United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Elko Field Office
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Elko, Nevada 89801-4611

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Dear Reader:

On September 8, 1998 and September 29, 1998, you were informed by letter that the Ely and Elko Field Offices were planning to remove excess wild horses from the Antelope and Antelope Valley Complex Herd Management Areas (HMAs). The purpose of the gathers is to achieve appropriate management level and to continue research using the fertility control vaccine. The gather is set to begin on or about November 16, 1998.

Since the time of the first notification letter, the BLM has had an opportunity to use the population model developed by Dr. Stephen Jenkins of the University of Nevada, Reno. The model was used to compare the results of several different management strategies on the Antelope/Antelope Valley HMAs. The results of the computer simulations are explained and summarized in the attached paper. If you have any questions, please contact Kathy McKinstry, Wild Horse and Burro Specialist, at (702) 753-0200 or at the above address.

Sincerely,

Roy Price, for

CLINTON R. OKE
Assistant District Manager
Renewable Resources

1 Attachment
1. Population Model - Antelope/Antelope Valley Complex Simulation

ANTELOPE/ANTELOPE VALLEY COMPLEX

HERD MANAGEMENT AREAS

POPULATION MODEL SIMULATIONS

Prepared by
Kathy McKinstry
Elko Field Office
Wild Horse and Burro Specialist

November 9, 1998

1. Introduction

The Ely and Elko Field Offices will be gathering wild horses from the Antelope and Antelope Valley Complex Herd Management Areas (HMAs) beginning on or about November 16, 1998. The Antelope Valley Complex includes the Goshute, Spruce-Pequop and Antelope Valley HMAs. The appropriate management level (AML) for the complex is 907 and the management range is between 618 and 907 horses yearlong. The current population exceeds 2,000 horses.

Each of the HMAs involved have been gathered in the last six years under an age selective removal strategy. These HMAs have been selected to conduct preliminary population level fertility control research. The purpose of the research is to study the effect of immunocontraception on population growth rates using three different populations of mares. The proposed project is a continuation of previous research on fertility control conducted in the Antelope/Antelope Valley HMAs (1992), Nevada Wild Horse Range (1996), and the Kamma Mountains/Antelope Range HMAs (1998). The immunocontraceptive vaccines that will be used in the project represent a refinement of the vaccine based on data obtained from previous research.

Development of an effective fertility control vaccine may lead to a reduction in the number of wild horses that need to be gathered nationally each year and/or increase the time period between maintenance gathers of excess wild horses. The results of the research may also lead to the development of a vaccine which could provide two to three years of contraceptive protection, with a minimum of disturbance to the animals. The current vaccine is only effective for one breeding season. The research is being conducted by John W. Turner, Jr., Ph.D., Jay F. Kirkpatrick, Ph.D., and Irwin K. Liu, Ph.D. To predict the outcome of the fertility project, data from the HMAs were entered into the model along with the parameters involved with the project. The fertility control process implemented and the results of the modeling effort will be described in this paper.

2. Project Objectives

Project objectives have been established by the research team of furthering the development of the vaccine and by BLM of studying the applicability in the management of animals within the HMAs. The following are the specific objectives that have been established.

a. Objectives of the Fertility Control Study

Research Team

This is the third and final step of the fertility control research using the one shot, one year vaccine. The fertility control drug will be administered to two populations of wild horses; a third population will not be treated and will serve as a control. The effectiveness of treatment on limiting population growth will be determined by foal counts in each population over the next three years. The study goal is to treat all the mares possible in a given population in order to determine a limiting effect of treatment on population growth.

Bureau of Land Management's Wild Horse Management Study

The objective of the BLM project is to establish a reasonable level of population growth, estimate through modeling if those lower growth levels can be achieved, administer the contraceptive during the 1998 gather, and determine if those objectives are met through monitoring population growth in calendar year 2000.

b. Objectives of Population Modeling

In an attempt to predict the effect of the gather and the implementation of fertility control on a large number of animals, two computer simulations were run using the wild horse population model developed by Dr. Stephen Jenkins of the University of Nevada, Reno. The first simulation was based on a selective removal of horses five years of age and younger and no fertility control measures implemented on the horses released back to the range. The second simulation was based on a selective removal of horses five years and younger and fertility control measures implemented on horses age six and older prior to their release back to the range.

The population model uses data on survival and reproductive rates of wild horses to predict population growth. The model uses a random process to simulate unpredictable future variation in survival and fecundity, reflecting the fact that future environmental conditions that may affect wild horse populations cannot be known in advance. The model uses a series of trials to project a range of possible population sizes after a given number of years, which is more realistic than predicting a single, specific population size.

2. Procedures

Gather Methods/Fertility Control

The BLM will gather approximately 85 to 90 percent of the total population of wild horses inhabiting the Antelope/Antelope Valley Complex HMA. Horses will be gathered via helicopter trapping. After trapping, horses will be sorted according to age and sex. All mares in the Antelope/Antelope Valley Complex HMAs that are six years of age and older (approximately 436), will be treated with a revised immunocontraceptive vaccine, porcine zona pellucidae (PZP). All treatments will consist of a single injection of PZP vaccine with a controlled-release component. This vaccine will provide infertility for one breeding season. Treatment will be administered as a single 1 cc. injection by pneumatic blowdart while each mare is in a squeeze stockchute. Of these mares, approximately 150 will be used as the core study group and will be permanently marked for later identification. The technique used to mark the animals will be a four inch freezebrand on the left hip. The brand will most likely be a "0" for ease of identification.

Wild horses that are five years of age and younger will be gathered and removed from the range and placed in BLM's Wild Horse and Burro Adoption Program and will not be treated with the immunocontraceptive vaccine.

Population Model

The basic parameters required by the model are initial population size, age-specific survival rate, age-specific fecundity (reproductive) rates for females, and sex ratio at birth. The initial population size was determined using the age structure from the horses released in the Antelope and Antelope Valley HMAs in 1994 and also those horses released in the Goshute HMA in 1996, following age selective removals. The model was allowed to compute an age distribution for a "normal" population (the "normal" population consists of those horses not gathered in 1994 nor 1996), then the older horses that were released were added back into the appropriate age classes of the computed generated "normal" population.

Age-specific survival data are lacking for the Antelope/Antelope Valley Complex horses. The initial survival rates used were those from the Garfield Flat, Nevada area, where a long-term study, which began in 1992, is in place. Foaling rate was determined from an analysis of 1994 and 1996 gather data of the Antelope/Antelope Valley Complex HMAs and is an average of .550. Since age-specific fecundity data for the area are not available, the .550 rate was assigned to all mares aged 2 and older. Sex ratio at birth was assumed to be 50-50.

The model uses coefficients of variation, which are indices of year-to-year variation in adult mortality, foal mortality and foaling rate, to simulate unpredictable variation in environmental conditions. Estimating these coefficients requires long-term demographic data, which are unavailable for the study area. Therefore, the program default values were used.

The model was run under two sets of conditions: one using no fertility control and the other assuming a one year fertility drug was used that was 95 percent effective. Other initial conditions for the simulation included a 10 year management period, 85% of horses are gathered (15% are able to elude capture), all horses 0-5 years of age that are captured are removed and no horses six years or older are removed, gather when the population reaches 907 and reduce to 618 (the range of AML for the area). This ensures a gather will take place the first year, as the population currently exceeds 917. For both simulations, 30 individual trials were run which is the program default. Each trial with the model will give a different pattern of population growth; some trials may include mostly "good" years, others may include a series of several "bad" years in succession. This approach to modeling population growth uses repeated trials to project a range of possible population sizes after a given number of years, which is more realistic than predicting a single, specific population size (Jenkins, Wild Horse Population Model, Version 3.1, User's Guide). Table 1 depicts the initial population parameters for the Antelope/Antelope Valley Complex.

Table 1.

INITIAL POPULATION PARAMETERS					
Age	**Initial**		**Survival**		**Fecundity**
	Females	Males	Females	Males	
0	156	156	.976	.917	.000
1	136	115	.977	.972	.000
2	110	95	.997	.972	.550
3	92	82	.976	.991	.550
4	77	72	.975	.991	.550
5	64	59	.973	.991	.550
6	64	59	.972	.991	.550
7	67	61	.971	.990	.550
8	44	33	.969	.990	.550
9	36	28	.967	.987	.550
10	61	38	.965	.988	.550
11	36	49	.962	.986	.550
12	36	54	.959	.984	.550
13	36	23	.955	.981	.550
14	18	28	.951	.978	.550
15	10	18	.950	.973	.550
16	5	10	.940	.967	.550
17	3	7	.934	.959	.550
18	3	10	.927	.948	.550
19	3	3	.919	.933	.550
20	10	15	.909	.914	.550
21	3	3	.898	.889	.550
22	1	0	.886	.857	.550
23	0	0	.872	.816	.550
24	0	0	.856	.764	.550
25	0	0	.000	.000	.550
Total	**1071**	**1018**	-	-	-

4. Results of Population Modeling

Before discussing the results of the population model, it is important to understand that population modeling has some drawbacks. The most important of these according to Jenkins is that results may be taken too seriously as predictions of what will happen to a particular population in the future. What we are really doing with the Wild Horse Population Model when we try to project population growth is saying: **If** a set of assumptions about survival, reproduction, environmental variability, and management actions hold true, **then** we expect the population to grow at a certain rate determined by the model. In other words, the results of this model, like those of any model, depend on its assumptions, and the user must always keep those assumptions in mind when interpreting the results. The most appropriate and effective way to use the model is for comparison of population growth under various conditions. The model is specifically designed for comparing fertility control and removal as management strategies (Jenkins, Wild Horse Population Model, Version 3.1, Users Guide).

The model was run for a ten year period (1998-2008) for both simulation using the assumptions listed on page 3. The model indicated that there would be an average of 82 foals produced in the year 2000 with fertility control and an average of 229 foals produced without fertility control. This is a 65% decrease in foal production in 2000 using fertility control, but foal production of the treated group returns to an average of 272 in the year 2001, which is slightly above normal.

The model indicates that by the end of the 10 year period, the overall population with fertility control implemented once every 3 years (assuming that fertility control is used during every scheduled gather) would be 797 total animals verses 715 total animals if no fertility control is implemented, but animals age 5 and under are removed from the range once every 3 years (Tables 3 and 4, Age Distribution by Year, Initial vs. Final Age Distribution - with and without fertility control). The mean population growth rate per year with fertility control was projected to be 7.8% with fertility control and 10.4% without fertility control over the 10 year period (Table 5, Average Growth Rate per Year). The fertility control project would not have a significant impact on the sex ratio of the horses. The projected sex ratio in 1998 without fertility control was 51% female/49% male and at the end of 10 years it was projected to be 49% female/51% male. The sex ratio with fertility control was 51% female/49% male in 1998 and 48% female/52% male in the year 2008.

Table 2.

INITIAL vs. FINAL AGE DISTRIBUTION (0-5 Year Olds Removed, Gather every 3 Years with Fertility Control, Years 1998-2008)						
Age	**Initial**		**Most Typical**		**Least Typical**	
	Females	Males	Females	Males	Females	Males
0	156	156	78	76	97	88
1	136	115	62	50	72	75
2	110	95	20	11	71	67
3	92	82	49	45	53	42
4	77	72	15	20	25	54
5	64	59	7	2	36	27
6	64	59	16	4	33	38
7	67	61	2	3	25	23
8	44	33	0	0	16	0
9	36	28	2	2	57	0
10	61	38	0	0	6	12
11	36	49	2	1	4	5
12	36	54	1	2	0	6
13	36	23	5	3	0	0
14	18	28	1	3	0	1
15	10	18	2	11	0	0
16	5	10	25	24	0	0
17	3	7	14	27	0	6
18	3	10	14	19	5	13
19	3	3	13	15	0	3
20	10	15	19	16	1	7
21	3	3	9	22	1	6
22	1	0	11	23	1	6
23	0	0	11	12	1	5
24	0	0	3	13	0	4
25	0	0	4	8	1	2
Total	**1071**	**1018**	**385**	**412**	**505**	**490**

Table 3.

INITIAL vs. FINAL AGE DISTRIBUTION (0-5 Year Olds Removed, Gather every 3 Years with no Fertility Control, Years 1998-2008)						
Age	**Initial**		**Most Typical**		**Least Typical**	
	Females	Males	Females	Males	Females	Males
0	156	156	64	75	107	115
1	136	115	34	38	66	80
2	110	95	24	14	99	54
3	92	82	23	22	62	58
4	77	72	4	5	21	12
5	64	59	4	3	26	17
6	64	59	3	3	15	7
7	67	61	2	3	2	2
8	44	33	2	5	4	6
9	36	28	2	0	1	0
10	61	38	3	1	0	2
11	36	49	2	2	3	2
12	36	54	1	0	0	0
13	36	23	2	13	8	6
14	18	28	6	6	7	4
15	10	18	3	2	3	4
16	5	10	23	33	21	24
17	3	7	32	25	15	33
18	3	10	17	17	15	18
19	3	3	13	11	13	13
20	10	15	23	22	19	18
21	3	3	12	27	11	17
22	1	0	14	24	10	18
23	0	0	17	8	9	11
24	0	0	6	10	9	13
25	0	0	3	7	5	11
total	**1071**	**1018**	**339**	**376**	**551**	**545**

Table 4.

AVERAGE GROWTH RATE PER YEAR (%)		
Trial	**With Fertility Control**	**No Fertility Control**
1	1.2%	6.9%
2	5.0%	7.0%
3	13.5%	-.2%
4	11.5%	-1.5%
5	9.6%	13.4%
6	6.3%	12.0%
7	13.2%	.4%
8	6.5%	14.8%
9	12.7%	13.0%
10	11.2%	18.2%
11	6.5%	-3.8%
12	8.1%	10.9%
13	-.5%	12.6%
14	.3%	13.8%
15	10.5%	16.9%
16	11.2%	12.1%
17	3.0%	14.5%
18	6.2%	5.3%
19	10.0%	-1.2%
20	8.4%	16.3%
MEAN	7.8%	10.4%
MINIMUM	-.5%	-3.8%
MAXIMUM	13.6%	18.2%
LO LIMIT	6.2%	8.0 (95% confidence limits)
HI LIMIT	9.4%	12.7% (95% confidence limits)

5. Summary

Implementation of fertility control measures should have a significant impact on foal recruitment rates in the year 2000. The recruitment rates should return to normal or above normal the following year. The long term impacts of fertility control verses no fertility control seems to have little impact on the *total* population of horses in Antelope/Antelope Valley Complex. The overall growth rate at the end of ten years is lower when fertility control is implemented. The difference in horse numbers at the end of ten years is 82 animals. The impacts of removing animals 0-5 years of age with a minimum of three years between gathers will result in more horses in the 16 to 25 year age category. This skewing of the age distribution happens with or without fertility control; however the number of horses in the 0-5 year age categories at the end of 10 years is large, ensuring that there will always be younger horses to keep the population viable. The computer model indicated that AML would not be reached until 2005 when removing 0-5 years olds. We were interested to know if AML could be reached more quickly, so the model was also run under the management strategy of removing horses up to 9 years of age, although that management strategy will not be implemented in the Antelope/Antelope Valley Complex HMAs in 1998. The conclusions are summarized in Table 5.

Other impacts of fertility control verses no fertility control can be seen in Table 6. This table shows the overall number of horses gathered, removed and treated during a ten year period with and without fertility control. It also shows the results of removing horses up to the age of nine. As can be seen from the table, fertility control results in fewer foals being conceived which results in fewer horses gathered, removed and treated with the immunocontraceptive vaccine. The modeling possibilities are endless and many management strategies were modeled while developing this paper but are too lengthy to describe and present here. Ultimately, a vaccine which is effective for two or three breeding season needs to be developed and would then provide the best management tool for controlling rates of increase in wild horse herds. Currently, a vaccine which is effective for two breeding seasons is being tested on domestic horses and may be available to the BLM for research purposes in the near future.

Table 5. Impacts of Different Management Strategies					
Management Strategy	Population Crash	Lowest Population Level within 95%confidence level	Mean Lowest Population Level	Year AML First Reached	Growth Rate
0-5 removed; no fertility control	No	743	804	2005	10.4%
0-5 year olds removed; fertility control implemented	No	635	730	2003	7.8%
0-9 year olds removed; no fertility control implemented	No	678	728	1999	11.4%
0-9 year olds removed; fertility control implemented	No	651	619	1999	10.7%

Table 6. Number of Horses Gathered, Removed and Treated Over Ten Year Period			
Management Strategy	Mean Number of Horses Gathered	Mean Number of Horses Removed	Mean Number of Mares Treated
0-5 Year Olds Removed, No Fertility Control Implemented	4797	2672	0
0-5 Year Olds Removed, Fertility Control Implemented	4220	2214	881
O-9 Year Olds Removed, No Fertility Control Implemented	3010	2165	0
0-9 Year Olds Removed, Fertility Control Implemented	3127	2006	491