Ungulate Management in U.S. National Parks: The Results of a Survey

Elena Robisch and R. Gerald Wright

Natural Resources Technical Report NPS/NRUI/NRTR-95/15

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Contents

Introduction / 3

Objectives / 7

Survey Methods / 11

- Questionnaire / 11
- Relationship of Questions to Objectives / 13
- Data Compilation / 14

Survey Results / 17

- Ungulate Population Data / 17
- Factors that Regulate, Limit, or Control Populations / 19
- Outside Boundary Influences / 19
- Management Techniques / 19
- Management Concerns / 19
- Population Regulation / 21
- Respondents / 21
- Validity of the Questionnaire / 21

Discussion / 27

- Ungulate Population Data / 27
- Influencing Factors / 27
- Outside Factors / 27
- Directed Management / 27
- Management Concerns / 28
- Natural Regulation? / 28
- Questionnaire as an Instrument / 28
- Concluding Thoughts / 29

Literature Cited / 30

Appendix A: Example of Questionnaire in Survey / 33

Tables

1. Twenty-nine national parks selected for surveying ungulate species where population size is known or unknown / 12
2. Ungulate species of 29 parks and populations selected for the survey / 13
3. Population size data for ungulate species in 29 parks / 17
4. Population trends data of number of populations in 29 parks / 18
5. Mean rating by degree of importance of factors that regulate, limit, or influence status of surveyed populations / 19
6. Frequency of direct management techniques used to alter the behavior, numbers, or distribution of ungulate species in the surveyed parks / 20
7. Primary ungulate management concerns identified for the surveyed parks and species / 20
8. Major factors influencing bighorn sheep and pronghorn antelope populations that were rated "too few" in number / 21
9. The number of species populations thought to be naturally or artificially regulated in the surveyed parks / 22
10. The number of species distribution thought to be naturally or artificially regulated in the surveyed parks / 23

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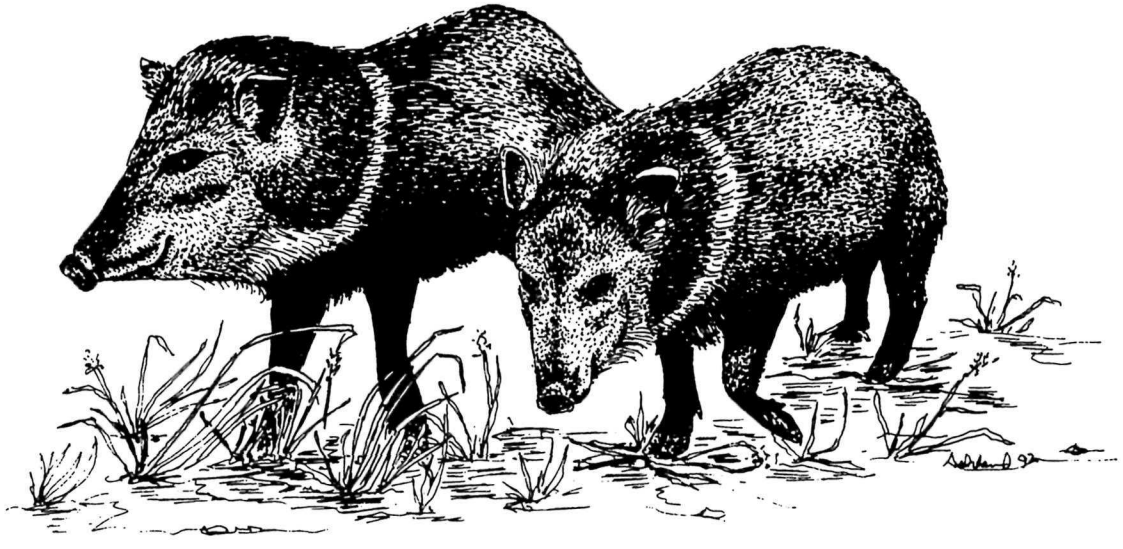
Summary

A detailed questionnaire was developed and mailed to 29 U. S. national parks to determine the extent to which native ungulate populations are naturally regulated in national parks. The questionnaire solicited information on six topics: (1) ungulate population size and trends, (2) factors influencing population size, (3) the degree to which ungulates were affected by activities outside the park boundary, (4) the use of human-directed population management techniques, (5) major ungulate management concerns, and (6) whether ungulate populations were considered to be naturally or artificially regulated. Results from 94 populations of 11 species (a 100% return rate of the questionnaire) indicated a lack of information on population size and trends, and on factors influencing the populations outside the parks. Since native ungulates are among the best studied species in the parks, the survey points out the need to devote even more effort in resource inventory and monitoring. Within parks, natural factors, such as food availability and winter severity, were considered to be the most important regulatory mechanisms; however, a majority of the populations displayed some type of movement beyond the park boundary. The ungulate populations in the surveyed parks appeared to pose few management problems, and most parks did not employ human-directed management techniques. We found 56% of the populations were regulated by one or more anthropogenic factors, 14% appeared to be naturally regulated, and the status of the remaining populations was not known. We conclude from the survey that in most cases it is difficult for parks to strictly adhere to a policy of *natural regulation for large wide-ranging species*.

Introduction



Managing natural resources in national parks[1] is a complex and difficult task because of the dynamics and diversity that are inherent in natural ecosystems, the myriad ecological linkages that exist between the various elements of natural systems, and the National Park Service (NPS) policy that imposes limitations on human intervention. Managing large ungulate species poses particularly unique resource management problems. The dynamic way their populations change, their potential impact on a variety of park resources, especially available forage, and their visibility and aesthetic importance to park visitors reflect these management challenges. These management issues are, in turn, directly related to the size of the ungulate species population being managed.

In the early decades of this century, NPS concern over the diminishing populations of certain large ungulate species, particularly Rocky Mountain elk (*Cervus elaphus*), motivated NPS personnel to initiate programs that controlled predators and fed ungulate populations during critical winter months to minimize mortality (Wright et al. 1933). These programs, combined with better protection from poaching and harassment, were markedly successful. By the 1950s, declines in the numbers of Rocky Mountain elk and mule deer (*Odocoileus hemionus*) in western parks were largely reversed and populations larger than they had been in recent history.

As populations continued to grow, park personnel began to see indications that some ungulate populations were actually too large (i.e., in excess of the ecological carrying capacity of their ranges). In response to this perception, management programs, such as culling and translocating of individual animals, were implemented in Yellowstone, Rocky Mountain, and Yosemite National Parks, and to a lesser degree in other areas, to reduce population numbers. For example, over 14,000 elk from Yellowstone were transplanted to other parks, zoos, or Native American reservations during the 1940s and 1950s (Wright 1992). Many other animals were killed.

By the early 1960s, the culling programs in the national parks, which were large and highly visible to the public, became increasingly controversial, and the merits of these programs were intensely debated in the press. In response to this controversy, the Secretary of the Interior convened a Special Wildlife Advisory Board, made up of prominent biologists who were to examine the issue of animal control in national parks. The recommendations in the report of this board (Leopold et al. 1963) have been widely and varyingly interpreted. Although the report endorsed the need for continued culling of overabundant animals in national parks as necessary to protect park resources, its primary focus was on the value of parks as places where natural ecological processes should be allowed to occur unimpeded from human actions. As a result of this report and the growing public scrutiny of park management, most direct human controls on native animal populations ceased by the mid-1960s.

However, concerns about the impacts on park resources from large ungulate populations and the potential impacts to these populations remained.

These concerns surfaced again in 1980, following the publication of the first complete survey which identified threats that endangered the natural and cultural resources of parks (U.S. Department of the Interior, National Park Service, Office of Science and Technology 1980). This survey found that land and water mammals were the most threatened biological resource and faced serious problems in 40% of all national park system units.

Today, concern still exists in many national parks on the impacts that large populations of ungulate species are causing. Along with Rocky Mountain elk, impacts associated with growing populations of white-tailed deer (*Odocoileus virginianus*) and bison (*Bison bison*) are challenging park managers. Significant impacts attributable to elk and deer have been documented on native flora and fauna (Storm et al. 1989, Wright 1993) and on historic and cultural resources (Wright 1990a, Warren 1991). Some species are also being implicated as potential reservoirs for the spread of disease to humans (e.g., Lyme disease) and other animals (e.g., brucellosis) (Aguirre and Starkey 1994, Meagher and Meyer 1994).

[1] Throughout this paper we use the term "national park or park" in a generic sense to include national monuments and recreation areas that the National Park Service administers.

However, at the same time as impacts associated with growing ungulate populations are being documented, visitors to parks are increasingly interested in large ungulates and value the opportunity to view them. Many of the same species are also important game animals on lands outside national parks; sport hunters have a vested interest in maintaining large park populations that supplement populations outside the park. In the end, however, human emotions often play a greater role in influencing policy than does scientific data, and as a result, managers' efforts to reduce populations usually meet with intense public criticism from a variety of sources (Wright 1992).

Natural areas in the national park system are managed with the goal of allowing the natural processes that regulate the growth and decline of native animal populations to take place unimpeded from direct human intervention (U.S. Department of the Interior, National Park Service 1988). This policy presumes that the number of animals of a given species will fluctuate over time, as a result of changes in the availability of food and cover, weather, predation, disease, and competition (Cayot et al. 1979), but the populations should not reach densities that would cause irreversible damage to park ecosystems (Houston 1982). Accordingly, the need for culling, harvesting, predator control, or habitat manipulation should be minimized.

This policy often is confronted by the ecological and socioeconomic realities of a park environment. For example, park resources are subjected to a variety of stresses, including increasing numbers of visitors using national parks, increasing intrusions of pollutants and other influences from adjacent regions, and increasing secondary consequences from changing land uses and habitat fragmentation in areas surrounding the parks. The effects of these stresses on specific ecological processes are often unknown (Freemuth 1991). Some processes, which formerly contributed to the regulation of ungulate populations, such as predation (e.g., by wolf (*Canus lupus*) and grizzly bear (*Ursus arctos*)), are now absent in most national parks. The effects of weather, such as harsh winters, are highly variable in time and space, and may have an impact on population numbers only once every few decades. Finally, establishing a consensus as to what constitutes the "natural" condition of a range that large numbers of ungulates occupy has been difficult (Macnab 1985).

In historic parks, or in historic sections of natural parks like Cades Cove in Great Smoky Mountains, different criteria apply (U.S. Department of the Interior, National Park Service 1988). Landscapes in these areas are managed to reflect their condition at the time of the cultural event and to maintain elements of the natural system. White-tailed deer browsing in many of these areas curtail the regeneration of native species and destroy agricultural crops that are associated with the historic scene. However, no clear consensus exists as to the long-term implications of this problem or the degree to which it is attributable to deer populations that may be unnaturally high (Porter et al. 1994).

In these situations, the ambiguity, between what conditions are natural and what are not, and whether ungulate populations are naturally regulated or dependent on artificial controls, makes it difficult for managers to determine the best course of action. Consequently, managers are unsure of when-or-if to intervene to limit the population growth of a species that may be potentially causing adverse impacts (Porter 1992).

In other NPS-administered areas in which sport hunting is permitted and used as a management tool (e.g., Rocky Mountain elk in Grand Teton), or in those areas that are totally or partially fenced (e.g., Wind Cave and Theodore Roosevelt), or those areas where managers periodically reduce populations, less uncertainty exists on ungulate management. At Theodore Roosevelt, for example, the stocking rate for bison is maintained at a level thought to be in balance with the available forage and in consideration of the forage needs of competing herbivores, such as pronghorn antelope (*Antilocapra americana*) and bighorn sheep (*Ovis canadensis*) (Norland et al. 1985).

Objectives

This study was undertaken to determine the extent to which park managers believe that viable naturally regulated ungulate populations are in national parks, what natural factors regulate those populations, and in the absence of natural regulation, the degree to which direct human management is employed. These questions are central to the preceding discussion and arise in part because, surprisingly, little detail is available on how resource management policy is applied throughout the National Park Service (Risser and Lubchenco 1992)--a situation due in part to the decentralized nature of the national park system and the autonomy of the individual parks (Clarke and McCool 1986).

We concluded that a review of the published literature alone was not sufficient to answer the above questions, since much of the information was only available in park files, unpublished administrative reports, and through employee knowledge. We, therefore, developed an eight-page 20 question questionnaire (Appendix A) to solicit information from selected parks (Robisch 1993). The objective of the questionnaire was to obtain information on six-related topics, all of which focused on the central question of ungulate population management in the National Park Service.

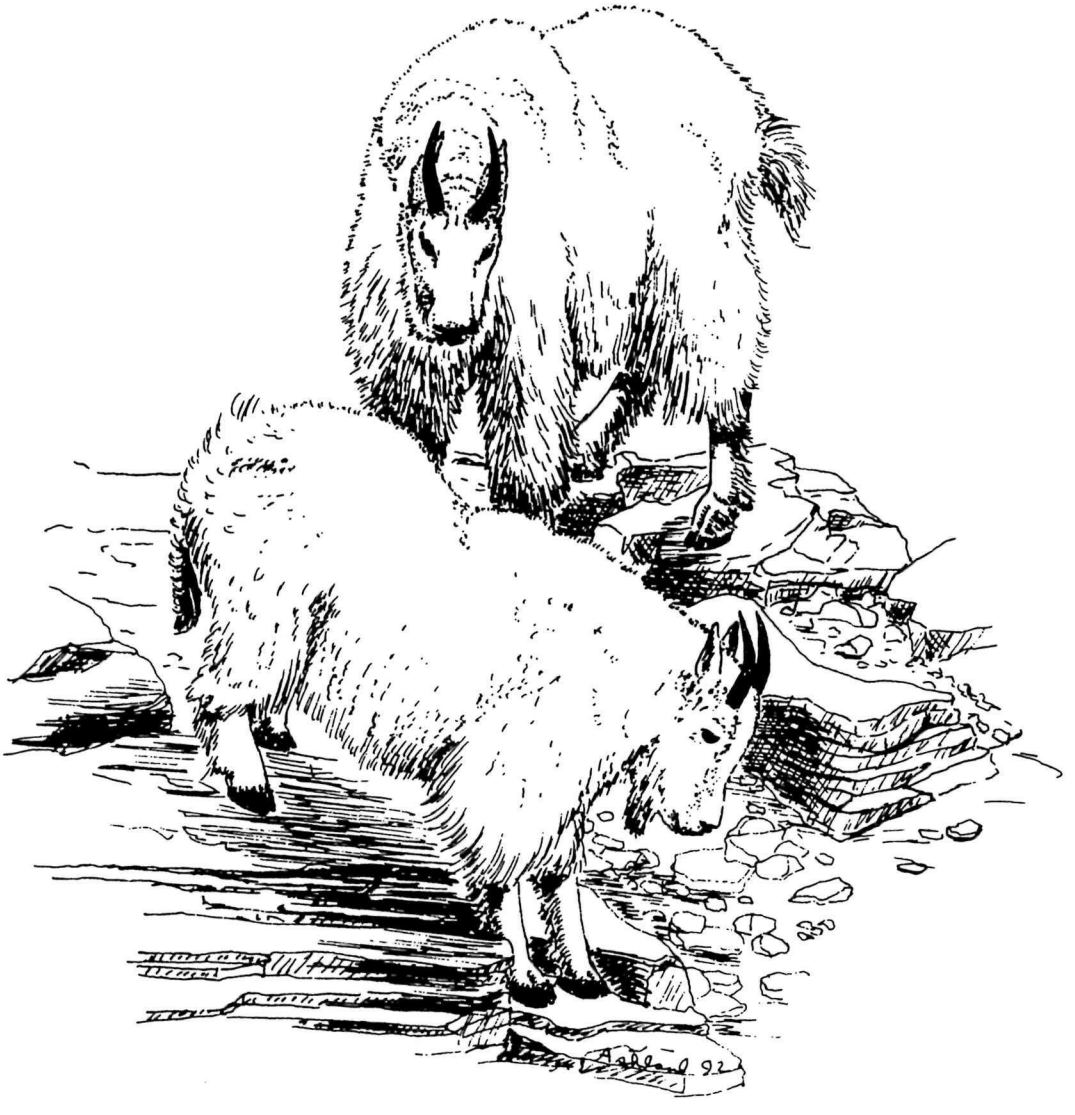
The relationship between survey objectives and specific questions in the questionnaire is discussed in the Survey Methods section.

We used as the unit of analysis the term "population," defined as a group of interbreeding individuals in a park that have little or no contact with other such groups in the same park or adjoining lands (Caughley 1977). Because some parks are so large or of such a heterogeneous landscape, under this definition, it is possible for a park to have more than one population of a given species that can be subjected to differing regulating processes and management strategies.

The specific objectives of the questionnaire were to determine:

1. *whether the surveyed parks had data on ungulate population size and trends over the past decade, and how these data were obtained*
2. *what were the factors that influenced or regulated the size of the surveyed populations, and how effective were these factors*
3. *to what extent were the ungulate populations affected from forces outside national park boundaries*
4. *what human-directed population management techniques were used, if any*
5. *what were the major ungulate management concerns of the surveyed parks*
6. *whether the ungulate populations in national parks were considered to be naturally or artificially regulated*

Survey Methods



We selected 29 U.S. national parks for the survey (Table 1). Selection criteria included the presence of viable populations of one or more ungulate species (based on data presented in Wright 1992), and obtaining a range of park sizes and geographic locations (Robisch 1993). To initiate the study, a letter of introduction and inquiry was sent to a named resource management specialist or research scientist, as appropriate, to each selected unit. The letter explained that the purpose of the study was to examine the process of natural regulation of ungulates in the national park system, and asked the respondents to provide the investigators with a list of all ungulate species in the park and identify how many separate populations, if known, there were of each species.

The 29 parks had 157 ungulate populations of 11 species. From these, 95 populations of the 11 species were selected for the survey. (In parks with multiple populations of the same species, 1 population was randomly selected for study.) Subsequently, mountain goats (*Oreamnos americanus*) in Olympic National Park were dropped from the analyses because of their status as an exotic species (Houston et al. 1991). The 94 populations that were used in the analyses are listed in Table 2.

Questionnaire

A detailed questionnaire was developed and mailed to each of the 29 national parks. A separate questionnaire was used for each selected population of each species, resulting in a total of 94 questionnaires being mailed. For those species for which the number of populations in a given park was unknown, the term "this species" rather than "this population" was used throughout the questionnaire. In all other respects, the questionnaires were identical.

The questionnaire was written and distributed using the Total Design Method of Dillman (1978). Some questions were designed, when possible, to be close-ended or close-ended with ordered choices. Other questions were designed as partially close-ended questions, and some were open-ended. The final question (Question 20; hereinafter numbered questions are identified in the format Q20) was an open-ended opportunity in which respondents could add any additional information they felt to be important and useful about the population.

We devoted considerable attention to the design and layout of the questionnaire to encourage respondents to participate. We made the questionnaire easy to read and attractive, and printed the questionnaire as a booklet. The cover of each questionnaire was unique and reflected the park name, the ungulate species being surveyed, the individual population name of that species, and a drawing of the ungulate species (Appendix A). The inside cover of each questionnaire repeated information from the introductory letter, including the definition of the term "population." We asked respondents to rely on published data from scientific journals, theses, NPS publications and reports, and unpublished file data to answer the questions. We stipulated that employee knowledge was a valid source of information if published information was not available.

We pretested the questionnaire, using resource managers working in national parks that were not included in the study, wildlife biologists working in other federal agencies and academia, and wildlife graduate students at the University of Idaho. This procedure clarified ambiguities in the way questions were stated and expanded the scope of the questionnaire.

During the pretesting of the questionnaire, we recognized that some responses could depend on how respondents interpreted the wording of the question, their familiarity with ungulate management in the park based on personal interest, training, and length of employment at the park, and other workload demands at the time of the survey request (Tyrrell 1992). We, therefore, eliminated as much ambiguity as possible in the wording and design. However, in spite of this effort, we recognized that many responses would be inherently subjective and that the results would need to be interpreted accordingly. A self-addressed stamped envelope was enclosed with the questionnaires to facilitate ease of return. We used follow-up postcards and telephone calls, as necessary, to encourage respondents to return the questionnaires.

TABLE 1. Twenty-nine (29) national parks selected for surveying ungulate species where population size is known or unknown. (Species codes for population sizes are in Table 2.)

National Parks - State	Population Size Known (Species Code)	Population Size Unknown (Species Code)
Big Bend National Park - Texas	2	5, 6, 7
Badlands National Park - South Dakota	2, 3, 9	6, 7
Canyonlands National Park - Utah	9	4, 6
Colorado National Monument - Colorado	9	4, 6
Death Valley National Park - California	9	6
Denali National Park and Preserve - Alaska	1, 10, 11	-
Everglades National Park - Florida	7	-
Glacier National Park - Montana	-	1, 4, 6, 7, 8, 9
Glen Canyon National Recreation Area- Arizona/Utah	-	6, 9
Grand Canyon National Park - Arizona	-	4, 6, 9
Grand Teton National Park - Wyoming	1, 2, 3, 4, 9	6, 7
Great Smoky Mountains National Park - Tennessee	-	7
Guadalupe Mountains National Park - Texas	4	5, 6
Isle Royale National Park - Michigan	1	-
Joshua Tree National Monument - California	9	6
Mesa Verde National Park - Colorado	-	4, 6, 9
Mount Rainier National Park - Washington	4	6, 8
North Cascades National Park - Washington	-	4, 6, 7, 8
Olympic National Park - Washington	4	6
Organ Pipe Cactus National Monument - Arizona	6, 9	2, 5, 7
Rocky Mountain National Park - Colorado	4, 9	6
Saguaro National Monument - Arizona	-	5, 6, 7
Sequoia Kings Canyon National Park - California	6, 9	-
Theodore Roosevelt National Park - North Dakota	2, 3, 4, 7, 9	6
Shenandoah National Park - Virginia	-	7
Voyageurs National Park - Minnesota	1, 7	-
Wind Cave National Park - South Dakota	2, 3, 4, 7	6
Yellowstone National Park - Wyoming	1, 2, 3, 4, 6, 9	7
Yosemite National Park - California	9	6

TABLE 2. Ungulate species of 29 parks and populations selected for the survey. (Species codes are used in Table 1.)

Species Code	Common Name	Taxonomic Name	Ungulate Populations and Number of Questionnaires
1	Moose	*Alces alces*	6
2	Pronghorn Antelope	*Antilocapra americana*	7
3	Bison	*Bison bison*	5
4	Elk	*Cervus elaphus*	14
5	Collared Peccary	*Dicotyles tajacu*	4
6	Mule Deer	*Odocoileus hemionus*	23
7	White-tailed Deer	*Odocoileus virginianus*	14
8	Mountain Goat	*Oreamnos americanus*	3
9	Bighorn Sheep	*Ovis canadensis*	16
10	Dall Sheep	*Ovis dalli*	1
11	Caribou	*Rangifer tarandus*	1
		Total	94

Relationship of Questions to Objectives

The survey included 17 questions that were explicitly related to the six study objectives, 2 questions sought information on the demographic attributes of the respondents and the sources of information they used in answering the questions, and 1 open-ended question solicited additional comments. Two separate sets of questions were written so that consistency in respondents' answers could be determined (Hopkins and Glass 1978). Some questions or parts thereof addressed more than one objective.

Objective 1

The first 6 questions and Q14 were designed to gather information on what data existed on population size and trends and how the data were collected. The order of the first 6 questions began with the broadest question: number of individuals in the population, and then followed by the types of surveys, dates of surveys, and number of surveys. We then asked respondents to identify the trends of the population between 1981-91. Finally, the most explicit question asked respondents to state if specific types of population data had been collected.

Objective 2

The multi-factor Q7, which listed factors that could influence populations, was designed to meet Objective 2. Q7 had a partially close-ended factor (Q7, item O), "other mortality factors outside park boundaries," which had space for respondents to specify what those other mortality factors could be. Q7 also had an open-ended choice of "other," where respondents could identify any influencing factor not listed. Q13 addressed the importance of predation in controlling populations.

Mean scores for each multiple factor in Q7 were calculated by multiplying the frequency of "very important" ratings by 4, "important" by 3, "somewhat important" by 2, and "not important" by 1. The rating of "unknown" was not used for calculating the mean. The sum per factor of these results was then divided by the number of "known" ratings. A mean score for the open-ended "other" factor was not calculated, since this category was an accumulation of different factors that the individual respondents specified.

Respondents were asked in Q8 to specify the three most important factors (from Q7) that have influenced the status of the populations. Weighted distributions of the three most important factors were calculated by multiplying the "first most important" by 3, "second most important" by 2, and "third most important" by 1, and then summed per factor.

Spearman's rank correlation (r_{ranks}) was calculated to determine consistency in respondents' answers to Q7 and Q8, and, therefore, to provide a measure of the validity of the questionnaire (Hopkins and Glass 1978) by comparing the rank order of individual means and scores of the two questions.

Objective 3

Three questions, Q9, Q10, and Q11, addressed Objective 3, the influence of factors outside the park boundary and ungulate movement patterns beyond the park.

Objective 4

Q12, another multi-factor question, which listed 15-specific active management techniques and 1 open-ended choice, was used in part to address Objective 4, the use of direct human management techniques. Respondents were asked to specify the frequency with which these techniques were used between 1981-91. Choices of frequency were "2 to 3 times per year," "yearly," "every 2 to 3 years," or "never." Respondents were also able, in an open-ended choice, to specify a frequency not otherwise listed.

Objective 5

Objective 5, which focused on major ungulate management concerns, was addressed in Q16--a multi-factor question that asked respondents to rate the importance of 11 specific management concerns. An open-ended choice was also given in which respondents could add other concerns not specified. Choices were rated (as in Q7) as "very important," "important," "somewhat important," "not important," and "unknown" and were given the same numerical ratings as in Q7. Three partially close-ended choices were given to further examine particular management concerns.

Q17 asked respondents to rank the three most important management concerns from Q16. Like Q7 and its counterpart Q8, Q17 was a cross validation of Q16. Spearman's rank correlation (r_{ranks}) was calculated to determine consistency in respondents' answers to Q16 and Q17, and by comparing the rank order of individual means and scores of the two questions, an indication of the validity of the questionnaire was provided.

Objective 6

In order to address Objective 6, whether populations were naturally or artificially regulated, responses to parts of three questions were analyzed: Q7, Q8, and Q12. Five artificial factors that could influence populations were embedded in Q7, items N through R; factor S was an open-ended choice where respondents could specify other factors. Responses to Q7-S that were specified as hunting, poaching, and artificial feeding beyond park boundaries were defined as artificial regulating factors. If respondents ranked factors Q7-N through Q7-S as "very important," "important," or "somewhat important," these populations were defined as being artificially regulated.

Any questionnaire that had all or almost all of the factors in Q7 ranked as "unknown" could not be identified as either artificially or naturally regulated because not enough information was available. These populations were classified as unknowns. If the first most important regulating factor in Q8 was answered as "unknown," these populations were likewise designated as unknowns, since not enough information was available to determine if they were artificially or naturally regulated.

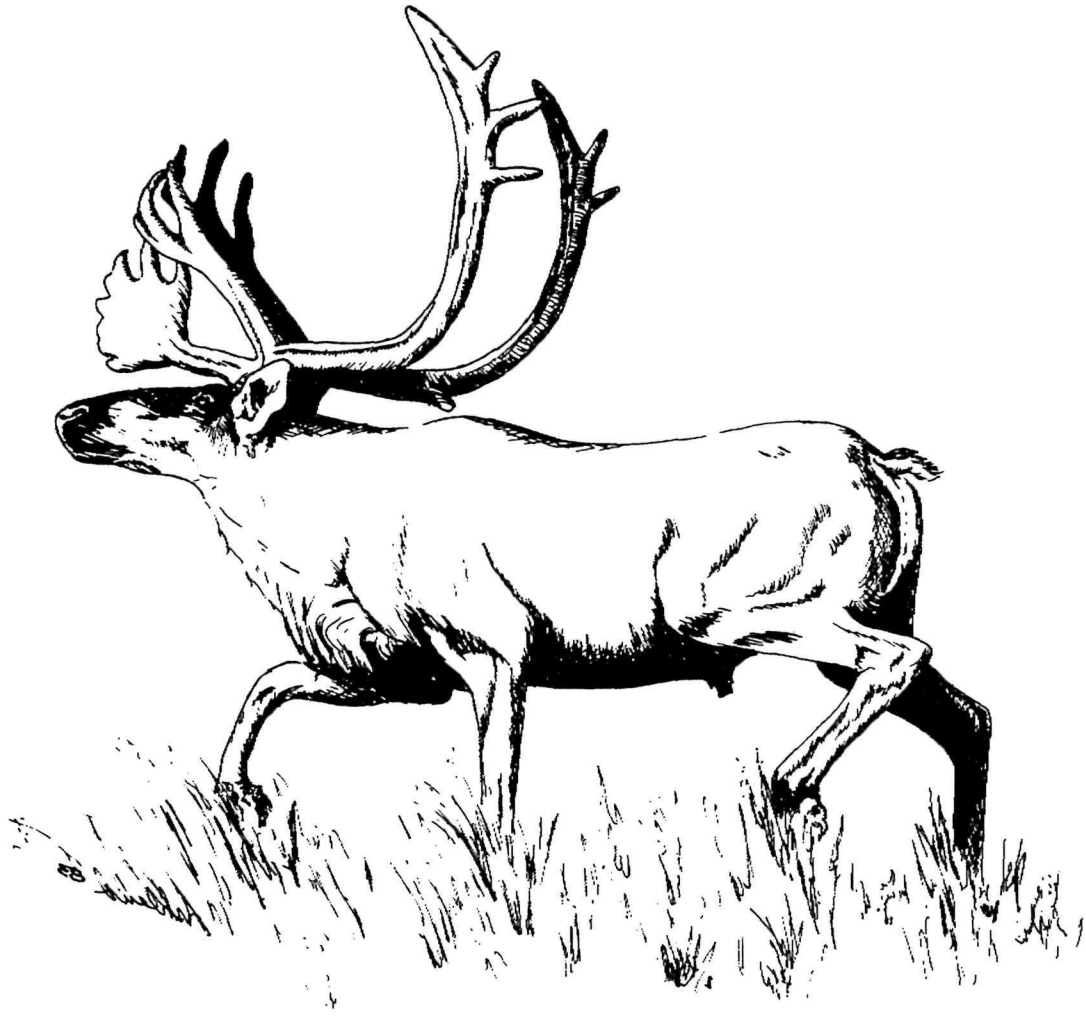
Q12 asked respondents to identify the frequency of the use of 15 hands-on management techniques. Those populations for which these techniques were rated as being used at any frequency were defined as artificially regulated populations. If responses to Q7, Q12, or elsewhere revealed legal hunting within park boundaries, the affected population was determined to be artificially regulated.

Data Compilation

An answer key was developed in the spreadsheet Quattro Pro for recording responses. Frequency distributions were constructed and category percentages calculated. In calculation and discussion of results, all questionnaires were treated as individual samples, even though the same person may have answered more than one questionnaire for one park.

Telephone calls were made to respondents to clarify any ambiguous answers. For questionnaires that had questions which respondents inadvertently missed, those respondents were called and the questions read to them over the phone. One park returned three questionnaires that had so many answers missing that answering questions read over the phone was not possible. For these three questionnaires, only the questions answered were included in the data set.

Survey Results



Fifty (50) of the surveyed populations came from parks with only 1 population of that species, 30 cases existed in which multiple populations of certain species existed, and 14 cases occurred where the number of populations of a given species was uncertain.

Ungulate Population Data

Data on both population size and trends for even the most widely studied species were scarce in the parks that were surveyed. Data on population size were lacking for 52% of the surveyed species (Table 3).

TABLE 3. Population size data for ungulate species in 29 parks.

Species	Population Size Known	Population Size Unknown	Total Populations
Bighorn Sheep	12	4	16
Bison	5	0	5
Caribou	1	0	1
Collared Peccary	0	4	4
Dall Sheep	1	0	1
Elk	8	6	14
Moose	5	1	6
Mountain Goat	0	3	3
Mule Deer	3	20	23
Pronghorn Antelope	6	1	7
White-tailed Deer	4	10	14
Totals	45	49	94

Many parks (83%) had no size data on at least one of their populations. Estimates of population size were available for all five bison populations that were surveyed. Three of these occurred in parks that are at least partially fenced (Wind Cave, Theodore Roosevelt, Badlands), and the remaining populations in Yellowstone and Grand Teton National Parks have been well-studied. Estimates of population size were available for all but one of the moose (*Alces alces*) (Glacier) and pronghorn antelope (Organ Pipe Cactus) populations. State game management agencies had conducted most of the pronghorn population surveys (86%). Size data were not available for any of the collared peccary (*Dicotyles tajacu)* populations, but were available for 19% of the mule deer (the species that occurred in the greatest number of surveyed parks), 44% of the white-tailed deer, 57% of the elk, and 75% of the bighorn populations.

Population size estimates were derived primarily from aerial surveys, or aerial surveys in combination with ground composition counts, although not all respondents provided information on survey methods. Approximately 40% of the populations (38) had not been surveyed in the 10 years preceding this study. Details on the type and extent of the population size surveys are available in Robisch (1993).

Over one-third of the surveyed parks lacked data on the trends of their species populations. Of the remaining, 37% of the populations were estimated to be stable or fluctuating, 20% were thought to be increasing, and 6% were indicated as decreasing. Details of population trends for all populations in each park are shown in Table 4.

TABLE 4. Population trends data of number of populations in 29 parks.

Park	Stable	Increasing	Decreasing	Fluctuating	Unknown
Big Bend	4	-	-	-	-
Badlands	-	1	1	2	1
Canyonlands	-	1	1	-	1
Colorado	-	2	-	-	1
Death Valley	-	1	-	-	1
Denali	2	1	-	-	-
Everglades	-	-	-	1	-
Glacier	-	-	-	-	6
Glen Canyon	2	-	-	-	-
Grand Canyon	-	-	-	-	3
Grand Teton	1	2	-	3	1
Great Smoky	-	-	-	1	-
Guadalupe Mountains	-	-	1	-	2
Isle Royale	-	1	-	-	-
Joshua Tree	1	-	-	-	1
Mesa Verde	1	-	1	1	-
Mount Rainier	-	-	-	1	2
North Cascades	-	-	1	2	1
Olympic	1	-	-	-	1
Organ Pipe	1	-	-	-	4
Rocky Mountain	2	1	-	-	-
Saguaro	-	-	-	-	3
Sequoia Kings Canyon	1	-	-	-	1
Theodore Roosevelt	1	2	1	2	-
Shenandoah	-	1	-	-	-
Voyageurs	-	-	-	-	2
Wind Cave	-	2	-	2	1
Yellowstone	1	4	-	1	1
Yosemite	-	-	-	1	1
Totals	18	19	6	17	34

Factors that Regulate, Limit, or Control Populations

We asked the respondents to rank the importance of all processes, actions, or environmental conditions that could potentially regulate, limit, or control each surveyed ungulate population in their park. The mean rating assigned to each of these factors, based on their level of importance, is shown in Table 5.

TABLE 5. Mean rating by degree of importance of factors that regulate, limit, or influence status of surveyed populations.

Factor	Mean Rating
Availability of Food	2.9
Survival of Young	2.8
Winter Severity	2.8
Drought	2.5
Availability of Water	2.3
Outside Park Mortality	2.3
Disease and Parasites	2.2
Predation	2.2
Intraspecific Competition	2.2
Low Productivity	2.0
Cover	2.0
Interspecific Competition	1.9
Fire	1.9
Lack of Predation	1.8
Animals Killed by Vehicles	1.4
NPS Controls	1.5
Poaching in the Park	1.3
Developments in the Park	1.3
MEAN RANGE:	1.0 = NOT IMPORTANT 2.0 = SOMEWHAT IMPORTANT 3.0 = IMPORTANT 4.0 = VERY IMPORTANT

Environmental factors, including availability of food, winter severity, drought, and availability of water, were perceived to have the greatest impact on population regulation. Mortality that occurred adjacent to a park included sport hunting, poaching, and road kill in order of importance. A high proportion (43%) of the total responses to any given factor was, however, "unknown," indicating a basic lack of knowledge of the processes that regulated the respective ungulate populations. This was true of all parks that were surveyed.

Outside Boundary Influences

Respondents indicated that 38 (40%) of the populations migrated outside of the park, 32 (34%) did not, and the migratory activities of the remaining 24 (26%) was not known. The questionnaire was designed to differentiate between populations that exhibited true migratory behavior from those populations that simply traveled between areas in and out of the park. Considerably more populations (65-69%) exhibited some kind of nonmigratory movement, which took them beyond the park boundaries. Only 10 (11%) of the surveyed populations appeared to remain within the park boundaries. The nonmigratory travel movements of the remaining 19 populations were unknown.

Management Techniques

Of the 15 direct management techniques that parks, and wildlife management agencies, use, as shown in Table 6, the management technique that parks most commonly used was water enhancement (through constructing water retention structures), which was used in 6 parks on 19 populations of 7 species. Some form of water enhancement was practiced in Death Valley, Joshua Tree, Saguaro, Theodore Roosevelt, Wind Cave, and Badlands. All other management techniques were rarely used.

Management Concerns

The top-ranked management concern of the 11 listed in Table 7 was fewer animals than the habitat could support. Concerns about the adverse changes in animal behavior, as a result of park development and visitor activities, ranked second and third, respectively. Concern about "too many animals" was ranked fourth and related primarily to populations of white-tailed deer and elk.

TABLE 6. Frequency of direct management techniques used to alter the behavior, numbers, or distribution of ungulate species in the surveyed parks.

Management Techniques	Frequency/Population
Providing Water	20.0%
Translocating or Destroying Problem Animals	10.0%
Translocating Animals outside the Park	8.0%
Inoculating Against Disease	5.0%
Manipulating Habitat to Enhance Forage	5.0%
Hazing to Keep Animals in Park	3.0%
Reducing Diseases and Parasites	2.0%
Feeding Artificially	1.0%
Culling	1.0%
Controlling Predators	1.0%
Restoring Predators	1.0%
Translocating Animals within the Park	0.0%
Hazing to Move Animals outside the Park	0.0%
Controlling Fertility	0.0%
Providing Salt Licks	0.0%

TABLE 7. Primary ungulate management concerns identified for the surveyed parks and species.

Management Concern	Mean Rating
Fewer Animals than Habitat could Support	1.9
Roads and Developed Sites Interfere with Animal Behavior	1.7
Visitors have Adverse Impact on Animals	1.6
Too Many Animals for Habitat to Support	1.5
Animals serve as Reservoirs for Disease or Parasites	1.5
Migration or Movement across Park Boundary	1.5
Accidents with Vehicles	1.4
Animals Adversely Impact other Animals	1.4
Animals are Dangerous to Visitors	1.3
Animals Damage Ornamental Vegetation	1.1
Animals Damage Park Buildings	1.1
MEAN RANGE: 1.0 = NOT IMPORTANT 2.0 = SOMEWHAT IMPORTANT 3.0 = IMPORTANT 4.0 = VERY IMPORTANT	

The top-ranked situation of fewer animals than the habitat could support existed in 9 of the 16 parks that had populations of bighorn sheep and in 5 of the 7 parks with populations of pronghorn antelope. The major factors influencing this concern are listed in Table 8.

TABLE 8. Major factors influencing bighorn sheep and pronghorn antelope populations that were rated "too few" in number.

Bighorn Sheep	N	Mean
Poor Lamb Survival	6	3.5
Diseases or Parasites	6	3.1
Water	6	3.1
Low Reproductive Rate	7	3.0
Predation	6	3.0
Winter Severity	6	2.3
Other Mortality	5	2.2
Pronghorn Antelope	**N**	**Mean**
Poor Fawn Survival	4	3.5
Other Mortality	2	3.5
Drought	4	3.0
Competition with Other Species	3	3.0
Winter Severity	4	3.0
Low Reproductive Rate	3	3.0
Food Supply	4	3.0

Population Regulation

The responses from several different questions were used to determine which factors were perceived to be most important in regulating park ungulate populations. We found that 53 (55%) of the surveyed populations were believed to be regulated by one or more anthropogenic factors. Fourteen (14) populations were reported to be naturally regulated, and the status of the remaining 27 was undetermined. No correlation was found between park size and whether the population was viewed to be naturally or artificially regulated. Regulation by species is shown in Table 9, and distribution by park is shown in Table 10.

Respondents

The personnel who completed the questionnaires were primarily employed as park management biologists or resource management specialists. Their average length of service at a given park was 8 years (range .3-32 years). The most commonly cited source of information used in filling out the questionnaires was employee knowledge.

Validity of the Questionnaire

We had a 100% return rate for the questionnaire. Spearman's rank-order correlation of the individual mean scores and weighted scores of the factors, which were believed to influence population regulation, showed a relatively high degree of consistency in respondents' answers (r^2 = .764). Similarly, the rank-order correlation of individual mean scores and weighted scores for ungulate management concerns provided an r^2 of .714. Both measures indicate that the respondents were relatively consistent in completing their questionnaires.

TABLE 9. The number of species populations thought to be naturally or artificially regulated in the surveyed parks.

Species	Naturally Regulated	Artificially Regulated	Unknown	Total
Moose	2	3	1	6
Pronghorn Antelope	1	5	1	7
Bison	1	4	-	5
Elk	-	11	3	14
Collared Peccary	1	1	2	4
Mule Deer	4	9	10	23
White-tailed Deer	-	10	4	14
Mountain Goat	1	-	2	3
Bighorn Sheep	4	8	4	16
Dall Sheep	-	1	-	1
Caribou	-	1	-	1
Totals	14	53	27	94

TABLE 10. The number of species distribution thought to be naturally or artificially regulated in the surveyed parks. (Refer to the species codes in Table 2.)

Park	Naturally Regulated	Artificially Regulated	Unknown	Total Species
Big Bend	2, 5	6, 7	-	4
Badlands	-	2, 3, 6, 7	9	5
Canyonlands	9	-	4, 6	3
Colorado	6	4, 9	-	3
Death Valley	-	9	6	2
Denali	-	1, 10, 11	-	3
Everglades	-	7	-	1
Glacier	-	-	1, 4, 6, 7, 8, 9	6
Glen Canyon	9	-	6	2
Grand Canyon	-	-	4, 6, 9	3
Grand Teton	1, 9	2, 3, 4, 7	6	7
Great Smoky Mountains	-	-	7	1
Guadalupe Mountains	-	4, 6	5	3
Isle Royale	1	-	-	1
Joshua Tree	-	9	6	2
Mesa Verde	-	4, 6, 9	-	3
Mount Rainier	-	4	6, 8	3
North Cascades	6, 8	4, 7	-	4
Olympic	6	4	-	2
Organ Pipe Cactus	-	-	2, 5, 6, 7, 9	5
Rocky Mountain	-	4, 6, 9	-	3
Saguaro	-	5, 6, 7	-	3
Sequoia Kings Canyon	6, 9	-	-	2
Theodore Roosevelt	-	2, 3, 4, 6, 7, 9	-	6
Shenandoah	-	-	7	1
Voyageurs	-	1, 7	-	2
Wind Cave	-	2, 3, 4, 6, 7	-	5
Yellowstone	3	1, 2, 4, 7, 9	6	7
Yosemite	-	6, 9	-	2
Totals	14	53	27	94

Discussion

Ungulate Population Data

The National Park Service is mandated by federal legislation and policy to know the resources of the areas it administers. Basic inventories and long-term monitoring of natural and cultural resources are essential to fulfilling this mandate (Silsbee and Peterson 1991). The quality and magnitude of inventory and monitoring programs in parks, however, varies widely with the type of resource and, in the case of plants and animals, with the kind of species. Terrestrial plants and vertebrate animals have received the greatest attention, whereas invertebrates and aquatic species have received little study (Wright and Hayward 1985, Stohlgren and Quinn 1992). Among animals, ungulates as a group have been the subject of more research and inventories in parks than any other group of species (Wright 1990b).

Unfortunately, accurate censuses of highly mobile ungulate species in the vast and varied terrain of areas like national parks are difficult and expensive (Caughley 1974). In addition, censuses often, because of sampling difficulties, have a high variance. This variance is probably the main reason that, relatively speaking, so little is known about the dynamics (size and trends) of many large animal species in parks. Likewise, it is probably the principal reason that much of the information used to fill out the questionnaires came from employee knowledge, which was based on their professional, but personal, syntheses of both park data and general scientific knowledge.

The ungulate species we surveyed in this study are, with the exception of bears, arguably the "best studied" species in parks (Wright 1990b). The lack of hard data on these species implies that knowledge of the hundreds of other vertebrate species that inhabit parks is even more sparse.

Influencing Factors

Although natural factors, such as food availability and winter severity, were considered to be most important in regulating the surveyed populations, most populations were also thought to be regulated or controlled by anthropogenic factors that occur beyond the park boundary. The operable word here is "thought," as there appeared to be little hard data on the sources of mortality outside of most parks. For example, while at least 68% of the populations was indicated to move beyond the park boundaries, potential mortality factors occurring outside the park were indicated as being important for only 37% of the populations (Robisch and Wright 1993). Almost one-half of the respondents (49%) answered the question "other mortality outside the park boundaries" as unknown.

Outside Factors

Our findings, with respect to the reported movements of ungulate populations in parks, indicated that few of the surveyed parks could be considered complete ecosystems for the species in question. This finding supports the need for cooperation between the parks and the owners and managers of the surrounding landscape that has been advocated elsewhere (Boyce 1991). At least one population of each species exhibited some type of movement beyond its park boundary. All but four of the surveyed parks had at least one population (generally more) that was reported to travel beyond the park boundaries. One of these four parks is Isle Royale--an island in Lake Superior. For the other three parks (Grand Canyon, Organ Pipe Cactus, and Shenandoah), whether their populations moved outside of the park was not known.

Directed Management

Although the goal of NPS policy, as indicated previously, is to minimize human intervention in managing park resources, such intervention is not necessarily prohibited. Habitat manipulation, such as water development, can be used to preserve native species or as mitigation for human-induced changes that have affected a population or its habitat (U.S. Department of the Interior, National Park Service 1988; Chapter 4:2). Park managers can remove or control native animal species such as ungulates when required to maintain the park ecosystem in its "natural state" or when animals present an explicit hazard to visitor health and safety or protected property (U.S. Department of the Interior, National Park Service 1988; Chapter 4:6).

Porter et al. (1994) suggest that the ambiguities on how much latitude park managers have in applying hands-on management has probably had the effect of dampening potential actions. This survey supports that suggestion--in that all but two of the management

techniques listed in Table 6 were used on no more than 10% of the populations. The most commonly used manipulative technique (19 populations) was water development--primarily for bighorn sheep in the Southwest. In addition, of the 28 populations subjected to some form of artificial manipulation, 16 were in the three fenced or partially fenced parks, where animal movements are restricted and park personnel attempt to maintain numbers at a predetermined level (Wydeven and Dahlgren 1985). These results, however, do not allow one to evaluate the alternative conclusion that park managers may readily manipulate populations when conditions warrant and that the low frequency of manipulation we identified was only because it was simply not necessary.

Management Concerns

The survey highlighted concerns about small or deficient populations of two species: pronghorn antelope and bighorn sheep. Researchers and managers have long recognized that bighorn sheep are threatened by disease and by competition with exotic and domestic herbivores (Risenhoover et al. 1988). In many Rocky Mountain and Southwest areas, bighorn sheep populations are acknowledged to be at historic lows (Douglas and Leslie 1986). In all cases, respondents considered poor lamb survival due to disease and disturbance to be the primary cause for unduly small bighorn populations. Diseases, parasites, and lack of water were other factors thought to be contributing to the fact that bighorn sheep populations are small. Why the five pronghorn populations were rated as being too small is less clear. Respondents most commonly attributed this to poor fawn survival; however, the importance of most influencing factors was indicated as being unknown.

Overpopulations of animals were most commonly associated with mule deer, elk, bison, and white-tailed deer.

The survey indicated that in terms of population size, impacts, and activities, native ungulates seemed to pose few problems to park management. These findings are somewhat surprising, given the high degree to which native ungulates have traditionally contributed to park management problems (Allen et al. 1981, Wright 1992). White-tailed deer are currently at their highest numbers in recent history in the core of their range and have been associated with many park management problems (Porter 1991, Wright 1990a). However, most of the parks included in this survey are not in the core range of white-tailed deer, and thus only 1 (Shenandoah National Park) of 14 parks with white-tailed deer populations listed overpopulation as an important factor. Although concerns about excessive numbers of white-tailed deer are widespread in the National Park Service, most of the focus has been on the smaller eastern historic parks, like Gettysburg, Saratoga, and Valley Forge, parks that are in the core of the white-tailed deer range (Hadidian 1993) but were not included in this survey.

Natural Regulation?

The results of this survey offer some insights as to why it may be difficult for parks to strictly adhere to a policy that advocates natural regulation. Ungulate population management in most national park system areas appears to be dictated by a variety of factors, many of which are beyond the ability of an individual park to control. For example, many parks are too small to contain all of the habitat that is needed by such large wide-ranging species, and populations are, as a consequence, affected by the complex sociopolitical elements of surrounding lands (Wright 1988).

Questionnaire as an Instrument

The 100% return of the questionnaires probably reflects the bias of the respondents: a select group of professionals employed by the agency being studied (Dillman 1978). However, diligent follow-up postcards and telephone calls to urge respondents to participate certainly contributed to the 100% return.

Spearman's rank-order correlation of the individual mean scores and weighted scores of the influencing factors showed that a consistency in respondents' answers was .76. The factor with the largest disparity in rank order, a difference of 7, was "competition between individuals of this population." This difference may be due to the fact that this same factor had one of the two highest frequency ratings in the "unknown" category.

Similarly, the rank-order correlation of mean scores of individual management concerns and weighted scores was .71, again illustrative of the fact that the respondents were consistent in completing their questionnaires. The results of both analyses indicate that sufficient internal consistency warrants the use of the responses in our analyses.

Concluding Thoughts

Basic information on ungulate ecology appears to be lacking in the surveyed parks, as evidenced by the high number of unknown responses to many questions. In the past 30 years, 12 major reviews of NPS research and natural resource management programs have been conducted (National Academy of Science 1992). All reviews have recognized the paucity of baseline natural resource data in parks, and all have concluded that the National Park Service needs to strengthen its resource management programs and increase its information-gathering capabilities. The fact that a lack of resource knowledge exists for some of the most visible and, to the visitor, most valued resources of the parks, is in some ways an even greater indication that the National Park Service needs to devote more effort than currently proposed in its ongoing systemwide program of resource inventory and monitoring.

Some parks have well-established ungulate management programs, with good long-term data on population sizes, trends, and regulating factors, and these programs should serve as models for other efforts. Olympic National Park, for example, has had an excellent long-term program to monitor population size and trends of elk populations (Houston et al. 1990). Theodore Roosevelt has based its stocking rate for bison on a program that seeks to minimize adverse impacts to native plant communities, provide for competing herbivores, and yet provide maximum viewing opportunities for park visitors (Norland et al. 1985).

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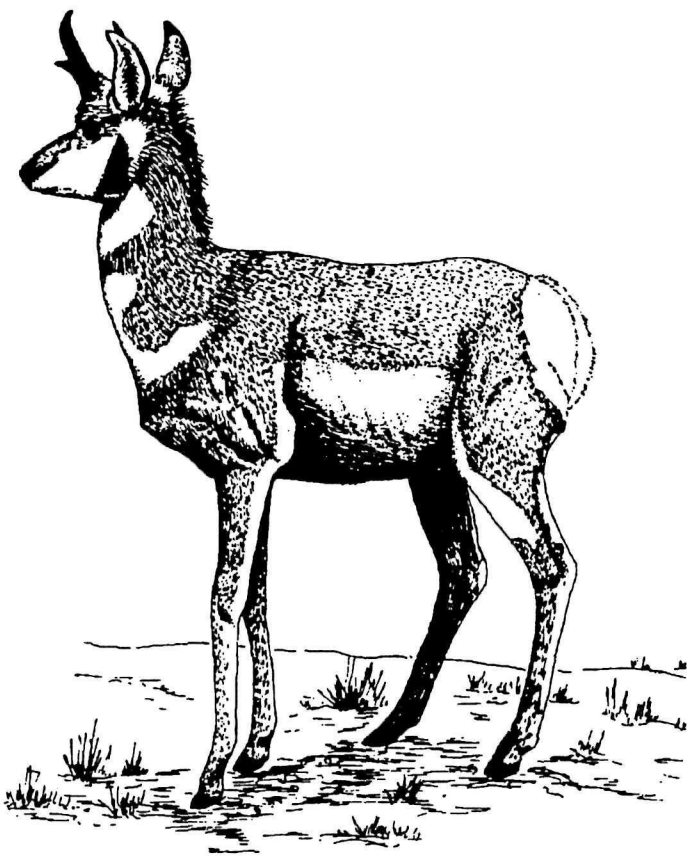
Appendix A: Example of Questionnaire in Survey

NPS UNGULATE QUESTIONNAIRE

THEODORE ROOSEVELT NATIONAL PARK



ANTILOCAPRA AMERICANA

South Unit Population

PLEASE READ BEFORE BEGINNING.

The following questionnaire is part of an NPS Special Initiatives grant to gather information regarding the status of ungulate populations in selected national parks. Your help in gathering this information is greatly needed to increase our understanding of the forces at work in our parks.

As previously explained in a letter to you, the term "population" is defined as any group of interbreeding individuals having little or no contact with other such groups. The species for this questionnaire is identified on the cover of this booklet. If there is more than one population of this species in your park, a randomly selected population for this questionnaire is also identified on the cover. We realize that lack of data may make answering some questions difficult, but the lack of information is an important aspect of this study as well.

While answering these questions we ask that, to the extent possible, you rely on published data from scientific journals, theses, NPS publications and reports, as well as your unpublished file data. If these are unavailable, employee knowledge is also an important source of information. If documents are relied upon in answering this questionnaire, we would appreciate it if these documents can be made available to us.

We appreciate the time and thoughtfulness you will be taking to participate in this important questionnaire.

Illustrations executed by Lorraine Ashland
College of Forestry, University of Idaho

Q-1. What is the approximate number of individuals of this population in your park? *(Circle No. 1 or 2, and fill in the blank if appropriate.)*

1. UNKNOWN → If UNKNOWN, go directly to Q-4 and continue
2. NUMBER: _____ → If KNOWN, go to Q-2 and continue

Q-2. How was this number determined? *(Circle the answer number, and fill in the blank if appropriate.)*

1. PERSONAL ESTIMATION
2. SURVEY: Specify method _____
3. OTHER: Specify _____

Q-3. When was the population number determined? *(Circle number and fill in the blank if appropriate.)*

1. DATE: _____
2. UNKNOWN

Q-4. Between 1981 and 1991, how many surveys of this population have been done? *(Circle answer number.)*

1. NONE
2. ONE TO THREE
3. FOUR TO SIX
4. SEVEN OR MORE

Q-5. Over the last decade (1981-1991), what has been the trend of this population? *(Circle answer number.)*

1. STABLE
2. INCREASING
3. DECREASING
4. FLUCTUATING
5. UNKNOWN

Q-6. Do you collect any of the following data for this population? *(Please circle yes or no for each item, and fill in which season and how many times in the last 10 years (1981-1991) the data has been collected, if appropriate.)*

			Season Collected (e.g., Winter):	No. of Times in Last 10 Years Data Collected:
SEX RATIOS	Yes	No	_____	_____
MORTALITY RATES	Yes	No	_____	_____
ADULT FEMALE:OFFSPRING RATIOS	Yes	No	_____	_____
PREGNANCY RATES	Yes	No	_____	_____

Q-7. Over the last decade (1981-1991) what is the level of importance of the following factors which have influenced the status of this population? *(Circle degree for each factor.)*

FOOD SUPPLY	Very Important	Important	Somewhat Important	Not Important	Unknown
WATER SUPPLY	Very Important	Important	Somewhat Important	Not Important	Unknown
COVER	Very Important	Important	Somewhat Important	Not Important	Unknown
PREDATION (presence of)	Very Important	Important	Somewhat Important	Not Important	Unknown
PREDATION (lack of)	Very Important	Important	Somewhat Important	Not Important	Unknown
LOW PRODUCTIVITY	Very Important	Important	Somewhat Important	Not Important	Unknown
FAWN SURVIVAL	Very Important	Important	Somewhat Important	Not Important	Unknown
DROUGHT	Very Important	Important	Somewhat Important	Not Important	Unknown
WINTER SEVERITY	Very Important	Important	Somewhat Important	Not Important	Unknown
DISEASES AND/OR PARASITES	Very Important	Important	Somewhat Important	Not Important	Unknown
FIRE	Very Important	Important	Somewhat Important	Not Important	Unknown
COMPETITION WITH OTHER SPECIES	Very Important	Important	Somewhat Important	Not Important	Unknown
COMPETITION BETWEEN INDIVIDUALS OF THIS POPULATION	Very Important	Important	Somewhat Important	Not Important	Unknown
POACHING WITHIN PARK BOUNDARIES	Very Important	Important	Somewhat Important	Not Important	Unknown
OTHER MORTALITY FACTORS OUTSIDE PARK BOUNDARIES Specify: _____	Very Important	Important	Somewhat Important	Not Important	Unknown
CONTROL TECHNIQUES BY NPS MANAGEMENT	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS KILLED BY VEHICLES	Very Important	Important	Somewhat Important	Not Important	Unknown
NPS SITE DEVELOPMENTS (Causing, e.g., displacement)	Very Important	Important	Somewhat Important	Not Important	Unknown
OTHER. Specify: _____ _____	Very Important	Important	Somewhat Important	Not Important	Unknown

Q-8. From the factors in Q-7, which do you consider to be the three most important factors which have influenced the status of this population between 1981-1991? *(No. 1 being most important, No. 2 next most important, etc. Please fill in the three blanks.)*

NO. 1 _____

NO. 2 _____

NO. 3 _____

Q-9. Does this population migrate beyond park boundaries? *(Migrate is defined as a periodic or seasonal movement from one area to another, specifically crossing park boundaries.) (Circle answer number, and fill in the blank if appropriate.)*

1. YES. Specify season or period _____. → If YES, go directly to Q-11 and continue
2. NO → If NO, go directly to Q-10 and continue
3. UNKNOWN → If UNKNOWN, go directly to Q-10 and continue

Q-10. Has this population migrated beyond park boundaries in the past but no longer does? *(Circle answer number and fill in appropriate blank.)*

1. YES. Specify why it no longer does if causes are known:

   _____

   _____

2. NO

3. UNKNOWN

Q-11. Does this population travel beyond the park boundaries? *(Travel is defined as nonmigratory movement back and forth across the park boundaries.) (Circle answer number.)*

1. YES
2. NO
3. UNKNOWN

Q-12. Over the last decade (1981-1991), what is the frequency of use of the following management techniques by NPS personnel in managing this population? *(Circle the appropriate frequency to the right of each technique.)*

HABITAT MANIPULATION TO INCREASE FORAGE	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
ARTIFICIAL FEEDING	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
PROVISION OF SALT LICKS	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
PROVISION OF WATER (e.g., guzzlers)	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
TRANSLOCATION OF ANIMALS TO OTHER AREAS IN PARK (to relieve population pressure)	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
TRANSLOCATION OF ANIMALS TO AREAS OUTSIDE PARK (to relieve population pressure)	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
CULLING (Defined as killing animals to reduce size of population.)	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
DESTROYING OR TRANSLOCATING INDIVIDUALS THAT CAUSE PROBLEMS. Specify problems: _____	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
HAZING TO MOVE ANIMALS OUTSIDE PARK BOUNDARIES	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
HAZING TO KEEP ANIMALS WITHIN PARK BOUNDARIES	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
INOCULATION AGAINST DISEASES	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
MANAGEMENT TECHNIQUES TO REDUCE POTENTIAL DISEASES/ PARASITES	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
ARTIFICIAL BIRTH CONTROL	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
CONTROL OF PREDATORS (to reduce predator numbers)	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
REINTRODUCTION OF PREDATORS (to increase predator numbers)	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____
OTHER: _____	2 to 3 Times Per Year	Yearly	Every 2 to 3 yrs	Never	If frequency not listed, specify: _____

Q-13. Please indicate below the present status of natural predators (excluding humans) which have impacts on this population in this park. *(Circle all appropriate answer numbers and fill in the blanks if appropriate.)*

1. THE FOLLOWING PREDATORS ARE PRESENT IN ADEQUATE NUMBERS TO IMPACT THE POPULATION.

   Identify species: _____

   _____

2. THE FOLLOWING PREDATORS ARE PRESENT BUT NOT IN SUFFICIENT NUMBERS TO IMPACT THE POPULATION.

   Identify species: _____

   _____

3. THE FOLLOWING PREDATORS WERE ONCE PRESENT, BUT ARE NOW EXTIRPATED FROM THE RANGE OF THIS POPULATION.

   Identify species: _____

   _____

4. UNKNOWN. (Information is unavailable as to whether the following species are now present or have been present in the past).

   Identify species: _____

   _____

Q-14. Is this ungulate population a native species of this park? *(Circle answer and fill in the blank if known.)*

1. YES.
2. NO; THIS IS AN INTRODUCED, EXOTIC SPECIES. If so, give date(s) when introduced, if dates are known _____.
3. UNKNOWN.

Q-15. Is this ungulate population the result of a reintroduction program into this park following extirpation of this species? *(Circle answer and fill in the blank if known.)*

1. YES. Reintroduced on (give date(s) if dates are known):_____
2. NO. (This population is not the result of a reintroduction program.)
3. UNKNOWN.

Q-16. For the following NPS management concerns, what is the degree of importance of each concern for this population in your park over the last decade (1981-1991)? *(Circle the degree of importance to the right for all items; fill in blanks if appropriate.)*

TOO MANY ANIMALS FOR HABITAT TO SUPPORT	Very Important	Important	Somewhat Important	Not Important	Unknown
TOO FEW ANIMALS (Habitat could support more)	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS ARE DANGEROUS TO VISITORS. Specify problems: _____	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS SERVE AS VECTORS FOR DISEASES/PARASITES	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS CAUSE PROBLEMS DUE TO MIGRATION & TRAVEL BEYOND PARK BOUNDARIES. Specify problems: _____	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS DAMAGE ORNAMENTAL VEGETATIVE RESOURCES IN THE PARK	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS DAMAGE BUILDINGS OR OTHER STRUCTURES IN THE PARK	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMAL ROAD KILLS ARE DANGEROUS TO AUTO DRIVERS	Very Important	Important	Somewhat Important	Not Important	Unknown
ANIMALS ADVERSELY IMPACT OTHER PARK SPECIES	Very Important	Important	Somewhat Important	Not Important	Unknown
ROADS AND/OR DEVELOPED SITES INTERFERE WITH ANIMAL BEHAVIOR	Very Important	Important	Somewhat Important	Not Important	Unknown
VISITORS HAVE ADVERSE IMPACTS ON ANIMALS (e.g., backcountry use, displacement) Specify problem(s): _____	Very Important	Important	Somewhat Important	Not Important	Unknown
OTHER PROBLEMS. Specify: _____ _____	Very Important	Important	Somewhat Important	Not Important	Unknown

Q-17. Of the above management concerns in Q-16, which were the three most important for this population between 1981-1991in your park. *(No. 1 being most important, No. 2, next most important, etc. Please fill in the blanks.)*

NO. 1 _____

NO. 2 _____

NO. 3 _____

Q-18. What sources did you use to fill out this questionnaire? *(Circle all numbers that apply and fill in the blank if appropriate.)*

1. NON-NPS SCIENTIFIC JOURNALS AND THESES
2. NPS PUBLICATIONS AND REPORTS
3. UNPUBLISHED NPS FILE DATA
4. EMPLOYEE KNOWLEDGE
5. OTHER. Specify: _____

Q-19. Please fill in the following information. Your name will not be used in any publication or report resulting from this study. Your identification is for the purpose of follow-up questions in case further clarification of answers is needed. We appreciate your cooperation.

NAME _____

JOB TITLE _____

PHONE NUMBER _____

LENGTH OF SERVICE AT
THIS NATIONAL PARK _____

PLEASE PROVIDE ADDITIONAL COMMENTS ON FOLLOWING PAGE.

Q-20. If there is any information regarding this population that you would like to add that has not been addressed in this questionnaire, please do so here.

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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