

The role of hunting in North American wildlife conservation

JAMES R. HEFFELFINGER^{†*}, VALERIUS GEIST[‡] AND WILLIAM WISHART[§]

[†]Arizona Game and Fish Department, 555 N. Greasewood Rd., Tucson, AZ 85745, USA; [‡]Faculty of Environmental Design, University of Calgary, Canada; [§]Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta, Canada

Regulated hunting is the foundation of the North American Model of Wildlife Conservation. This conservation paradigm arose out of a movement, led by prominent hunters, to stop over-exploitation of wildlife by market hunters and the desire to have wildlife accessible to all people. Since then, hunters have contributed billions of dollars to wildlife management that benefit countless wildlife species. These funds support wildlife management agencies which manage all wildlife species, not just those that are hunted. This unique and successful conservation paradigm is responsible for supporting a wide variety of conservation activities, including law enforcement, research, information and education, habitat management and acquisition, as well as wildlife population restoration and management. Although wildlife conservation activities embrace far more than the hunted species, hunters continue to be the primary agents of financial support, management assistance and organized advocacy.

Keywords: Conservation; Hunting; North American model; Wildlife

Introduction

During the twentieth century, there arose a system of wildlife conservation in North America with an infrastructure supported by a unique environmental ethic so effective and exemplary that it defied political and historical expectations [1–6]. It was remarkable that wildlife would be given such high priority in a culture where capitalism, free enterprise and private property rights are held in high esteem. With firearms in private hands outnumbering big game many fold, wildlife could be easily killed off. Yet, it is extraordinary that hunting emerged as a positive and constructive force in the conservation of wildlife [7,8]. Today wildlife has become so treasured that it enjoys universal legal protection and public good will.

This is remarkable as, historically, hunting has often been associated with wildlife destruction. There is controversy about the causes of the collapse of the Quaternary megafauna around the world, but some have associated this with over-exploitation by human beings [9,10]. There is an extensive history of extirpation, which followed seafarers on their extensive travels. Native North Americans may have impacted wildlife populations locally, for the archeological record shows very different distribution patterns of large mammals in pre-Columbian times. There are indications of some wildlife being more

*Corresponding author: Email: jheffelfinger@azgfd.gov

abundant in inter-tribal zones where hunters went rarely and only with great caution in justified fear of being caught and killed by a neighboring tribe's war parties.

Furthermore, throughout much of world history, wildlife became a symbol of the hated ruling elite and was destroyed to spite it [11–13]. In North America, there was no 'conservation ethic', but rather a complete disregard for the future of wildlife resources that persisted into the nineteenth century. During those dark times, market hunters drove wildlife to near extinction apparently proving the validity of Garret Hardin's Tragedy of the Commons [14]. Even today, there is no conservation ethic in poachers [15,16] and generating such is difficult, complex and daunting [17–22].

The North American model, whereby hunting is an ethical and conservation-motivated force is a modern phenomenon [23]. The term 'sport' hunting is not always well-received by the non-hunting public. For some it brings to mind frivolous killing of animals just for 'sport'. The origin of this term is not, however, a reference to competition or irreverent armed pursuit, but rather the opposite. Original references to sport hunting are rooted in ethical pursuit and a code of honorable, restrained, fair chase that was so championed by Theodore Roosevelt [5]. Sportsmen were clearly differentiated from market hunters of the day: 'True sportsmen, worthy of the name, men who shoot only in season and in moderation, do no harm whatever to game' [24].

What is now referred to as the North American Model of Wildlife Conservation was created by hunters and arose out of the massive wildlife destruction in the nineteenth century [25]. This new model generated an unequalled abundance of native wildlife (predators included), created a new profession of university-trained wildlife biologists and made wildlife a creator of wealth and employment. This transparent and accountable system of sustainable natural resource use has resulted in comprehensive and effective international conservation treaties and also local laws which do not allow the frivolous killing of wildlife. It is a product of grassroots democracy that has mobilized society into passionate support for a nearly ubiquitous conservation ethic.

The North American hunter deserves special recognition for the great achievements detailed in this paper. Professor David Lavigne recognized the significance of the North American Model of Wildlife Conservation for global consideration and asked that it be presented to an international audience in Limerick, Ireland [4]. At recent symposia in London and Namibia, participants reaffirmed the importance of hunting to wildlife conservation and urged others to model conservation programs after the North American model [26,27]. Whatever the motive, the management assistance, financial support and wildlife advocacy of North American hunters, they generated a unique system of conservation as detailed here.

Population management

Both the need and success of the North American Model of Wildlife Conservation has revolved around sustainability of harvest [6]. Indeed it was the depletion of wildlife resources in the late 1800s that spurred the invention of a unique system of conservation in which wildlife could be used in a sustainable manner that was closely regulated by law and based on the best available science. In its infancy, wildlife management began as a system of limiting harvest to stop the rapid decline of wildlife populations during the era of over-exploitation [28]. As the laws gained effectiveness, management programs developed to manage hunted species as they responded positively to early protection efforts. It is a common misconception that 'hunting' caused the extinction or extirpation of

some species. *Unregulated* killing caused such depletions. When this was controlled, populations rebounded vigorously with *regulated* hunting being used to drive a boldly experimental system of comprehensive wildlife conservation.

Today, hunters are the cornerstone of North American wildlife management not only because of the funds and advocacy they bring to the table, but also because they remain the most effective logistical agents of actual population management. State and provincial wildlife agencies use research, monitoring, adaptive management and experience to develop management guidelines and protocols to determine the appropriate level of harvest for each population. The allowable level of harvest might simply be, that which, is sustainable with no ill effects to the hunted species or it may be a prescription to reach specific management goals of animal abundance and demography. Social pressures play a role in some cases; for example, animal-vehicle collisions or agricultural crop damage. Proper management involves monitoring not only population abundance and demography, but also estimating the removal by harvest. Using these points of information, the manager can learn from and predict how certain management actions will affect the population.

Managing animal abundance

The early days of North American wildlife management were spent stopping declines of those species the human population found useful in some way and encouraging population growth with limited seasons, male-only hunting, daily bag limits and other restrictions. As successful law enforcement, habitat preservation and wildlife management programs grew, so did most wildlife populations.

Studies show that when large mammal populations are too abundant for the amount of habitat, reproduction decreases and mortality increases because of intra-specific competition for resources [29,30]. Reducing densities lessens competition and increases the population growth rate by improving reproduction and survival. Early biologists saw this compensatory effect of harvest as evidence that game populations could be managed as a renewable natural resource where the population replaces the portion removed by hunters.

In cases where population reduction is the management goal, managers must implement female harvest beyond the level at which the population can replace itself in the short-term [31]. Population reductions or maintenance at appropriate levels are a clear case of hunters acting as partners in wildlife management. Conflicts with man in the form of vehicle collisions, nuisance wildlife, livestock depredation, predation on crops and risks to human safety may result in a goal to manage at a 'Social Carrying Capacity' lower than the biological limit of the habitat [26,32]. For example, the number of deer-vehicle collisions is estimated to exceed 1.5 million every year on U.S. roadways [33]. This tremendous loss of life and property, illustrates the importance of effectively managing wildlife abundance to appropriate levels. Recent international symposia have reaffirmed that regulated hunting is the most effective tool to assure species exist in balance with their habitat [34].

In recent decades, there are also examples of hunting being ineffective in controlling a few species, most obviously white-tailed deer [35]. White-tailed deer is a highly prolific species benefiting from habitat disturbance (including agriculture) and urban refugia. Declining hunter numbers, hunter reluctance to harvest females and a counter-productive protectionist attitude toward wildlife have strengthened these patterns. This does not show the failure of hunting as a wildlife management tool in general, but is an example of how socially and biologically complex wildlife management can be in some areas.

Over-abundant big game populations can alter the habitat to the detriment of many other sympatric species [36,37]. This shows the importance of hunting in controlling wildlife populations. In some areas, deer overpopulation increases because landowners charge access fees or otherwise restrict hunting access and thereby greatly reduce the number of hunters on the landscape [31]. Hunters paying for access expect lower hunter densities and high deer densities, which makes it more difficult for agencies to control game populations without full cooperation of the private landowner.

For many years hunting was justified as a necessary management action to save animals from a lingering death of starvation. That is certainly true in many cases, but also not true in many more. If prey species have to be hunted because predator populations were reduced, why are predators still being hunted? The truth is more complicated than the simplistic idea of wildlife overpopulation. In reality, the importance of hunting to conservation in the broad sense is not tied simply to population control. One has to understand that a simple deer season or duck season, may seem like an isolated activity, but it is merely a component – and a critical one – of a much larger wildlife conservation model. Game populations are renewable resources that literally pay the bills for a far-reaching, comprehensive system of sustainable wildlife conservation that has proven itself superior to any other widely implemented model.

Demographic effects of hunting

Harvesting certain sex or age classes disproportionately can affect the demographics of the population. Heavily hunted populations might have age structures and sex ratios that are very different from non-hunted populations. Males of many species naturally have a higher mortality rate, which results in more females in the population even when not hunted, but this becomes exaggerated in populations with a predominately male harvest.

Many ungulate populations are managed for maximum hunter opportunities, which often results in more females than males in the population. Besides, heavy exploitation of the male segment will lower the average age of that part of the population. Low male:female ratios have been shown to affect reproductive behaviour, but not to significantly affect productivity [38–40]. In heavily hunted populations of white-tailed and mule deer, there is no indication that a low number of bucks negatively affect reproductive rates or overall population robustness [41,42].

Changes to population demographics may alter social structure and breeding behaviour in ungulates. Studies have suggested white-tailed deer populations with a young buck age structure and low buck:doe ratios experience a longer, later and less intensive rut, in the southeastern US where photoperiod changes less than in northern latitudes [43,44]. When hunting occurs prior to rut, this effect may be more pronounced. Concerns have been raised that a delay in the breeding dates in northern climates may result in younger and smaller offspring entering the harsh winter period which then experience lower over-winter survival rates. Although more research is needed, there is currently very little empirical evidence to indicate that this is a problem [45]. In fact, some of the populations with the heaviest buck exploitation also have the highest reproductive rates [46]. Low male:female ratios in ungulates appear to be less of a biological concern and much more of a social concern in terms of hunter perception and satisfaction.

Hunting older males appears to be increasing in popularity, encouraged by an industry that places heavy emphasis on large horns and antlers. Although mounted heads on the wall may not be popular with some members of the general public, in many cases they are the product of hunters who limit themselves by hunting exclusively for a mature

representative of the species. Individuals who prefer hunting large mature animals, sometimes pressure wildlife agencies to manage the entire state or province more conservatively to provide for a mature male age structure and higher hunt success. Requests by this minority of hunters to reduce the harvest, present a dilemma for agencies because reducing hunter opportunity would in turn negatively affect the financial support and advocacy for wildlife and their habitat. Restricting hunting unnecessarily over large areas runs contrary to the foundational success of the North American model and the principle that everyone should have reasonable access to hunting opportunity.

Genetic effects of hunting

Harvest strategies that remove a high percentage of the male segment can affect the genetic composition of a population. Changes to the gene pool could occur simply from the outright reduction in the number of male individuals which might result in the loss of genetic material in the population. If certain traits (e.g. horn or antler size) are heritable and hunters are exerting an intensive directional selective pressure it could change the frequency of alleles affecting that phenotypic trait. One fact that is frequently overlooked is that for hunter selection to reduce horn size, animals with poor genetic potential for horn growth must be given fitness advantage and pass on more genes than those with superior genetic potential. Hunters removing the largest males may simply be removing the oldest males in the population, not removing genetically superior animals.

Recent research, found that intense selection of large rams resulting from a specific hunting regime contributed to a reduction in horn size in a bighorn sheep population in Alberta [47]. This finding, triggered a chain reaction of reports in the news media and several speculative pieces in the scientific literature that inappropriately extrapolated these findings to other populations and even to all hunting in general [48,49]. In fact, this study focused on an isolated and bottlenecked population with a unique hunting structure that allowed for intensive selection against rams with fast growing horns. No other studies have shown significant phenotypic changes in ungulates that could be attributed to selective hunting. Singer and Zeigenfuss [50] offer an alternative view regarding genetic diversity and removal of old males: *... trophy hunting permits more subdominant and smaller-horned rams to obtain copulations, and thus may increase the ratio of effective population size to census population size ($N_e:N$) and thus increase total genetic diversity.*

Financial support for conservation programs

Nearly everyone enjoys wildlife, but most are not aware of the financial contributions made by the hunters, anglers and recreational shooters to support sustainable conservation in North American. Neither do they realize the fundamental role hunters play in preserving the wildlife and wild places they enjoy [51]. Although many hunters know their financial contributions help pay for wildlife management, even they do not always fully appreciate the key role they play in wildlife conservation on the broader scale.

Some of these contributions are voluntary, but most are a requirement of participation. These requirements were built into the system by hunters who saw the value of a conservation model that protects nature through collective public stewardship [52]. During 2006, the last year for which data are available, \$233 million were provided to state wildlife agencies in the U.S. from the conservation directed excise tax collected on hunting, fishing and

shooting purchases [53]. Combined with funds from the sale of hunting licenses (\$612 million) and private donations by hunters for conservation efforts (\$313 million) the total hunter-based contributions was nearly \$1.2 billion dollars in 2006 alone [53]. In Canada, a similar survey in 1996 found hunters spent more than \$823 million participating in hunting as their main activity [54]. Most of this investment flowed into the Canadian economy as hunters buy equipment, lodging, transportation, food and other related expenses.

There are about 13.7 million hunters in the U.S. [55] plus 1.2 million in Canada [56] and their annual expenditures support rural communities in the United States, Mexico and Canada. Overall, hunting voluntarily redistributes wealth from urban centers to smaller rural communities where it is multiplied through the local economy [26]. Economic multipliers are commonly used to estimate this compounding ripple effect. In 2006, it was estimated that \$24.7 billion spent in America by 12.5 million hunters had an economic impact of \$66.7 billion supporting almost 660,000 jobs in the United States alone [53]. Hunting expenditures in Canada, contributed \$815 million to their Gross Domestic Product, sustained 14,200 jobs and generated \$384 million in tax revenue all levels of government [54].

In addition to institutionalized programs, hunter-based non-governmental organizations raise and contribute additional money for specific research projects, habitat acquisition and enhancement, and population monitoring. For example, the Wild Sheep Foundation has raised and contributed more than \$70 million in the last 30 years on activities to benefit wild sheep and other wildlife (Ray Lee, Former CEO, Wild Sheep Foundation, personal communication, 2010).

Monitoring and management of wildlife populations

Monitoring wildlife populations and accumulating baseline trend data is the basis of well-informed, science-based decisions in the North American Model [28]. Hunted species are not the only ones monitored, but they do receive the most attention. State, provincial, and federal agencies have a long history of monitoring wildlife populations beginning at the very genesis of wildlife conservation in North America. Many agencies have examples of monitoring programs that have remained relatively consistent for decades and provide valuable trend data. The Canadian Wildlife Service and US Fish and Wildlife Service have conducted continent-wide aerial waterfowl surveys since 1955. This cooperative survey effort involves flying 80,000 miles of survey each year, throughout waterfowl areas from southern Mexico to northern Canada.

It is usually not necessary to monitor intensively the abundance and demographics of populations that are not being annually harvested. Hunted species are monitored and managed fairly intensively by agencies financially solvent enough to use resources for any species as the need arises.

Agency infrastructure

The excise tax on hunting, fishing and shooting equipment along with funds from the sale of hunting and fishing licenses, fund an average of 75% of the wildlife agencies' annual budget in the U.S. [57]. In recent decades, state and provincial wildlife agencies have become creative in their ability to garner additional funding sources to supplement the long-standing contribution of hunters, anglers and shooting enthusiasts. Lottery sources, state income tax, special stamps and similar funds are sometimes channelled to wildlife agencies and earmarked for things that have not received adequate financial support in the

past, such as non-game or habitat acquisition and management. These recent supplemental funds are an important addition to the budgets of wildlife agencies, but they are vulnerable to legislative meddling and do not replace or negate the importance of the base funds from consumptive activities. These funds are only effective because there is an agency infrastructure in place that can take additional money and apply it directly to a specific program area. Law enforcement, personnel resources and all other day-to-day agency operations are in place because of the funds from hunting, allowing these supplemental dollars to be effective. The agencies most effective in conserving all resources, whether hunted or not, are those with a solid financial foundation provided by the well-regulated consumption of a few wildlife species.

Law enforcement

One of the most important financial contributions to wildlife conservation made by hunters and anglers in North America is the maintenance of a large force of law enforcement officers. Regulated hunting is only regulated if the laws are obeyed. Surveys consistently show that about 50% of hunters and anglers have had recent contact with these enforcement personnel in the field and hold them in very high regard [51].

Currently thousands of wildlife conservation law enforcement officers are actively working in the U.S. and Canada and most are paid with funds generated by hunters and anglers. This ubiquitous wildlife law enforcement force is almost always independent of other law enforcement agencies and allows for all their time and energy to be devoted to protecting natural resources. Besides policing hunters and anglers, they also perform duties related to water quality, habitat protection, public safety, search and rescue, littering, vandalism and the trade in threatened and endangered species. These personnel frequently provide backup to other local law enforcement agencies. Those who campaign against hunting rarely offer alternatives for funding this enormous force of trained officers to protect wildlife against unregulated exploitation. Without legal hunting in place, we would lose this protection force in most areas of North America.

Population restoration

The restoration of wildlife populations across North America is one of the greatest wildlife success stories in the history of conservation anywhere. Nearly all populations that were badly over-exploited before the development and implementation of the North American Model have been restored. Species like Canada geese (*Branta canadensis*), white-tailed deer (*Odocoileus virginianus*), pronghorn (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*) and turkeys (*Meleagris gallopavo*), all represent important species whose restoration was made possible by funding and advocacy generated by hunting.

As an example, the State of Arizona began reintroducing desert bighorn sheep in 1955. Since then, through more than 100 translocations of at least 1800 animals of desert bighorn sheep have been restored to all previously occupied habitat and many other areas of suitable habitat [58] in that state. Across North America, wild sheep populations have been restored with more than 1500 translocations involving about 25,000 wild sheep, since 1922 (Kevin Hurley, Pers. Comm., WAFWA Wild Sheep Working Group, 2010). This exemplifies the type of restoration activity that has occurred for decades throughout all states and provinces in North America with the funds generated from the regulated consumption of a few species.

North America has nearly a full complement of native wildlife living in habitat that has changed remarkably little in the last 300 years compared to other continents. Restoration of large mammal populations continue today with elk (*Cervus elaphus*) being successfully reintroduced into historical ranges in the east for the enjoyment of all residents. Work also continues for other species, such as bison (*Bos bison*) and large predators whose restoration comes with significant controversy. Individual hunters or even some organizations may not be supportive of the restoration of some large predators, but they support the system of collective stewardship that works to restore native species. With the success of hunted species, focus has shifted to restoring non-hunted species with threatened and endangered animals receiving the highest priority.

Habitat acquisition, protection, restoration and enhancement

Land management agencies manage wildlife habitat on millions of acres of federal land and Crown land. In addition, many states and provinces have also purchased wildlife habitat with the proceeds from hunting licenses and taxes on hunting, fishing and shooting equipment. Funding sources for habitat varies among Canadian provinces. For example, in British Columbia, surcharges collected on hunting, angling, trapping and guide-outfitting licenses go into a trust fund managed by an independent organization, the Habitat Conservation Trust Foundation (HCTF). Annually the HCTF invests \$5–6 million in habitat acquisition, restoration and enhancement and other priority conservation projects throughout the province.

During a 5 year period (2005–2009) in the U.S., \$58.5 million dollars from the Federal Aid in Wildlife Restoration funds were apportioned to the states for the acquisition of more than 12.2 million acres of wildlife habitat [59]. A comprehensive survey of provinces for the period 1984–1999 revealed that in that time, \$335 million were contributed by hunters for habitat conservation projects in Canada [60]. This figure does not include the hundreds of millions of dollars spent on license fees, equipment, clothing, lodging, travel and related expenses that fund other wildlife conservation programs [54].

In addition, wildlife conservation organizations such as Rocky Mountain Elk Foundation, Wildlife Habitat Canada, Mule Deer Foundation, Habitat Conservation Trust Fund, The Nature Conservancy, Ducks Unlimited, Canadian Wildlife Federation, Pheasants Forever, the Wild Sheep Foundation and a myriad of state and provincial wildlife organizations have used private donations to purchase land or conservation easements on large tracts of wildlife habitat. Most of these acreages are purchased with game animals in mind, but wetlands acquired for waterfowl, forests purchased for deer and grasslands preserved for quail and pronghorn have benefitted countless non-game and endangered species that rely on those habitat associations. Recent estimates indicate that about 70% of users in these areas are not hunting and in some properties the figure may be as high as 95% [61]. Ironically, there are sometimes conflicts when non-consumptive users express concern about seeing hunters on these properties during the few days or weeks each year the hunting seasons are open.

Research

As noted earlier, management decisions in the North American model are based on science. In the USA, about \$57 million were apportioned in 2009 to state wildlife agencies from the Federal Aid in Wildlife Restoration program for conducting more than 10,000 wildlife research projects [59]. In the early years of the wildlife management profession,

the money was spent exclusively on learning more about game species that were at low levels due to the lack of a comprehensive system of wildlife conservation. As these game species were brought back to abundance, the research focus shifted to encompass all species and their habitats.

Canadian wildlife researchers obtain funding from a wide variety of sources. In Canada most revenue from hunting and fishing is placed in government general revenue which then funds each fish and wildlife agency. Recently, several provinces have created associations or trust funds that receive hunter based funds and help support wildlife research and land acquisition. Wildlife conservation organizations (e.g. Rocky Mountain Elk Foundation, Alberta Conservation Association and Wild Sheep Foundation) and extractive industries (e.g. oil companies) also contribute money for wildlife research.

To facilitate useful research in the U.S., a series of Cooperative Wildlife Research Units were established in 1935 at universities to provide an opportunity for the federal government, state wildlife agencies, universities and non-governmental organizations to work together. These units are allocated federal funds to employ 2–5 scientists, but most of the annual budgets for baseline operating come from hunters and anglers through the state wildlife agencies. This system began with seven ‘Coop Units’ and has grown to a current total of 44, distributed across 40 states. Canada has also established a Cooperative Fish and Wildlife Research Unit in New Brunswick modelled after this US system.

Hunter education programs

Hunter education programs are important to wildlife conservation because unsafe or illegal acts by a few hunters can cast all hunters in a bad light and erode public support. North America has an incredible volunteer driven network of hunter education programs delivering structured coursework on wildlife management, hunter ethics, firearms safety and hunting techniques. Each year about 650,000 hunters are trained by this volunteer hunter education instructor force of more than 70,000 (Wayne East, IHEA, personal communication, 2010). Funding for this in the U.S. is provided by an annual apportionment of Federal Aid in Wildlife Restoration Funds which exceeded \$472 million in 2010. Each state receives between \$2 million and \$20 million depending on their size and need [62]. In Canada, these programs are either user-paid or funded through the provincial wildlife agencies. The successful completion of a hunter education course is mandatory for certain age classes and certain kinds of hunting in all 50 states and 10 Canadian Provinces and has resulted in more than 35 million students being trained since the program began in 1949 [63,64].

Non-hunted, threatened and endangered species

A preponderance of hunter-generated money is still spent on hunted species. This is appropriate for the most part, since populations of species that are being annually hunted require a greater intensity of monitoring, law enforcement, research and management.

In North America, programmes for non-hunted species activities are funded through a myriad of different sources dependent on the agency in question, including income tax donations, special stamps, independent grants, donations, lottery or gambling money, some sales tax and hunters’ dollars from the Federal Aid in Wildlife Restoration program (Wildlife Restoration). In Canada, funding comes from both provincial and federal sources with the management responsibility remaining with provinces (except for migratory birds).

A portion of Wildlife Restoration funds in the U.S. is available to the states for conservation of non-hunted birds and mammals. While this funding mechanism provides millions of dollars annually for such programs, this is a small percentage of what is needed for the many taxa involved. As a consequence, wildlife agencies have had to be creative to find and maintain funds for species that were not hunted historically and which therefore were not the immediate focus of the Wildlife Restoration program. From 1984 to 1999, habitat initiatives in all Canadian provinces supported by Wildlife Habitat Canada invested \$40 million on projects directly benefitting non-game species and their habitat [60].

Through the Wildlife Restoration program, hunters' dollars also contribute to the restoration of many species such as California condor (*Gymnogyps californianus*), Mexican wolf (*Canis lupus baileyi*), black-tailed prairie dog (*Cynomys ludovicianus*) and the black-footed ferret (*Mustela nigripes*). In this way, conservation actions have the potential to protect other wildlife species *before* they become threatened or endangered [28]. Using hunters' dollars to conserve all wildlife for all people is an important component of the North American Model.

Information and public outreach

Communicating with the public and considering human dimensions in wildlife management has become vital to the effectiveness of wildlife management agencies. All wildlife agencies have some public information officers on staff to disseminate wildlife information to stakeholders on agency activities through press releases, websites, social networking media, radio, television and a multitude of publications for diverse audiences. In the United States, some wildlife agencies use Federal Aid in Wildlife Restoration funds, but most simply use money garnered from the sale of hunting and fishing licenses. In Canada, much of the funding for these kinds of activities comes from tax revenue. The dissemination of information on all wildlife is yet another example of the entire public benefitting from the baseline funding provided by regulated hunting.

Advocacy and support

Hunting is controlled by restrictions enforced by law enforcement officers, but much of North America's conservation success is due to incentives based on self-interest and personal ethics [65]. Many hunters in North America go far beyond what is required of them by law. Historically, hunting has been the greatest passion that assured wildlife its place on the landscape. Utility fosters attention and wildlife thrives with attention and withers from neglect [4]. The powerful urges to hunt wildlife appear to be deeply primordial. Most commonly the passion to hunt expresses itself as a deep, life-long interest in and devotion to wildlife, often accompanied by considerable work, even sacrifice, by the hunter on behalf of wildlife. Witness the many organizations dedicated to the conservation of wildlife in North America. There are endless examples of hunter advocacy for, and in assistance with, implementing not only game management, but wildlife conservation on a broad scale. It comes as no surprise that Aldo Leopold, considered the founder of the wildlife management profession, was a hunter [66].

No collective group is comprised entirely of active leaders and hunting is no different. A small percentage of the hunting community typically rises to the position of spokespersons or leaders of conservation organizations. As in any group, the majority are happy to follow leaders and follow the rules. As such, it may be unreasonable to expect every hunter to act

as a steward of broad scale biodiversity at the individual level [67]. Nevertheless, the North American conservation paradigm has been driven by the hunting community acting as collective stewards for the greater good of wildlife and their habitat.

Political support

Early groups of organized hunters were instrumental in providing the political support to implement many of the laws that coalesced into the system of conservation we have today. For example, Theodore Roosevelt organized the Boone and Crockett Club in 1887 by assembling some of the powerful and influential conservation-minded people of the day – many of them hunters. The Boone and Crockett Club successfully lobbied for the establishment of Yellowstone National Park, the preservation of the bison, cessation of market hunting and much more, in the last 100 years.

It is difficult to maintain separation between the sometimes-detrimental world of politics and wildlife management. When political influence threatens proper wildlife conservation efforts, hunters at the local and national levels have shown themselves willing, and able to rise up in support of wildlife. There are many examples of wildlife agency funds or commission structure coming under attack by politicians only to have the organized wildlife groups intervene and defend the agency. A survey of outdoor user groups in the southwestern U.S. asked respondents if they would be willing to write a letter if wildlife conservation funding was threatened with diversion to other uses. Seventy four percent of hunters responded they would be likely or very likely to write a letter protesting that action [68].

Non-hunters are often involved in advocating for wildlife of course, but it is the organizational infrastructure of hunting organizations that frequently drives coordinated advocacy. This infrastructure is also used for mounting campaigns in defense of crucial wildlife habitat threatened by conflicting interests. With declines in the proportion of the population that hunts, wildlife may have a less effective voice speaking on its behalf. As wildlife populations and habitat are subjected to increasing pressures, hunters and non-hunters will need to focus on common goals and combine their collective resources for the good of the wildlife they both enjoy.

Biological samples and information

Hunters are an important source of biological information for wildlife researchers and managers. A variety of hunting related information including total number of animals harvested, sex and age ratios, body weights or condition and harvest location have been collected in the field or through questionnaires since the early years of wildlife management. Data such as hunter success rates, the total number of hunter-days expended, area hunted and other information can be used to track trends in population parameters or abundance. In many instances hunters go to great lengths to provide information that might help wildlife managers.

Biological samples are used to determine prior disease exposure, parasite loads, nutritional status, genetic relationships or diversity and to determine age more accurately. The collection of these types of samples is sometimes done by hunters themselves requiring a certain amount of cooperation and commitment on their part. Along with other members of the public, hunters routinely provide information on species distribution and sources of unusual mortality. These kinds of input are valuable for tracking changes in wildlife distributions in the face of climate change and emerging disease issues.

Volunteerism

Hunters individually and the organizations they belong to have always been very active in providing volunteer labour for habitat improvement projects, construction of nesting structures or boxes, altering fences to be wildlife-friendly, teaching hunter education courses, wildlife surveys, working check stations, routine facility maintenance, cleaning up trash and many other beneficial activities. These volunteer efforts benefit wildlife directly and allow wildlife management agencies to stretch their conservation dollars farther to accomplish more.

Most of these projects benefit more than hunted species. For example, water collection and retention devices have been installed for big game animals by hunters throughout the western states of the United States, but uncounted numbers of bird, mammal, insect and herptile species are known to use these structures. Designs of these water catchments have been altered through the years to accommodate the needs of bats and smaller terrestrial non-game animals specifically.

A survey across all Canadian provinces revealed that hunters were volunteering more than one million hours every year on wildlife habitat projects [60]. Residents in the State of Maryland were asked if they would be interested in volunteering their time to help the state wildlife agency [69]. Results revealed that 22% of hunters were 'very likely' to volunteer compared to 7% of the non-hunters. This does not imply non-hunters do not care about wildlife, but it does illustrate the level of commitment to collective stewardship of natural resources that is inherent in the hunting community.

Celebrating the past, preparing for the future

The North American Model of Wildlife Conservation arose from a continent-wide agreement on policies of conservation a century ago. These informal policies have worked extremely well as North America enjoys a nearly complete compliment of native predators and prey species. Hunters have been the cornerstone of this success from the beginning. Wildlife thrives whenever and wherever it is seen as valuable to human beings. Geist [4] noted: *with self-interests in wildlife, hunters become concerned, active spokesmen for and supporters of wildlife, and experience shows that wildlife will then flourish*. The more tangible that value, the more successful the conservation effort. Tangible benefits, however, must be supported by those who do not participate, but also enjoy wildlife in other ways. The more species of wildlife that are seen as valuable, the broader will be the support for maintaining complex and species-rich ecosystems. Hunters have been the central pillar of this conservation effort for game and non-game species and thus are responsible for supporting a wide variety of conservation activities the public values, including law enforcement, habitat management and acquisition, research and population management. Wildlife resources are not abundant enough to support hunting by everyone; but we cannot escape the fact that hunting and gathering helps maintains more biodiversity than the removal of native vegetation to raise agricultural crops.

We cannot continue to maintain wildlife unless its welfare is passionately defended and politically secured. Historically, hunters were the indispensable defenders of wildlife and any decline of hunting in North America is detrimental to wildlife and ultimately to the biodiversity of this continent. Unfortunately, the hunting participation rate has declined over the last five decades [70]. Our increasingly urban lifestyles take people away from

their connection with nature [71]. The populace is getting more of their information about the natural world from television and internet sources rather than through personal experience. These ubiquitous trends are leading to a disconnected and apathetic view of wildlife and wild places. We may not have control over many of these trends, but an effort must be made to inform, the increasingly disengaged, about how the North American Model for Wildlife Conservation operates. Additionally, we must encourage other continents to apply sustainable use principles as much as possible

While the North American Model of Wildlife Conservation is a great cultural achievement of society, there are forces in opposition, poised to destroy it if we are not vigilant. Agricultural interests fostering wildlife domestication for profit, animal rightists advocating the abolition of hunting based on so called ‘moral values,’ and advocates of privatizing wildlife see lucrative opportunities in a market for shooting or selling of genetically selected trophy animals [3,72].

Although, hunters accrue many psychological, physical, sociological and nutritional benefits from hunting, the real benefit of hunting in the North America is that of collective stewardship for all wildlife species and the habitats they rely on. Maintaining this system of conservation will require hunters to develop partnerships with non-hunting conservation groups to focus their combined efforts on common goals. The future role of hunters in North American conservation will have to include a broader emphasis on those species not hunted and more attention to desires of a general public that will continue to reap the rewards of the conservation efforts hunters have made.

References

- [1] Geist, V., 1991, Some lessons from North American wildlife management. Proceedings Symposium on Wildlife Conservation, Yokahama, Intercol 90, 21–25 August 1990, pp. 7–10.
- [2] Geist, V., 1993, Great achievements, great expectations: Success of North American wildlife management. In: A.W.L. Hawley (Ed.) *Commercialization and Wildlife Management: Dancing with the Devil*, (Malabar, FL: Florida Krieger), pp. 47–72.
- [3] Geist, V., 1995, North American policies of wildlife conservation. In: V. Geist and I. McTaggart-Cowan (Eds.) *Wildlife Conservation Policy*, (Calgary: Detselig), pp. 77–129.
- [4] Geist, V., 2006, The North American model of wildlife conservation: A means of creating wealth and protecting public health while generating biodiversity. In: D.M. Lavigne (Ed.) *Gaining Ground: In Pursuit of Ecological Sustainability* (Limerick: University of Limerick, International Fund for Animal Welfare), pp. 285–293.
- [5] Geist, V., Mahoney, S.P. and Organ, J.F., 2001, Why hunting has defined the North American model of wildlife conservation. *Transactions of the North American Wildlife and Natural Resources Conference*, **66**, 175–185.
- [6] Mahoney, S.P., 2009, Recreational hunting and sustainable wildlife use in North America. In: B. Dickson, J. Hutton and W.M. Adams (Eds.) *Recreational Hunting, Conservation and Rural Livelihoods: Science and Practice* (Hoboken, NJ: Wiley-Blackwell), pp. 266–281.
- [7] Mahoney, S.P., 2000, The enduring relevance of man’s first try at life: Hunting viewed from the escarpment of history. In: W.D. Mansell (Ed.) *Proceedings of the 2000 Premier’s Symposium on North America’s Hunting Heritage* (Eden Prairie, MN: Wildlife Forever), pp. 13–17.
- [8] Thomas, Jr., E.D., 2010, *How Sportsmen Saved the World: The Unsung Conservation Effort of Hunters and Anglers* (Guilford, CT: Lyons Press), pp. 1–231.
- [9] Martin, P.S. and Klein, R.G., 1984, *Quaternary Extinctions* (Tucson, AZ: The University of Arizona Press), pp. 1–892.
- [10] Grayson, D.K. and Meltzer, D.J., 2003, A requiem for North American overkill. *Journal of Archaeological Science*, **30**, 585–593.
- [11] Stahl, D., 1979, *Wild, Lebendige Umwelt [Wild, vibrant environment]* (Munich: K. Alber).
- [12] Manning, R.B., 1993, *Hunters and Poachers: A Social and Cultural History of Unlawful Hunting in England, 1485–1630* (Oxford: Clarendon Press), pp. 1–255.
- [13] Threlfall, W., 1995, Conservation and wildlife management in Britain. In: V. Geist and I. McTaggart Cowan (Eds.) *Wildlife Conservation Policy* (Calgary: Detselig), pp. 27–76.
- [14] Hardin, G., 1968, The tragedy of the commons. *Science*, **162**, 1243–1248.

- [15] Grosz, T., 2001, *Defending our Wildlife Heritage: The Life and Times of a Special Agent* (Boulder, CO: Johnson Books), pp. 1–347.
- [16] Reinsner, M., 1991, *Game Wars: The Undercover Pursuit of Wildlife Poachers* (New York: Viking Penguin), pp. 1–304.
- [17] Ortega y Gasset, J., 1942, *Meditations on Hunting* (New York: Scribner), pp. 1–140.
- [18] Petersen, D., 1996, *A Hunter's Heart. Honest Essays on Blood Sport* (New York: Henry Holt), pp. 1–331.
- [19] Kerasote, T., 1993, *Bloodties: Nature, Culture and the Hunt* (New York: Random House), pp. 1–277.
- [20] Posewitz, J., 1994, *Beyond Fair Chase: The Ethics and Tradition of Hunting* (Helena, MT: Falcon Press), pp. 1–118.
- [21] Bodio, S.J., 2003, *Eagle Dreams* (Guilford, CT: Lyons Press), pp. 1–216.
- [22] Kowalsky, N., 2010, *Hunting: In Search of the Wild Life* (Chichester: Wiley-Blackwell), pp. 1–258.
- [23] Organ, J.F., Muth, R.M., Dizard, J.E., Williamson, S.J. and Decker, T.A., 1998, Fair chase and humane treatment: Balancing the ethics of hunting and trapping. *Transactions of the North American Wildlife and Natural Resources Conference*, **63**, 528–543.
- [24] Roosevelt, T., Van Dyke, T.S., Eliot, D.G. and Stone, A.J., 1902, *The Deer Family* (New York: MacMillan), pp. 1–334.
- [25] Sandlos, J., 2013, Nature's Nations: The Shared Conservation History of Canada and the United States. *International Journal of Environmental Studies*, DOI: 10.1080/00207233.2013.800356.
- [26] Duda, M.D., Jones, M., Criscione, A. and Ritchie, A., 2010a, The importance of hunting and the shooting sports on state, national and global economies. In: Ted Rowe (Ed.) *Symposium Proceedings on the Ecologic and Economic Benefits of Hunting* (Roma: World Forum on the Future of Sport Shooting Activities), pp. 276–293.
- [27] Rowe, T., 2009, WFSA president Ted Rowe's closing remarks. In: Ted Rowe (Ed.) *The Symposium on the Ecologic and Economic Benefits of Hunting* (Roma: World Forum on the Future of Sport Shooting Activities), p. 392.
- [28] Baughman, J. and King, M., 2008, Funding the North American model of wildlife conservation in the United States. In: J. Nobile and M.D. Duda (Eds.) *Strengthening America's Hunting Heritage and Wildlife Conservation in the 21st Century: Challenges and Opportunities* (Washington, DC: Sporting Conservation Council), pp. 57–64.
- [29] McCullough, D.R., 1979, *The George Reserve Deer Herd: Population Ecology of a K-Selected Species*, (Ann Arbor, MI: University of Michigan Press), pp 1–271.
- [30] Dusek, G.L., Mackie, R.J., Herringes, Jr., J.D. and Compton, B.B., 1989, Population ecology of white-tailed deer along the lower Yellowstone River. *Wildlife Monographs*, **104**, 3–68.
- [31] Carpenter, L.H., 2000, Harvest management goals. In: S. Demarais and P.R. Krausman (Eds.) *Ecology and Management of Large Mammals in North America* (Upper Saddle River, NJ: Prentice-Hall.), pp. 192–213.
- [32] Conover, M.R., 2002, *Resolving Human-Wildlife Conflicts: The Science of Wildlife Damage Management*, (Salt Lake City, UT: CRC Press), pp 1–440.
- [33] Conover, M.R., Pitt, W.C., Kessler, K.K., DuBow, T.J. and Sanborn, W.A., 1995, Review of human injuries, illnesses, and economic losses caused by wildlife in the United States. *Wildlife Society Bulletin*, **23**, 407–414.
- [34] Patterson, R., 2009, Executive Summary. In: Ted Rowe (Ed.) *The Symposium on the Ecologic and Economic Benefits of Hunting* (Roma: World Forum on the Future of Sport Shooting Activities), pp. 391–392.
- [35] Brown, T.L., Decker, D.J., Riley, S.J., Enck, J.W., Lauber, T.B., Curtis, P.D. and Mattfeld, G.F., 2000, The future of hunting as a mechanism to control white-tailed deer populations. *Wildlife Society Bulletin*, **28**(4), 797–807.
- [36] Horsley, S.B., Stout, S.L. and deCalesta, D.S., 2003, White-tailed deer impact on the vegetation dynamics of a northern hardwood forest. *Ecological Applications*, **13**, 98–118.
- [37] Rawinski, T.J., 2008, *Impacts of White-tailed Deer Overabundance In Forested Ecosystem: An Overview*, (U.S. Department of Agriculture, Forest Service, Northeastern Area Field office). Available online at: http://www.na.fs.fed.us/fhp/special_interests/white_tailed_deer.pdf (accessed 11 November 2010).
- [38] Desimone, R., Vore, J. and Carlson, T., 1993, Older bulls: Who needs them? In: J.D. Cada, J.G. Peterson and T.N. Lonner (Eds.) *Proceedings of the Western States and Provinces Elk Workshop* (Helena, MT: Montana Wildlife, Fisheries and Parks), pp. 29–35.
- [39] Noyes, J.H., Johnson, B.K., Bryant, L.D., Findholt, S.L. and Thomas, J.W., 1996, Effects of bull age on conception dates and pregnancy rates of cow elk. *Journal of Wildlife Management*, **60**, 508–517.
- [40] Bender, L.C. and Miller, P.J., 1999, Effects of elk harvest strategy on bull demographics and herd composition. *Wildlife Society Bulletin*, **27**, 1032–1037.
- [41] Ozoga, J.J. and Verme, L.J., 1985, Comparative breeding behavior and performance of yearling vs. prime-age white-tailed bucks. *Journal of Wildlife Management*, **49**, 364–372.
- [42] White, G.C., 2001, Effect of adult sex ratio on mule deer and elk productivity in Colorado. *Journal of Wildlife Management*, **65**, 543–551.
- [43] Jacobson, H.A., 1992, Deer condition response to changing harvest strategy, Davis Island, Mississippi. In: R.D. Brown (Ed.) *The Biology of Deer* (New York: Springer-Verlag), pp. 48–55.

- [44] Guynn, Jr., D.C., Sweeney, J.R., Hamilton, R.J. and Marchington, R.L., 1988, A case study in quality deer management. *South Carolina White-Tailed Deer Management Workshop*, **2**, 72–79.
- [45] Bender, L.C., 2002, Effects of bull elk demographics on age categories of harem bulls. *Wildlife Society Bulletin*, **30**, 193–199.
- [46] McCaffery, K.R., Ashbrenner, J.E. and Rolley, R.E., 1998, Deer reproduction in Wisconsin. *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, **86**, 249–261.
- [47] Coltman, D.W., O'Donoghue, P., Jorgenson, J.T., Hogg, J.T., Strobeck, C. and Festa-Bianchet, M., 2003, Undesirable evolutionary consequences of trophy hunting. *Nature*, **426**, 655–658.
- [48] Allendorf, F.W. and Hard, J.J., 2009, Human-induced evolution caused by unnatural selection through harvest of wild animals. *Proceedings of the National Academy of Sciences*, **106**, 9987–9994.
- [49] Minard, A., 2009, Hunters speeding up evolution of trophy prey? *National Geographic News*, Available online at: <http://news.nationalgeographic.com/news/2009/01/090112-trophy-hunting.html> (accessed 14 November 2010).
- [50] Singer, F.J. and Zeigenfuss, L.C., 2002, Influence of trophy hunting and horn size on mating behavior and survivorship of mountain sheep. *Journal of Mammalogy*, **83**, 682–698.
- [51] Duda, M.D., Bissell, S.J. and Young, K.C., 1998, *Wildlife and the American Mind: Public Opinions on and Attitudes Toward Fish and Wildlife Management*, (Harrisonburg, VA: Responsive Management), pp 1–804.
- [52] Geist, V., 1994, Wildlife conservation as wealth. *Nature*, **368**, 491–492.
- [53] Southwick, R. and Allen, T., 2010, Expenditures, economic impacts and conservation contributions of hunters in the United States. In: Ted Rowe (Ed.) *Symposium Proceedings on the Ecologic and Economic Benefits of Hunting* (Roma: World Forum on the Future of Sport Shooting Activities), pp. 308–313.
- [54] Federal-Provincial-Territorial Task Force on the Importance of Nature to Canadians, 2000, *The Importance of Nature to Canadians: The Economic Significance of Nature-related Activities* (Ottawa: Environment Canada), pp. 1–42.
- [55] USFWS, 2012, *National survey of fishing, hunting, and wildlife-associated recreation – 2011*, (U.S. Fish and Wildlife Service) Available online at: <http://wsfprograms.fws.gov/subpages/NationalSurvey/NatSurveyIndex.htm> (accessed 14 May 2013).
- [56] Federal-Provincial-Territorial Task Force on the Importance of Nature to Canadians, 1999, *The Importance of Nature to Canadians: Survey Highlights* (Ottawa: Environment Canada), pp. 1–46.
- [57] Scott, R., Hansen, P. and Mosher, J., 1999, *Passing the Buck: A Comparison of State Fish and Wildlife Agency Funding and the Economic Value of Wildlife-related Recreation* (Gaithersburg, MD: Izaak Walton League of America), p. 14.
- [58] O'Dell, J., 2007, *50 years and a Lot of Sheep Later, Arizona Wildlife Views, November–December*, (Phoenix, AZ: Arizona Game and Fish Department), pp 8–12.
- [59] USFWS, 2010b, *National Summary of Accomplishments, 2005-2009*, (U. S. Fish and Wildlife Service) Available online at: http://faims.fws.gov/reports/rwservlet?faimskeys & report=fwrg0040_p (accessed 17 September 2010).
- [60] Wildlife Habitat Canada, 2000, *Investors in Habitat: Hunter Contributions to Wildlife Habitat Conservation in Canada* (Ottawa: Wildlife Habitat Canada), pp. 1–40.
- [61] USFWS, 2010c, Federal Aid Division – The Pittman-Robertson Federal Aid in Wildlife Restoration Act, Available online at: <http://www.fws.gov/southeast/federalaid/pittmanrobertson.html> (accessed 29 September 2010).
- [62] USFWS, 2010a, *Final Apportionment of Pittman-Robertson wildlife restoration Funds (CFDA # 15.611) for fiscal year 2010*, (U. S. Fish and Wildlife Service). Available at: <http://wsfprograms.fws.gov/subpages/Grant-Programs/WR/WRFinalApportionment2010.pdf#page=4> (accessed 11 November 2010).
- [63] IHEA, 2010a, Who we are. *International Hunter Education Association*, Available online at: <http://www.ihea.com/about-ihea/who-we-are.php> (accessed 11 November 2010).
- [64] IHEA, 2010b, Hunter education requirements. *International Hunter Education Association*, Available online at: <http://www.ihea.com/hunter-education/hunter-education-requirements.php> (accessed 11 November 2010).
- [65] Leopold, R.A., 1933, *Game Management* (New York: Charles Scribner's Sons), pp. 1–481.
- [66] Peyton, R.B., 2000, Wildlife management: Cropping to manage or managing to crop? *Wildlife Society Bulletin*, **28**, 774–779.
- [67] Holsman, R.H., 2000, Goodwill hunting? Exploring the role of hunters as ecosystem stewards *The Wildlife Society Bulletin*, **28**, 808–816.
- [68] Responsive Management, 1995, *Federal Aid Outreach Survey, Region II: Arizona Anglers, Boaters, and Hunters; New Mexico Anglers, Boaters and Hunters; Oklahoma Anglers, Boaters and Hunters; Texas Anglers, Boaters, Hunters and Passport Holders, Report Prepared for U.S. Fish and Wildlife Service* (Harrisonburg, VA: Responsive Management), p. 85.
- [69] Responsive Management, 1993, *Wildlife Viewing in Maryland: Participation, Opinions and Attitudes of Adult Maryland Residents Towards a Watchable Wildlife Program*, Report Prepared for the Maryland Wildlife Division (Harrisonburg, VA: Responsive Management), p. 46.
- [70] Duda, M.D., Jones, M.F. and Criscione, A., 2010, *The Sportsman's Voice* (State College, PA: Venture), pp. 1–259.
- [71] Louv, R., 2006, *Last Child in the Woods* (Chapel Hill, NC: Algonquin Books of Chapel Hill), pp. 1–334.
- [72] Baier, L.E., 2010, The secret world inside the animal rights agenda – part one. *Fair Chase*, **25**, 6–10.