MOOSE CONSERVATION IN THE NATIONAL WILDLIFE REFUGE SYSTEM, USA

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ABSTRACT: The National Wildlife Refuge System in the United States includes about 150 million acres of lands and waters within 550 refuges managed for conservation. A variety of laws, regulations, and management polices help ensure these areas will be preserved for future generations. In a web-based survey, 35 refuges reported having established populations of moose (*Alces alces*) within their boundaries with nearly 40 million acres of moose habitat, 99% in Alaska. The 4 recognized subspecies of moose in North America were represented on refuges found in 12 states. Approximately 39,000 moose were reported inhabiting refuges in the USA; about 38,000 in Alaska. Only 9 refuges used management practices specifically to benefit moose, primarily prescribed or wildland fire. Moose populations on refuges varied greatly and refuge managers reported numerous concerns including climate change, illegal harvest, habitat loss or degradation, parasites, disturbance, moose-vehicle collisions, predators, and both recreational and subsistence hunting. Future management implications of these issues are discussed.

ALCES VOL. 45: 59-65 (2009)

Key words: *Alces alces,* climate change, management, moose, national policy, survey, wildlife refuges.

The National Wildlife Refuge System (NWRS) was created in 1903 when President Theodore Roosevelt set aside the first refuge at Pelican Island, Florida. Today 550 refuges, at least one in each of the 50 states, encompass approximately 150 million acres of lands and waters and are managed for conservation of fish, wildlife, and plants as part of the NWRS in the U.S. Department of Interior's Fish and Wildlife Service (U.S. Fish and Wildlife Service 2009). The mission of the NWRS, formalized with the passage of "organic legislation" in 1997 that amended the National Wildlife Refuge Administration Act of 1966 is:

"… to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

National Wildlife Refuges (NWR) support a diverse variety of wildlife species including the 4 recognized North American subspecies of moose as described by Bubenik (1997). Alaska has the majority of the acreage, the most moose habitat, and the most moose within the NWRS. Kenai National Wildlife Refuge, nearly 2 million acres of boreal forest located in south central Alaska, was established as the Kenai National Moose Range by Executive Order in 1941 and was managed specifically to conserve and protect moose until the Refuge's purposes were expanded in 1980. Predator management and enforcement against poaching dominated early activities at the Kenai National Moose Range, but by the 1960s management efforts became more focused on habitat conservation and treatments.

METHODS AND OBJECTIVES

A web-based survey was employed early

in 2008 to gather information to 1) better understand the role of the NWRS in moose conservation, and 2) identify the most important issues or constraints facing management of moose on refuges. The survey was developed at SurveyMonkey.com and included 21 questions including basic questions about the refuge (i.e., size, purpose, date established) and moose-specific questions regarding the abundance, habitat, harvest, and management of moose. Refuge biologists and managers were notified of the request through regional biologists in 5 of the 8 administrative regions of the U.S. Fish and Wildlife Service that were within the range of moose. Reminders were provided to help ensure near complete responses, and follow-up contacts were made where clarification was needed.

RESULTS

Thirty-nine refuges from 12 states responded to the survey. One refuge, Kodiak NWR in Alaska, reported that moose had been introduced but were no longer present. Three refuges, the Charles M. Russell in Montana, Rachel Carson in Maine, and Rydell in Minnesota reported only incidental sightings of moose, but that healthy populations occurred in nearby areas. The remainder (35 refuges) reported moose as occupying refuge lands on a regular basis (Table 1, Fig. 1).

The total combined area of refuges reporting the presence of moose was 72,024,112 acres; the estimated moose habitat was 39,599,769 acres (55%). These areas were not based on quantifiable data but were estimates that generally eliminated unsuitable moose habitat such as glaciers and alpine tundra. The vast majority (approximately 99%) of the total acreage and suitable moose habitat was on refuges in Alaska. Population estimates (N = 33; 4 refuges in Alaska reported as 2 since

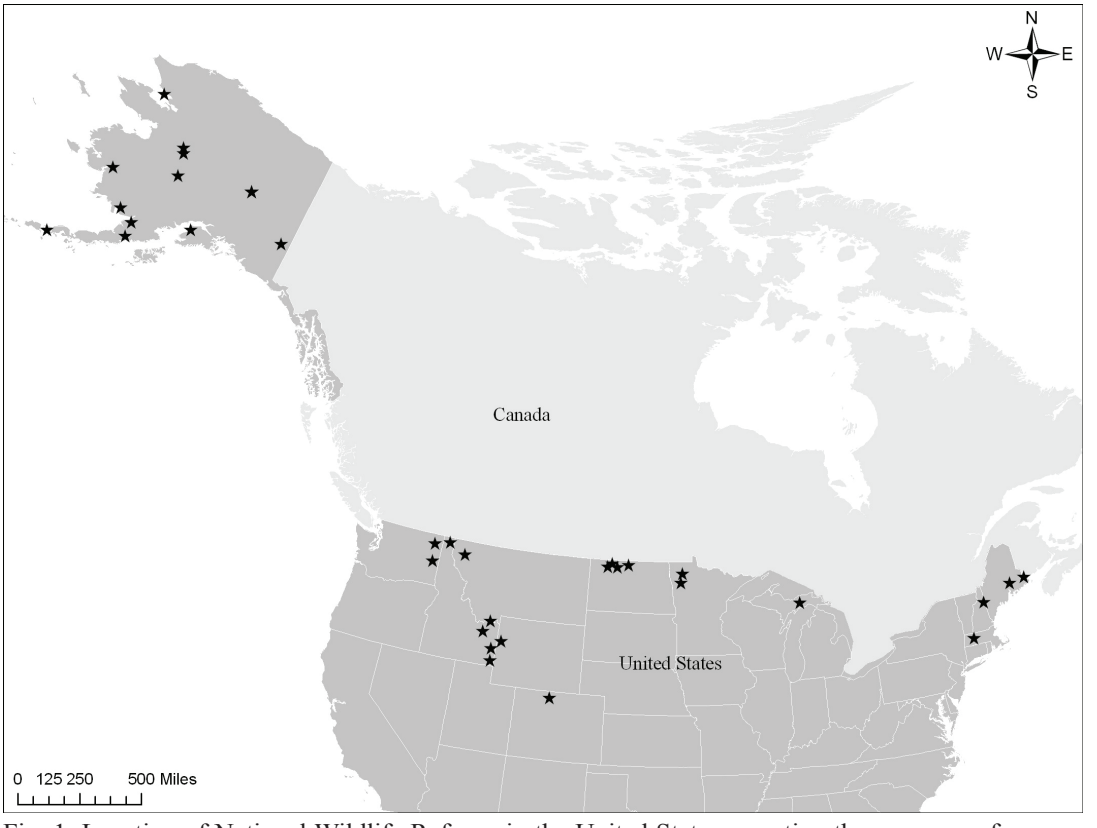

Fig. 1. Location of National Wildlife Refuges in the United States reporting the presence of moose, 2007.

Table 1. Summary data from 39 National Wildlife Refuges in the United States reporting the presence of moose, 2007. The population status was described as: 0 = stable, + = increasing, - = decreasing, and ? = unknown.

Refuge Name	State	Refuge Size (acres)	Percent Moose Habitat	Population Estimate	Population Status	Annual Harvest Estimate
Alaska Peninsula	AK	3,563,489				
&			81%	2,500	?	51-100
Becharof	AK	1,200,060				
Arctic	AK	19,286,322	26%	1,000	?	51-100
Innoko	AK	3,850,481	100%	3,700	-	10-50
Izembek	AK	311,076	10%	101	+	<10
Kanuti	AK	1,430,160	52%	588	?	10-50
Kenai	AK	1,912,425	89%	3,481	-	301-400
Koyukuk	AK	3,550,160				
&			100%	15,000	0	301-400
Nowitna	AK	1,560,000				
Selawik	AK	2,150,162	100%	2,100	0	51-100
Tetlin	AK	700,059	96%	1,272	+	51-100
Togiak	AK	4,101,178	30%	1,600	0	51-100
Yukon Delta	AK	19,162,297	20%	4,700	+	301-400
Yukon Flats	AK	8,633,385	100%	2,500	0	201-300
Arapaho	CO	23,271	19%	20	0	0
Bear Lake	ID	18,086	22%	5	0	0
Camas	ID	10,578	60%	8	-	0
Grays Lake	ID	20,125	50%	12	0	0
Kootenai	ID	2,774	100%	12	?	<10
Moosehorn	ME	28,874	100%	20	+	<10
Sunkhaze Meadows	ME	11,217	87%	25	?	0
Seney	MI	93,245	95%	50	?	0
Agassiz	MN	61,501	73%	33	?	0
Glacial Ridge	MN	2,360	50%	7	?	0
Lost Trail	MT	8,834	38%	5	+	0
Red Rock Lakes	MT	68,810	84%	93	+	<10
Des Lacs	ND	19,547	51%	10	0	0
J. Clark Salyer	ND	59,376	42%	40	0	0
Lostwood	ND	26,904	100%	8	0	0
Upper Souris	ND	32,302	69%	4	+	0
Lake Umbagog	NH	13,173	50%	100	0	<10
Silvio O. Conte	VT	26,574	100%	85	-	10-50
Little Pend Oreille	WA	42,594	100%	10	+	<10
Turnbull	WA	17,935	64%	10	0	0
National Elk	WY	24,778	20%	20	-	0

they are managed as complexes) were derived from expert opinion (5), incidental observation (11), refuge-specific aerial surveys (12), or state agency aerial surveys (5). Population status was reported as increasing (8), decreasing (5), stable (12), and unknown (8). This assessment was made by expert opinion (9), incidental observation (12), or statistical trend analysis (12).

Hunting occurred on 20 refuges. The estimated annual harvest on refuges that allowed hunting ranged from <10 (6), 10-50 (3), 51-100 (5), 201-300 (1) and 301-400 (3); only Alaskan refuges reported harvests >10 moose. The harvest at Izembek NWR in Alaska was <10 moose with an increasing population. Most moose reported at Izembek were on an adjacent unit of the Alaska Peninsula NWR but were managed by Izembek. All Alaskan refuges that allow hunting have both recreational and subsistence hunting, but harvest estimates were not differentiated by type (Table 1).

Only 9 of 35 refuges reported specific management actions to benefit moose such as prescribed fire (8), re-vegetation (2), willow cutting (1), rest area from grazing (1), and wildland fire use (2). Wildland fire use is the practice of allowing naturally ignited fire to burn for resource benefits and differs from prescribed fire that is a management-ignited fire for resource benefit. New terminology being used to describe various strategies to suppress all or part of a wildfire, or permit portions to burn, equate all fire management decisions other than prescribed fire as "appropriate management response" so future habitat treatment by fire management decisions may be more difficult to track. Some refuges historically used crushing or chaining to set back forest succession to benefit moose, but these techniques are not currently employed. Follow-up conversations with biologists and managers revealed that fire is generally considered cheaper, more ecologically acceptable, and more effective than mechanical treatments. Kenai NWR reported that nearly 60,000 acres received vegetation treatment for habitat improvement in 1960-2008 (21,697 acres of mechanical, 4,863 acres of prescribed fire, and 29,638 acres of wildland fire use) with wildland fire use accounting for nearly all acreage treated in the past 5 years. The current assessment of moose habitat on refuges (N = 33) included improving (7), stable (12), declining (5), and unknown (9) conditions. These assessments were largely reported as qualitative (84%) not quantitative.

The most important issues or management concerns about moose on refuges were climate change (13), habitat degradation (12), illegal harvest (11), subsistence hunting (10), recreational hunting (8), parasites (5), habitat loss (3), disturbance (2), and moose-vehicle collisions (2). Fifteen refuges reported "other" that included practical and political issues involving predators, coordination and education with rural users, drought, vegetation management, practical fire management programs, and reliable population surveys. All issues were identified by at least one manager in both Alaska and the lower 48 states except subsistence hunting was identified as a management concern only in Alaska; parasites were identified as a concern by lower 48 refuge managers only.

DISCUSSION

Refuge managers are charged with achieving specific refuge purposes and the mission of the NWRS. Management of the NWRS has evolved from the beginning of the 20th century when refuges were viewed as inviolate sanctuaries, and little or any public use was allowed – to post-World War II when refuges were managed increasingly for multiple uses – to the current era (post-1997) when refuges are managed primarily for wildlife. Human uses are allowed only when such uses are compatible with (i.e., do not materially interfere with or detract from) refuge purposes and the NWRS mission. Additionally, in 1997

Congress mandated that wildlife-dependent recreational uses (i.e., hunting, fishing, wildlife viewing, photography, and outdoor education and interpretation) were appropriate uses of the NWRS and should be permitted if compatible. It is this mandate that may help ensure opportunity for moose hunting well into the future, though this applies mostly to Alaska where the majority of moose and moose habitat occur in the NWRS. Kenai NWR has a specific purpose to provide for wildlife-oriented recreation including hunting. The other 15 Alaskan refuges have a specific purpose to provide continued opportunities for subsistence hunting and fishing, but also have the general mandate to permit hunting and other wildlife-dependent recreational uses whenever compatible with other purposes. While subsistence hunting in Alaska is administered differently under Federal law than state managed recreational hunting, ample opportunity exists for both user groups. This dual management program began in 1990 and has resulted in frequent philosophical debate and legal challenge, but no significant conservation concerns have developed to date.

The survey indicated no identifiable trend in the status of moose regionally or by state. Informal discussions with refuge managers suggest that site-specific habitat variables probably drive moose numbers more than any other factor; however, there were a few exceptions, such as concern over the role of parasites in the population decline of moose in Agassiz NWR in Minnesota. Habitat treatment on refuges is guided by a number of factors including the legal purposes for establishing the area, and other legal mandates, policies, and economics.

Wilderness designations by Congress are relatively new protective layers applied to areas in certain refuges, as well as portions of some National Parks, National Forests, and Bureau of Land Management lands. Wilderness designations provide legal protection from development such as logging, mining, oil and gas extraction, and road building, but also limit the intensive management options of managers. The legal guidelines for wilderness management require natural processes to dominate, but active management may be used to restore or help facilitate natural processes, prevent loss of species, or be implemented in case of emergency. When active management is to be undertaken, or where mechanization is necessary to access the area or complete the proposed work in designated wilderness, federal policies require that the minimum tool practical be employed to successfully complete the task. Wilderness designations may prevent some managers from undertaking active moose management practices, but the long-term additional protection given to these areas should ultimately benefit moose and other wildlife and outweigh any detriment from lost management flexibility.

Refuge management emphasis has also changed to include broader purposes and attention to wildlife diversity from earlier years when certain refuges were established as game ranges such as Hart Mountain National Antelope Refuge in Oregon, National Bison Range in Montana, National Elk Refuge in Wyoming, and Kenai National Moose Range in Alaska. This is especially true in Alaska where the majority of moose and moose habitat occurs within the NWRS. In 1980 Congress passed the Alaska National Interest Lands Conservation Act (ANILCA) which expanded the 7 existing refuges and created 9 new ones, establishing approximately 77 million acres in the NWRS (about 50%). The primary management purpose established by ANILCA for all Alaska refuges was:

"to conserve fish and wildlife populations and habitats in their natural diversity …".

ANILCA also emphasized specific species for which the areas were primarily known. Moose were specifically mentioned in 8 refuges: Kenai, Alaska Peninsula, Innoko, Kanuti,

Koyukuk, Nowitna, Tetlin, and Yukon Flats. However, the stated emphasis was clearly not exclusive and does not justify management activities benefiting highlighted species while clearly harming other species.

The overall goal of managing the largely pristine Alaskan refuges is to preserve natural diversity and natural processes. This has provided some unique challenges, but has largely been realized in the 29 years since ANILCA was enacted. The long-term prognosis is less certain given the increasing issues associated with climate change. This is no simple phenomena but rather a threat of ecosystem level change within decades rather than centuries. Increased prevalence of wildfire, drying of lakes and wetlands, elevated levels of forest insect outbreaks, rising tree lines, and melting of glaciers and permafrost are some of the potential effects of climate warming (Wiles et al. 1995, Klein et al. 2005, Berg and Anderson 2006, Berg et al. 2006, Dial et al. 2007, Wiles et al. 2008). Perhaps most notable in Alaska is the predicted shift from a largely spruce (*Picea* spp.)-dominated forest to a deciduous forest because of a projected increase in the fire cycle (Chapin et al. 2003, Rupp and Mann 2005). Such a shift should substantially favor moose, but could drastically reduce suitability of large areas to caribou (Rupp et al. 2006). While warmer climates (and increased prevalence of fire) may benefit moose, other factors may have the opposite effect such as the emergence of parasitic infections (Kutz et al. 2004).

Refuge managers charged with maintaining natural diversity need to have meaningful philosophical discussions to accompany data gathering, economic analyses, and management planning actions. First, there must be a common understanding of what is "natural diversity" if it is to be a management goal, followed by a decision of whether climate change is natural or anthropomorphic. If anthropomorphic, this could logically justify actions to prevent, reverse, or restore losses reasonably linked to climate change; however, practical consideration of social, technological, and economic issues should be addressed in long-term landscape management. Because of the potential magnitude of ecological change, managers may have little choice other than documenting habitat changes and tracking plant and animal diversity, particularly in large remote refuges. It seems evident that if significant climate change is realized in the short-term, species composition in ecological communities will change and moose populations, habitat, and range will likely shift.

ACKNOWLEDGEMENTS

I am grateful to all the NWRS staff from the 39 refuges that provided information for this summary, and wish to offer special thanks to Dr. Eric Taylor and Dr. Joel Reynolds who helped devise the survey instrument.

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