

RESOURCE NOTES

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Density Dependence in Population Dynamics of Feral Horses

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Background

Populations of wild horses on rangelands in the western U.S. have the capacity for rates of increase as high as 20 to 25% per year. For this reason, intensive and expensive management is often necessary to reduce populations periodically to appropriate management levels. The effects of density on population dynamics of wild horses are not presently known although, in other species, negative density dependence can contribute to population stability. Negative density dependence implies that birth rate decreases or death rate increases as the density of a population increases. Several mechanisms may contribute to these processes, including competition for food, disease or parasitism, social factors, and possibly predation. Demonstrating the existence of density dependence in populations of wild horses doesn't preclude the need for active management, but may influence optimal decisions about management.

Discussion

Two general methods can be used to test for density dependence in population dynamics: experimental manipulations and statistical analyses of density estimates for unmanipulated populations. Choquenot (1991) showed experimentally that juvenile survival, and hence rate of population growth, depended on density for feral donkeys in Australia. However, this experiment was unreplicated, and rigorous experimental studies of the population dynamics of large, wide-ranging mammals such as wild horses and burros are difficult in general.

Therefore, I used time-series analysis of data for seven populations of wild horses in the western U.S. to look for evidence of density dependence. Data for two of these populations came from intensive ground surveys of known individuals (Berger, 1986 and L. Coates-Markle, personal communication). The remaining data came from aerial censuses. Despite the large amount of effort expended by BLM in censusing populations of wild horses, few available data sets meet the assumptions necessary for rigorous statistical tests of the hypothesis of density dependence. These assumptions are that the population should be relatively closed to immigration and emigration, that there should be a series of counts in the same season of successive years without intervening removals, that counts should

not be gross underestimates because of poor sighting conditions, and that there should not be illegal gathers and removals during the sampling period.

There were 5 to 21 years of usable data for the seven populations analyzed. I found negative relationships between growth rate and population size for all seven cases, although only one was statistically significant at the conventional 5% level. However, I used a form of meta-analysis (Rice, 1990) to calculate that the overall probability of getting the complete set of results purely by chance was only 0.001. If these seven populations are representative of others in the western U.S., this is strong evidence of negative density dependence in wild horses.

Conclusion

If the negative density dependence found in this study is strong enough in comparison to other factors that impact population dynamics, such as severe winters or droughts that cause density-independent mortality, then unmanaged populations of wild horses might eventually stabilize at their ecological carrying capacities. However, obvious degradation of habitat might occur at these population levels; i.e., appropriate management levels for horses may be substantially lower than ecological carrying capacities. Nevertheless, this analysis of density dependence implies that appropriate management levels should be

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carefully justified by sound scientific research, in order to forestall the potential argument that populations should simply be allowed to stabilize on their own.

Negative density dependence also implies that population growth rate increases as density decreases. This means that small populations may be able to recover more rapidly than expected based on their performance at higher densities. BLM should continue to monitor populations with aerial censuses; whenever possible, these censuses should be done in the same season of two or more successive years without intervening

removals in order to establish more clearly the details of density dependence so that more accurate population models can be developed. In addition, we need to collect specific data on the effects of density on survival and reproduction. The improved models resulting from these data will contribute to better prediction of potential effects of alternative management plans.

Sources

Berger, Joel. 1986. Wild horses of the Great Basin: social competition and population size. Chicago: University of Chicago Press, 326 p.

Choquenot, D. 1991. Density-dependent Growth, Body Condition & Demography in Feral Donkeys: Testing the food hypothesis. Ecology vol. 72(3): 805-813.

Rice, 1990: Biometrics 46:303-308.

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