



# Elk Management in the National Park Service

## *Two Case Studies in the Use of Public Volunteers*

Natural Resource Report NPS/NRSS/BRD/NRR—2016/1119



**ON THE COVER**

Photograph of Elk on winter range at Rocky Mountain National Park.  
Photo credit: National Park Service

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## Introduction

The National Park Service (Service, NPS) has a long history of ungulate management dating from its inception in 1916 (NPS 2014). As defined by the NPS Organic Act, the enabling legislation for the Service, the primary purpose of the bureau is to “conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (54 USC §100101). The NPS has authority to manage wildlife populations and habitats under the NPS Organic Act (16 USC 1, 2-4), the General Authorities Act, as amended (16 USC 1a-1 et seq.), and other authorities. NPS policies for wildlife management are set out in section 4.4 and other provisions of NPS Management Policies 2006 (NPS 2006).

At the time the Service was founded, many wildlife populations were in decline and there was a need to create protected areas where wildlife and their habitats could find refuge and protection from human exploitation (Wright et al. 1933). For example, portions of Yellowstone National Park’s enabling legislation, from the 19th century prior to the Organic Act, specifically prohibit “all hunting, or the killing, wounding, or capturing at any time of any bird or wild animal, except dangerous animals, when it is necessary to prevent them from destroying human life or inflicting an injury, is prohibited within the limits of [the] park” (16 USC §26). Additionally NPS regulations state, “hunting shall be allowed in park areas where such activity is specifically mandated by Federal statutory law; [or] hunting may be allowed in park areas where such activity is specifically authorized as a discretionary activity under Federal statutory law” (36 CFR §2.2). This is a different mandate than that of other federal land management agencies such as U.S. Forest Service and Bureau of Land Management, where lands are typically open to hunting unless expressly prohibited and regulation of these practices are largely deferred to state wildlife management agencies. Most NPS units (~85%; NPS 2014) do not have specifically mandated or discretionary hunting allowed within their enabling legislation and thus remain closed to hunting. With more than 20 different potential designations for NPS units, areas open to hunting are not “parks” but rather are designated as preserves, seashores, lakeshores and recreation areas.

As wildlife populations recovered in the 20th century due to a variety of factors including the absence of top predators, changing wildlife regulations and abolishment of market hunting, ungulates, specifically those which thrive at the human-wildlife interface such as elk (*Cervus elaphus nelsoni*) and white-tailed deer (*Odocoileus virginianus*) became prevalent in many parks. In some cases the Service initiated this process by restoring elk (Sargeant and Oehler 2007) and deer (Wright and Thompson 1935) to habitats where they had previously been extirpated. In areas with appropriate habitat, lack of sufficient predators and protection from hunting, these species have often reached both ecological and social carrying capacity of parks and surrounding areas. In part due to changing societal attitudes and an influential report written for the Secretary of the Interior in 1963, the NPS incrementally adopted a policy of ecological or “natural” regulation in parks which strives to maintain or restore ecosystems to conditions that “prevailed when the area was first visited by the white man” (Leopold et al. 1963). With the exception of restoration of native species, an era of minimal intervention in wildlife management began in the late 1960s (Olliff et al. 2013) and until

recently has remained the overarching, although not explicitly expressed, paradigm in the NPS. During this time, park managers recognized the need for ungulate management to protect habitat, biodiversity, cultural resources, and the environment; however, there have been relatively few novel ways to mitigate effects of abundant ungulates, meet the mission and mandate of the NPS, and satisfy the social and political environments that parks operate within. While recreational hunting remains the primary management tool on most public lands, within National Parks techniques have historically been limited to trap and transplant, trap and euthanize, culling by government employees or contractors, or restoration of predators.

Two parks which have experienced this situation of locally high elk densities are Rocky Mountain National Park (RMNP) near the town of Estes Park, Colorado and the south unit of Theodore Roosevelt National Park (TRNP) which borders the town of Medora in western North Dakota. Both have restored native elk populations, neither park's enabling legislation authorizes hunting and both needed to address on-going or anticipated habitat issues caused in large part by elk herbivory. These two parks developed methods to use public volunteers to reduce elk populations. While both parks used volunteers to shoot and remove elk, each did so in different ways. The purpose of this investigation is to describe these two programs and to compare and contrast the ecological and sociopolitical drivers which led to using volunteers to remove elk in each park.

# Background

## Rocky Mountain National Park Elk Management

Rocky Mountain National Park (40.3333°N, 105.7089°W) is located in northern Colorado and covers 415 square miles which span the continental divide. Nearly 95% of the park is designated wilderness and wilderness character is an important part of management objectives. The park is in close proximity to major metropolitan areas on the Front Range of the Rocky Mountains including the Denver metropolitan area with a combined population of approximately 3.5 million people. The west side of the park is accessed through the town of Grand Lake, Colorado and is bordered by much less human development. The park receives more than 3 million visitors per year. Elk viewing is a major attraction for visitors to the park and the Estes Valley. The park is not fenced and wildlife moves freely across jurisdictional boundaries. Elk are hunted on the boundaries of RMNP on both public and private lands. While this is a locally important elk population in the state, it is not in the top 10 units in Colorado for either population size or harvest and thus not of statewide importance to the hunting public (Colorado Parks and Wildlife, 2015).

With locally significant impacts to habitat and corresponding biodiversity in RMNP and decreasing tolerance for high elk numbers in and around the town of Estes Park, RMNP engaged in a 5 year planning process (2003-2008) with the intent to restore the park vegetation to levels that would be expected with a more migratory, less sedentary and smaller elk population (NPS 2008). The Colorado Division of Wildlife and the Town of Estes Park were partners in the process.

After lengthy discussion and analysis at the local and national levels, there was agreement that culling was a necessary component to any logistically and politically feasible alternative. The idea and development of including members of the public to assist in elk culling was derived from inter-agency discussion and cooperation between, working group members, the Director of the Colorado Division of Wildlife (CDOW; now known as Colorado Parks and Wildlife) and RMNP Superintendent, senior NPS leadership and input from the Colorado Wildlife Commission, a citizen board appointed by the Governor to direct policy for the state wildlife agency.

It was important to the park and the NPS leadership that public volunteers would not be a proxy for hunters, as hunting is not legal in RMNP, and it was important to the CDOW that volunteers have the opportunity to shoot elk and at least some potential to retain meat, with the recognition that this was not a hunt in the manner offered by the state. These discussions occurred at the highest levels of each agency. This was the first time the NPS had used volunteers to cull animals and was a precedent setting event. Therefore, these two key areas of compromise resulted in development of the structure and function of the volunteer component of the elk management program at RMNP.

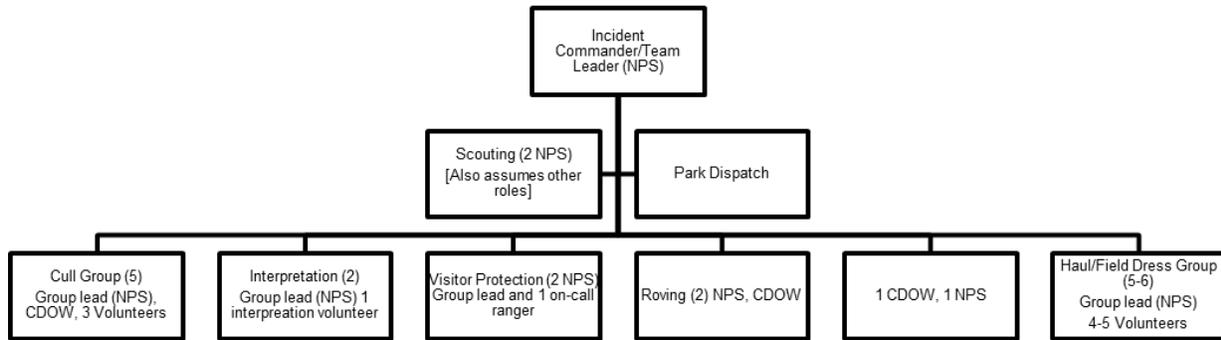
In February 2008, the final decision was made and the park began implementing its Elk and Vegetation Management Plan/ Environmental Impact Statement (the Plan) which consisted of fencing critical vegetation communities and slowly reducing the number of elk to achieve an elk population size of 600-800 in the park sub-population and 1,000-1,300 in the town sub-population (NPS 2008). Within the park, up to 200 elk could be removed annually for the lifetime of the Plan (~20 years). Most elk on the eastern winter range at RMNP are habituated to human presence and

are often easily accessed by roads, simplifying removal. Additionally, fences protecting up to 440 acres of willow and 160 acres of aspen could be constructed and aversive conditioning techniques could be used to re-distribute elk if needed to protect unfenced vegetation (NPS 2008).

During the planning stages and prior to implementing the Plan there were approximately 1,000-1,500 elk that used the eastern side of RMNP with densities of up to 110 elk/sq. km (Lubow et al. 2002). At the time the plan was implemented (2009-2011), there were approximately 400-700 elk using the RMNP winter range. At this time (2016) it is unknown exactly why the wintering elk population within the park has declined; however, there were likely multiple factors including redistribution to alternate winter habitat further east of the park (Loveland, CO area), a large elk harvest outside the park in the adjacent hunt unit during the 2006/2007 hunting season associated with heavy snowfall, historically low calf recruitment rates within the park (Lubow et al. 2002), relatively high mortality rate due to chronic wasting disease (Monello et al. 2014), and exclusion from prime winter habitat within the park due to fencing. While it is beyond the scope of this paper to explore the causes of population decline within the park, it is clear that the large elk population using the park prior to and during the planning process had decreased dramatically prior to implementing culling.

The park began culling elk in January 2009. During the fall of 2008, in close partnership with CDOW staff, the park advertised on RMNP and CDOW websites asking for public volunteers to assist with elk removal. The response was enthusiastic and more than 100 people submitted on-line application surveys. Applicants were screened on the basis of the background investigation results and their written self-assessments as well as oral interviews of knowledge and skill with firearms, killing and field dressing of large animals, conservation practices and philosophies, working with agencies and in a team environment, and their physical abilities or limitations. The park was clear with the public that volunteers were not hunters. Key distinctions included no hunting license requirement to participate, no direct meat retention by the volunteer and no expectation of a traditional recreational hunting experience (i.e., fair chase, self-selection of animals, self-regulation of state imposed rules, etc.).

All volunteers had to commit to being teammates, filling a variety of roles through an entire culling season (January – March) and had to be within commuting distance of the park. All culling teams were led by an NPS staff member. Each volunteer was given a shooting test. Only non-lead ammunition was used for qualifying and culling. If a volunteer did not pass the shooting test or did not want to volunteer in a shooting capacity they were allowed to remain in non-shooting volunteer positions such as carcass processing or providing interpretation for visitors. In addition to firearms training and qualification, each volunteer attended 2 days of classroom training and a 1 day dry-run operation in the field. Due to significant visitation during the culling period, legal challenges and intense public scrutiny, RMNP chose to implement a formalized operational structure that adheres to the Incident Command System (ICS, NPS Director's Order 55). Job duties fell within the ICS structure and required 16-17 people (8 volunteers and 9 agency personnel) to remove 1-2 elk per day (Fig. 1).



**Figure 1.** Team organizational structure and staffing for culling operations at Rocky Mountain National Park. Total of 16-17 individuals (8 volunteers, 9 agency personnel [7 NPS and 2 CDOW]) per culling operation per day to remove 1-2 elk.

Operations occurred in high visitation areas on the elk winter range without closing the park to visitors. The process was highly controlled; roads were temporarily closed and public access restricted in the immediate area of field operations by the team members, generally for periods less than 30 minutes. The actions were designed to have minimal impact to visitors, maintain elk viewing opportunities, have minimal impact on wilderness character, kill the elk as humanely and quickly as possible and maintain the meat for donation.

To have the greatest effect on population size and fecundity as well as maintain elk viewing opportunities, only female elk were targeted for removal. Female elk were identified in areas where there was a safe shooting backdrop, they could be easily removed via a hand pushed sled and where the area could be secured of visitors. Elk were not difficult to locate or approach. Shots were taken from 40-250 yards. A second shot was rarely required. The carcass was field dressed, biological measurements were taken and samples were collected for chronic wasting disease testing at the site. Upon moving the carcass to the road for transport, possession was transferred to CDOW and all costs incurred for carcass disposition were covered by the state. Meat was donated through a state run lottery system to members of the public if test results showed that chronic wasting disease was not detected. Volunteers were allowed to enter the meat lottery if they desired. Operations took an average of 1.5 hours per elk and 7-8 volunteers were involved in each removal.

### **Theodore Roosevelt National Park Elk Management**

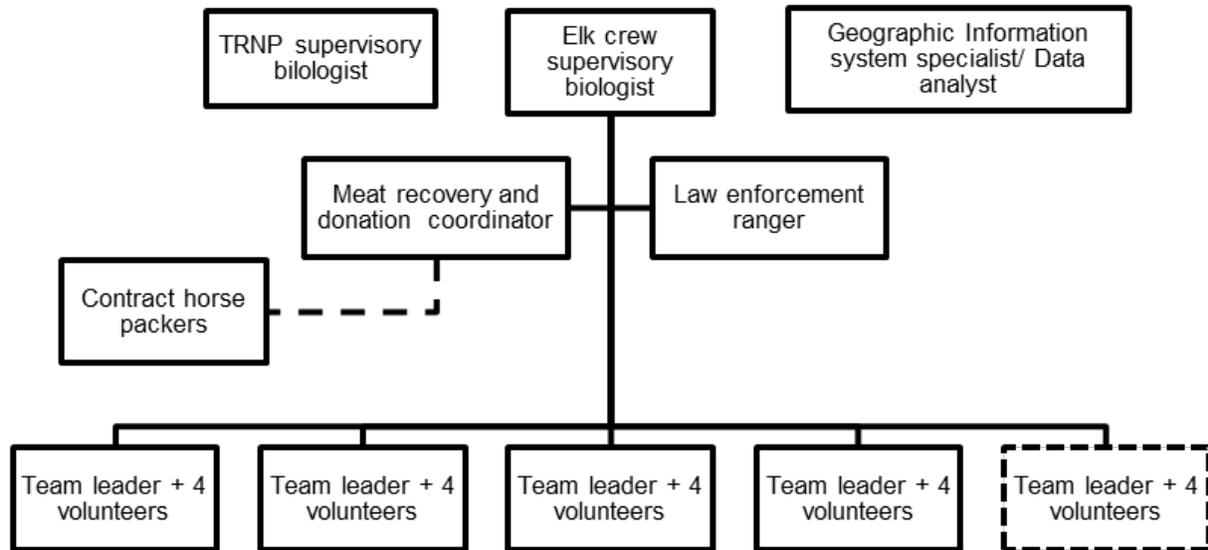
Theodore Roosevelt National Park (46.9667°N, 103.4500°W) is located in southwestern North Dakota within the Little Missouri River Badlands. The park consists of highly erodible badlands with gullies and ravines separated by upland plateaus and small erosion-resistant buttes (Laird 1950). Approximately 600,000 people come to the park annually, the great majority of who report wildlife viewing as a primary motive for visiting. There are 3 units of the park; however, only the south unit has a resident elk population. Adjacent to the town of Medora (permanent population of 100) and surrounded by 1.2 million acres of Dakota Prairie National Grasslands, this unit is approximately 72 square miles and completely fenced to prevent egress of bison (*Bison bison*) and feral horses (*Equus caballus*) which also reside in the park. Elk can pass freely over or under much of the fence but tend to spend most of their time within the park (Sargeant and Oehler 2007). Approximately 23% of the

park's south unit is wilderness. It is located in a predominantly rural area and the resident elk herd supports the majority of the hunted elk in the western half of the state. Through a competitive draw process, successful hunters are allowed an once-in-a-lifetime opportunity to harvest an elk on private or public land surrounding the park. There are also limited landowner depredation permits when elk cause damage to private property. The hunt is considered highly desirable and it is difficult to draw a license.

In 2002 an internal NPS policy pertaining to chronic wasting disease prohibited moving elk out of the park without extensive disease testing (NPS 2002). At that time, facing a growing elk population which could have impacts on vegetation inside the park and could exceed social carrying capacity outside the park, park managers began an Elk Management Plan/ Environmental Impact Statement (the Plan). The process took 6 years (2004-2010). Although the U.S. Forest Service (Dakota Prairie Grasslands) did not manage specifically for elk, they and the North Dakota Game and Fish Department (NDGFD) were instrumental in the initial elk reintroduction effort and therefore both served as cooperators on the Plan. At the time planning began, the park elk population was approximately 500 and there were no easily recognizable vegetation impacts due to excessive browsing or grazing; however, managers had to change allocations of bison and horses on the landscape to accommodate the growing elk population. The intent of the Plan was to be proactive in preventing resource damage rather than reactive to degradation that had already occurred. At the end of the planning process there were more than 1,200 elk in the south unit of TRNP. Reaching the population objective of 100-400 elk as quickly as possible was desirable to minimize cost and disturbance to park visitors and operations. During the planning process, a volunteer-based culling program was projected to take many years, require substantial funds to administer, expose the government to liability, and yield uncertain results in terms of meeting management objectives. Therefore, at that time this alternative was not likely to be chosen as the preferred action. The NDGFD advocated strongly for outcomes that involved the public, leading to a U.S. Senator from North Dakota contacting the Acting Director of the NPS asking for consideration of significant public involvement in culling elk from TRNP as part of the Plan.

The final decision was made in June 2010 and culling using public volunteers was the preferred method, although round up and euthanasia or live transfer remained an option if the population goals (e.g., removing an average of 250 elk/year) were not met in the first two years (NPS 2010). Between June and October of 2010 park staff developed a highly structured culling program and automated volunteer selection system. Volunteers were recruited from across the U.S. via the park website. Response was overwhelming. Over 5,000 people from 46 states applied and a sophisticated program was developed to select volunteers randomly from the pool. Approximately 200 volunteers participated each year, although there was less interest and a higher attrition rate during the second year. Potential volunteers self-certified in writing that they were capable of passing a shooting test using their own firearm and self-supplied non-lead ammunition. This was confirmed during a shooting test administered by NPS staff. If a volunteer did not pass the test they were asked to leave and could not participate in any portion of the culling activities. Volunteers also self-certified that they were capable of strenuous exercise and carrying heavy loads. Each volunteer was required to sign a volunteer agreement describing expectations and obligations as a team member and park

ambassador and pass a criminal background check. No state hunting licenses were required. Volunteers had to commit to one week during the culling season (October – December/January). The first day of each week 16-20 new volunteers came to the park and they were divided into 4-5 teams of 4 volunteers each (Fig. 2). Each team was led by a seasonal NPS employee who was skilled at locating, killing, field dressing and transporting elk out of the backcountry. Six hours at the start of each week were dedicated to volunteer education, training and firearms qualification.



**Figure 2.** Team organizational structure for culling operations at Theodore Roosevelt National Park. Total of 25 individuals (20 volunteers, 5 NPS staff) for 5 culling teams per day (2010) or 20 individuals for 4 culling teams per day (2011) with an average of 12 elk taken per day.

The backcountry of the park was closed to visitors when culling occurred; however, this area does not receive high visitation during the winter months and little if any visitor disruption was reported or observed. Team leaders selected areas of the park where radio-collared locator elk (i.e., Judas) were located and had a GPS location of these elk each morning. Elk are not habituated within TRNP and generally occupy backcountry areas distant to humans and developed areas. Elk frequently occupied areas where strenuous hiking was required to reach them. Reduction teams spent 3 days per week killing as many elk as could be safely and effectively removed from the backcountry then meat was kept in refrigeration units throughout the week. Elk were killed by both volunteers and NPS team leaders. Moreover, team leaders would routinely fire a follow up shot if a volunteers' shot failed to quickly drop the elk. Team leaders controlled group movements and direction, indicating which elk to shoot, when to shoot, and how many elk would be shot from a group of animals. Primarily adult female elk were taken in the first 2 years of the operation and later sub-adult males and calves were taken to meet population objectives. Biological samples and extensive data were taken and recorded on hand-held data devices then elk were field dressed. Volunteers and team leaders backpacked meat out of the backcountry to refrigeration units at headquarters each day. If it was unsafe to pack the meat out via the team members, horse packers were contracted for assistance.

A portion of the meat was donated to NDGFD and if volunteers spent four days of their time (1 training day and 3 removal days) the state allowed them to take the meat of 1 elk home with them if the team had successfully removed at least 1 elk per team member, otherwise meat was divided equally among team members. NPS employees did not retain any meat. All remaining meat was donated directly to Native American tribes and to the North Dakota Community Alliance (state food bank) through North Dakota Sportsmen Against Hunger. All elk were tested for chronic wasting disease and none were found positive to date (2016).

## **Methods**

### **Interviews**

We conducted a series of interviews with key personnel from RMNP, TRNP, and from neighboring state wildlife agencies, specifically Colorado Parks and Wildlife (formerly known as CDOW) and the NDGFD. The intent of interviews was to reveal motivations leading to the structure and function of the elk removal programs at RMNP and TRNP, to quantify the perceptions of success and failure and to describe attitudes toward elk management at each park from both NPS and state wildlife agency personnel perspectives. We sought to identify common ideas and areas of disagreement between parks and state agencies and also between North Dakota and Colorado.

By phone and in person, we interviewed personnel (RMNP n=4, CDOW n=4, TRNP n=5, NDGFD n=2) who had significant involvement in the creation or implementation of the elk management plans at each park. Interviewees were from all levels of the organizations from field biologists to upper level management. We asked the same series of questions of each person to learn the key factors which determined the shape and structure of each plan and implementation process and to try to understand not only the technical aspects of their involvement but also their perception of the processes and outcomes. Interviews were not recorded but notes were taken and summarized. Interviewees had the opportunity to review and correct their interview summary. Main themes of interviews were identified by first 2 authors (Powers and Kahn) and discussed with other authors.

### **Economics and Structure of Elk Management Programs**

Separate from the interviews, park personnel provided information on the economic implementation costs associated with using volunteers to remove elk in the respective parks and described the structure of each program. Costs accompanying the procurement of equipment and supplies, as well as volunteer selection, training, and supervision are included. Additionally, costs related to collaring Judas elk, if used, are also included in cost per elk removed. Elk population surveys, which are critical to achieving management objectives, are reported separately. Costs associated with compliance planning, research activities or other management actions are not included in cost per elk analyses.

## Results

At RMNP, in January 2009 a total of 13 elk, in 2010 23 elk, and in 2011 16 elk were removed (52 total elk removed 1 male, 51 female) utilizing public volunteers. During the three years that culling occurred an additional 79 elk (n = 20, 25, 34 elk/yr) were taken for research purposes (Monello et al. 2014, Powers et al. 2014). Volunteers were not involved in the research portion of elk removal. A total of 33 field days were spent with volunteers from January 2009 – January 2011 and more than 2000 volunteer hours were donated for both the training and field operations. Training accounted for more than 800 volunteer hours. In 2012 and continuing to present, population surveys indicate that the elk population in the park (200-400) is below population objective (600-800) called for in the Plan and there has been no need to cull elk.

At TRNP, during the first (2010/11) and second years (2011) of the program 406 and 462 elk, were removed using public volunteers. Approximately 2-3 elk were culled per 5 member team per 8-10 hour day. Most of the animals removed (87%) were females. More than 400 volunteers contributed in excess of 12,000 hours supporting the reduction effort during these 2 years. This initial or “reduction” phase of the program was intended to reach the target population size (100-400). During the “maintenance” phase the population was intended to be controlled with relatively small amounts of effort by removing only the recruitment fraction of the population each year. This population goal was expected to take 5 years to achieve. At TRNP, the program was more successful than predicted, allowing population objectives to be met in just 2 years. During the third year the maintenance phase began and use of volunteers was evaluated annually (NPS 2010). In the first 3 years of this phase, elk were removed solely by NPS employees without the use of volunteers (n = 69, 46, 38 in 2012-2014 respectively). Maintenance phase removal efforts will continue throughout the lifetime of the plan (15-20 years) unless there is a change in population dynamics, habitat utilization, or elk survival within TRNP.

### Interview Insights and Findings

Personnel from state wildlife agencies and the NPS had similar educational backgrounds in wildlife biology and natural resource management and often similar personal backgrounds and experience with hunting. However, their professional beliefs differed greatly. Most state employees had actively managed elk through hunting for most if not all of their professional careers. The common sense answer to having too many elk on the landscape for state agency employees was to open the area to public hunting. Conversely, most NPS employees had worked in an environment which promotes wildlife protection and preservation. If elk needed to be removed to protect their habitat then it should be done with ecological restoration of predators, when socially attainable, and if not with the fewest negative effects on park management, visitors and resources including the elk themselves. Both state and NPS employees approached the problem of too many elk with a firm understanding of their positions or outcomes for desired elk management methods but, as described by Fisher and Ury (1991) there was less clarity on the interests or underlying desires and concerns that motivated these positions.

The interviews revealed recognition that the elk at both parks are shared resources and both state wildlife agencies and NPS have joint management responsibility. Similarly, the overarching goal of managing a healthy free-ranging elk population was shared by state and NPS personnel at all levels. However, there was little flexibility expressed on either side to leave the stated positions of each agency and explore the breadth and depth of acceptable management actions to meet common interests. In general, the NPS personnel at both parks took a position that predator restoration was the most consistent resolution with NPS values but understood that there would be insufficient public, state, and political support to implement this action. Baring this option, they felt using members of the public to cull elk would be too laborious, expensive, and time-consuming to be a useful elk management tool. On the other hand, in North Dakota state employees took the position that traditional hunting was the desired management solution, while in Colorado, state employees had strong negative sentiments toward any option that did not incorporate public involvement and take of elk (e.g., they were strongly opposed to fertility control and wolf restoration). All sides felt strongly and were often philosophically tied to their position. Only when the interests, including needs, desires and goals, underlying the agency positions were expressed, most often between senior key decision makers, was substantial progress made toward resolving differences in what methods would be used to manage elk. This led to the evolution of use of public volunteers. The concept of volunteers met the fundamental NPS need to stay consistent with one of its mandates of prohibiting hunting in National Parks and met the states' need to be consistent with many of the principles described in the North American Model of Wildlife Management (NAMWM; Organ et al. 2010), specifically public access to wildlife trust resources and responsible use of the meat.

Nearly all interviewees agreed that both the NPS and state wildlife agencies did a good job of communicating with the press and getting information out to the public but that communications within and more importantly between agencies could be improved to increase clarity and trust. All interviewees agreed that while the National Environmental Policy Act (NEPA) process was successful in creating an actionable plan, it alone was not an efficient method for meaningful interagency communication, nor did it encourage informal conflict resolution due in part to the rigid process and large working groups. Due to the controversial nature and strong attachment by agency staff, the most productive and collaborative discussion which led to constructive compromise occurred where trust and understanding of opposing views and interests could be developed between key decision makers. It was even more successful when relationships had been established prior to the conflict. The use of public volunteers in the preferred alternative at each park was a compromise in positions but a success in interests for both the parks and state wildlife agencies involved.

Both state wildlife agencies and the parks emphasized that elk are a public trust resource and that they are managing these iconic and highly desirable wildlife species for the good of the American public and also as part of the larger context of habitat sustainability for the elk and all species that share these ecosystems. States emphasized managing these resources for state constituents, where they acknowledged that hunters are their key public, whereas the NPS managed for both local and national constituents. States managed and advocated from a position consistent with the values identified in the North American Model of Wildlife Management. The guidance for wildlife management in parks was broadly defined without specific requirements as in state wildlife

management agencies. This is likely a function of an NPS policy which emphasizes letting nature regulate ecosystems and is unconstrained by past elk management practices given comparatively little contemporary elk population management has occurred in parks. Additionally, until recently, there has been little overall national direction on wildlife management within the NPS except in very broad terms (NPS 2006, NPS 2014). Finally, decision making within the NPS is more flexible than that which occurs at the state level likely due to the influence of State Wildlife Commissions, State Legislatures, and user groups which are more influential at the state level and often have less impact on wildlife issues at the federal level.

Both parks selected volunteers as a principle means of elk management; however, the differences in the external socio-political environment and surrounding human population demographic at each park resulted in meaningfully different implementation of this technique. The rural nature of North Dakota verses the more urbanized setting of the Front Range of Colorado meant that local publics had significantly different concerns and expectations about elk management in each park. Hunting is a predominant part of the culture in North Dakota whereas in Colorado there is a greater range of ideas regarding what constitutes appropriate elk management methods. Additionally, elk at RMNP are highly valued as watchable wildlife. Elk contribute large social and economic benefits to the local economy and the opportunity to experience elk by driving the park roads is one reason visitors come to the park. At TRNP, while visiting publics often know elk inhabit the park, they are rarely observed by simply driving the scenic road.

It was important to both state wildlife agencies that members of the public be included in removal activities; initially both states strongly urged the NPS to use some form of traditional hunting. When it became clear in both situations that a hunting solution would require congressional action, which in the case of TRNP was proposed by the state, and that NPS leadership at the highest levels would not support that action, discussion moved towards other options involving the public. This discussion led to the use of volunteers. It was important to the NPS to distinguish elk removal by volunteers from hunting from both legal and logistical perspectives. Some of the attributes of each program were designed for this purpose. Specifically, at both parks wildlife population and habitat management as well as biodiversity goals were emphasized and recreational experience of the volunteer was restrained or curtailed. Volunteers were informed the primary purpose of their participation was to safely and efficiently remove elk. At no time were volunteers allowed to make decisions about which animals to take nor were volunteers allowed to pose for photographs with downed elk. Service personnel were in control of the logistics and specifics of how, when, where, and which elk were removed, dressed and prepared for donation. While most volunteers were experienced hunters, there were no state issued hunting licenses or tags associated with these management actions, nor were any federal licenses or permits required. Volunteers received no compensation for their services and likewise did not pay for the opportunity. Emphasis was placed on completing a job efficiently and taking pride in assisting the parks with a resource issue. While each in itself is not definitive, these details in combination were critical in defining differences between hunting and volunteer culling.

Donation of the meat was important to everyone; however, states were more interested in volunteers having the opportunity to retain meat. While it may have been consistent with NPS policy to leave a portion or all of removed animals in the field for scavengers, this would not have been consistent with the expectations of the public or state wildlife agencies for responsible use of wildlife resources. The desire not to leave salvageable meat in the field was recognized and supported by all interviewees regardless of agency.

Just as it was important to distinguish between hunting and the use of volunteers, it was also important to nearly all interviewees that there be distinguishing features between volunteers and agency culling. It was particularly important to state agency personnel that volunteers be allowed to not only assist with the operation in general but specifically allowed to use firearms and kill animals. For NPS personnel it was less important whether agency personnel or volunteers did the killing and more imperative that safety be maintained and overall management goals achieved with minimal disruption to park operations. It was, however, important to each park that if volunteers were to do the shooting that they have the desired skills or qualifications outlined by each park. At TRNP these skills were primarily related to proficiency with firearms and ability to complete extremely physically challenging work. At RMNP the qualifications focused on a strong conservation ethic and desire to assist in resource management in addition to shooting and meat processing skills.

Despite strong reservations initially, personnel at both parks found that the elk management volunteers they recruited, trained and worked alongside were tremendously valuable assets to the programs. While each park recruited volunteers differently, both found that their strongest advocates and most vocal supporters were the volunteers themselves. They added legitimacy to the programs by providing positive feedback to the press and other venues about the professionalism of both operations and they decreased the cost of the overall process, particularly at TRNP, by providing valuable labor. One NPS person even commented that volunteers became “park ambassadors” and several commented on the positive aspects of “citizen wildlife managers”. At RMNP many of the elk volunteers have remained engaged in volunteering at the park on projects other than the elk cull. Volunteers were viewed as valuable resources and significant time and energy were considered assets well spent on selecting, training, developing and managing volunteers. State wildlife agency personnel echoed these sentiments that volunteers provided overwhelmingly favorable feedback of the programs and that the programs provided a positive alternative to traditional hunting.

### **Economics of Elk Removal**

The largest cost incurred at both parks to administer elk removal programs using volunteers was personnel time. We included the time associated with designing the removal program, public relations, interagency (between NPS and state wildlife agencies) discussion and negotiation on how to implement the programs, field operations including culling, meat processing, elk marking with GPS collars (TRNP only), and volunteer selection, training, and supervision. We did not include time associated with compliance planning, vegetation surveys, fencing (RMNP only), or research activities. Yearly elk population survey costs are included separately from the cost per elk. At RMNP during the 3 years of removal an average of \$70,000/yr was spent on personnel time. At TRNP during the months prior to removal during project planning (2010) and the 2 years when

volunteers were used (2010-2011) \$378,000/yr was spent on personnel time. During the first year when only NPS employees were used (2012) \$184,000 was spent on personnel time.

The type of equipment and supplies used including, rifles, non-lead ammunition, backpacks, range finders, knives, game bags, sleds, vehicles, and personal protective equipment were similar at both parks. At RMNP \$15,500 was spent on equipment and supplies and at TRNP \$53,000 was spent to initiate the program not including \$177,000 for GPS collars for Judas animals. Supply costs were minimal at RMNP after the first year (~\$2,000-4,500/year), but at TRNP were significant due in large part to 4-wd vehicle rentals and fuel costs to transport staff and volunteers to remote locations of the park (~ \$40,000/yr with volunteers and \$10,000/yr with staff only) and rental of 1-2 refrigerated container trucks to store meat (~\$10,000/yr October-January). The cost of elk surveys using ground counts and helicopter surveys at RMNP was ~\$22,000/yr and the cost of fixed wing surveys at TRNP was ~ \$3500/yr.

At TRNP the logistics of getting meat out of the backcountry were more difficult than at RMNP. During the first two years, most meat (~ 60%) was removed from the backcountry by volunteers and NPS employees; however, carcasses which could not be safely retrieved on foot were recovered by contract horse packers. The cost of carcass recovery using contractors averaged nearly \$300 per animal retrieved. Meat recovery using contract packers cost an average of \$53,000/yr during the first 2 years of the program when volunteers were used and packers cost \$12,000 the first year of NPS-only removal. A greater percentage of elk (~60% vs ~40%) were removed using humans than horses when volunteers were engaged in the operation.

At RMNP meat was held at a contracted meat processing facility prior to donation. The cost of meat processing and distribution is not included in RMNP costs because it was covered by CDOW. It cost the state of Colorado approximately \$1,100 per year to contract with a local meat processor to skin, quarter and distribute the meat from culled elk. At RMNP approximately 11,000 lbs of quartered carcasses were donated to the public through the CDOW and at TRNP more than 150,000 lbs of meat were donated to volunteers, Native American tribes, and state food banks. All donations to private individuals were completed through the state wildlife agency partners.

The cost per elk removed for the entire program as described above was ~\$4,700/elk at RMNP and ~\$1,450/elk removed using volunteers at TRNP. All elk culled at RMNP were removed using volunteers (n = 52) whereas only elk removed during the first two years incorporated volunteers at TRNP (n = 868). During the first year of elk maintenance (2012) at TRNP, 69 elk were removed using NPS personnel and the cost was ~\$3,000/elk. This did not include amortized start-up costs. Volunteers decreased the cost of elk removal at TRNP by approximately half due to the efficiencies of scale and lower meat packing costs. There was no maintenance removal period required at RMNP due to decreased elk population size on the park winter range. Due in part to lack of need to remove elk, efficiencies of scale were not realized at RMNP.

At RMNP fencing was the largest expense of the program and will likely have the greatest effect on the outcome of re-vegetation and short-term recovery of aspen and willow communities. Fencing costs were not included in the cost per elk. Despite fences, willow communities sustained such

significant damage that re-planting will be required in many areas for restoration. Using independent contractors to fence ~230 acres with 7 foot high woven wire fencing over a period of 5 years cost \$1.2 million. All fences have a 16 inch gap at the bottom to allow for ingress and egress of smaller wildlife species. Long-term fencing maintenance costs are not available at this time.

Volunteer hours spent in parks are commonly valued at ~\$20/hr. Estimated value of volunteer time during the elk culling operations at RMNP was \$40,000 and at TRNP was \$240,000. At RMNP these volunteers have been retained and continue to assist with elk ground count surveys, vegetation monitoring and elk exclosure monitoring.

## Discussion

Ungulate management in the NPS has been evolving since the inception of the Service nearly 100 years ago (Sellars 1997, Singer et al. 1998, Wright 1999, NPS 2014). While the Leopold Report (1963) is often cited as the document that directed the NPS towards decades of natural regulation as the primary means of managing ungulates (Singer et al. 1998, Olliff et al. 2013, Wright 1999), a careful reading of the Leopold Report reveals that the authors did not direct the NPS to rely solely on natural regulation. Indeed, the Leopold Report stated that "Direct removal by killing is the most economical and effective way of regulating ungulates in a park," and stated that recreational hunting "is an inappropriate use of national parks." The reconciliation of these two perspectives led the report authors to state that "the National Park Service may find it advantageous to employ or otherwise engage additional shooters from the general public". Nearly 45 years elapsed before the NPS implemented the use of public volunteers to regulate ungulate populations in parks.

With the exception of Grand Teton National Park, which has an elk reduction program that allows state licensed hunters deputized as rangers to remove elk in areas that were added to the park in 1950 (16 USC § 673c), elk have not been culled from NPS units for population management since the 1960s. At that time agency culling was viewed unfavorably by local and national constituents, state wildlife agencies and the NPS itself (Packard 1947, Olliff et al. 2013, Wright 1998). A period of natural regulation was adopted nearly Service-wide for approximately the next quarter century (1968-1995), followed by re-evaluation of this policy to prevent irreparable harm to park resources (NPS 2014). In many situations throughout the NPS, elk and other large ungulates interact with larger scale drivers and stressors such as land use change and invasive species to disturb their habitat and that of other species that share the same ecological communities. In only a few cases is wildlife translocation an option to mitigate these effects and the likelihood of these situations increasing in either desirability or feasibility is diminishing. Likewise, although consistent with NPS policy and often scientifically defensible (Estes et al. 2011), the potential for restoring large predators to the landscape of most parks is socially and politically difficult. Presently, viable management options are constrained for both state and federal wildlife management agencies, the desire to maintain naturally functioning large landscapes is high and there is strong public sentiment to provide opportunity for citizen science and public input to wildlife management (Wright 1998). Using volunteers as members of a combined agency personnel and public team may meet many of these objectives.

The local social environment has a significant impact on how parks may utilize volunteers. Local attitudes may influence agency decisions on the intensity and rate of culling. Visitation will have a great impact on when and how animals can be removed safely and with minimal disruption to park operations and visitor satisfaction. Park staff attitudes and perception of the social and inter-agency environments also play a role in implementation of this method. In spite of differences in their state constituencies and staffs, both RMNP and TRNP had successful programs from both the NPS and state wildlife agency perspective. The population goals were met in both parks within 3 years. At TRNP, this was due exclusively to efficient field protocols, highly orchestrated use of volunteers, and support of park employees from all divisions. At RMNP, elk removal using volunteers was one

piece of a larger more complex management plan; large fencing projects, high elk harvest adjacent to the park, large movements of elk out of the park and removal associated with research objectives all contributed to the overall goal of a reduced park elk population.

## Management Implications

Rocky Mountain and Theodore Roosevelt National Parks demonstrated that with appropriate supervision and training, volunteers can safely and successfully remove large numbers of ungulates from the landscape and can do so in a cost effective manner when compared to using solely agency personnel. The experience gained through these two parks is potentially applicable to other overabundant ungulate situations within the National Park System.

White-tailed deer are deemed overabundant in several eastern and Midwestern NPS units. For white-tailed deer population management, trained volunteers may be a feasible, safe and efficient alternative, though consideration of local issues will be warranted.

Despite the NPS and state wildlife agencies having similar broad wildlife management goals of fostering healthy free-ranging wildlife populations, too often areas of disagreement on the approach to management have remained challenging problems to resolve. The situation improves when state and federal wildlife managers focus on common interests rather than opposing positions to find a path forward. Wildlife is a shared public trust resource and both state and federal agencies have been entrusted to make management decisions. By seeking common ground while respecting inherent differences in agency cultures and laws, we may find unique solutions to recurring problems that can meet the most important objectives of NPS and state wildlife agency policies, and interested publics. Removing elk using volunteers is one example of a novel solution which required compromise by all agencies involved and met the most important needs and objectives of each. We suggest this may be one effective solution to consider, after careful analysis of interested publics, in other NPS units facing similar ungulate abundance issues.

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# Appendix A: Interview Information and Questions

## **Project Objective:**

To understand and describe the intent and the reality of elk management using volunteers at Theodore Roosevelt and Rocky Mountain National Parks. We are interested in both planning and implementation processes.

## **Rationale:**

We anticipate this information may be used by other parks analyzing the option to engage volunteers in ungulate management projects and will be useful when communicating to outside entities about how the NPS uses volunteers in elk management and engages state agencies. Finally, we believe this will increase transparency and provide context for NPS management actions to the broader public and wildlife management profession.

## **Your background:**

1. How did you end up in the field of park or wildlife management?
2. Describe your experience with elk management prior to this one.
3. How did you become involved in the RMNP or TRNP elk management issue?

## **Planning process:**

4. What was the primary reason to undergo elk management at RMNP or TRNP?
5. How were you involved in the planning process?
6. How did laws/regulations/policies influence the discussions during planning?
7. What made volunteers a critical component of this plan?
8. What changes would you make to the planning process?

## **Implementation process:**

9. How were you involved in the implementing the plan?
10. How well do you think implementation went?
11. How did these actions affect visitor experience in your park or state?
12. What were the most valuable aspects of using volunteers?
13. What were the most difficult aspects of using volunteers?
14. What changes would you make to implementation of the plan?

## **Outcomes and lessons learned:**

15. How well were objectives met?

16. What do you think the outcome would have been had a different alternative been chosen?
17. Do you think this plan will affect other national parks? If so, how?
18. What words of wisdom do you have for other state or NPS managers faced with similar decisions and interactions?

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