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CHARISMATIC MEGAFUNA OR EXOTIC PEST? INTERACTIONS BETWEEN POPULAR PERCEPTIONS OF FERAL HORSES (*EQUUS CABALLUS*) AND THEIR MANAGEMENT AND RESEARCH

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ABSTRACT: To date, management and research on feral horses have been strongly influenced by concerns and priorities of the general public. Due to outcry from numerous interest groups, research and management of feral horses have tended to be autecological, focused on individuals rather than populations, and addressing potential competition between horses and cattle, thus largely ignoring questions addressing roles that feral horses may play in arid and semiarid ecosystems. Management can never satisfy all desires of all interest groups, and research rarely can give answers so definitive that further questions will not arise. However, as we attempt to demonstrate, both management and research can help shape and inform public opinion through numerous means. Because feral horses have been one of the most contentious management issues of the last 100 years, it is critical that managers and investigators address both immediate and long-term concerns in their work. Honest communication of results and associated levels of uncertainty, along with rigorous testing of alternative explanations, are essential in issues having high levels of socio-political interest. Continued use of relevant, well-planned investigations in concert with thoughtful management may help define the future role the feral horse will play as "an integral part of the system of public lands" in the western United States.

KEY WORDS: feral horses, *Equus caballus*, public participation, management, research, socio-political inputs, media

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BACKGROUND

Although equids arose and diversified in North America during the Eocene (Simpson 1951), they were extirpated from the continent near the end of the Pleistocene, 10 to 14 thousand years ago (Martin 1984). Horses (*Equus caballus*) are believed to have been first domesticated more than 4,000 years ago in Europe and Asia (Zarn et al. 1977). Since that time, while nearly all of the world's equid species have suffered steep declines (Corbet and Hill 1986), the domesticated horse has flourished and played a key role in the development of human civilizations, providing transportation, advantage in battle, a work implement, recreation, and, in some cases, nutrition. During this longstanding relation with humans, the horse has become an integral part of many cultures. Since horses were re-introduced to North America during the 16th century (Zarn et al. 1977; Wagner 1983), they have occupied a controversial and continually changing role that reflects the diversity of attitudes produced by horses' close relationship with humans through time.

The high profile of horses in Western culture has had profound impacts on public perception of and media orientation towards horses, as well as on the treatment, legislation, management, and research of feral horses. In this paper, we discuss the image of feral horses (commonly referred to as "wild" horses) in United States (U.S.) culture, issues and challenges for management created by extensive socio-political participation, and potential roles of management and research in socio-political discussion. Finally, we offer examples of potential solutions and suggestions for appropriate research on feral horses.

HORSES IN POPULAR CULTURE OF THE UNITED STATES

Throughout their history, domesticated horses have been esteemed for their loyalty, speed, endurance, power, grace, and relative intelligence. In contrast, since the horses of the 16th century Spanish conquistadors were released and became feral in North America, feral horses have been viewed alternatively as unimportant residents, resilient survivors, work animals, transportation, or potential competitors with livestock. Trends in total population size of horses in the western U.S. have reflected changing attitudes towards horses. The population grew to an estimated two to seven million animals in the 19th century, then fell to an estimated low of 17,300 animals in 1971 (Anonymous n.d.; Wagner 1983). The work of Velma Johnston (better known as "Wild Horse Annie") of Reno, Nevada during the 1940s onward, bolstered by subsequent efforts of horse advocate and animal rights groups, has molded the current perceptions of feral horses. These efforts initially enjoyed widespread popularity at least partially because they attempted to correct gruesome and relatively frequent abuses of animals. As a result, populations of feral horses grew rapidly, as the U.S. estimate of horses on public lands rose from the 1971 minimum to 56,335 animals in 1976 and peaked at 57,202 animals by 1978 (Anonymous 1997).

In many circles, feral horses recently have been romanticized to represent a host of positive traits and ideals. This romanticization often engenders attitudes of wonder, fascination, and awe towards feral horses. Horses are large, generally attractive mammals that only infrequently cause physical injury to humans, but instead

have enjoyed a longstanding positive relation with humans. Because all of these traits appeal to aesthetic, utilitarian, and humanistic appraisals of horses, it is not surprising that Kellert (1980, 1996) found horses to be one of the most positively rated species by humans, second only to the domestic dog. Evidence of horses' strong presence in the American psyche abounds. Persistent use of horses in advertising products such as cigarettes and beer as well as their use as mascots (e.g., Denver Broncos, San Luis Obispo Mustangs, Birmingham Stallions) relies upon the perception of feral horses as rugged, swift, wild, strong, and perhaps avant-garde. Use of horses in advertising is so widespread that >50% of varieties of beer labels that contained any mammal image contained images of horses (American Society of Mammalogists poster presentation, 1998 Annual Meeting). The appearance of the Pinto, Mustang, and Bronco automobiles, as well as the continued use of the unit of horsepower to measure work, attest to the foundational and symbolic relationship of horses to humankind.

The presentation of feral horses in public media has also focused on idealized notions of horses. Since Wild Horse Annie catapulted the plight of "wild" horses to international attention during the 1950s, most presentations of horses largely have unilaterally been supportive of horses. Symanski (1994) similarly found that in Australia, more attention has been paid to damage done to horses than to damage done by horses. Media attention sympathetic to horses has existed in the West since the 19th century, and recent examples of media attention in support or defense of horses also abound. For example, the rapid sale of horses to slaughterhouses by horse adopters created a scandal that implicated federal employees and at least temporarily disrupted the federal horse and burro program. The gruesome shooting, maiming, and killing of 33 horses in Storey County in western Nevada in December 1998 galvanized animal rights and horse advocates into action. The advocates initiated a campaign to raise funds to locate and prosecute the shooters and raised over \$200,000 from around the globe in less than 48 hours. In discussing several legislative bills relating to management and welfare of horses in 1999 (e.g., SB 396, AB 300, AB 509, AB 291), the major Reno, Nevada newspaper used the headline "Potential state laws threaten wild horses." Replacement of the term "feral horses" with more idealized names such as "wild horses," "mustangs," and "stallions" has accompanied concerted attention to the "plight" of feral horses. In sum, mainstream public opinion on horses may be illustrated by the cover title and byline for an article in the *Smithsonian*, "Mustangs: Spirits of the West. Without free-roaming bands of wild horses, the American West just wouldn't be the same" (Momiatiuk 1997).

Balanced, thoughtful, and in-depth popular articles about feral horses and their role in western ecosystems such as that of Bama (1998) are exceedingly rare. More commonly, discussion is dominated by a polarization of issues into artificial dichotomies having little room for neutrality. Although such polarization is common in public media, the accompanying mudslinging and personal attacks intensify emotions and inhibit productive communication and consensus-building. Furthermore, such polarization often unnecessarily simplifies an issue

with many biological, social, and economic complexities. Because feral horses have been one of the most contentious management issues during the last 100 years (Thomas 1979; Wagner 1983; Symanski 1994; Bama 1998), progress will likely only be made by infusing discussion with solid empirical data and by balancing current and future priorities.

HORSES AS PESTS?

Because feral horses are not as commensal with humans as are most pest species (e.g., raccoons, coyotes, pocket gophers, white-tailed deer, invertebrate pests), humans are far less likely to encounter feral horses near human settlements or well traveled roadways than in remote regions (unpublished BLM distribution censuses). Furthermore, feral horses occupy portions of the arid and semiarid West, where urban and suburban centers are more sparse and less spread-out than in other regions. Both of these tendencies dictate that most humans rarely interact directly with feral horses. In the West, forests are relatively uncommon, and horses (like most other large herbivores) cannot impose significant effects on extant mature trees. Agricultural lands, on the other hand, fall into two categories. Many agricultural lands in the West are near human population centers, and thus are not close to herd management areas (HMAs) where horses primarily graze. More remote agricultural lands are often in valley floors, cover more extensive areas, receive varying amounts of irrigation, and may or may not be fenced. Because horses most frequently occupy lower elevations such as valley bottoms during winter (Pellegrini 1971; Crane et al. 1997), when many agricultural lands are dormant, less crop damage is observed than perhaps might be expected. Thus, horses are generally not seen as pests in the U.S. because they infrequently infringe upon human economic activities and because many romantic qualities have been ascribed to them. Such romanticizing of objects until they infringe upon personal property or income is commonplace; this phenomenon has been termed the NIMBY effect (Carroll and Meffe 1997).

Because of the prevailing sociopolitical attitudes toward horses, attributing the title "pest" to feral horses would likely be counterproductive. However, it is worthwhile to consider influences that an introduced large mammal such as the feral horse may have on the natural system of public lands of which the horse is a legal element (Anonymous n.d.). For example, when horses occupy forested areas, although they usually do not affect mature trees, they may alter future forest characteristics by altering edaphic conditions and tree recruitment schedules as do cattle (Belsky and Blumenthal 1997). Although conflict with agriculture has occurred less frequently than perhaps expected, it has been observed occasionally (Symanski 1994), especially in unfenced rural lands that receive heavier irrigation (E. Beever, pers. observ.).

In our own research, we compared the composition and structure of ecosystems at horse-grazed and horse-excluded areas by selecting sites within two elevational zones of sagebrush that were similar in aspect, slope gradient, fire history, and soil type that had negligible cattle use (Beever 1999). We censused soil surface

compaction, the vegetative community, granivorous rodent guild, ant mounds, and squamate reptiles at 19 sites from nine mountain ranges in western and central Nevada. Although sites showed no difference in any of the ten abiotic variables for which we could obtain data, horse-occupied sites exhibited: more deer mice (*Peromyscus maniculatus*); more depauperate mammal and plant communities; greater grass, shrub, and overall vegetative cover; fewer aboveground ant mounds; greater soil penetration resistance; and lower species diversity of squamates (Beever 1999). During both years, stepwise regressions that accounted for several environmental variables generally failed to reject the hypothesis that horse presence significantly determined levels of response variables listed immediately above. Most variables that differed between horse-occupied and horse-removed sites were not influenced strongly enough by environmental variables to swamp out the apparent effects of horses on ecosystem components (Beever 1999). Thus, at least in semiarid mountain ranges, areas used by horses are ecologically different from sites from which horses have been removed.

ISSUES AND CHALLENGES FOR MANAGEMENT AND RESEARCH CREATED BY SOCIO-POLITICAL PARTICIPATION

To this point, most research performed on feral horses in the U.S. has been autecological, due in part to the public's desire to more fully understand the intricacies of feral horse biology. Such research has investigated various elements of horse behavior (Pellegrini 1971; Feist and McCullough 1976; Miller 1980), diet (e.g., Hansen 1976; Hanley and Hanley 1982), and social structure and life history traits (Berger 1977, 1986). Thus, it is not surprising that Berger (1986), perhaps the most widely cited scientific text on feral horses, focused much more strongly on dynamics occurring within horse bands as opposed to interactions between horses and other ecosystem components. As another example, a Committee on Wild and Free-Roaming Horses and Burros was formed in 1979 to "assess the state of knowledge on wild horses and burros, [and] to recommend research to fill gaps in knowledge" (Wagner et al. 1982). The final report of this effort recommended 18 research projects, of which only three expressly targeted interactions of horses with other components of western ecosystems (Wagner et al. 1982). In contrast, the Committee proposed six projects (including one with three components, for a total of eight foci) on "socioeconomic and political issues," seven projects on the autecology of horses and burros (i.e., studies of basic biology), and another project on immunocontraception. We have highlighted the allocation of past research effort to illustrate the degree to which public input has shaped past research on feral horses. Although examination of horses in isolation of the ecosystems in which they exist may be of great interest to various groups, it can contribute only marginally to some of the most pressing questions in feral horse management.

The polarization of attitudes towards horses into a "horses-versus-cows" debate has been produced in part by claims by livestock ranchers of competition between the

two species and reinforced by most public media. This debate, in turn, has led to a proliferation of research (e.g., Zarn et al. 1977; Miller 1980) explicitly designed to address competition between horses and cattle. In our view, however, only two research articles treat the issue with sufficient complexity and balance (Wagner 1983; Krysl et al. 1984). Although dietary overlap between the species can be as high as 70% to 95% (Hanley and Hanley 1982), there is not yet conclusive evidence of the conditions necessary to demonstrate exploitative competition (Colwell and Futuyma 1971).

In a related example, immunocontraception, one of two strategies deemed appropriate for population regulation by public consensus (along with the adoption program, discussed below) was the dominant focus of research on feral horses during the late 1980s and 1990s (e.g., Eagle et al. 1993; Turner et al. 1997; Miller et al. 1998). Unfortunately, there has been no accompanying research published to help determine the extent, timing, spatial distribution, or appropriateness of such immunocontraception with respect to other resources in western ecosystems.

Management efforts for feral horses have also been strongly shaped by public input. First, management (as well as some research) has demonstrated a strong preoccupation with genetic impoverishment, and managers therefore sample extensively to avoid such a possibility. Long-term mindfulness of inbreeding depression may be prudent, but research to date has not yet produced evidence of decreased fitness resulting from genetic problems. Until data are available to support claims of inbreeding made by members of the public to justify larger herd sizes, this argument should be viewed with caution. Second, horse management in the U.S. has exhibited concern for the welfare of individual animals, much more so than in management of other ungulates. In certain instances, supplemental food, water, and mineral licks are provided. This heightened attention to animal welfare was similarly evidenced in a detailed account of each collar-induced mortality that occurred in a review volume (Wagner et al. 1991), although total mortality was less than 2% of the collared horses in the HMA. The BLM's high-profile Adopt-A-Horse program, initiated almost entirely in response to public input, acts as the agency's main conduit of information to the general public, and leads to an even greater focus on individuals, at least in the public consciousness. The Biological Resources Division of the U.S. Geological Survey has also given strong attention to individual animals, and it has developed programs to use CD-based pictures of individual animals to manage particular herds.

In yet another management example, the National Park Service (NPS) is caught between mandates to serve both visitors and the natural resources within Park boundaries at Assateague Island National Park in Maryland and Virginia. In part because of limited funds and because the island's population of feral horses is its biggest attraction, NPS and other agencies have emphasized programs designed to understand the behavior, identities, parentage, and condition of individual horses within the population. In contrast, methods used to determine appropriate numbers of horses within Park

boundaries have been only weakly developed and rely on trial-and-error strategies that use overall assessments of horse damage at two to four different population sizes.

On a broader level, public participation has restricted management options available to agency biologists for maintaining populations at appropriate management levels (AMLs). In practice, feral horses in the U.S. are treated unlike either domestic ungulates (in that they are not fenced, herded frequently, or seasonally rotated) or native ungulates in western ecosystems (in that they are not hunted legally). Such limitation can increase program costs of management, as demonstrated by Horse and Burro program costs of \$14.6 to \$16.6 million annually during 1992 to 1995 (Anonymous 1997). Despite the drawbacks, however, public concern for this and other issues has facilitated a more "user-friendly" approach to management. For example, public participation increasingly has been included in the decision-making process and in performing roundups.

ROLES OF RESEARCH AND MANAGEMENT IN SOCIO-POLITICAL DISCUSSION

To this point, much research has attempted to address questions or issues raised by public participation—an appropriate and logical foundation for research. However, in addition to trying to answer such pressing questions, research can also provide questions to enrich, clarify, or redirect public discussion. Research may also provide a domain space of possible solutions, eliminating options that are not feasible ecologically, economically, or politically. Research ideally should indicate how to answer remaining questions and should also communicate current levels of uncertainty, gaps in knowledge, and a range of outcomes for alternative management options.

Finally, much research to date has unfortunately been conducted over very small spatial scales, and often with limited replication. By performing studies with greater replication in the future, researchers can both elucidate which factors influence results of investigations over a broader inference space and benefit from greater statistical power to detect effects. As an example, our research from 19 Great Basin sites suggests that horse grazing may more profoundly affect plant life at higher (versus lower) elevations, yet more seriously affect communities of small mammals at lower elevations (Beever 1999). Current questions that also may benefit from greater spatial and temporal replication include: 1) determining population sizes necessary to avoid genetic problems associated with inbreeding; and 2) determining efficacies of alternative immunocontraception techniques. We feel that research addressing these kinds of issues will be most useful for informing public discussion about feral horses and their role in public lands.

Management efforts similarly can interface with public participation in a positive manner. By explicitly communicating a population-level (versus individual-level) perspective on horses as one member of complex, often low-productivity ecosystems, managers may win greater empathy for difficult decisions. In some cases, it may be useful to demonstrate the lack of feasibility of particular recommendations, to guide future suggestions and discussion. On a long-term level, management decisions will be defensible to the extent that they are objective,

scientifically sound, consistent with broad objectives yet flexible enough to facilitate adaptive management (Holling 1978). Decisions should also be cognizant of long-term sustainability (both ecologically and economically), yet sensitive to priorities and goals of the general public.

POTENTIAL SOLUTIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Decentralized, locale-specific umbrella groups that seek common ground among diverse interests provide an excellent mechanism for achieving consensus among managers and the general public. Clearly, the variability in biological, economic, and sociological conditions that exists across 186 HMAs encompassing 19 million ha (48 million ac) in ten western states (Anonymous n.d.) demands some flexibility in implementing management of feral horses. Although diversity in goals and paradigms exists among interest groups, achieving "win-win" solutions is possible by focusing attention on areas where some consensus already exists. For example, many residents in the western U.S. possess a general appreciation for the land. This appreciation has been used to build consensus in Nevada and other areas in the past through such groups as Coordinated Management Planning Locals (Wagner 1983), and is currently being attempted in Nevada by three separate Resource Advisory Councils (M. Farman, Federal Issues Resource Planner, Nevada Division of State Lands, pers. comm.). Such organizations facilitate an important element for future success in management of feral horses; namely, continued open communication of goals, priorities, and concerns among involved groups.

Monitoring provides another avenue for potential solutions. If management can be viewed as an ongoing experiment, by which management actions are implemented as manipulations, monitoring is the tool that permits experimental testing. In these cases, basic techniques of experimental design must be implemented to the greatest extent possible. Such techniques include statement of objectives as testable (and falsifiable) hypotheses, collection of baseline (i.e., before-treatment) and after-treatment data when manipulations are imposed, manipulation of very few (usually one to two) factors, and replication of treatment across space and time (i.e., large sample sizes) (Sutherland 1996; Underwood 1997). When monitoring is budgeted into programs from the beginning, adaptive management and fine-tuning of implementation strategies become much more likely. When monitoring is scientifically sound, includes variables of interest to both the public and ecologists, and proceeds adaptively, management can simultaneously help clarify the role of feral horses in ecosystems and address accusations against agencies made by various interest groups.

According to Noss (1990), indicators that are monitored should be economically efficient and easy to monitor, sufficiently sensitive to detect changes, broadly distributed, independent of sample size, and should be relevant to the condition or disturbance being indicated. Accordingly, we sought in our research to find one or more variables that would circumvent the need to measure all ecosystem components that might be affected by feral horse grazing yet still capture the processes of trampling,

forage consumption, and nitrogen redistribution performed by feral horses. Using data from 19 sites in nine mountain ranges described above, we found during both 1997 and 1998 that ten abiotic variables failed to distinguish horse-occupied sites from sites from which horses had been removed for 10 to 15 years, using multivariate reciprocal averaging (Beever 1999). Furthermore, sites were poorly distinguished when using data from all plant species measured in current monitoring efforts in the area (i.e., several grasses and very few shrubs). This finding suggests that monitoring only grass species consumed by horses may ignore processes other than forage consumption that large herbivores such as horses impose on arid ecosystems. Cover data for every plant species was the second best data set for discriminating horse-occupied

and horse-removed sites, but because we had up to 182 variables (i.e., species) per year, sites often grouped more strongly according to mountain range than to horse grazing (Beever 1999). In spite of these findings, another suite of ten variables predicted to be sensitive to disturbance (Table 1) clearly discriminated all but one site into horse-occupied and horse-removed groups (Beever 1999).

Clearly, a large-bodied mammalian herbivore such as the feral horse will exert some influence on arid ecosystems. More research that is well replicated, synecological in focus, and expressly communicated to the public, combined with experimental or adaptive management, will provide information useful for determining the amount of influence that is acceptable on public lands.

Table 1. Variables known to respond to disturbance by large herbivores, and recommended collectively for assessing disturbance in issues of high socio-political importance. This group of variables, selected *a priori*, clearly discriminated horse-occupied from horse-removed sites using 1997 and 1998 data in multivariate reciprocal averaging analyses.

Response Variable	Unit of Measure
Penetration resistance (compaction of soil surface)	Mpa
Abundance of ant mounds in a standardized transect area	Mounds/m ²
Percentage of small mammal community as deer mice	Arcsine-transformed percentage
Total number of small mammal individuals captured, 3 d trapping	Animals
Species richness of plants at a site	Species
Average percent cover of grasses	Arcsine-transformed percentage
Average percent cover of forbs	Arcsine-transformed percentage
Average percent cover of shrubs	Arcsine-transformed percentage
Abundance of cheatgrass (<i>B. tectorum</i>)	Number of stems/50 m transect

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