Your tax dollars at work: cost effective wild horse management

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Abstract

An iterative model was constructed which simulates one horse population over time and calculates the average yearly costs involved in management. Given relatively high costs of gathering and assuming unlimited holding capacity, the optimal number of years between gathers was obtained as well as the effects of varying herd proportion gathered.

Introduction

Since legislation enacted in 1971, the U.S. government Bureau of Land Management (BLM) has actively managed wild horse populations in order to protect rangeland ecosystems. Using established range carrying capacities for each horse herd site (the appropriate management level or AML), the BLM reduces populations through periodic removal of animals to maintain the balance between wild horses and available resources, in conjunction with the needs of livestock and natural communities.

In many ways, a simple mathematical model facilitates the understanding of the various requirements and pressures involved in wild horse management and their relative importance. We have constructed a static model that compares the yearly cost of various management strategies. Specifically, we determine the optimal number of years between gathers, the cost-effectiveness of using horse birth control (1-year vs. 2-year applications), and the optimal proportion of the population relative to AML that should be gathered.

Methods

We constructed our model using MatLab software. The program simulates one horse population over time, and calculates the yearly costs of administering birth control, gathering, holding, and shipping horses under two sets of management regimes. The first set of regimes examines how changing the number of years between gathers affects yearly costs; in the second we vary the proportion of the herd which is removed at each gather.

The following model parameters are based on data provided by the BLM:

1. All horse populations grow 20% per year, including birth, death, immigration, and emigration.
2. The sex ratio in all horse populations is 52 (mares):48 (stallions).
3. Gather success is 85%.
4. Birth control effectiveness is 70%.
5. Time spent in holding facility per horse (before adoption) averages 120 days.
6. Cost per day per horse in a holding facility is $3.00.
7. The gather cost per horse in a population of 50 is $500.00; gather cost per horse in a population of 1000 is $150.00.
8. Shipping costs to haul 40 horses is $2.50 per mile for 12-24 hour distances and $3.25 per mile for distances less than 12 hours.

We also make the following calculations and assumptions:

1. Taking into account horses not gathered and horses on which birth control is ineffective, *horse populations on birth control increase by 8.1% per year*.
2. Gather cost per horse decreases linearly as herd size increases: *Per horse gather cost = 518.42 + (-0.37 * herd size). Gather cost for 1000 or more horses is assumed to be $150 per horse.*
3. Based on distances between herds, holding facilities and adoption sites (based on adoption data from 1998-2000), and shipping costs per mile, *average shipping cost for one horse from range to adoption site = $185.00.*

Figure 1—Management methods and cost overview

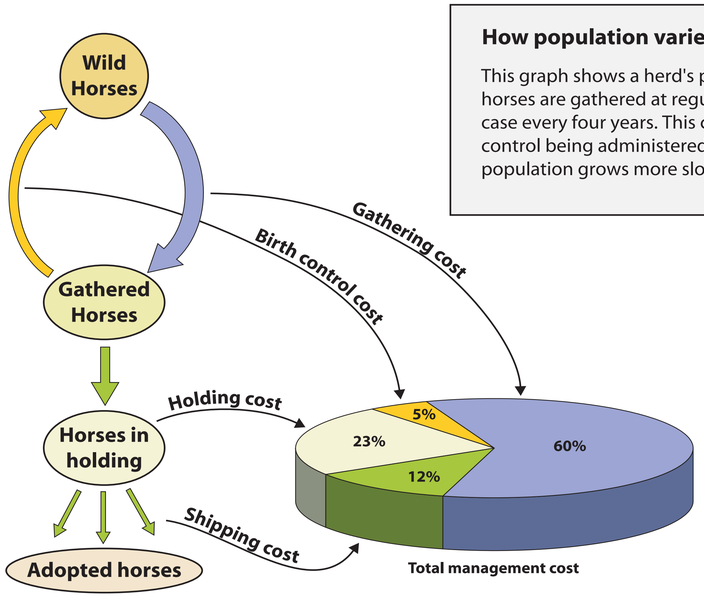
How wild horses are managed

1. When a gather occurs, the majority (about 85%) of the horses in a herd are gathered.

2. A proportion of the horses (depending on the size of the range) are kept for adoption. The remainder are returned to the wild, and the mares may be given birth control.

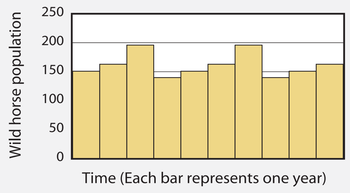
3. Horses that are not released are given veterinary treatment and kept in holding facilities until shipment or adoption.

4. Horses which are not adopted near holding facilities are shipped to various locations across the country for adoption.



How population varies over time

This graph shows a herd's population over time as horses are gathered at regular intervals, in this case every four years. This case also shows birth control being administered, thus the horse population grows more slowly following a gather.

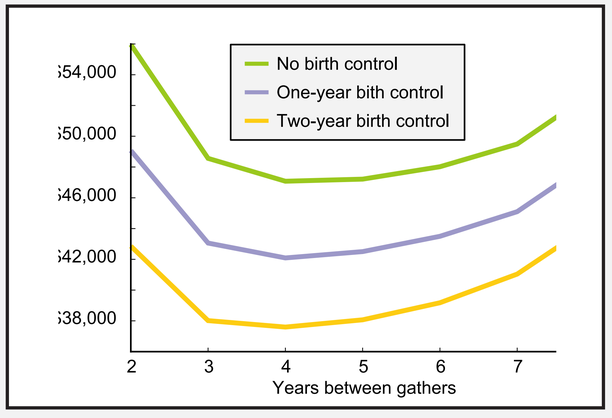


How management costs are calculated

Management costs were divided into four categories:
1. Gathering cost- the BLM provided per horse gathering costs. As the number of horses gathered decreases, the cost per horse increases.
2. Birth control cost- the BLM provided per horse birth control costs for one and two-year duration applications.
3. Holding cost- the BLM provided per horse, per day holding costs, as well as the average holding time of horses gathered for adoption.
4. Shipping cost- average shipping cost was calculated from the BLMs data on gather location, adoption location, and per-load, per-mile shipping costs over the last three years.
The pie chart shows the cost ratios for a herd of 200 horses being managed by the optimal management strategy predicted by our model.

Results & Conclusions

Figure 2—Gather frequency vs. yearly cost and birth control



This figure shows the yearly cost (including gathering, transportation, holding, & birth control costs) of managing a herd of 200 horses given various gathering frequencies and three birth control techniques. If birth control is administered, it is done every time the herd is gathered. One-year birth control refers to a dosage lasting one year, and two-year birth control to a dosage lasting two years. Two-year birth control is the most cost effective management strategy.

Table 1—Parameter sensitivity analysis

Parameter	Sensitivity	Change in strategy prediction
Herd size (AML)	Moderate	no
Reproduction rate	Low	yes
Birth control efficiency	very low	no
Gather success	very low	no
Shipping rate	very low	no
Holding rate	very low	yes

Sensitivity analysis was done by measuring the change in average yearly cost when the parameters were changed by 50%. S-values were calculated , and a qualitative summary of the results is shown here (very low=0.0-0.3, low=0.3-0.6, moderate=0.6-0.9). Change in prediction strategy indicates that the parameter change resulted in 3 or 5 years being the optimal gathering cycle instead of 4 years. Overall, the parameters are very insensitive.

Brief Conclusion: gathering every 4 years to 70% of AML and administering 2-year birth control is the most cost-effective overall strategy.

The details: The most cost-effective gather cycle for herds smaller than 400 horses (most herds) is every 4 years. Larger herds require less frequent gathers for optimal cost-effectiveness (not shown). The administration of birth control does not affect the 4-year optimum (Figure 2), and is more cost-effective. Although gathering more horses below AML decreases costs and the number of horses adopted(not shown), gathering to 70% of AML results in herd size peaking at AML between gathers (Figure 1). If current adoption rates cannot be maintained, horses should be gathered farther below AML to decrease the number of horses for adoption. These predictions are largely unaffected by drastic (50%) changes in parameter values (Table 1). Therefore, the model's management predictions are probably accurate.