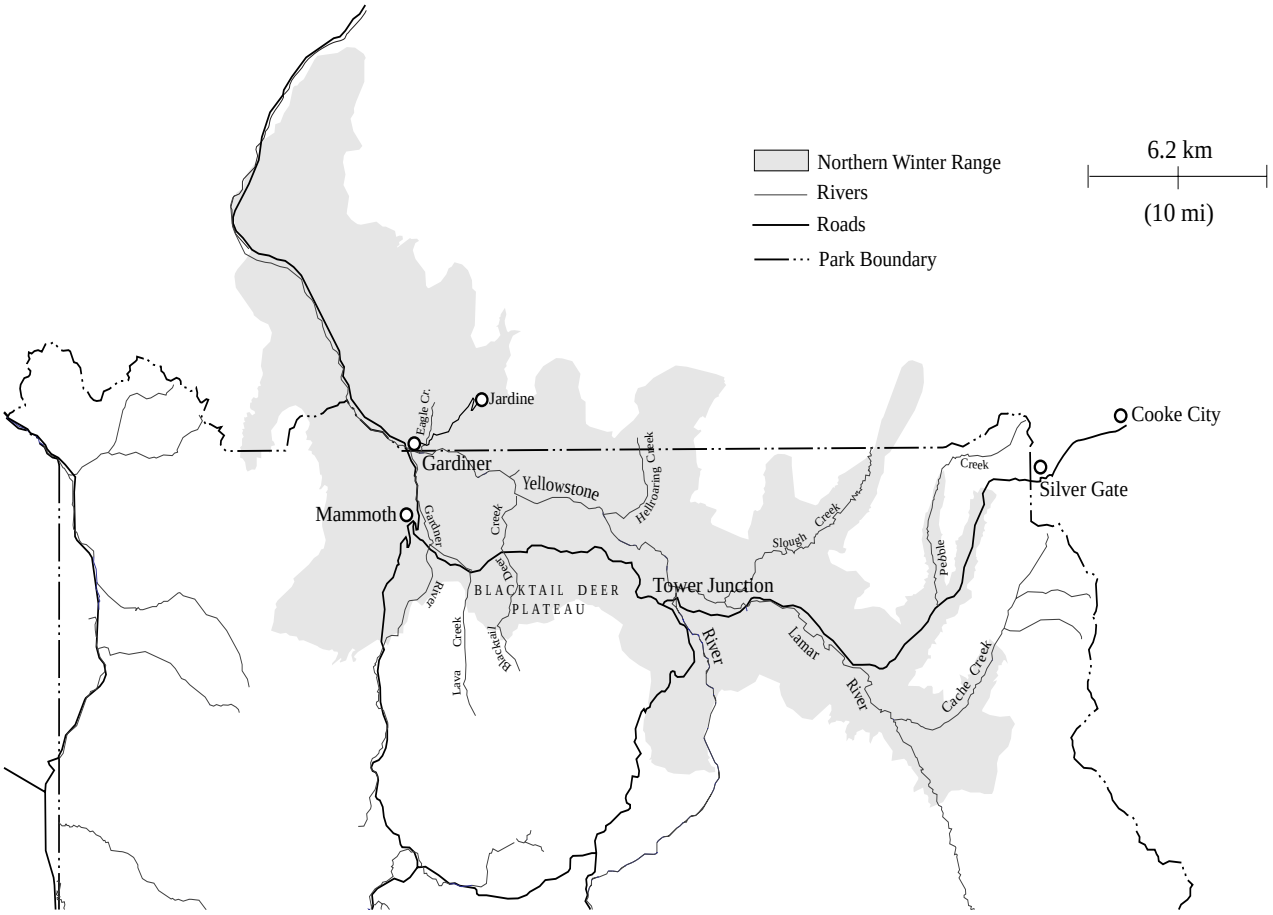
Yellowstone Science

A quarterly publication devoted to the natural and cultural resources

Ungulate Management in Yellowstone

A National Academy of Sciences Review Begins

Volume 7 Number 3



No Ambivalence Here

Never let it be said that we shy away from controversy in Yellowstone. As if we could… Controversy over management of the park, particularly the elk of the northern range, has existed since at least the earliest decades of the 20th century, and likely will be with managers well into the next millenium. The debate is tinged by a number of factors, not just science—as legitimately debated by professionals of varying expertise, but also by land managers, recreationists, ranchers, and others representing a wide spectrum of backgrounds, philosophies, and beliefs.

During the smoldering aftermath of the fiery summer of 1988, park staff were inundated with angst-filled letters and endless emotive phone calls, some accusing whoever was on the receiving end of carelessly, callously destroying Yellowstone. It was a great strain to have lived through the sky-reaching flames and the smoke and the stress of watching our own big backyard burn hotter and farther than we ever could have imagined, whether or not we believed in the "naturalness" of fire. At the end of a particularly exhausting day in which I had personally heard one too many phone complaints and somewhat lost my patience with a caller, a fellow worker reminded me that we could never doubt that Americans cared about Yellowstone.

The same lesson might be taken from the perennial disputes over the northern range. A major scientific review of ungulate management in the park, requested by the U.S. Congress, is underway. In this issue, we feature six viewpoints presented to the National Academy of Sciences at their opening session in January 1999. In a subsequent issue, we will present a series of recently transcribed interviews with survivors of the 1960s-era controversy, done as part of an oral history project. We hope to inform thought-provoking discussion around your table and ours, always keeping in mind that whatever the disparate opinions, all the players are expressing their concern for the resources of Yellowstone.

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On the cover: Young elk in burned area on the Northern Range after the fires of 1988. Photo Renée Evanoff.

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Ungulate Management in Yellowstone:

A National Academy of Sciences Review

In 1964, at the height of the elk reduction program, a helicopter (lower left) drives a herd into corrals for processing. NPS photo.

This summary is a compilation of information from Yellowstone's Northern Range: Complexity and Change in a Wildland Ecosystem *(YNP 1997) and from the National Academy of Sciences' website, used by permission.*

Wildlife management in Yellowstone National Park (YNP) has undergone many changes, based on prevailing values about wildlife as well as on both managers' and constituents' current knowledge of biology and ecology. From the time of the park's establishment in 1872 until 1883, public hunting was legal, partly because there were few staff to protect the park and partly because visitors killed wildlife to supplement their provisions. When "market hunting" swept many western gamelands in the 1870s and early 1880s , the park's early civilian administrators were neither equipped nor funded to prevent industrial-scale slaughter of park wildlife, which usually took place in early spring. By 1883, when public hunting became illegal in the park, wolves and other carnivores may have already been seriously reduced in number. From the arrival of the U.S. Cavalry in 1886 to the 1930s, wildlife management was in good part seen as protecting the grazing animals and reducing if not eliminating most predator populations. Winter feed was sometimes left for ungulates, and wolves were extirpated from the area.

A number of scientists question the natural regulation management program conducted by Yellowstone National Park as it relates to bison and elk, while others defend the approach. The [House Appropriations] Committee wishes to resolve the issue of population dynamics of the northern elk herd as well as the bison herd. The Committee thus directs the [National Park] Service to initiate a National Academy of Sciences (Board of Environmental Studies and Toxicology) review of all available science related to the management of ungulates and the ecological effects of ungulates on the range land of Yellowstone National Park and to provide recommendations for implementation by the Service.

—U.S. Congress, House of Representatives, 1998. House Report 105-163.

As early as 1919, managers assumed that large grazing animals were not native but had been driven into the mountains by human settlement. Despite confusion and uncertainty over how many ungulates, especially elk, actually existed in Yellowstone, efforts were undertaken to reduce their numbers for reasons that included preventing the seeming waste of animals that might die in winter as well as preventing overgrazing. Elk from northern Yellowstone were trapped and shipped alive to restock depleted game ranges across North America. Rangers also shot elk and the meat was shipped to Indian reservations. Park records indicate that 26,400 elk were removed from the park between 1923 and 1968. The northern range elk population had been reduced from some 10,000 animals to below 5,000. Bison and pronghorn were also fed, trapped, and subjected to research and management efforts from the mid-1930s to the mid-1960s.

In the early 1960s, Yellowstone increased the intensity of their elk control efforts on the advice of commercial range management authorities. Controversy over this and issues in other regions led to a review by the Secretary of Interior's Special Advisory Board on Wildlife Management in the National Parks, documented in what became known as "the Leopold Report," which advocated the recognition of ecological complexity, the use of diverse management procedures to protect native species, and expansion of research to prepare for future management and restoration programs. But unfavorable reactions to control measures led to Senate hearings and a cessation of "direct reduction" of the elk population. After considering other management options, Yellowstone adopted a new policy, testing a hypothesis proposed by Chief Park Biologist Glen Cole that the elk population might be naturally regulated if given a chance.[1] Under natural regulation, herd size is primarily determined by ecological processes , rather than by hunting and other human influences.

Native ungulates that live in YNP include elk, bison, bighorn sheep, moose, deer, and pronghorn. The northern range—defined by former park researcher Douglas Houston as an area of approximately 100,000 hectares (247,000 acres), about 81 percent of which is within YNP[2]—supports the largest concentration of wintering ungulates. In the 1970s and 1980s, many research projects on park wildlife and their habitat were conducted by both resident NPS scientists and permitted researchers from universities, other state and federal agencies, and private institutes. Due to continued controversy over the park's ungulate management policies, the U.S. Congress mandated a major new research initiative in 1986, and a series of experts from the academic community were convened to design studies related to grasslands, elk, deer, pronghorn, and riparian areas. Further facilitating the initiative was a Northern Range Wildlife Working Group, consisting of representatives from Yellowstone, the U.S. Forest Service (Gallatin National Forest), and the Montana Department of Fish, Wildlife and Parks.

More than 40 research projects were conducted, resulting in numerous technical papers in books and scientific journals, primarily focussing on the relationship between elk and grasslands. Some scientists have found that ungulates are subject to natural regulation through density-dependent factors such as forage availability, predation, and intraspecific competition, and to the partially density-independent effects of severe weather on mortality and natality.[3] Another research-supported finding is that ungulate grazing habits and their effects on the ecosystem cannot be compared with rangeland used to graze domestic livestock, and that broad variation among herd sizes across the landscape is to be expected. Several studies concluded that upland grass areas were not overgrazed, and that ungulates were not causing long-term damage to these resources.

The NAS Committee visits a vegetation exclosure to discuss Northern Range research, July 1999. NPS photo.

However, the effects of ungulate grazing on other plant communities, particularly shrublands and riparian zones, have not been addressed in depth, and objections to the park's natural regulation practices have continued to surface. Along with ongoing claims from some public and scientific quarters that the northern range is overgrazed by elk are concerns that woody vegetation in riparian areas is being eliminated—primarily aspens, cottonwoods, and willows—reducing the food available for other species such as beaver, moose, and deer. Overgrazing by elk and bison could theoretically also cause stream degradation and serious erosion. The spread of diseases such as brucellosis among dense wildlife populations is also a concern.

Elk and bison numbers did increase after the direct reduction program ended, particularly during years with mild winters. Counts of the northern elk herd have fluctuated substantially from year to year, reaching a recorded high of 19,045 in the winter of 1993-94, but in the last two winters have dropped to 11,000 to 12,000 elk.

The parkwide bison count, which was kept below 600 in the 1960s, had risen to to nearly 4,000 by the winter of 1994-95. However, the growing number of bison leaving the park in the winter heightened concern over potential conflicts with livestock, and in 1998 control actions outside the park and an unusually severe winter reduced bison numbers to about 2,200.

This bison culling and other concerns about the northern range prompted the United States Congress to mandate and fund a new study. The National Research Council, the working arm of the National Academy of Sciences, will review the scientific literature and other information related to ungulate populations on Yellowstone's northern range, particularly in regard to natural regulation and the ecological effects of elk and bison populations on the landscape.

Thirteen committee members with expertise in ungulate ecology, wildlife biology, animal/veterinary science, animal population modeling, grassland ecology, riparian ecology, climatology, hydrology/geomorphology, landscape ecology, and soil science will conduct the NAS review in 1999 and 2000. Meetings and field trips were conducted in and near the park in January and July 1999. Subsequent meetings, expected to be held in other locations, are to be devoted to development of a final consensus report that responds to the assigned task and will be provided to the U.S. Department of the Interior and Congress.

The National Academy of Sciences review will address these specific scientific questions within the context of the park's goals:

— What are the current population dynamics of ungulates on the northern range of the greater Yellowstone area?

— To what extent do density-dependent and density-independent factors determine densities and fluctuations in populations of YNP ungulates?

— What are the consequences of continuing the current natural regulation practices, e.g., on range condition, habitat for other species, and risk of disease transmission?

— How do current ungulate population dynamics and range conditions compare with historical status and trends in those processes?

— How do ungulate population dynamics in the greater Yellowstone area compare with other North American grassland and savannah ecosystems that still have large native predators?

— What are the implications and limitations of natural regulation practices as applied to other biota?

— What gaps and deficiencies in scientific knowledge should future research attempt to address?

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[1]Cole, G.M. 1971. An ecological rationale for the natural or artificial regulation of native ungulates in parks. Transactions of the North American Wildlife and Natural Resources Conference 36:417-425.

[2]Houston, D.B. 1982. The northern Yellowstone elk, ecology and management. Macmillan Publishing Company, New York. 474pp.

[3]Singer, F.J., D.M. Swift, M. B. Coughenour, and J. D. Varley. 1999. Thunder on the Yellowstone revisited: an assessment of management of native ungulates by natural regulation, 1968-1993. Wildlife Society Bulletin 26(3):375-390.

Remarks Delivered to the National Academy of Science Committee, January 14, 1999

Perspective:

John Dennis, Biologist, National Park Service

I appreciate the chance to be here this morning. I was listed in the agenda as representing the Department of Interior, but mostly today I will represent the National Park Service. From the Interior perspective, the department is very concerned and desirous that we use good science in departmental decisionmaking and bureau decisionmaking, and also that departmental activities work through partnerships. This meeting is a partnership, and it is focussed on science, so it is clearly meeting departmental objectives.

That said, for the remainder of this talk I'd like to touch a little bit on the benefits to the park, to the Park Service, and to science. And especially, I want to thank all of you on the committee for agreeing to take on this task—it's going to be a lot of work, it's going to stimulate your creative juices, and you'll find some frustrations and some struggles as you go along. But the Park Service does welcome your energies.

For today, I'd like to offer you my perspective on the role of science and resource management, then briefly remind you of the relationship of Yellowstone as a national park to the other parks in the national park system and to the National Park Service, and then spend a fair amount of time on the contribution of this review and some answers that I hope this review will seek to develop. I will conclude by identifying some of the ways the Park Service will look forward to using the results.

The role of science in resource management is fairly straightforward. The contribution on one hand is to develop a broad process understanding of what the natural resources are doing—work that in my view can done anywhere—in the field, in the lab, wherever is suitable in terms of the scientific questions being addressed. The other contribution of science is site-specific facts, a contribution that can only be made at the site of application of the scientific information to resource management. A key component of the scientific approach is to integrate the process understanding and the site-specific facts to generate models or assessments of what seems to be going on in the natural resources in the area.

And then, to keep the system objective, I believe science should produce alternative future scenarios rather than recommendations, because recommendations imply values connected into the system. So I will stress throughout the rest of my talk the goal of some alternative future scenarios that, if given some kind of management application based on our best scientific knowledge, we can use to project what outcomes to expect in the future. Given the system that we're dealing with, I urge you to think of the future as being 30, 50, 100, 200 years. Or more!

In terms of some Arctic research, once I was advocating to the National Science Foundation that, if in fact caribou operate at about a 70-year population cycle (which is a factoid I'd been given at some point along the way), then to do some reasonable replication of monitoring of population dynamics in caribou, we'd need about 350 years of monitoring. To the National Science Foundation, that time frame didn't apply. Yet in the terms of the parks, in theory we're asking for an infinite time frame, not just 350 years.

Yellowstone is one park out of what I think are now 378 parks (but I keep losing track as parks get added to the system). Despite what you always are told—and I'm doing this deliberately to sort of move our thinking to a different stage—the land of Yellowstone is not the first land now in the national park system that was set aside by Congress. The first piece of land now in the national park aystem that was set aside by Congress is a part of what is now the National Mall in Washington, D.C. It was set aside in 1790, whereas Yellowstone was set aside in 1872. So there is some history here that is worth keeping in mind.

Yellowstone *is* the first national park, and because it is the first national park the legislation creating it or amending it was very influential in creating the national park system. However, even though it's the first park, it is managed within the context of the overall management policies of the Park Service that apply to all parks. Because these management policies apply to all parks, the language in them is broad enough to cover the entire range of natural resources found in units of the national park system.

What we have learned in Yellowstone through the years has influenced the development of these policies. And in turn, how we've developed these policies now influences how the natural resources in Yellowstone are managed. Yellowstone, because of its size and, for a long period of time, its relative isolation from human development, is at one end of the spectrum of the parks contained in the national park system. As a result, the choice of management policies that we apply in

Yellowstone will be quite different from the full range of available management policies, and it will also be different from the choice of management policies that we apply in, say, Saratoga National Historical Park or Gettysburg National Military Park.

In the course of all the controversies at Yellowstone, Yellowstone ultimately adopted as its expression of National Park Service policies the natural regulation hypothesis and tested the hypothesis as its application of the Service's management policies, thus applying a particular viewpoint of natural resource policies. Over the years, Yellowstone has sponsored the development of information that now fuels the application of that hypothesis.

I'd like to turn to what I hope this review might generate. I'll start by saying some of the obvious things. It is a review being conducted by scientists. The goal is to review a body of science, and therefore it is a scientific review. The value it is contributing to this arena in northern Yellowstone and for the Park Service as a whole is its focus on the science, its focus on the facts—what facts are available, what are the quality of the facts that are available, and what facts are missing.

One question to examine is replication, which is an important scientific component—what kind of replication exists for the work done at Yellowstone? Based on the availability of replication, how reliable is what we know about natural resources in Yellowstone? How well does what we know represent what is actually going on? In a second line of inquiry there are other key questions. How accurate is the information? How precisely has it been obtained? How comprehensive has it been?

We say that there is a hypothesis driving the management. How has the hypothesis or hypotheses been expressed? How have they been tested to date? And what kinds of modelling have been done associated with these hypotheses? I earlier had stressed assessments. What kinds of assessments could we generate for future management scenarios? As we look to the future, how can we expect the northern range ecosystem to change?

As a scientific review, this committee's work may clarify what I will say are half the issues in the debate over northern Yellowstone; those are the science issues. By clarifying the science issues, you can identify what are the value choices in this debate, and suggest how we make those value choices more clearly identified and more clearly expressed.

It is a review being conducted by scientists…The value it is contributing to this arena in northern Yellowstone and for the Park Service as a whole is its focus on the science—what facts are available, what are the quality of the facts that are available, and what facts are missing... As we look to the future, how can we expect the northern range ecosystem to change?

And then the committee's review definitely includes use of the results. Whatever you find, the park can apply directly, in this case conducting science for the benefit of management of the parks. As a case study of a long-term hypothesis-testing and adaptive management activity, your results can generate information of value to science; in this case it's parks for science. This duality picks up on another National Academy review of Park Service research. Other parks and the Park Service can apply your general conclusions to thinking about park management in other areas. Presumably, scientists and resource managers in other land management organizations and in other countries will find the concepts and processes involved in this assessment of value in their thinking.

I'd like to go through a long series of questions and answers that I hope the panel can deal with. I'm reminded in doing this of a comment that Lewis Anderson, another biologist, used to say about ecology and ecologists—as an ecologist, I'm doing it right now—that is, that ecology elucidates the obvious. All of you already have asked yourselves these questions. But I'd like to emphasize the interest that the National Park Service has in what this review can generate.

We're looking at research that's been done with relationship to a natural park management system. It's a system in which, by law and policy, the human disruption of natural resources is inappropriate. The policy developed from that statement is that we eliminate disruptive human impacts where we can, and we mitigate the management of the natural system where we can't eliminate the human disruptions. We are dealing with natural ecosystems, not with rangelands, and there is a difference. We are dealing with all the native plant and animal species that occur in a natural, wild setting. We are not dealing with wildlife as might be traditionally defined. In a natural system we assume that plant and animal populations fluctuate, and because of this fluctuation there is no economic carrying capacity.

Congress, in its appropriation of the funds for the study, identified a number of things of interest to Congress. One is the resolution of the issue of population dynamics. I hope that the report will discuss what are the issues of population dynamics in terms of natural processes and in terms of human social dynamics. Congress has requested that the review look at, in essence, the effects of ungulate management on the ecosystem. With respect to the management of ungulates, I would hope the report will look at what we know regarding ungulates in Yellowstone, what we don't know, and what we need to know to be able to do a better job. With respect to the ecological effects of the ungulates, the same thing—I hope the report will clearly show what we do know for the Yellowstone ecosystem, what we don't know, and what we need to know.

Turning to the specific choice by the park over the years of using the natural regulation hypothesis as its vehicle for implementing the Service's natural process policy, I hope the report can look at whether Yellowstone is collecting appropriate data, both component data and process data, to test its natural regulation hypothesis. I hope the report looks at the

nature of any missing data that prevent drawing conclusions in terms of a hypothesis, and discusses why the missing data prevent the drawing of such conclusions. And I hope the report looks at how long a time period of data-gathering is required to permit drawing conclusions.

Congress indicated in its request that there is disagreement in the scientific communityabout what is occurring in Yellowstone. I hope the report can identify clearly what *is* the scientific disagreement, and what is the scientific basis for that disagreement. Having done that, I hope the report also can discuss whether there is a value basis for the scientific disagreement, and if so, what are the value conflicts that are contributing to the scientific conflicts. If the review determines that there are data gaps fueling the scientific disagreement, I hope the report can identify what the gaps are, what research would be needed to fill the gaps, and how long it will take to do the research. And as a conclusion, if it's possible I would hope the report can decide whether or not the disagreement in the scientific community *can* be resolved. And if so, how do we determine when we have resolved it, and what steps are needed to achieve that resolution? Are they all scientific steps? Are some of them value-choice steps, or is there a combination?

Congress has requested recommendations for implementing the results of the review. As I have indicated, I personally believe that the assessment of alternatives is the best way for science to present its findings in an objective manner. So I would hope that the committee's recommendations will be drawn from assessments of future alternatives that the panel presents. I would hope that the recommendations will clearly show, if there are both science and value components to the recommendations, which is which. Sometimes resource managers forget that the role of science is to ask questions, so they get frustrated when scientists come back and ask for more research. Nevertheless, where the recommendations clearly call for more research, can they break out activities associated with science—such as inventory, research, monitoring, adaptive management, and assessment—by the disciplines of research needed, or by the interdisciplinary collaboration of research, and by what kinds of resource management activities would be necessary to support the development of information.

These are the general questions. I also have specific questions, and I'd like to address these.

- Have all the involved vegetation, habitat, hydrologic, and ecosystem types involved with the northern range ungulate herds been assessed adequately by past research and past monitoring and other investigations?
- How far can we validly extrapolate from research done in some sites in the park to similar resources in other sites in the park? The scientific part of this question is, has there been enough replication of work in space, season, and time to permit drawing conclusions for the whole ecosystem?
- How do the local conditions in Yellowstone National Park relate to the broader landscape as a whole? Is the area within the park ecologically self-sufficient for all the plant and animal species and all vegetation and habitat types? I mention all plant and animal species to emphasize that we are dealing with a natural system, not rangeland or some other kind of economic system.
- Given that natural systems and the natural processes that drive them both fluctuate and evolve over time, what does the body of natural and cultural resource science tell us about the past and current northern range ecosystem, its components, and its processes? What do we know about these topics, what do we assume we know, and what don't we know?

I hope the report can identify clearly what *is* the scientific disagreement, and what is the scientific basis for that disagreement…whether there is a value basis for the scientific disagreement, and if so, what are the value conflicts that are contributing to the scientific conflicts… whether or not the disagreement in the scientific community *can* be resolved… and what steps are needed to achieve that resolution...

As you go through the reports and look at the data, I hope you will ask how good are the available data, how good are the models, how good is the overall information regarding the northern range ecosystem, its components, and its processes.

As you read through the literature, I hope you'll be thinking about the fact that humans have had and are having varying roles on the landscape that contains the northern range and Yellowstone National Park. And I hope you'll be asking yourselves what is known about the variations and types, amounts, and locations of these human roles and uses up to the present, and what effects if any these varied roles had on the northern range ecosystem, its components, and its processes.

There has clearly been change in the overall climate from the Pleistocene to current time, and I hope that this change will be underlying your thinking as you look at the evolution of the system and in the way people have used the system. What, if any, cultural research such as anthropology, archeology, and ethnography, or what social science research such as economics, political science, and sociology would help develop information that could improve our understanding of the issue of the natural regulation management program conducted by the park?

What scientific criteria should be used for developing alternative futures assessments and for drawing science-based recommendations from these assessments? Essentially, can you develop some evaluation criteria before you start doing these assessments, so there's a way of testing how the assessments are coming out?

With respect to spatial locations or scientific disciplines where you believe current knowledge is inadequate, what future scientific work and what sampling strategies could be used to develop adequate information? And how should the priorities for such work be assigned? How

much would the work likely cost, and would it be more effective scientifically to coordinate that work or to conduct it on an opportunistic basis?

Those are some of the questions that I have, and some of the real opportunities that I see laid before this committee to really get into ecosystem management or landscape management or whatever science we wish to call it. And to really capitalize on an opportunity where there's a fairly long-term data set, and there's a good opportunity for long-term protection of a landscape in the future, to look at how science understands what's going on and contributes to future decisions or management scenarios.

Turning to how the Park Service might be able to use the results of this review, the park itself clearly can use the information directly in whatever resource management it conducts and in whatever monitoring programs it maintains, expands, or changes. This report can generate a wealth of information to help the interpretation program, and in planning future research.

The Park Service can use the information from this review to identify opportunities for other parks in their resource management programs, and to inform policy development. In fact, the 1988 *Management Policies* are undergoing internal review now and will be available for public review, I believe, sometime later this year. The policy review may be a little ahead of what the committee is doing, but I suspect the two will catch up to each other in the not-too-distant future. So there is a real opportunity to bring some modern landscape ecological thinking—interdisciplinary thinking in long-term resource management, ecological research, ecological monitoring—into a very useful framework.

I believe this review is a significant opportunity to assess scientifically a 30-year adaptive management effort which has a long history…The Academy plays a key role in bringing scientific discipline and rigor to the scientific and management activities that right now have generated a lot of argument and heat…

The other kind of contribution this report will make is to identify specific and general research needs that the Park Service can supply to its governmental and academic partners. The Park Service has a small relationship in the international arena as well, with other services around the world, and I would hope the results of this work will be found useful in the cooperative training, monitoring, and research activities that go on among the nations.

To conclude, I think you've figured out by now that I believe this review is a significant opportunity to assess scientifically a 30-year adaptive management effort which has a long history, dating even before that 30-year period. The Academy plays a key role in bringing scientific discipline and rigor to the scientific and management activities that have generated a lot of argument and heat. I'm hoping that the review will bring some light to it. The results of the review contribute both to long-term science and to understanding the scientific basis for managing ecosystems of Yellowstone and, by extrapolation, other units of the national park system. Thank you.

Roy Renkin, Yellowstone Management Biologist, discusses his research on the effects of fire and ungulate grazing on aspen, July 1999. NPS photo.

Perspective:
Michael V. Finley, Superintendent, Yellowstone National Park

There's a sad truth in modern natural resource management, and it is that many resource managers tend to become skeptical about science. This is because advocates of every conceivable management direction can usually invoke a card-carrying scientist to support their case…

For many reasons, we in Yellowstone are pleased that the National Academy of Sciences is addressing Yellowstone management, especially natural regulation and the northern range issue. As some of you know, we and others have for years attempted to persuade some impartial group to conduct a review of this sort, with a sufficiently broad-based, interdisciplinary approach to do it justice. Now, here you are, and we are very pleased about it. We wish you every success in this very important task.

Twenty-five years ago, the National Academy took on the leading Yellowstone controversy at that time, grizzly bear management. The NAS report released in 1974 was a milestone, and, in a way, a turning point in that controversy. Predictably, all position holders in the bear controversy disagreed with at least some findings of the NAS Committee on the Yellowstone grizzlies, but, without question, the committee's report moved the scientific and public dialogue along to a new and considerably better-informed stage. More recently, the NAS report on brucellosis in the greater Yellowstone had a similar effect on that issue. If you can do the same for Yellowstone ungulate management, and especially for natural regulation and the northern range, you will have earned the gratitude of all of us who care about Yellowstone.

The next couple of days you will be touring parts of the northern Yellowstone winter range. As you are already aware, there is a huge quantity of published research on the subject. This stack [*indicating pile of material*] includes most of the more recent material, and I brought it here to illustrate the richness of the scientific information base, as well as to emphasize that we stand ready to provide you with copies of any of these reports and publications. This material represents perhaps the largest and longest-running single research effort in the history of the national parks.

Just within the past ten years, following the 1986 Congressional mandate to research northern range issues, Yellowstone National Park has sponsored three professional workshops on northern range research and several more specialized work groups on aspects of the northern range. Starting in 1991, we have hosted four very well-attended biennial scientific conferences, the first three focussing on plants, fire, and predators, all crucial topics for your work. More recently, scientific societies have also devoted sessions to northern range issues and natural regulation, and the General Accounting Office completed a summary report on the issue of elk and bison management. The result of all this attention is an unprecedented flow of new data and new interpretations. It is diffuse, it is often in disagreement, and it is daunting in its complexity, but it is the most important set of tools that today's managers have available in planning the future of this important resource.

This is why we welcome you. We count on you to apply your considerable combination of skills to this information so that all of us can face up to the challenges of Yellowstone.

There's a sad truth in modern natural resource management, and it is that many resource managers tend to become skeptical about science. This is because advocates of every conceivable management direction can usually invoke a card-carrying scientist to support their case. As the current manager on the hot seat here in Yellowstone and as the interface between science and politics, I want to offer you some candid thoughts that get right to the heart of the practical end of management here.

Let me get right to the touchiest issue we face today, because it provides such a great example of how issues challenge park managers. Many of our critics be-

lieve we have too many elk. The most recent science doesn't suggest that to us, but let's say that somehow, the scientific consensus returned to what it was 50 years ago—that we have too many elk. As managers here, we don't have the luxury of simply unilaterally saying, okay, let's reduce the elk herd.

First, we must ask the question, "How many is the right number?" Virtually all ecologists would then tell us that there is no right number, that their numbers will change as environmental conditions change; all you can hope for is some general rough number that you will have to maintain through aggressive manipulation. But our most outspoken critics disagree among themselves about that number; there is no consensus among them. Some say the elk should be eliminated entirely, some say 5,000 would be about right, and others don't even say, except to assert that the current number isn't the right one. You can understand where this kind of vagueness or disagreement would leave a manager.

But let's say that somehow we came up with a rough number of elk that everybody agreed upon—a prospect that is much more difficult since the recent reintroduction of the wolf after a 60-year lapse. How do we plan to reduce the current number? We would start with an environmental impact statement to spell this out, and we can assure you that it would have to be a brilliantly stated document, but even then it would be immediately in court. Opponents to elk reduction would point out that it would jeopardize our grizzly bears and wolves, to say nothing of the many other predators and scavengers; frankly, we think that unless the data is absolutely bomb-proof, we would lose that case. We could count on our opponents to mention not only the bears and wolves, but also the eagles, the mountain lions, and every other charismatic animal out there whose fate is tied to those elk.

But as managers, we must think beyond ecology, to economy and visitor use and enjoyment. The northern Yellowstone elk herd supports one of the largest, most economically important elk hunting and elk viewing resources in North America. If that herd is reduced even by half, much less by the 95 percent as some insist upon, the economic hardship on our neighbors and the diminished visitor experience would be tremendous.

Today's late-season elk hunt has both ecological and economic impacts. After consultation with the NPS, the state of Montana has issued 2,765 late-season elk permits for the Gardiner area and approximately 1,200 late-season permits for the Madison and Gallatin river basins. These figures demonstrate two points: first, the great economic impact and benefit of cooperative management; and second, that natural regulation recognizes cooperative wildlife actions taken outside the park by other jurisdictions.

Again, given the severe consequences, I doubt we would have a chance in court on severe reductions without bomb-proof data and studies. We in Yellowstone have plenty of experience in court. Currently, four federal judges are helping us manage the park. [*Ed. note: Legal orders are in place affecting the park's management of bison, and that could potentially affect wolves, grizzly bears, and winter visitation.*] We have seen less volatile issues that we couldn't win. Again and again, the question must be asked: "Too many elk for whom? Hunters? Commercial range managers? Livestock operators? Tourists? Grizzly bears? Wildland ecologists?" They all have different answers.

It's our job as managers to deal with issues like these. I'm not complaining. In fact, addressing these issues is one of the most exciting and important things that we do in Yellowstone, because we are constantly reminded that many people throughout the whole world are watching and either following our example or learning from our mistakes.

Here is another manager's question. In recent years, a number of scientific studies, including last year's NAS report on brucellosis, have indicated that there is sound reason to believe that the northern Yellowstone elk herd is naturally regulated. This is perhaps the foremost issue today in the public debate over Yellowstone management. As a manager who must often mediate these dialogues, I have begun to wonder how many times natural regulation of these elk must be scientifically demonstrated before we can get on to other topics. You are in a position to either disagree with past interpretations or confirm them, and, either way, you will be performing a service and moving the conversation along.

Part of that service, one we would be extremely grateful for, is an analysis of the term "natural regulation." It has been proposed we abandon the term. Should we? Should we replace it with another, such as Mark Boyce's suggested phrase "ecological process management" or, as others suggest, "minimal management of natural processes"? We can assure that *all* these terms are very poorly understood by the general public and additional education is required.

We also are counting on you to provide some perspective on the overgrazing issue. The reported overgrazing of the northern range has almost a century-long history, but in the past 20 years, virtually every researcher doing grasslands work in the park has said that this grassland is not overgrazed, and they have published an impressive array of papers to support their case. And again, we have begun to wonder if it is naive of us to ever regard their case as "proved," or if we should expect to live indefinitely with this disagreement no matter how conclusive the science may appear.

We likewise count on you to referee similar disagreements over woody vegetation, erosion, biodiversity, climate, and other topics that are entangled in the natural regulation debate. As you wade through the relevant literature, you will see how tightly argued the various positions are. I am sure that you will also be able to appreciate the position into which managers and the public are placed by such debates, where advocates of every

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position firmly believe that they have science on their side.

We also hope that in every one of these issues, you will suggest directions for future research. I understand that you all received the book *Yellowstone's Northern Range*. Please consider the research needs discussed in there, and tell us how to improve them.

As if this weren't enough, we hope you will address other issues for us as well. There is much more to this debate than disagreements over scientific findings. Most participants, especially in the management agencies, shy away from even bringing this up, but it must be faced, and you are our best hope for facing it fairly and helpfully. Any report that confines itself only to evaluating scientific findings and management results will leave the all-important issue of human values out. Yellowstone management is not merely about understanding the animals, vegetation, and geophysical systems here. Yellowstone is known as a great laboratory as much because the place tests ideas as well as it gives scientists such a wonderful place to study nature and natural processes.

Yellowstone has always been a battleground on which competing values systems have fought it out. Whether it was differing beliefs about damming many park streams in the 1920s, or how predators should be managed in the 1930s, or about the bioprospecting of Yellowstone microorganisms in the 1990s, Yellowstone is a great forum for public debate. That forum is one of the most important things Yellowstone gives the world. It is also why the park is such a controversy magnet. You have just stepped onto the stage of one of the best-attended theaters in the world of conservation. The interest and pressure that this committee's work has already generated in the political arena is an early warning to keep your seat belts fastened.

Genuine scientific disagreements notwithstanding, many perspectives in the natural regulation debate are the result of significantly different views of the world and how nature should work. The Yellowstone manager deals with all of them, from people who view nature as having a nearly godlike perfection to people who regard nature as existing solely for the convenience and development of humans, with every imaginable gradation of belief in between. One person's overgrazed range is another person's healthy wildland grazing ecosystem. Those two people can reach their respective interpretations even if they agree completely on what science tells us about the physical characteristics of the area in question. It is often foolish for a manager to think that these disagreements are ever going to be settled by science, because the various positions are often deeply held social and religious positions. Yellowstone managers must never forget that one of the most important factors in terminating the slaughter of park elk by rangers in the 1960s was the political reaction to a flood of letters from school children.

Genuine scientific disagreements notwithstanding, many perspectives in the natural regulation debate are the result of significantly different views of the world and how nature should work…One person's overgrazed range is another person's healthy wildland grazing ecosystem…

We do not expect you to analyze why American society is composed of people who believe such wildly different things. But acknowledgment of this aspect of the debate, and its important role in the scientific and political sides of the issue, would seem within your reach. By the way, a good example of this kind of acknowledgment was provided in a recent NAS report on wolves, bears, and their prey in Alaska. We hope that you will find some way to bring these social aspects of the natural regulation debate to light. We don't ask you to decide anything about them; we just wish you could broaden the description of the controversy to more openly acknowledge them.

Last, we dearly hope that your report will do something to calm the rhetoric that has too long characterized this debate. Washington, D.C. isn't the only place that can be accused of practicing the "politics of personal destruction." It has become a matter of routine for researchers and managers to find themselves characterized as incompetents and liars by their opponents. In the natural regulation debate, we in the National Park Service have been accused of all manner of unfounded things, from racism to criminal malfeasance to the worst kinds of deceit. No less acrimony has been aimed at any university researcher who dares to agree with us. One expects a certain amount of this in any public arena; it comes with the territory, especially in the media-intense realm of Yellowstone. But too much of this overheated and destructive rhetoric is coming from the scientific community. Only some separate and unaligned body such as this committee stands a chance of providing discipline to this unprofessional behavior so that the dialogues are a little more responsibly conducted.

Again, I welcome you here. You have taken on a very important task, one with great and even global implications in conservation. You will be influencing the future expectations of millions of Americans who love Yellowstone. I wish you well in it. We are ready to help you in any way we can.

Superintendent Mike Finley addresses the NAS committee, July 1999. NPS photo.

Perspective:

Frederic H. Wagner, National Center for Ecological Analysis and Synthesis

I have been asked to offer the Committee certain of my views on the question of natural regulation and my thinking on the major scientific questions needing investigation during the course of its study. Before doing so, I would like to give a bit of background on where I am coming from vis-à-vis the northern-range situation.

I have been observing, exchanging professional views, and reading the literature on the northern-range issue since first joining the Utah State University faculty in 1961-62, and I took a bus load of students to the park in February 1962 just after it had completed the big herd reduction of that winter. I continued taking bus loads of students to the park for several winters thereafter to interact with park biologists and discuss management programs.

I served on the doctoral committee of park biologist William Barmore, who submitted his immense three-volume study as a park final report in 1980 and as a dissertation draft in 1981. Unfortunately, Bill never finished his degree. From 1986 to 1990 I advised my doctoral student, Charles Kay, who conducted a massive study on the northern range. From 1988 to 1993 I chaired an ad hoc committee commissioned by the president of The Wildlife Society to review wildlife policies in the national parks. The seven-person committee's report, with one member of your committee as a joint author, was published by Island Press in a book entitled *Wildlife Policies in the U.S. National Parks*. In January, 1998, I was awarded a one-year fellowship, now extended to 15 months, by the National Center for Ecological Analysis and Synthesis in Santa Barbara, California, to synthesize the entire 126-year data base on the effects of elk on the northern-range ecosystem, and to explore certain policy questions. I have never received nor sought research funding from the park or from the National Park Service.

What is Natural Regulation?

There is much discussion about natural regulation, but most of it fails to recognize that the term is used for two separate and distinct entities, and thus does not distinguish between these in the discourse. One entity is the ungulate-management *policy* adopted by Yellowstone Park in 1967 (YNP, 1967a,b,c). It stated that there would no longer be advertent human control of the ungulates in the park, and that henceforth non-human, "natural," processes would be relied upon to "regulate" the ungulate herds.

The second entity is an *ecological hypothesis* proposed by Douglas Houston (1971) at the 1971 American Association for the Advancement of Science (AAAS) meetings. The hypothesis also has two distinct aspects. The first hypothesized that the northern-range elk herd would limit (in population-ecology terminology this is the more appropriate term than "regulate" for the process in question) its own numbers by a combination of intraspecific competition for its forage resource and unfavorable winter weather, and without human intervention. The hypothesis was posed as a prediction of future events because it was articulated when the herd was recovering from a low level to which it had been driven by the previous management policy of advertent, human control.

The second aspect of the hypothesis proposed that the population limitation would be achieved without significant impact on the ecosystem, particularly the vegetation and sympatric fauna. Some of the population discourse, and I suspect the strong emphasis on population questions in the Congressional and NRC charges, implies that the population aspect is the more important, and may tend at times to suggest that if the population equilibrates, the hypothesis is sustained. But the effects on the ecosystem are, by far, the more complex and pose a much larger test of the hypothesis.

In my opinion, much of the debate on natural regulation fails to distinguish between these two entities—the policy and the hypothesis—of natural regulation. Whether or not the elk herd has equilibrated and, if so, how; what numbers the herd has achieved as a result of the natural-regulation management policy; and what effects the herd is having on the ecosystem under the policy are, in my view, questions of scientific fact and subject to tests of evidence. Whether or not those effects are desirable, and whether or not the natural-regulation policy is appropriate for managing a national park, are value and policy questions, not scientific ones.

Failure to distinguish these two entities has, in my experience, affected objectivity of inference in much of the science on the issue. I have seen cases where scientific inference has been colored by what it might imply for supporting or challenging the policy.

The question also arises as to the Committee's charge. I believe the seven questions posed in the NRC charge are appropriately addressed by a committee of 13 people whose credentials are in the biological sciences. I think that is also the case for most of the charge in the original legislative wording, with the possible exception of what is implied in the last phrase "…to provide recommendations for implementation by the Service."

If the Congressional intent in the latter phrase is for the Committee to recommend policy, it raises the question of whether policy advocacy is standard procedure for NRC studies. In the ones in which I have participated, such advocacy has not been our charge. It has been appropriate to point out the ecological implications of policy alternatives, but to stop short of recommending any of the options among them.

If the charge carries the advocacy intent, it raises the further socio-political questions of who should recommend pub-

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lic policy, and what is the appropriate policy-setting mechanism for national parks. National parks are a public resource, and as the recent policy literature generalizes, public-policy setting is a socio-political process carried out to satisfy societal values. It is not a scientific process. Individual scientists may have personal values which they hold for public resources, but those individuals are but a few of the larger public for whom the policies are set.

I apologize for the diversion, but it is not uncommon to hear biologists asserting what the proper policy should be for national parks. I suggest that these views are based on their personal values. They are certainly entitled to them, and merit serious consideration. But I contend that they should carry no disproportionate weight vis-à-vis the values of the broader public who owns the parks. I personally do not take a professional position on what park policy should be, and have so stated in several publications.

I am confident that the Committee will address the scientific questions surrounding the natural-regulation hypothesis objectively, whatever the policy implications may be.

What Scientific Questions?

I have been asked to comment on what I consider to be the important scientific questions needing to be addressed. My view is that they are the same set of questions that I am addressing in my own on-going synthesis. I have considered it desirable first to reconstruct the elk population trajectory from before park establishment to the present. While it is true that the natural-regulation policy has only been in place about 31 years, the park and interactions between its ungulates and their ecosystem had existed for nearly a century before the policy was adopted. There had been nearly a half century of research prior to enunciation of the natural-regulation hypothesis. Much of that is relevant to, and provides perspective for, analyzing the natural-regulation era. In a sense, the first century provides a second replicate. Moreover, there is disagreement among those taking positions on different points, and familiarity with much of this material helps understand the background and frequently unstated premises that are the bases for the different positions taken.

Reconstructing the population trend is relatively straightforward for the years since 1923, the year in which Houston (1982:15) considers the first reasonable census was carried out. But there is disagreement over the numbers before park establishment in 1872, and over the population's trajectory from 1872 to 1923. Addressing this question requires obtaining and weighing the evidence for the schools of thought. Relevant information is provided by reference to the archaeological literature. For that reason, I think it unfortunate that there is no well-established archaeologist familiar with western U.S. archaeology on the Committee.

Publications on the population dynamics, based on recent research, are effective and, I think, have elucidated the mechanisms underway reasonably well. I think the population questions can be resolved, even if in some cases not unequivocally, fairly promptly.

The much more extensive and complex questions are those addressing the ecosystem effects. And since most of the Committee's charge as presently posed deals with the population aspects, I consider that the charge could have been weighted more proportionately to the magnitude of the task. There is an immense mass of material ranging through the technical literature, public-information documents, theses and dissertations, an extensive photographic record in several photographic archives, and unpublished reports all dating back to park establishment and before. Much of this contains relevant evidence.

There is a large amount of research and numerous publications that address the vegetation, and their analysis is well served by substantial recourse to the west-

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ern North American range-ecology literature and paradigms with their emphasis on the effects of herbivory on plant populations and communities. Thus, I think it fortunate that there is a well-known range ecologist on the Committee to address this aspect. However, it is a very large task. It would be helpful if there were one or two more people from this discipline on the Committee to help carry the load.

Beyond this, the existing vegetation literature has focused to a major extent on plant species and groups of species without extending the concern to the ecological subsystems for which those plant species provide the major structural characteristics. Examples are aspen woodlands, the shrub-steppe, and the riparian type. Collectively, these subsystems form the northern-range ecosystem. I suggest that ungulate effects on these need to be analyzed individually, and then collectively as they function within the entire system.

Effects on much of the smaller fauna can be analyzed in the process of scrutinizing the subsystems. But larger, more mobile species like the other ungulates range across the subsystems and need to be addressed individually, and in terms of their roles within the entire northern-range ecosystem. While the charge directs the Committee to compare the northern-range situation with other North American grassland and savannah ecosystems that still have large predators, it does not specifically direct analysis of the likely effects of wolf reintroduction on the elk herd and other ungulates. I would think this surely appropriate. Moreover, inasmuch as the northern-range situation has been likened to other large-ungulate grazing systems in recent publications, I think it desirable to elucidate ways in which the northern-range is, like other western North American grazing systems, unique.

I think there is a need to evaluate the effect of ungulates on hydrologic processes, including surface run-off and associated soil erosion, and fluvial geomorphology. I think it is, therefore, unfortunate that there is no mention of hydrologic aspects in the Committee's charge. In my view, the Committee would be well served if it had a watershed hydrologist and stream morphologist in its membership.

By way of integration, I suggest that the above be synthesized into a set of landscape-ecology inferences, and within the emerging concepts of ecosystem integrity and health. I think it is fortunate that there is an eminent landscape ecologist on the Committee.

Finally, the Committee is charged with recommending needed additional research. While there is always need for more research, and certain helpful projects come to mind, the northern range is commonly said to be the most studied large-ungulate grazing system in the western hemisphere, and surely one of the most studied in the world. There is surely enough evidence to draw a set of conclusions about the nature of the northern-range situation conclusions which, as always in science, are subject to change with new evidence but which portray the understanding we have of the system on the basis of the evidence to date. After more than seven decades of research we are surely in a position to hand over to policy process a set of inferences that describe the ecological implications of the policy alternatives. A plea for more research can always provide an escape for drawing pro tem conclusions. But as the Committee members know very well, all scientific conclusions are pro tem.

I thank you for the opportunity to present my views. The Committee has a huge task before it in finding, accessing, and evaluating the relevant evidence; and in obtaining the help of key individuals who are knowledgeable on the subject. I offer my services at any time and in any way that I might be helpful in the Committee's efforts. This is an important, much needed undertaking, and the Committee and NRC will provide a valuable public service in carrying it out.

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Yellowstone Management Biologist Roy Renkin explains preliminary results of experiments on Northern Range vegetation, July, 1999. NPS photo.

Perspective:
John Baughman, Director, Wyoming Game and Fish Department

The State of Wyoming is pleased the National Research Council will conduct an independent, objective, and scientific study of natural regulation and the associated effects on Yellowstone National Park's large ungulates (especially bison and elk) and their respective habitats. Debate regarding these issues has persisted for many years and has often been contentious. Because free-ranging wildlife do not respect political boundaries, even those congressionally authorized boundaries established long ago for Yellowstone, natural regulation or management of Yellowstone's wildlife invariably affects neighboring states, sometimes to the states' disadvantage. This problem is oftentimes compounded when wildlife management actions are unilaterally taken in the park without state knowledge, concurrence, or input. Primacy over public trust wildlife, and hence wildlife management decisions, was reserved for the states by various congressional actions as well as state constitutions when states were admitted to the Union. It is therefore critical that the states of Montana, Idaho, and Wyoming be in the forefront of any decisions about wildlife within the northern range of Yellowstone. Although Montana is more directly affected by Yellowstone's natural regulation policy and conditions on the park's northern range, Wyoming does have concerns. Wildlife in and around Yellowstone and its northern range are important to Wyoming for wildlife viewing for its citizens and as an attraction for visitors to Wyoming. Just as important, however, are the effects the policy of natural regulation in Yellowstone can and does have on disease transmission, hunting and viewing opportunities, and wildlife population objectives.

In 1998, another National Research Council study, "Brucellosis in the Greater Yellowstone Area," was completed. It evaluated the brucellosis problem in the Greater Yellowstone Area and recommended the application of "adaptive management" to the problem. Although that study was commissioned and funded by the U.S. Department of Interior, from the state's perspective it has had no impact on philosophy, management, planning, administration or direction, and Interior has not heeded the study's findings and recommendations. We believe the Department of Interior should seriously consider the conclusions of that brucellosis study and implement appropriate recommendations. In addition, we hope the current panel on natural regulation and Yellowstone's northern range will provide independent, objective, and scientific recommendations and that Interior will seriously consider and implement those recommendations.

Because free-ranging wildlife do not respect political boundaries, even those congressionally authorized boundaries established long ago for Yellowstone, natural regulation or management of Yellowstone's wildlife invariably affects neighboring states, sometimes to the states' disadvantage… It is therefore critical that the states of Montana, Idaho, and Wyoming be in the forefront of any decisions about wildlife within the northern range of Yellowstone.

Of considerable importance to Wyoming are the consequences of natural regulation on numbers of bison and elk, condition of ranges used by them in Yellowstone National Park, and tendencies of these animals to move outside of the park. The Wyoming Game and Fish Department manages all its big game herds for specific posthunt population objectives. These objectives are established based on a mix of input including carrying capacity of crucial winter ranges, landowner tolerance of wild ungulates on their private lands, and the desires of the general public.

A high percentage of the elk and all the bison in the Cody region spend the late spring, summer, and early fall in Yellowstone National Park. Past movement studies indicate up to 80 percent of the elk wintering in Sunlight Basin summer in the upper Lamar River drainage in the Park and 70 percent of the elk wintering along the Shoshone River and on Carter Mountain summer in the upper Yellowstone River drainage inside and outside of Yellowstone National Park. There is limited interchange of mule deer, bighorn sheep, and moose.

Due to the significant interchange of elk and bison between Yellowstone National Park and the public/private lands to the east, active management of these ungulates within Yellowstone affects management in the Cody area. The amount of impact is an issue that should be evaluated by the study team.

In past statements, the Wyoming Game and Fish Department has recommended Yellowstone National Park be managed for specific population objectives to make management of elk and bison in the Cody area more predictable. This is especially true for bison. Recent records show bison move out of the park to winter in the Cody region when the Yellowstone bison herd

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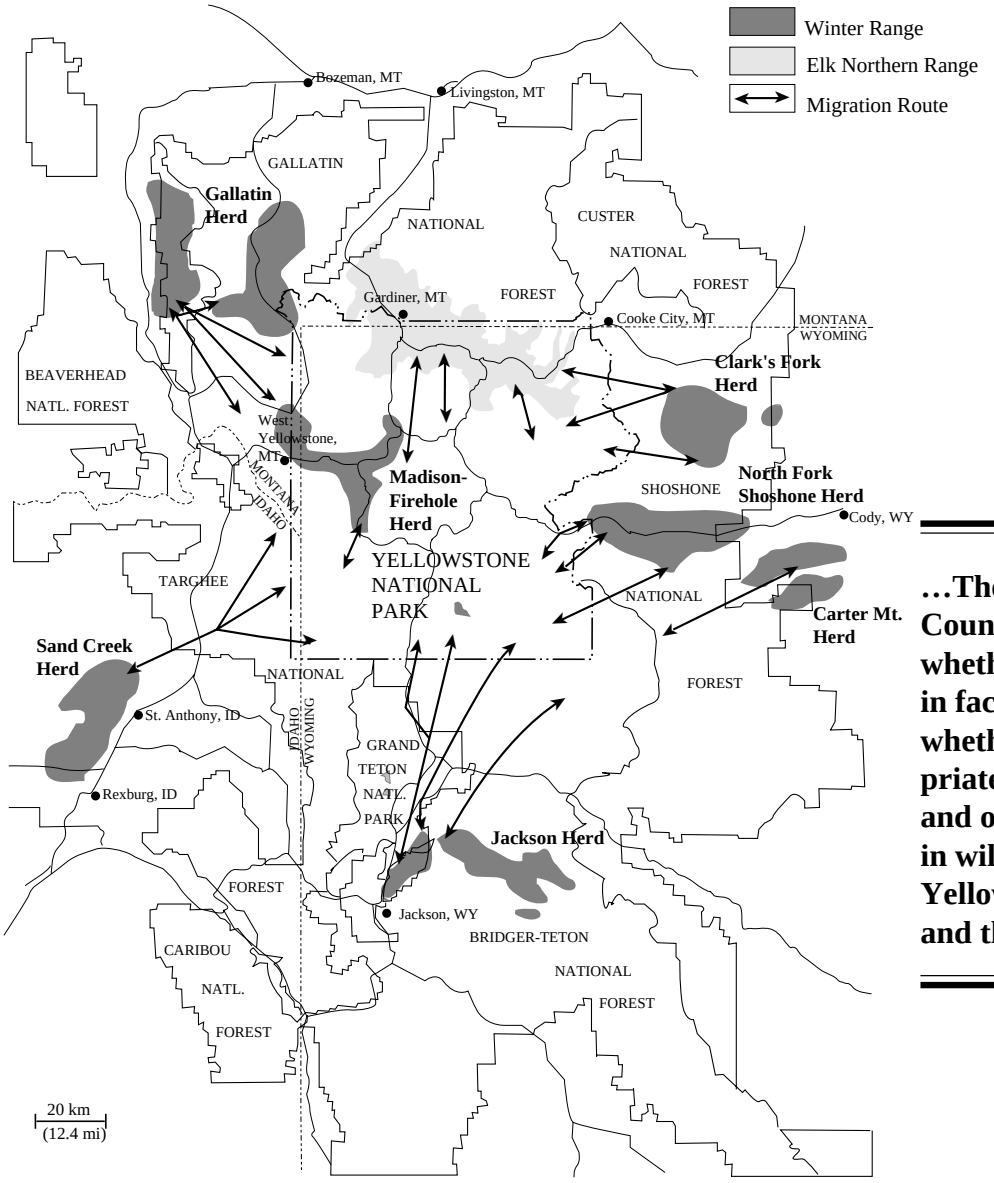

Winter ranges of greater Yellowstone elk herds, with migration routes. YNP map.

…The National Research Council panel should consider whether natural regulation is in fact management, and whether it is realistic or appropriate in the face of brucellosis and other introduced diseases in wildlife of the Greater Yellowstone Area in general, and the park in particular…

exceeds 2,500 animals. The largest movements have occurred when the herd surpassed 3,500 animals. Current objectives for the Absaroka bison management area located east of Yellowstone National Park can be effectively achieved when Yellowstone National Park bison numbers are maintained within this range. If numbers increase above 3,500, larger numbers of bison would move into the Cody region to winter, requiring more harvest and increasing the chance bison will mingle with domestic livestock on private lands.

Because most of the elk and bison that winter near Cody and summer in Yellowstone National Park annually use the same summer and winter ranges, management objectives both in the park and in the Cody region could be better achieved if Yellowstone National Park and Wyoming Game and Fish Department personnel cooperatively developed management plans.

Another concern is that animals migrating out of the park might transmit diseases to wild and domestic animals which could adversely affect Wyoming. Brucellosis is of greatest concern and, as was previously noted, was the subject of a recent National Research Council Review. The report noted that "the risk of bison or elk transmitting brucellosis to cattle is small, but it is not zero." We agree that risk of brucellosis transmission to Wyoming livestock is low, but the risk of national cattle markets adversely reacting to the perception that Wyoming cattle can be exposed to brucellosis is a reality. Wyoming is committed to controlling and eventually eliminating brucellosis, but Wyoming can never be successful in these efforts if our elk and bison, or cattle, are re-infected by wild animals from Yellowstone over which Wyoming has little control.

Whether brucellosis is affecting bison and elk populations in Yellowstone should also be considered. Although it is generally agreed that brucellosis is not a self-maintained disease among elk in the absence of elk feedgrounds, this may not be true for Yellowstone's large northern range elk population. The panel should consider whether brucellosis is a self-maintained disease in Yellowstone's northern elk.

The National Research Council panel should also consider the influence of the size of the Yellowstone elk and bison population on brucellosis transmission within and outside the park. These deliberations should include the impact of large and small bison and elk populations on Wyoming's ongoing efforts to control and eliminate brucellosis from bison and elk within our borders.

Additionally, the National Research Council panel should contrast the real effects of natural regulation versus "adaptive management" on eventual control and elimination of brucellosis. Although brucellosis is the disease of greatest concern, the influence of natural regulation on other diseases should also be evaluated. The northern range elk have been exposed to bovine tuberculosis, Johne's disease, and hemorrhagic pasteurellosis.

In summary, the National Research Council panel should consider whether natural regulation is in fact management, and whether it is realistic or appropriate in the face of brucellosis and other introduced diseases in wildlife of the Greater Yellowstone Area in general, and the park in particular.

We have endured two Animal and Plant Health Inspection Service station reviews, a Government Accounting Office study for Congress, and two National Research Council studies (including this one). The Governor has repeatedly told Secretary Babbitt that our states are caught in a crossfire between agencies of the federal government who have not found a remedy for their in-house differences. We do not consider promulgating new studies and investigations to be remedies. We have only one Congress and one President—we should expect the federal agencies to come up with one strategy to deal with animal health and wildlife management when working with the states.

Elk and bison in holding corrals, 1961. Both elk and bison numbers were substantially reduced during the 1960s. NPS photo.

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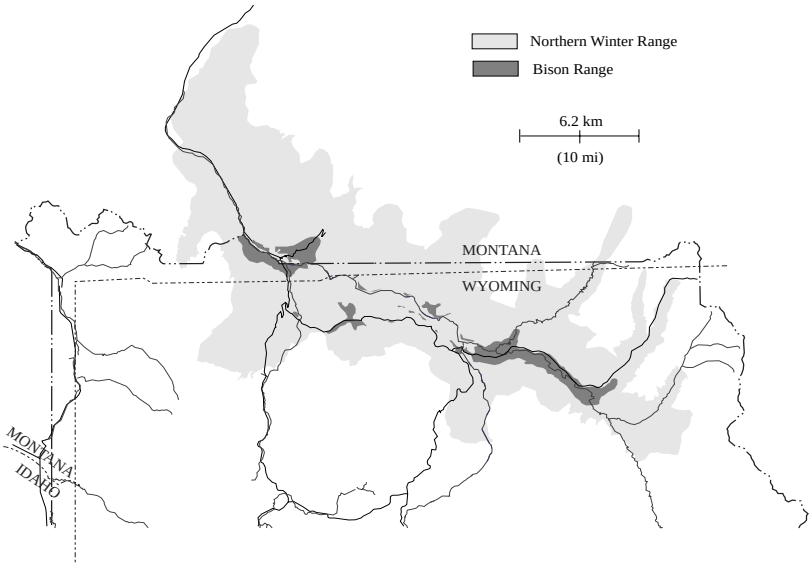

Bison winter range. Since the early 1980s bison have found winter ranges north of the park boundary, leading to a variety of controversial management actions, including public hunting in the 1980s and capture, test, and slaughter operations more recently. YNP map.

Perspective:

Andrea Lococo, Rocky Mountain Coordinator, The Fund for Animals

Park employees sawing off elk antlers in portable elk trap, 1946. NPS photo.

The Fund for Animals is a national animal rights organization headquartered in New York City with one of its regional offices in Jackson, Wyoming. The Fund has been involved in a number of Yellowstone National Park issues over the last several years.

Let me preface my comments by saying that my background is philosophy. First, let me express my appreciation to science as a discipline for serving as a catalyst to stimulate philosophical reflection. Science has contributed to shifts in philosophical paradigms for analyzing the reality in which we find ourselves and shifts in ethical frameworks with which we evaluate our own behavior.

In fact, the evolving consciousness taking place in our society with regard to how humans relate to other animals is attributable to a great degree to the newfound knowledge emerging from scientific disciplines such as wildlife biology and ecology, animal physiology, psychology, ethology, and many of your own areas of expertise. Of course, the moral implications of this knowledge are just beginning to be explored.

But the exchange runs both ways. Philosophy greatly influences the scientific enterprise today as it has throughout history. I want to encourage all committee members to be ever mindful that science is not value-neutral. We all operate within certain philosophical frameworks that influence not only how we interpret data, but how we gather it (how we choose and frame the questions we ask and how we design and carry out research projects.

I hope that you will think carefully about not just the answers to questions you pose, but the questions themselves. Questions are usually rooted in certain assumptions and we should strive to be aware of the assumptions with which we operate. Some assumptions may be well-grounded; others may not be.

…I hope that you will think carefully about not just the answers to questions you pose, but the questions themselves. Questions are usually rooted in certain assumptions and we should strive to be aware of the assumptions with which we operate…

That being said, I would now like to share with you some of the specific concerns that The Fund for Animals has regarding the project before you.

First, it would be our hope that this committee does not rely upon the conclusions drawn in a recent National Research Council report on brucellosis to assess the impacts of snowmobile trail grooming on wildlife population dynamics. We hope that the committee will conduct a much more thorough and comprehensive investigation of such impacts. [*Ed. note: The National Research Council published a report on "Brucellosis in the Greater Yellowstone Area" (NAS 1998) after a six-month study in which the authors assessed the risks of brucellosis transmission from wildlife to cattle, as well as whether winter use and management likely affects the bison population and behavior.*]

Snowmobiles queuing at the West Yellowstone entrance gate. NPS photo.

…I wonder whether there will be places in the future where nature can take its course, or will nature become nothing more than a human artifact shaped by what a given community of scientists define as "healthy" ecosystems in a freeze-frame in time… are we in essence transforming all pockets of "wildness" into botanical gardens and zoological parks or some other human-contrived model?

Second, we hope that the Committee will explore whether natural regulation is in fact operating to the fullest extent in Yellowstone National Park, especially given a statement by a Park Service official yesterday that the park would eliminate disruptive human impacts where we can when this is the typical scene during winter months. We also hope that you will explore why most national parks do not groom snowmobile trails and why parks such as Glacier National Park prohibit snowmobiles all together.

Third, I hope the committee will bear in mind that hunting as it is carried out today is a very different enterprise than aboriginal hunting or very often aboriginal scavenging, and can have serious impacts on wildlife populations and behavior.

Fourth, and on a personal note, I wonder whether there will be places in the future where nature can take its course, or will nature become nothing more than a human artifact shaped by what a given community of scientists define as "healthy" ecosystems in a freeze-frame in time. Ecosystems change in time—floral and faunal compositions change, perhaps to our liking, perhaps not. But are we in essence transforming all pockets of "wildness" into botanical gardens and zoological parks or some other human-contrived model? Yellowstone National Park is in many ways a living laboratory from which we can learn about natural processes. If we try to control or manipulate the processes, that laboratory is lost.

Finally, given that the committee has thus far heard from a variety of perspectives—the rancher's, the conservationist's, the wildlife manager's, and the researcher's perspective—The Fund for Animals would welcome the opportunity to have our biologist address the committee at a future meeting. I believe we have a unique perspective and can offer valuable insight into the examination of issues facing you. Thank you.

Elk on feed line at upper Slough Creek, 1931. NPS photo.

Perspective:
Steve Torbit, National Wildlife Federation

It's a pleasure to be here today. I think it's important for me to give some background about the organization that I represent before I start to comment on our perspective to the charge of the committee and the work in front of you, and the issues surrounding Yellowstone National Park (YNP). It's important because the National Wildlife Federation (NWF) is one of the oldest conservation organizations; we were founded during the Depression by a sporting public who saw the loss of natural resources caused by the overzealous exploitation of natural resources, including wildlife. At the heart of the NWF's founding was the feeling that natural resources should be utilized, but in a conservative, responsible manner, and that scientific information, and a scientific framework form the foundation of management, recognizing that policy flows from the social sciences and the politics.

We were founded by, and are still made up of, hunters and anglers and consumptive and non-consumptive users of wildlife. As an organization we have enjoyed many of the consumptive and non-consumptive uses of all the wildlife populations in and around the greater Yellowstone area. We are concerned about the controversy and conflict surrounding YNP, not just the charge of this committee but some of the other issues, especially the National Research Council (NRC) investigation of the brucellosis issue, because we see requests to investigate issues through the scientific method and then we frequently see that science ignored in the larger policy decisions when science does not support a preconceived agenda.

We are convinced and absolutely committed to maintaining wildlife and other natural resources as a public trust, not to be managed to the dictates of a single entity. We believe the North American model is the most successful wildlife management system in the world, characterized by a balance of uses, a balance of considerations, a balance of many different interests. And we're very concerned that that balance is not being maintained. I've been asked to speak to our perspective of the ungulate situation in and around YNP and make some recommendations to the committee on some aspects that are particularly of concern to us.

Yellowstone to us, like it is to most of the public, is an area of paradox. Yellowstone has been incredibly vital to the restoration of wildlife all across the West. Yellowstone was the one place where bison were able to find refuge from the carnage of the 1880s and 1890s. Only 23 were left at the turn of the century, but it was here that they remained intact. It is the only herd that has held on continuously since the last Ice Age. Yes, the genetics of the herd have changed, but Yellowstone has served as a refuge.

Elk survived here, too, in meaningful numbers and served as the seed source for elk restoration all across the country. We have elk populations in the West today because elk were not destroyed in Yellowstone. Yellowstone has served as a significant focus for scientific and ecological research, an area where ungulate numbers and movement patterns are less interrupted than they are anyplace else in the lower 48 states. So, Yellowstone is an incredible resource. Yellowstone has provided uncountable days of enjoyment to the public. Hunters in all three GYE states enjoy hunting one of the largest elk herds in the country (outside the park). And visitors to the GYE enjoy viewing wildlife with an ease and a dpendability you can find nowhere else in the lower 48.

But Yellowstone's wildlife have also provided some of the most negative images of hunters, some of the most negative images of hunter behavior, and some of the most unimaginable scenes of wildlife destruction for the public. Of course, I refer to the previous history of reductions inside the park, and firing lines for both elk and bison just at the park boundaries. So the NWF, its 45 affiliated state organizations, and 4 million members and supporters are very concerned about wildlife management actions in and around the GYE. We are looking for ways to maintain the image of wildlife managers in a positive way as ethical, responsible, and sportsmanlike. Hunting in these days is merely tolerated by the public. Hunting is very important to our national history, but hunting in general is a declining recreational activity. We see and will oppose any efforts that will tarnish the image of consumptive users.

How can it be that Yellowstone at once provides all this enjoyment, all this opportunity to visit and observe wildlife, provides consumptive recreational opportunities, and yet at the same time causes such conflict? I don't have to tell you that Yellowstone does not exist in a vacuum. It's at or near its boundaries that the significant issues arise, and it's where functionally we begin to limit its values. Yellowstone is in fact an island, where the needs of wildlife and the ability of the public to see and enjoy wildlife take precedence over other uses that exist over 99.9 percent of the rest of the landscape.

We have a clash in this area between different ways of utilizing the landscape. Areas like Yellowstone are very rare in this country. We've dedicated the vast, overwhelming majority of the country's land mass to commodities production, and right in the middle of this we've plunked a national park and gone to a different style of land management, i.e.,

Elk and bison in the Lamar Valley in Yellowstone National Park. NPS Photo.

protection. Because we recognize that there is value to those wildlife resources, those natural resources, the public's ability to enjoy those resources, and we need places like Yellowstone.

That's not to say that the resources in Yellowstone are not utilized as they are outside the park. Although they're not packaged and sold out of a factory, or made into building materials, they are utilized and they have economic value. And so one of the big concerns to us as a public wildlife advocacy organization is that these boundary disputes with Yellowstone and its neighboring land users, private and public, are manifested by this clash in perception of economic value and political goals. It think its important to keep in mind that the park is as large as it politically could be at the time it was established. The few boundary additions that have occurred since establishment of the park in 1872 were drawn along political lines after political dog fights— "we can tolerate this much and no more." So, every aspect of what Yellowstone is has been political. And now you are charged with the scientific task of evaluating the data, evaluating the information, and coming up with recommendations for more work, more science, answers to specific questions, and, as Fred Wagner said, perhaps some policy recommendations.

We believe the boundary of Yellowstone is the epicenter of the conflict, because we believe that the most fundamental constraint to Yellowstone's wildlife is the intolerance for wildlife outside park boundaries. This intolerance affects migration patterns and other ecological parameters for the wildlife. We understand and believe that the evidence is sufficient to show that the park is not a contained ecosystem for elk or buffalo. If you look at the historical, legal, and Congressional literature you'll see that the Congress always intended for areas outside of the park to be utilized by wildlife migrating from Yellowstone.

It has been at the boundaries that the real and political firing lines have been drawn and those negative public images of hunter behavior have been shown on national TV. This didn't just happen in the 1960s; we're not past it yet. It was repeated in the 1980s to the point where Montana rescinded the ability of the Fish, Wildlife and Parks Department to hold a bison hunt in the state of Montana. Currently, the Montana Department of Livestock (taking their numbers out of the press releases) has hazed since October 500 bison migrating out of the park near West Yellowstone back into the park. Bison management is still under a lot of debate; we don't know how bison are going to be managed outside the park, but it has an effect inside the park. The fact that buffalo are pushed into the park from West, come out at night, are pushed back in, has an effect on the ecology of the grazing resources inside the park. You absolutely cannot separate what happens outside the park from the ecological impacts inside the park. The ability of wildlife to use areas outside the park varies. There's total intolerance for buffalo, especially in Montana.

And there are subtle forces that advocate to diminish or minimize the value of wildlife habitat because there are other resources that need to be extracted for the public benefit, or that wildlife must find another place to move, in order to extract commodities. The NWF doesn't have the luxury of just dealing with wildlife management issues in and around Yellowstone. We're also involved in other issues, too. One of the things that is very disconcerting about the whole debate about Yellowstone and its ungulate situation is that it's been implied through numerous publications that Yellowstone is an area where the wildlife and natural resource management is dirty with politics. These publications proclaim, "If science would prevail, things would be better."

Well, as far as politics is concerned, Yellowstone is not an isolated, unique case where politics rule wildlife management. I've worked for three agencies (two state and one federal), and in my experience the biological potential of wildlife outside YNP in the states that

…We believe that the most fundamental constraint to Yellowstone's wildlife is the intolerance for wildlife outside park boundaries…If you look at the historical, legal, and Congressional literature you'll see that the Congress always intended for areas outside of the park to be utilized by wildlife migrating from Yellowstone.

I've worked in is significantly reduced by the politics of the moment. Just to set the record straight and to dissipate some of the calls that Yellowstone is the only place where the politics in wildlife management is dirty, let's go clear to Colorado. I'll report to you how the elk herd down there is in many places a great concern. Yellowstone is not the only place where the elk population is high. So, the state Division of Wildlife wanted to reduce the elk herd in one particular area where they were getting a lot of complaints by ranchers about elk getting in the haystacks in wintertime. The state's plan was to liberalize the female elk kill. They provided a situation where people could buy over-the-counter, either-sex elk permits for the late season. The very people who were complaining about too many elk in the haystacks, who by then had an outfitter hunt on, sued the state because they thought the overly liberal harvest would hurt their outfitting business.

The state is very interested in reintroducing lynx in Colorado. Lynx are under total state management authority. A decision to reintroduce lynx was made; the state moved forward with a plan to capture lynx in Canada and move them to Colorado. The very people who had been screaming that the federal government has no jurisdiction inside the state regarding commodity extraction and wildlife management in the West sued the state, because they said "You didn't comply with NEPA. You need to go through the Endangered Species Act. We want a nonessential, experimental designation for this lynx population." The judge laughed at them, and threw it out of court. The judge said, "This is a state issue, there is not federal involvement, the very thing you asked for in my court three weeks ago."

Yellowstone is a very special place to people, and people will be involved in resource decisions. That's why the elk reduction program, the firing lines have disappeared. Whatever happens in this park and around it has got to be supported by the public. If you look at the National Environmental Policy Act documents that have come out in the last 10 or 15 years, the NEPA document that has generated record comment from the public was the wolf reintroduction EIS—165 to 170,000 comments by the public. I don't mean to imply those were all in favor of the wolves, but the point is, people get involved when it comes to Yellowstone. The recent bison management EIS generated 65 to 66,000 comments. People care about this park.

Not only does Yellowstone not exist in an ecological vacuum, it does not exist in an economic vacuum. Look at channel 17 on your TV in this hotel…watch how many times they mention wildlife and wildlife observation, not just for people to go to spot "X" in the park and see the elk, but for outfitters, for guides, for concessioners to take people to visit the park. Anything that happens with the wildlife in and around this park affects people's pocketbooks. Montana Governor Racicot, in his charge to the legislature yesterday, said "We've got to reform the tax system. We've got to take more advantage of the visitors that come to Montana; it will help the state."

So, all of this controversy is whirling around, and you have been handed the political hot potato. I think if you do the science, focus on the science and maybe hand-off the sociological ball back to those who gave it to you, you will greatly benefit the debate going on here.

The NWF and groups like it are dedicated to responsible, scientific investigations that lead us to manage our natural resources in the most sustainable manner. We have a very long history of good resource stewardship. We brought wildlife back from the decimations of the 19th century to what we enjoy today. The key to the conflicts in and around Yellowstone is factually based cooperation, not confrontation.

There are natural questions that should come up to this group. I don't believe that you'll be able to come up with definitive answers. I believe you'll be able to point the public in a direction of probabilities, likelihoods, and further-testable hypotheses. A couple of them have already been brought up in the discussion today.

Is there a role for climate change in what's going on here? Is it a significant factor or is it insignificant? I've read a lot of literature, including the new *Science* article that came out of work at Colorado State University (CSU) that shows a decline in blue grama on the Pawnee National Grasslands as a consequence of the increase in average annual temperature documented over the last 60 years—the same time frame we're looking at here.

A lot of people are concerned, happy, mad as hell about wolves being in Yellowstone. There are questions about the impacts of wolves. I think it's bigger than just wolves. We have significant recovering predator populations in and around this area. Mountain lions, black bears, grizzly bears are increasing in numbers compared to the recent past. We obviously have wolves here; their numbers are increasing and they're having an effect on the coyote population. What is the effect of this new, more complete guild of predators, not only in species composition, but in numbers compared to the situation over the last 100 years?

And you're going to find some gaps. Recommend ways that we can fill those gaps. There are some mysteries out there, and I think we have in Yellowstone the opportunity to solve some of those mysteries that will give us information and valuable insight, not just for this ecosystem but for other areas in the intermountain West.

If there is a desire on the part of the committee, or if you don't feel your charge is complete unless you make some kind of policy recommendation, we would simply ask that you put it all on the table. Recognize that Yellowstone is an island, that the boundaries are political. Is there any merit to the "buffer zone" concept that the previous NRC committee advocated for lands surrounding Yellowstone?

I suggest that you write up your findings in a way that is understandable to lay people, because your report is going to be read by many, many people in a lot of different disciplines. And unless the data are unambiguous to a reasonable confidence interval, your interpretations should also be written in a way that lay people can understand.

The most important aspect of your debate, for the NWF and many other public interest groups, is that the science does come to bear, but we recognize that how scientific decisions are implemented is in the public arena. It's important, I think politically, for all of us to be careful what we ask for.

Yellowstone National Park Employees Receive Awards

Two Yellowstone National Park employees recently received prestigious National Park Service (NPS) awards.

Tim Hudson, Chief of Maintenance, received the Director's Award for Excellence in Natural Resource Stewardship through Maintenance for 1999. Hudson has been instrumental in implementing a wide variety of sustainability improvement projects under the banner, the "Greening of Yellowstone." Projects include recycling, composting, use of cleaner fuels and lubricants, and use of less toxic cleaning materials. He has worked closely with other federal, state, and local governments and private entities in the greater Yellowstone area to explore and implement more environmentally-friendly methods for conducting business.

Mona Divine, Assistant Chief Ranger, received the Harry Yount Award for the Intermountain Region. The award honors those rangers who have demonstrated an overall excellence in service and leadership abilities, excelled in traditional ranger duties and skills, and are dedicated to the ranger profession and the National Park Service. Ms. Divine was selected for the award because of her accomplishments in the field of traditional as well as modern ranger skills, her dedication to resource protection, and for the inspiration and guidance she provides to park staff and the public in her daily conduct.

USGS Scientist Receives Award for Brucellosis Research in Greater Yellowstone

U.S. Geological Survey scientist Dr. Thomas J. Roffe recently received the Department of the Interior's Superior Service Award during a recent meeting of the Greater Yellowstone Interagency Brucellosis Committee. According to the citation, Roffe's leadership of the Department of Interior's brucellosis research program since 1995 resulted in a long-needed dedicated program focused on resolving the issue of brucellosis in Greater Yellowstone Area wildlife.

Bison and elk in 27 separate herd units in the Greater Yellowstone Area are affected by brucellosis, a disease that can cause cattle and wildlife to abort their first calves following infection. The issue has national and international significance because of expensive *brucellosis* eradication programs in the United States and many other countries. After millions of dollars of research since 1934, the nation is now on the verge of completing brucellosis eradication in cattle.

Soon, elk and bison in Greater Yellowstone will be the only reservoir for potential re-infection of livestock. Consequently, states and countries that have successfully eradicated the disease may require extensive testing or forbid import of cattle from Montana, Wyoming and Idaho. Controlling and eliminating a disease in free-ranging wildlife distributed over an immense area will not be easy. Roffe is exploring the potential for eradicating brucellosis in wild elk and bison through a brucellosis vaccine.

"Tom Roffe designed and helped implement some of the first statistically valid experiments to determine both the effectiveness and safety of cattle brucellosis vaccines in elk and bison," said Dr. Chip Groat, Director of the U.S. Geological Survey. Groat said that "solid and sound" information resulting in more accurate wildlife disease transmission models is the result of Roffe's other research, done in collaboration with other agencies, on how brucellosis originates and develops, as well as on the epidemiology of the disease in free-ranging bison (that is, the incidence, distribution and factors related to disease in a population. Before Roffe's research, scientists had to use less reliable cattle data to model how the disease might work in free-ranging bison.

NPS Announces Plan to Strengthen and Revitalize Natural Resource Programs

On August 12, 1999, NPS Director Robert Stanton announced a major effort to substantially improve how the NPS manages the natural resources under its care. The Natural Resource Challenge: The National Park Service's Action Plan for Preserving Natural Resources addresses the challenges of caring for our country's natural heritage within the complexities of today's modern landscapes.

NPS Historian Richard West Sellars' 1997 *Preserving Nature in the National*

Parks: A History (featured in Yellowstone Science, Vol. 6 (2)) brought attention to the challenges threatening natural resource preservation, such as urban development, habitat destruction, non-native species invasions, and air and water pollution–things that could not have been imagined by the early pioneers of the National Park System–and inspired the Service to develop this renewed commitment to preserving America's natural heritage.

The 5-year strategic action plan emphasizes that the NPS will make resource preservation and conservation an integral consideration in all management actions the agency undertakes, while maintaining if not improving the outstanding recreational and educational experiences embraced by park visitors. The plan calls for substantially increasing the role of science in decision-making, revitalizing and expanding natural resource programs, gathering baseline data on resource conditions, strengthening partnerships with the scientific community, and sharing knowledge with educational institutions and the public. It specifically addresses habitat protection for endangered and native species, targeting non-native species for removal, inventorying natural resources and monitoring their condition, monitoring air and water quality, collaborating with other natural resource experts, and using parks as scientific laboratories and classrooms.

Specific actions to be taken immediately include implementing an environmental leadership program to reduce the impact of park operations on the natural environment, implementing a new and uniform scientific research and collecting permit process, merging resource preservation into mainstream park planning, and establishing a Sabbatical-in-Parks program for visiting scientists.

The President's FY 2000 budget includes nearly $20 million in increases that would help complete natural resource inventories so that park managers have critical baseline data available for informed decision making and increase funding for large-scale preservation projects, restoration of threatened and endangered species and restoration of areas damaged due to human disturbance. Future budget requests will increase park base-funding, expand the air quality monitoring network, establish water quality monitoring stations in 75 park units, and enhance NPS capability to prevent and prosecute resource crimes such as poaching.

World's Fastest Bird No Longer Endangered

The peregrine falcon (featured in *Yellowstone Science*, Vol. 6 (2)) was removed from the endangered species list on August 20, 1999. In announcing the decision, the U.S. Fish and Wildlife Service noted one of the most dramatic success stories of the Endangered Species Act.

Peregrines once ranged from the subarctic boreal forests of Canada to Mexico and even today migrate to Latin and South America for the winter. A massive population decline was attributed largely to the use of DDT and other pesticides earlier in this century. The falcon, which can dive at speeds of 200 mph, was listed as endangered in 1970 and in 1975 only 324 nesting pairs were found in North America. In Yellowstone and other locations across the continent, efforts to ban DDT and, subsequently, to restore captive-born peregrines resulted in the speciesí remarkable recovery. Currently there are at least 1,650 breeding pairs of birds in the U.S. and Canada. Although no longer endangered, peregrine falcons, their eggs, parts, and nests will continue to be protected from unauthorized killing, possession, transportation, and importation by the Migratory Bird Treaty Act. Also, the species will continue to be monitored across the nation for the next 13 years to provide data on at least two generations of peregrines and ensure that the bird is doing well after being delisted.

Park Partners Begin New Remote Sensing Project

The NASA Stennis Space Center and Yellowstone Ecosystem Studies (Y.E.S.) of Bozeman recently initiated a joint project to evaluate how two new remote sensing instruments might be used for various ecological applications. Researchers from NASA, Y.E.S., and Montana State University (MSU) will compare imagery from the new sensors, used in conjunction with hyperspectral imagery data, with other data sets of Yellowstone National Park. One of the sensors, a radar instrument called AirSAR (developed at NASA's Jet Propulsion Laboratory), has high potential for mapping in areas that are often obscured by clouds. The other sensor is a Stennis scanning device called ATLAS, which has 15 channels that operate in the visible through the thermal-infrared wavelengths. Fieldwork began this summer; researchers hope the new technology will help answer questions pertaining to streams, wildlife habitat, and forest health.

Yellowstone Hires New Staff Geologist

After a lengthy search, Yellowstone is pleased to announce that Dr. Paul Doss will join the park staff as a supervisory geologist in charge of the park's physical sciences program. Doss is currently Chairman of the Department of Geology at the University of Southern Indiana in Evansville. He completed his Ph.D. through Northern Illinois University at Indiana Dunes National Lakeshore, where he studied the physical and chemical dynamics of the hydrogeological system in wetlands along the southern shore of Lake Michigan. His scholarly expertise and interests include surficial and shallow hydrogeologic systems and process geomorphology. As a member of the summer faculty for the Indiana University Geologic Field Station, he has conducted teaching and research activity on the Beartooth Plateau, the Absaroka Range, and the Yellowstone Plateau and calderas. Paul has also volunteered at Everglades National Park and his wife, Heidi, has worked as an interpretive ranger at Indiana Dunes. They plan to relocate to Yellowstone permanently in June 2000.

DNA Analysis Assists Grizzly Bear Managers

A 180-pound subadult (2 to 3 years old) male grizzly bear from Yellowstone was recently transferred to the Wildlife

Sub-adult grizzly bear (dubbed "Kelty" because of his preoccupation with tents). Photo taken in the holding facility at the Grizzly Discovery Center before his transfer to the Wildlife Way Station of Sylmar, California. Photo by Kerry Gunther.

Way Station of Sylmar, California. The bear first came to the attention of park staff in late June when it entered the Indian Creek Campground, brushed against a couple of tents, and damaged a third. Other incidents occurred in July and August, resulting in damage to a total of six tents were damaged—four in the front country and two in the backcountry. Several unsuccessful attempts were made to capture the bear before success was finally achieved when a decoy tent was set up next to the trap; after the bear stepped on, tore, and crushed the tent, it entered the trap. The bear was deemed a danger to public safety and was not considered suitable for release back into the wild. The grizzly was temporarily held at a commercial facility while the park and the U.S. Fish and Wildlife Service (USFWS) searched for possible new homes for the bear. After the necessary permits were granted from the California Game and Fish Department and the USFWS, staff from the Wildlife Way Station picked up the bear on September 27, 1999.

Although the animal was caught weeks after his last alleged offense, there is little doubt that the subadult bear was the offender. DNA testing on bear hair obtained from the incident sites, done at the University of Idaho, matched the DNA of the captured bear. The chance of a genotype match with any other grizzly bear in the park was approximately 1 in 21,000; the estimated grizzly bear population in the Yellowstone ecosystem is approximately 600 bears. The development of DNA fingerprinting technology was made possible because of an enzyme named Taq polymerase, initially isolated from the microorganism *Thermus aquaticus*, which was first discovered in one of Yellowstone's thermal pools. The use of the Taq enzyme in the polymerase chain reaction process for DNA fingerprinting gives biologists the ability to make multiple copies of genes from DNA within living cells, making identification of individual animals possible. It is ironic that a biological test with origins in Yellowstone (and now used in medicine, law enforcement, and biology worldwide) can now be used in routine park management activities.

Ultralight Whooper Found Dead

In late August, the USFWS recovered the carcass of a whooping crane that had been part of an experimental effort to teach the birds to migrate; the crane had summered in Yellowstone in 1998. Whooping crane #35 was part of Kent Clegg's ultralight aircraft journey from southeastern Idaho to Bosque Del Apache National Wildlife Refuge in New Mexico in 1997 (featured in *Yellowstone Science* Volume 7 (1)). The bird was attacked by an eagle in Colorado during the southward migration, tended to by a veterinarian and trucked to New Mexico where it survived the winter of 1997-98. It migrated north to the Colorado-Wyoming border where it was captured by Clegg, transported to Yellowstone on May 1, 1998, and summered in the park before returning on its own to Bosque del Apache the following autumn. In March 1999, two survivors of the ultralight experiment flew north, but crane #35 apparently stopped in Rich County in northeastern Utah. When found, its scavenged carcass left little evidence of the crane's cause of death.

New Publications Available About Yellowstone Resources

Several publications produced by or about Yellowstone National Park may be of interest to readers. Papers produced as an outgrowth of the park's Fourth Biennial Science Conference, held in 1997, include "Eliminating the 'Human Experience' in Grand Teton National Park," an opinion piece by Robert W. Righter, published in the summer 1999 issue of *Annals of Wyoming.*

The George Wright Forum (Volume 15 (4), 1998) featured four papers related to historical perspectives on science and management in Yellowstone, introduced by guest editors Susan Rhoades Neel and Paul Schullery: "Preserving the Beast of Waste and Destruction: Theodore Roosevelt and Predator Control in Yellowstone National Park," by Jeremy Johnston; "Charles C. Adams and Early Ecological Rationales for Yellowstone National Park, 1916-1941," by James Pritchard; "The War Against Blister Rust in Yellowstone National Park, 1945-1978," by Katherine C. Kendall and Jennifer M. Asebrook; and "A Public Face for Science: A. Starker Leopold and the Leopold Report," by Kiki Leigh Rydell.

The *Yellowstone Wolf Project, Annual Report 1998* has been completed; limited copies may be available from the Yellowstone Center for Resources. The report may also be viewed in its entirety on the World Wide Web at http://www.nps.gov/yell.