

Appendix C

Results - Population Modeling, Buffalo Hills Complex

Version 1.40 of the WinEquus program, created April 2, 2002, was utilized to complete population modeling for the Buffalo Hills Complex (Buffalo Hills (NV-220), Fox-Lake Range (NV-228), and Granite Range (NV-221) HMAs).

Objectives of Population Modeling

Review of the data output for each of the simulations provided many useful comparisons of the possible outcomes for each alternative. The developer, Stephen Jenkins, recommends thinking about the range of possible outcomes and not just focusing on one average or typical trial. Some of the questions that need to be answered through the modeling include:

- Do any of the alternatives “crash” the population?
- What effect does fertility control have on population growth rate?
- What effects do the different alternatives have on the average population size?

Population Data, Criteria, and Parameters utilized for Population Modeling

Age-sex distribution data for each HMA was compiled and modeled from existing capture data records and census counts. Modeled age-sex distributions were then used to represent the post-foaling 2004 age-sex structure for each HMA as displayed in the table below.

Initial Age-Sex Structure (2004) – Buffalo Hills Complex HMAs

Age Class	Buffalo Hills		Fox-Lake Range		Granite Range (North/South)	
	Females	Males	Females	Males	Females	Males
Foals	8	5	57	65	67	74
1	32	26	52	57	77	57
2	43	30	47	43	57	48
3	33	33	10	9	12	10
4	27	19	15	10	19	13
5	31	16	18	12	28	18
6	30	16	22	13	28	13
7	17	8	14	7	22	15
8	10	5	12	5	15	14
9	3	3	8	8	11	12
10-14	6	9	13	10	20	16
15-19	10	17	7	6	15	10
20+	10	27	7	9	10	10
Total	260	214	282	254	381	310

All simulations used the survival probabilities and foaling rates supplied with the WinEquus population model for the Granite Range HMA. Survival and foaling rate data were extracted from, *Wild Horses of the Great Basin*, by J. Berger (1986, University of Chicago Press, Chicago, IL, xxi + 326 pp.). Rates are based on Joel Berger’s 6 year study in the Granite Range HMA in northwestern Nevada. However, the sex ratio at birth observed by Berger in the Granite Range was modified from 57% males at birth to 50% males at birth for this modeling effort based on capture histories.

Survival probabilities, foaling rates, and selective removal criteria utilized in the population modeling for each alternative are displayed in the following tables. Fertility treatment is only applied to breeding age (3 and older) mares:

Survival Probabilities and Foaling Rates

Age Class	Survival Probabilities		Foaling Rates
	Females	Males	
Foals	.917	.917	--
1	.969	.969	--
2	.951	.951	.35
3	.951	.951	.40
4	.951	.951	.65
5	.951	.951	.75
6	.951	.951	.85
7	.951	.951	.90
8	.951	.951	.90
9	.951	.951	.90
10-14	.951	.951	.85
15-19	.951	.951	.70
20	.951	.951	.70

Removal Criteria - Standard

Age	Percentages for Removals	
	Females	Males
Foal	100%	100%
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	--	--
7	--	--
8	--	--
9	--	--
10-14	100%	100%
15-19	100%	100%
20+	100%	100%

Population Modeling Criteria

The following summarizes the population modeling criteria common to action alternatives:

- Starting Year: 2004
- Initial gather year: 2004 (prior to 2005 foaling)
- Gather interval: 4 (4-year gather cycle, e.g., 2005, 2009, 2013)
- Sex ratio at birth: 50% male
- Percent of the population that can be gathered: 90%
- Minimum age for long term holding facility horses: 10 years old
- Foals are included in the AML: Yes
- Simulations were run for 10 years with 100 trials each

The following summarizes the population modeling criteria for the No Action alternative:

- Starting Year: 2004
- Sex ratio at birth: 50% male
- Simulations were run for 10 years with 100 trials each

Additional population modeling parameters utilized in modeling the alternatives:

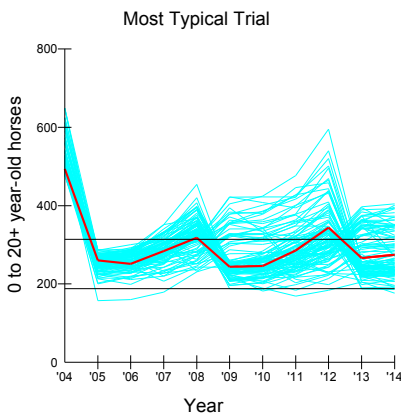
Alternative	I (Proposed)	II	III (No Action)
AML Range	Varies by HMA	Varies by HMA	Varies by HMA
Management by removal only	No	Yes	No
Management by removal and fertility control	Yes,	No	No
Threshold population size for gathers – “Gather when population exceeds X horses”	High AML range by HMA	High AML range by HMA	None
Target population size following gathers – “Reduce population to X horses”	Low AML range by HMA	Low AML range by HMA	None
Gather for fertility control regardless of population size?	Yes	N/A	N/A
Gathers continue after removals to treat additional females?	Yes	N/A	N/A
Effectiveness of Fertility Control: year 1	94%	N/A	N/A
Effectiveness of Fertility Control: year 2	82%	N/A	N/A
Effectiveness of Fertility Control: year 3	68%	N/A	N/A

Population Modeling Results

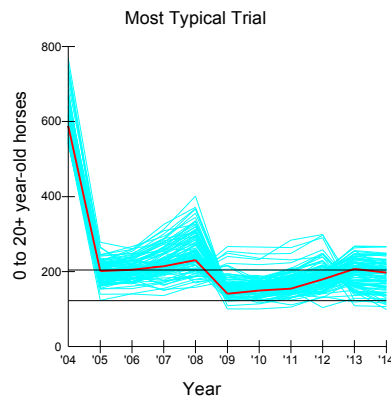
Each HMA population was run through a 10 year simulation for each alternative. Simulations were run with applicable management options selected for a time period of ten years. Simulations were based on individual HMA populations to assess management affects on smaller population numbers as the degree of herd mixing within the complex is unknown. Alternative 1, the Proposed Action, modeled the affects of removal and fertility treatment management actions on wild horse populations based on a four-year gather cycle. Alternative 2 modeled affects of removal actions only on population based on a four-year gather cycle. Alternative 3 modeled the growth of horse populations with no management actions.

Alternative 1, Proposed Action (Gather to Low AML with Fertility Control)

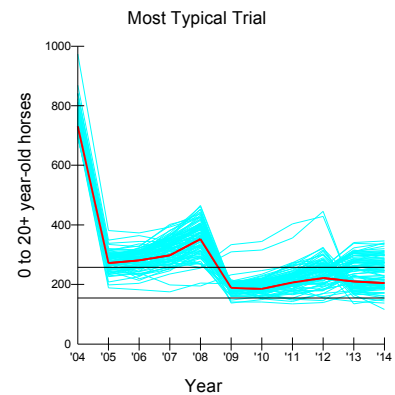
Displayed in the graphs below are the most typical (median) trials (dark line) of the 100 simulations (lighter lines) based on the Proposed Action alternative by HMA. Horse populations are modeled over ten years on a 4-year gather/fertility treatment cycle. Results indicate wild horse populations could generally be maintained between the high and low AML range (black horizontal lines). Additionally, graphs show the range of population values based upon 100 simulation runs. It is important to note that none of the populations crash over the ten year time period.



Buffalo Hills HMA populations, Alt. 1



Fox-Lake HMA populations, Alt. 1

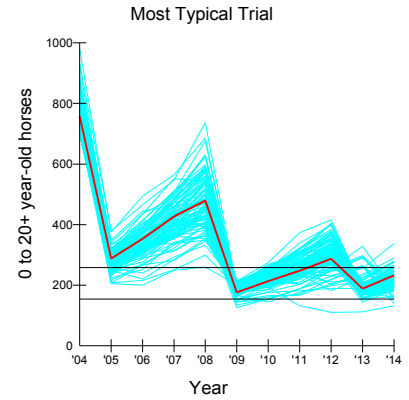
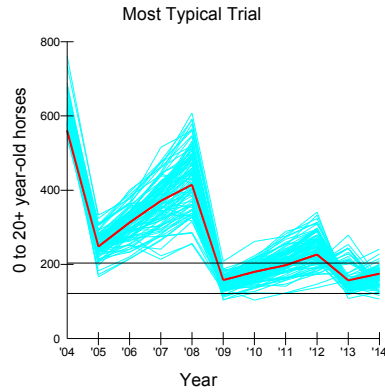
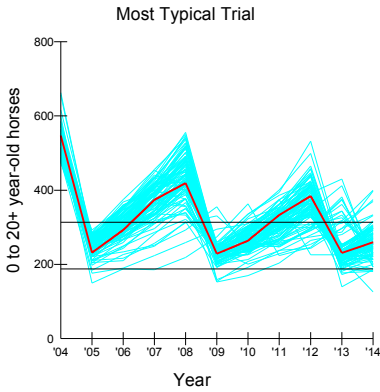


Granite Range HMA populations, Alt 1

The results of the average growth rate based on the management scenario for Alternative 1, Proposed Action, incorporate animal removals in addition to fertility-control applications on a 4-year gather schedule over a ten year period. Modeling results for the median average growth rate of wild horse populations within the Buffalo Hills HMA is 12.4%; the Fox-Lake Range HMA, 10.4%; and the Granite Range HMA, 12.8%.

Alternative 2, Gather to Low AML without Fertility Control

Displayed in the graphs below are the most typical (median) trials (dark line) of the 100 simulations (lighter lines) based on Alternative 2 by HMA. Horse populations are modeled over ten years on a 4-year gather cycle, the same as the Proposed Action, however, no fertility treatments are administered. Results indicate wild horse populations may be maintained between the high and low AML range (black horizontal lines) if removals occurred on a regular basis or if a shorter gather cycle (three years instead of four) was implemented. Additionally, graphs show the range of population values based upon 100 simulation runs. It is important to note that none of the populations crash over the ten year time period.

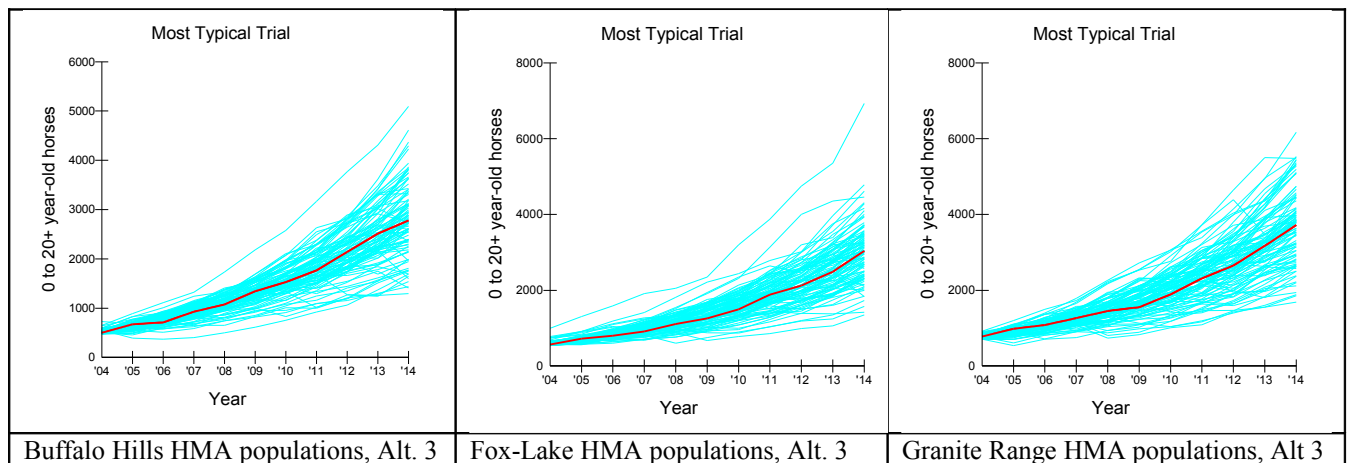


Buffalo Hills HMA populations, Alt. 2 Fox-Lake HMA populations, Alt. 2 Granite Range HMA populations, Alt 2

The results of the average growth rate are based on the management scenario for Alternative 2 of animal removals only on a 4-year gather schedule over a ten year period. Modeling results for the median average growth rate of wild horse populations within the Buffalo Hills HMA is 20.1%; the Fox-Lake Range HMA, 18.7%; and the Granite Range HMA, 19.3%.

Alternative 3, No Action

Displayed in the graphs below are the most typical (median) trials (dark line) of the 100 simulations (lighter lines) based on the No Action alternative by HMA. Horse populations are modeled over ten years without management actions. Results indicate wild horse populations would quickly grow if unmanaged. Again, graphs show the range of population values based upon 100 simulation runs.



The results of the average growth rate based on no management actions, Alternative 3, No Action. The median average growth rate for unmanaged wild horse populations within the Buffalo Hills HMA is 18.3%; the Fox-Lake Range HMA, 17.6%; and the Granite Range HMA, 16.8%.

Population Modeling Summary

To summarize the modeling results, 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 populations. 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?

As expected, the Proposed Action alternative implementing fertility control reflects the lowest overall growth rate. Populations appear to level out over time with regular removal/fertility treatments. However, the percent of the population that is actually gathered may not allow enough treated animals to be released to be effective. This model used 90%. If treatments occur on enough animals, these results suggest gather cycles may be increased to more than four years once populations are stabilized. Alternative 2 population results might be contained within the AML range if gather cycles are less than four years and removals are consistent (little deviation from the gather cycle). But, it is evident in the No Action alternative that horse populations quickly grow without management actions even though average growth rates are slightly less than those rates identified for Alternative 2.

- What effects do the different alternatives have on the average population size?

Effects are addressed in the previous question above and displayed in the graphs following each alternative.