d] with or without pentobarbital [e] for induction and maintenance. 4. Inhalation anesthesia (halothane [f] or methoxyflurane [g]) induction and intubation.	
Midline or paramedian	[1 through 4 under general anesthesia]	

Brand Name	Generic Name	Company
[a] Xylocaine	Lidocaine U.S.P.	Astra Pharmaceutical Products, Inc. Worcester, MA 01606 USA
[b] Gecolate Sterile Pwd.	Glyceryl guaiacolate	Summit Hill Laboratories Avalon, NJ 08202 USA
Guaifenesin, N.F. XIV	Glyceryl guaiacolate	Gane's Chemical Works, Inc. Industrial Park Road Pennsville, NJ 08070 USA
[c] Surital	Thiamylal sodium	Parke, Davis & Company Detroit, MI 48232 USA
[d] Mag-Chloral	Chloral hydrate Magnesium sulfate Chlorobutanol	Haver-Lockhart Laboratories Division of Bayvet Corporation Shawnee, KS 66201 USA
[e] Equi-Thesin	Chloral hydrate Pentobarbital Magnesium sulfate	Jensen-Salsbery Laboratories Division of Richardson-Merrell, Inc. Kansas City, MO 64141 USA
[f] Fluothane	Halothane	Ayerst Laboratories, Inc. Veterinary Med. Division New York, NY 10017 USA
[g] Metofane	Methoxyflurane	Pitman-Moore, Inc. Washington Crossing, NJ 08560 USA
[h] Betadine Surgical Scrub	Povidone-iodine	The Purdue Frederick Company Norwalk, CT 06856 USA
[i] Nolvasan Solution	Chlorhexidine	Fort Dodge Laboratories, Inc. Fort Dodge, IA 50501 USA

alveolar emphysema, if present, is a deterrent to general anesthesia if an alternate method will suffice.

If any doubt exists in the mind of the surgeon as to the status of organ function (liver, pancreas, lungs, heart, kidney, etc.), then appropriate laboratory tests should be performed. In all cases scheduled for surgery, a complete physical examination may provide the most rewarding and fruitful information obtainable.

Surgical Considerations

Experience of Surgeon — Previous experience tends to be a major factor in planning an operative procedure. However, a lack of experience or experience in abundance should not prevent one from integrating personal knowledge, knowledge of literature written on the subject, and the expertise of colleagues in formulating a surgical plan. This plan by necessity must vary with individual cases. No single approach will suffice for all ovariectomy procedures.

Anesthetic, Anesthetic Equipment, and Surgical Facilities — Surgical facilities and a recovery area with inhalation anesthesia are optimal. A standing flank or vaginal approach is facilitated by a stock or chute to confine the operative case. This affords some safety to the operator with mares that become unruly for a period of time. Various acceptable methods of anesthesia for selected laparotomy approaches are listed in Table 1. For a better understanding of specific anesthetic agents and anesthesia procedures, the reader is referred to selected writings.[6,7]

Special Instruments — A chain ecraseur (Fig 1) is a valuable surgical instrument in selected approaches to ovariectomy. It is essential for ovariectomy through the vagina and can also be used with other laparotomy approaches. This instrument is not available commercially, and, unless one is presently owned, the instrument can not be procured.

Preparation of Mare for Surgery — In all operative cases, starving the animal 24 hours prior to surgery is recommended. In vaginal ovariectomies this is absolutely essential to avoid penetration of viscera during colpotomy incisions. Fasting will also increase exposure in the ovarian area and enhance manipulative procedures.

Surgical areas of the external abdominal wall are clipped and scrubbed with appropriate antiseptic preparations.[a] Preparation of the mare for vaginal ovariectomy involves removal of feces manually from the rectum, wrapping of tail, and surgical scrub of perineal area. The vagina is douched with an antiseptic solution[b] and the mare's bladder emptied by catheterization. A small area

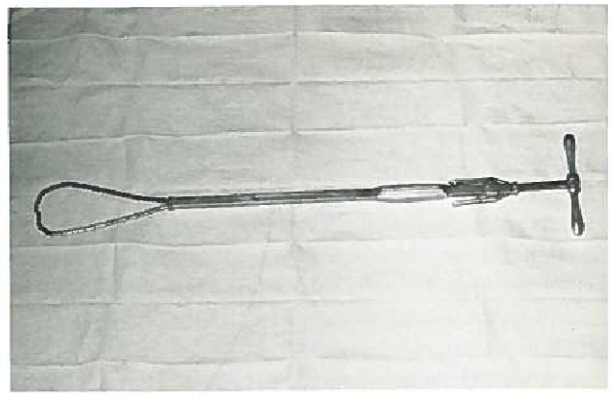

Fig 1— Example of a chain ecraseur that is commonly used fc ovariectomy via colpotomy.

over the tailhead is clipped and scrubbed in preparatio for anesthesia.

Laparotomy Approaches — For concise descriptio of various surgical approaches to the abdominal wal readers are referred to the following writings.[10,22,23] I this discussion, 3 procedures will be discussed: (1) flan approach (paralumbar fossa), (2) midline or paramediar and (3) vaginal (via colpotomy).

Flank (paralumbar fossa) approach — This is a ve satile approach that can be performed standing (loc anesthesia) or in lateral recumbency (general anesthesia) For ovaries that are small (less than 8–10 cm) a gri approach (muscles separated in direction of fiber rathe than incised) may suffice. For greater exposure and re moval of larger ovaries (up to 15–16 cm in diameter) th muscle layers can be transected in a parallel manner t the skin incision. Use of a chain ecraseur is applicable i this procedure, particularly when a bilateral ovariectom is performed. In this case the preferred method would b transfixation ligation of the pathological ovary through laparotomy performed on the same side and chain ec raseur removal of the opposite through the same incisior Removal of both ovaries utilizing the chain ecraseur ca also be performed through a grid incision, if the ovarie are small.

An example of a through and through flank incisio is shown in Fig 2, and the left ovary is indicated by th arrow. Shown in Fig 3 is the correct placement of a chai ecraseur over the hand of the operator. The correc placement of chain loop over the ovary, is shown in Fi 4, and the size of left ovary after removal is illustrated i Fig 5. This ovary could have safely been remove through a grid or vaginal approach also.

Primary advantages of this method are: (1) it can b

a,b See footnotes h and i, Table 1.

Fig 2— Paralumbar fossa laparotomy, left flank approach, with left ovary visualized at the end of the arrow.

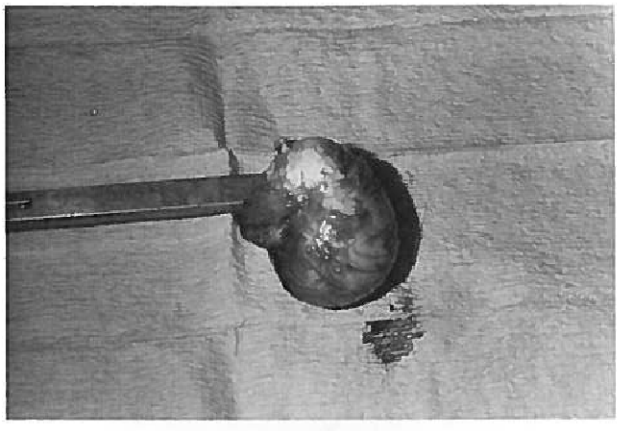

Fig 5— Left ovary after removal, with chain ecraseur also shown.

Fig 3— Hand of operator placed through chain loop of ecraseur.

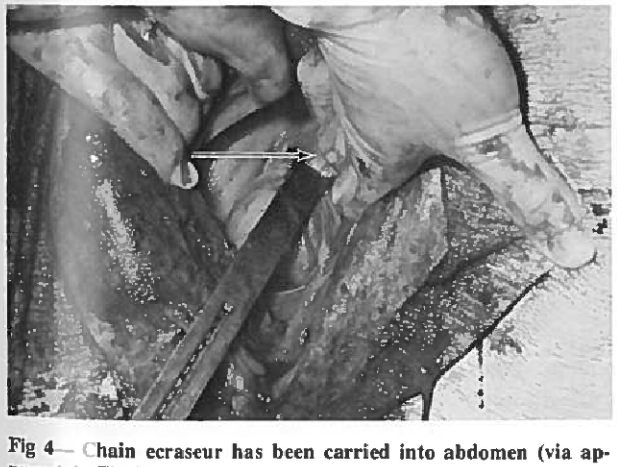

Fig 4— Chain ecraseur has been carried into abdomen (via approach in Fig 2) and properly placed for removal of the left ovary. Mesovarium is at end of pointer.

performed in the standing mare under local infiltration of anesthesia, and (2) it minimizes the problem of postsurgical dehiscence, herniation, and evisceration that are more commonly seen with ventral approaches.

Midline or paramedian — The most versatile approach is one that has inherent allowances for errors committed by the surgeon. This approach is the preferred method of exposure for: (1) large tumorous ovaries, (2) bilateral ovariectomies in vicious mares where an ecraseur is not available, and (3) ovaries for which an accurate assessment of size was not obtained. This laparotomy gives adequate exposure for even unusually large ovaries (Fig 6), and transfixation ligation of the ovarian pedicle with #1-2 medium chromic gut (Fig 7).

Its major disadvantages are: (1) requirement for general anesthesia, (2) surgical time necessary for approach, ovariectomy, and closure, and (3) tendency toward incision problems (dehiscence, etc.). The incision should be located just anterior to the mammary glands and extended forward as necessary.

Vaginal approach via colpotomy[1,23] — A contraindication to this procedure is the presence of vaginal, cervical, or uterine infection. As previously mentioned, the maximal size of ovary (diameter) that can safely be removed via colpotomy is smaller than the other laparotomies discussed and should not exceed 8–9 cm (baseball size). After careful surgical preparation of the perineal and vaginal area, the mare is placed in stocks with her tail wrapped. Epidural anesthesia is used if deemed necessary. A fully gloved hand and arm (obstetric length) is wetted and inserted into the vagina, carrying along a solid scalpel or scissors. Moving the arm back and forth will allow air to enter and distend the vaginal wall. An incision is made in the anterior fornix of the vagina, off the midline and dorsolateral to the exter-

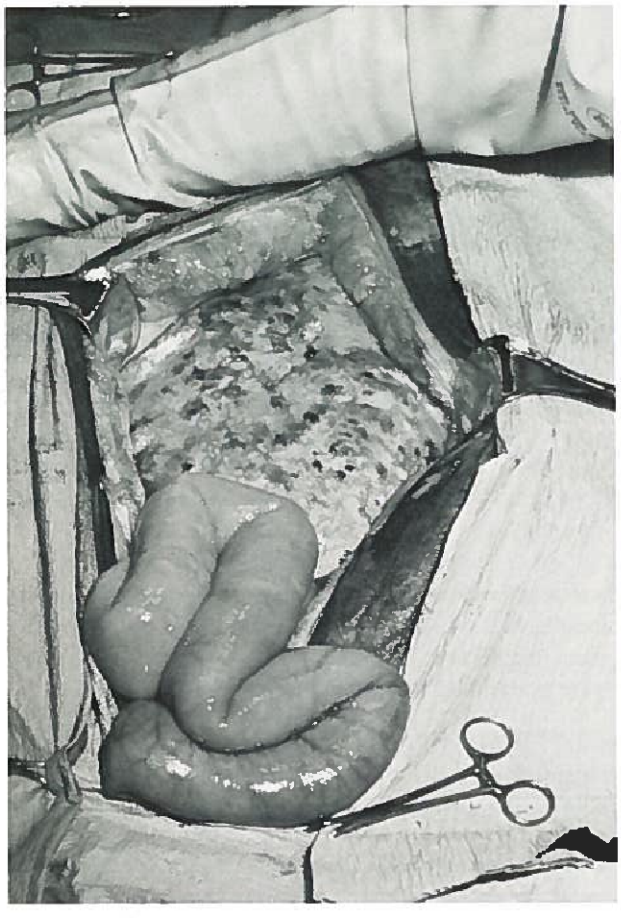

Fig 6— Midline laparotomy with large neoplastic ovary visualized through the incision.

Fig 7— Ovarian pedicle is ligated with transfixation ligature of #1-2 medium chromic gut (arrow). Ovary seen in this figure weighed over 45 pounds (20 kg).

nal os of the cervix. If the right ovary is to be removed, the left hand is gloved and incision of the vaginal wall located at about a 2 o'clock position. Both ovaries can be removed through 1 incision, and the location of the incision in this case is not important. Incising the vaginal wall with a scalpel is effected with a controlled depth incision. The solid scalpel is guarded with the blade properly positioned between the thumb and forefinger with the blade projecting approximately 3 cm. A thrust is made with scalpel in the proper area of vaginal fornix. Directing the knife forward and slightly ventral will prevent accidental laceration of the rectum, bladder, and major vessels in the area. An alternative to sharp incision with a scalpel is perforation of the same area with a pair of scissors. Entry into the peritoneal cavity is through a reflection of pelvic peritoneum, the rectogenital pouch (Fig 8, arrow). If the complete thickness of vaginal wall (mucosa-muscularis-peritoneum) is not incised, the scal-

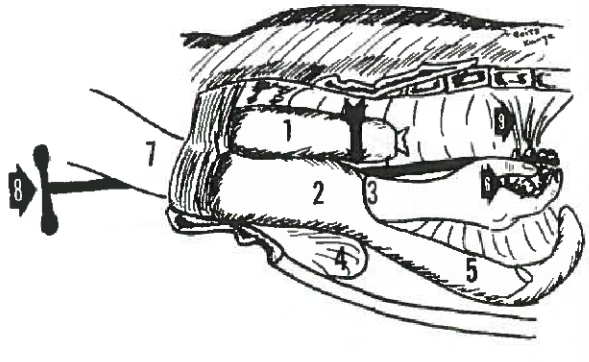

Fig 8— Vaginal approach to ovariectomy via colpotomy—lateral view and important anatomical areas are identified. Rectum (1); vagina (2); colpotomy incision (3); bladder (4); uterine horn (5); ovary (6); operator's arm (7); ecraseur (8); mesovarium (9); rectogenital pouch (arrow).

pel or scissors are withdrawn and the remaining layers perforated with a sharp thrust of a pointed finger. Once the abdomen is entered, enlargement of the incision is accomplished with 2 fingers followed by 3 and then a coned hand. Tracing a uterine horn will aid in locating the proper ovary. If mesovarian anesthesia is desired, a gauze sponge soaked in a local anesthetic preparation is secured to a long piece of suture (umbilical tape) and placed around the ovarian pedicle. This should be held in place for 2–3 minutes and can be retrieved safely if inadvertently dropped.

Passing an ecraseur along the area, the chain is looped over the hand within the abdomen, in a manner similar to that demonstrated in Fig 3. Alternatively, the hand may be withdrawn and reentry made with the ecraseur. The ovary is grasped and the chain loop passed over the ovary which is elevated upward, away from the viscera. The chain loop is closed slowly by an assistant with the surgeon checking the loop repeatedly to insure that no loops of intestine or the tip of a uterine horn have been included (Fig 8). Additional tension is placed on the chain loop until considerable resistance or crushing of mesovarium is palpable. This action should be slowly advanced over a period of 5–8 minutes. A separated ovary may be dropped into the vagina or held until completion of the operation, at which time both the ovary and ecraseur are removed. Once the chain loop has been closed to the point of lying withing the ecraseur handle, the ovarian pedicle is crushed and divided, and the operation virtually completed. Hemorrhage, if it occurs, is palpable by the surgeon. Removal of a secondary ovary may be similarly accomplished if desired.

A Caslick operation completes the surgical procedure and is performed with local or existing epidural anesthesia. This prevents vaginal aerophagia if straining should occur, thus enhancing healing and minimizing herniation or evisceration.

Postsurgical Care

In general, antimicrobial therapy is systemically administered for 3–7 days in ovariectomy cases and longer in selected cases. In uncomplicated cases, a broad spectrum antibiotic should suffice. In cases complicated by sepsis or infection, antimicrobial agents should be chosen on the basis of culture and susceptibility testing results. Tetanus toxoid or antitoxin is administered according to the vaccination status.

Feeding is restored slowly to the ovariectomy case since bowel distention and excessive peristalsis may produce pain. Bulk is slowly added to the diet using bran or pelleted feed. Grain is given in handsful initially and progressively increased over 7–10 days.

Controlled exercise is encouraged to alleviate edema of limbs and surgical site and stimulate bowel movements. This should be controlled as excessive exercise may disrupt incisions and ligatures and produce episodes of severe abdominal pain.

A mare operated through the vagina (unilateral or bilateral ovariectomy) is placed in a stall and cross-tied after surgery. This cross-tied and standing position is continued for 36–48 hours to reduce the possibility of herniation or evisceration.

Hemorrhage — Hemorrhage usually occurs at the time of ovariectomy and should be managed at this point. The mare spayed through the vagina that hemorrhages after ovariectomy with an ecraseur can be ecraseured a second time. A long suture of #2-3 medium chromic gut may be carried into the abdomen through the vaginal incision, passed around the ecraseur positioned snugly on the bleeding pedicle, exteriorized, and knots placed on the outside. This knot is carried in and repeatedly tied until secure. Long ends are cut off with scissors carried into the abdomen while some slight tension is maintained on the suture. Hemorrhage postsurgically occurs when a ligated pedicle is disturbed by movement of ligatures or when an unligated pedicle is disturbed by massage of adhesions. Thrashing during recovery and blood disorders may be contributing causes. Transfixation of ligatures placed in the ovarian stump (Fig 7) and individual ligation of large vessels is the most effective way to control hemorrhage.

Shock — Acute blood loss, hypovolemia, severe abdominal pain, and adverse responses to use of the ecraseur in the standing unanesthetized mare are probable causes of shock. Blood or fluid volume replacement, effective anesthesia (particularly of ovarian pedicle in vaginal approach), and control of postsurgical pain may circumvent this problem. The first few hours after surgery are critical and a surgical case should be carefully watched during this period.

Abdominal Pain — Ovariectomy is attended by various degrees of pain in all cases. Judicious use of analgesics during the first 24–48 hours after surgery will enhance postsurgical recovery. It should be noted that sedatives or tranquilizers are potentially hypotensive and should be used with caution. Severe intractable abdominal pain is suggestive of a more severe state. Rectal palpation, physical examination, and laparotomy results may reveal the cause.

Hematoma, Abscess, Granuloma, and Adhesions – Rectal palpation should be routinely performed 2-3 days after surgery, or immediately in the case that differs from the usual and expected response. Formation of adhesions occurs early in most cases and can be gently broken down by manual massage. Any enlargement of the ovarian pedicle or unmanageable adhesions should be noted. Very large hematomas of the right ovary or ova-

rian pedicle may place extramural pressure on the terminal ileum or proximal jejunum. This interrupts the flow of ingesta and may produce signs of colic. Subsequent rectal examinations will reveal the progress of these conditions.

Unless the hematoma, abscess, or granuloma becomes excessively large or painful, interrupts digestive function, or is complicated by unmanageable adhesions, surgical intervention is elective.

Peritonitis — A degree of localized peritonitis with adhesions is not uncommon as sequelae to ovariectomy. If they are confined to the ovarian pedicle and abdominal wall, minimal problems will be seen. Severe peritonitis is accompanied by more extensive adhesions and, if the animal recovers, will manifest variable degrees of recurrent abdominal pain (colic). Peritonitis in the acute phase is a medicinal problem. Abdominal paracentesis and culture and susceptibility testing are guides to appropriate antimicrobial therapy. A broad spectrum antibiotic should be administered while culture and susceptibility results are forthcoming. If peritonitis is responsive to antimicrobial therapy, surgical intervention for the correction of adhesions is elective.

Dehiscence, Herniation, and Evisceration — Sepsis at the surgical site, unnecessary trauma, hematomas, seromas, and improper laparotomy closure are factors that promote this category of problems. Herniation occurs when the primary confining layers of the abdominal wall are disrupted. If the intact skin and subcutaneous layers prevent evisceration, adhesions may form between a herniated organ and the abdominal wall. Clincial signs of colic, sepsis of incision area, enlargement of incision site, anorexia, depression, and fever are common. Evisceration may occur through any abdominal approach but is more likely to occur with a vaginal approach since the incision is not sutured. If herniated and eviscerated organs are identified before gross injury or contamination has occurred, the organs may be replaced and appropriate reconstruction performed on the laparotomy incision. Herniation may be acceptable, depending on the organ herniated and site of hernia. Herniation following a vaginal approach may be managed by manual reduction per rectum.

Behavioral Changes and Fertility — As mentioned previously, the vicious chronic nymphomaniac mare will probably not be altered by surgical removal of ovaries. An unfavorable prognosis for behavioral changes following surgery is therefore justified. Other mares less severely influenced show varying degrees of response, and some improvement is usually seen. Prognosis for fertility is guarded for the mare that has 1 ovary removed. Radioimmunoassays of blood withdrawn from operated cases before and after surgery may be helpful in suggesting medicinal (hormone) treatment and evaluating progress of mares that continue to be infertile.

Conclusions

This paper is an attempt to relate the various factor involved in the successful approach to ovariectomy in th mare. Of prime importance is the choice of anesthesi used and laparotomy approach employed. Failure t select a combination that is complementary for each cas will complicate all aspects of the procedure and promot unfavorable results.

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Appendix G

Fertility Control Review

Porcine Zona Pellucida (PZP) Vaccine

Immune-contraceptive PZP vaccines have been used on dozens of horse herds by the National Park Service, US Forest Service, BLM, and Native American tribes and its use is approved for free-ranging wild horse herds. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that PZP was one of the preferable available methods for contraception in wild horses and burros (NRC 2013). PZP use can reduce or eliminate the need for gathers and removals (Turner et al. 1997). PZP vaccines meet most of the criteria that the National Research Council (2013) used to identify promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. It has been used extensively in wild horses (NRC 2013), and in feral burros on Caribbean islands (Turner et al. 1996, French et al. 2017). PZP is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is commercially produced as ZonaStat-H, an EPA-registered product (EPA 2012, SCC 2015), or as PZP-22, which is a formulation of PZP in polymer pellets that can lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017). 'Native' PZP proteins can be purified from pig ovaries (Liu et al. 1989). Recombinant ZP proteins may be produced with molecular techniques (Gupta and Minhas 2017, Joonè et al. 2017a). It can easily be remotely administered in the field in cases where mares are relatively approachable. Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 m (BLM 2010).

PZP Direct Effects

The historically accepted hypothesis explaining PZP vaccine effectiveness posits that when injected as an antigen in vaccines, PZP causes the mare's immune system to produce antibodies that are specific to zona pellucida proteins on the surface of that mare's eggs. The antibodies bind to the mare's eggs surface proteins (Liu et al. 1989), and effectively block sperm binding and fertilization (Zoo Montana, 2000). Because treated mares do not become pregnant but other ovarian functions remain generally unchanged, PZP can cause a mare to continue having regular estrus cycles throughout the breeding season. More recent observations support a complementary hypothesis, which posits that PZP vaccination causes reductions in ovary size and function (Mask et al. 2015, Joonè et al. 2017b).

Research has demonstrated that contraceptive efficacy of an injected PZP vaccine is approximately 90% for mares treated twice in the first year and boostered annually (Turner and Kirkpatrick 2002, Turner et al. 2008). High contraceptive rates of 90% or more can be maintained in horses that are boostered annually (Kirkpatrick et al. 1992). Approximately 60% to 85% of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg et al. 2017). Application of PZP for fertility control would reduce fertility in a large percentage of mares for at least one year (Ransom et al. 2011). Horses treated with PZP-22 vaccine pellets at the same time as a primer dose may experience

two years of ~40% - 50% reduced foaling rates, compared to untreated animals (Rutberg et al. 2017). Other trial data, though, indicate that the pelleted vaccine may only be effective for one year (J. Turner, University of Toledo, Personal Communication).

The fraction of mares treated in a herd can have a large effect on the realized change in growth rate due to PZP contraception, with an extremely high portion of mares required to be treated to lead prevent population-level growth (e.g., Turner and Kirkpatrick 2002). Gather efficiency would likely not exceed 85% via helicopter, and may be less with bait and water trapping, so there would be a portion of the female population uncaptured that is not treated in any given year. Additionally, some mares may not respond to the fertility control vaccine, but instead would continue to foal normally.

Reversibility and Effects on Ovaries

In most cases, PZP contraception appears to be temporary and reversible (Kirkpatrick and Turner 2002, Joonè et al. 2017a). Although the rate of long-term or permanent sterility following repeated vaccinations with PZP has not been quantified, it must be acknowledged that this could be a result for some number of wild horses receiving multiple repeat PZP vaccinations.

The purposes of applying PZP treatment is to prevent mares from conceiving foals, but BLM acknowledges that long-term infertility, or permanent sterility, could be a result for some number of wild horses receiving PZP vaccinations. The rate of long-term or permanent sterility following vaccinations with PZP is hard to predict for individual horses, but that outcome appears to increase in likelihood as the number of doses increases (Kirkpatrick and Turner 2002). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez et al. (2010, 2017). In a graduate thesis, Knight (2014) suggested that repeated treatment with as few as three to four years of PZP treatment may lead to longer-term sterility. Repeated treatment with PZP led long-term infertility in Przewalski's horses receiving as few as one PZP booster dose (Feh 2012). If some number of mares become sterile as a result of PZP treatment, that potential result would be consistent with the contraceptive purpose of applying the vaccine.

In some mares, PZP vaccination may cause direct effects on ovaries (Gray and Cameron 2010, Joonè et al. 2017b). Joonè et al. (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. Bechert et al. (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask et al. (2015) demonstrated that equine antibodies that resulted from SpayVac immunization could bind to oocytes, ZP proteins, follicular tissues, and ovarian tissues. It is possible that result is specific to the immune response to SpayVac, which may have lower PZP purity than ZonaStat or PZP-22 (Hall et al. 2016). However, in studies with native ZP proteins and recombinant ZP proteins, Joonè et al. (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. SpayVac is a patented formulation of PZP in liposomes that can lead to multiple years of infertility (Roelle et al. 2017) but which is not reliably available for BLM to use at this time. Kirkpatrick et al. (1992) noted effects on ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicate that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that

continued applications of PZP may result in decreased estrogen levels (Kirkpatrick et al. 1992) but that decrease was not biologically significant, as ovulation remained similar between treated and untreated mares (Powell and Monfort 2001). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez et al. (2010, 2017). In a graduate thesis, Knight (2014) suggested that repeated treatment with as few as three to four years of PZP treatment may lead to longer-term sterility, and that sterility may result from PZP treatment before puberty. Skinner et al. (1984) speculated about PZP effects on ovaries, based on their study in laboratory rabbits, as did Kaur and Prabha (2014), though neither paper was a study of PZP effects in equids.

Effects on Existing Pregnancies, Foals, and Birth Phenology

PZP vaccine application at the capture site does not appear to affect normal development of the fetus or foal, hormone health of the mare or behavioral responses to stallions, should the mare already be pregnant when vaccinated (Kirkpatrick et al. 2002).

If a mare is already pregnant, the PZP vaccine has not been shown to affect normal development of the fetus or foal, or the hormonal health of the mare with relation to pregnancy (Kirkpatrick and Turner 2003). It is possible that there may be transitory effects on foals born to mares or jennies treated with PZP. In mice, Sacco et al. (1981) found that antibodies specific to PZP can pass from mother mouse to pup via the placenta or colostrum, but that did not apparently cause any innate immune response in the offspring: the level of those antibodies were undetectable by 116 days after birth. There was no indication in that study that the fertility or ovarian function of those pups was compromised, nor is BLM aware of any such results in horses or burros. Unsubstantiated speculative connections between PZP treatment and foal stealing has not been published in a peer-reviewed study and thus cannot be verified. Similarly, although Nettles (1997) noted reported stillbirths after PZP treatments in cynomolgus monkeys, those results have not been observed in equids despite extensive use.

On-range observations from 20 years of application to wild horses indicate that PZP application in wild mares does not generally cause mares to foal out of season or late in the year (Kirkpatrick and Turner 2003). Nuñez's (2010) research showed that a small number of mares that had previously been treated with PZP foaled later than untreated mares and expressed the concern that this late foaling "may" impact foal survivorship and decrease band stability, or that higher levels of attention from stallions on PZP-treated mares might harm those mares. However, that paper provided no evidence that such impacts on foal survival or mare well-being actually occurred. Rubenstein (1981) called attention to a number of unique ecological features of horse herds on Atlantic barrier islands, which calls into question whether inferences drawn from island herds can be applied to western wild horse herds. Ransom et al. (2013), though, identified a potential shift in reproductive timing as a possible drawback to prolonged treatment with PZP, stating that treated mares foaled on average 31 days later than non-treated mares. Those results, however, showed that over 81% of the documented births in this study were between March 1 and June 21, i.e., within the normal spring season. Ransom et al. (2013) advised that managers should consider carefully before using PZP in small refugia or rare species. Wild horses and burros in Nevada do not generally occur in isolated refugia, and they are not a rare species. Moreover, an effect of shifting birth phenology was not observed uniformly: in two of three

PZP-treated wild horse populations studied by Ransom et al. (2013), foaling season of treated mares extended three weeks and 3.5 months, respectively, beyond that of untreated mares. In the other population, the treated mares foaled within the same time period as the untreated mares. Furthermore, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season. If there are shifts in birth phenology, though, it is reasonable to assume that some negative effects on foal survival might result from particularly severe weather events.

Effects of Marking and Injection

Standard practices for PZP treatment require that treated animals be readily identifiable, either via brand marks or unique coloration (BLM 2010). BLM has instituted guidelines to reduce the sources of handling stress in captured animals (BLM 2015). Some level of transient stress is likely to result in newly captured mares that do not have markings associated with previous fertility control treatments. It is difficult to compare that level of temporary stress with long-term stress that can result from food and water limitation on the range (e.g., Creel et al. 2013). Handling may include freeze-marking, for the purpose of identifying that mare and identifying her PZP vaccine treatment history. Under past management practices, captured mares experienced increased stress levels from handling (Ashley and Holcombe 2001). Markings may also be used into the future to determine the approximate fraction of mares in a herd that have been previously treated, and could provide additional insight regarding gather efficiency.

Most mares recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile. Injection site reactions associated with fertility control treatments are possible in treated mares (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017), but swelling or local reactions at the injection site are expected to be minor in nature. Roelle and Ransom (2009) found that the most time-efficient method for applying PZP is by hand-delivered injection of 2-year pellets when horses are gathered. They observed only two instances of swelling from that technique. Use of remotely delivered, 1-year PZP is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever. The longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns and in most cases did not appear to differ in magnitude from naturally occurring injuries or scars.

Indirect Effects

One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health (Turner and Kirkpatrick 2002). Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares, and their better health is expected to be reflected in higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the

mares' milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition remains improved even after fertility resumes. PZP treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a). To the extent that this happens, changes in lifespan and decreased foaling rates could combine to cause changes in overall age structure in a treated herd (i.e., Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares.

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects; however, it is believed that repeated contraceptive treatment may minimize the hypothesized rebound effect.

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect would be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. So long as the level of contraceptive treatment is adequate, the lower expected birth rates can compensate for any expected increase in the survival rate of treated mares. Also, reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to long term pastures (ORPs) or for other statutorily mandated disposition. A high level of physical health and future reproductive success of fertile mares within the herd would be sustained, as reduced population sizes would be expected to lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the population nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources, which would have many benefits to the wild horses still on the range. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should PZP booster treatment and repeated fertility control treatment continue into the future, the chronic cycle of overpopulation and large gathers and removals would no longer occur, but instead a consistent cycle of balance and stability would ensue, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with PZP could

reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated in almost every year.

Behavioral Effects

The NRC report (2013) noted that all fertility suppression has effects on mare behavior, mostly as a result of the lack of pregnancy and foaling, and concluded that PZP was a good choice for use in the program. The result that PZP-treated mares may continue estrus cycles throughout the breeding season can lead to behavioral differences, when compared to mares that are fertile. Such behavioral differences should be considered as potential consequences of successful contraception.

Ransom and Cade (2009) delineate behaviors that can be used to test for quantitative differences due to treatments. Ransom et al. (2010) found no differences in how PZP-treated and untreated mares allocated their time between feeding, resting, travel, maintenance, and most social behaviors in three populations of wild horses, which is consistent with Powell's (1999) findings in another population. Likewise, body condition of PZP-treated and control mares did not differ between treatment groups in Ransom et al.'s (2010) study. Nuñez (2010) found that PZP-treated mares had higher body condition than control mares in another population, presumably because energy expenditure was reduced by the absence of pregnancy and lactation. Knight (2014) found that PZP-treated mares had better body condition, lived longer and switched harems more frequently, while mares that foaled spent more time concentrating on grazing and lactation and had lower overall body condition. Studies on Assateague Island (Kirkpatrick and Turner 2002) showed that once fillies (female foals) that were born to mares treated with PZP during pregnancy eventually breed, they produce healthy, viable foals.

In two studies involving a total of four wild horse populations, both Nuñez et al. (2009) and Ransom et al. (2010) found that PZP-treated mares were involved in reproductive interactions with stallions more often than control mares, which is not surprising given the evidence that PZP-treated females of other mammal species can regularly demonstrate estrus behavior while contracepted (Shumake and Wilhelm 1995, Heilmann et al. 1998, Curtis et al. 2001). There was no evidence, though, that mare welfare was affected by the increased level of herding by stallions noted in Ransom et al. (2010). Nuñez's later analysis (2017) noted no difference in mare reproductive behavior as a function of contraception history.

Ransom et al. (2010) found that control mares were herded by stallions more frequently than PZP- treated mares, and Nuñez et al. (2009, 2014, 2017) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Madosky et al. (2010) and Knight (2014) found this infidelity was also evident during the breeding season in the same population that Nuñez et al. (2009, 2010, 2014, 2017) studied; they concluded that PZP-treated mares changing bands more frequently than control mares could lead to band instability. Nuñez et al. (2009), though, cautioned against generalizing from that island population to other herds. Nuñez et al. (2014) found elevated levels of fecal cortisol, a marker of physiological stress, in mares that changed bands. The research is inconclusive as to whether all the mares' movements between bands were related to the PZP treatments themselves or the fact

that the mares were not nursing a foal, and did not demonstrate any long-term negative consequence of the transiently elevated cortisol levels. The authors (Nuñez et al. 2014) concede that these effects "…may be of limited concern when population reduction is an urgent priority." Nuñez (2018) and Jones et al. (2019, 2020) noted that band stallions of mares that have received PZP treatment can exhibit changes in behavior and physiology. In contrast to transient stresses, Creel et al (2013) highlight that variation in population density is one of the most well-established causal factors of chronic activation of the hypothalamic-pituitary-adrenal axis, which mediates stress hormones; high population densities and competition for resources can cause chronic stress. Creel also states that "…there is little consistent evidence for a negative association between elevated baseline glucocorticoids and fitness." Band fidelity is not an aspect of wild horse biology that is specifically protected by the WFRHBA of 1971. It is also notable that Ransom et al. (2014b) found higher group fidelity after a herd had been gathered and treated with a contraceptive vaccine; in that case, the researchers postulated that higher fidelity may have been facilitated by the decreased competition for forage after excess horses were removed. At the population level, available research does not provide evidence of the loss of harem structure among any herds treated with PZP. Long-term implications of these changes in social behavior are currently unknown, but no negative impacts on the overall animals or populations welfare or well-being have been noted in these studies.

The National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares:

> "The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low."

Nuñez (2010) stated that not all populations would respond similarly to PZP treatment. Differences in habitat, resource availability, and demography among conspecific populations would undoubtedly affect their physiological and behavioral responses to PZP contraception, and need to be considered. Kirkpatrick et al. (2010) concluded that: "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative," and that the "…other victory for horses is that every mare prevented from being removed, by virtue of contraception, is a mare that would only be delaying her reproduction rather than being eliminated permanently from the range. This preserves herd genetics, while gathers and adoption do not."

The NRC report (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts research up to that date by Nuñez's et al. (2009, 2010) into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

> ". . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive "failure" due to contraception)."

Genetic Effects of PZP Vaccination

In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses such as the Confusion HMA, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC report (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of natural and human-facilitated movements. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviated potential inbreeding concerns (BLM 2010).

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from multiple domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer et al. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treating young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or periodic gathers and removals.

Even if it is the case that repeated treatment with PZP may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain unique or historically unusual genetic markers. Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e., human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in case where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5% per year), and very large fractions of the female population are permanently sterilized.

It is worth noting that, although maintenance of genetic diversity at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual herd management area or complex. Also, there is no Bureau-wide policy that requires BLM to allow each female in a herd to reproduce before she is treated with contraceptives.

One concern that has been raised with regards to genetic diversity is that treatment with immunocontraceptives could possibly lead to an evolutionary increase in the frequency of individuals whose genetic composition fosters weak immune responses (Cooper and Larson 2006, Ransom et al. 2014a).Many factors influence the strength of a vaccinated individual's immune response, potentially including genetics, but also nutrition, body condition, and prior immune responses to pathogens or other antigens (Powers et al. 2013). This premise is based on an assumption that lack of response to PZP is a heritable trait, and that the frequency of that trait would increase over time in a population of PZP-treated animals. Cooper and Herbert (2001) reviewed the topic, in the context of concerns about the long-term effectiveness of immunocontraceptives as a control agent for exotic species in Australia. They argue that immunocontraception could be a strong selective pressure, and that selecting for reproduction in individuals with poor immune response could lead to a general decline in immune function in populations where such evolution takes place. Other authors have also speculated that differences in antibody titer responses could be partially due to genetic differences between animals (Curtis et al. 2001, Herbert and Trigg 2005). However, Magiafolou et al. (2013) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there would be no expected effect of the immune phenotype on future generations. It is possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (NRC 2013).

Correlations between physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Unfortunately, predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments are speculative at this point, with results likely to depend on several factors, including: the strength of the genetic predisposition to not respond to PZP; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of PZP (which generally has a short-acting effect); the number of mares treated with multiple booster doses of PZP; and the actual size of the genetically-interacting metapopulation of horses within which the PZP treatment takes place.

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GnRH in horses. At this point there are no studies available from which one could make conclusions about the long-term effects of sustained and widespread immunocontraception treatments on population-wide immune function. Although a few, generally isolated, feral horse populations have been treated with high fractions of mares receiving PZP immunocontraception for long-term population control (e.g., Assateague Island and Pryor Mountains), no studies have tested for changes in immune competence in those areas.

Relative to the large number of free-roaming feral horses in the western United States, immunocontraception has not been used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response.
Although this topic may merit further study, lack of clarity should not preclude the use of immunocontraceptives to help stabilize extremely rapidly growing herds.

GonaCon-Equine Contraception

The GonaCon immunocontraceptive vaccine has been shown to provide multiple years of infertility in several wild ungulate species including horses (Killian et al., 2008; Gray et al., 2010). GonaCon utilizes a gonadotropin-releasing hormone (GnRH) which is a small neuropeptide that performs an obligatory role in mammalian reproduction. When combined with an adjuvant, the GnRH vaccine stimulates a persistent immune response resulting in prolonged antibody production against GnRH, the carrier protein, and adjuvant (Miller et al., 2008). The most compelling hypothesis on the vaccine effectiveness suggests that antibodies to GnRH likely induce transient infertility by binding to endogenous GnRH, thus preventing attachment to receptors on gonadotropes and suppression of pulsatile luteinizing hormone (LH) secretion (Molenaaret al., 2010). As anti-GnRH antibodies decline over time, concentrations of available endogenous GnRH increase and treated animals usually regain fertility (Power et al., 2011). GonaCon™-Equine has been registered with the U.S. Environmental Protection Agency (EPA) since January 2013.

GonaCon-Equine vaccine meets most of the criteria that the National Research Council of the National Academy of Sciences (NRC 2013) used to identify the most promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. GonaCon-Equine is approved for use by authorized federal, state, tribal, public and private personnel, for application to wild and feral equids in the United States (EPA 2013, 2015). Its use is appropriate for free-ranging wild horse herds. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) was one of the most preferable available methods for contraception in wild horses and burros (NRC 2013). GonaCon-Equine has been used on feral horses in Theodore Roosevelt National Park and on wild horses in one BLM-administered HMA (BLM 2015). GonaCon-Equine can be remotely administered in the field in cases where mares are relatively approachable, using a customized pneumatic dart (McCann et al. 2017). Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 m (BLM 2010).

As with other contraceptives applied to wild horses, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals (NRC 2013). GonaCon-Equine vaccine is an EPA-approved pesticide (EPA, 2009a) that is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced in a USDA-APHIS laboratory. Its categorization as a pesticide is consistent with regulatory framework for controlling overpopulated vertebrate animals, and in no way is meant to convey that the vaccine is lethal; the intended effect of the vaccine is as a contraceptive. GonaCon is produced as a pharmaceutical-grade vaccine, including aseptic manufacturing technique to deliver a sterile

vaccine product (Miller et al. 2013). If stored at 4° C, the shelf life is 6 months (Miller et al 2013).

Miller et al. (2013) reviewed the vaccine environmental safety and toxicity. When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2009b). EPA waived a number of tests prior to registering the vaccine, because GonaCon was deemed to pose low risks to the environment, so long as the product label is followed (Wang-Chaill et al. 2017, *in press*).

Under Alternative B, the BLM would return to the HMA as needed to re-apply GonaCon-Equine and initiate new treatments in order to maintain contraceptive effectiveness in controlling population growth rates. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate; booster dose effects may lead to increased effectiveness of contraception, which is generally the intent. Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, although the average duration of effect after booster doses has not yet been quantified. It is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine. Once the herd size in the project area is at AML and population growth seems to be stabilized, BLM could make a determination as to the required frequency of new mare treatments and mare re-treatments with GonaCon, to maintain the number of horses within AML.

GnRH Vaccine Direct Effects

GonaCon-Equine is one of several vaccines that have been engineered to create an immune response to the gonadotropin releasing hormone peptide (GnRH). GnRH is a small peptide that plays an important role in signaling the production of other hormones involved in reproduction in both sexes. GnRH is highly conserved across mammalian taxa, so some inferences about the mechanism and effects of GonaCon-Equine in horses can be made from studies that used different anti-GnRH vaccines, in horses and other taxa. Other anti-GnRH vaccines include: Improvac (Imboden et al. 2006, Botha et al. 2008, Janett et al. 2009, Schulman et al. 2013, Dalmau et al. 2015), made in South Africa; Equity (Elhay et al. 2007), made in Australia; Improvest, for use in swine (Bohrer et al. 2014); Repro-BLOC (Boedeker et al. 2011); and Bopriva, for use in cows (Balet et al. 2014). Of these, GonaCon-Equine, Improvac, and Equity are specifically intended for horses. Other anti-GnRH vaccine formulations have also been tested, but did not become trademarked products (e.g., Goodloe 1991, Dalin et al 2002, Stout et al. 2003, Donovan et al. 2013). The effectiveness and side-effects of these various anti-GnRH vaccines may not be the same as would be expected from GonaCon-Equine use in horses. Results could differ as a result of differences in the preparation of the GnRH antigen, and the choice of adjuvant used to stimulate the immune response. While GonaCon-Equine can be administered as a single dose, most other anti-GnRH vaccines require a primer dose and at least one booster dose to be effective.

GonaCon has been produced by USDA-APHIS (Fort Collins, Colorado) in several different formulations, the history of which is reviewed by Miller et al. (2013). In any vaccine, the antigen is the stimulant to which the body responds by making antigen-specific antibodies. Those antibodies then signal to the body that a foreign molecule is present, initiating an immune

response that removes the molecule or cell. GonaCon vaccines present the recipient with hundreds of copies of GnRH as peptides on the surface of a linked protein that is naturally antigenic because it comes from invertebrate hemocyanin (Miller et al 2013). Early GonaCon formulations linked many copies of GnRH to a protein from the keyhole limpet (GonaCon-KHL), but more recently produced formulations where the GnRH antigen is linked to a protein from the blue mussel (GonaCon-B) proved less expensive and more effective (Miller et al. 2008). GonaCon-Equine is in the category of GonaCon-B vaccines.

Adjuvants are included in vaccines to elevate the level of immune response, inciting recruitment of lymphocytes and other immune cells which foster a long-lasting immune response that is specific to the antigen. For some formulations of anti-GnRH vaccines, a booster dose is required to elicit at contraceptive response, though GonaCon can cause short-term contraception in a fraction of treated animals from one dose (Powers et al. 2011, Gionfriddo et al. 2011a, Baker et al. 2013, Miller et al 2013). The adjuvant used in GonaCon, Adjuvac, generally leads to a milder reaction than Freunds complete adjuvant (Powers et al. 2011). Adjuvac contains a small number of killed *Mycobacterium avium* cells (Miller et al. 2008, Miller et al. 2013). The antigen and adjuvant are emulsified in mineral oil, such that they are not all presented to the immune system right after injection; it is thought that the mineral oil emulsion leads to a depot effect and longer-lasting immune response (Miller et al. 2013). Miller et al. (2008, 2013) have speculated that, in cases where memory-B leukocytes are protected in immune complexes in the lymphatic system, it can lead to years of immune response. Increased doses of vaccine may lead to stronger immune reactions, but only to a certain point; when Yoder and Miller (2010) tested varying doses of GonaCon in prairie dogs, antibody responses to the 200μg and 400μg doses were equal to each other but were both higher than in response to a 100μg dose.

The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in leutinizing hormone levels, and a cessation of ovulation. Antibody titer measurements are proximate measures of the antibody concentration in the blood specific to a given antigen. Anti-GnRH titers generally correlate with a suppressed reproduction system (Gionfriddo et al. 2011a, Powers et al. 2011). Various studies have attempted to identify a relationship between anti-GnRH titer levels and infertility, but that relationship has not been universally predictable or consistent. The time length that titer levels stay high appears to correlate with the length of suppressed reproduction (Dalin et al. 2002, Levy et al. 2011, Donovan et al. 2013, Powers et al. 2011). For example, Goodloe (1991) noted that mares did produce elevated titers and had suppressed follicular development for 11-13 weeks after treatment, but that all treated mares ovulated after the titer levels declined. Similarly, Elhay (2007) found that high initial titers correlated with longer-lasting ovarian and behavioral anoestrus. However, Powers et al. (2011) did not identify a threshold level of titer that was consistently indicative of suppressed reproduction despite seeing a strong correlation between antibody concentration and infertility, nor did Schulman et al. (2013) find a clear relationship between titer levels and mare acyclicity.

In many cases, young animals appear to have higher immune responses, and stronger contraceptive effects of anti-GnRH vaccines than older animals (Brown et al. 1994, Curtis et al. 2001, Stout et al. 2003, Schulman et al. 2013). Vaccinating with GonaCon at too young an age, though, may prevent effectiveness; Gionfriddo et al. (2011a) observed weak effects in 3-4 month

old fawns. It has not been possible to predict which individuals of a given age class would have long-lasting immune responses to the GonaCon vaccine. Gray (2010) noted that mares in poor body condition tended to have lower contraceptive efficacy in response to GonaCon-B. Miller et al. (2013) suggested that higher parasite loads might have explained a lower immune response in free-roaming horses than had been observed in a captive trial. At this time it is unclear what the most important factors affecting efficacy are.

Females that are successfully contracepted by GnRH vaccination enter a state similar to anestrus, have a lack of or incomplete follicle maturation, and no ovarian cycling (Botha et al. 2008). A leading hypothesis is that anti-GnRH antibodies bind GnRH in the hypothalamus – pituitary 'portal vessels,' preventing GnRH from binding to GnRH-specific binding sites on gonadotroph cells in the pituitary, thereby limiting the production of gonadotropin hormones, particularly luteinizing hormone (LH) and, to a lesser degree, follicle-stimulating hormone (FSH) (Powers et al. 2011, NRC 2013). This reduction in LH (and FSH), and a corresponding lack of ovulation, has been measured in response to treatment with anti-GnRH vaccines (Boedeker et al. 2011, Garza et al. 1986).

Females successfully treated with anti-GnRH vaccines have reduced progesterone levels (Garza et al 1986, Stout et al. 2003, Imboden et al. 2006, Elhay 2007, Botha et al. 2008, Killian et al. 2008, Miller et al. 2008, Janett et al. 2009, Schulman et al. 2013, Balet et al 2014, Dalmau et al. 2015) and β-17 estradiol levels (Elhay et al. 2007), but no great decrease in estrogen levels (Balet et al. 2014). Reductions in progesterone do not occur immediately after the primer dose, but can take several weeks or months to develop (Elhay et al 2007, Botha et al. 2008, Schulman et al. 2013, Dalmau et al. 2015). This indicates that ovulation is not occurring and corpora lutea, formed from post-ovulation follicular tissue, are not being established.

Changes in hormones associated with anti-GnRH vaccination lead to measurable changes in ovarian structure and function. The volume of ovaries reduced in response to treatment (Garza et al. 1986, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Botha et al. 2008, Gionfriddo 2011a, Dalmau et al. 2015). Treatment with an anti-GnRH vaccine changes follicle development (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay et al. 2007, Donovan et al. 2013, Powers et al. 2011, Balet et al 2014), with the result that ovulation does not occur. A related result is that the ovaries can exhibit less activity and cycle with less regularity or not at all in anti-GnRH vaccine treated females (Goodloe 1991, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Janett et al. 2009, Donovan et al. 2013, Powers et al. 2011). In studies where the vaccine required a booster, hormonal and associated results were generally observed within several weeks after delivery of the booster dose.

GnRH Vaccine Contraceptive Effects

The NRC (2013) review pointed out that single doses of GonaCon-Equine do not lead to high rates of initial effectiveness, or long duration. Initial effectiveness of one dose of GonaCon-Equine vaccine appears to be lower than for a combined primer plus booster dose of the PZP vaccine Zonastat-H (Kirkpatrick et al. 2011), and the initial effect of a single GonaCon dose can be limited to as little as one breeding season. However, preliminary results on the effects of boostered doses of GonaCon-Equine indicate that it can have high efficacy and longer-lasting

effects in free-roaming horses (Baker et al. 2017) than the one-year effect that is generally expected from a single booster of Zonastat-H.

GonaCon and other anti-GnRH vaccines can be injected while a female is pregnant (Miller et al. 2000, Powers et al. 2011, Baker et al. 2013) – in such a case, a successfully contracepted mare would be expected to give birth during the following foaling season, but to be infertile during the same year's breeding season. Thus, a mare injected in November of 2018 would not show the contraceptive effect (i.e., no new foal) until spring of 2020.

Too few studies have reported on the various formulations of anti-GnRH vaccines to make generalizations about differences between products, but GonaCon formulations were consistently good at causing loss of fertility in a statistically significant fraction of treated mares for at least one year (Killian et al. 2009, Gray et al. 2010, Baker et al. 2013, 2017). With few exceptions (e.g., Goodloe 1991), anti-GnRH treated mares gave birth to fewer foals in the first season when there would be an expected contraceptive effect (Botha et al. 2008, Killian et al. 2009, Gray et al. 2010, Baker et al. 2013). Goodloe (1991) used an anti-GnRH-KHL vaccine with a triple adjuvant, in some cases attempting to deliver the vaccine to horses with a hollow-tipped 'biobullet,'but concluded that the vaccine was not an effective immunocontraceptive in that study.

Not all mares should be expected to respond to the GonaCon-equine vaccine; some number should be expected to continue to become pregnant and give birth to foals. In studies where mares were exposed to stallions, the fraction of treated mares that are effectively contracepted in the year after anti-GnRH vaccination varied from study to study, ranging from ~50% (Baker et al. 2017), to 61% (Gray et al. 2010) to ~90% (Killian et al. 2006, 2008, 2009). Miller et al. (2013) noted lower effectiveness in free-ranging mares (Gray et al. 2010) than captive mares (Killian et al. 2009). Some of these rates are lower than the high rate of effectiveness typically reported for the first year after PZP vaccine treatment (Kirkpatrick et al. 2011). In the one study that tested for a difference, darts and hand-injected GonaCon doses were equally effective in terms of fertility outcome (McCann et al. 2017).

In studies where mares were not exposed to stallions, the duration of effectiveness also varied. A primer and booster dose of Equity led to anoestrus for at least 3 months (Elhay et al 2007). A primer and booster dose of Improvac also led to loss of ovarian cycling for all mares in the short term (Imboden et al. 2006). It is worth repeating that those vaccines do not have the same formulation as GonaCon.

Results from horses (Baker et al. 2017) and other species (Curtis et al. 2001) suggest that providing a booster dose of GonaCon-Equine would increase the fraction of temporarily infertile animals to higher levels than would a single vaccine dose alone.

Longer-term infertility has been observed in some mares treated with anti-GnRH vaccines, including GonaCon-Equine. In a single-dose mare captive trial with an initial year effectiveness of 94%, Killian et al. (2008) noted infertility rates of 64%, 57%, and 43% in treated mares during the following three years, while control mares in those years had infertility rates of 25%, 12% and 0% in those years. GonaCon effectiveness in free-roaming populations was lower, with

infertility rates consistently near 60% for three years after a single dose in one study (Gray et al. 2010) and annual infertility rates decreasing over time from 55% to 30% to 0% in another study with one dose (Baker et al. 2017). Similarly, gradually increasing fertility rates were observed after single dose treatment with GonaCon in elk (Powers et al. 2011) and deer (Gionfriddo et al. 2011a).

Baker et al. (2017) observed a return to fertility over 4 years in mares treated once with GonaCon, but then noted extremely low fertility rates of 0% and 16% in the two years after the same mares were given a booster dose four years after the primer dose. These are extremely promising preliminary results from that study in free-roaming horses; a third year of post-booster monitoring is ongoing in summer 2017, and researchers on that project are currently determining whether the same high-effectiveness, long-term response is observed after boosting with GonaCon after 6 months, 1 year, 2 years, or 4 years after the primer dose. Four of nine mares treated with primer and booster doses of Improvac did not return to ovulation within 2 years of the primer dose (Imboden et al. 2006), though one should probably not make conclusions about the long-term effects of GonaCon-Equine based on results from Improvac.

It is difficult to predict which females would exhibit strong or long-term immune responses to anti-GnRH vaccines (Killian et al. 2006, Miller et al. 2008, Levy et al. 2011). A number of factors may influence responses to vaccination, including age, body condition, nutrition, prior immune responses, and genetics (Cooper and Herbert 2001, Curtis et al. 2001, Powers et al. 2011). One apparent trend is that animals that are treated at a younger age, especially before puberty, may have stronger and longer-lasting responses (Brown et al. 1994, Curtis et al. 2001, Stout et al. 2003, Schulman et al. 2013). It is plausible that giving ConaGon-Equine to prepubertal mares would lead to long-lasting infertility, but that has not yet been tested.

To date, short term evaluation of anti-GnRH vaccines, show contraception appears to be temporary and reversible. Killian et al. noted long-term effects of GonaCon in some captive mares (2009). However, Baker et al. (2017) observed horses treated with GonaCon-B return to fertility after they were treated with a single primer dose; after four years, the fertility rate was indistinguishable between treated and control mares. It appears that a single dose of GonaCon results in reversible infertility but it is unknown if long term treatment would result in permanent infertility.

Other anti-GnRH vaccines also have had reversible effects in mares. Elhay (2007) noted a return to ovary functioning over the course of 34 weeks for 10 of 16 mares treated with Equity. That study ended at 34 weeks, so it is not clear when the other six mares would have returned to fertility. Donovan et al. (2013) found that half of mares treated with an anti-GnRH vaccine intended for dogs had returned to fertility after 40 weeks, at which point the study ended. In a study of mares treated with a primer and booster dose of Improvac, 47 of 51 treated mares had returned to ovarian cyclicity within 2 years; younger mares appeared to have longer-lasting effects than older mares (Schulman et al. 2013). In a small study with a non-commercial anti-GnRH vaccine (Stout et al. 2003), three of seven treated mares had returned to cyclicity within 8 weeks after delivery of the primer dose, while four others were still suppressed for 12 or more weeks. In elk, Powers et al. (2011) noted that contraception after one dose of GonaCon was reversible. In white-tailed deer, single doses of GonaCon appeared to confer two years of

contraception (Miller et al. 2000). Ten of 30 domestic cows treated became pregnant within 30 weeks after the first dose of Bopriva (Balet et al. 2014).

Permanent sterility as a result of single-dose or boostered GonaCon-Equine vaccine, or other anti-GnRH vaccines, has not been recorded, but that may be because no long-term studies have tested for that effect. It is conceivable that some fraction of mares could become sterile after receiving one or more booster doses of GonaCon-Equine, but the rate at which that could be expected to occur is currently unknown. If some fraction of mares treated with GonaCon-Equine were to become sterile, though, that result would consistent with text of the WFRHBA of 1971, as amended, which allows for sterilization to achieve population goals.

In summary, based on the above results related to fertility effects of GonaCon and other anti-GnRH vaccines, application of a single dose of GonaCon-Equine to gathered or remotely-darted wild horses could be expected to prevent pregnancy in perhaps 30%-60% of mares for one year. Some smaller number of wild mares should be expected to have persistent contraception for a second year, and less still for a third year. Applying one booster dose of GonaCon to previously-treated mares should lead to two or more years with relatively high rates (80+%) of additional infertility expected, with the potential that some as-yet-unknown fraction of boostered mares may be infertile for several to many years. There is no data to support speculation regarding efficacy of multiple boosters of GonaCon-Equine; however, given it is formulated as a highly immunogenic long-lasting vaccine, it is reasonable to hypothesize that additional boosters would increase the effectiveness and duration of the vaccine.

GonaCon-Equine only affects the fertility of treated animals; untreated animals would still be expected to give birth. Even under favorable circumstances for population growth suppression, gather efficiency might not exceed 85% via helicopter, and may be less with bait and water trapping. Similarly, not all animals may be approachable for darting. The uncaptured or undarted portion of the female population would still be expected to have normally high fertility rates in any given year, though those rates could go up slightly if contraception in other mares increases forage and water availability.

GnRH Vaccine Effects on Other Organ Systems

BLM requires individually identifiable marks for immunocontraceptive treatment; this may require handling and marking. Mares receiving any vaccine as part of a gather operation would experience slightly increased stress levels associated with handling while being vaccinated and freeze-marked, and potentially microchipped. Newly captured mares that do not have markings associated with previous fertility control treatments would be marked with a new freeze-mark for the purpose of identifying that mare, and identifying her vaccine treatment history. This information would also be used to determine the number of mares captured that were not previously treated, and could provide additional insight regarding gather efficiency, and the timing of treatments required into the future. Most mares recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile.

Injection site reactions associated with immunocontraceptive treatments are possible in treated mares (Roelle and Ransom 2009). Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2013). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses. When PZP vaccine was delivered via dart it led to more severe swelling and injection site reactions (Roelle and Ransom 2009), but that was not observed with dart-delivered GonaCon (McCann et al. 2017). Mares treated with one formulation of GnRH-KHL vaccine developed pyogenic abscesses (Goodloe 1991). Miller et al. (2008) noted that the water and oil emulsion in GonaCon would often cause cysts, granulomas, or sterile abscesses at injection sites; in some cases, a sterile abscess may develop into a draining abscess. In elk treated with GonaCon, Powers et al. (2011) noted up to 35% of treated elk had an abscess form, despite the injection sites first being clipped and swabbed with alcohol. Even in studies where swelling and visible abscesses followed GonaCon immunization, the longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns (Powers et al. 2013, Baker et al. 2017).

The result that other formulations of anti-GnRH vaccine may be associated with less notable injection site reactions in horses may indicate that the adjuvant formulation in GonaCon leads a single dose to cause a stronger immune reaction than the adjuvants used in other anti-GnRH vaccines. Despite that, a booster dose of GonaCon-Equine appears to be more effective than a primer dose alone (Baker et al. 2017). Horses injected in the hip with Improvac showed only transient reactions that disappeared within 6 days in one study (Botha et al. 2008), but stiffness and swelling that lasted 5 days were noted in another study where horses received Improvac in the neck (Imboden et al. 2006). Equity led to transient reactions that resolved within a week in some treated animals (Elhay et al. 2007). Donovan et al. noted no reactions to the canine anti-GnRH vaccine (2013). In cows treated with Bopriva there was a mildly elevated body temperature and mild swelling at injection sites that subsided within 2 weeks (Balet et al. 2014).

Several studies have monitored animal health after immunization against GnRH. GonaCon treated mares did not have any measurable difference in uterine edema (Killian 2006, 2008). Powers et al. (2011, 2013) noted no differences in blood chemistry except a mildly elevated fibrinogen level in some GonaCon treated elk. In that study, one sham-treated elk and one GonaCon treated elk each developed leukocytosis, suggesting that there may have been a causal link between the adjuvant and the effect. Curtis et al. (2008) found persistent granulomas at GonaCon-KHL injection sites three years after injection, and reduced ovary weights in treated females. Yoder and Miller (2010) found no difference in blood chemistry between GonaCon treated and control prairie dogs. One of 15 GonaCon treated cats died without explanation, and with no determination about cause of death possible based on necropsy or histology (Levy et al. 2011). Other anti-GnRH vaccine formulations have led to no detectable adverse effects (in elephants; Boedeker et al. 2011), though Imboden et al. (2006) speculated that young treated animals might conceivably have impaired hypothamic or pituitary function.

Kirkpatrick et al. (2011) raised concerns that anti-GnRH vaccines could lead to adverse effects in other organ systems outside the reproductive system. GnRH receptors have been identified in tissues outside of the pituitary system, including in the testes and placenta (Khodr and Siler-Khodr 1980), ovary (Hsueh and Erickson 1979), bladder (Coit et al. 2009), heart (Dong et al.

2011), and central nervous system, so it is plausible that reductions in circulating GnRH levels could inhibit physiological processes in those organ systems. Kirkpatrick et al. (2011) noted elevated cardiological risks to human patients taking GnRH agonists (such as leuprolide), but the National Academy of Sciences (2013) concluded that the mechanism and results of GnRH agonists would be expected to be different from that of anti-GnRH antibodies; the former flood GnRH receptors, while the latter deprive receptors of GnRH.

GnRH Vaccine Effects on Fetus and Foal

GonaCon had no apparent effect on pregnancies in progress, foaling success, or the health of offspring, in horses that were immunized in October (Baker et al. 2013), elk immunized 80-100 days into gestation (Powers et al. 2011, 2013), or deer immunizeed in February (Miller et al. 2000). Kirkpatrick et al. (2011) noted that anti-GnRH immunization is not expected to cause hormonal changes that would lead to abortion in the horse, but this may not be true for the first 6 weeks of pregnancy (NRC 2013). Curtis et al. (2011) noted that GonaCon-KHL treated white tailed deer had lower twinning rates than controls, but speculated that the difference could be due to poorer sperm quality late in the breeding season, when the treated does did become pregnant. Goodloe (1991) found no difference in foal production between treated and control animals.

Offspring of anti-GnRH vaccine treated mothers could exhibit an immune response to GnRH (Khodr and Siler-Khodr 1980), as antibodies from the mother could pass to the offspring through the placenta or colostrum. In the most extensive study of long-term effects of GonaCon immunization on offspring, Powers et al. (2012) monitored 15 elk fawns born to GonaCon treated cows. Of those, 5 had low titers at birth and 10 had high titer levels at birth. All 15 were of normal weight at birth, and developed normal endocrine profiles, hypothalamic GnRH content, pituitary gonadotropin content, gonad structure, and gametogenesis. All the females became pregnant in their second reproductive season, as is typical. All males showed normal development of secondary sexual characteristics. Powers et al. (2012) concluded that suppressing GnRH in the neonatal period did not alter long-term reproductive function in either male or female offspring. Miller et al. (2013) report elevated anti-GnRH antibody titers in fawns born to treated white tailed deer, but those dropped to normal levels in 11 of 12 of those fawns, which came into breeding condition; the remaining fawn was infertile for three years.

Direct effects on foal survival are equivocal in the literature. Goodloe (1991), reported lower foal survival for a small sample of foals born to anti-GnRH treated mares, but she did not assess other possible explanatory factors such as mare social status, age, body condition, or habitat in her analysis (NRC 2013). Gray et al. (2010) found no difference in foal survival in foals born to free-roaming mares treated with GonaCon.

There is little empirical information available to evaluate the effects of GnRH vaccination on foaling phenology. It is possible that immunocontracepted mares returning to fertility late in the breeding season could give birth to foals at a time that is out of the normal range (Nuñez et al. 2010, Ransom et al 2013). Curtis et al. (2001) did observe a slightly later fawning date for GonaCon treated deer in the second year after treatment, when some does regained fertility late in the breeding season. In anti-GnRH vaccine trials in free-roaming horses, there were no published differences in mean date of foal production (Goodloe 1991, Gray et al. 2010).

Unpublished results from an ongoing study of GonaCon treated free-roaming mares indicate that some degree of aseasonal foaling is possible (D. Baker, Colorado State University, personal communication to Paul Griffin, BLM WH&B Research Coordinator). Because of the concern that contraception could lead to shifts in the timing of parturitions for some treated animals, Ransom et al. (2013) advised that managers should consider carefully before using PZP immunocontraception in small refugia or rare species. The same may also apply to GonaCon. It should be noted that wild horses and burros in most areas do not generally occur in isolated refugia, they are not a rare species at the regional, national, or international level, and genetically they represent descendants of domestic livestock with most populations containing few if any unique alleles (NAS 2013). Moreover, in PZP-treated horses that did have some degree of parturition date shift, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season. If there were to be a shift in foaling date for some treated mares, the effect on foal survival may depend on weather severity and local conditions; for example, Ransom et al. (2013) did not find consistent effects across study sites.

Indirect Effects of GnRH Vaccination

One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health. Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares, and their better health is expected to be reflected in higher body condition scores. After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mares' milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition can remain improved even after fertility resumes. Anecdotal, subjective observations of mares treated with a different immunocontraceptive, PZP, in past gathers showed that many of the treated mares were larger, maintained better body condition, and had larger healthy foals than untreated mares.

Body condition of anti-GnRH-treated females was equal to or better than that of control females in published studies. Ransom et al. (2014) observed no difference in mean body condition between GonaCon-B treated mares and controls. Goodloe (1991) found that GnRH-KHL treated mares had higher survival rates than untreated controls. In other species, treated cats gained more weight than controls (Levy et al. 2011), as did treated young female pigs (Bohrer et al. 2014).

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called by some a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect.

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect would be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. Contraception would be expected to

lead to a relative increase in the proportion of older animals in the herd. Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to ORCs or ORPs. Among mares in the herd that remain fertile, a high level of physical health and future reproductive success of fertile mares within the herd would be expected as reduced population sizes should lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the local horse abundance nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA or HMAs. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should GonaCon-Equine treatment, including booster doses, continue into the future, with treatments given on a schedule to maintain a lowered level of fertility in the herd, the chronic cycle of overpopulation and large gathers and removals might no longer occur, but instead a consistent abundance of wild horses could be maintained, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with GonaCon-Equine could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated with primer and booster doses, and perhaps repeated booster doses.

Behavioral Effects of GnRH Vaccination

Behavioral differences should be considered as potential consequences of contraception with GonaCon. The NRC report (2013) noted that all successful fertility suppression has effects on mare behavior, mostly as a result of the lack of pregnancy and foaling, and concluded that GonaCon was a good choice for use in the program. The NRC report suggested that additional research on behavioral effects of GonaCon could be warranted; since the publication of that report, additional results of behavioral studies have become available, confirming the suitability of GonaCon for use in wild mares. The result that GonaCon treated mares may have suppressed estrous cycles throughout the breeding season can lead treated mares to behave in ways that are functionally similar to pregnant mares.

While successful in mares, GonaCon and other anti-GnRH vaccines are expected to induce fewer estrous cycles when compared to non-pregnant control mares. This has been observed in many studies (Garza et al. 1986, Curtis et al. 2001, Dalin et al. 2002, Killian et al. 2006, Dalmau et al. 2015). In contrast, PZP vaccine is generally expected to lead mares to have more estrous cycles

per breeding season, as they continue to be receptive to mating while not pregnant. Females treated with GonaCon had less estrous cycles than control or PZP-treated mares (Killian et al. 2006) or deer (Curtis et al. 2001). Thus, concerns about PZP treated mares receiving more courting and breeding behaviors from stallions (Nuñez et al. 2009, Ransom et al. 2010) are not generally expected to be a concern for mares treated with anti-GnRH vaccines (Botha et al. 2008).

Ransom et al. (2014) found that GonaCon treated mares had similar rates of reproductive behaviors that were similar to those of pregnant mares. Among other potential causes, the reduction in progesterone levels in treated females may lead to a reduction in behaviors associated with reproduction. Despite this, some females treated with GonaCon or other anti-GnRH vaccines did continue to exhibit reproductive behaviors, albeit at irregular intervals and durations (Dalin et al. 2002, Stout et al. 2003, Imboden et al. 2006), which is a result that is similar to spayed (ovariectomized) mares (Asa et al. 1980). Gray et al. (2009) found no difference in sexual behaviors in mares treated with GonaCon and untreated mares. When progesterone levels are low, small changes in estradiol concentration can foster reproductive estrous behaviors (Imboden et al. 2006). Owners of anti-GnRH vaccine treated mares reported a reduced number of estrous-related behaviors under saddle (Donovan et al. 2013). Treated mares may refrain from reproductive behavior even after ovaries return to cyclicity (Elhay et al. 2007). Studies in elk found that GonaCon treated cows had equal levels of precopulatory behaviors as controls (Powers et al. 2011), though bull elk paid more attention to treated cows late in the breeding season, after control cows were already pregnant (Powers et al. 2011).

Stallion herding of mares, and harem switching by mares are two behaviors related to reproduction that might change as a result of contraception. Ransom et al. (2014) observed a 50% decrease in herding behavior by stallions after the free-roaming horse population at Theodore Roosevelt National Park was reduced via a gather, and mares there were treated with GonaCon-B. The increased harem tending behaviors by stallions were directed to both treated and control mores. It is difficult to separate any effect of GonaCon from changes in horse density and forage following horse removals.

Mares in untreated free-roaming populations change bands; some have raised concerns over effects of PZP vaccination on band structure (Nuñez et al. 2009), with rates of band fidelity being suggested as a measure of social stability. With respect to treatment with GonaCon or other anti-GnRH vaccines, it is probably less likely that treated mares would switch harems at higher rates than untreated animals, because treated mares are similar to pregnant mares in their behaviors (Ransom et al. 2014). Indeed, Gray et al. (2009) found no difference in band fidelity in a free-roaming population of horses with GonaCon treated mares, despite differences in foal production between treated and untreated mares. Ransom et al. (2014) actually found increased levels of band fidelity after treatment, though this may have been partially a result of changes in overall horse density and forage availability.

Even in cases where there may be changes in band fidelity, the National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares:

> "The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest

> that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low."

Kirkpatrick et al. (2010) concluded that "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative."

The NRC (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts Nuñez's (2009, 2010) research into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

> ". . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive "failure" due to contraception)."

Gray et al. (2009) and Ransom et al. (2014) monitored non-reproductive behaviors in GonaCon treated populations of free-roaming horses. Gray et al. (2009) found no difference between treated and untreated mares in terms of activity budget, sexual behavior, proximity of mares to stallions, or aggression. Ransom et al. (2014) found only minimal differences between treated and untreated mare time budgets, but those differences were consistent with differences in the metabolic demands of pregnancy and lactation in untreated mares, as opposed to non-pregnant treated mares.

Genetic Effects of GnRH Vaccination

In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses such as the Confusion HMA, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC report recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer et al., 2006). Based on a population model, Gross (2000) found that

an effective way to retain genetic diversity in a population treated with fertility control is to preferentially treat young animals, such that the older animals (which contain all the existing genetic diversity available) continue to have offspring. Conversely, Gross (2000) found that preferentially treating older animals (preferentially allowing young animals to breed) leads to a more rapid expected loss of genetic diversity over time.

Even if it is the case that booster treatment with GonaCon may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain genetic markers that have been identified as unique or historically unusual (NRC 2013). Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e. human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in cases where all four of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, intrinsic population growth rate is low (5% per year), and very large fractions of the female population are permanently sterilized.

Many factors influence the strength of a vaccinated individual's immune response, potentially including genetics, but also nutrition, body condition, and prior immune responses to pathogens or other antigens (Powers et al 2013). One concern that has been raised with regards to genetic diversity is that treatment with immunocontraceptives could possibly lead to an evolutionary increase in the frequency of individuals whose genetic composition fosters weak immune responses (Cooper and Larson 2006, Ransom et al. 2014a). This premise is based on an assumption that lack of response to PZP is a heritable trait, and that the frequency of that trait would increase over time in a population of PZP-treated animals. Cooper and Herbert (2001) reviewed the topic, in the context of concerns about the long-term effectiveness of immunocontraceptives as a control agent for exotic species in Australia. They argue that imunocontraception could be a strong selective pressure, and that selecting for reproduction in individuals with poor immune response could lead to a general decline in immune function in populations where such evolution takes place. Other authors have also speculated that differences in antibody titer responses could be partially due to genetic differences between animals (Curtis et al. 2001, Herbert and Trigg 2005).

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses. At this point there are no studies available from which one could make conclusions about the long-term effects of sustained and widespread immunocontraception treatments on population-wide immune function. Although a few, generally isolated, feral horse populations have been treated with high fractions of mares receiving PZP immunocontraception for long-term population control (e.g., Assateague Island and Pryor Mountains), no studies have tested for changes in immune

competence in those areas. Relative to the large number of free-roaming feral horses in the western United States, immunocontraception has not been used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response at a large scale.

Magiafolou et al. (2013) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there would be no expected effect of the immune phenotype on future generations. Correlations between immune response and physical factors such as age and body condition have been documented; it remains untested whether or not those factors play a larger role in determining immune response to immunocontraceptives than heritable traits. Several studies discussed above noted a relationship between the strength of individuals' immune responses after treatment with GonaCon or other anti-GnRH vaccines, and factors related to body condition. For example, age at immunization was a primary factor associated with different measures of immune response, with young animals tending to have stronger and longer-lasting responses (Stout et al. 2003, Schulman et al. 2013). It is also possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (Gray 2009, NRC 2013). Miller et al. (2013) speculated that animals with high parasite loads also may have weaker immune reactions to GonaCon.

Correlations between such physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Unfortunately, predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments are speculative at this point, with results likely to depend on several factors, including: the strength of the genetic predisposition to not respond to GonaCon-Equine; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of GonaCon-Equine (which generally has a short-acting effect, if any); the number of mares treated with a booster dose of GonaCon-Equine; and the actual size of the genetically-interacting metapopulation of horses within which the GonaCon treatment takes place.

IUDs

IUDs are considered a temporary fertility control method that does not generally cause future sterility (Daels and Hughes 1995). Use of IUDs is an effective fertility control method in women, and IUDs have historically been used in livestock management, including in domestic horses. Insertion of an IUD can be a very rapid procedure, but it does require the mare to be temporarily restrained, such as in a squeeze chute. IUDs in mares may cause physiological effects including discomfort, infection, perforation of the uterus (by a hard IUD), endometritis, uterine edema (Killian et al. 2008), and pyometra (Klabnik-Bradford et al. 2013). In women, deaths attributable to IUD use may be as low as 1.06 per million (Dales and Hughes 1995).

The exact mechanism by which IUDs prevent pregnancy is uncertain (Daels and Hughes 1995), but the presence of an IUD in the uterus may, like a pregnancy, prevent the mare from coming back into estrus (Turner et al. 2015). However, some domestic mares did exhibit repeated estrus

cycles during the time when they had IUDs (Killian et al. 2008, Gradil et al. 2019). The main cause for an IUD to not be effective at contraception is its failure to stay in the uterus (Daels and Hughes 1995). As a result, one of the major challenges to using IUDs to control fertility in mares on the range is preventing the IUD from being dislodged or otherwise ejected over the course of daily activities, which include, at times, frequent breeding.

At this time, it is thought that any IUD inserted into a pregnant mare may cause the pregnancy to terminate, which may also cause the IUD to be expelled. For that reason, it is expected that IUDs would only be inserted in non-pregnant (open) mares. Wild mares receiving IUDs would be checked for pregnancy prior to insertion of an IUD. This can be accomplished by transrectal palpation and/or ultrasound performed by a veterinarian. Pregnant mares would not receive an IUD. The IUD is inserted into the uterus using a thin, tubular applicator similar to a shielded culture tube, and would be inserted in a manner similar to that routinely used to obtain uterine cultures in domestic mares. If a mare has a zygote or very small, early phase embryo, it is possible that it will fail to develop further, but without causing the expulsion of the IUD.

Hard IUDs, such as metallic or glass marbles, may prevent pregnancy (Nie et al. 2003) but can pose health risks to domestic mares (Turner et al. 2015, Freeman and Lyle 2015). Marbles may break into shards (Turner et al. 2015), and uterine irritation that results from marble IUDs may cause chronic, intermittent colic (Freeman and Lyle 2015). Metallic IUDs may cause severe infection (Klabnik-Bradford et al. 2013). The University of Massachusetts has developed a magnetic IUD (Gradil et al. 2019) which consist of three oblong, shatter-proof, magnetic beads that has been effective at preventing estrus in non-breeding domestic mares. In an early trial, two sizes of those magnetic IUDs fell out of breeding domestic mares at high rates (Holyoak et al., unpublished results). In 2019, the magnetic IUD was used in two trials where mares were exposed to stallions, and in one where mares were artificially inseminated; in all cases, the IUDs were reported to stay in the mares without any pregnancy (Gradil 2019).

In domestic ponies, Killian et al. (2008) explored the use of three different IUD configurations, including a silastic polymer O-ring with copper clamps, and the “380 Copper T” and “GyneFix” IUDs designed for women. The longest retention time for the three IUD models was seen in the “T” device, which stayed in the uterus of several mares for 3-5 years. Reported contraception rates for IUD-treated mares were 80%, 29%, 14%, and 0% in years 1-4, respectively. They surmised that pregnancy resulted after IUD fell out of the uterus. Killian et al. (2008) reported high levels of progesterone in non-pregnant, IUD-treated ponies.

Soft IUDs may cause relatively less discomfort than hard IUDs (Daels and Hughes 1995). Daels and Hughes (1995) tested the use of a flexible O-ring IUD, made of silastic, surgical-grade polymer, measuring 40 mm in diameter; in five of six breeding domestic mares tested, the IUD was reported to have stayed in the mare for at least 10 months. In mares with IUDs, Daels and Hughes (1995) reported some level of uterine irritation but surmised that the level of irritation was not enough to interfere with a return to fertility after IUD removal.

Several types of flexible IUDs are being tested for use in breeding mares. When researchers attempted to replicate the O-ring study (Daels and Hughes 1995) in an USGS / Oklahoma State University (OSU) study with breeding domestic mares, using various configurations of silicone O-ring IUDs, the IUDs fell out at unacceptably high rates over time scales of less than 2 months (Baldrighi et al. 2017). Subsequently, the USGS / OSU researchers have tested a Y-

shaped silicone IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUD (Holyoak et al., unpublished results).

IUDs seem to be effective, as long as the device remains in place the mare should remain infertile. Mares should return to fertility if the device is removed or falls out. Mares would likely continue to cycle and be bred for several months each year, though the length of time between estrus may be prolonged by the presence of an IUD (Gradil et al. 2019).

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Appendix H

Sterilization Methods and Review

Brief description of Sterilization Methods in Mares

Laparoscopic Ovariectomy
This procedure is performed using standing sedation with a mare restrained in a stocks or squeeze chute. Ovaries are removed using a fiber optic laparoscope and three small incisions in the body wall. This method allows direct visualization of ovaries and it generally has a lower complication rate. The surgery takes about an hour per horse. Horses have three to six external incisions that can get infected unless they are confined and stay calm, which is not easy to guarantee in wild horses. The surgery requires a specialized skill set and equipment beyond that of the typical practicing veterinarian. The equipment is delicate and unlikely to withstand the rigors of use with wild horses in a corral setting. The horses must stand very still throughout the procedure, which could be difficult if not impossible for wild horses. It is unclear how reliably the surgery can be done in pregnant mares at various pregnancy stages.

Surgical Spaying – Ventral midline, oblique, or flank laparotomy
A ventral midline or oblique laparotomy is performed under general anesthesia, the horse is anesthetized and placed in dorsal recumbence. Flank laparotomy is typically performed under standing sedation but can be done under general anesthesia. The abdomen is opened, the ovaries are surgically removed, and the incision is stitched close. This maximizes safety for the surgeon and allows for direct visualization of the ovaries. This is not a technique routinely used in practice. Abdominal incisions are prone to swelling and if they become infected this would be very difficult if not impossible to manage post operatively in a wild horse. The surgery takes about 45 minutes or more per horse including induction and recovery. The surgery is not appropriate for pregnant mares after early gestation.

Ovariectomy via Colpotomy
This procedure is performed using standing sedation with a horse restrained in a stocks or squeeze chute. The surgeon accesses the ovaries through an incision in the vagina. The ovaries are anesthetized, then removed. The incision shrinks and heals quickly, with minimal risk of infection. The method has been in use on domestic horses for 100+ years and is well-established. Surgery time is about 15 minutes total, from injecting sedation to the horse walking away. The method was used in a large-scale USFWS project on the Sheldon National Wildlife Refuge, with less than 2% mortality rate. The surgeon must be skilled at handling internal organs without seeing them. There is some risk to the surgeon because the horse may kick out or sit down while the surgeon's arm is in the animal.

Laparoscopic-Assisted Colpotomy for Ovariectomy

The use of a laparoscope to assist with an ovariectomy via colpotomy allows the surgeon to visualize the ovaries prior to removal, which has potential to reduce risks associated with

transection of the ovary and associated bleeding at that location. However, the inclusion of laparoscopy requires an increased duration (at least 20–30 minutes for bilateral ovariectomy as per Tate et al. 2012). In the transcript of Bowen (2015, p. 17) it was discussed that a laparoscope could be used to train veterinarians in ovariectomy via colpotomy, but it would not likely be preferred for field conditions and wild horses.

Oviduct Blockage

This non-surgical procedure causes a long-term blockage of the oviduct, so that fertile eggs cannot go from the ovaries to the uterus. One form of this procedure infuses medical cyanoacrylate glue into the oviduct to cause long-term blockage (Bigolin et al. 2009). Treated mares would need to be screened to ensure they are not pregnant. The procedure is transcervical, so the treated mare cannot have a fetus in the uterus at the time of treatment. The mare would be sterile, although she would continue to have estrus cycles.

Cervical Resection

This brief surgical procedure involves an incision across the circular muscles that contract to close the cervix. As seen through a speculum, the cervix is grasped with forceps, and cut with a surgical tool. The result of having an incompetent cervix is that embryos are lost from the uterus before implantation. After cervical resection, mares should not be able to keep future pregnancies. However, existing fetuses that are already implanted in the uterine wall should continue developing through to normal foaling.

Pharmacological or Immunocontraceptive Sterilization

At this time (May 2020) BLM has not yet identified a pharmacological or immunocontraceptive method to sterilize mares that would be suitable for wild mares. However, there is the possibility that future development and testing of new methods could make an injectable sterilant available for wild horse mares. BLM cannot analyze some aspects of the specific method that may be used in the future, but analyses of the effects of having sterile mares as a part of the Confusion HMA herd, such as due to surgical sterilization, would likely be applicable to non-surgical methods as well.

Review

Spaying via Flank Laparoscopy

Flank laparoscopy is now commonly used in domestic mares due to its minimal invasiveness and full observation of the operative field (Lee and Hendrickson 2008). Ovariectomy via flank laparoscopy was seen as the lowest risk method in terms of mortality and morbidity when discussed in Bowen (2015). Flank laparoscopy requires a far longer surgical duration than ovariectomy via colpotomy and requires that the patient remain standing still for the duration of the surgery, which may be over 45 minutes (Bowen 2015). During that time, the horse must be maintained in an anesthetic plane that prevents it from making sudden movements. If the mare is not still during surgery, there is a risk that the instruments placed inside the body cavity may damage internal organs or that the instruments may become malfunctional. The long duration and requirement that mares stand peacefully reduce the likelihood that this surgical method

would be feasible for most wild horses. BLM is not aware of any studies documenting the use of ovariectomy via flank laparoscopy in wild mares.

This surgical approach costs at least $450–$500 per mare (Bowen et al. 2015), but with inflation since 2015 may be higher. The procedure involves three small incisions on each flank of the animal, through which three cannulas (tubes) allow entry of narrow devices to the body cavity: these are the insufflator, endoscope, and surgical instrument. The surgical procedure involves the use of narrow instruments introduced into the abdomen, via cannulas, for the purpose of transecting the ovarian pedicle, but the insufflation should allow the veterinarian to navigate inside the abdomen without damaging other internal organs. The insufflator blows air into the cavity to increase the operating space between organs, and the endoscope provides a video feed to visualize the operation of the surgical instrument. Flank laparoscopy may leave three small (<5 cm), visible scars on each side of the horse's flank, which would be subject to infection and dehiscence. It may be possible to access both ovaries from one side of the animal, using longer surgical tools. Because of the three or six external wounds, domestic mares recovering from surgery are typically confined alone in small pens after surgery for several days. Experience handling wild animals in relatively confined areas shows that wild horses, as compared to domestic horses, cannot and should not be restrained for long periods of time or confined in individual pens that prevent them from rolling or interacting with other horses. Restraint for long periods of time (days) would induce additional stress on a wild animal as well as added risk when the treated animals would fight the restraint. Fowler (2008) cautioned that, "Animals may become overstimulated with an epinephrine rush during restraint procedures. They may be inclined to and capable of, feats of athleticism beyond imagination"; such struggles could cause unnecessary injury. Furthermore, rolling on the ground is not conducive to external wound healing. If the patient does not roll and remove bandages to expose the wound from flank laparoscopy, it is expected that the tissues and musculature under the skin at the site of the incisions in the flank will heal quickly, leaving no long-lasting effects on horse health. However, as noted above, preventing (by restraint) wild horses from rolling is not expected to be safe for the animal.

BLM is unaware of previous use of flank laparoscopy, or other flank approaches, for ovariectomy on ungentled mares. Therefore BLM must reach out to experts, as was done through Bowen (2015), for interpretation of the potential applicability of this technique on wild horses. The above discussions indicate to BLM that until adjustments are made to this technique showing that this method can be successfully demonstrated in conditions that are comparable to those expected for wild horse mares, spaying via flank laparoscopy may be technically infeasible for application due to the higher risk of infection at external incision sites, the time required to perform each surgery, and the post-surgical care requirements.

Surgical Spaying – Ventral midline, oblique, or flank laparotomy

The ventral midline or oblique laparotomy is performed under general anesthesia, the horse is anesthetized and placed in dorsal recumbence. Flank laparotomy is typically performed under standing sedation, but can be done under general anesthesia. In each of these approaches one to two large incisions are made and the abdomen is opened; the ovaries are surgically removed and

the incision(s) is stitched closed. Dorsal recumbence maximizes safety for the surgeon while the standing sedation is cheaper and has less risk to the horse. All three approaches allow for direct visualization of the ovaries. These surgeries take about 45 minutes or more per horse including induction and recovery. Abdominal incisions are prone to swelling and if they become infected this would be very difficult if not impossible to manage post operatively in a wild horse. If bandages are needed to help prevent inflection, it is unlikely that wild horses would keep them on. Biting and kicking of incision sites creates higher risk for infection and complications and is not reasonably preventable with wild horses. Incision complications under sterile conditions with domestic horses are 5% and under field conditions may be 10-20% (Bowen 2015). Anywhere between 4 and 12 weeks recovery time is needed before full exercise and natural servicing should be allowed (Loesch and Rodgerson 2003). These surgeries are not appropriate for pregnant mares after early gestation. These approaches cost approximately $350 or more per mare. See Appendix H for more information.

Laparoscopic-Assisted Colpotomy for Ovariectomy

Laparoscopic-assisted colpotomy allows the surgeon to visualize the ovaries prior to removal, which has potential to reduce risks associated with transection of the ovary and associated bleeding at that location. However, the inclusion of laparoscopy requires an increased duration (at least 20–30 minutes for bilateral ovariectomy as per Tate et al. 2012), which adds stress to an already stressed animal; requires insufflation of the abdomen, which can cause post-laparoscopic pain due to the pneumoperitoneum created (Devick et al. 2018); and requires external (flank) incisions for insertion of the laparoscope, which necessitates post-operative restraint and increases the risk of infection (discussed above). In the transcript of Bowen (2015, p. 17) it was discussed that a laparoscope could be used to train veterinarians in ovariectomy via colpotomy, but it would not likely be preferred for field conditions and wild horses due to the reasons described above. This procedure conducted on domestic horses in a veterinary teaching hospital costs approximately $2,500 per mare (including two nights' board). To BLM's knowledge, this procedure has never been conducted on ungentled mares and, therefore, best estimates for costs in a field setting and in larger quantities of wild mares would be approximately $750 to $1,500 each.

Non-surgical, Physical Sterilization

This type of procedure would include any physical form of sterilization that does not involve surgery. This could include any form of physical procedure that leads a mare to be unable to become pregnant, or to maintain a pregnancy. For example, one form of physical, non-surgical sterilization causes a long-term blockage of the oviduct, so that fertile eggs cannot go from the ovaries to the uterus. The mare retains her ovaries. The mare would be sterile, although she would continue to have estrus cycles. Because of the retention of estrus cycles, it is expected that behavioral outcomes would be similar to those observed for PZP vaccine treated mares. The procedure is transcervical, so the treated mare cannot have a fetus in the uterus at the time of treatment. Treated mares would need to be screened to ensure they are not pregnant, because transcervical procedures can cause a pregnancy to terminate. Screening could be with transrectal palpation or ultrasonography. Those procedures require restraint and evacuation of the colon, and for a veterinarian to feel across the rectum, or hold an ultrasound probe there, but do not

require sedation or analgesia.

The oviduct blockage form of physical sterilization infuses medical-grade N-butyl cyanoacrylate glue into the oviduct to cause long-term blockage (Bigolin et al. 2009). A pilot project used this approach in six domestic mares, and has shown that after three years of breeding by a fertile stallion, all six mares remained infertile (Dr. I. Liu, UC Davis Emeritus Professor, personal communication to BLM). A three person team of experts is required to manipulate and operate an endoscope monitor, insert and hold the endoscope, manipulate and position a fine-tipped catheter into the oviduct, and infuse the fluid into the oviduct. After restraint, sedation and analgesic administration, fecal material is removed from the rectum, the tail is wrapped and suspended, and the vaginal area is cleaned with betadine. An endoscope is inserted through the cervix to the uterotubal junction (which is the entrance to the oviduct). A sterile catheter is inserted into the uterotubal junction. A half mL of N-butyl cyanoacrylate is infused into each oviduct. A new catheter is used for the procedure on the second oviduct. The mares are monitored initially for 10 minutes, but no further pain management is expected to be needed. The total time required for the procedure is approximately 30-40 minutes, and costs may be approximately $500-1000.

Ovariectomy via Colpotomy

Colpotomy is a surgical technique in which there is no external incision, reducing susceptibility to infection. For this reason, ovariectomy via colpotomy has been identified as a good choice for feral or wild horses (Rowland et al. 2018). Ovariectomy via colpotomy is a relatively short surgery, with a relatively quick expected recovery time. Surgery cost is approximately $250-$300 dollars per mare.

In 1903, Williams first described a vaginal approach, or colpotomy, using an ecraseur to ovariectomize mares (Loesch and Rodgerson 2003). The ovariectomy via colpotomy procedure has been conducted for over 100 years, normally on open (non-pregnant) domestic mares. Removal of the ovaries is permanent and 100 percent effective; however, the procedure is not without risk. In its review, the NRC (2013) briefly discussed surgical ovariectomy (removal of the ovaries) as a method of female-directed fertility control, noting that although ovariectomy is commonly used in domestic species, it has been seldom applied to free-ranging species. The committee cautioned that “the possibility that ovariectomy may be followed by prolonged bleeding or infection makes it inadvisable for field application” (NRC Review 2013); however, they explained that ovariectomy via colpotomy was an alternative approach that avoids an external incision and reduces the chances of complication and infection (NRC Review 2013). This NRC Review (2013) was prior to the Collins and Kasbohm (2017) publication where 114 feral horse mares were treated with ovariectomy via colpotomy with results showing a less than two percent mortality rate associated with the procedure. Although gestational stage was not recorded, many of the mares treated were pregnant (Gail Collins, US Fish and Wildlife Service (USFWS), pers. comm.). The NRC (2013) also noted that no fertility control method existed that did not affect physiology or behavior. The committee warned that the impacts of not managing population numbers were potentially harsher than contraception, as population numbers would likely be limited by starvation (NRC Review 2013).

The surgical outcomes that were reported from management use of ovariectomy (spaying) via colpotomy at Sheldon NWR (Collins and Kasbohm 2017) are strong evidence that this method can be used in wild horse management, with an acceptable level of safety for people and treated horses. Also, behavioral observations from Collins and Kasbohm (2017) demonstrated that ovariectomized (spayed) mares were always observed with other feral horses. This result indicates that spayed mares continued to have social relationships with other feral horses in the Sheldon NWR. Collins and Kasbohm (2017) definitively showed that feral horse herd growth rates decreased in proportion to the fraction of mares in the herd that were spayed.

Given the published scientific studies that are already available, BLM is not required to have completed its own ovariectomy via colpotomy study, such as the one that was proposed to have taken place at the Warm Springs HMA in Oregon, before using the method in wild horse management. There is ample evidence from available published literature to make informed decisions about the suitability, safety, and management application of surgical ovariectomy via colpotomy, as demonstrated in the literature review for this (Confusion HMA) EA. BLM's decision to attempt a study of the surgical, behavioral, and population-level effects of ovariectomy via colpotomy (at Warm Springs HMA) does not preclude the agency from considering use of the technique at other HMAs, consistent with the WFRHBA. There is no statute or regulation that requires BLM to conduct or wait for the results of any study before it uses a particular population control method, and the notion cannot be squared with the WFRHBA, which expressly authorizes sterilization. The EA associated with the proposed Warm Springs HMA study made clear that no future BLM decisions would depend directly on results from that planned study. At no time did BLM suggest that further management decisions about surgical sterilization would be suspended until and unless the proposed Warm Springs HMA study took place.

Anticipated Complications and Complication Rates Associated with Ovariectomy via Colpotomy

Between 2009 and 2011, the Sheldon NWR in Nevada conducted ovariectomy via colpotomy surgeries (August through October) on 114 feral mares and released them back to the range with a mixture of sterilized stallions and untreated mares and stallions (Collins and Kasbohm 2017). As stated previously, gestational stage was not recorded, but a majority of the mares were pregnant in the Sheldon NWR study. Only a small number of mares were very close to full term (Gail Collins, USFWS, pers. comm.). Those mares with late term pregnancies did not receive surgery as the veterinarian could not get good access to the ovaries due to the position of the foal (Gail Collins, USFWS, pers. comm.). After holding the mares for an average of 8 days after surgery for observation, they were returned to the range with other treated and untreated mares and stallions (Collins and Kasbohm 2017). During holding the only complications were observed within 2 days of surgery. The observed mortality rate for ovariectomized mares following the procedure was less than 2 percent (Collins and Kasbohm 2017, Pielstick pers. comm.). Similar to these findings, Prado and Schumacher (2017) reported observation of "… only two surgical complications after performing over 100 ovariectomies by colpotomy."

The proposed action does not include treatment of pregnant mares. Collins and Kasbohm (2017) reported less than 2 percent mortality rate, but did not note any relationship between mortality

and pregnancy status; however, treating only open (non-pregnant) mares may reduce additional risks associated with the maintenance of a pregnancy. During the Sheldon NWR ovariectomy study, mares generally walked out of the chute and started to eat; some would raise their tail and act as if they were defecating; however, in most mares one could not notice signs of discomfort (Bowen 2015). In their discussion of ovariectomy via colpotomy, McKinnon and Vasey (2007) considered the procedure safe and efficacious in many instances, able to be performed expediently by personnel experienced with examination of the female reproductive tract, and associated with a complication rate that is similar to or less than male castration. Nevertheless, all surgery is associated with some risk. Bilateral ovariectomy through either a colpotomy or flank approach can be performed efficiently in a standing mare, but potentially serious complications can occur with these approaches; unidentified and potentially fatal hemorrhage from the mesovarium, intestinal and mesenteric trauma, peritonitis, adhesions, and death are complications associated with both approaches (Rodgerson et al. 2001). Loesch and and Rodgerson (2003) add to the potential risks with colpotomy: pain and discomfort, delayed vaginal healing, evisceration of the bowel, incisional site hematoma, intra-abdominal adhesions to the vagina, and chronic lumbar or bilateral hind limb pain. Prado and Schumacher (2017) added hemorrhage from the ovarian pedicle as a potential complication. Shock is also a possibility that could be associated with any surgery. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, as reported by Prado and Schumacher (2017), including feral horses (Collins and Kasbohm 2017). In the two out of 100 horses observed to have surgical complications from ovariectomy via colpotomy, Prado and Schumacher (2017) stated one mare experienced severe hemorrhage at the ovarian pedicle and the other strained after surgery, presumably because of vaginitis induced by an unsuccessful attempt to suture the colpotomy. Both mares survived, however the mare experiencing severe hemorrhage required multiple blood transfusions. Blood transfusions are not possible when applying this procedure to wild horse mares as blood from acceptable donors would not be available. Measures are in place, described in the proposed action, to minimize the risk of hemorrhage at the ovarian pedicle. A complication of the colpotomy itself is fatal hemorrhage cause by inadvertent perforation of the vaginal artery with a scalpel blade, “but this artery is avoided if it is located by palpation before the fornix of the vagina is incised and if the incision is created at the proper location (Embertson 2009, Prado and Schumacher 2017).” Prado and Schumacher (2017) also considered evisceration a possibility, but considered it rare. Mortality due to surgery or post-surgical complications is not anticipated, but it is a possibility and therefore every effort would be made to mitigate risks.

In September 2015, the BLM solicited the USGS to convene a panel of veterinary experts to assess the relative merits and drawbacks of several surgical ovariectomy techniques that are commonly used in domestic horses for potential application in wild horses. A table summarizing the various methods was received by the BLM (Bowen 2015 and Appendix F) and provides a concise comparison of several methods. Of these, ovariectomy via colpotomy was found to be relatively safe when practiced by an experienced surgeon and was associated with the shortest duration of potential complications after the operation. The panel discussed the potential for evisceration through the vaginal incision with this procedure. In marked contrast to a suggestion by the NRC Review (2013) who explained that domestic mares are typically cross-tied to keep them standing for 48 hours post-surgery to prevent evisceration through the unclosed incision in

the anterior vagina, this panel of veterinarians (Bowen 2015) identified evisceration as not being a probable risk associated with ovariectomy via colpotomy and "none of the panel participants had had this occur nor had heard of it actually occurring."

One reason why evisceration is rarely observed could be the small, vaginal incision (1–3 cm long) enlarged by blunt dissection. "This method separates rather than transects the muscle fibers so the incision decreases in length when the vaginal muscles contract after the tranquilization wanes post-surgery. Three days post-op the incision edges are adhered, and healed after 7–10 days" (Bowen 2015).

Most spay surgeries on mares have low morbidity[1] and with the help of medications pain and discomfort can be mitigated. Pain management is an important aspect of any ovariectomy (Rowland et al. 2018); according to the surgical protocol described in the proposed action, a long-lasting direct anesthetic would be applied to the ovarian pedicle, and systemic analgesics in the form of butorphanol and flunixin meglumine would be administered. In a study of the effects of bilateral ovariectomy via colpotomy on 23 mares, Hooper and others (1993) reported that post-operative problems were minimal (1 in 23, or 4 percent). Hooper and others (1993) noted that four other mares were reported by owners as having some problems after surgery, but that evidence as to the role the surgery played in those subsequent problems was inconclusive. In contrast, Röcken and others (2011) noted a morbidity of 10.8 percent for mares that were ovariectomized via a flank laparoscopy. "Although 5 mares in our study had problems (repeated colic in 2 mares, signs of lumbar pain in 1 mare, signs of bilateral hind limb pain in 1 mare, and clinical signs of peritonitis in 1 mare) after surgery, evidence is inconclusive in each as to the role played by surgery" (Hooper et al. 1993). A recent study showed a 2.5 percent complication rate where one mare of 39 showed signs of moderate colic after laparoscopic ovariectomy (Devick et al. 2018).

The NRC (BLM 2015) who reviewed an ovariectomy via colpotomy protocol on wild horse mares believed "this procedure could be operationalized immediately to sterilize mares, with the caveat that fatalities may be higher than the 1% reported in the literature…and quoted in the protocol, which is based on domestic mares." The NRC did not explain what literature they were referencing. However, the near 1 percent reference in the protocol was referring to the, at that time, unpublished (now Collins and Kasbohm 2017) ovariectomy via colpotomy study conducted on feral horse mares at the Sheldon NWR where they documented a less than 2 percent loss.

Anticipated Effects on Mare Health and Behavior on the Range

No fertility control method exists that does not affect physiology or behavior of a mare (NRC 2013). Any action taken to alter the reproductive capacity of an individual has the potential to affect hormone production and therefore behavioral interactions and ultimately population dynamics in unforeseen ways (Ransom et al. 2014a). The health and behavioral effects of spaying wild horse mares that live with other fertile and infertile wild horses has not been well

1 Morbidity is defined as the frequency of the appearance of complications following a surgical procedure or other treatment. In contrast, mortality is defined as an outcome of death due to the procedure.

documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

Horses are anovulatory (do not ovulate/express estrous behavior) during the short days of late fall and early winter, beginning to ovulate as days lengthen and then cycling roughly every 21 days during the warmer months, with about 5 days of estrus (Asa et al. 1979, Crowell-Davis 2007). Estrus in mares is shown by increased frequency of proceptive behaviors: approaching and following the stallion, urinating, presenting the rear end, clitoral winking, and raising the tail towards the stallion (Asa et al. 1979, Crowell-Davis 2007). In most mammal species other than primates estrous behavior is not shown during the anovulatory period, and reproductive behavior is considered extinguished following spaying (Hart and Eckstein 1997). However, mares may continue to demonstrate estrous behavior during the anovulatory period (Asa et al. 1980). Similarly, ovariectomized mares may also continue to exhibit estrous behavior (Scott and Kunze 1977, Kamm and Hendrickson 2007, Crabtree 2016), with one study finding that 30 percent of mares showed estrus signs at least once after surgery (Roessner et al. 2015) and only 60 percent of ovariectomized mares cease estrous behavior following surgery (Loesch and Rodgerson 2003). Mares continue to show reproductive behavior following ovariectomy due to non-endocrine support of estrous behavior, specifically steroids from the adrenal cortex. Continuation of this behavior during the non-breeding season has the function of maintaining social cohesion within a horse group (Asa et al. 1980, Asa et al. 1984, NRC Review 2013). This may be a unique response of the horse (Bertin et al. 2013), as spaying usually greatly reduces female sexual behavior in companion animals (Hart and Eckstein 1997). In six ponies, mean monthly plasma luteinizing hormone2 levels in ovariectomized mares were similar to intact mares.

The likely effects of spaying on mares' social interactions and group membership can be inferred from available literature, even though wild horses have rarely been spayed and released back into the wild, resulting in few studies that have investigated their behavior in free-roaming populations. Wild horses are instinctually herd-bound and this behavior is expected to continue. However, no study has documented the rate at which spayed mares will continue to remain with the stallion and band to which the mare was most recently attached. Overall, the BLM anticipates that some spayed mares may continue to exhibit estrous behavior that could foster band cohesion. If free-ranging ovariectomized mares show estrous behavior and occasionally allow copulation, interest of the stallion may be maintained, which could foster band cohesion (NRC Review 2013). This last statement could be validated by the observations of group associations on the Sheldon NWR where feral mares were ovariectomized via colpotomy and released back onto the range with untreated horses of both sexes (Collins and Kasbohm 2017). No data were collected on inter- or intra-band behavior (e.g. estrous display, increased tending by stallions, etc.). During multiple aerial surveys in years following treatment, all treated individuals appeared to maintain group associations, and there were no groups consisting only of treated males or only of treated females (Collins and Kasbohm 2017). In addition, of solitary animals documented during surveys, there were no observations of solitary treated females (Collins and

2 Luteinizing hormone (LH) is a glycoprotein hormone produced in the pituitary gland. In females, a sharp rise of LH triggers ovulation and development of the corpus luteum. LH concentrations can be measured in blood plasma. the anestrous season and during the breeding season were similar to levels in intact mares at mid-estrus (Garcia and Ginther 1976).

Kasbohm 2017). These data help support the expectation that ovariectomized mares would not lose interest in or be cast out of the social dynamics of a wild horse herd. As noted by the NRC Review (2013), the ideal fertility control method would not eliminate sexual behavior or change social structure substantially.

A study conducted for 15 days in January 1978 (Asa et al. 1980), compared the sexual behavior in ovariectomized and seasonally anovulatory (intact) pony mares and found that there were no statistical differences between the two conditions for any measure of proceptivity or copulatory behavior, or days in estrus. This may help to explain why treated mares at Sheldon NWR continued to be accepted into harem bands, in that they may have been behaving similarly to a non-pregnant mare. Five to ten percent of pregnant mares exhibit estrous behavior (Crowell-Davis 2007). Although the physiological cause of this phenomenon is not fully understood (Crowell-Davis 2007), it is hypothesized to be a bonding mechanism that assists in the maintenance of stable social groups of horses year-round (Ransom et al. 2014b). The complexity of social behaviors among free-roaming horses is not entirely centered on reproductive receptivity, and fertility control treatments that suppress the reproductive system and reproductive behaviors may only lead to minimal changes to social behavior (Ransom et al. 2014b, Collins and Kasbohm 2017).

The BLM expects that wild horse family structures would continue to exist under the proposed action because fertile mares, stallions, and their foals would continue to be a component of the herd. It is not expected that spaying a subset of mares would significantly change the social structure or herd demographics (age and sex ratios) of fertile wild horses.

Movement, Body Condition, and Survival of Ovariectomized Mares

The free-roaming behavior of wild horses is not anticipated to be affected by this alternative as the definition of free-roaming is the ability to move without restriction by fences or other barriers within an HMA (H-4700-1, 2010), and there are no new, permanent physical barriers being proposed.

In domestic animals spaying is often associated with weight gain and associated increase in body fat (Fettman et al. 1997, Beckett et al. 2002, Jeusette et al. 2006, Belsito et al. 2009, Reichler 2009, Camara et al. 2014). Spayed cats had a decrease in fasting metabolic rate, and spayed dogs had a decreased daily energy requirement, but both had increased appetite (O'Farrell and Peachey 1990, Hart and Eckstein 1997, Fettman et al. 1997, Jeusette et al. 2004). In wild horses, contracepted mares tend to be in better body condition than mares that are pregnant or that are nursing foals (Nuñez et al. 2010); the same improvement in body condition is likely to take place in spayed mares. In horses spaying has the potential to increase risk of equine metabolic syndrome (leading to obesity and laminitis), but both blood glucose and insulin levels were similar in mares before and after ovariectomy over the short term (Bertin et al. 2013). For wild horses the quality and quantity of forage is unlikely to be sufficient to promote over-eating and obesity.

Coit and others (2009) demonstrated that spayed dogs have elevated levels of LH-receptor and GnRH-receptor mRNA in the bladder tissue, and lower contractile strength of muscles. They

noted that urinary incontinence occurs at elevated levels in spayed dogs and in post-menopausal women. Thus, it is reasonable to suppose that some ovariectomized mares could also suffer from elevated levels of urinary incontinence.

Sterilization had no effect on movements and space use of feral cats or brushtail possums (Ramsey 2007, Guttilla and Stapp 2010), or greyhound racing performance (Payne 2013). Rice field rats (*Rattus argentiventer*) tend to have a smaller home range in the breeding season, as they remain close to their litters to protect and nurse them. When surgically sterilized, rice field rats had larger home ranges and moved further from their burrows than hormonally sterilized or fertile rats (Jacob et al. 2004). Spayed possums and foxes (*Vulpes vulpes*) had a similar core range area after spay surgery compared to before and were no more likely to shift their range than intact females (Saunders et al. 2002, Ramsey 2007).

The likely effects of spaying on mares' home range and habitat use can also be surmised from available literature. Bands of horses tend to have distinct home ranges, varying in size depending on the habitat and varying by season but always including a water source, forage, and places where horses can shelter from inclement weather or insects (King and Gurnell 2005). It is unlikely that spayed mares will change their spatial ecology, but being free from the energy demands of lactation may imply they could spend more time away from water sources and increase their home range size. Lactating mares need to drink every day, but during the winter when snow can fulfill water needs or when not lactating, horses can traverse a wider area (Feist and McCullough 1976, Salter 1979). During multiple aerial surveys in years following the mare ovariectomy study at the Sheldon NWR, it was documented that all treated individuals appeared to maintain group associations, no groups consisted only of treated females, and none of the solitary animals observed were treated females (Collins and Kasbohm 2017). The result that treated females in that study maintained group associations suggests that wild mare movement patterns and travel distances may not change due to spaying.

Spaying wild horses does not change their status as wild horses under the WHB Act (as amended). In terms of whether spayed mares would continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that spayed mares would continue to roam unhindered in the Confusion HMA where this action would take place. Wild horse movements may be motivated by a number of biological impulses, including the search for forage, water, and social companionship that is not of a sexual nature. As such, a spayed animal would still be expected to have a number of internally-motivated reasons for moving across a landscape and, therefore, exhibiting "free-roaming" behavior. Despite marginal uncertainty about subtle aspects of potential changes in habitat preference, there is no expectation that spaying wild horses will cause them to lose their free-roaming nature.

In this sense, a spayed wild mare would be just as much "wild" as defined by the WHB Act as any temporarily contracepted or fertile wild mare, even if her patterns of movement differ slightly. Congress specified that sterilization is an acceptable management action (16 U.S.C. 1333.b.1). Sterilization is not one of the clearly defined events that cause an animal to lose its status as a wild free-roaming horse (16 U.S.C. 1333.2.C.d). The BLM must adhere to the legal

definition of what constitutes a wild free-roaming horse3, based on the WHB Act (as amended). The BLM is not obliged to base management decisions on personal opinions, which do not meet the BLM's principle and practice to "[u]se the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer reviewed literature when it exists" (Kitchell et al. 2015).

Spaying is not expected to reduce mare survival rates. Individuals receiving fertility control often have reduced mortality and increased longevity due to being released from the costs of reproduction (Kirkpatrick and Turner 2008). Similar to contraception studies, in other wildlife species a common trend has been higher survival of sterilized females (Twigg et al. 2000, Saunders et al. 2002, Ramsey 2005, Jacob et al. 2008, Seidler and Gese 2012). Observations from the Sheldon NWR provide some insight into long-term effects of ovariectomy on feral horse survival rates. The Sheldon NWR ovariectomized mares were returned to the range along with untreated mares. Between 2007 and 2014, mares were captured, a portion treated, and then recaptured. There was a minimum of 1 year between treatment and recapture; some mares were recaptured a year later and some were recaptured several years later. The long-term survival rate of treated wild mares appears to be the same as that of untreated mares (Collins and Kasbohm 2017). Recapture rates for released mares were similar for treated mares and untreated mares.

Bone Histology

The BLM knows of no scientific, peer-reviewed literature that documents bone density loss in mares following ovariectomy. A concern has been raised in an opinion article (Nock 2013) that ovary removal in mares could lead to bone density loss. That paper was not peer reviewed nor was it based on research in wild or domestic horses, so it does not meet the BLM's standard for "best available science" on which to base decisions (Kitchell et al. 2015). Hypotheses that are forwarded in Nock (2013) appear to be based on analogies from modern humans leading sedentary lives. Post-menopausal women have a greater chance of osteoporosis (Scholz-Ahrens et al. 1996), but the BLM is not aware of any research examining bone loss in horses following ovariectomy. Bone loss in humans has been linked to reduced circulating estrogen. There have been conflicting results when researchers have attempted to test for an effect of reduced estrogen on animal bone loss rates in animal models; all experiments have been on laboratory animals, rather than free-ranging wild animals. While some studies found changes in bone cell activity after ovariectomy leading to decreased bone strength (Jerome et al. 1997, Baldock et al. 1998, Huang et al. 2002, Sigrist et al. 2007), others found that changes were moderate and transient or minimal (Scholz-Ahrens et al. 1996, Lundon et al. 1994, Zhang et al. 2007) and even returned to normal after 4 months (Sigrist et al. 2007).

Consistent and strenuous use of bones, for instance using jaw bones by eating hard feed, or using leg bones by travelling large distances, may limit the negative effects of estrogen deficiency on micro-architecture (Mavropoulos et al. 2014). The effect of exercise on bone strength in animals has been known for many years and has been shown experimentally (Rubin et al. 2001). Dr. Simon Turner, Professor Emeritus of the Small Ruminant Comparative Orthopaedic Laboratory

3 "Wild free-roaming horses and burros" means all unbranded and unclaimed horses and burros on public lands of the United States.

at Colorado State University (CSU), conducted extensive bone density studies on ovariectomized sheep, as a model for human osteoporosis. During these studies, he did observe bone density loss on ovariectomized sheep, but those sheep were confined in captive conditions, fed twice a day, had shelter from inclement weather, and had very little distance to travel to get food and water (Simon Turner, CSU Emeritus, written comm., 2015). Dr. Turner indicated that an estrogen deficiency (no ovaries) could potentially affect a horse's bone metabolism, just as it does in sheep and human females when they lead a sedentary lifestyle, but indicated that the constant weight bearing exercise, coupled with high exposure to sunlight ensuring high vitamin D levels, is expected to prevent bone density loss (Simon Turner, CSU Emeritus, written comm., 2015).

Home range size of horses in the wild has been described as 4.2 to 30.2 square miles (Green and Green 1977) and 28.1 to 117 square miles (Miller 1983). A study of distances travelled by feral horses in "outback" Australia shows horses travelling between 5 and 17.5 miles per 24 hour period (Hampson et al. 2010a), travelling about 11 miles a day even in a very large paddock (Hampson et al. 2010b). Thus, extensive movement patterns of wild horses are expected to help prevent bone loss. The expected daily movement distance would be far greater in the context of larger pastures typical of BLM ORPs. A horse would have to stay on stall rest for years after removal of the ovaries in order to develop osteoporosis (Simon Turner, CSU Emeritus, written comm. 2015), and that condition does not apply to any wild horses turned back to the range or any wild horses that go into off-range pastures.

Effects on Genetic Diversity

It is true that spayed mares are unable to contribute to the genetic diversity of a herd, but that does not lead to an expectation that the Confusion HMA would necessarily experience high levels of inbreeding because there would continue to be a core breeding population of mares present, because horses could always be introduced to augment genetic diversity if future monitoring indicates cause for that management action, and because there is an expectation of continued positive growth in the herd. Here, population growth rate expresses the annual percentage increase in the total number of animals. "Fertility control application should achieve a substantial treatment effect while maintaining some long-term population growth to mitigate the effects of environmental catastrophes" (BLM IM 2009-090). This statement applies to all population growth suppression techniques, including spaying. According to the WinEquus population model trial for population growth suppression, the health the herd would not be threatened and the population will not crash. (refer to Appendix A).

In HMAs with adequate levels of genetic diversity (i.e., well above the critical value for observed heterozygosity), or which have recent and/or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC Review (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, with the potential for

interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. It is worth noting that, although maintenance of genetic diversity at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual HMA or complex. Also, there is no BLM-wide policy that requires BLM to allow each female in a herd to reproduce. Introducing 1–2 mares every generation (about every 10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010). There would be little concern with regards to effects on genetic diversity of the herd because this action incorporates BLM's management plan for genetic monitoring and maintenance of genetic diversity.

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, including the Confusion HMA. As a result, most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives on the HMA and in the larger metapopulation of which that herd is a part. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; if fertile mares also have increased longevity as a result of improved resource conditions, this result would be expected to slow the rate of genetic diversity loss (Hailer et al. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals or a strategy with periodic gathers and removals.

There would be little concern for effects to genetic diversity of the Confusion HMA wild horses because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic diversity. Wild horses in most HMAs are descendants of a diverse range of ancestors coming from many breeds of domestic horses. Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e., human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. The Confusion HMA is no exception. Mares captured in 2016 from the Conger HMA were fitted with GPS collars to gain horses movement data for a gelding study; one of those mares after being released back to the Conger HMA made its way to the northeast end of the Swasey HMA (a distance of over 30 miles) where it was adopted into a band and remained there. The researchers monitored that mare for approximately one year before they had to drop off the collar; by which time the mare was well established in the Swasey herd. This level of movement suggests a relatively high rate of interchange between HMAs in the region, over the timescale of a horse generation. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that only in the most extreme circumstances (where all of the following conditions are met: low initial genetic diversity, low population growth rate, high proportion of mares treated, and no change in management for 50 years) would there likely be any noticeable effect

on genetic diversity or a significant probability of extirpation of a herd. Monitoring and adaptive management would reduce the probability of unacceptable results even further. Roelle and Oyler-McCance (2015) conclude that nothing in their results indicates wild horse managers should steer away from permanent contraceptive techniques, as long as results are monitored and adjustments are made if necessary.

Effects of Neutering Wild Horse Stallions

In the context of BLM wild horse and burro management, the success of neutering for fertility control can be measured successful to the extent that the treatment reduces the number of reproducing females. Neutering males can be effective in one of two ways. First, neutered males may continue to guard fertile females, preventing the females from breeding with fertile males. Second, if neutered males are included in a herd that has a higher than 50% male-to-female sex ratio, then the neutered males may comprise some of the animals within the appropriate management level (AML) of that herd, which would effectively reduce the number of females in the herd. Although these and other fertility control treatments may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, those impacts are generally minor and transient, do not prevent overall maintenance of a self-sustaining population, and do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013).

Peer-reviewed scientific literature details the expected impacts of neuter methods on wild horses and burros. No finding of excess animals is required for BLM to pursue sterilization in wild horses. Cited studies are generally limited to those involving horses, except where including studies on other species helps in making inferences about physiological or behavioral questions not yet addressed in horses or burros specifically. While most studies reviewed here refer to horses, burros are extremely similar in terms of physiology, such that expected effects are comparable, except where differences between the species are noted.

On the whole, the identified impacts at the herd level are generally transient. The principle impact to individuals treated is sterility, which is the intended outcome. Sterilization that affects individual horses does not prevent BLM from ensuring that there will be self-sustaining populations of wild horses in single herd management areas (HMAs), in complexes of HMAs, and at regional scales of multiple HMAs and complexes. Under the WFRHBA of 1971, BLM is charged with maintaining self-reproducing populations of wild horses and burros. The National Academies of Sciences (2013) encouraged BLM to manage wild horses and burros at the spatial scale of "metapopulations" – that is, across multiple HMAs and complexes in a region. In fact, many HMAs have historical and ongoing genetic and demographic connections with other HMAs, and BLM routinely moves animals from one to another to improve local herd traits and maintain high genetic diversity.

Discussions about herds that are 'non-reproducing' in whole or in part are in the context of this 'metapopulation' structure, where self-sustaining herds are typically at a spatial scale that is larger than single HMAs or even of single complexes. So long as the definition of what

constitutes a self-sustaining herd includes the larger set of HMAs that have past or ongoing demographic and genetic connections – as is recommended by the NAS 2013 report – it is clear that single HMAs and complexes can be managed as non-reproducing in whole or in part while still allowing for a self-sustaining population of wild horses or burros at the broader spatial scale. Wild horses are not an endangered species (USFWS 2015), nor are they rare.

All fertility control methods affect the behavior and physiology of treated animals (NAS 2013), and are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton et al. 2015). Contraception methods alone do not remove excess horses from an HMA's population, so one or more gathers are usually needed in order to bring the herd down to a level close to AML. Horses are long-lived, potentially reaching 20 years of age or more in the wild. Except in cases where extremely high fractions of mares are rendered infertile over long time periods of (i.e, 10 or more years), neutering would not be expected to be very effective at reducing population growth rates to the point where births would be fewer than deaths in a herd. However, even modest levels of fertility control activities can reduce the frequency of horse gather activities, and costs to taxpayers. Population growth suppression becomes less expensive if fertility control is long-lasting (Hobbs et al. 2000), such as with neutering. Because neutering animals requires capturing and handling, the risks and costs associated with capture and handling of horses may be comparable to those of gathering for removal, but with expectedly lower adoption and long-term holding costs.

Effects of handling and marking

Surgical sterilization techniques, while not reversible, may control horse reproduction without the kind of additional handling or darting that can be needed to administer contraceptive vaccines. In this sense, sterilization surgeries can be used to achieve herd management objectives with a relative minimum level of animal handling and management over the long term. The WFRHBA (as amended) indicates that management should be at the minimum level necessary to achieve management objectives (CFR 4710.4), and if neutering some fraction of a managed population can reduce population growth rates, it then follows that neutering some individuals can lead to a reduced number of handling occasions and removals of excess horses from the range, which is consistent with legal guidelines for a minimal level of management. Other fertility control options that may be temporarily effective on male horses, such as the injection of GonaCon-Equine immunocontraceptive vaccine, apparently require multiple handling occasions to achieve longer-term male infertility. Similarly, some formulations of PZP immunocontraception that are currently available for use in female wild horses and burros require handling or darting every year. By some measures, any management activities that require multiple capture operations to treat a given individual would be more intrusive for wild horses and potentially less sustainable than an activity that requires only fewer handling occasions.

It is prudent for neutered animals to be readily identifiable, either via freeze brand marks or unique coloration, so that their treatment history is easily recognized (e.g., BLM 2010). Markings may also be useful into the future to determine the approximate fraction of neutered

animals in a herd, and could provide additional insight regarding gather efficiency. BLM has instituted capture and animal welfare program guidelines to reduce the sources of handling stress in captured animals (BLM 2015). Handling may include freeze-marking, for the purpose of identifying an individual. Some level of transient stress is likely to result in newly captured horses that are not previously marked. Under past management practices, captured horses experienced increased, transient stress levels from handling (Ashley and Holcombe 2001). It is difficult to compare that level of temporary stress with long-term stress that can result from food and water limitation on the range (e.g., Creel et al. 2013), which could occur in the absence of herd management.

Most horses recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from gelding, other than the direct consequence of becoming infertile.

Observations of the long term outcomes of spaying and neutering may be recorded during routine resource monitoring work and through aerial surveys. Such observations could include but not be limited to band size, social interactions with other geldings and harem bands, distribution within their habitat, forage utilization and activities around key water sources. Periodic population inventories and future gather statistics could provide additional anecdotal information to bolster existing understandings about how logistically effective it is to manage a portion of the herd as non-breeding animals.

Neutering Males

Castration (the surgical removal of the testicles, also called gelding or neutering) is a surgical procedure for the horse sterilization that has been used for millenia. Vasectomy involves severing or blocking the vas deferens or epididymis, to prevent sperm from being ejaculated. The procedures are fairly straight forward, and have a relatively low complication rate. As noted in the review of scientific literature that follows, the expected effects of gelding and vasectomy are not scientifically controversial; they are well understood overall, even though there is some degree of uncertainty about the exact quantitative outcomes for any given individual (as is true for any natural system).

Including a portion of neutered males in a herd can lead to a reduced population-level per-capita growth rate if the neutered males prevent fertile males from mating with fertile females, or if the neutered males take some of the places that would otherwise be occupied by fertile females. By having a skewed sex ratio with fewer females than males (fertile stallions plus neutered males), the result will be that there will be a lower number of breeding females in the population. Including neutered males in herd management is not new for BLM and federal land management. Geldings have been released on BLM lands as a part of herd management in the Barren Valley complex in Oregon (BLM 2011), the Challis HMA in Idaho (BLM 2012), and the Conger HMA in Utah (BLM 2016). Vasectomized males were studied in the Flanigan HMA in Nevada and in the Beaty Butte HMA in Oregon (Eagle et al. 1993, Asa 1999). Vasectomized males and geldings were also included in US Fish and Wildlife Service management plans for the Sheldon National Wildlife Refuge that relied on sterilization and removals (Collins and

Kasbohm 2017). Taking into consideration the literature available at the time, the National Academies of Sciences concluded in their 2013 report that a form of vasectomy was one of the three most promising methods for WH&B fertility control (NAS 2013).

Nelson (1980) and Garrott and Siniff (1992) modeled potential efficacy of male-oriented contraception as a population management tool, and both studies agreed that while slowing growth, sterilizing only dominant males (i.e., harem-holding stallions) would result in marginal reduction in female fertility rates. Eagle et al. (1993) and Asa (1999) tested this hypothesis on herd management areas (HMAs) where dominant males were vasectomized. Their findings agreed with modeling results from previous studies, and they also concluded that sterilizing only dominant males would not provide the desired reduction in female fertility and overall population growth rate, assuming that the numbers of fertile females is not changed. While bands with vasectomized harem stallions tended to have fewer foals, breeding by bachelors and subordinate stallions meant that population growth still occurred – female fertility was not dramatically reduced. Therefore, for vasectomy to work to achieve fertility reduction goals, the treatment should be applied across not only dominant harem stallions. Collins and Kasbohm (2017) demonstrated that there was a reduced fertility rate in a feral horse herd with both spayed and vasectomized horses – some geldings were also present in that herd. They showed that, in the presence of between ~20-48% vasectomized stallions, fertile female reproductive rates declined in some years by more than 40%. Garrott and Siniff (1992) concluded from their modeling that male sterilization would effectively cause there to be zero population growth (the point where births roughly equal deaths) only if a large proportion of males (i.e., >85%) could be sterilized. In cases where the goal of harem stallion sterilization is to reduce population growth rates, success appears to be dependent on a stable group structure, as strong bonds between a stallion and mares reduce the probability of a mare mating an extra-group stallion (Nelson 1980, Garrott and Siniff 1992, Eagle et al. 1993, Asa 1999).

In addition to the conclusion that neutering stallions can reduce fertile female reproductive rates, neutered males can be used to reduce overall growth rates in a management strategy that does not rely on any expectation that geldings will retain harems or lead to a reduction in per-female fertility rates. By including some neutered males in a herd that also has fertile mares and stallions, the neutered males would take some of the spaces toward AML that would otherwise be taken by fertile females. If the total number of horses is constant but neutered males are included in the herd, this can reduce the number of fertile mares, therefore reducing the absolute number of foals produced. Put another way, if neutered males occupy spaces toward AML that would otherwise be filled by fertile mares, that will reduce growth rates merely by the fact of causing there to be a lower starting number of fertile mares.

Direct Effects of Neutering

No animals which appear to be distressed, injured, or in poor health or condition should be selected for gelding. Stallions should not typically be neutered within 72 hours of capture. Surgery would be performed by a veterinarian using general anesthesia and appropriate surgical techniques. The final determination of which specific animals would be gelded would be based on the professional opinion of the attending veterinarian in consultation with the Authorized

Officer (i.e., See the SOPs for neutering in the Antelope / Triple B gather EA, DOI-BLM-NV-E030-2017-010-EA).

Though neutering is a common equine surgical procedure, especially gelding, some level of minor complications after surgery may be expected (Getman 2009), and it is not always possible to predict when postoperative complications would occur. Fortunately, the most common complications are almost always self-limiting, resolving with time and exercise. Individual impacts to the stallions during and following the gelding process should be minimal and would mostly involve localized swelling and bleeding. Complications of gelding may include, but are not limited to: minor bleeding, swelling, inflammation, edema, infection, peritonitis, hydrocele, penile damage, excessive hemorrhage, and eventration (Schumacher 1996, Searle et al. 1999, Getman 2009). A small amount of bleeding is normal and generally subsides quickly, within 2-4 hours following the procedure. Some degree of swelling is normal, including swelling of the prepuce and scrotum, usually peaking between 3-6 days after surgery (Searle et al. 1999). Swelling should be minimized through the daily movements (exercise) of the horse during travel to and from foraging and watering areas. Most cases of minor swelling should be back to normal within 5-7 days, more serious cases of moderate to severe swelling are also self-limiting and are expected to resolve with exercise after one to 2 weeks. Older horses are reported to be at greater risk of post-operative edema, but daily exercise can prevent premature closure of the incision, and prevent fluid buildup (Getman 2009). In some cases, a hydrocele (accumulation of sterile fluid) may develop over months or years (Searle et al. 1999). Serious complications (eventration, anesthetic reaction, injuries during handling, etc.) that result in euthanasia or mortality during and following surgery are rare (e.g., eventration rate of 0.2% to 2.6% noted in Getman 2009, but an eventration rate of 4.8% noted in Shoemaker et al. 2004) and vary according to the population of horses being treated (Getman 2009). Normally one would expect serious complications in less than 5% of horses operated under general anesthesia, but in some populations these rates have been as high as 12% (Shoemaker 2004). Serious complications are generally noted within 3 or 4 hours of surgery but may occur any time within the first week following surgery (Searle et al. 1999). If they occur, they would be treated with surgical intervention when possible, or with euthanasia when there is a poor prognosis for recovery. Vasectomized stallions may remain fertile for up to about 6 weeks after surgery, so it is optimal if that treatment occurs well in advance of the season of mare fertility starting in the spring (NAS 2013). Vasectomy may be performed via laparoscopy (Vitoria et al. 2019), but that method is not widely used. The NAS report (2013) suggested that chemical vasectomy (reviewed in Fesseha 2017), which has been developed for dogs and cats, may be appropriate for wild horses and burros, but results from the Collins and Kasbohm (2017) study indicated that chemical vasectomy failed to block sperm transport in the treated animals (Scully et al. 2015). Despite the NAS report suggestions (2013), chemical vasectomy will not be considered for use under this alternative because of the poor outcome in that published study.

For intact stallions, testosterone levels appear to vary as a function of age, season, and harem size (Khalil et al 1998). It is expected that testosterone levels will decline over time after castration. Testosterone levels should not change due to vasectomy. Vasectomized stallions should retain their previous levels of libido. Domestic geldings had a significant prolactin

response to sexual stimulation, but lacked the cortisol response present in stallions (Colborn et al. 1991). Although libido and the ability to ejaculate tends to be gradually lost after castration (Thompson et al. 1980), some geldings continue to mount mares and intromit (Rios and Houpt 1995, Schumacher 2006).

Indirect Effects of Neutering

Other than the short-term outcomes of surgery, neutering is not expected to reduce males' survival rates. Castration is actually thought to increase survival as males are released from the cost of reproduction (Jewell 1997). In Soay sheep castrates survived longer than rams in the same cohort (Jewell 1997), and Misaki horse geldings lived longer than intact males (Kaseda et al. 1997, Khalil and Murakami 1999). Moreover, it is unlikely that a reduced testosterone level will compromise gelding survival in the wild, considering that wild mares survive with low levels of testosterone. Some fraction of geldings may not expend as much energy toward in attempts to obtain or defend a harem; it is expected that such wild geldings may have a better body condition that wild, fertile stallions. In contrast, vasectomized males may continue to defend or compete for harems in the way that fertile males do, so they are not expected to experience an increase in health or body condition due to surgery.

Depending on whether an HMA is non-reproducing in whole or in part, reproductive stallions may or may not still be a component of the population's age and sex structure. The question of whether or not a given neutered male would or would not attempt to maintain a harem is not germane to population-level management. Hypothetical changes in the behavioral choices that a given neutered stallion may make would not compromise the neutered stallion's wild and free-ranging status. It is worth noting, though, that the BLM is not required to manage populations of wild horses in a manner that ensures that any given individual maintains its social standing within any given harem or band. Neutering a subset of stallions would not prevent other fertile stallions and mares from continuing with the typical range of social behaviors for sexually active adults. For fertility control strategies where gelding is intended to reduce growth rates by virtue of sterile males defending harems, the NAS (2013) suggested that the effectiveness of gelding on overall reproductive rates may depend on the pre-castration social roles of those animals. If sex ratio manipulation is included as a management technique, then having a post-gather herd with some neutered males and a lower fraction of fertile mares necessarily reduces the absolute number of foals born per year, compared to a herd that includes more fertile mares. An additional benefit is that neutered males that would otherwise be permanently removed from the range (for adoption, sale or other disposition) may be released back onto the range where they can continue to engage in free-roaming behaviors.

Behavioral Effects of Neutering

Feral horses typically form bands composed of an adult male with 1 to 3 adult females and their immature offspring (Feist and McCullough 1976, Berger 1986, Roelle et al. 2010). In many populations, subordinate 'satellite' stallions have been observed associating with the band, although the social role of these males continues to be debated (see Feh 1999, and Linklater and Cameron 2000). Juvenile offspring of both sexes often leave the band at sexual maturity

(normally around two or three years of age (Berger 1986), but adult females may remain with the same band over a span of years. Group stability and cohesion is maintained through positive social interactions and agonistic behaviors among all members, and herding and reproductive behaviors from the stallion (Ransom and Cade 2009). Group movements and consortship of a stallion with mares is advertised to other males through the group stallion marking dung piles as they are encountered, and over-marking mare eliminations as they occur (King and Gurnell 2006).

In horses, males play a variety of roles during their lives (Deniston 1979): after dispersal from their natal band they generally live as bachelors with other young males, before associating with mares and developing their own breeding group as a harem stallion or satellite stallion. In any population of horses, not all males will achieve harem stallion status, so all males do not have an equal chance of breeding (Asa 1999). Stallion behavior is thought to be related to androgen levels, with breeding stallions having higher androgen concentrations than bachelors (Angle et al. 1979, Chaudhuri and Ginsberg 1990, Khalil et al. 1998). In one study, a bachelor with low libido had lower levels of androgens, and two-year old bachelors had higher testosterone levels than two-year olds with undescended testicles who remained with their natal band (Angle et al. 1979).

Vasectomized males continue to attempt to defend or gain breeding access to females. It is generally expected that vasectomized wild horses will continue to behave like fertile males, given that the only physiological change in their condition is a lack of sperm in their ejaculate. If a vasectomized stallion retains a harem, the females in the harem will continue to cycle until they are fertilized by another stallion, or until the end of the breeding season. As a result, the vasectomized stallion may be involved in aggressive behaviors to other males through the entire breeding season (Asa 1999), which may divert time from foraging and cause him to be in poorer body condition going into winter. Ultimately, this may lead to the stallion losing control of a given harem. Feral horse herds with high numbers of vasectomized stallions retained typical harem social structure (Asa 1999, Collins and Kasbohm 2017). Again it is worth noting that the BLM is not required to manage populations of wild horses in a manner that ensures that any given individual maintains its social standing within any given harem or band.

Neutering males by gelding adult male horses is expected to result in reduced testosterone production, which is expected to directly influence reproductive behaviors (NAS 2013), though it is not known how long after gelding surgery any change in behavior will take place. Moreover, testosterone levels alone are not a reliable predictor of masculine behavior (Line et al. 1985, Schumacher 2006). In domestic geldings, 20-30% continued to show stallion-like behavior, whether castrated pre- or post-puberty (Line et al. 1985). Gelding of domestic horses most commonly takes place before or shortly after sexual maturity, and age-at-gelding can affect the degree to which stallion-like behavior is expressed later in life. In intact stallions, testosterone levels peak increase up to an age of ~4-6 years, and can be higher in harem stallions than bachelors (Khalil et al 1998). It is assumed that free roaming wild horse geldings would generally exhibit reduced aggression toward other horses, and reduced reproductive behaviors (NAS 2013). With the exception of an ongoing study in Utah which has not yet led to published

results (BLM 2016), the behavior of wild horse geldings in the presence of intact stallions has not been well documented, but the literature review below can be used to make reasonable inferences about wild geldings' likely behaviors.

Despite livestock being managed by neutering males for millenia, and the relatively scant amount of published research on castrates' behaviors (Hart and Jones 1975), inferences about how the behaviors of geldings will change, how quickly any change will occur after surgery, or what effect gelding an adult stallion and releasing him back in to a wild horse population will have on his behavior and that of the wider population may be made from the existing literature. There is an ongoing BLM study in Utah focused on the individual and population-level effects of including some geldings in a free-roaming horse population (BLM 2016). Published results from that study are not yet available, but geldings in the first year after surgery exhibited behaviors, movements, and habitat choices that appeared to be generally comparable to fertile stallions (P. Griffin, BLM, reporting personal communication from USGS about unpublished data during the 2018 WHB Advisory Board meeting in Salt Lake City).

The effects of castration on aggression in horses have been quantified in a few cases. One report has noted that high levels of aggression continued to be observed in domestic horse geldings who also exhibited sexual behaviors (Rios and Houpt 1995). Stallion-like behavior in domestic horse geldings is relatively common (Smith 1974, Schumacher 1996), being shown in 20-33% of cases whether the horse was castrated pre- or post-puberty (Line et al. 1985, Rios and Houpt 1995, Schumacher 2006). While some of these cases may be due to cryptorchidism or incomplete surgery, it appears that horses are less dependent on hormones than other mechanisms for the maintenance of sexual behaviors (Smith 1974). Domestic geldings exhibiting masculine behavior had no difference in testosterone concentrations than other geldings (Line et al. 1985, Schumacher 2006), and in some instances the behavior appeared context dependent (Borsberry 1980, Pearce 1980).

Dogs and cats are commonly neutered, and it is also common for them to continue to exhibit reproductive behaviors several years after castration (Dunbar 1975). Dogs, ferrets, hamsters, and marmosets continued to show sexually motivated behaviors after castration, regardless of whether they had previous experience or not, although in beagles and ferrets there was a reduction in motivation post-operatively (Hart 1968, Dunbar 1975, Dixson 1993, Costantini et al. 2007, Vinke et al. 2008). Ungulates continued to show reproductive behaviors after castration, with goats and llamas continuing to respond to females even a year later in the case of goats, although mating time and the ejaculatory response was reduced (Hart and Jones 1975, Nickolmann et al. 2008).

The likely effects of castration on geldings' social interactions and group membership can be inferred from available literature. In a pasture study of domestic horses, Van Dierendonk et al. (1995) found that social rank among geldings was directly correlated to the age at which the horse was castrated, suggesting that social experiences prior to sterilization may influence behavior afterward. Of the two geldings present in a study of semi-feral horses in England, one was dominant over the mares whereas a younger gelding was subordinate to older mares; stallions were only present in this population during a short breeding season (Tyler 1972). A

study of domestic geldings in Iceland held in a large pasture with mares and sub-adults of both sexes, but no mature stallions, found that geldings and sub-adults formed associations amongst each other that included interactions such as allo-grooming and play, and were defined by close proximity (Sigurjónsdóttir et al. 2003). These geldings and sub-adults tended to remain in a separate group from mares with foals, similar to castrated Soay sheep rams (*Ovis aries*) behaving like bachelors and grouping together, or remaining in their mother's group (Jewell 1997). In Japan, Kaseda et al. (1997) reported that young males dispersing from their natal harem and geldings moved to a different area than stallions and mares during the non-breeding season. Although the situation in Japan may be the equivalent of a bachelor group in natural populations, in Iceland this division between mares and the rest of the horses in the herd contradicts the dynamics typically observed in a population containing mature stallions. Sigurjónsdóttir et al. (2003) also noted that in the absence of a stallion, allo-grooming between adult females increased drastically. Other findings included increased social interaction among yearlings, display of stallion-like behaviors such as mounting by the adult females, and decreased association between females and their yearling offspring (Sigurjónsdóttir et al. 2003). In the same population in Iceland Van Dierendonck et al. (2004) concluded that the presence of geldings did not appear to affect the social behavior of mares or negatively influence parturition, mare-foal bonding, or subsequent maternal activities. Additionally, the welfare of broodmares and their foals was not affected by the presence of geldings in the herd (Van Dierendonck et al. 2004). These findings are important because treated geldings will be returned to the range in the presence of pregnant mares and mares with foals of the year.

The likely effects of castration on geldings' home range and habitat use can also be surmised from available literature. Bands of horses tend to have distinct home ranges, varying in size depending on the habitat and varying by season, but always including a water source, forage, and places where horses can shelter from inclement weather or insects (King and Gurnell 2005). By comparison, bachelor groups tend to be more transient, and can potentially use areas of good forage further from water sources, as they are not constrained by the needs of lactating mares in a group. The number of observations of gelded wild stallion behavior are still too few to make general predictions about whether a particular gelded stallion individuals will behave like a harem stallion, a bachelor, or form a group with geldings that may go to forage and water differently from fertile wild horses.

Gelding wild horses does not change their status as wild horses under the WFRHBA (as amended). In terms of whether geldings will continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that wild geldings released back to the range would continue to roam unhindered. Wild horse movements may be motivated by a number of biological impulses, including the search for forage, water, and social companionship that is not of a sexual nature. As such, even a gelded animal that has become relatively uninterested in breeding would still be expected to have a number of internal reasons for moving across a landscape and, therefore, to still exhibit 'free-roaming' behavior. Despite marginal uncertainty about subtle aspects of potential changes in habitat preference, there is no expectation that gelding wild horses will cause them to lose their free-roaming nature. It is worth noting that individual choices in wild horse group membership, home range, and habitat use are not

protected under the WFRHBA. BLM acknowledges that geldings may exhibit some behavioral differences at some time after surgery, compared to intact stallions, but those differences are not in any way expected to remove the geldings' rebellious and feisty nature, or their defiance of man. While it may be that a gelded wild horse could have a different set of behavioral priorities than an intact wild stallion, the expectation is that wild geldings will choose to act upon their behavioral priorities in an unhindered way, just as is the case for an intact wild stallion. In the legal sense, a wild gelding would be just as much 'wild' as defined by the WFRHBA as any intact stallion, even if his patterns of movement may differ from those of an intact stallion. Congress specified that sterilization is an acceptable management action (16 USC §1333.b.1). Sterilization is not one of the clearly defined events that cause an animal to lose its status as a wild free-roaming horse (16 USC §1333.2.C.d). Several academics have offered their opinions about whether gelding a given stallion would lead to that individual effectively losing its status as a wild horse (Rutberg 2011, Kirkpatrick 2012, Nock 2017). Those opinions are based on a semantic and subjective definition of 'wild' that is not rooted in the law, while BLM must adhere to the legal definition of what constitutes a wild horse, based on the WFRHBA (as amended). Furthermore, those individuals have not conducted any studies that would test their speculative opinion that gelding wild stallions would cause them to become docile. BLM is not obliged to base management decisions on such opinions, which do not meet the BLM's principle and practice to "Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer reviewed literature when it exists" (Kitchell et al. 2015).

Genetic Effects of Neutering

It is true that neutered males are unable to contribute to the genetic diversity of the herd. BLM is not obligated to ensure that any given individual in a herd has the chance to sire a foal and pass on genetic material. Management practices in the BLM Wild Horse and Burro Handbook (2010) include measures to increase population genetic diversity in reproducing herds where monitoring reveals a cause for concern about low levels of observed heterozygosity. These measures include increasing the sex ratio to a greater percentage of fertile males than fertile females (and thereby increasing the number of males siring foals) and bringing new animals into a herd from elsewhere.

In herds that are managed to be non-reproducing, it is not a concern to maintain genetic diversity because the management goal would be that animals in such a herd would not breed.

In reproducing herds where there is a recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, spaying and neutering is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NAS report (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. It is worth noting that, although maintenance of genetic diversity

at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual herd management area or complex. Also, there is no Bureau-wide policy that requires BLM to allow each female or male in a herd to reproduce before it is treated with contraceptives or sterilized. Introducing 1-2 fertile mares every generation (about every 10 years) is a standard management technique that can alleviate potential inbreeding concerns in most cases (BLM 2010). The NAS report (2013) recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements.

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM. As a result, most alleles that are present in any given wild horse are likely to already be well represented in siblings, cousins, and more distant relatives on the HMA. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NAS 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from extant domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer et al. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Although those results are specific to mares, some inferences about potential effects of stallion sterilization may also be made from their results. Roelle and Oyler-McCance (2015) showed that the risk of the loss of genetic heterozygosity is extremely low except in cases where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5% per year), and very large fractions of the population are permanently sterilized. Given that 94 of 102 wild horse herds sampled for genetic diversity at the time of the 2013 NAS report did not meet a threshold for concern (NAS 2013), the starting level of genetic diversity in most wild horse herds is relatively high.

In a breeding herd where more than 85% of males in a population are sterile, there could be genetic consequences of reduced heterozygosity and increased inbreeding coefficients, as it would potentially allow a very small group of males to dominate the breeding (e.g., Saltz et al. 2000). Such genetic consequences could be mitigated by natural movements or human-facilitated translocations (BLM 2010). Garrott and Siniff's (1992) model predicts that gelding 50-80% of mature males in the population would reduce, but not halt, mare fertility. Also, fertile male colts that eventually become sexually mature stallions can contribute genetically to the herd.

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ATTACHMENT 1: COMPREHENSIVE ANIMAL WELFARE PROGRAM FOR WILD HORSE AND BURRO GATHERS

STANDARDS

Developed by

The Bureau of Land Management
Wild Horse and Burro Program

in collaboration with

Carolyn L. Stull, PhD
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June 30, 2015

WELFARE ASSESSMENT STANDARDS for GATHERS

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STANDARDS

Standard Definitions

Major Standard: Impacts the health or welfare of WH&Bs. Relates to an alterable equipment or facility standard or procedure. Appropriate wording is "must," "unacceptable," "prohibited."

Minor Standard: unlikely to affect WH&Bs health or welfare or involves an uncontrollable situation. Appropriate wording is "should."

Lead COR = Lead Contracting Officer's Representative

COR = Contracting Officer's Representative

PI = Project Inspector

WH&Bs = Wild horses and burros

I. FACILITY DESIGN

A. Trap Site and Temporary Holding Facility

1. The trap site and temporary holding facility must be constructed of stout materials and must be maintained in proper working condition, including gates that swing freely and latch or tie easily. (**major**)
2. The trap site should be moved close to WH&B locations whenever possible to minimize the distance the animals need to travel.(minor)
3. If jute is hung on the fence posts of an existing wire fence in the trap wing, the wire should be either be rolled up or let down for the entire length of the jute in such a way that minimizes the possibility of entanglement by WH&Bs unless otherwise approved by the Lead COR/COR/PI. (minor)
4. Fence panels in pens and alleys must be not less than 6 feet high for horses, 5 feet high for burros, and the bottom rail must not be more than 12 inches from ground level. (**major**)

5. The temporary holding facility must have a sufficient number of pens available to sort WH&Bs according to gender, age, number, temperament, or physical condition. (**major**)
    a. All pens must be assembled with capability for expansion. (**major**)
    b. Alternate pens must be made available for the following: (**major**)
        1) WH&Bs that are weak or debilitated
        2) Mares/jennies with dependent foals
    c. WH&Bs in pens at the temporary holding facility should be maintained at a proper stocking density such that when at rest all WH&Bs occupy no more than half the pen area. (minor)
6. An appropriate chute designed for restraining WH&Bs must be available for necessary procedures at the temporary holding facility. This does not apply to bait trapping operations unless directed by the Lead COR/COR/PI. (**major**)
7. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels or other structures that may cause escape or possible injury. (**major**)
8. Padding must be installed on the overhead bars of all gates and chutes used in single file alleys. (**major**)
9. Hinged, self-latching gates must be used in all pens and alleys except for entry gates into the trap, which may be secured with tie ropes. (**major**)
10. Finger gates (one-way funnel gates) used in bait trapping must be constructed of materials approved by the Lead COR/COR/PI. Finger gates must not be constructed of materials that have sharp ends that may cause injuries to WH&Bs, such as "T" posts, sharpened willows, etc. (**major**)
11. Water must be provided at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals, and environmental conditions, with each trough placed in a separate location of the pen (i.e. troughs at opposite ends of the pen). Water must be refilled at least every morning and evening. (**major**)
12. The design of pens at the trap site and temporary holding facility should be constructed with rounded corners. (minor)

13. All gates and panels in the animal holding and handling pens and alleys of the trap site must be covered with materials such as plywood, snow fence, tarps, burlap, etc. approximately 48" in height to provide a visual barrier for the animals. All materials must be secured in place.(**major**)

    These guidelines apply:

    a. For exterior fences, material covering panels and gates must extend from the top of the panel or gate toward the ground.(**major**)
    b. For alleys and small internal handling pens, material covering panels and gates should extend from no more than 12 inches below the top of the panel or gate toward the ground to facilitate visibility of animals and the use of flags and paddles during sorting. (minor)
    c. The initial capture pen may be left uncovered as necessary to encourage animals to enter the first pen of the trap. (minor)
14. Non-essential personnel and equipment must be located to minimize disturbance of WH&Bs. (**major**)
15. Trash, debris, and reflective or noisy objects should be eliminated from the trap site and temporary holding facility. (minor)

B. Loading and Unloading Areas

1. Facilities in areas for loading and unloading WH&Bs at the trap site or temporary holding facility must be maintained in a safe and proper working condition, including gates that swing freely and latch or tie easily. (**major**)
2. The side panels of the loading chute must be a minimum of 6 feet high and fully covered with materials such as plywood or metal without holes that may cause injury. (**major**)
3. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels or other structures that may cause escape or possible injury. (**major**)
4. All gates and doors must open and close easily and latch securely. (**major**)

5. Loading and unloading ramps must have a non-slip surface and be maintained in a safe and proper working condition to prevent slips and falls. Examples of non-slip flooring would include, but not be limited to, rubber mats, sand, shavings, and steel reinforcement rods built into ramp. There must be no holes in the flooring or items that can cause an animal to trip. (**major**)
6. Trailers must be properly aligned with loading and unloading chutes and panels such that no gaps exist between the chute/panel and floor or sides of the trailer creating a situation where a WH&B could injure itself. (**major**)
7. Stock trailers should be positioned for loading or unloading such that there is no more than 12" clearance between the ground and floor of the trailer for burros and 18" for horses. (minor)

II. CAPTURE TECHNIQUE

A. Capture Techniques

1. WH&Bs gathered on a routine basis for removal or return to range must be captured by the following approved procedures under direction of the Lead COR/COR/PI. (**major**)
   a. Helicopter
   b. Bait trapping
2. WH&Bs must not be captured by snares or net gunning. (**major**)
3. Chemical immobilization must only be used for capture under exceptional circumstances and under the direct supervision of an on-site veterinarian experienced with the technique. (**major**)

B. Helicopter Drive Trapping

1. The helicopter must be operated using pressure and release methods to herd the animals in a desired direction and should not repeatedly evoke erratic behavior in the WH&Bs causing injury or exhaustion. Animals must not be pursued to a point of exhaustion; the on-site veterinarian must examine WH&Bs for signs of exhaustion. (**major**)

2. The rate of movement and distance the animals travel must not exceed limitations set by the Lead COR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors. (**major**)
    a. WH&Bs that are weak or debilitated must be identified by BLM staff or the contractors. Appropriate gather and handling methods should be used according to the direction of the Lead COR/COR/PI. (**major**)
    b. The appropriate herding distance and rate of movement must be determined on a case-by-case basis considering the weakest or smallest animal in the group (e.g., foals, pregnant mares, or horses that are weakened by body condition, age, or poor health) and the range and environmental conditions present. (**major**)
    c. Rate of movement and distance travelled must not result in exhaustion at the trap site, with the exception of animals requiring capture that have an existing severely compromised condition prior to gather. Where compromised animals cannot be left on the range or where doing so would only serve to prolong their suffering, euthanasia will be performed in accordance with BLM policy. (**major**)
3. WH&Bs must not be pursued repeatedly by the helicopter such that the rate of movement and distance travelled exceeds the limitation set by the Lead COR/COR/PI. Abandoning the pursuit or alternative capture methods may be considered by the Lead COR/COR/PI in these cases. (**major**)
4. When WH&Bs are herded through a fence line en route to the trap, the Lead COR/COR/PI must be notified by the contractor. The Lead COR/COR/PI must determine the appropriate width of the opening that the fence is let down to allow for safe passage through the opening. The Lead COR/COR/PI must decide if existing fence lines require marking to increase visibility to WH&Bs. (**major**)
5. The helicopter must not come into physical contact with any WH&B. The physical contact of any WH&B by helicopter must be documented by Lead COR/COR/PI along with the circumstances. (**major**)
6. WH&Bs may escape or evade the gather site while being moved by the helicopter. If there are mare/dependent foal pairs in a group being brought to a trap and half of an identified pair is thought to have evaded capture, multiple attempts by helicopter may

be used to bring the missing half of the pair to the trap or to facilitate capture by roping. In these instances, animal condition and fatigue must be evaluated by the Lead COR/COR/PI or on-site veterinarian on a case-by-case basis to determine the number of attempts that can be made to capture an animal.(**major**)

7. Horse captures must not be conducted when ambient temperature at the trap site is below 10ºF or above 95ºF without approval of the Lead COR/COR/PI. Burro captures must not be conducted when ambient temperature is below 10ºF or above 100ºF without approval of the Lead COR/COR/PI. The Lead COR/COR/PI will not approve captures when the ambient temperature exceeds 105 ºF. (**major**)

C. Roping

1. The roping of any WH&B must be approved prior to the procedure by the Lead COR/COR/PI. (**major**).
2. The roping of any WH&B must be documented by the Lead COR/COR/PI along with the circumstances. WH&Bs may be roped under circumstances which include but are not limited to the following: reunite a mare or jenny and her dependent foal; capture nuisance, injured or sick WH&Bs or those that require euthanasia; environmental reasons such as deep snow or traps that cannot be set up due to location or environmentally sensitive designation; and public and animal safety or legal mandates for removal. (**major**)
3. Ropers should dally the rope to their saddle horn such that animals can be brought to a stop as slowly as possible and must not tie the rope hard and fast to the saddle so as to intentionally jerk animals off their feet. (**major**)
4. WH&Bs that are roped and tied down in recumbency must be continuously observed and monitored by an attendant at a maximum of 100 feet from the animal. (**major**)
5. WH&Bs that are roped and tied down in recumbency must be untied within 30 minutes. (**major**)
6. If the animal is tied down within the wings of the trap, helicopter drive trapping within the wings will cease until the tied-down animal is removed. (**major**)
7. Sleds, slide boards, or slip sheets must be placed underneath the animal's body to move and/or load recumbent WH&Bs. (**major**)

8. Halters and ropes tied to a WH&B may be used to roll, turn, position or load a recumbent animal, but a WH&B must not be dragged across the ground by a halter or rope attached to its body while in a recumbent position. (**major**)
9. Animals captured by roping must be evaluated by the on-site/on-call veterinarian within four hours after capture, marked for identification at the trap site, and be re-evaluated periodically as deemed necessary by the on-site/on-call veterinarian. (**major**)

D. Bait Trapping

1. WH&Bs may be lured into a temporary trap using bait (feed, mineral supplement, water) or sexual attractants (mares/jennies in heat) with the following requirements:
   a. The period of time water sources other than in the trap site are inaccessible must not adversely affect the wellbeing of WH&Bs, wildlife or livestock, as determined by the Lead COR/COR/PI. (**major**)
   b. Unattended traps must not be left unobserved for more than 12 hours. (**major**)
   c. Mares/jennies and their dependent foals must not be separated unless for safe transport. (**major**)
   d. WH&Bs held for more than 12 hours must be provided with accessible clean water at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals and environmental conditions. (**major**)
   e. WH&Bs held for more than 12 hours must be provided good quality hay at a minimum rate of 20 pounds per 1000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals. (**major**)
      1) Hay must not contain poisonous weeds, debris, or toxic substances. (**major**)
      2) Hay placement must allow all WH&Bs to eat simultaneously. (**major**)

III. WILD HORSE AND BURRO CARE

A. Veterinarian

1. On-site veterinary support must be provided for all helicopter gathers and on-site or on-call support must be provided for bait trapping. (**major**)

2. Veterinary support must be under the direction of the Lead COR/COR/PI. The on-site/on-call veterinarian will provide consultation on matters related to WH&B health, handling, welfare, and euthanasia at the request of the Lead COR/COR/PI. All decisions regarding medical treatment or euthanasia will be made by the on-site Lead COR/COR/PI. (**major**)

B. Care

1. Feeding and Watering
   a. Adult WH&Bs held in traps or temporary holding pens for longer than 12 hours must be fed every morning and evening with water available at all times other than when animals are being sorted or worked. (**major)**
   b. Water must be provided at a minimum rate of ten gallons per 1000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals, and environmental conditions, with each trough placed in a separate location of the pen (i.e. troughs at opposite ends of the pen). . (**major**)
   c. Good quality hay must be fed at a minimum rate of 20 pounds per 1000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals. (**major**)
      i. Hay must not contain poisonous weeds or toxic substances. (**majo**r)
      ii. Hay placement must allow all WH&Bs to eat simultaneously. (**major**)
   d. When water or feed deprivation conditions exist on the range prior to the gather, the Lead COR/COR/PI should adjust the watering and feeding arrangements in consultation with the onsite veterinarian as necessary to provide for the needs of the animals. (minor)
2. Dust abatement
   a. Dust abatement by spraying the ground with water must be employed when necessary at the trap site and temporary holding facility. (**major**)

3. Trap Site
    a. Dependent foals or weak/debilitated animals must be separated from other WH&Bs at the trap site to avoid injuries during transportation to the temporary holding facility. Separation of dependent foals from mares must not exceed four hours unless the Lead COR/COR/PI authorizes a longer time or a decision is made to wean the foals. (**major**)
4. Temporary Holding Facility
    a. All WH&Bs in confinement must be observed at least once daily to identify sick or injured WH&Bs and ensure adequate food and water. (**major**)
    b. Foals must be reunited with their mares/jennies at the temporary holding facility within four hours of capture unless the Lead COR/COR/PI authorizes a longer time or foals are old enough to be weaned during the gather. (**major**)
    c. Non-ambulatory WH&Bs must be located in a pen separate from the general population and must be examined by the BLM horse specialist and/or on-call or on-site veterinarian as soon as possible, no more than four hours after recumbency is observed. Unless otherwise directed by a veterinarian, hay and water must be accessible to an animal within six hours after recumbency.(**major**)
    d. Alternate pens must be made available for the following: (**major**)
        1) WH&Bs that are weak or debilitated
        2) Mares/jennies with dependent foals
    e. Aggressive WH&Bs causing serious injury to other animals should be identified and relocated into alternate pens when possible. (minor)
    f. WH&Bs in pens at the temporary holding facility should be maintained at a proper stocking density such that when at rest all WH&Bs occupy no more than half the pen area. (minor)

C. Biosecurity

1. Health records for all saddle and pilot horses used on WH&B gathers must be provided to the Lead COR/COR/PI prior to joining a gather, including: (**major**)
   a. Certificate of Veterinary Inspection (Health Certificate, within 30 days).
   b. Proof of:
      1) A negative test for equine infectious anemia (Coggins or EIA ELISA test) within 12 months.
      2) Vaccination for tetanus, eastern and western equine encephalomyelitis, West Nile virus, equine herpes virus, influenza, *Streptococcus equi*, and rabies within 12 months.
2. Saddle horses, pilot horses and mares used for bait trapping lures must not be removed from the gather operation (such as for an equestrian event) and allowed to return unless they have been observed to be free from signs of infectious disease for a period of at least three weeks and a new Certificate of Veterinary Examination is obtained after three weeks and prior to returning to the gather. (**major**)
3. WH&Bs, saddle horses, and pilot horses showing signs of infectious disease must be examined by the on-site/on-call veterinarian. (**major**)
   a. Any saddle or pilot horses showing signs of infectious disease (fever, nasal discharge, or illness) must be removed from service and isolated from other animals on the gather until such time as the horse is free from signs of infectious disease and approved by the on-site/on-call veterinarian to return to the gather. (**major**)
   b. Groups of WH&Bs showing signs of infectious disease should not be mixed with groups of healthy WH&Bs at the temporary holding facility, or during transport. (minor)
4. Horses not involved with gather operations should remain at least 300 yards from WH&Bs, saddle horses, and pilot horses being actively used on a gather. (minor)

IV. HANDLING

A. Willful Acts of Abuse

1. Hitting, kicking, striking, or beating any WH&B in an abusive manner is prohibited. (**major**)
2. Dragging a recumbent WH&B without a sled, slide board or slip sheet is prohibited. Ropes used for moving the recumbent animal must be attached to the sled, slide board or slip sheet unless being loaded as specified in Section II. C. 8. (**major**)
3. There should be no deliberate driving of WH&Bs into other animals, closed gates, panels, or other equipment. (minor)
4. There should be no deliberate slamming of gates and doors on WH&Bs. (minor)
5. There should be no excessive noise (e.g., constant yelling) or sudden activity causing WH&Bs to become unnecessarily flighty, disturbed or agitated. (minor)

B. General Handling

1. All sorting, loading or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the Lead COR/CO/PI approves the use of supplemental light. (**major**)
2. WH&Bs should be handled to enter runways or chutes in a forward direction. (minor)
3. WH&Bs should not remain in single-file alleyways, runways, or chutes longer than 30 minutes. (minor)
4. Equipment except for helicopters should be operated and located in a manner to minimize flighty behavior . (minor)

C. Handling Aids

1. Handling aids such as flags and shaker paddles must be the primary tools for driving and moving WH&Bs during handling and transport procedures. Contact of the flag or paddle end of primary handling aids with a WH&B is allowed. Ropes looped around the hindquarters may be used from horseback or on foot to assist in moving an animal forward or during loading. (**major**)

2. Electric prods must not be used routinely as a driving aid or handling tool. Electric prods may be used in limited circumstances only if the following guidelines are followed:
    a. Electric prods must only be a commercially available make and model that uses DC battery power and batteries should be fully charged at all times. (**major**)
    b. The electric prod device must never be disguised or concealed. (**major**)
    c. Electric prods must only be used after three attempts using other handling aids (flag, shaker paddle, voice or body position) have been tried unsuccessfully to move the WH&Bs. (**major**)
    d. Electric prods must only be picked up when intended to deliver a stimulus; these devices must not be constantly carried by the handlers. (**major**)
    e. Space in front of an animal must be available to move the WH&B forward prior to application of the electric prod. (**major**)
    f. Electric prods must never be applied to the face, genitals, anus, or underside of the tail of a WH&B. (**major**)
    g. Electric prods must not be applied to any one WH&B more than three times during a procedure (e.g., sorting, loading) except in extreme cases with approval of the Lead COR/COR/PI. Each exception must be approved at the time by the Lead COR/COR/PI. (**majo**r)
    h. Any electric prod use that may be necessary must be documented daily by the Lead COR/COR/PI including time of day, circumstances, handler, location (trap site or temporary holding facility), and any injuries (to WH&B or human). (**major**)

V. TRANSPORTATION

A. General

1. All sorting, loading, or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the Lead COR/CO/PI approves the use of supplemental light. (**major**)

2. WH&Bs identified for removal should be shipped from the temporary holding facility to a BLM facility within 48 hours. (minor)
    a. Shipping delays for animals that are being held for release to range or potential on-site adoption must be approved by the Lead COR/COR/PI. (**major**)
3. Shipping should occur in the following order of priority; 1) debilitated animals, 2) pairs, 3) weanlings, 4) dry mares and 5) studs. (minor)
4. Planned
5. transport time to the BLM preparation facility from the trap site or temporary holding facility must not exceed 10 hours. (**major**)
6. WH&Bs should not wait in stock trailers and/or semi-trailers at a standstill for more than a combined period of three hours during the entire journey. (minor)

B. Vehicles

1. Straight-deck trailers and stock trailers must be used for transporting WH&Bs. (**major**)
    a. Two-tiered or double deck trailers are prohibited. (**major**)
    b. Transport vehicles for WH&Bs must have a covered roof or overhead bars containing them such that WH&Bs cannot escape. (**major**)
2. WH&Bs must have adequate headroom during loading and unloading and must be able to maintain a normal posture with all four feet on the floor during transport without contacting the roof or overhead bars. (**major**)
3. The width and height of all gates and doors must allow WH&Bs to move through freely. (**major**)
4. All gates and doors must open and close easily and be able to be secured in a closed position. (**major**)
5. The rear door(s) of the trailers must be capable of opening the full width of the trailer. (**major**)
6. Loading and unloading ramps must have a non-slip surface and be maintained in proper working condition to prevent slips and falls. (**major**)

7. Transport vehicles more than 18 feet and less than 40 feet in length must have a minimum of one partition gate providing two compartments; transport vehicles 40 feet or longer must have at least two partition gates to provide a minimum of three compartments. (**major**)
8. All partitions and panels inside of trailers must be free of sharp edges or holes that could cause injury to WH&Bs. (**major**)
9. The inner lining of all trailers must be strong enough to withstand failure by kicking that would lead to injuries. (**major**)
10. Partition gates in transport vehicles should be used to distribute the load into compartments during travel. (minor)
11. Surfaces and floors of trailers must be cleaned of dirt, manure and other organic matter prior to the beginning of a gather. (**major**)

C. Care of WH&Bs during Transport Procedures

1. WH&Bs that are loaded and transported from the temporary holding facility to the BLM preparation facility must be fit to endure travel. (**major**)
   a. WH&Bs that are non-ambulatory, blind in both eyes, or severely injured must not be loaded and shipped unless it is to receive immediate veterinary care or euthanasia. (**major**)
   b. WH&Bs that are weak or debilitated must not be transported without approval of the Lead COR/COR/PI in consultation with the on-site veterinarian. Appropriate actions for their care during transport must be taken according to direction of the Lead COR/COR/PI. (**major**)
2. WH&Bs should be sorted prior to transport to ensure compatibility and minimize aggressive behavior that may cause injury. (minor)
3. Trailers must be loaded using the minimum space allowance in all compartments as follows: (**major**)
   a. 12 square feet per adult horse.
   b. 6.0 square feet per dependent horse foal.
   c. 8.0 square feet per adult burro.
   d. 4.0 square feet per dependent burro foal.

4. The Lead COR/COR/PI in consultation with the receiving Facility Manager must document any WH&B that is recumbent or dead upon arrival at the destination. (**major**)
    a. Non-ambulatory or recumbent WH&Bs must be evaluated on the trailer and either euthanized or removed from the trailers using a sled, slide board or slip sheet. (**major**)
5. Saddle horses must not be transported in the same compartment with WH&Bs. (**major**)

VI. EUTHANASIA OR DEATH

A. Euthanasia Procedure during Gather Operations

1. An authorized, properly trained, and experienced person as well as a firearm appropriate for the circumstances must be available at all times during gather operations. When the travel time between the trap site and temporary holding facility exceeds one hour or if radio or cellular communication is not reliable, provisions for euthanasia must be in place at both the trap site and temporary holding facility during the gather operation. (**major**)
2. Euthanasia must be performed according to American Veterinary Medical Association euthanasia guidelines (2013) using methods of gunshot or injection of an approved euthanasia agent. (**major**)
3. The decision to euthanize and method of euthanasia must be directed by the Authorized Officer or their Authorized Representative(s) that include but are not limited to the Lead COR/COR/PI who must be on site and may consult with the on-site/on-call veterinarian. (**major**)
4. Photos needed to document an animal's condition should be taken prior to the animal being euthanized. No photos of animals that have been euthanized should be taken. An exception is when a veterinarian or the Lead COR/COR/PI may want to document certain findings discovered during a postmortem examination or necropsy. (minor)
5. Any WH&B that dies or is euthanized must be documented by the Lead COR/COR/PI including time of day, circumstances, euthanasia method, location, a

description of the age, gender, and color of the animal and the reason the animal was euthanized. (**major**)

6. The on-site/on-call veterinarian should review the history and conduct a postmortem physical examination of any WH&B that dies or is euthanized during the gather operation. A necropsy should be performed whenever feasible if the cause of death is unknown. (minor)

B. Carcass Disposal

1. The Lead COR/COR/PI must ensure that appropriate equipment is available for the timely disposal of carcasses when necessary on the range, at the trap site, and temporary holding facility. (**major**)
2. Disposal of carcasses must be in accordance with state and local laws. (**major**)
3. WH&Bs euthanized with a barbiturate euthanasia agent must be buried or otherwise disposed of properly. (**major**)
4. Carcasses left on the range should not be placed in washes or riparian areas where future runoff may carry debris into ponds or waterways. Trenches or holes for buried animals should be dug so the bottom of the hole is at least 6 feet above the water table and 4-6 feet of level earth covers the top of the carcass with additional dirt mounded on top where possible. (minor)

CAWP

REQUIRED DOCUMENTATION AND RESPONSIBILITIES OF LEAD COR/COR/PI

Required Documentation

Section	Documentation
II.B.5	Helicopter contact with any WH&B.
II.C.2	Roping of any WH&B.
III.B.3.a and III.B.4.b	Reason for allowing longer than four hours to reunite foals with mares/jennies. Does not apply if foals are being weaned.
III.C.1	Health status of all saddle and pilot horses.
IV.C.2.h	All uses of electric prod.
V.C.4	Any WH&B that is recumbent or dead upon arrival at destination following transport.
VI.A.5	Any WH&B that dies or is euthanized during gather operation.

Responsibilities

Section	Responsibility
I.A.10	Approve materials used in construction of finger gates in bait trapping
II.A.1	Direct gather procedures using approved gather technique.
II.B. 2	Determine rate of movement and distance limitations for WH&B helicopter gather.
II.B.2.a	Direct appropriate gather/handling methods for weak or debilitated WH&B.
II.B.3	Determine whether to abandon pursuit or use other capture method in order to avoid repeated pursuit of WH&B.
II.B.4	Determine width and need for visibility marking when using opening in fence en route to trap.
II.B.6	Determine number of attempts that can be made to capture the missing half of a mare/foal pair that has become separated.
II.B.7	Determine whether to proceed with gather when ambient temperature is outside the range of 10°F to 95°F for horses or 10°F to 100°F for burros.
II.C.1	Approve roping of any WH&B.
II.D.1.a	Determine period of time that water outside a bait trap is inaccessible such that wellbeing of WH&Bs, wildlife, or livestock is not adversely affected.
III.A.2	Direct and consult with on-site/on-call veterinarian on any matters related to WH&B health, handling, welfare and euthanasia.

III.B.1.e	Adjust feed/water as necessary, in consultation with onsite/on call veterinarian, to provide for needs of animals when water or feed deprivation conditions exist on range.
III.B.4.c	Determine provision of water and hay to non-ambulatory animals.
IV.C.2.g	Approve use of electric prod more than three times, for exceptional cases only.
V.A.1	Approve sorting, loading, or unloading at night with use of supplemental light.
V.A.2.a	Approve shipping delays of greater than 48 hours from temporary holding facility to BLM facility.
V.C.1.b	Approve of transport and care during transport for weak or debilitated WH&B.
VI.A.3	Direct decision regarding euthanasia and method of euthanasia for any WH&B; may consult with on-site/on-call veterinarian.
VI.B.1	Ensure that appropriate equipment is available for carcass disposal.

INTERDISCIPLINARY TEAM CHECKLIST

Project Title: Confusion HMA Wild Horse Gather and Management

NEPA Log Number: DOI-BLM-UT-W020-2018-0015-EA

File/Serial Number:

Project Leader: Trent Staheli

DETERMINATION OF STAFF: ***(Choose one of the following abbreviated options for the left column)***

NP = not present in the area impacted by the proposed or alternative actions
NI = present, but not affected to a degree that detailed analysis is required
PI = present with potential for relevant impact that need to be analyzed in detail in the EA
NC = (DNAs only) actions and impacts not changed from those disclosed in the existing NEPA documents cited in Section D of the DNA form. The Rationale column may include NI and NP discussions.

Determi-nation	Resource	Rationale for Determination	Signature	Date
RESOURCES AND ISSUES CONSIDERED (INCLUDES SUPPLEMENTAL AUTHORITIES APPENDIX 1 H-1790-1)				
NI	Air Quality	The proposed action would have no effect on air quality.	/s/ Paul Caso	3/9/18
NI	Areas of Critical Environmental Concern	The Gandy Salt Marsh ACEC lies on the western perimeter of the Confusion Herd Management Area. Reduction of herd size will reduce any impacts by wild horses and should improve aquatic and riparian habitat at the marsh for least chub and Columbia spotted frog.	/s/ Teresa Frampton	5/14/18
NI	Cultural Resources	No potential to affect NHP	/s/ Wesley Willoughby	4/2/18
NI	Greenhouse Gas Emissions	The proposed action would have a negligible, short-term effect on greenhouse gas emissions.	/s/ Paul Caso	3/9/18
NI	Environmental Justice	Low income or minority populations would not be disproportionately impacted by the project.	/s/R.B. Probert	6/25/18
NI	Farmlands (Prime or Unique)	There are no prime or unique farmlands that would be affected by the proposed action	/s/ Paul Caso	3/9/18
NP	Floodplains	No Concerns.	/s/ Tom Gibbons	3/12/18
NI	Fire/Fuels Management	The proposed action would have no impact on Fire and Fuels Management.	/s/ Nate Hunter	3/16/18
NI	Geology / Mineral Resources/Energy Production	Project is a temporary surface action that will not impact Geology / Mineral Resources/Energy Production	/s/ Todd Leeds	02/26/18
NI	Invasive Species/Noxious Weeds (EO 13112)	All equipment would be clean free of any plant or dirt debris prior to entering the gather area and a pre survey for weeds would be done prior to project implementation..	/s/R.B. Probert	4/25/18
NP/NI	Lands/Access	As described, the proposed project would not affect access to public land. The proposed project would be subject to valid prior existing rights-of-way (ROW).	/s/Fred Braun	03/06/18
PI	Livestock Grazing	Removal of excess horses would benefit the rangeland conditions and available forage, allowing livestock grazing to be permitted by the reduced competition for vegetation and water resources.	/s/ Paul Caso	3/9/18

Determi-nation	Resource	Rationale for Determination	Signature	Date
NI	Migratory Birds	Given the low magnitude and short duration of the proposed action, no impacts to migratory birds are anticipated. Migratory birds would benefit from the reduction of herd numbers and anticipated improved range and riparian conditions.	/s/ Jim Priest	3/6/18
NP	National Historic Trails	No Historic Trails present within APE	/s/ Wesley Willoughby	4/2/18
NP	Native American Religious Concerns	There are no known Native American Religious Concerns or Traditional Properties that will be impacted by the project. Letters were sent to the tribes May 25, 2018, notifying them of the project. A single response was received from the Hopi June 7, 2018 requesting additional consultation if there are any prehistoric sites that may be affected by the project. Impacts to cultural sites will be avoided by all project activities.	/s/ Wesley Willoughby	8/22/18
NI	Paleontology	Project will not impact paleontological resources.	/s/ Todd Leeds	02/26/18
NI	Property Boundary Evaluation	Project will not impact property boundary markers.	/s/ Kyle Monroe	3/5/2018
PI	Rangeland Health Standards	Removal of excess horses would reduce the potential for soil erosion (standard #1). Riparian areas would receive less grazing pressure thereby reducing impacts to these areas (standard #2). Removal would reduce competition for vegetation and contribute to the maintenance of desired plant species (standard #3).	/s/ Paul Caso	3/9/18
NI	Recreation	Recreation activities in the proposed project area is dispersed and some displacement may occur during gather operations; however, impacts would not be substantial. Coordination with the Utah Division of Wildlife Resources and the public is necessary if the proposal takes place during hunting season.	/s/ Teresa Frampton	3/6/18
NI	Sensitive Animal Species	Given the low magnitude and short duration of the proposed action, no impacts to sensitive animal species are anticipated. Sensitive animal species would benefit from the reduction of herd numbers and the anticipated improved range and riparian conditions.	/s/ Jim Priest	3/6/18
NI	Socio-Economics	No quantifiable additional or decreased economic impact to the local area (Millard/Juab County) would be caused by the proposed action.	/s/R.B. Probert	4/25/18
PI	Soils	The removal of excess horses would contribute to the maintenance of sufficient vegetation and litter to protect soil from erosion.	/s/ Paul Caso	3/9/18
NP	Threatened, Endangered, Candidate or Special Status Plant Species	There are no known federally-listed or other special status rare plant species at or near the proposed wild horse trap sites of the Confusion HMA gather.	/s/DWhitaker	2/27/18
NP	Threatened, Endangered, or Candidate Animal Species	There are no known federally listed ESA threatened, endangered, or candidate species known to occur within or reasonably near the proposed action.	/s/ Jim Priest	3/6/18
NI	Wastes (hazardous or solid)	Project will not impact or generate hazardous or solid waste	/s/ Todd Leeds	02/26/18
NP	Water Resources/Quality (drinking/surface/ground)	No Concerns.	/s/ Tom Gibbons	3/12/18
NP	Water Rights	No Concerns. May actually decrease in the short term demands on BLM undeveloped water rights (springs).	/s/ Tom Gibbons	3/12/18

Determi-nation	Resource	Rationale for Determination	Signature	Date
PI	Wetlands/Riparian Zones	Removal of excess horses would reduce the pressure on riparian areas and contribute to improved riparian condition	/s/ Cassie Mellon	3/12/18
NI	Wilderness/WSA	Placement of gather sites in previously disturbed areas and along existing roads would ensure no impacts to Wilderness Study Areas. If current protocol for gathers are followed, there would be no impacts to WSA's. A monitor will be assigned to this project.	/s/ Teresa Frampton	3/6/18
NI	Wildlife and Fish Excluding Designated/Special Status Species	General wildlife species, such as mule deer, antelope, mountain lion, coyote, rattle snakes, lizards and jack rabbits occur within the scope of the proposed action. Managing herd numbers will benefit wildlife overall by reducing competition and improving range and riparian conditions.	/s/ Jim Priest	3/6/18
NI	Woodland / Forestry	There would be no impact to woodland/forestry with the implementation of the proposed project.	/s/ Eric Reid	3/27/18
PI	Vegetation Excluding Designated/Special Status Species	Removal of excess horses would benefit vegetation through reduced utilization levels of desirable forage species in high use areas.	/s/ Paul Caso	3/9/18
NI	Visual Resources	The proposed action is located within Visual Resource Management Class II, III and IV. The proposed action includes only minor temporary disturbance. The actions would not impact visual resources.	/s/ Teresa Frampton	3/6/18
PI	Wild Horses and Burros	The wild horse gather will reduce the amount of horses in the Confusion HMA and may apply population suppression techniques. Impacts to horses associated with gathers such as stress and possible injuries. Horses removed would be taken to short-term holding and put into the adoption program.	/s/ Trent Staheli	3/5/18
NI	Lands with Wilderness Characteristics	The proposed project, as described, would not change the character of the landscape.	/s/ Teresa Frampton	3/6/18

FINAL REVIEW:

Reviewer Title	Signature	Date	Comments
Environmental Coordinator	R.B. Robert	10/5/20	
Authorized Officer	Michael D. [illegible]	10/5/2020	

U.S. Department of the Interior
Bureau of Land Management

Comment Report

Environmental Assessment
DOI-BLM-UT-W020-2018-015-EA
Confusion HMA
Wild Horse Gather Plan

U.S. Department of the Interior
Bureau of Land Management
West Desert District
Fillmore Field Office
95 East 500 North
Fillmore, Utah 84631

BLM offered a 30-day comment period (6/26/2020 - 7/25/2020) on the EA in ePlanning, but additional comments were received through email until 7/27/2020 due to the press release stating comments were due by July 27. The EA information was provided on the project's webpage on the BLM's NEPA Register and announced through Press Releases/Distribution Lists (Media and Wild Horse Advocates). Public outreach information is contained in the EA in Section 8. Using letters, emails, and the NEPA Register, 16 entities submitted comments to the FFO as follows:

- 5 advocacy groups (The Cloud Foundation (TCF), The American Wild Horse Campaign (AWHC) and Animal Welfare Institute (AWI) combined, Return to Freedom Wild Horse Conservation (RTF), and Wild Horse Education (WHE)) and Utah Farm Bureau
- 7 individuals, one of which was an unknown submitter
- Local and State governments (Iron County, Beaver County, Public Lands Policy Coordinating Office (PLPCO)).

AWHC and AWI submitted a comment letter together and AWHC also submitted a form letter written by AWHC and signed by approximately 4,545 individuals. The list of substantive comments is included below. Similar comments were generally reviewed collectively. BLM reviewed and considered all comments received. A couple of the comments resulted in BLM making a change to portions of the EA. When comments promoted a change in the EA, such a change is noted in the list of comments response column. Some of the comments were broad in scope and consisted mainly of personal opinion or non-substantive input not requiring a response; however, due to the low number of submissions those comments are included. A couple commenters specifically discussed the conditions and wild horses in the Confusion HMA. Most of the comments were opposed to gather and removal of wild horses and proposed the implementation of some form of PZP use to control population growth. Several comments were in favor of the action of removing wild horses down to low AML of 70 horses and implementing some form of population growth suppression. All the commenters are mentioned on this list. The comments and responses shown in the List of Comments capture the range of content sent in by all commenters.

List of Comments

Number	Submitter	Comment	Response	Changed EA
1	AWHC, AWI	In addition, the legal authority for the BLM to conduct a broad and sweeping programmatic action before properly amending the Resource Management Plan ("RMP") is questionable at best. A management and roundup plan is	This is a site-specific EA for the Confusion HMA (refer to Chapter 1) intended to achieve and maintain a wild horse population within AML on the HMA by using gathers and scientifically viable population controls to reduce the need for future gathers in the short term.	No

		meant to serve as a narrow, site-specific plan that can tier from programmatic options previously analyzed in the region's RMP. Thus, based on legal precedent, this draft EA is not a lawful option for setting new wild horse and burro management options for the Confusion HMA. Those actions must instead follow the legally required procedures for achieving those outcomes.	This is not a programmatic action. It is not an action contemplating RMP-level decisions to change AML, eliminate wild horses from public lands, or allocate grazing AUMs.	
2	AWHC, AWI	The BLM must prepare an Environmental Impact Statement ("EIS") rather than an Environmental Assessment ("EA") because the Federal Land Policy Management Act ("FLPMA") designates RMPs as the appropriate programmatic written document for analyzing future management actions and from which future, limited scope plans may be developed and implemented. Thus, an amendment to the 1987 RMP is appropriate here and the only way the BLM may lawfully accomplish the objectives identified in the Draft EA. If the BLM does not seek to amend the 1987 RMP, an EIS is still required because several distinct National Environmental Policy Act ("NEPA") "significance"	Amending the 1987 House Range RMP is outside the scope of this EA and not necessary to gather horses in the Confusion HMA and manage for AML. Refer to EA Chapter 1.0. BLM did not identify significant impacts requiring an EIS and prepared a FONSI to document that fact.	No

		factors are triggered, any one of which requires preparation of an EIS.		
3	AWHC, AWI	The BLM has not taken the requisite “hard look” at the environmental impacts of its action, which will result in significant short-term and long-term effects to wild horses left on the range, to the rangeland ecosystem, and to the family bands of wild horses that reside in this area. The BLM has also failed to appropriately consider the potential measures that could mitigate the impacts resulting from the BLM’s proposed action. The BLM has failed to adequately analyze a range of reasonable alternatives, in violation of NEPA.	Refer to Chapters 2, 3, and 4 of the EA, which disclose and discuss potential impacts of the alternatives, along with appendices F, G, and H.	No
4	AWHC, AWI	In the meantime, the Groups’ ask that the BLM use the opportunity of this roundup action EA to consider how the agency could vigorously implement a fertility control program using the cost-effective and scientifically proven PZP immunocontraceptive vaccine instead of mass roundup and removal combined with surgical sterilization.	PZP is considered under Alternative C, Refer to Chapter 2 of the EA.	No

5	AWHC, AWI	The BLM must abandon its plan to conduct a mass helicopter roundup and removal of roughly 87 percent of the federally protected wild horses in the Confusion HMA. The BLM must abandon its consideration of any permanent, surgical sterilization options for controlling the population in the Confusion HMA.	Helicopter roundups are analyzed and necessary to gather horses in the Confusion HMA. Sterilization is part of Alternative D, Proposed Action, and the impacts are analyzed in Appendix H and is considered a viable option by the BLM and is authorized by the WFRHBA.	No
6	AWHC, AWI	The Groups ask that spaying mares be eliminated from consideration in this proposal. However, if the BLM moves forward with its analysis of these methods, to comply with NEPA the agency must document, discuss, and otherwise note the risks of pain and mortality in its NEPA document. As written, the EA does not adequately consider the scientific controversy, risks, detrimental effects, etc., that many of the proposed procedures could have on wild mares.	The spaying of mares is considered to be a viable alternative by BLM. Impacts including but not limited to mortality, pain, evisceration, risks, etc. are discussed in Appendix H of the EA. Also noted in the EA in Chapter 2.2.4 the procedure would be carried out at a veterinarian facility to ensure the best possible care will be provided, both during and post operation.	No
7	AWHC, AWI	The reduction in the number of wild free-roaming, reproductively intact horses and the management of such a reproductively altered population, which has never been done in any HMA. There is no research regarding the impacts of maintaining a significant	The effects of having non-reproducing horses on the range such as the effects on genetics, behavior, movement, etc. is discussed in Appendix H of the EA. The October 1987 House Range RMP/ROD states "Wild horses will continue to be managed in accordance with provisions	No

		portion of the wild horse population as nonreproducing. Additionally, this option was not considered in the RMP for this area and is therefore inappropriately considered in this EA.	of the Wild Horse and Burro Act of 1971 and subsequent legislation and regulations." Sterilization is authorized in the WFRHBA.	
8	AWHC, AWI	Besides being counter to scientific recommendations, the BLM's decisions in this EA would set dangerous precedent for management of federally protected horses across the West. Moreover, the BLM is purporting to analyze the impacts of ovariectomy via colpotomy without making any effort to assess the social acceptability of this procedure. As the BLM is aware, a federal court previously found that the Groups were likely to succeed on a claim regarding a similar failure to assess this procedure's social acceptability and issued a preliminary injunction against an experiment on this procedure partially on that basis. (Attachment 3). The BLM previously found that social acceptability was a critical component of studying ovariectomy via colpotomy, and it may not now logically or legally simply abandon that effort – and especially may not do so without offering any explanation of that abandonment.2 Likewise,	BLM has taken in account many scientific articles and recommendations in the preparation of the Confusion EA. This EA does not set a precedent for management of federally protected horses across the West as it is a site specific EA for the Confusion HMA only. Any other locations would have to produce their own EA discussing their management plans. BLM is not required to consider "Social acceptability" in NEPA documents or wild horse management decisions. Ovariectomy via colpotomy is an accepted method on sterilization for mares by the veterinarian community. This method of sterilization was successfully and safely used and documented on wild horses in the Sheldon NWR (see Appendix H of the EA for discussion on ovariectomy via colpotomy). Given the published scientific studies that are already available, BLM is not required to have completed its own ovariectomy via colpotomy study, such as the one that	No

		the agency is now evidently abandoning the research/experimental route – without explanation – that it previously deemed essential to its efforts to pursue ovariectomies (e.g., in order to gauge the complications, safety, and efficacy of the procedure, according to the BLM's own previous research proposals). Instead, the BLM is attempting to integrate ovariectomies directly as a management tool into EAs, without the necessary data that the agency previously sought to obtain – i.e., bypassing the research route altogether. This barefaced reversal is both arbitrary and capricious.	was proposed to have taken place at the Warm Springs HMA in Oregon, before using the method in wild horse management. There is ample evidence from available published literature to make informed decisions about the suitability, safety, and management application of surgical ovariectomy via colpotomy, as demonstrated in Appendix H for this Confusion HMA EA. The fact that BLM had decided to attempt a study of the surgical, behavioral and population-level effects of ovariectomy via colpotomy at Warm Springs HMA does not mean that the agency is precluded from making individual gather plan decisions to manage the wild horse population consistent with the WFRHBA, using the full range of population control tools that are currently available to the BLM. There is no statute or regulation that requires BLM to conduct or wait for the results of any study before it uses a particular population control method, and the notion cannot be squared with the WFRHBA, which expressly authorizes sterilization. The EA associated with the proposed Warm Springs HMA study made clear that no future BLM decisions would depend directly on	

			results from that planned study. At no time did BLM suggest that further management decisions about surgical sterilization would be suspended until and unless the proposed Warm Springs HMA study took place.	
9	AWHC, AWI	The BLM must consider the impacts that gelding will have on wild and free-roaming horses. As such, the Groups argue that the BLM must not proceed with implementing surgical sterilization of stallions as analyzed in the draft EA. At the very least, the final EA should review the scientific controversy surrounding the proposed gelding. The impacts of gelding on stallions can be severe, affecting their physiology, behavior, environment and impact on the herd. Therefore, there must be discussion in the agency's analysis which includes a prohibition on the use of gelding in the Confusion HMA.	Impacts of neutering (via gelding and vasectomy) wild stallions are discussed in Appendix H of the EA.	No
10	AWHC, AWI	The final EA must include the NAS conclusions on the impacts of gelding and must disclose the research underway on gelding. Significantly, the EA fails to disclose that when geldings were released in the Conger HMA in 2016, it was done as part of a BLM-USGS research project designed to "inform	NAS and other scientific conclusions are considered and addressed in the EA (See Chapter 4 and associated appendices). The gelding study in the Conger HMA is ongoing, and is led by the US Geological Survey. The USGS data will be released after the study is completed. Release of such data before USGS	No

		BLM about the behavioral effects of gelding a portion of a wild horse herd" because that information "is not currently available."	has published them is not within BLM's discretion. The ongoing study is in a separate HMA and does not have any effect on the implementation of the EA alternatives thus it is not analyzed in the EA.	
11	AWHC, AWI	For scientific, economic and social reasons, the ten-year plan to reduce the wild horse population in the Confusion HMA to the low AML of 70 horses should be eliminated from consideration in this EA. This would result in a density of one horse per 3,350 acres and reduce the population to an unnaturally low population size that the NAS warned maximizes population growth rate. (Attachment 1). As such, if the roundup option is retained in the final EA, it is essential for the BLM to further analyze the following: • Impacts of drastic reduction of population size on population growth rate; • Impacts of drastic population reduction on genetic health of the populations within the HMA; • Direct impacts of helicopter drive trapping to the environment and the horses; and	Having a ten-year plan gives BLM FFO the flexibility needed to achieve a thriving natural ecological balance, by getting the population within AML and manage the wild horses within AML. Monitoring of the horses and HMA, including genetic monitoring, will continue throughout the life of this plan. Should monitoring reveal that changes need to be made, BLM will adjust plans appropriately and in accord with all applicable laws. For discussion of population size on growth rate, genetics, helicopter drive trapping, off range holding, and managing wild horses at the minimum feasible level refer to Chapters 2, 4, and Appendix A of the EA	No

		• Economic and welfare concerns related to increasing the off-range holding population of wild horses. Thus, if the BLM receives authorization and moves forward with a roundup and removal action, the agency must note that the WHA requires the BLM to manage wild horses at the minimum feasible level. Such a roundup and removal operation will fail to meet that standard. Instead, the proposed action will continue the business-as-usual approach of "management" by removal and stockpiling more wild horses in off-range holding facilities.		
12	AWHC, AWI	According to the Council on Environmental Quality, under NEPA, "agencies are required to determine if their proposed actions have significant environmental effects and to consider the environmental and related social and economic effects of their proposed actions."	Socio-Economics: Although costs incurred by different methods and procedures are discussed throughout the EA; " No quantifiable additional or decreased economic impact to the local area (Millard/Juab County) would be caused by the proposed action." (ID Team Checklist). The action will have no quantifiable increased or decreased economic impact to the local area. Social and economic effects themselves do not ordinarily rise to the level of a	No

			significant impact on the human environment (40 CFR 1508.14). Because there is no prospect that social and economic effects would rise to a level of significance here, and because examining those effects would not assist BLM in making a reasoned choice among alternatives, it does not examine those issues in great detail in the EA. People who visit the HMA to view wild horses may still do so after implementation. Horses will still be present in the HMA.	
13	AWHC, AWI	Irrespective of whether an EIS or EA is appropriate under the circumstances, pursuant to NEPA BLM must analyze all reasonable alternatives to the proposal, which the BLM has failed to do. An agency's duty to consider alternatives to the proposed action has been described as the "heart" of the NEPA process.	NEPA requires BLM to analyze alternatives to the proposed action if there are unresolved conflicts concerning alternative uses of available resources (40 CFR 1508.9(b)). BLM FFO has considered 5 alternatives in detail, and has several alternatives considered but eliminated from further analysis. Refer to Chapter 2 in the EA.	No
14	AWHC, AWI	Instead of implementing a proposed action that includes roundups and removals, the Groups urge the BLM to manage wild horses humanely through the comprehensive application of PZP as an alternative. Even though the BLM included the use of vaccines under Alternative C, that alternative also included IUDs. A PZP only approach must be fully	PZP is considered for use in Alternative C and variations of PZP application were considered but eliminated from further analysis (see Chapter 2 of the EA). The Catch Treat Release method referred to is the same as the alternative considered but eliminated from further analysis in Chapter 2.4.4 Fertility Control Treatment Only (No Removal). IUDs are included in Alternative	No

		considered because it would reduce population growth rates and population numbers over time, ultimately save taxpayers money, and maintain herd social structures. It is also consistent with the BLM's legal requirement under the WHA to manage wild horse and burro herds for minimal feasible management. The BLM should analyze a Catch Treat Release ("CTR") method without the mass removals to low AML that the draft EA proposes. While the Groups would rather see the more humane and fiscally responsible field darting option implemented, if roundups or trapping efforts are used to vaccinate mares, then the EA should clarify what CTR protocols it would implement under Alternative C.	C. However, BLM has discretion to implement all, part of, or none of the action alternatives presented in the EA.	
15	AWHC, AWI	The BLM has a statutory mandate to protect wild horses, while livestock grazing is permitted only as a discretion. Federal regulation 43 CFR §4710.5 "Closure to livestock grazing" authorizes the BLM to "close appropriate areas of the public lands to grazing use by all or a particular kind of livestock" "[i]f necessary to provide habitat for wild horses or burros, to implement herd management actions, or to	BLM is not revisiting the grazing and wild horse management decisions made in the October 1987 House Range RMP/ROD at this time. BLM is not required to reduce livestock grazing to accommodate excess horses. Refer to Chapter 2.4.2 in the EA.	No

		protect wild horses or burros from disease, harassment or injury." Livestock grazing is not required to fulfill the agency's "multiple use" mandate. Therefore, the BLM should pursue analysis of an alternative that considers how the agency could accommodate a larger wild horse population through adjustments to livestock stocking rates with options such as voluntary grazing retirement opportunities. Such options should be explored with permittees in order to determine an equitable means to achieve a fairer allocation of resources for wild horses on public lands.		
16	AWHC, AWI	The use of IUDs, as included in Alternative C, is experimental and therefore the impacts cannot be properly analyzed in the EA because they are unknown. In fact, the BLM admits that it has never before used IUDs to control fertility of wild horses and burros on the range. Instead, the agency relies on unpublished studies conducted under far different conditions than on-range management in order to justify its approach. In fact, the draft EA notes that "if" the IUDs implanted in fifteen mares are proven effective after	Given the published scientific studies that are already available, BLM is not required to have completed its own IUD study before using the method in wild horse management. The Confusion EA is not proposing a research experiment on wild horses if Alternative C is chosen. Observations of horses that may receive IUDs would not be structured in a way that would be construed as a scientific study, but opportunistic observations of such IUD-treated mares may provide BLM with additional information. For	No

		two years of observation, then additional mares may receive IUDs. Given this, it is clear that the BLM would be proposing a research experiment on wild horses if Alternative C is chosen, rather than an established management program that will safely, humanely, and effectively control the population in the Confusion HMA.	example, if a high number of IUD-treated mares were to be observed with foals at their side, it would not require a research study or extensive analysis to make common sense conclusions about the prudence of applying additional IUDs.	
17	AWHC, AWI	Skewing of sex ratios is not reasonable or scientifically supported. In fact, the draft EA indirectly notes how skewed sex ratios have historically not been effective at controlling population growth in this HMA. In 2004, the herd was rounded up and a skewed population of 70 percent males to 30 percent females was left on the range. Yet, the BLM has returned and continued to roundup and remove wild horses despite this skewed ratio. Further, the BLM has dismissed this practice in other NEPA actions.	Sex ratio adjustment is included in the Confusion EA because it has been used in the past on this HMA. Impacts of sex ratio adjustments are discussed in Chapter 4 of the EA.	No
18	AWHC, AWI	Upper Limit AML Even though the BLM dismissed this management alternative from further analysis, the BLM's consideration of upper limit AML did not consider it used in combination with a comprehensive PZP program. Thus, the BLM must further analyze an	Use of PZP with gathering to AML upper limit would still result in AML being exceeded following the next foaling season. This alternative essentially is not any different than 2.4.3 Gather the HMA to the AML Upper Limit that was considered but eliminated from detailed analysis.	No

		alternative to manage wild horses in the Confusion HMA at least at the high AML of 115 horses rather than reducing it to the low AML of 70 horses when a PZP program is used in the HMA.		
19	AWHC, AWI	The BLM Must Consider Reasonably Foreseeable Actions	Refer to Chapter 4.3 of the EA.	No
20	AWHC, AWI	<u>The EA Must Disclose Necessary Information</u> **1.** Livestock Use for the Past Decade **2.** Annual Census Information **3.** Rangeland Health Data	Refer to Chapter 1. 3.2.1, and 3.2.2 of the EA.	No
21	AWHC, AWI	With respect to the question of public observation, the present EA specifically notes that "as the surgery would be conducted at a private facility, public observation of the surgical procedure would not be allowed" (however, the BLM is "willing to consider" observation by an unaffiliated veterinarian "if the contracted veterinarian consents").3 A federal court blocked the BLM's prior attempt to ovariectomize wild horses in the Warm Springs HMA in large part due to concerns over the lack of independent observation. The court ruled that plaintiffs were	in the text in Chapter 2.2.4 has been edited for clarity.	Yes

		likely to prevail on claims that the BLM's restrictions on public observation of the procedures violated their First Amendment rights. The present EA seems tailor-made to impede outside and independent observation given that the BLM is unambiguously seeking to carry out surgical sterilizations away from public view. As the Groups have repeatedly advised the BLM in past comments on the Warm Springs HMA "spay feasibility" EAs, the First Amendment to the U.S. Constitution establishes the public's right to observe government activities; moreover, the Ninth Circuit has held that this right extends to the BLM's management of wild horses. *See Leigh, 677* F.3d at 898. Where the public has a right to observe government activities, any restrictions on public observation must be narrowly tailored to serve an overriding government interest. *Id.*		
22	Form letter written by AWHC and signed by 4,545 individuals	Dear Mr. Trent Staheli, I strongly oppose the Bureau of Land Management's plan to spend my tax dollars to round up and permanently remove 481 horses from the Confusion Herd Management Area (HMA) and reduce the population	Refer to comments 1 -20 of this document.	No

		to just 70 horses on 235,000 acres of public land. This large-scale removal, if combined with the proposed permanent sterilization, will irreversibly set this wild horse population on a path to extinction. The Confusion wild horses must be preserved and humanely managed, not decimated and destroyed. The Environmental Assessment (EA) on the Confusion HMA Wild Horse Management & Gather Plan is inadequate. The EA fails to consider an alternative to reduce livestock grazing in the Confusion HMA in order to maintain a larger, genetically viable wild horse herd in the HMA. This option is legally within the purview of the BLM, as, under the law, protection of wild horses and burros is a legal mandate, while authorization of livestock grazing is a discretionary action. The EA failed to consider the impacts of utilizing surgical sterilization procedures on wild mares and did not address the National Research Council's conclusion that "spaying" of mares through the invasive ovariectomy via colpotomy procedure is		

		"inadvisable for field application" due to risk of bleeding and infection. The BLM must fully consider the health risks, behavioral consequences, and genetic implications of utilizing permanent sterilization methods on individual wild horses and in a small population. The EA failed to adequately consider the impacts of gelding that could result in the loss of male-type behaviors necessary for maintaining social organization and expression of the natural behaviors that the public is interested in protecting. The EA failed to consider humane and scientifically recommended PZP fertility control program to maintain the Confusion wild horse population at a genetically viable number without constant removals or surgical sterilization methods that will take the wild out of wild horses. Sincerely, The Undersigned		
23	TCF	TCF and its board members, staff and supporters, as well as the general public, enjoy and appreciate having our wild horses (and burros) living on our public lands in Utah.	Wild Horses will remain on the HMA. Permanently removing wild horses below the low AML will not occur. Livestock management is outside the scope of this EA.	No

		As interested and affected parties, we will be harmed if the Bureau of Land Management (BLM) proceeds with the Proposed Action or alternative actions addressed herein and as outlined in the Environmental Assessment (EA). Reducing wild horse populations to lower levels while allowing larger numbers of livestock in the same area is opposed by the American people, illegal and wrong. Removing these wild horses and/or destroying the natural behaviors of these cherished animals through sterilization or drugs, will have a negative impact on us, by definition, causing harm to the human environment:		
24	TCF	The House Range RMP 1987 RMP and LUP process has not authorized the Proposed Actions. The BLM must publish the House Range RMP in order for the public to provide meaningful input on the Proposed Action.	See comment 7 of this document. The 1987 House Range RMP/ROD has been is available to the public at https://eplanning.blm.gov/eplanning-ui/project/65875/570. The document was available online to the public before and during the comment period on this EA.	No
25	TCF	The EA fails to adequately analyze what the 1971 WFRHBA outlines as the mandates for the BLM management of wild horses on public lands.	Challenges to or questioning of statutes, regulations, and policies for BLM programs (including wild horses and livestock grazing) are out of scope of this EA. Confusion HMA is not a	No

		A. "Range" Is "Devoted Principally" for Wild Horse Use Congress clearly stated in the Act that wild horses have a special, protected status. The Act specifically defines the *"range"* where wild horses were *"presently found'* (in 1971) as *"the land necessary to sustain an existing herd or herds of wild free-roaming horses."* The Act also specifically states that this wild horse habitat ***"is devoted principally*** *but not necessarily exclusively ta their [wild horses and burros] welfare..."* **[Public Law 92-195 § 1332]** The BLM does not hold any discretion or authority to diverge from the clear, stated intent of the United States Congress. Congress *told* the BLM those lands *are* (must be) devoted principally to these federally protected animals. Had Congress wanted to provide BLM with discretion, the word "may" would have been used rather than "is". Wild horse habitat *"ls devoted principally* but not necessarily exclusively to their [wild horses and burros] welfare..." **[Public Law 92-195 § 1332)** Again, the language of the Act leaves no possible	designated wild horse range, and changing the HMA's designation is outside the scope of this analysis.	

		ambiguity for Congress' intent, that wild horses "are to be considered in the area where presently found, **as *an integral part of the natural system of the public lands."*** The EA and existing LUPs fail to take a hard look at the BLM's clear authority to limit livestock grazing, pursuant to 43 C.F.R. 4710.S(a), to close livestock grazing on areas of public lands		
26	TCF	We have grave concerns about the physiological and psychological Impacts that result from ovariectomy and the related conditions and Implications - both direct and indirect. There is scientific literature that outlines the various deleterious effects of Inducing premature menopause *(especially* in a species that does not go into menopause).	Refer to Appendix H of the EA.	No
27	TCF	We now know that GonaCon literally shuts down a mare's estrus cycle destroying the natural production of hormones which are known to have behavior consequences. Castration (gelding), ovariectomy (spaying), and Gonacon shut down the natural production of hormones cause changes to wild horses' natural behaviors including:	Refer to Chapter 4, and Appendices F, G, and H of the EA.	No

		•behavioral disruption of social structure and band integrity •physiological disruption of hormones that play a vital role in survival ability in the harsh and rugged wild environments •environmental impacts caused by sterilization procedures which may alter the way horses utilize the land		
28	TCF	There is no scientific information or data to support the artificial skewing of the sex ratio. Wild horse natural sex ratios favor females - the natural ratio is generally between 55/45 female/male ranging up to 60+/40- female/male. Creating unnatural sex ratios increases aggression among males and causes stress and social disruption. It would create dangerous situations for females, who are subject to repeated rape by stallions as a result of the lack of mares. The increased aggression between stallions and against mares puts foals at great risk of injury and death. This Ill-conceived management strategy has no basis in science and would have a devastating impact on both individual horses and family bands.	See comment 17 of this document.	No

29	TCF	The *"BLM has not used IUDs to control fertility* as a *wild horse and burro fertility control method on the range."* An Environmental Impact Statement (EIS) is necessary before implementing the administration of IUDs in wild mares living on the range. IUDs are known to fall out of mares and may cause complications which would never be detected, given that wild horses are free- roaming and cannot be regularly monitored. Before subjecting free-roaming mares to the potentially painful and dangerous condition of a partially-ejected IUD - the complications of which could be serious - an EIS is required. This is precisely the type of situation that calls for an EIS to ensure the safety and efficacy of implementing this precedent-setting government action.	Refer to Chapter 4.2.3 of the EA and comment 2 of this document.	No
30	TCF	The EA fails to take a hard look at fully implementing (administer to a minimum of 85% of all mares) a humane PZP fertility control program and reducing livestock grazing as an alternative to the Proposed Action. The EA fails to consider implementing a humane PZP fertility control	See comment 4 of this document. Working with volunteers is not a NEPA decision and does not need to be in the EA. Should BLM FFO decide to call on volunteers it will be made known to the public through press releases.	No

		program as an alternative. If wild horses need to be reduced in the HMA, humane PZP fertility control should be used to accomplish this as recommended by the NAS (Attachment 1) The BLM must be open to working with volunteer groups to determine whether bait trapping may be effective to administer PZP. If not, the humane helicopter protocol (see Addendum) for capture-treat-release should be considered and adopted when utilizing helicopters to capture horses for fertility control. TCF and other volunteer organizations would be happy to work with the BLM to implement this humane management that prevents removals, and allows wild horses to live and die wild as intended by the WFRHBA.		
31	TCF	The EA does not sufficiently justify the Proposed Action as the law does not require that wild horses be removed merely because they are over the AML; rather, the agency must show that the existence of the horses on the range - as opposed to livestock or other factors - are causing harm to the Thriving Natural Ecological Balance (TNEB).	Refer to Chapters 3 and 4 of the EA.	No

32	TCF	The EA fails to provide Rangeland Health Assessments for the allotments within the HMA. The EA fails to indicate whether livestock allotments are meeting Rangeland Health.	Chapter 3.2.2 of the EA discusses rangeland health of the Confusion HMA and monitoring data shows that the HMA has received moderate to high levels of use.	No
33	TCF	The EA fails to consider utilizing Adaptive Management to address the dangerously low AML which is in direct violation of the WFRHBA's requirement that this HMA be managed "principally - for wild horses. BLM Adaptive Management document states, "The RMP will be implemented using adaptive management processes. Under adaptive management, decisions, plans and proposed activities are treated as working hypotheses rather than final solutions to management of resources and uses. For the purposes of this plan, adaptive management represents a process that tests, evaluates and adjusts the assumptions, objectives, actions, and subsequent on-the ground results from the implementation of RMP decisions.	See comment 25 of this document. Refer to section 5 for a discussion of monitoring that will be ongoing during the implementation of the adopted plan. If monitoring indicates a change in management is appropriate, BLM will consider such change in accord with applicable laws.	No
34	TCF	Based on current scientific evidence, in order to maintain an acceptable level of genetic diversity,	The AML range for the HMA was established in the October 1987 Range House RMP/ROD and represents	No

		AML must **be set at a** minimum **of 150 to 200 horses** (In **order to have 50 effective breeding animals) as recommended for wild horse management** in **the BLM Wild Horse and Burro Handbook.** (Attachment 17) *"A minimum population* size *of 50 effective breeding animals (i.e.,* a *total population size of about 150-200 animals) is the minimum number of animals recommended to maintain an acceptable level of genetic diversity within reproducing WH&B populations."* **(Cothran, Gus, 2009. BLM Letter dated July 16, 2009.)** *"This number is required to keep the rate of loss of genetic variation at 1 percent per generation. Animal interchange between adjacent* HMAs *with smaller population sizes may reduce the need for maintaining populations* of *this* size *within each individual HMA."*	the population range in which the resources in the HMA can achieve a thriving natural ecological balance. Adjusting the AML is outside the scope of this EA. Animal interchange between adjacent HMAs does occur on occasion and introduction of wild horses from other HMAs has occurred over the past 20 years to help maintain adequate levels of observed heterozygosity. As stated in the EA and as contemplated by the Handbook; BLM will introduce wild horses from other HMAs should the results of genetic monitoring show the need. As noted in the EA Section 4.2.3, wild horses in the Confusion HMA are not an isolated population; they are part of a larger metapopulation that includes other herds of wild horses. Even if genetic diversity measures are relatively low at some point in the future, natural and human-assisted migration into the HMA can increase that genetic diversity to acceptable levels; these actions are specified in the EA.	
35	TCF	The EA proposes highly questionable actions with uncertain short- and long-term impacts and outcomes, particularly regarding the safety and health of this herd. Thus, a 10-year	Having a ten-year plan gives BLM FFO the flexibility needed to achieve a thriving natural ecological balance, by getting the population within AML and manage the wild horses	No

		Decision Record is counter to the best interests of the public and also puts the wild horses the agency is required to protect at risk. By issuing a 10-year Decision Record, the public's ability to take legal action may be constrained. It is our right to oppose actions covered by the DR within the 10-year period as more information becomes available. Given that the Proposed Action includes vague and expansive terminology to include and implement currently untested fertility control methods, citizens would have no legal recourse to object to actions which may be taken in the future that would not be disclosed to the public. National Environmental Policy Act (NEPA) requires that agencies review current data and seek public input and information regarding governmental actions. Indicating that this EA would satisfy the NEPA requirement for future actions over the next 10 years is blatantly incorrect, unethical and sidetracks Congress' intent to include the public and ensure that agencies have the best *current* Information when making decisions.	within AML. Monitoring of the horses and HMA will continue throughout the life of this plan. Should monitoring reveal that changes need to be made, BLM will adjust plans appropriately and in accord with all applicable laws. BLM has satisfied its legal requirement for public input on this EA by providing a 30-day public comment period through which these comments have come. Adoption of a gather plan covering a period of years and a series of gather operations is consistent with BLM policy and applicable law, and does not impact legal rights to challenge any decision. The analysis in this EA is based on current information.	

36	TCF	The EA fails to adequately address the protection of wild horses during the proposed roundup. BLM's "Comprehensive Animal Welfare Program (CAWP)" is woefully inadequate for establishing humane standards for the treatment of wild horses and burros during a roundup.	BLM will follow the CAWP and SOPs for Wild Horse Gathers (Refer to Chapter 2 and 4 of the EA).	No
37	TCF	Real-time cameras with GPS should be installed on all aircraft and/or helicopters used in operations and video should be live streamed on the Internet. This will improve the transparency and accountability of roundup operations and enable the BLM and public to monitor the direct impact motorized vehicle usage has on wild horses and the environment. Real-time cameras should be installed on any traps, corrals and temporary holding pens, again, so that BLM personnel, public and media can monitor the entire roundup operation and treatment of the horses.	Public observation protocol and SOPs are addressed in appendix B and section 2.3 of the EA. Comments requesting cameras/video stream are noted	No
38	TCF	Improved public observation of all agency actions. There is significant public interest in the agency's management of wild horses and burros and its management of these protected animals. The NAS specifically recommended to the BLM	Public observation of gathers will be provided in accordance with BLM policy, SOPs, and as discussed in Chapter 2 and 4 of the EA. Removal operations will follow BLM policy.	No

		to improve the transparency of its management of the Wild Horse and Burro Program (Attachment 1). The treatment of the wild horses and agency transparency are paramount. All removal operations must be located on public lands to allow public observation of all activities. No government operations should be located on private lands for which the owners will not give permission for public observation of activities.		
39	RTF	Comments to Section 1.0, Introduction Return to Freedom is dedicated to preserving the freedom, diversity, and habitat of America's wild horses and burros through sanctuary, education, advocacy, and conservation while enriching the human spirit through direct experience with the natural world. Part of our mission is to engage members, donors, visitors, and youth in working for and on behalf of their public lands. We provide support for cooperative projects between non-profits and government agencies, and we involve the public in discourse about management of resources.	Thank you for your comments. See comments 1-38 of this document. Effects on bone histology are discussed in Appendix H. As shown in Appendix F aside from just using scientific articles regarding spaying, BLM has also had conversations with veterinarians about spaying and spaying procedures.	No

		BLM is soliciting comments for the Confusion HMA Wild Horse Management and Gather Plan (DOI-BLMUT-W020-2018-015-EA). The Confusion HMA has a small AML of 70 - 115 horses, with a current estimated population of 661. Horses have increased in areas outside of the HMA, livestock AUMs were reduced by 34% in 2018, and some riparian areas have not met rangeland health assessment standards. There are solid alternatives listed in this EA, however, the preferred Alternative D, Proposed Action: Gather and removal of excess wild horses to low AML, implementing population growth control by establishing non-reproducing components, misses the mark. Return to Freedom has suggestions, relevant both ecologically and programmatically, for combining aspects of the different alternatives analyzed into a humane, robust and sustainable management paradigm: Comments to Section 2.2, Description of Alternatives Considered in Detail • "Under Alternative D management actions would be similar to the Alternative A and C with the exception		

		that a fraction of the mares returning to the HMA would be humanely sterilized, sex ratio adjustments would not be done, and fertility control vaccines and IUDs would not be administered. Mares younger than the age of 5 would not be returned to the HMA. A select number of humanely neutered male horses may also be returned to the HMA as part of the nonreproducing component." (EA, p. 10-11) We assume this could include several forms of surgical spay, as well as blockage of the oviduct, cervical resection, or future sterilization via immuno-contraceptive vaccines, when and if they are developed. We understand that an EA should evaluate all potential options, and use this opportunity to express that we do not support any surgical sterilization of animals for management purposes. Here is why: - There are no substantive studies to evaluate long term health of ovariectomized mares. At the Center for Equine Health (UC Davis), a herd of twenty older ovariectomized mares were housed. Eighteen of them showed advanced musculoskeletal deterioration, which led		

		veterinarians on-site to wonder at the effect of removing estrogen from the system, as an ovariectomy does. - Surgical spays polarize stakeholders and lead to litigation. The BLM has an opportunity here to set this management strategy aside – because it can: because other forms of proven, safe, humane reproductive growth suppression exist and their use is generally supported by the public (PZP, PZP-22, GonaCon). - Every time the BLM has proposed to research surgical spays the projects have been delayed due to litigation. One can assume that the same would happen if BLM pursued surgical spays in this context and thus, not be a feasible management tool for years. - We do not advise gelding as a population management tool since there are effective and well-studied, safe, effective, and humane and reversible population growth suppression alternatives and there are not sufficient studies to understand the behavioral effects of gelding some proportion of a population. Modeling for population effects is a guess, at best. In regard to the preferred alternative not including		

		fertility control vaccines, please consider the following: While we understand that implementing fertility control vaccine measures in large HMAs is challenging and not without constraints, a slower and multi-faceted approach to wild horse management could include some removals, some on-range fertility control (via remote darting), and some gather-administer-release fertility control. This multi-pronged approach will be effective at more sustainable and longer-term wild horse management (with less dependence on short- and long-term holding, where a majority of the wild horse and burro program budget is spent). This better implements an "HMA-by-HMA approach": in some instances, AML will be reached and then fertility control applied so that re-visiting that same HMA for further removals has a larger time interval between what had been typical. To reduce stress on holding facilities, contractor availability, and budget, some HMAs necessitate the application of immune-contraceptive vaccine alongside gather-removals, and AML will not be reached immediately. Even so, population growth rates on the range will be		

		reduced, and time between gathers can be extended. At the time of another gather, fertility control vaccine can be reapplied to mares that had received initial doses, new mares can receive treatment, and some animals can be gathered and removed, in effect scaling up fertility control at each opportunity. Though AML may not be achieved, progress towards AML certainly will be, population growth rates will decline at each gather, and holding facilities will not be burdened. As well, recently published data (Rutberg 2017) shows that horses treated initially with PZP-22, and boosted with a single PZP injection (hand or remote delivery) 2-4 years later, extends contraception for at least three years, with fertility in treated animals reduced by an average of 70%. Applying this formula to gather-treat-release strategies can further help to increase time between gathers and reduce population growth rates. In regards to mares younger than 5 not being returned to the range, healthy populations rely on whatever the norms are in terms of that population's demographics. Adjusting a population of wild horses to		

		skew for more or less of anything does not attain a natural state for that population, with behavior ramifications that are not yet understood. Comments to 2.4 Alternatives Considered but Eliminated from Detailed Analysis “2.4.3 Gather the HMA to the AML Upper Limit Under this Alternative, a gather would be conducted to remove enough wild horses to achieve the upper AML of 115 wild horses.” (EA, p. 17) AML is set at a range so that the low end can be achieved, and then there is sufficient time between gathers (as the population creeps up from the low to the high AML). The AML for the Confusion HMA was determined based on gather-and-removal-ONLY management scenarios. If fertility control is some portion of the management plan, AML can be brought into context: a decreased population growth rate translates to both longer times between gathers and fewer horses needing to be gathered if the growth rate is reduced. “Due to the flightiness of the Confusion wild horses,		

		sterilization is likely the minimum feasible level of management possible." (EA, p. 47) It is understood that reducing the number of times horses must be handled and managed is a logical approach. Because some portion of the herd would be left as a reproducing portion, periodic gathers will still be necessary. By that same logic, we would recommend that immunocontraception vaccines be the mechanism to achieve population growth suppression, since there is more acceptance of this method by the public; it is less technically rigorous and thus easier to be administered by moderately trained field staff (as opposed to veterinarians); and the perceived gain of fewer gathers and a minimum feasible level of management achieved by surgical sterilization is not borne out in this case.		
40	Beaver County	Beaver County would give preference to Alternative A in the Action Alternatives within the EA - to remove excess wild horses to the lower AML limit and then adjust population sex ratios. However, we would also like to see the use of fertility control treatments integrated into management of this herd as we believe it will slow the population	Thank you for your comments.	No

		growth and reduce the need to regather horses as frequently. Also, with this proposed plan in place, the number of wild horses sent to permanent long term holding facilities will be significantly reduced. Wild Horses are a wonderful resource and an iconic symbol of western landscapes and freedom. However, these animals MUST be managed properly to balance the other resources and range needs to maintain a thriving ecological balance. The current over-population of horses is creating a severe imbalance and is very detrimental to rangeland health, wildlife populations, permitted livestock use, and to the health of the horses themselves. We fully support and encourage all efforts to bring wild horse numbers into compliance with the prescribed AML and to maintain that level.		
41	PLPCO	The State of Utah (State) has reviewed the Draft Environmental Assessment and appreciates the Fillmore Field Office efforts in managing wild horses and burros on public lands. Productive rangelands and healthy ecosystems in areas populated by wild horses and burros require the best possible management.	Thank you for your comments.	No

		Unfortunately, the United States Congress has placed land management agencies in a precarious position. The laws require federal agencies to manage herd populations in balance with other uses and resources without providing adequate funding or management tools to accomplish these aims. The State supports the proposal to gather and remove excess wild horses from inside and outside the Herd Management Area (“HMA”). The State further supports the use of population suppression measures to help maintain the wild horse population within the appropriate management level (“AML") of 70 to 115. This gather will substantially benefit public, state, and private property in Juab and Millard Counties. In collaboration with the Utah Department of Agriculture and Food (UDAF), the State provides the following comments for your consideration.		
42	PLPCO	The Wild Free-Roaming Horses and Burros Act of 1971 established HMA’s to be managed to “maintain a thriving natural ecological balance among wild horse populations, wildlife, livestock, and vegetation and to protect the range from the deterioration	Issues with the rangeland are discussed in Chapters 3 and 4 of the EA. The Confusion HMA is not part of any sage grouse conservation plan because sage grouse and their priority habitat do not exist in the Confusion HMA.	No

		associated with overpopulation." Each HMA has an AML, which is the population range that will allow the area to maintain its necessary balance between multiple uses. Currently, the Confusion HMA has an AML of 70-115 horses. However, the current population is estimated to be 551 horses. This drastic overpopulation of horses has severe negative effects on other multiple uses within the HMA. Wild horses and burros have been identified as a threat to greater sage-grouse (Conservation Plan for Greater Sage-grouse in Utah 2013). Under the plan, by maintaining sage-grouse habitat and invigorating beneficial plant growth proper domestic livestock grazing is identified as a benefit. Livestock grazing can be controlled and managed to effectively benefit sage-grouse habitat, while wild horse herds are much harder to control. Proper grazing in Sage Grouse Management Areas (SGMA) is controlled through the principles of time, timing, and intensity (Conservation Plan for Greater Sage-grouse in Utah 2013). Under current population levels, wild horses and burros are having negative grazing		

		impacts under all three grazing principles. The horses are present year-round (time), they graze new growth during critical growing periods for plant growth and health (timing), and they overpopulate, which increases the intensity of grazing in the area (intensity).		
43	PLPCO	The Gandy allotment, which is within the Confusion HMA, currently has 342 suspended AUMs. In addition, the Thousand Peaks allotment suffered an AUM reduction of 6,308 in 2018. Wild horses might not be the only cause for AUM reduction, but they are a contributing factor. If the herd is allowed to continue growing without population control, more cattle AUMs could face suspension and the local economy would face economic losses from the degradation of multiple uses on public land. Unchecked wild horse herds have an average growth rate of 20 percent, resulting in a herd doubling in size every five years (Garrot et al. 1991). Fertility control and other uses of contraceptives only slow the rate of growth and are insufficient to remove the need for wild horse removals (Barthalow 2007). The State is appreciative and supportive of the	Thank you for your comments. Refer to Chapters 3 and 4 for rangeland issues.	No

		BLM's decision to follow the process outlined in the regulations found in 43 CFR Part 4100 under the authority of the Taylor Grazing Act, which does not recommend livestock grazing reduction. Overall, the Confusion HMA faces several severe issues that require the removal of overpopulated wild horses. Wild horse overpopulation has serious negative impacts on rangeland health. The continued growth of the herd threatens the ability of this land to sustain multiple uses including wildlife habitat, recreation and tourism, and domestic livestock grazing. The proposed horse gather is the most effective way to return the Confusion herd to the desired AML, meet rangeland health standards, avoid future economic losses, and protect the health of the Confusion herd and all multiple uses in the area.		
44	Alice Burkhart	PZP darting is cost effective birth control for horses. It is humane, inexpensive and not cruel. ABOUT US PRIVACY POLICY DISCLAIMERS ACCESSIBILITY NOTICES	Thank you for your comments. See comments 1-38 of this document.	No

		Surgical sterilization of wild horses is not recommended by Veterinary boards, and every government organization that examined the practice. II is cruel, destroys the social structure of the wild horses and will kill many. My tax dollars would be better used by PZP darting. Keep the wild horses free. protect our range lands from welfare ranchers,		
45	Debra Cook	I am responding to this preliminary draft with a heavy heart. It was recommended strongly by the National Academy of Science report given to you back in 2013 that your numbers were not genetically viable and that the use of a safe, proven birth control method out on the range lands was the recommended management route to take - PZP. It's been proven to be a minimum of 90% effective in various places that have implemented it through the years, unlike the procedures you are stating in your draft. There are too many cattle/sheep allotments, yet they seem to continue to take priority over the wild horses, the latter of which are supposed to be federally	Thank you for your comments. See comments 1-38 of this document.	No

		protected, by you. And humanely managed, by you. None of which seems to be the case. This is by no means any scientific means of humanely managing any of the native inhabitants of these lands, nor protecting our public lands. I find it very interesting that the dates you provide are old, yet you expect people to by into this "smoke and dagger" approach. Estimating a 20% increase in herds sizes annually, not taking into account those who perish from old age, injury, etc. is also irresponsible. I would like to know who's the benefactors of your intentions, as this should be public knowledge. Please reconsider your options and priorities as they seem direly skewed. Thank you for you time.		
46	AWHC Form Letter with added comments from Lisa Scharin	I strongly oppose the Bureau of Land Management's plan to spend my tax dollars to round up and permanently remove 481 horses from the Confusion Herd Management Area (HMA) and reduce the population to just 70 horses on 235,000 acres of public land. This large scale removal, if combined with	Thank you for your comments. See comments 1-38 of this document.	No

		the proposed permanent sterilization, will irreversibly set this wild horse population on a path to extinction. The Confusion wild horses must be preserved and humanely managed, not decimated and destroyed. The Environmental Assessment (EA) on the Confusion HMA Wild Horse Management & Gather Plan is inadequate. The EA fails to consider an alternative to reduce livestock grazing in the Confusion HMA in order to maintain a larger, genetically viable wild horse herd in the HMA. This option is legally within the purview of the BLM, as, under the law, protection of wild horses and burros is a legal mandate, while authorization of livestock grazing is a discretionary action. The EA failed to consider the impacts of utilizing surgical sterilization procedures on wild mares and did not address the National Research Council's conclusion that "spaying" of mares through the invasive ovariectomy via colpotomy procedure is "inadvisable for field application" due to risk of		

		bleeding and infection. The BLM must fully consider the health risks, behavioral consequences, and genetic implications of utilizing permanent sterilization methods on individual wild horses and in a small population. The EA failed to adequately consider the impacts of gelding that could result in the loss of male-type behaviors necessary for maintaining social organization and expression of the natural behaviors that the public is interested in protecting. The EA failed to consider humane and scientifically recommended PZP fertility control program to maintain the Confusion wild horse population at a genetically viable number without constant removals or surgical sterilization methods that will take the wild out of wild horses. STOP wasting MY money and other Tax payers money!!! STOP catering to ranchers, cattle, oil, gas interests! Millions have been fighting for horses and the END of Rounding them up-confining them-it is TIME to implement REAL "management". The AML		

		is TOO low-NOT a viable, sustainable number that will threaten the horses existence! These horses have lived in this habitat and other portions of our Plains for Centuries-they ARE ICONS-Part of OUR History, Culture and Success as a Country! PROTECT THEM! STOP CONFINING THEM!!!!		
47	P. German	It is not true that the wild horse population is large. There are many more cattle on our public lands. Remove the cattle! Let the wild horses and burros run free without interference. I do NOT support any more roundups of horses. It is cruel and unnecessary. This practice is not management. It is mismanagement. The BLM needs to promote conservation, not decimation of our wild horse population.	Thank you for your comments. See comments 1-38 of this document.	No
48	Pamela Spicer	You want my comment? Having lived out west I've seen and been unbelievably disappointed in the MISMANAGEMENT by the BLM concerning the mustangs. Horribly cruel and unnecessary roundups, keeping them for years in holding facilities ... .I could go on and on and on ..... there is much evidence that they can be	Thank you for your comments. See comments 1-38 of this document.	No

		well managed and do no damage to the environment. Please STOP these heinous practices. Work with the groups, as I have, that have some great ideas for a humane solution. Please. Please. Please. Pam Spicer.		
49	Paul Cozzens (Iron County Commisioner)	I support this Horse Gathering effort, we have recently had horses gathered In Iron County that has helped the range a great deal from overcrowding. I am happy to voice support for our neighboring county.	Thank you for your comment.	No
50	Unknown Submitter	There are solid alternatives listed in this EA, but the preferred Alternative D: Gather and removal of excess wild horses to low AML, implementing population growth control by establishing non. reproducing components, misses the mark. We have relevant suggestions for a humane and sustainable management paradigm: • "Under Alternative D management actions would be similar to the Alternative A and C with the exception that a fraction of the mares returning to the HMA would be humanely sterilized .... A select number of humanely	Thank you for your comments. See comments 1-38 of this document.	No

		neutered male horses may also be returned to the HMA as part of the non reproducing component• (EA, p. 10-11) We do not support any surgical sterilization of animals for management purposes because: (1) There are no substantive studies evaluating long term health of ovariectomized mares. At the Center for Equine Health (UC Davis), a herd of twenty older spayed mares were housed. Eighteen of them showed advanced musculoskeletal deterioration, which led veterinarians on-site to wonder at the effect of removing estrogen, as an ovariectomy does. (2) Surgical spays polarize stakeholders and lead to litigation. The BLM has an opportunity to set this management strategy aside because other forms of proven, safe, humane fertility control exist and their use is generally supported by the pub~c (PZP, PZP-22, GonaCon). (3) Every lime the BLM has proposed surgical spays the projects have been delayed due to litigation One can assume that the same would happen if BLM pursued surgical spays in this context (4) We do not advise gelding as a population		

		management tool: there are well-studied fertility control alternatives and there are not sufficient studies to understand the behavioral effects of gelding some proportion of a population. In regard to the preferred alternative not induding fertility control vaccines: we understand that implementing fertility control vaccine in large HMAs is challenging, but a slower and multi-faceted approach to management could include some removals, some on-range fertility control, and some gather-administer-release fertility control. This multi•pronged approach will be effective at more sustainable and longer-term wild horse management. This better implements an "HMA-by-HMA approach"; in some instances, AML will be reached and then fertility control applied so that re-visiting that same HMA for further removals has a larger time interval. To reduce stress on holding facilities, contractor availability, and budget, some HMAs necessitate the application of immunecontraceptive vaccine alongside gather-removals, and AML will not be reached immediately, but population growth rates on the range are reduced, and time		

		between gathers is extended. At the lime of another gather, fertility control vaccine can be reapplied to primed mares, new mares can receive treatment, and some animals can be gathered and removed. Though AML may not be achieved, progress towards AML will be, population growth rates will decline at each gather, and holding facilities will not be burdened. Rutberg (2017) shows that horses treated initially with PZP-22, and boosted with a single PZP injection 2-4 years later, extends contraception for at least three years, with fertility in treated animals reduced by an average of 70%. Applying this formula to gather-treat-release strategies can increase time between gathers and reduce population growth rates. In regards to mares younger than 5 not being returned to the range, populations rely on norms for that population's demographics. Falsely adjusting those demographics does not attain a natural state for that population.		
51	Garrick Hall (Utah Farm Bureau)	Utah Farm Bureau is writing in support of BLM's wild horse gather on the Confusion Herd Management Area. This HMA has nearly five times	Thank you for your comment.	No

		the number of wild horses recommended in the AML and needs to be reduced back to appropriate numbers. Overgrazing of this fragile desert rangeland has devastating long term impacts on domestic livestock grazing and other wildlife species. We understand that wild horse management is an emotional and controversial issue. We appreciate the efforts of local and regional BLM's officials to recognize and take action to address this difficult problem. Utah Farm Bureau supports all efforts to manage wild horse herds at AML in an effort to protect and preserve the range for future generations.		
52	Marybeth Devlin	On page 75 of the EA, BLM reports the results of the November 2017 aerial inventory of the Confusion herd. The census' numbers showed ***significantly fewer*** horses than BLM had reported in March 2017. Per this finding, BLM reduced the March 20**18** HMA statistics by **191**, a drop of **41**%. BLM staff should have purposeful, meaningful work. The mandate to protect and preserve the Confusion wild-horse herd needs a management-model that befits that mission.	Thank you for your comments. Wild horse population numbers are discussed in Chapter 1.1 of the EA. The Reserve Design concept suggested in this comment is similar to Section 2.4.6 in the EA (Control of Wild Horse Numbers by Natural Means). The 2013 National Academies of Sciences report found that allowing uncontrolled wild horse herd growth would lead to severe ecosystem degradation, a result which would not be in keeping with a thriving natural ecological balance. The	No

		Reserve Design is the model ideally-fit-for-purpose. Below are links to a study, and an article introducing the study, on the optimal way to implement Reserve Design. I urge BLM to adopt this approach. Mountain Lions Are Effective Population-Control Agents for Wild Horses. Confusion should be a safe-haven for predators, which will serve as wild-horse population-control agents. WILD HORSES BENEFIT THE ECOSYSTEM	Confusion HMA does not support any substantial population of predators large enough in size or number to regulate the wild horse herd in the HMA. Introducing such predators is outside BLMs authority and outside the scope of this EA. The benefits that wild horses in sustainable numbers can provide to the ecosystem are not exclusive to wild horses and can be achieved by other grazers as well. However, the overpopulation of horses has negative impacts such as overgrazing. Refer to Chapter 3 and 4 of the EA. BLM has read all of your comments not shown and has responded to similar comments for other commenters. See comments 1-38 of this document.	
53	WHE	On behalf of Wild Horse Education ("WHE") and all of its staff and members, and myself as an individual, I submit these comments on the Draft Confusion HMA Wild Horse Management and Gather Plan Environmental Assessment (DOI-BLM-UT-W020-2018-015-EA) for the Confusion Herd Management Area ("HMA"). Wild Horse Education is a 501(c)(3) nationally recognized wild horse advocacy organization over 150,000 members strong.	The scope of the Confusion EA is to restore a TNEB and multiple use relationship on the public lands consistent with the provisions of Section 1333 (a) of the WFRHBA as amended, to remove excess wild horses from within and outside the HMA, and to manage wild horses to achieve and maintain established AML ranges for the HMA and to reduce the wild horse population growth rate in order to prevent undue or unnecessary degradation of the public lands by	Yes

		Wild Horse Education contends that this roundup cannot and should not go forward for several fundamental reasons, as follows. 1. As stated in the "Dear Reader" letter dated June 25, 2020, and in the EA's Introduction on p.3, this Draft Management and Gather Plan EA is tiered to the House Range Resource Area Final Resource Management Plan/Environmental Impact Statement (RMP/EIS), 1986; and the Final RMP/ROD, 1987. These are 34- and 33-year-old documents, respectively, outdated information. Land Use Plans need to be updated every 10 to 15 to be relevant to management decisions of any significant magnitude. Since that time, BLM contracted with the NAS for at least three reviews of the WH&B program, most recently in 2013. Every single review	protecting rangeland resources from deterioration associated with an overpopulation excess wild horses within and outside the HMA. So as to be in compliance with the 1987 House Range RMP/ROD. Additional language has been added to Section 8 of the EA that address public involvement. This language was added after the public comment period. This plan is not a Herd Management Area Plan (HMAP). To address the commenter's confusion, BLM has removed the word "management" from the plan's title.	

		from NAS has pointed out multiple deficits in data, transparency, public participation, and inability of BLM to follow its own protocol. 2. This EA is masquerading as a Herd Management Area Plan, which it is not, and it implies a level of scoping and public involvement which doesn't actually exist. Pursuant to BLM Handbook *H-4700-1 Wild Horses and Burros Management Handbook (Public),* p.10, habitat, population management and monitoring objectives are appropriately defined in a Herd Management Area Plan (HMAP) rather than a Land Use Plan. A Herd Management Area Plan is where HMA goals, management, and implementation strategies are decided and established after extensive scoping as provided by law is done. WHE points out that virtually all other issues in this 2020 Draft Confusion HMA EA (DOI-BLM-UT-W020-2018-015-EA) are Management and		

		Implementation decisions that should have been part of an HMAP tiered to the Land Use Plan and subjected to full scoping, for example and including but not limited to: means of capture (i.e., helicopter or bait); Fertility Control methods(how many horses treated, the methods used, the protocols per method); genetic preservation implementation actions such introducing mares/horses from other herds; gender skewing; Appropriate Management Level ("AML"). Without the HMAP, the asserted AML of 70 to 115 determined in the 1986 or 87 RMP is invalid. BLM must create an HMAP before moving forward with any actions in this EA. This EA does not provide a management discussion. It implies some type of management discussion that was never actually carried out according to the above-referenced BLM Handbook, which is protocol BLM created to follow the law in its mandate of management of wild horses and burros in much the same way that they deal with livestock, mining, and every other interest. Wild Horse Education asserts that the only issues legitimately addressed in this Environmental		

		Assessment are the number of horses to be removed and whether the actions of the roundup impact wildlife, endangered or threatened species, or artifacts. What BLM is doing here is denying the public any opportunity to comment or craft an actual management plan for the herd. STATUS OF WILD HORSES AND BURROS BLM Handbook Section *2.1.2 Comparability Consideration* makes clear that: *Under 43 CFR 4700.0-6(b) WH&B shall be considered comparably with other resource values in the formulation of LUPs. This means WH&B are to be considered in the same manner as other resource values …WH&B are a resource value, as opposed to a land use (e.g., livestock grazing or timber harvest).* If BLM deviated from their protocol with other interests in the way they deviate with Wild Horse and Burro management protocols, other public lands interests (livestock, mining, and every other interest) would be litigating. According to BLM handbook, management planning actually begins with a scoping period. If		

		BLM is presenting this EA as a management plan, it is not. A management plan according to the BLM handbook begins with extensive scoping. Until BLM crafts an HMAP specific to this Confusion HMA that includes public scoping, every other action in this EA besides the removal is actionable. Respectfully submitted, Elyse Gardner Walsh, representing Wild Horse Education		

DATE:_____

NAME:_____

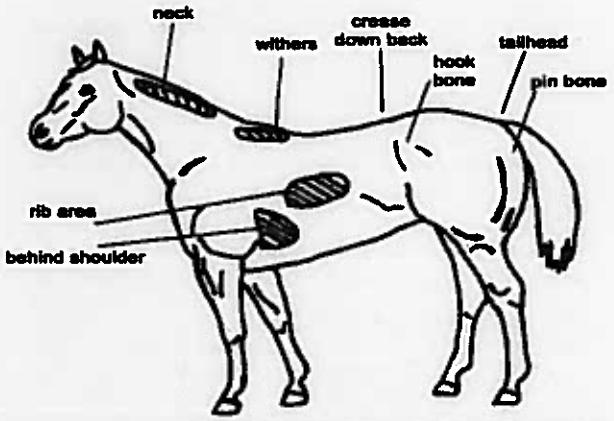
FREEZEMARK:_____

SIGNALMENT KEY:_____

HOOF CONDITION:_____

COMMENTS: _____

OVERALL HENNEKE BODY CONDITION SCORE: [ ]



modified from Henneke et al. EVJ 1983;15:371-372

(circle descriptions for each area of the body then average together)

Condition	Neck	Withers	Shoulder	Ribs	Back	Tailhead Area
1 Poor (*extremely emaciated*)	Bone structure easily noticeable	Bone structure easily noticeable	Bone structure easily noticeable	Ribs projecting prominently	Spinous processes projecting prominently	Tailhead, pinbones, and hook bones projecting prominently
	No fatty tissue can be felt					
2 Very Thin (*emaciated*)	Bone structure faintly discernible	Bone structure faintly discernible	Bone structure faintly discernible	Ribs prominent	Slight fat covering over base of spinous processes. Transverse processes of lumbar vertebrae feel rounded. Spinous processes are prominent	Tailhead prominent Pin bones prominent Hook bones prominent
3 Thin	Neck accentuated	Withers accentuated	Shoulder accentuated	Slight fat cover over ribs. Ribs easily discernible	Fat buildup halfway on spinous processes, but easily discernible. Traverse processes cannot be felt	Tailhead prominent but individual vertebrae cannot be visually identified. Hook bones appear rounded, but are still easily discernible. Pin bones not distinguishable
4 Moderately Thin	Neck not obviously thin	Withers not obviously thin	Shoulder not obviously thin	Faint outline of ribs discernible	Negative crease (peaked appearance) along back	Prominence depends on conformation. Fat can be felt. Hook bones not discernible
5 Moderate	Neck blends smoothly into body	Withers rounded over spinous processes	Shoulder blends smoothly into body	Ribs cannot be visually distinguished, but can be easily felt	Back is level	Fat around tailhead beginning to feel spongy
6 Moderately Fleshy	Fat beginning to be deposited	Fat beginning to be deposited	Fat beginning to be deposited behind shoulder	Fat over ribs feels spongy	May have a slight positive crease (a groove) down back	Fat around tailhead feels soft
7 Fleshy	Fat deposited along neck	Fat deposited along withers	Fat deposited behind shoulder	Individual ribs can be felt, but noticeable fat filling between ribs	May have a positive crease down the back	Fat around tailhead is soft
8 Fat	Noticeable thickening of neck	Area along withers filled with fat	Area behind shoulder filled with fat	Difficult to feel ribs	Positive crease down the back	Fat around tailhead very soft
9 Extremely Fat	Bulging fat	Bulging fat	Bulging fat	Patchy fat appearing over ribs	Obvious crease down the back Flank filled with fat	Bulging fat around tailhead

(2/5/2013)