STATUS OF MOOSE IN THE CONTIGUOUS UNITED STATES

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ABSTRACT: Moose have expanded their range in the northern tier of the United States and along the Rocky Mountains in Utah and Wyoming over the past several decades. The expansion has been occurring since the 1940's, but has apparently accelerated in recent decades. Introductions in Colorado, Idaho, Michigan, and Utah have been successful as well. Reasons for the expansion include habitat change favoring moose and reduction in exploitation. Uncontrolled exploitation, including harvest by native Americans, poaching, and unintended take as through vehicle accidents may limit populations in some areas. Records on population size and harvest are provided for the states that monitor and hunt this species.

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Moose populations in the contiguous 48 states were dramatically exploited from the late 1600's and either extirpated in the eastern states or limited to remote regions until protection in the 1900's (Peterson 1955). Moose populations were discovered in the early 1900's in Yellowstone National Park, and subsequently in southeastern Idaho and Glacier National Park in Montana. Moose now occupy the northern tier of states south of the Canadian border, with populations extending down the Rocky Mountains into southwestern Colorado (Fig. 1). The Shiras moose *Alces alces shirasi*, occupies the western mountainous areas while the Canadian subspecies *A. a. andersoni* occurs from eastern North Dakota east to Michigan and Isle Royale, and *A. a. americana* occurs in New York and further east. As moose populations have increased, hunting

Fig. 1. Occupied moose range in the contiguous 48 states, 1997.

seasons have been initiated and provide a record of a remarkable recovery of a major game species, primarily through judicious protection and population management, coupled with natural recolonization of suitable habitat and in some instances, transplants to unoccupied habitat. We document prevailing status and management of these populations, primarily using reports from the state wildlife agencies.

EASTERN STATES

(*A. a. andersoni, americana*)

Maine

Moose were rare in Maine in the early half of the 20th century when the population was estimated at 2,000. Moose are now found statewide with most dense populations in the commercial forest lands in northern and western areas. By 1985 limited census work indicated 20-25,000 moose in the state (Morris and Elowe 1993). Based on increases in sighting rates reported by hunters, the population has continued to grow and is probably 32,000 to 38,000.

Moose hunting was banned in 1936 and reinstated in 1980. In 1980 hunting was limited to northern Maine with a legislatively mandated maximum of 700 permits. Although any area of the state may now be opened to moose hunting, only 6 zones in the northern two-thirds have been opened to date. The legislature has gradually increased the maximum number of permits to 2,000. The maximum number of permits has been issued each year and the success rate is typically over 90 % and approaches 100 % in several zones. Harvested animals must be presented for registration, for official notification. Hunters are selective: antlered bulls typically account for about 80% of the kill and calves rarely comprise more than 1%. The Passamaquoddy and Penobscot Indian Nations administer moose hunts on their lands and report about 100 animals taken annually. Maine now harvests the largest number of moose in the 48 contiguous states (Table 1).

As vehicle traffic and moose numbers have increased, road safety has become a major concern. About 600 vehicle collisions with moose have been reported annually in recent years. Crowd control problems occasionally occur in urban areas, but seem to decline as the novelty wears off with increasing numbers of moose in an area.

Massachusetts

Moose were extirpated from Massachusetts by the mid 1800's. Near the turn of the century 3 pairs were placed in a fenced private game preserve in western Massachusetts and a small number of animals escaped when the fences were destroyed. Remnants of this introduction apparently persisted until the mid 1920's. Occasional animals believed to be vagrants from the north were reported over the next 50 years. During the 1980's the number of moose sightings began to increase (Vescellio *et al.* 1993) The population is now believed to number at least 75 and includes cows with calves. Last year there were 12 road kills, 4 nuisance animals were destroyed, and another 4 were immobilized and relocated, supporting opinions that moose are incompatible with an urbanized area like Massachusetts. Moose hunting is not permitted (J. McDonald, MA Div. Fish and Wildl., *pers. comm.*, Mar 1997).

Michigan

During the 19th century Michigan's moose herd was near extinction due to habitat changes, unrestricted hunting and parelaphostrongylus infection associated with increasing numbers of white-tailed-deer (Aho and Hendrickson 1989). There are now 550-600 moose on the Upper Peninsula. The 100-150 animals in the eastern section are the descendants of a remnant

Table 1. Harvest of moose in the contiguous 48 states since 1980[1].

	CO	ID	ME[2]	MN[3]	MT	ND	NH	UT	VT	WA	WY	TOTAL
1980		118	636		369	14		101		3	1410	2682
1981		116		764	400	14		96		2	1369	2761
1982		153	883		497	23		94		3	1288	2941
1983		231	745	1179	481	30		89		3	1154	3912
1984		301	819		554	50		113		3	1196	3036
1985	3	347	881	968	515	93		105		4	970	3886
1986	3	383	856		591	96		134		4	1059	3126
1987	3	399	891	1163	581	126		154		5	1076	4398
1988	3	427	932		595	126	57	167		5	1216	3528
1989	5	400	922	882	595	117	59	206		6	1432	4624
1990	5	412	882		613	107	53	282		6	1634	3994
1991	7	428	959	359	595	109	89	291		8	1490	4335
1992	57	420	908		655	106	172	298		11	1349	3976
1993	101	557	934	686	621	121	281	233	25	10	1247	4816
1994	92	535	1130	399	655	132	305	157	28	19	1121	4573
1995	104	637	1304	327	628	178	384	156	61	20	1058	4803
1996	81[4]	581	1384	194	---[4]	---[4]	374	---[4]	78	30	---[4]	

[1]Hunts began in Colorado in 1985, New Hampshire in 1988, Vermont in 1993.

[2]No season in Maine in 1981.

[3]Alternate year seasons in Minnesota until 1993. No season in northeast in 1991.

[4]Information incomplete or not available at time of writing.

population and animals introduced from Isle Royale in the 1930's. The 450 animals in the western section of the Upper Peninsula are the result of an introduction of 61 animals from Ontario in 1985 and 1987. There is currently no open season on moose but hunting is expected to resume when moose numbers have increased (Aho *et al.* 1996). The Isle Royale moose population reached a peak of 2,000 to 2,500 animals in 1995 and declined to less than 1,200 in 1996 (Peterson 1996).

Minnesota

Current estimates of moose in Minnesota are 5,800, with 4,800 in the northeastern area and 1,000 in the northwest (M.S. Lenarz, MN Dep. Nat. Resour., office memoranda dated 25 March 1996, and *pers. comm.*, Feb 1997). Population estimates for the northeastern range, east of Grand Rapids, varied between 3,572 in 1990-91 and 5,600 in 1995-96. Population estimates varied between 1,985 in 1989-90 to 4,086 in 1984-85 during the 1984-1996 period.

Moose harvests have occurred in Minnesota since 1971, when 400 permits were issued by lottery to residents and 374 moose were harvested. Seasons were originally established for alternate years, and changed to annual hunts in 1994 (Table 1). In the northeastern region, permits increased from 150 in 1971 to a high of 545 in 1989, then have declined to between 315 and 188 since. Hunter success has consistently been above 80% until 1996, when it was 75% in this area. No season was held in 1991. Harvests increased from 134 animals in 1971 to a high of 44 animals in 1989, declining to 155 in 1994, where harvest has remained since. Fond du Lac band hunters killed an additional 30 bulls and 6 cows, and hunters licensed by the 1854 Authority killed 21 bulls and 6 cows in 1996. State-licensed hunters killed 5.3 bulls for every cow in 1996, probably due to shifting the season to earlier time. The hunting season normally starts on the Saturday closest to October 1 and runs for 2 weeks in the northeast region.

In 1988, three bands of Chippewa and Minnesota DNR negotiated an agreement for the bands to harvest 60 moose in each of the biennial moose seasons in most of northeastern Minnesota which were traditional hunting grounds, based on the 1854 Treaty. The Fond du Lac band withdrew from the settlement and legal resolution of their suit is pending. Total Indian harvest is judged to be more than 30 moose per year but is generally restricted to certain areas which makes coordination with state harvests possible (M. Lenarz, *pers. comm.*, 5 Mar 97).

Permits and harvests in northwestern Minnesota have ranged from 250 permits and 240 moose taken in 1971 to 780 permits and 737 taken in 1983, with declines since, to lows of 39 permits and 38 moose taken in 1996. White Earth tribe issues permits to their members, including 4 permits and 2 moose taken in 1996. Take by state hunters in 1996 was 31 bulls and 7 cows. The decline in harvest in recent years reflects the decline in moose population in this region. Hunting starts the second Saturday in October and runs for 1 week in the northwestern region. Minnesota monitors harvests, and conducts census and production estimates annually.

New Hampshire

Moose hunting was prohibited in 1901 when moose were limited to extreme northern New Hampshire and the population may have included as few as 13 individuals. The population is now estimated to be about 5,000. Sport hunting was resumed in 1988 when 75 permits were issued for zones in northern sections (Bontaites and Gustafson 1993). By 1996, the number of permits had been increased to 493 and the entire state was open to hunting (Table 1). There have been no sex or age restrictions and the

harvest has been about 70% bulls. Last year hunter success was 76% for all zones and ranged from 33% to 97% with success highest in the north. Harvested animals are registered at official check stations.

Next year the Department of Fish and Game is proposing to issue some antlerless only permits to reduce the population in northern New Hampshire and return the sex ratio to 1:1 (K.M. Bontaites, NH Dep. Fish and Game, *pers. comm.*, Mar 1997).

New York

Moose were extirpated from New York in the 1860's and were absent for the next century. In the 1980's a few animals immigrated to northern New York. and the population began to increase. Although most sightings are in the Adirondacks in northern New York, radio collared animals indicate that New York moose wander widely and may appear almost anywhere in the state. Based on public reports and observations by Department of Environmental Conservation personnel, the population is believed to number at least 50 with several cows with calves. A study to determine the desirability of increasing the population by translocating moose from other areas indicated that New York citizens tended to favor a natural return of moose but most did not support an augmentation program. There is no hunting season (A. Hicks, NY Dep. Env. Cons., *pers. comm.*, Mar 1997).

North Dakota

Moose occupy the Triangle area, the Pembina River, Tongue River, and Turtle Mountain regions in North Dakota (Johnson 1996). Census and classification of moose in these units is done with fixed wing aircraft with 100% coverage. Surveys in 1996, documented 112 moose on Turtle Mountain, 92 on the Pembina Hills, 19 in the Triangle area, and 58 on the Tongue River. In addition, moose have been observed in other areas and a population of 41 moose on the J. Clark Salyer National Wildlife Refuge suggests that consistent monitoring of that area will become necessary. Moose populations have been counted since 1979.

Moose are hunted in 8 units, with permittees in 5 units being restricted to the specific hunting unit but able to hunt either sex. In 3 units, permits are issued for either antlered or antlerless moose. Hunters must declare whether they will hunt with a bow or gun. A total of 174 moose permits were issued by lottery from 12,244 applications (odds: 1 in 70.4), with 155 permittees harvesting 97 bulls, 58 cows, and 23 calves in 1995 (Table 1). A gun season was held between December 1-24 and a bow season from September 8 through October 8, in 1995. Hunts were initiated in 1977 in North Dakota. The state monitors moose harvest, including sex and age.

Vermont

By the mid 1800's moose were rare and limited to the northeast section of the state. The population increased to about 200 in 1980, 1,500 in 1993 (Alexander 1993), and is currently estimated to be 2,000. Road kills are common with 60 to over 80 a year reported in the 1990's and complaints of damage to livestock fencing and maple sap collection tubing. In 1993, 30 either sex permits were issued for a 3 day season (Table 1). The success rate was 87% and 56 % of the harvest was bulls. Increasing the season length to 4 days allowed hunters to select for bulls. To stabilize the population some of the 100 permits issued in 1996 were for antlerless animals. Permits will increase to 165 total (115 either sex, 50 antlerless) and 4 new areas will be opened to hunting (C.Alexander, memorandum of 14 Jan 1997, VT Dept. of Fish & Wildlife).

Wisconsin

A small number of moose, probably

fewer than 100, are found in northern Wisconsin. Some cows with calves have been reported but many are likely wanderers from farther north (K. McCafferty, WI Dep. Nat. Resour., *pers. comm.*).

WESTERN STATES (*A. a. shirasi*)

Colorado

Colorado's moose population is largely the result of transplants in 1978, 1979, and 1987 to north central Colorado, and transplants into southwestern Colorado in 1991, 1992, and 1993 (Olterman *et al.* 1994). High survival occurred (Kufeld and Bowden 1996) and populations have stabilized at approximately 600 animals in the North Park area, including 100 animals that have colonized the Middle Park region (J. Olterman, CO Div. Wildl., *pers. comm.*, Feb 1997).

Initial hunting occurred in 1985 in the North Park with the issuance of 5 bull permits and the harvest of 3 bulls (Table 1). In 1995, 128 licenses were issued, including 54 for bulls and 74 for cows, with a total harvest of 104 moose and an 81% hunter success rate.

Colorado monitors harvest of cows and bulls, total harvest, and percent hunter success, and number of applicants for hunting permits. Illegal harvest and other nonhunting mortality contributed 17% of losses in a study of radio-collared moose in north central Colorado from 1992-1995. This suggested that high rates of nonregulated take can result in overharvest, but nevertheless survival rates were high enough to make hunting a viable method for maintaining moose populations (Kufeld and Bowden 1996).

Season openings were typically in mid-November or earlier, but now start in mid-October for the North Park area (Kufeld 1994). Archery season starts in early September and a muzzleloading rifle season started on September 11 in 1993.

Idaho

Moose have expanded their range in Idaho (Compton and Oldenburg 1994). The increase apparently started in the late 1800's or early 1900's and has essentially continued through the present. Moose are present in sufficient numbers in Latah County on the Washington border to warrant a hunting season, where no breeding population existed 15 years previously. Hunting was initiated in 1946 after seasons had been closed since 1898, with 30 permits offered in the southeastern portion of the state. A mandatory check of all moose hunters was instigated in 1982, which provides information on success, sex, age, and antler measurements. In 1994 and 1995, 669 and 793 permits were offered for the two respective years. Drawing odds have ranged between 1 in 7 to 1 in 12.8 over the 1993-95 period. In 1995, 637 moose were taken, an 81.9% success rate, which compares with 525 moose and a 78.5% success rate in 1994 (Oldenburg 1996). The overall hunter success rate over the 1946-94 period is 81%.

Hunting permits were increased in 1982 after relatively stable numbers over the 1946-1981 period, resulting in an increased harvest (Table 1). Hunting seasons are mostly bulls-only and last for 86 days (Aug. 30-Nov. 23), with a few shorter seasons in southeastern Idaho for antlerless moose where depredations to crops occur. Antler spread and hunter success show no discernible trend from the 1986-1993 period, suggesting that hunter harvest is not altering the male age structure. Idaho monitors harvest for moose, augmented with census in some southeastern areas. Moose are tallied when observed during elk census in other regions.

The nonlicensed kill of moose in Idaho is high. In 1993, 33 illegally taken moose in the Panhandle (northern) region accounted for 28% of known mortality. Fremont County in southeastern Idaho was closed to

hunting in 1977 because of high unregulated harvest (Ritchie 1978, Pierce *et al.* 1985). The population recovered sufficiently to be opened again in 1983 for 8 permits. High moose mortality on roads occurs along US Highway 12 in the Lochsa River drainage and in 2 units in southeastern Idaho. These areas have major highways passing through moose winter range.

Montana

Moose have been increasing in Montana since 1941, and hunting was resumed in 1945 after having been closed between 1897 and 1944 (Stevens 1971). The opportunity to harvest is regulated through a random drawing for permits. Harvest has increased from 369 in 1980 to 628 in 1995 (Table 1). Moose may be censused incidentally on flights to census elk, or flights specifically for moose. A current project is designed to refine an aerial survey to provide more reliable information in northwestern Montana (H.E. Nyberg, MT Dep. Fish Wildl. and Parks, *pers. comm.*, Mar 1997). In northwestern Montana, observed cow:calf ratios have declined for unknown reasons, but harvest information showed older age animals in the kill with reduced hunter success and increased hunter effort. Hunters in this region are asked to provide officials with a jaw from moose taken during the hunt for purposes of determining age. Telephone surveys are used to contact all moose hunters, which resulted in about a 95% contact to determine harvest. Nonresident hunters take approximately 2% of the total moose harvest.

Utah

The moose population in Utah is currently estimated at approximately 2,700 individuals (M. Welch, UT Div. Wildl. Resour., *pers. comm.*, Feb 1997). Expansion of moose into areas has been ongoing since 1950 (Babcock *et al.* 1983). The major population is located primarily in the Uinta Mountains, but has expanded and been introduced into other areas (Evans and Westphal 1996). Areas include Chalk Creek, Ogden River, Lost Creek, Cache, and Rich Counties. Reintroductions began in 1973, when 18 animals were moved into Fish Creek on Manti Mountain. Approximately 147 moose have been captured and released in other areas in Utah, and 12 animals were moved to Colorado in 1978.

Hunter harvest began in 1958 with the issuance of 10 bull permits for the Uintas, of which 7 were harvested (Table 1). Hunter success ranged from 47-87 % over the next 10 years, and permits were increased as numbers and distributions increased. Hunting seasons have typically been in September for bulls and November for cows. The first cow seasons were established for the Uinta North Slope unit in 1977, with 18 permits being issued. A single permit has also been sold to the highest bidder each year since 1987, with bids ranging from $5,000 to $7,100, the money being used for moose management. Drawing odds for bull moose in 1996 ranged between 1 in10 to 1 in 42 for resident hunters. Nonresident hunters have odds of 1 in 18, 1 in 24, and 1 in 35, in the 3 units where they are allowed to participate. Odds for antlerless moose range from 1 in 5.3 to 1 in 7.7 in 2 units for nonresidents. A total of 192 permits were available in 1996. Hunting moose in Utah is a once-in-a-lifetime opportunity.

Washington

Moose occupy the Selkirk Range and the Okanogan region in northern Washington (J Pierce, WA Dep. Fish & Wildl., *pers. comm.*, Feb 1997). Currently population estimates are 250-300 moose in the northeastern core area of the state. Moose began to colonize the area from Idaho in the 1950's or early 1960's (Poelker 1972). Moose populations have apparently been

increasing, and occasional animals occurring well outside of the known range. In 1994, 2 moose wintered near Bellingham near the Pacific coast, which may indicate additional range expansion across the northern portion of the state. Moose are hunted on a once-in-a-lifetime basis through a random drawing season. In 1996, over 5,000 people applied for 31 either-sex permits. Permit hunting started in 1977 when 3 permits were issued for 1 unit near Sullivan Lake (Table 1). Permits have increased and presently 6 hunting units are established. Season is October 1 - November 30. As the moose distribution spreads west from the current range, other hunting units will be established as populations allow.

Wyoming

Moose have expanded their range in Wyoming, primarily by natural dispersal but with some transplants to the Bighorn mountains in 1948 and 1950 (Stradley 1962). During the 1945-1956 period, approximately 2,400-3,200 moose were estimated to occur in the state (Hnilicka and Zornes 1994). Total moose population for the state was listed as 12,467 in 1994. Currently moose occur in the western mountainous regions, the Snowy Range and the Bighorn Mountains.

In 1962, 22 moose hunting units were listed, with total permits to hunt being 1,038 and 913 harvested. In 1996, 43 hunting units were listed with 1,234 permits being issued and 1,118 were harvested for a success of 91.9%. Permits to hunt have declined from a high of 1,920 in 1990, with a corresponding decline in harvest (Table 1), due to perceived population declines and lower calf production. Hunting seasons vary by unit, with opening dates being September 10 and October 1, depending on access and local migration patterns with November 1 openings attributable to late season migration in some areas. Nearly 50% of the seasons open on October 1, with 30% opening on September 10. Approximately 60% of the licenses are for antlered moose, 36% for antlerless, and 4% for any moose. Twenty percent of the licenses are reserved for nonresidents. Wyoming harvests the largest number of Shiras moose in the contiguous states.

Wyoming has an active prescribed burning program to improve moose habitat. Moose are surveyed after the season to determine sex and age composition and numbers. All hunters are surveyed and requested to return samples, with about 50% compliance. Concerns over the future of moose in Wyoming center around increased recreation using snowmobiles and all-terrain vehicles, habitat loss and fragmentation (D Brimeyer, WY Game and Fish Dep., *pers. comm.*, May 1997).

DISCUSSION

Moose have expanded their range and increased in numbers across the northern tier of states. The pattern of population increase, as indicated by harvest records, suggests that populations have stabilized in long-occupied habitat and continue to expand into some unoccupied habitat. The Minnesota and Wyoming populations exemplify stabilization and perhaps declines (in Minnesota) in long-occupied habitat. Massachusetts, New York, North Dakota, and Vermont populations reflect increases in recently colonized habitat. The pattern is not unique to the US, since moose numbers are increasing in New Brunswick (Boer 1992) and other portions of Canada as well. The increase is generally by natural dispersal, although transplants of moose to unoccupied habitat in Wyoming, Idaho, and Utah have occurred, and the present Colorado population is the result of translocations.

In the east, moose were once present as far south as Pennsylvania (Peterson 1955). Forest clearing for agriculture and unregu-

lated hunting resulted in severe population declines and moose were extirpated from southern parts of this region and became rare in northern areas. The role of brain worm (*Parelaphostrongylus tenuis*) and climatic changes are less clear but may have influenced the pattern. In the early part of the 20th century moose received protection from hunting and habitat improved as abandoned farmland regenerated. During the later part of this century increasingly mechanized forestry has resulted in an abundance of regenerating clearcuts in northern areas of the northeast. The resulting browse supply has helped increase moose numbers and breeding populations are now found in 5 northeastern states, with occasional moose wandering into southern New England. Dunn and Morris (1981) reported that probable causes of increased moose populations in Maine included expansion of clearcutting, more beaver flowages, climatic changes, and a declining deer herd.

The return of significant moose numbers to the northeastern U.S. has had both positive and negative effects. Hunting has resumed in 3 northeastern states and moose watching has become a popular activity and an important tourist attraction. However, moose and the heavy vehicle traffic in much of this region are a poor combination. In sections with few moose and many, predominately urban, people, the presence of a moose has caused crowd congestion problems, and mortalities and injuries from vehicle collisions are increasing.

In the west, reasons for the increase have been speculated on, and include predator control, habitat change, reduced nonregulated exploitation, and conservative harvest. Hnilicka and Zornes (1994) reported 206 fatalities attributable to collisions in Wyoming over the 1979-1993 period, and Oldenburg (1996) reported 273 known moose fatalities over the 1986-1995 period in Idaho. In Idaho, unregulated mortality on moose, including illegal, Indian and vehicle-related mortality, accounted for 9.6-12.9% of the known mortality of moose between 1993 and 1995 (Oldenburg 1996). Unregulated mortality of moose may be sufficient to minimize population increases until general public awareness of their presence suppresses traffic collisions and other illegal take (Yeo and Peek 1994).

Forests in deeper snow country which have not been harvested have continued to mature as a result of protection from fire and may be providing better winter cover and in some cases, forage, for moose than in the recent past (Peek *et al.* 1987). Conversely, in other areas such as northeastern Washington (Poelker 1972), northern Idaho, and northwestern Montana (Matchett 1985), moose may have responded to increased logging and burning which provided abundant shrub fields that serve as forage. Hnilicka and Zornes (1994) speculate that moose expansion in Wyoming is a result of natural colonization of suitable habitat, coupled with conservative harvest and lack of natural predation by wolves.

Alternatively, Kelsall and Telfer (1974) postulated that the southern limits to moose habitat may be related to their inability to withstand heat in areas with climates that exceed 27° C for long periods, pointing out that a number of temperate species do not thrive in hotter climates because of heat stress. Mortality has now been documented in Utah, attributable to stress-induced pneumonia and pink-eye during dry summers (M. Welch, UT Div. Wildl., *pers. comm.*, Feb 1997). Moose apparently evolved in the cooler more northern climates (Franzmann 1981) and may not be able to eliminate heat when exposed to prolonged periods of hot summer days at lower elevations along the southern limits of their range. This may explain why moose are now colonizing low-elevation forests in central Idaho where sufficient area of forest has matured

to provide closed-canopy, shady habitat suitable for use by moose in mid-summer.

The most commonly accumulated information on moose available from across the southern moose range comes from hunter harvest surveys. Since hunting is limited by permits, hunters may be directly polled after the season and a total count of moose harvested can be approximated. However, whether hunter harvest and hunter success can be used to indicate population trend is questionable without corroborating information to verify. In the early 1980's, moose permits were arbitrarily increased in several states, which resulted in increased hunter harvest with no change in hunter success. This may indicate that harvests are quite low and do not track population trend. The information from Minnesota suggests that the opposite is more typical, and as populations are perceived to change, moose harvests are adjusted to what is deemed an appropriate level.

Winter classification counts are conducted by a number of states, including Colorado, Wyoming, Idaho, Minnesota, North Dakota, and Montana, and where aerial surveys have been accomplished annually for a number of years, these data provide direct evidence of population trend. Additionally, Maine, New Hampshire, North Dakota, Vermont, and Wyoming collect teeth to estimate age structure of the harvest. Efforts to collect age/sex information from harvested moose in northwestern Montana have produced variable information and small sample sizes which has restricted their value (H. Nyberg, MT Dep. Fish, Wildl. and Parks, *pers. comm.*, Mar 1997). For many hunting units with few permits, age/sex data from the harvest and hunter effort information will not likely provide adequate information on population characteristics to be of value.

Monitoring moose populations is a low priority for most states. State agencies spend more effort in monitoring deer and elk, the major game species, and only in some areas where moose are especially prominent in the fauna and management situation will they justify intensive monitoring. While current methods to monitor populations will often provide minimal information, the effort to increase monitoring will be evaluated against other priorities and needs. There is, however, more need for information on what is causing the population increases and fluctuations. An evaluation of the role of hunter harvest in management and monitoring of moose populations would help assess whether current monitoring is adequate.

Habitat management for moose may tie in with other forest management activities as in Minnesota (Potter 1985) and central Idaho (Peek *et al.* 1987). Intensive forest management with suppression of shrub development by glyphosate can adversely affect moose habitat (Kennedy and Jordan 1985), and must be effectively coordinated at landscape levels to minimize effects (Servello *et al.* 1995). Occasionally habitat management occurs for moose on western ranges in the form of burning aspen and willow stands. Stevens (1971) stated that moose populations in Montana would not be secure until the place of wildlife in multiple use management is firmly established. In the lower 48 states, that statement applies 26 years later, where moose will typically be managed in concert with other wildlife species and other natural resources.

We conclude that the expansion of moose along the southern boundaries of the range in North America is attributable to a variety of causes which favor reductions in mortality and improved habitat conditions.

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