TESTIMONY BEFORE THE U.S. HOUSE OF REPRESENTATIVES SUBCOMMITTEE ON NATIONAL PARKS AND PUBLIC LANDS OVERSIGHT HEARING ON SCIENCE AND RESOURCE MANAGEMENT IN THE NATIONAL PARK SYSTEM

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I would first like to thank the Chairman and the Committee for inviting me to testify here today. I have a B.S. in Wildlife Biology and a M.S. in Environmental Studies both from the University of Montana, and a Ph.D. in Wildlife Ecology from Utah State University. I am presently an Adjunct Assistant Professor in the Department of Political Science and a Senior Environmental Scholar at that University's Institute of Political Economy. I am the only independent, independently funded scientist to have conducted a detailed evaluation of Yellowstone National Park's "natural regulation" management program. Not only have I conducted scientific research on the elk overgrazing question, but I have also studied wolf recovery, grizzly bear management, the bison problem, and other key issues in that ecosystem. I have also traveled widely throughout the West and am familiar with similar resource management problems in other national parks. Moreover, I have conducted extensive research on long-term ecosystem states and processes in the southern Canadian Rockies for Parks Canada. This included work in Banff, Yoho, and Kootenay National Parks.

My research in Yellowstone and Canada has been widely published in books and scientific journals and I have submitted copies of those papers to the committee's staff. In addition, GAO is presently investigating the Yellowstone situation and I have submitted copies of my research to that agency as well. Moreover, I have volunteered to take GAO on a field tour of my study sites in Yellowstone next summer.

As you know, Yellowstone is presently managed under what is termed "natural

regulation." This, though, is more than simply letting nature take its course for it entails a specific view of how nature operates. According to the Park Service, predation is an assisting but nonessential adjunct to the regulation of elk and bison populations. Instead, ungulates are limited by their available forage supply- -termed resource or food-limited. In other words, the Park Service contends that ungulate populations will self regulate without overgrazing the range. This means that if wolves are present, they will only kill animals slated by nature to die from other causes and thus, would not lower the elk population. In the debate over wolf recovery, the Park Service has adamantly denied that wolves are needed to control elk or bison numbers in Yellowstone Park. Instead, under "natural regulation," elk and bison die from starvation, and according to the Park Service, thousands of animals starving to death is natural.

Now, the Park Service is fond of saying that it has 3 million dollars worth of research which supports "natural regulation." Unfortunately, most of those studies have not directly tested "natural regulation" and have largely been a waste of taxpayer's money. Furthermore, the Park Service has refused to fund research that may prove "natural regulation" wrong and they have generally awarded contracts only to people who produce results that support agency management. In the rare circumstance where a contractor has produced a report critical of park management, he has never received additional funding and his credibility has been attacked by the agency. In the equally rare circumstance where Park Service employees have dared challenge established agency dogma, they have been reassigned, force transferred, or suffered disciplinary action. The next witness, Dr. Richard Keigley, can address these points in detail since he has been the subject of internal agency harassment.

There is also the question of how the Park Service has awarded contracts to non-agency, supposedly independent biologists. Information on who applied for these contracts and how they were awarded is supposed to be available to the public. But when an associate and I filed a Freedom of Information Act (FOIA) request on three specific contracts, we were told the information was not available for public review, because the agency had given that money to the University of Wyoming and then the University, not the agency, technically awarded those contracts. And as we were told by a University Vice-President, the University does not have to comply with FOIA requests. This raises the question of why the Park Service chose to follow a procedure that hid the awarding of these research contracts from public review. At least two of the biologists who received those contracts have been repeatedly funded by the Park Service, and have since produced a series of reports favorable to the agency. In my opinion, this certainly does not qualify as an independent test of "natural regulation" management.

The Park Service's data supporting "natural regulation" is suspect because it cannot be replicated. A case in point is aspen, which has declined by more than 95%

since Yellowstone Park was established. The Park Service has attributed that decline to the lack of lightning-caused fires which the agency claims are necessary to regenerate aspen--fire kills the old trees but then the aspen clone's roots send up a profusion of suckers, a process termed root suckering (aspen clones have not regenerated from seed for several thousand years due to the species' demanding seed bed requirements).

According to the Park Service, Yellowstone's aspen would successfully regenerate--defined as producing new stems greater that 6 feet tall--if those stands were burned. In fact, agency scientists have claimed for twenty years that their data proves burned aspen will regenerate in the park despite repeated elk browsing. They claimed to be stating a proven fact, not a hypothesis.

An independent test of the Park Service's claims was provided when Yellowstone's 1988 wildfires burned approximately one-third of the aspen on the park's northern range. After the fires, I established 765 permanent plots in burned aspen stands. Despite initial aspen sucker densities of over 50,000 stems per acre, I found that elk and other ungulates repeatedly browsed all those stems to within inches of the ground and prevented height growth. In fact, several clones have now been completely killed-out by repeated browsing. How then, could it be a "proven fact" for nearly twenty years that, if burned, Yellowstone's aspen would successfully regenerate despite abnormally high elk numbers? Clearly, there was something wrong with the agency's earlier "data." As it turns out, burning plus grazing are the worst things that can happen to the park's aspen.

The Park Service has not responded by rejecting "natural regulation" even though it is now clear an underlying part of that hypothesis has been falsified. Instead, the agency has proposed a new hypothesis. They now claim that aspen was historically rare in the park so the decline of aspen is evidence that "natural regulation" is returning the park to its natural state.

I and my co-workers tested this new hypothesis last summer. We used the same procedures the Park Service reported it had used to collect samples from aspen clones and we collected our samples in the same areas used by the agency. We then sent our samples to an independent laboratory for analysis in a blind test. That is, the laboratory did not know where the samples had been collected or the hypothesis being tested. Thus, this was a truly scientific test of the Park Service's new hypothesis. We were unable to confirm the Park Service's new hypothesis. In fact, our data produced results entirely different from those obtained by the agency. Simply put, we could not replicate the data reported by the agency even though we used the same methods and techniques in the same study areas.

In science, if the same experiment or test is repeated, all the various data sets

must support the same conclusion or the hypothesis must be discarded. Our data suggest that the Park Service's new hypothesis is, at best, suspect and does not absolve "natural regulation" management of aspen's continued decline in the park.

The Park Service has also systematically attempted to suppress the publication of research that does not conform to the agency's "natural regulation" management of the park. After the U.S. Forest Service and other public agencies spent several hundred thousand dollars on a moose study inside and outside Yellowstone Park, the publication of that research was blocked. The official explanation is that the Forest Service does not have sufficient funds to publish the final report, but I suspect the real reason is that work does not support "natural regulation" management- -please see Attachment B for details.

After I published an article critical of park management, representatives of the Department of Interior repeatedly called the University and asked them to fire me. They also repeatedly called Parks Canada, for whom I was conducting ecological research at the time, and asked them to fire me. Both refused. Then they called my Department Chairman and informed him that my research was endangering the lives of their people in the field because, and this is an exact quote, based on what I had written "those neo-Nazis in Montana were going to start shooting government officials." My "crime" Mr. Chairman, was to have published an independent analysis of wolf recovery in the park and other areas of the northern Rockies.

Having admitted to spending at least 3 million dollars of taxpayer's money on research in Yellowstone, you would think that the Park Service would have a detailed study plan of how all that work was designed to formally test "natural regulation" management. That, though, turns out not to be the case. In 1989, for instance, the Department of Interior's Inspector General conducted an audit of natural resource research in Yellowstone and three other national parks. The Inspector General found that "Yellowstone National Park did not have study plans for 23 of 41 research studies performed by its research staff. In addition, the study plans that existed for the other 18 research studies were generally deficient with respect to content." As the Inspector General pointed out, study plans are needed to ensure that research is conducted efficiently. The only time the Park Service has told the public exactly what is meant by "natural regulation," and laid out a detailed plan for its study, was 1971, and the agency subsequently never followed its own study plan. Instead, I am the only scientist who has systematically tested "natural regulation" management.

Alston Chase has called "natural regulation" a scientific fraud and from my own detailed measurement of vegetation in Yellowstone Park, I can say that I have found no evidence to support the "natural regulation" paradigm. Instead, all my data indicate that "natural regulation" must be rejected as a valid scientific explanation of the natural world.

As you know, riparian management has recently been a hot political topic in the West, with environmentalists blaming ranchers for overgrazing these critical habitats. So, as an example of what "natural regulation" means on the ground, let us look at the condition and trend of willow communities on Yellowstone's northern range- -please see Attachment A for additional details and references. Now if "natural regulation" management represents the epitome of land management, as claimed by the Park Service and various environmental groups, then surely Yellowstone's riparian areas should be in excellent condition.

To test this part of the "natural regulation" paradigm, I (a) measured willows inside and outside the park; (b) measured willows inside and outside long-term ungulate-proof fenced plots, called exclosures, on Yellowstone's northern range; (c) measured willow seed production inside and outside park exclosures; and (d) compiled repeat-photographs to measure long-term vegetation change.

Based on 44 repeat photosets of riparian areas on the northern range, tall willows have declined by more than 95% since Yellowstone Park was established in 1872. In 28 repeat photosets outside the park, tall willows had not declined, but, if anything, had increased. That these differences are due to excessive browsing by Yellowstone's burgeoning "naturally regulated" elk population, not other environmental factors as postulated by the Park Service, is shown at the park's exclosures.

On permanent plots outside exclosures, willows averaged only 13 inches tall, had only 14% canopy cover, and produced no seeds. In contrast, protected willows averaged nearly 9 feet tall, had 95% canopy cover, and produced over 300,000 seeds per square meter of female canopy cover- -in willows there are separate male and female plants. Not only are Yellowstone's willow communities severely overgrazed, but they are among the most overgrazed in the entire West. This has had a devastating effect on riparian songbirds and other animals.

Beaver, for instance, were once common in the park but that species is now ecologically extinct on the northern range because overgrazing by an unnaturally large elk population has eliminated the aspen, willows, and cottonwoods beaver need for food and dam building materials. Without beaver in the system, park streams have down cut, which has lowered water tables and destroyed more riparian vegetation. Beaver is also a critical keystone species whose loss has seriously reduced park biodiversity.

The roots of willows, aspen, and cottonwoods are also critical in maintaining streambank stability, and as elk have eliminated these woody species, this has produced major hydrologic changes. Dr. David Rosgen, one of North America's leading hydrologists, for instance, reported 100 times more bank erosion on

Yellowstone's denuded streams than on the same willow-lined streams outside the park.

Last summer, I took Dr. William Platts, one of the West's leading riparian experts, and Dr. Robert Beschta, a hydrologist at Oregon State University on a three-day field tour of sites inside and outside Yellowstone Park. What they saw shocked them. After looking at one stream that had blown out and eroded down to Pleistocene gravels, something that has not happened in 12,000 years- -all because the elk had destroyed the woody vegetation that once protected the stream banks, these experts declared that if you gave them a billion dollars they could not put the system back together again. This then is the type of resource damage that has occurred under "natural regulation" management. I submit that not only must "natural regulation" be rejected, but that what has happened in Yellowstone is a clear violation of the park's Organic Act, the Endangered Species Act (see Attachment B), and other federal legislation.

The Park Service, however, has responded by producing a series of research studies that blame these problems on factors other than "natural regulation" management. However, bad science leads to bad policy, and if you do not follow proper scientific procedures, or don't measure the correct variables, or don't have a large enough sample size, what you invariably get is junk science.

Elk-induced soil erosion has long been a concern in Yellowstone, but the agency claims recent research has proven that the park's burgeoning ungulate populations have not caused accelerated soil erosion. A careful review of the Park Service's data, however, shows that not to be true.

In their work, the Park Service used a simulated rainfall machine to measure soil erosion inside and outside Yellowstone's long-term grasslands exclosures. The rainfall simulator was set at the rate of one inch per hour and was run for 15 minutes on a 26X26 inch square plot. This automatically biased the study, though, because it is standard scientific practice to use a rate of 2.5 inches per hour for 15 minutes. A lower simulated rainfall rate automatically guarantees less soil erosion.

The Park Service then measured soil erosion on five outside plots and five inside plots per exclosure and found that there was more erosion on outside plots, which have a long history of heavy elk use, than on inside plots, but reported that difference was not statistically significant. Yellowstone's superintendent then publicly proclaimed the agency's research had proven there was no accelerated erosion in the park. That, though, is incorrect, as the Park Service grossly misrepresented the results of their research.

To statistically compare the average amount of soil eroded from inside versus

outside plots, the samples' variances are used. If those variances are high, as they invariable are in soil work, and sample size is low, like say only five samples, then God himself could not generate statistical significance. So while it is true that statistically the agency's data showed no increased soil erosion on grazed plots at each exclosure, that does not mean elk have not caused widespread soil erosion in the ecosystem.

This is what mathematicians call a Type II error- -concluding that there is no significant difference, when in fact there is. To correct for this problem, the Park Service should have measured more plots inside and outside each exclosure, but it did not- -I suspect because those data would have embarrassed the agency. However, if you combine that study's original data inside and outside all the exclosures that were measured, which effectively increases sample size, then the agency's data shows significantly more soil erosion from heavily grazed sites. When it rains, I have watched mud flow off Yellowstone's hillsides and it is not uncommon to find exposed tree roots in the park.

The Park Service, however, continues to deny that Yellowstone is overgrazed, or that if it is, "natural regulation" is to blame. The agency, though, has not been receptive to independent review of its "natural regulation" program. In the early 1990s, the Society for Range Management, the Ecological Society of America, the American Fisheries Society, and the Wildlife Society asked the Park Service for approval to conduct an independent review of the Yellowstone situation, but they failed to obtain permission. More recently, a group of preeminent ecologists informed the Secretary of Interior that they would be willing to serve, without pay, on a panel to review the entire Yellowstone matter, but the Secretary declined.

Now if the Park Service has nothing to hide, and actually has the research to support its claims regarding "natural regulation," why then have they not welcomed an independent review of Yellowstone's management? If, on the other hand, as I have argued, "natural regulation" is the greatest threat to Yellowstone Park, then it is easy to see why the agency attempts to prevent Congress and the American public from knowing the truth. In my opinion "natural regulation" is also a failed environmental philosophy, which explains why environmental groups such as the Greater Yellowstone Coalition have largely ignored the resource damage that has occurred in the park (please see Attachment A for details).

Moreover, this problem is not confined to Yellowstone but is endemic throughout our National Parks System. Dr. Carl Hess, for instance, has documented how "naturally regulated" elk have overgrazed Colorado's Rocky Mountain National Park, while Dr. William Bradley documented the negative impacts abnormally large elk populations are having on subalpine meadows in Washington's Mount Rainier National Park. Similarly, "naturally regulated" elk populations have had a dramatic impact on understory species composition and tree regeneration in Washington's Olympia

National Park. While in New Mexico's Bandolier National Monument, elk-induced soil erosion is threatening that park's archaeological resources.

The simple truth is that ungulate populations will not internally self-regulate before those animal's have had a serious impact on the vegetation. Now, wildlife biologists often cite Africa's Serengeti as an example of how North America must have looked before it was despoiled by Europeans. The Park Service, in fact, has not only claimed that Yellowstone National Park is the last remnant of North America's Serengeti, but the agency has actively recruited Serengeti scientists to support "natural regulation" management. Today's Serengeti, however, is not a natural ecosystem, nor is it a vignette of "wilderness" Africa. Instead, the Serengeti is a romantic, European, racist view of how "primitive" Africa should have looked, for one of the first things that Europeans did when they created Serengeti and other African national parks was to forcefully remove all the indigenous peoples. For various reasons, colonial governments did not want black Africans in their white national parks.

Now, there have been hominoid predators in Africa for at least 3.5 million years, and our species, Homo sapiens, evolved in Africa 100,000± years ago. Thus, I submit that there is nothing more unnatural than an African ecosystem without hominoid predators and the Serengeti, therefore, is not a "natural" ecosystem nor is it an example of how North America teemed with wildlife before the arrival of Columbus.

In all the ecological studies that have been done on the Serengeti, native people have generally not even been mentioned, or if they have, it has invariably been as "poachers," in the pejorative sense. Based on recent modeling, it has been suggested that Serengeti's wildlife populations will collapse if present levels of "poaching" increase by as little as 10%. While others may view this as "poaching," I suggest that this is a case of native people, who are simply exercising their aboriginal rights.

As I have documented elsewhere, elk and bison never historically overgrazed Yellowstone or other National Parks because native hunting kept ungulate numbers low. That is to say, hunting by Native Americans actually promoted biodiversity. Giving Yellowstone's bison additional areas to roam outside the park, for instance, will never solve the bison problem. For under "natural regulation," bison numbers will simply increase until the starving animals again move beyond whatever boundary has been set.

Thus, I respectfully offer the following recommendation for Congress' consideration:

(1) Congress should mandate an independent park science program. This is the same conclusion that has been reached by every panel that has ever reviewed Park Management. Since the Park Service has never followed any of those

recommendations, I submit that Congress must legislate the needed changes, for the agency has repeatedly demonstrated its refusal to comply with anything less. Because of the politics in Yellowstone, I also suggest that Congress appoint an independent panel of eminent scientists to set priorities for park research and to review/approve competitive research proposals for funding, similar to what the Bureau of Land Management did with wild horse and burro research.

(2) In addition, I suggest that Congress appoint an independent commission to review "natural regulation" management and park science in Yellowstone. What I am asking is for a fair impartial hearing of the available evidence, which after all is the American way. If we cannot straighten out Yellowstone, Mr. Chairman, there is little hope for the rest of our national parks.

(3) Furthermore, I would suggest that if you want independent scientists to critically evaluate various aspects of park management then Congress must establish a mechanism to directly fund that research. This need not come from new appropriations but from a reapportionment of existing funds. Money, after all, may be the root of all evil, but it is also the root of all science. Without adequate funding there will be no independent evaluation of park management.

(4) And finally, I invite you Mr. Chairman and others on your committee to personally tour Yellowstone with me this coming summer. At least one U.S. Senator has already asked me to accompany him on a fact finding tour of the park's northern range. It is quite an educational experience to be standing on a site and to be handed a photograph of how that area looked back in 1871. I wager, Mr. Chairman, that you will never view park management in the same light again.

We simply need an impartial review of the available evidence. For Mr. Chairman, if we can not agree on the science, then we surely can never reach agreement on how our National Parks should be managed to insure that they will be unimpaired for future generations of Americans.

Quite honestly, Mr. Chairman, based on what I know about "natural regulation" management, if I wanted to protect an area, the last thing I would do would be to make it a national park, and the next to last thing I would do would be to turn it into a wilderness area. I believe that our natural resources should be protected and America's heritage preserved, but that management should be based on the best available science, not on romantic, often religious, views of nature.

Thank you for your time and consideration.

SCIENCE AND RESOURCES MANAGEMENT IN THE NATIONAL PARK SERVICE

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL PARKS AND PUBLIC LANDS

OF THE

COMMITTEE ON RESOURCES
HOUSE OF REPRESENTATIVES

ONE HUNDRED FIFTH CONGRESS

FIRST SESSION

ON

RESEARCH OF OUR NATIONAL PARKS TO DETERMINE THEIR CONDITION, TO ADDRESS ANY THREATS TO PARK RESOURCES, AND DETERMINE THE BEST SCIENCE AND RESOURCES MANAGEMENT POSSIBLE

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ATTACHMENT A

DO LIVESTOCK OR WILD UNGULATES HAVE A GREATER IMPACT ON RIPARIAN AREAS?

A COMPARISON OF WILLOW COMMUNITIES ON THE U.S. SHEEP EXPERIMENT STATION AND IN YELLOWSTONE NATIONAL PARK - -

OR WHY WE NEED AN INDEPENDENTLY FUNDED PROGRAM TO REVIEW PARK SCIENCE.

Testimony presented at the Oversight Hearing on Science and Resource Management in the National Park System held by the U.S. House of Representatives Subcommittee on National Parks and Public Lands, February 27, 1997.

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INTRODUCTION

In 1922, 16,645 acres along the Continental Divide in the Centennial Mountains of southwestern Montana were withdrawn from the Public Domain and transferred to the U.S. Sheep Experiment Station headquartered in Dubois, Idaho. Elevations in the Odell (12,885 A) and Tom (3,760 A) drainages range from 9,800 feet on Slide Mountain to 7,000 feet along the lower reaches of Odell Creek. After leaving the Sheep Station, Tom and Odell Creeks flow through Bureau of Land Management (BLM) acreage, and then private lands, before entering Red Rock Lakes National Wildlife Refuge and emptying into Upper Red Rock Lake.

Two bands, each of approximately 2,000 ewes and lambs, now graze the two allotments in Odell Creek and the one allotment in Tom Creek for 60 days in July and August under rest-rotation management. In the past, however, when the Station had three bands of sheep, each allotment was grazed every year. Coniferous forests cover nearly 65% of the area while montane and subalpine grasslands (20%) and perennial tall-forb communities (15%) produce most of the forage. The Centennial's tall- forb communities are climax and do not represent retrogressive plant succession (Ecret 1986).

The Station's Centennial summer range has been grazed by domestic sheep since 1922, but cattle have never been permitted. Elk (Cervus elaphus), moose (Alces alces), and mule deer (Odocoileus hemiouus) also use the Sheep Station's summer range. Deep snow, however, forces all but moose to migrate to distant lower-elevation wintering areas in Montana or Idaho (BLM 1990).

Yellowstone National Park (2.2 million acres) was set aside as our nation's and the world's first national park in 1872. Park administrators originally thought there were not

enough game animals so they killed predators and fed wintering elk, bison (Bison bison), and other wild ungulates. By the late 1920's, however, concerns grew that the unnaturally large elk population was severely overgrazing the park, and in particular Yellowstone's northern winter range. In fact, the National Park Service was so convinced elk were destroying Yellowstone that from 1949 to 1968 rangers shot over 13,500 elk to reduce the northern herd. Under mounting political opposition, though, the Park Service abandoned its control program in 1968 and by the early 1970's had switched to "natural regulation" or "hands-off" management (Kay 1990).

Under "natural regulation," predation is an assisting but non-essential adjunct to the regulation of ungulates through density-dependent homeostatic mechanisms; i.e., the animals will self-regulate without destroying the range. Elk and other wild ungulates are limited by food, and according to the Park Service, thousands of animals starving to death is natural. If wolves (Canis lupus) or other predators are present, they would only kill animals slated by nature to die of other causes and would not limit or lower ungulate numbers. In the current debate over reintroducing wolves to Yellowstone, the Park Service has never said wolves are needed to control the elk herd, and in fact, that agency and the U.S. Fish and Wildlife Service adamantly deny that wolves will have any significant impact on Yellowstone's game populations (Kay 1996).

The Park Service also denies that Yellowstone was ever or is now overgrazed (Houston 1982, Despain et al. 1986). Today, the agency contends that large numbers of elk (12-15,000+) have wintered on the park's northern range for the last 8-10,000 years and that those animals have been in equilibrium with Yellowstone's plant communities. According to the Park Service, any recent (1872-1990) vegetation changes are due primarily to suppression of lightning fires, normal plant succession, or climatic change, not

ungulate grazing (Singer et al. 1994). The agency also steadfastly maintains that Yellowstone's elk have not competitively excluded sympatric herbivores, such as smaller ungulates or beaver (Castor canadensis) (Kay 1990).

Both the U.S. Sheep Experiment Station and Yellowstone National Park are part of what is termed the Greater Yellowstone Ecosystem (see Figure 1) (Tixier 1986). National and regional environmental groups, such as the Greater Yellowstone Coalition (GYC), not only support "natural regulation," "hands-off," "let-nature-take-its-course" management, but would like to extend that program to other lands in the ecosystem (Harting and Glick 1994). Those same environmental groups, though, would like to see livestock grazing reduced or eliminated, because they claim cattle and domestic sheep are overgrazing the range and damaging sensitive riparian areas (Harting and Glick 1994). In fact, GYC has called for closure of the U.S. Sheep Experiment Station because it contends that sheep have overgrazed the Station's Centennial summer range causing massive erosion (GYC 1986, Lewis 1993). Soil erosion is claimed to be so bad that it, via Tom and Odell Creeks, has filled in Upper Red Rock Lake miles below the U.S. Sheep Experiment Station (BLM 1990).

As studies throughout the West have demonstrated, riparian areas, and especially willow (Salix spp.) communities, can easily be damaged if livestock are improperly managed (Platts 1991). So if the U.S. Sheep Experiment Station's summer range has been overgrazed, riparian areas in the Odell and Tom Creek drainages should reflect that condition. Willows should be heavily browsed, short-statured, and declining (Platts et al. 1987). Furthermore, if sheep grazing has been so severe as to cause lake-filling soil erosion miles downstream, the Station's riparian areas should also reflect that fact. Overbank deposits, mud flows, and debris flows should have buried willow communities and choked stream channels. On the other hand, if "natural regulation" represents the

epitome of ecosystem management as claimed by GYC and others, then Yellowstone National Park's willow communities should be in a near pristine state or at least be in better condition than those grazed by livestock (Kay 1990, Chadde and Kay 1991, Wagner et al. 1995, Kay and Platts 1997).

METHODS

At the request of the U.S. Sheep Experiment Station, I surveyed and measured willow communities in the Tom and Odell Creek drainages during the summer of 1993 (Kay 1994a) and then compared those data to my earlier research in Yellowstone National Park (Chadde and Kay 1998, 1991; Kay 1990, 1994b; Kay and Chadde 1992; Kay and Wagner 1994; Kay and Platts 1997). I used repeat photographs, and inside-outside exclosure height and canopy-cover measurements to determine the condition and trend of willow communities in Yellowstone Park. There are, however, no long-term willow exclosures on the Sheep Station or in the Centennial Mountains. Instead, I surveyed all of Tom and Odell Creek on foot or horseback, as the Station's summer range is largely unroaded, and I measured ten representative willow communities for height and canopy cover (Kay 1994a). I also conducted a repeat-photo study for the entire Centennial Mountains, including riparian areas.

Since the abundance of beaver can be used to judge the long-term health of stream-side willow communities, overgrazed areas generally have fewer beaver, I also recorded beaver activity on the Station's summer range, similar to my previous work in Yellowstone Park (Kay 1990, 1994b; Chadde and Kay 1991). Here I only summarize my findings, but details of my study designs, methods, and results are found in the papers cited above.

RESULTS

Willow Communities

I made 44 repeat photosets of willow communities on Yellowstone Park's northern range, dating to the 1870's. In 41 of those comparisons, tall willows have totally disappeared (see Figure 2), while in the other three, only 5 to 10 percent of the original tall willows remain (also see published repeat photos in Kay 1990, 1992; Chadde and Kay 1991; Wagner and Kay 1994; Kay and Platts 1997). In 1871, Captains Barlow and Heap toured Yellowstone Park, and on the northern range, they reported "thickets of willows along the river banks" (Chadde and Kay 1991:236). Philetus Norris, Yellowstone's second superintendent, noted that the park was "well supplied with rivulets invariably bordered with willows" (Chadde and Kay 1991:236). Since that time, though, the area occupied by tall willow communities on the northern range has declined by 95% or more.

Measurements of total willow canopy cover and height inside and outside four ungulate-proof exclosures constructed on the park's northern range back in the late 1950's and early 1960's show that repeated browsing by wild ungulates, primarily elk, is having a severe impact on Yellowstone's willow communities. At permanent transects outside exclosures, willows had a canopy cover of only 14% while those same species inside totaled 95% canopy cover. Outside, willows averaged only 13 inches tall, while inside, plants averaged 108 inches (9 feet) (see Figure 3). Female plants outside exclosures produced no catkins or seeds, while protected willows produced over 300,000 seeds per square meter of canopy cover, a difference that is statistically and ecologically significant (Kay and Chadde 1992).

Willows inside Yellowstone's exclosures today, in physical appearance, resemble those found on the park's northern range during the 1870's. This suggests that the level of ungulate use inside the exclosures approximates the level of ungulate use when Yellowstone Park was established. The same is true of aspen (Populus tremuloides) and conifer communities. Historical photographs of woody species show no evidence of the ungulate browsing or high-lining that are now common (Kay and Wagner 1994). Today, even species such as Engelmann spruce (Picea engelmannii), the least palatable conifer in the park, have had all their lower branches consumed by starving elk. In 1871, though, Yellowstone's conifers had branches down to the ground (Kay 1990, Kay and Wagner 1994).

In contrast to present conditions in Yellowstone Park, willow communities on the Sheep Station's Centennial Mountains range are generally in good to excellent condition (see Figure 4). On ten plots, total willow canopy cover ranged from 77% to 104% and averaged 93% (Kay 1994a), while the mean height of the three major willow species ranged from 47 to 153 inches (13 feet). Many willows, though, showed extensive signs of repeated browsing by wild ungulates, primarily wintering moose, not domestic sheep. First plants were browsed to 3 m or more, well above what domestic sheep can reach, and second, willow height declined with decreasing elevation.

Normally, willows of the same species tend to decrease in height with increasing elevation due to environmental factors, but on the Sheep Station this pattern was reversed. On Spring Creek, for instance, Geyer's willow (Salix geyeriana) had a mean height of 52 inches at the lowest elevation sample site compared to a mean of 83 inches on the uppermost plot ($p < .001$). The same was true on Twin Basin Creek, 54 versus 87 inches ($p < .001$), and along Odell-Meadow Creeks, 68 versus 83 inches ($p < .001$). Communities

at lower elevations also had less total willow canopy cover than stands at higher elevation – range 77% - 89% versus 100% to 104% (Kay 1994a). This pattern of shorter willows at lower elevations and taller plants at higher elevations appears related to the intensity of winter moose browsing. Deepening snow at higher elevations apparently limits moose utilization on those sites.

Repeat photographs also demonstrate that managed livestock grazing has had little impact on willow communities in the Centennial Mountains (see Figure 5). Of the more than 100 repeat photosets that I made in the Centennials, including five that date to 1872, 28 depict riparian communities. Unlike Yellowstone Park, none of the willows in the Centennial photosets show any significant decline. Instead, willows have increased in several photos. Since the Centennials are part of the Yellowstone Ecosystem, this is further evidence that willows in the park have not declined due to climatic change or the other factors postulated by the Park Service.

Beaver

Beaver were exceedingly common on Yellowstone Park's northern range during the 1800's, but are now ecologically extinct due to repeated ungulate browsing of the willows and aspen beaver need for food and dam building materials. Even as late as the 1920's, a detailed survey of one small portion of the park's northern range reported extensive active dams and 232 beaver. When repeated during the 1950's, though, no beaver nor any recent activity were recorded, and when I redid that study in 1986-88, I found no beaver nor any activity since the 1920's (Kay 1990, Chadde and Kay 1991, Kay and Platts 1997).

In contrast, today there are more active beaver colonies in the Sheep Station's Odell

Creek drainage than the Park Service has reported for all of Yellowstone Park's northern range (Kay 1994a). Without tall willows and beaver in Yellowstone, biodiversity has been greatly reduced and many streams have downcut lowering watertables. A recent study reported 100 times more bank erosion on denuded streams in the park than on those same, willow-lined streams outside the park (Rosgen 1993). Since beaver is a keystone species, its loss has ramifications far beyond the demise of a single species (Naiman et al. 1988, Kay 1994b, Pollock et al. 1995).

CONCLUSIONS

Willow communities on the Sheep Station's Centennial Mountains range are in much better condition than those in Yellowstone Park. Contrary to popular claims (Harting and Glick 1994), Yellowstone is not an intact natural ecosystem, but instead is highly degraded. The park today does not represent the conditions that existed when Yellowstone was declared the world's first national park in 1872. Repeated browsing by unnaturally large numbers of elk and other wild ungulates has completely altered willow and other communities. Instead of being in pristine condition, Yellowstone's riparian communities are among the worst overgrazed in the entire West due to "natural regulation" management (Patten 1993, Wagner et al. 1995, Kay and Platts 1997).

U.S. Sheep Experiment Station riparian areas, on the other hand, are generally in good to excellent condition. Over 70 years of managed grazing by domestic sheep have had little impact on willow or other plant communities (Ecret 1986). Moreover, there is no evidence of sheep-induced overgrazing or soil erosion, lake filling or otherwise. Siltation behind beaver dams is not excessive, and debris or mud flows have not buried riparian

communities or stream channels (Kay 1994a). Clearly, unregulated wild ungulate populations can have a greater impact on western riparian communities than well managed grazing by domestic livestock. These data also demonstrate that agency claims that Yellowstone Park is not overgrazed and blanket claims by GYC that livestock are destroying areas outside the park are simply not true. Several streams in the park have now blown-out and downcut to Pleistocene gravels, something that has not happened in over 12,000 years, because elk and other "naturally regulated" ungulates have destroyed the woody riparian vegetation that once protected those streambanks (Beschta and Platts 1986, Elmore and Beschta 1987). This is not only a clear violation of the park's organic act, but of other federal statutes, as well.

These data also demonstrate that the greatest threat to the Yellowstone Ecosystem is "natural regulation" management, and that unless ungulate populations are controlled, they will severely impact plant and animal communities. These data also show that neither the Park Service nor GYC can be trusted to evaluate the consequences of their management philosophies. Thus, not only do we need a Park Service science program separate from park management, but Congress must also insure that funding is available for independent scientists, who are willing to critically evaluate key aspects of park programs. Money may be the root of all evil, but money is also the root of all science. Without adequate funding, there will be no independent review of park management and America's heritage will continue to be lost.

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Figure 1. Map showing the location of Yellowstone National Park and the U.S. Sheep Experiment Station's summer range in the Centennial Mountains.

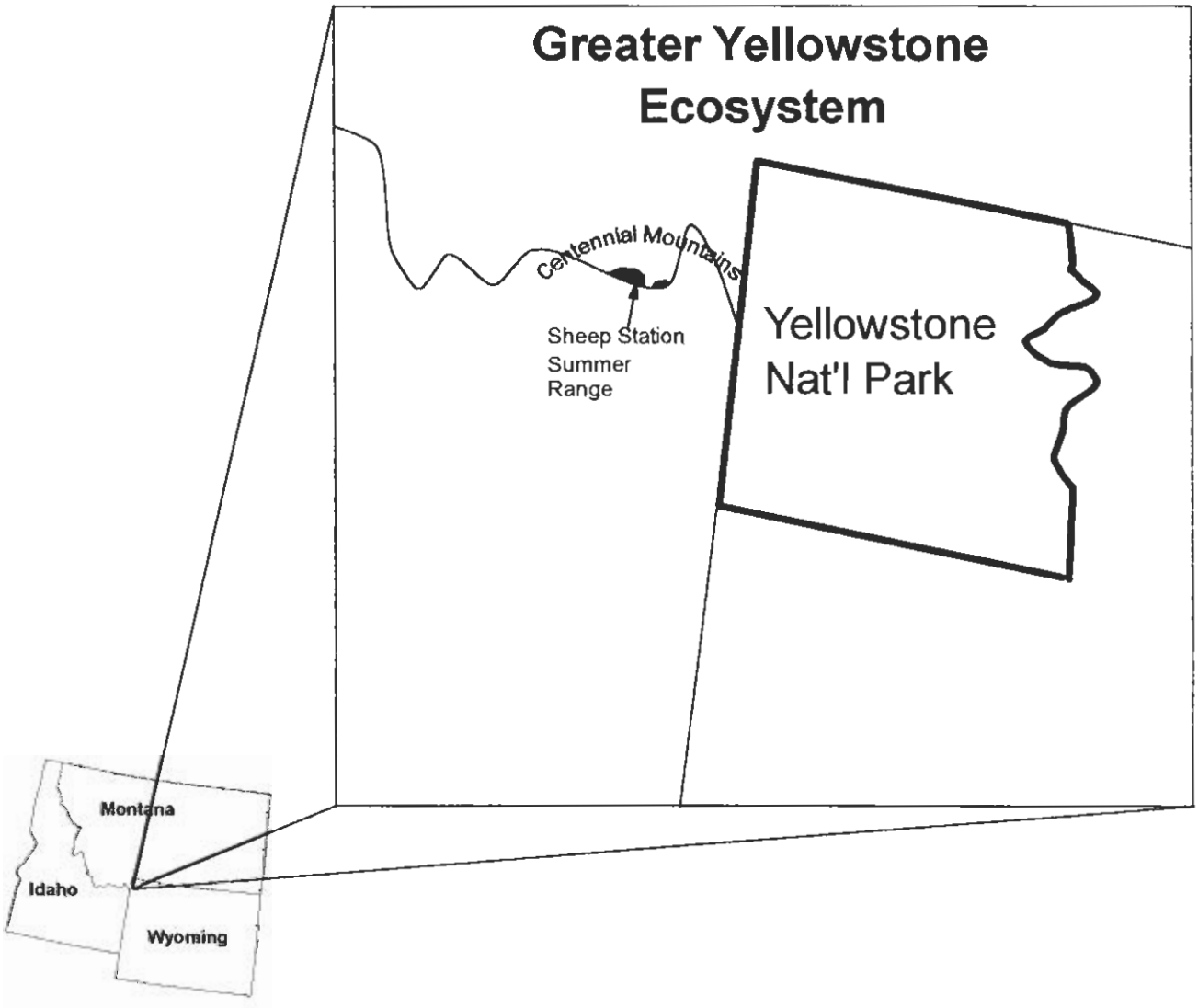

Greater Yellowstone Ecosystem
Centennial Mountains
Sheep Station Summer Range
Yellowstone Nat'l Park
Montana
Idaho
Wyoming

Figure 1.

Figure 2. A repeat photoset showing the dramatic impact native ungulates have had on willow communities in Yellowstone National Park. (a) Willows in this 1915 photograph already show the effects of repeated browsing, but are still plentiful. (b) By the 1950s, however, tall willows had been completely eliminated by repeated ungulate browsing. Contrary to what one might expect, Yellowstone Park contains some of the worst overgrazed riparian areas in the entire West. This is one of 44 repeat photosets of willows made in the park by Charles E. Kay.

Figure 3. Fenceline contrast of willows inside (photo left) and outside (photo right) a fenced exclosure in Yellowstone National Park. Where elk and bison have been excluded, willows are in excellent condition - - similar to willow communities present in 1872 when Yellowstone was established as the world's first national park. Even to the casual observer, it is obvious that Yellowstone is severely overgrazed. This evidence, however, has been ignored by the Park Service and environmentalists because it does not support their political agendas. Photo by Charles E. Kay.

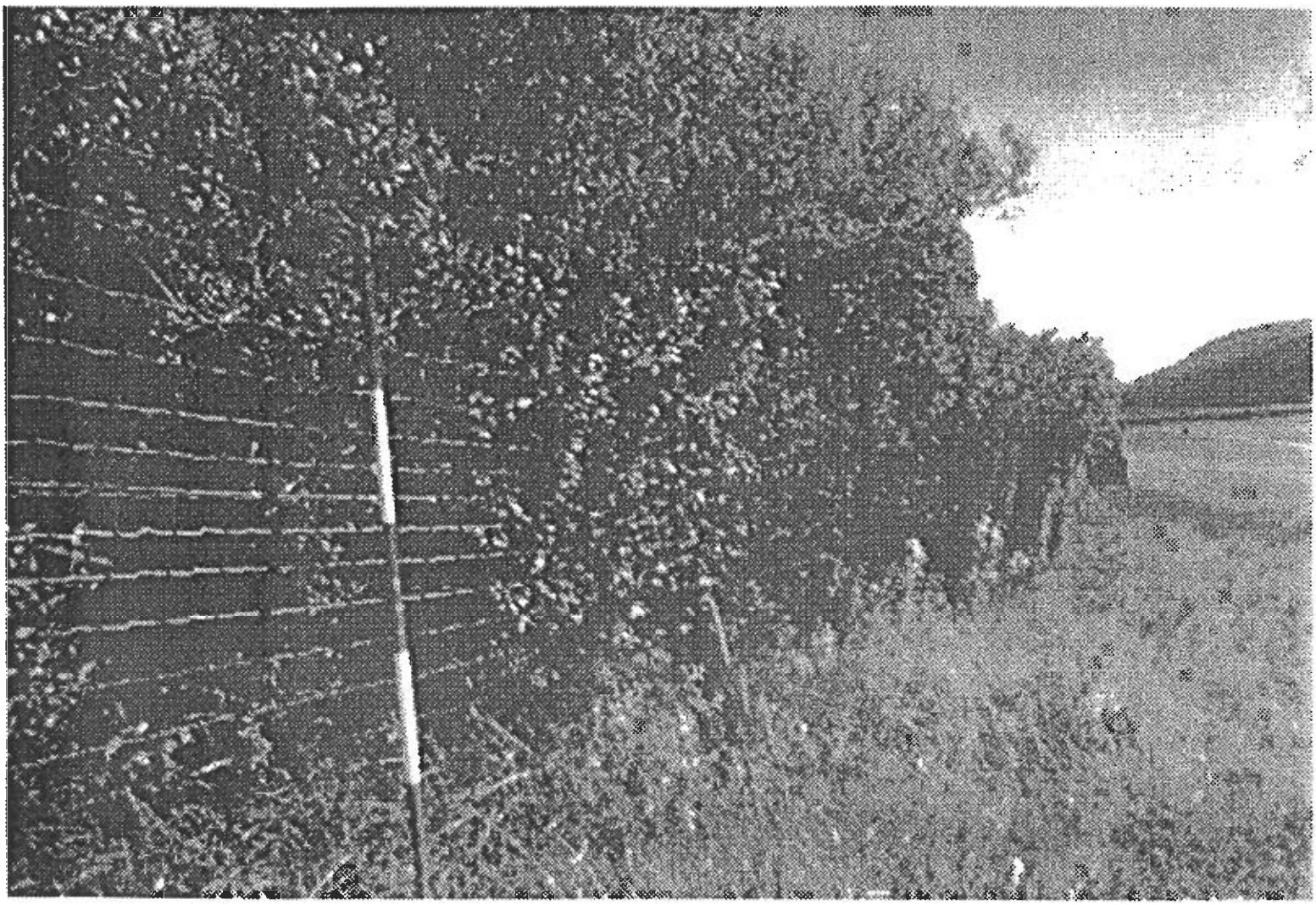


Figure 4. Willow communities on the U.S. Sheep Experiment Station's Centennial Mountains summer range. (a) Willows along Spring Creek had 100% canopy cover and an average height of nearly 7 feet. Note the 6 foot red and white survey pole for scale. (b) Willows along Twin Basin Creek also had 100% canopy cover with an average height of more than 7 feet. Again, note the survey pole for scale. Both 1993 photographs by Charles E. Kay used with permission of the U.S. Sheep Experiment Station, Dubois, ID.

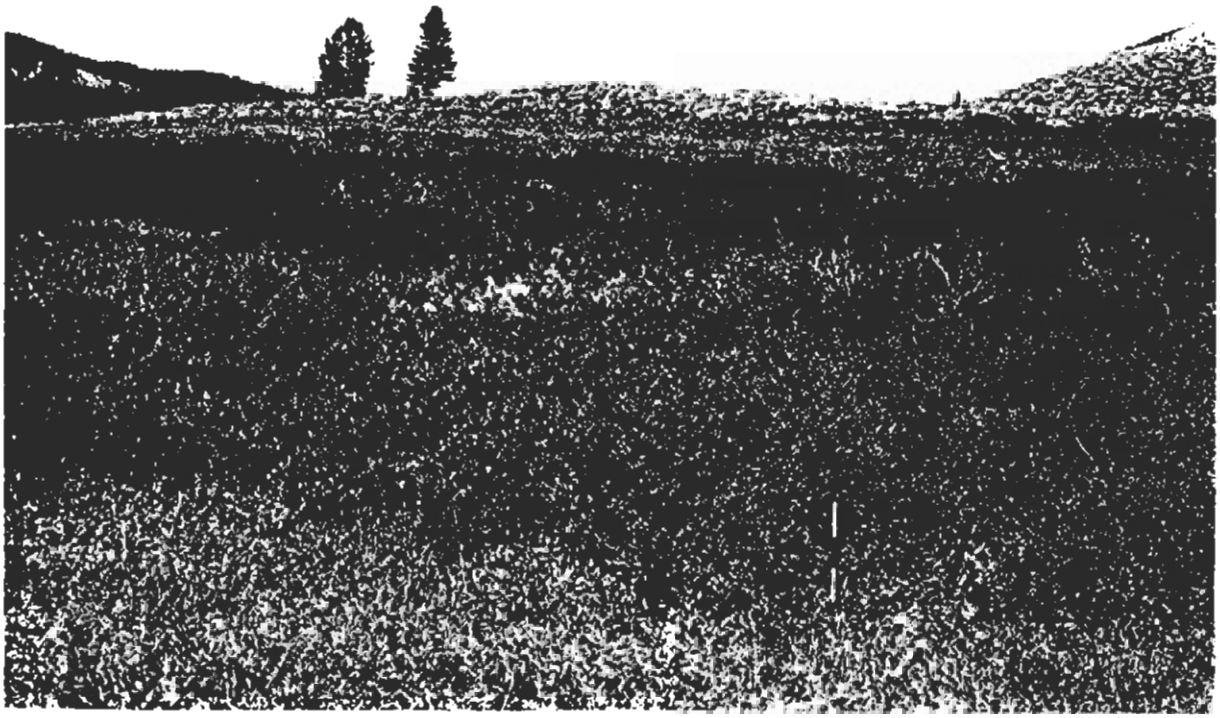
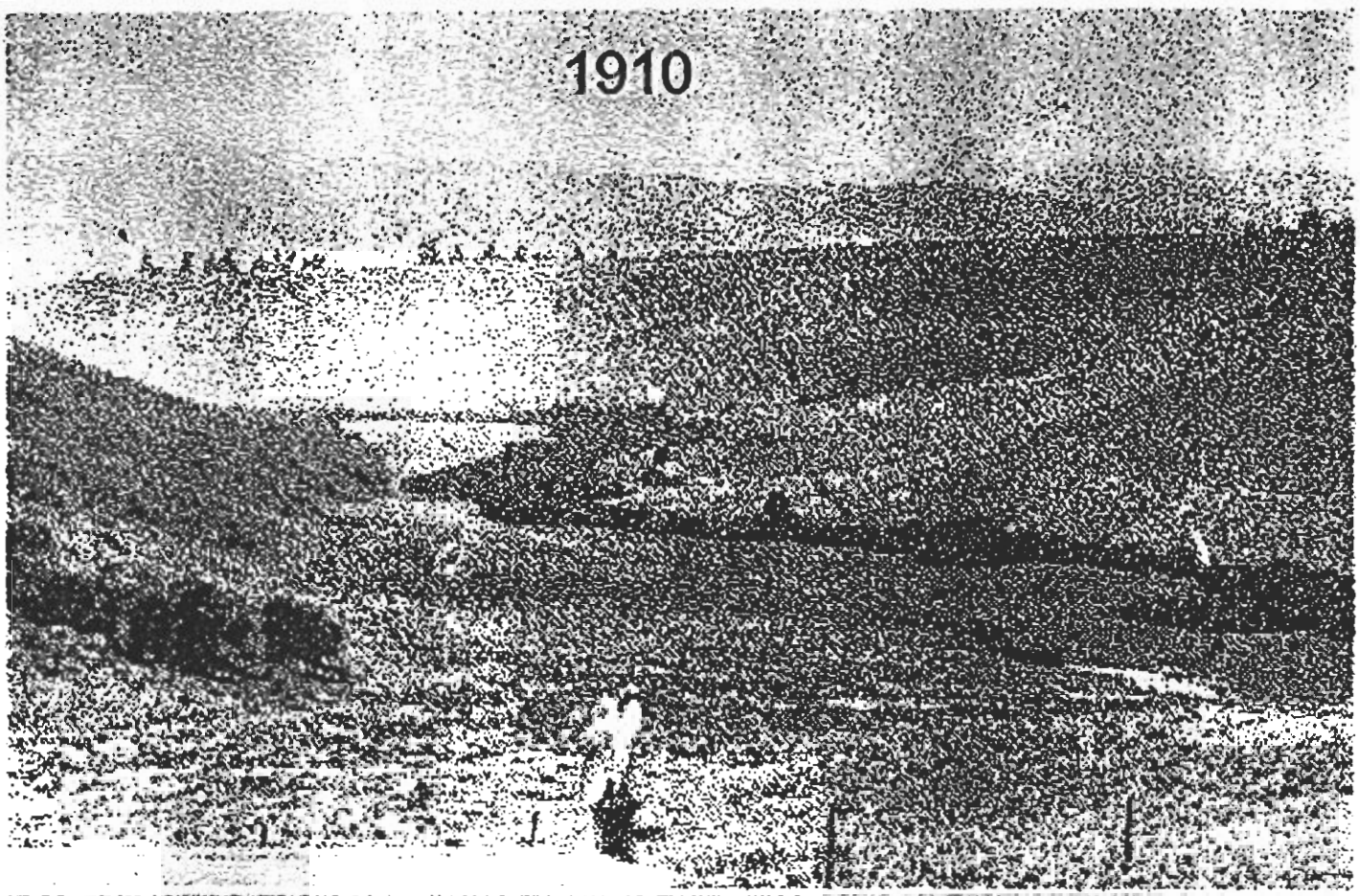


Figure 5. A repeat photoset of willows along Miners Creek in the Centennial Mountains. The original photograph was taken in 1910 while the retake was made in 1994. Despite yearly grazing by cattle and sheep, the willows are unchanged except where disturbed by recent road constriction. Repeat photoset by Charles E. Kay used with permission of the U.S. Sheep Experiment Station, Dubois, ID.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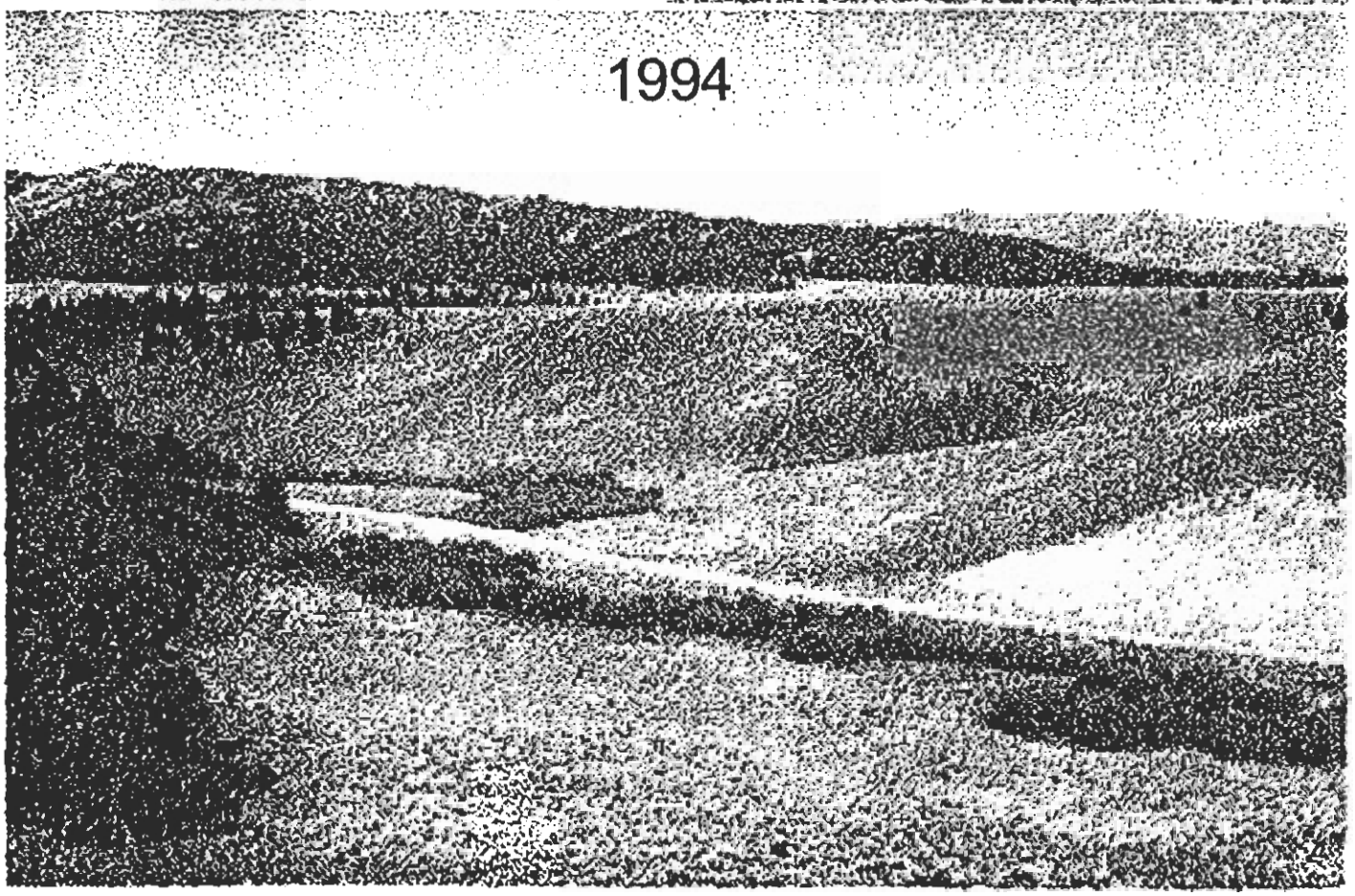
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SCIENCE AND RESOURCES MANAGEMENT IN THE NATIONAL PARK SERVICE

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL PARKS AND PUBLIC LANDS

OF THE

COMMITTEE ON RESOURCES
HOUSE OF REPRESENTATIVES

ONE HUNDRED FIFTH CONGRESS

FIRST SESSION

ON

RESEARCH OF OUR NATIONAL PARKS TO DETERMINE THEIR CONDITION, TO ADDRESS ANY THREATS TO PARK RESOURCES, AND DETERMINE THE BEST SCIENCE AND RESOURCES MANAGEMENT POSSIBLE

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ATTACHMENT B

COMPETITIVE EXCLUSION OF SYMPATRIC HERBIVORES IN YELLOWSTONE NATIONAL PARK - -

OR WHY WE NEED AN INDEPENDENT PARK SCIENCE PROGRAM

Testimony presented at the Oversight Hearing on Science and Resource Management in the National Park System held by the U.S. House of Representatives Subcommittee on National Parks and Public Lands, February 27, 1997.

by

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ABSTRACT

The National Park Service recently presented data on competitive exclusion of sympatric ungulates by Yellowstone's northern elk herd between 1967 and 1988 (Singer ad Norland 1994), but that is not the most appropriate test of the agency's "natural regulation" management program. Instead, a more robust test would be to determine whether elk have competitively excluded sympatric herbivores since park establishment in 1872. Historical, archaeological, and ecological data indicate that elk on Yellowstone's northern range have competitively excluded mule deer, white-tailed deer, beaver, moose, and grizzly bears. This is in clear violation of the park's organic act and endangered species legislation. As it also violates one of the main tenets of "natural regulation" management, that paradigm cannot be sustained and must be rejected. Prior to park establishment, predation by Native Americans kept elk and other ungulate numbers low which, in turn, prevented elk from competitively excluding sympatric herbivores, as those animals do today.

INTRODUCTION

The National Park Service has recently argued that Yellowstone's burgeoning elk population has not negatively effected other animals in the park (Singer and Norland 1994) - - this is termed competitive exclusion where one species out competes others - - but the agency failed to put the problem in proper historical and ecological perspective. Thus in evaluating the validity of recent claims by the agency, it is first necessary to present a short history of wildlife management in Yellowstone National Park.

HISTORY OF WILDLIFE MANAGEMENT

After Yellowstone was designated as the world's first national park in 1872, a succession of civilian (1872-1886), military (1886-1916), and National Park Service (1916 -present) administrators believed that there were not enough game animals in the park so they fed wintering elk (Cervus elaphus) and other ungulates, and they killed predatory animals such as wolves (Canis lupus) and mountain lions (Felis concolor). During the 1920s, however, concerns grew that too many elk were overgrazing the park's northern winter range, so the agency began trapping and transplanting elk to areas outside the park. Trapping alone, though, did not reduce the herd to the range's estimated carrying capacity, so rangers began shooting elk in the park to prevent resource damage. This program was called direct reduction, and by 1967 the Park Service had killed over 13,500 elk from Yellowstone's northern herd (Houston 1982, Kay 1990).

This upset many people who exerted political pressure to stop the Park Service from shooting elk in the park. After a U.S. Senate (1967) Subcommittee hearing at which the chairman threatened to terminate park funding, the Park Service agreed to abandon

its direct reduction program -- although the agency still contended that Yellowstone was seriously overgrazed (Wagner et al. 1995a). By 1968, the Park Service had switched to a program called "natural control" which the agency changed to "natural regulation" management in the early 1970s. As explained elsewhere (Chase 1986, Kay 1990, Wagner et al. 1995a), this occurred without public review despite NEPA requirements. The Park Service originally based "natural regulation" on a presumed "balance-of-nature," but more recently the agency has cited Caughley's (1976) plant-herbivore model to support its "natural regulation" paradigm (Kay 1990). Under "natural regulation," the Park Service rewrote the history and ecology of elk in Yellowstone.

Until 1968, Park Service officials contended that an unnaturally large elk population, which had built up in Yellowstone during the late 1800s and early 1900s, had severely damaged the park's northern winter range, including aspen (Populus tremuloides) and willow (Salix spp.) communities (Tyers 1981). Agency biologists now hypothesize, however, that elk and other ungulates in Yellowstone are "naturally regulated," being resource (food) limited, and that the condition of the ecosystem today is much like it was at park formation (Houston 1982, Despain et al. 1986). Elk influences on Yellowstone's vegetation are now thought to be "natural" and to represent the "pristine" condition of the park. According to the Park Service, Yellowstone is not now, nor has it ever been, overgrazed and all previous studies to that effect are wrong (Houston 1982).

Under "natural regulation" (Kay 1990:1-31): (1) Predation is an assisting but non-essential adjunct to the regulation of ungulate populations. If wolves are present, they will only take the ungulates slated to die from other causes, such as starvation, and hence predation will not lower ungulate numbers. In the current debate over reintroducing wolves to Yellowstone, the Park Service has adamantly denied that wolves are needed to control the park's elk herds (Boyce 1992, Kay 1996a). (2) If ungulates and vegetation

have co-evolved for a long period of time and if they occupy an ecologically complete habitat, the ungulates cannot cause retrogressive plant succession or range damage. The ungulates and vegetation will reach an equilibrium, termed ecological carrying capacity, where continued grazing will not change plant species composition or the physical appearance of plant communities. According to the Park Service, thousands of elk starving to death during winter is natural. (3) At equilibrium, competitive exclusion of sympatric herbivores due to interspecific competition will not occur. In Yellowstone, this means that competition by elk has not reduced the numbers of other animals since park formation.

The Park Service's "natural regulation experiment" (cf. Despain et al. 1986) is predicated on the assumption that large numbers of elk (12,000 - 15,000) wintered on Yellowstone's northern range for the last several thousand years. Park Service biologists hypothesize that elk, vegetation, and other herbivores in Yellowstone have been in equilibrium for that period of time (Houston 1982, Despain et al. 1986). The agency now contends that any changes in plant communities since the park was established are due primarily to suppression of lightning fires, normal plant succession, or climatic change, not ungulate grazing.

Between 1967 when the Park Service stopped controlling elk in Yellowstone and 1988, the park's northern herd increased from a count of 3,178 to a count of nearly 20,000 animals (Kay 1990). Recently, the Park Service presented data on bison (Bison bison), bighorn sheep (Ovis canadensis), mule deer (Odocoileus hemionus), and pronghorn antelope (Antilocapra americana) populations between 1967 and 1988 to determine if the park's growing elk herd had adversely impacted sympatric ungulates (Singer and Norland 1994). That, though, is not the most appropriate test of "natural regulation." Instead, a more robust test would be to determine whether elk have

competitively excluded sympatric herbivores since park establishment in 1872. To test this part of the "natural regulation" paradigm, I gathered existing historical, archaeological, and ecological data on mule deer, white-tail deer (O. virginianus), beaver (Castor canadensis), grizzly bear (Ursus arctos), and moose (Alces alces) populations on Yellowstone's northern range.

Establishing if ungulates in Yellowstone are "naturally regulated" is important because (1) it has bearing on that park's management direction and whether or not the range is overgrazed; (2) it has bearing on similar management schemes in other national parks in the U.S. (Hess 1993) and around the world (Kay and White 1995); and (3) in a broader context, it is a test of an ecological model which attempts to explain how ungulate populations interact with their plant resources (Kay 1990). Determining the accuracy of recent Park Service claims will also help determine if the agency has a credible science program.

VEGETATION CHANGES

The Park Service recently reported "no consistent evidence of any increased use of less palatable" forage plants between 1967 and 1988 and noted that aspen, willows, and other woody plants were rare in ungulate diets during their study (Singer and Norland 1994:1389). That is true, though, only because elk had virtually eliminated those species prior to the agency's study (Kay 1990).

Based on 44 repeat photosets of willow communities on Yellowstone's northern range, tall willows (defined as plants greater than 6 feet tall) have declined by approximately 95% since park establishment and most of that decrease occurred ca. 1910-1950 (Chadde and Kay 1988, 1991; Kay 1990). Willows inside long-term ungulate-

proof exclosures on Yellowstone's northern range averaged 9 feet tall while those outside averaged only 13 inches in height (Kay 1990, 1994b; Chadde and Kay 1991). Willow canopy cover inside exclosures averaged 95% while it averaged only 14% on outside plots (Kay 1990, 1994b; Chadde and Kay 1991). Willows inside exclosures produced an average of 306,000 seeds per square meter of female canopy cover while plants outside produced none (Kay and Chadde 1992). Since willows continue to flourish inside exclosures and tall willows are still common outside the park (Kay 1994c), the decline of willows in Yellowstone is not due to climatic fluctuations or other natural factors postulated by the Park Service (Kay 1990, 1994b; Chadde and Kay 1991). Instead, the decline is due to repeated browsing by the park's burgeoning elk population (Kay 1990, 1994a; Patten 1993; Wagner et al. 1995b; Kay and Platts 1997).

Based on an additional 81 repeat photosets, the area occupied by aspen on Yellowstone's northern range has also declined by approximately 95% since park establishment (Kay 1990; Kay and Wagner 1994, 1996). Inside exclosures and outside the park, however, aspen continues to flourish, which again indicates that the park's burgeoning elk population is responsible for the observed decrease in aspen, not climatic change or other environmental factors. Even when a third of the northern range's aspen was burned by Yellowstone's 1988 wildfires, aspen still was not able to successfully regenerate (defined as producing new stems greater than 6 feet tall) due to repeated elk browsing (Kay and Wagner 1996).

Similarly, deciduous shrubs have been virtually eliminated from Yellowstone's northern range and much of the ecosystem due to excessive ungulate browsing (Kay 1990, 1995b). Inside the Lamar-West exclosure on Yellowstone's northern range, for instance, serviceberry (Amelanchier alnifolia) canopy cover was 77 times greater than on outside plots, while chokecherry (Prunus virginiana) canopy cover was 98 times greater

inside the exclosure (Kay 1995b:312). Shrub heights were also significantly lower outside exclosures where serviceberry averaged only 8 inches tall and chokecherry averaged only 10 inches in height (Kay 1995b:312). Even normally unpalatable buffaloberry (Shepherdia canadensis) had 15 times more canopy cover inside Yellowstone's Mammoth exclosure (Kay 1995b:312). As discussed elsewhere (Kay 1990, 1995b), this decline in deciduous shrubs is not due to climatic variation, fire suppression, or other such factors. Moreover, Yellowstone's northern elk herd has also impacted other plants in the park.

One of the conspicuous characteristics of today's northern range, and indeed other parts of the park as well, is the browsing highline on conifers (Kay and Wagner 1994). Evident to the most casual observer, the configuration is widely cut into all of the park's coniferous species, including spruce (Pices spp.). Of the woody species in the park, conifers are among the least palatable to ungulates (Nelson and Leege 1982), and if other foods are available, elk and other herbivores will take them in preference to conifers. When deep snows cover most vegetation and elk are facing starvation, however, they will turn to conifers in an attempt to satisfy their hunger. It is not uncommon for 1,000 or more elk to die from starvation during normal winters on the northern range, and as many as 5,000 have died during some winters (Lemke 1989). In addition, historical photographs indicate that willows, aspen, and deciduous shrubs were virtually unbrowsed ca. 1800-1890 and that conifers were not highlined ca. 1750-1890 (Kay and Wagner 1994). Thus, there is abundant evidence that there have been major changes in Yellowstone's plant communities since park establishment, and that those changes are due to repeated ungulate browsing, not other factors (Kay 1990, Wagner et al. 1995b, Kay and Platts 1997).

MULE DEER

The Park Service has noted that the number of mule deer wintering on the park's northern range declined from approximately 230 animals in 1967 to only around 98 animals in 1988, but the agency contends that decline is not significant (Singer and Norland 1994:1387). Historical documents, however, indicate that 1,000 to 2,000 mule deer wintered in the park ca. 1900-1940 (Bailey 1930, Russell 1932, Murie 1940, Barmore 1981:580-590, Houston 1982:156-160). Those reports also indicate that few mule deer wintered outside the park ca. 1900-1940, the exact opposite of the pattern present today -- compare Houston (1982:159) with Russell (1932:42). According to Russell (1932:36) "only in years of excessive snowfall ... do the deer make a considerable effort to leave the protecting limits of the park." Singer and Norland (1994:1387) reported that only 5% of the mule deer now winter in the park.

First-person historical journals and archaeological data also indicate that mule deer were more abundant, relative to elk, in the past than is the case today. At present, elk make up approximately 80% of the ungulate population on the northern range and throughout the core of the Yellowstone Ecosystem, while mule deer make up only 10% of total ungulate numbers; i.e., elk outnumber mule deer 8 to 1. Yet between 1835 and 1876, early explorers, who spent 765 days in the ecosystem on foot or horseback, reported seeing elk only 1.4 times more frequently than they saw mule deer (Kay 1990:273). While in archaeological sites dating back nearly 10,000 years, mule deer faunal remains outnumber those of elk nearly 6 fold (Kay 1990, 1994a). In fact, as explained elsewhere, elk bones are rarely unearthed from archaeological sites in Yellowstone or anywhere else in the Intermountain West (Kay 1990, 1992, 1994a).

Thus, the long-term trend is one of declining mule deer abundance relative to elk.

This and the fact that mule deer no longer winter on parts of the northern range they once used is consistent with the hypothesis that elk have competitively excluded mule deer from most of the park's northern range. Early accounts also suggest that serviceberry, chokecherry, aspen, willow, and other deciduous shrubs made up a larger proportion of mule deer diets ca. 1900-1940 than those plants do at present (Bailey 1930, Russell 1932). As Murie (1940:86) suggested over 50 years ago, "if there were fewer elk [in the park] there would probably be more deer." Moreover, others have reported similar trends of increasing elk and decreasing mule deer numbers throughout western North America (Olmstead 1977, 1979), which is not surprising since elk are physiologically superior competitors to mule deer on western ranges (Kay 1990, 1994a).

WHITE-TAILED DEER

Singer and Norland (1994) did not include white-tailed deer in their study, probably because no whitetails wintered in the park ca. 1967-1988. In the past, however, white-tailed deer commonly wintered in the park. As late as 1914, approximately 100 whitetails wintered along the Gardiner River between Mammoth Hot Springs and Yellowstone's northern boundary (Skinner 1929, Bailey 1930:65-69, Murie 1940:9, Houston 1982:182), but those animals had disappeared by ca. 1930. Small numbers of whitetails that migrate-in from outside the park, where the species is relatively abundant, are occasionally seen in Yellowstone today but only during summer. Murie (1940:9) noted that the whitetail's winter range along the Gardiner River was "heavily browsed" by elk and that "the vanishing of a suitable winter habitat for this brush-loving ... species was probably the basic cause of its disappearance." That is to say, the park's whitetails were competitively excluded by Yellowstone's northern elk herd -- repeat photographs indicate

that woody riparian vegetation has been eliminated from along the Gardiner River by repeated elk browsing (Kay 1990). If suitable habitat still existed, there is no reason why white-tailed deer could not winter in the park today, since whitetails presently winter immediately north of the park. In this part of Montana and Wyoming, whitetails are common only where they have access to dense riparian shrub communities, the very communities that have been destroyed by overgrazing in the park (Swenson et al. 1983, Compton et al. 1988, Dusek 1989, Wood et al. 1989, Dusek et al. 1992).

BEAVER

The Park Service has implied that beaver were not widespread in Yellowstone until around 1900 and suggested that "ephemeral colonies may be characteristic of most of the park" (Houston 1982:182-183). From 1835 to 1837, though, Osborne Russell (1965) trapped beaver in Yellowstone Park, and he found a great many on the northern range. Russell and his companions, for instance, trapped beaver from August 3 to 20, 1835, on the upper Gardner River, while in 1836, they spent several days trapping beaver on streams in the Lamar Valley. The next year, Russell and his party spent nearly three weeks trapping beaver on Slough and Hellroaring Creeks.

Norris (1880:613) reported that beaver were common in the park during the 1870s and 1880s, while Seton (1909) found beaver abundant near Tower Junction on the northern range in 1897. Skinner (1927:176) noted that "beaver had always been quite common in Yellowstone National Park, and although fluctuations are noticed at times, the actual number present remains about the same throughout a course of years." Skinner added, "beaver occur in practically every stream and pond (where there is suitable food) in the park." He estimated that there were "about 10,000" beaver in the park.

During the early 1920s, Warren (1926) conducted a detailed beaver study in a relatively small area around Tower Junction on Yellowstone's northern range. He reported 232 beaver and extensive beaver dams. Jonas (1955) repeated Warren's study in the early 1950s and found no beaver nor any recent dams. In 1986, I (Kay 1990, Chadde and Kay 1991, Kay and Platts 1997) repeated Warren's and Jonas's surveys and found no beaver and no indication of beaver activity since the 1950s.

Beaver need tall willows or aspen for food and dam-building materials. Aspen and willows cut by beaver normally resprout and in turn provide additional beaver food (Kay 1994b). Once the mature aspen trees or tall willows are cut, however, the new suckers are entirely within reach of browsing elk. By preventing aspen and willows from growing into sizable plants, Yellowstone's elk have eliminated beaver foods, and thus beaver themselves. Flook (1964) reported that high elk numbers negatively affected beaver through interspecific competition for willows and aspen in Banff and Jasper National Parks. Bergerud and Manuel (1968) noted that high moose densities had a similar negative effect on beaver in Newfoundland. While in South Dakota, heavy grazing by domestic livestock negatively impacted woody vegetation and beaver populations (Smith and Flake 1983, Dieter 1987, Dieter and McCabe 1989). Although a few beaver persist in Yellowstone, for all practical purposes that species is ecologically extinct (Estes et al. 1989) on the park's northern range. Wright and Thompson's (1935:72) warning 60 years ago that beaver in Yellowstone were "endangered through the destruction of aspen and willow on the overbrowsed elk winter ranges" has proven correct.

Beaver, though, are still common outside Yellowstone Park. In fact, during 1993 there were more active beaver colonies on one stream on the U.S. Sheep Experiment Station's Centennial Mountain rangelands, than on the park's entire northern range (Kay 1994c). So beaver have not declined in Yellowstone due to climatic change or other

factors, as suggested by the Park Service (Houston 1982, Despain et al. 1986), but because elk have competitively excluded them from the northern range (Kay 1990). Moreover, beaver is a critical keystone species and its loss has ramifications far beyond the loss of a single species (Kay 1994b).

MOOSE

According to historical records, moose were not observed on Yellowstone's northern range until 1913 (Houston 1982). Moose are also exceedingly rare in the archaeological record (Kay 1990) -- the reasons for this are discussed elsewhere (Kay 1994a, 1995a, 1997) but are not related to habitat availability; moose habitat was abundant ca. 1800-1900 and in earlier times, as well. Nonetheless, moose increased on the northern range from 1913 to ca. 1930 where they were commonly associated with willow and aspen communities, as is generally true throughout Wyoming and Montana (McDowell and Moy 1942; McMillan 1950, 1953a, 1953b; Houston 1968; Stevens 1970; Chadde and Kay 1988).

Although accurate counts are lacking, moose have declined since ca. 1940 and moose are no longer associated with low-elevation willow communities during winter, especially in Yellowstone Park (Tyers and Irby 1995). Instead, moose on the northern range are now largely confined to old-growth forests at higher elevations, up to 9,000 feet or more (Tyers 1993, Maxwell 1994, Tyers and Irby 1995). Most winter browsing in Yellowstone now occurs in coniferous forests 300$\pm$ years old, and during a recent 5-year moose study, not a single moose bite (n=144, 786) was recorded in a forest less than 100 years old (Maxwell 1994:112). This extensive use of old-growth forests as moose winter range is different from what occurs in surrounding areas (Knowlton, 1960; Peek 1963,

1974; Houston 1968; Stevens 1970, 1974; Ritchie 1978), and I suggest that it is due to competitive exclusion by elk on the park's northern range. By eliminating low-elevation willow and aspen communities usually preferred by moose, elk have forced moose to winter in other, less favorable habitats. According to Tyers and Irby (1995), "the manipulation of elk numbers and/or distribution should ... be considered as a mechanism to improve conditions for moose [on the northern range]."

GRIZZLY BEAR

As grizzlies are primarily vegetarians, overgrazing can have a severe negative impact on bear numbers (U.S. Fish and Wildlife Service 1982, Mealey 1986). Across North America, grizzlies commonly consume large quantities of berries during fall as the bears store fat for hibernation (LeFranc et al. 1987). It has been estimated that a single grizzly can consume more than 200,000 berries per day (LeFranc et al. 1987). Serviceberries, chokecherries, and buffaloberries are among the bears' favorite foods in the northern Rockies (LeFranc et al. 1987). Unlike their counterparts in other ecosystems, though, Yellowstone's grizzlies consume few berries. Of over 10,000 grizzly scats analyzed from Yellowstone, serviceberries were found in only 2, chokecherries in 1, and buffaloberries in 51 (Knight et al. 1984, Mattson et al. 1991). Government biologists contend that this is because Yellowstone is naturally poor habitat for berry-producing shrubs, but historical journals do not support that supposition (Kay 1995b).

In September 1869, the Cook-Folsom-Peterson Expedition encountered Native Americans who were gathering and drying large quantities of chokecherries at the mouth of Tom Miner Creek a few kilometers north of Yellowstone Park. "Here we found a wickiup inhabited by two old squaws who were engaged in gathering and drying

chokecherries ... they had two or three bushels drying in the sun" (Haines 1965:16). The Washburn Expedition of 1870 reported that near Yellowstone Park "we crossed a small stream bordered with black cherry trees [chokecherries], many of the smaller ones broken down by bears, of which animal we found many signs" (Langford 1972:13). Since shrubs have to be at least 2 m tall before branches are commonly broken down by feeding bears, chokecherry plants in 1870 not only produced abundant berries, but were also much taller than today's plants (see above). Thus, early records suggest that berries were once common in the Yellowstone Ecosystem, and that the present lack of berries was not the condition prevailing in presettlement times (Kay 1995b).

In addition to shrub measurements reported above (Kay 1990, 1995b), I also measured berry production inside and outside long-term ungulate-proof exclosures on the park's northern range and throughout the Yellowstone Ecosystem. At the Lamar-West exclosure in Yellowstone Park, 100 protected serviceberry plants produced 111,047 berries, while 100 shrubs outside produced none. At the same exclosure, 100 protected chokecherry plants produced 212,178 berries while 100 shrubs outside produced none (Table 1).

Given this evidence, there can be little doubt that Yellowstone's grizzlies consume few berries because repeated ungulate browsing has eliminated berry production, not because berry-producing shrubs do not normally grow or do well in the park. Moreover, since government biologists have admitted "that the density of grizzly bears in the Yellowstone area is limited in large measure by a lack of flesh fruits [i.e., berries]" (Mattson et al. 1991:1627), it appears logical to conclude that Yellowstone's elk are having a negative impact on the park's grizzlies (Kay in press a, in press b). Moreover, there is additional evidence that elk have competitively excluded grizzlies from Yellowstone's northern range.

Hiding or security cover is extremely important to grizzly bears (Weaver et al. 1986, 1987). Except in alpine or tundra settings, grizzlies seldom use a food source if thick cover is not close at hand (Zager and Jonkel 1983, Aune and Kasworm 1989). This is especially true in Yellowstone. Of the grizzlies instrumented in Yellowstone, over 90% of the radio relocations have been in timber. Even the majority of the bears observed in the open were less than 300 feet from cover and over half were less than 100 feet from timber (Blanchard 1983, Knight et al. 1984, Mattson et al. 1987).

As part of my research in Yellowstone, I used a 6 foot by 6 foot cover-cloth to measure security cover in aspen and willow communities, similar to what has been done in other studies (Loft et al. 1987). The cover-cloth contained 36 red or white colored squares. I read the cover-cloth from a distance of 100 feet and recorded the number of visible squares. Those readings were then converted to percent security cover (Kay in press a). I measured security cover of aspen and willow communities inside and outside the park, as well as inside and outside park exclosures. For comparison, I also measured security cover in willow and aspen habitats frequented by grizzly bears on the Blackleaf Game Range and Pine Butte Preserve, both situated along Montana's East Front. Blackleaf is owned by the Montana Department of Fish, Wildlife, and Parks while Pine Butte is owned by The Nature Conservancy (Aune and Kasworm 1989).

Aspen and willow stands in Eagle Creek, immediately outside Yellowstone Park, had significantly more security-cover than those in the park. Eagle Creek is part of the northern range, but elk grazing is less intense because the area is open to public hunting including a special late season designed to cull Yellowstone's northern elk herd (Lemke and Singer 1989). Aspen and willows inside exclosures on the park's northern range also had significantly more security cover than communities grazed by elk. Willow and aspen habitats used by grizzlies along Montana's East Front had nearly 100% security cover

while similar sites in the park provided virtually no security cover for Yellowstone's grizzlies (Figure 1).

In areas other than Yellowstone Park, grizzlies use low-elevation riparian habitats extensively, especially willow and aspen communities. Grizzlies are drawn to those sites in the spring and early summer because they contain an abundance of succulent vegetation and other bear foods. In many areas, grizzlies return to those same habitats in late summer or early fall to feed on ripening berries. This twice-a-year-migration to low elevations enables bears to make full use of important foods available in riparian and aspen zones. Without low-elevation riparian and aspen habitats, grizzlies probably would not survive in Montana's Mission Mountains or along Montana's East Front (Lee and Jonkel 1980:53, Servheen 1983, Jonkel and Hadden 1986, Aune and Kasworm 1989). Yellowstone's grizzlies, though, seldom use low-elevation riparian or aspen communities, especially on the park's northern range (Knight et al. 1984, Blanchard and Knight 1991, Blanchard et al. 1992). I suggest that this is because elk have eliminated the security-cover value of those habitats in the park, as well as berry producing shrubs and other plants preferred by grizzlies. I also suggest that this represents competitive exclusion, as well as a clear violation of the Endangered Species Act (U.S. Fish and Wildlife Service 1982, Mealey 1986).

It should also be noted the federal agencies charged with conducting research on Yellowstone's grizzlies have consistently refused to consider the impact the park's burgeoning elk population has had on grizzlies because that work might compromise existing arrangements. It should be noted that grizzly bear research in Yellowstone is headed by a National Park Service employee, a move the National Academy of Sciences characterized as "unwise" - - they recommended that grizzly bear research be headed "by a respected neutral individual" (Cowan et al. 1974) - - a recommendation the Park

Service has never followed. Grizzlies may be dying outside the park but they are really being killed by "natural regulation" management because Yellowstone's burgeoning elk population has destroyed grizzly food sources in the park (Kay in press a, in press b).

CONCLUSIONS

The available evidence indicates that elk on Yellowstone's northern range have competitively excluded mule deer, white-tailed deer, beaver, moose, and grizzly bears. Other studies suggest that elk have also competitively excluded riparian songbirds (Jackson 1992, 1993). As this violates one of the main tenets of "natural regulation," that paradigm cannot be sustained and must be rejected, contrary to recent assertions by the National Park Service. Furthermore, an independent commission, originally empaneled by The Wildlife Society, concluded that the available scientific data did not support "natural regulation" management in Yellowstone or in any other U.S. National Park (Wagner et al. 1995a).

These data also clearly demonstrate that the National Park Service cannot be trusted to produce an unbiased review of its "natural regulation" management program. Thus, not only should Congress mandate a park science program separate from park management, but Congress must also insure that funding is available for independent scientists, who are willing to critically evaluate key aspects of park programs. These data also demonstrate that the greatest threat to the Yellowstone Ecosystem is "natural regulation" management, and that unless ungulate populations are controlled, they will severely impact plant and animal communities.

So if "natural regulation" cannot be sustained; i.e., ungulates were not historically food limited; then what structured the Yellowstone Ecosystem prior to park

establishment? First-person journals ca. 1835-1876, historical photographs, and archaeological data all indicate that the large elk and bison populations assumed under "natural regulation" did not exist until after Yellowstone was designated a national park (Kay 1990, Kay and Wagner 1994). I suggest that prior to park establishment, Yellowstone's elk and bison populations were limited at low densities by native hunting. This, in turn, prevented elk from competitively excluding sympatric herbivores, as those animals do today. As I (Kay 1994a, 1995a, 1996b, 1997, in prep) have presented my Aboriginal Overkill hypothesis elsewhere, I will not elaborate on its detail here except to note that, contrary to prevailing beliefs, Native Americans were not conservationists. Moreover, because native peoples could prey-switch to small mammals, plant foods, and fish, they could take their preferred ungulate prey to low levels or extinction without having any adverse effect on human populations. In fact, once Native Americans killed off most ungulates, human populations actually rose (Hawkes 1991, 1992, 1993). Native Americans were the ultimate keystone species and their removal has completely altered ecosystems, not only in Yellowstone, but throughout North America (Wagner and Kay 1993).

Moreover, large numbers of native peoples inhabited the Yellowstone Ecosystem ca. 12,000 $\pm$ years BP (before present) to 1878 (Hultkrantz 1974, Wright 1984). The claim that Native Americans seldom visited Yellowstone because they feared the park's geysers and hot springs is false, and in fact, that myth was invented by early park administrators to promote tourism after the Nez Perces incident of 1877 (Hultkrantz 1979). Yellowstone's original inhabitants were forcefully removed ca. 1878 to reservations in Idaho and Wyoming for the same reason (Haines 1977).

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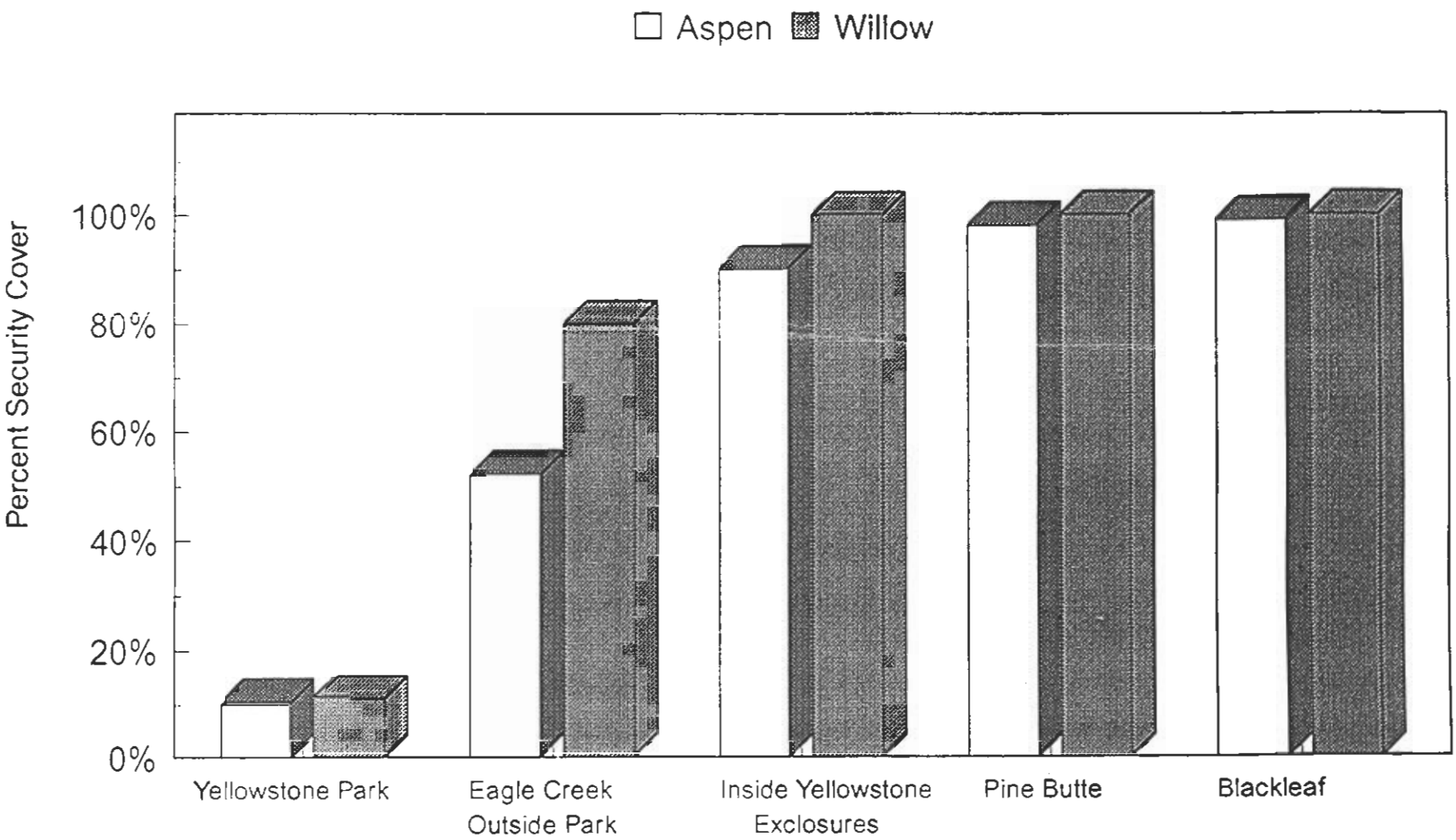
Table 1. The effect of ungulate browsing on berry production in the Yellowstone Ecosystem. The number of berries produced by plants protected from browsing inside ungulate-proof exclosures compared with the number of berries produced by the same species outside the exclosure. Yellowstone's grizzlies eat few berries because repeated browsing by an unnaturally large population of elk has virtually eliminated berry production, not because berry producing shrubs do not grow well in the ecosystem. Adapted from Kay (1995b:312).

	Number of Berries per 100 Plants		
Exclosure-species	Inside	Outside	p
Camp Creek			
Serviceberry	133,307	7	<.001
Lamar-west			
Serviceberry	111,047	0	<.001
Chokecherry	212,178	0	<.001
Uhl Hill			
Serviceberry	10,468	0	<.001
Chokecherry	6,508	0	<.001
Mammoth			
Buffaloberry	119,146	250	<.001
Total	592,654	257	<.001

Figure 1. Security-cover of aspen and willow communities inside and outside Yellowstone Park. Repeated ungulate browsing has eliminated most grizzly bear security cover on Yellowstone's northern range. Pine Butte and Blackleaf are situated along Montana's East Front and both areas are heavily used by grizzly bears. Graphed are 1,200 individual security cover-measurements. Adapted from Kay (in press a).


Aspen
Willow
Percent Security Cover
100%
80%
60%
40%
20%
0%
Yellowstone Park
Eagle Creek
Outside Park
Inside Yellowstone
Exclosures
Pine Butte
Blackleaf

SCIENCE AND RESOURCES MANAGEMENT IN THE NATIONAL PARK SERVICE

OVERSIGHT HEARING

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OF THE

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HOUSE OF REPRESENTATIVES

ONE HUNDRED FIFTH CONGRESS

FIRST SESSION

ON

RESEARCH OF OUR NATIONAL PARKS TO DETERMINE THEIR CONDITION, TO ADDRESS ANY THREATS TO PARK RESOURCES, AND DETERMINE THE BEST SCIENCE AND RESOURCES MANAGEMENT POSSIBLE

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