STATUS AND MANAGEMENT OF MOOSE IN MASSACHUSETTS

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ABSTRACT: Moose (*Alces alces*) have inhabited Massachusetts at various times both before and since the colonial period. However, moose were extirpated with the advent of agriculture and land clearing in the early to mid-1800's. As agriculture faded in the 1900's, moose returned to Massachusetts. In recent years sightings of moose have increased dramatically with most occurring during late summer to autumn. Many moose sighted are dispersing young bulls, although reports of calf and cow groups have been increasing. Man's activities, including urbanization, agriculture and high speed automobile travel, make much of Massachusetts unsuitable for moose both ecologically and from a human cultural perspective. Automobile strikes, crop damage and nuisance complaints have increased along with sightings. The Massachusetts Division of Fisheries and Wildlife (DFW) has developed a moose response protocol and coordinates response activities with other state and local agencies. The current response protocol, molded by public and political constraints, includes monitoring and hazing, immobilization and translocation, and euthanasia depending on potential threats to public safety.

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HISTORICAL ACCOUNTS

Pre-extirpation

Moose are known to have been present in Massachusetts at the time of colonial settlement (Lechford 1833, Morton 1972, Higginson 1976). However, Wood (1977:43) remarked in 1634 that there were "not many" in the Massachusetts Bay area, but a "great store" 40 miles to the Northeast. At this time, moose were often utilized by Indians for food and clothing (Lindholdt 1988), and moose hides were an important article of commerce among fur traders in the Connecticut River Valley (Judd 1857). Breeding moose apparently remained present in Massachusetts at least through the early 1700's, as a cow was killed within 2 miles of Boston "a few years" prior to 1721 (Merrill 1916). Moose were occasionally seen or killed in Berkshire, Essex, Middlesex, and Worcester Counties from ca. 1733 to 1769 (Bullock 1865, Hyde and Hyde 1878, Ewell 1904, Judd 1905, Torrey and Allen 1962). They were probably extirpated from the state by ca. 1800. Emmons (1840) remarked that moose were "extinct" in Massachusetts and had not been taken there for 30 or 40 years. Loss of forested habitat due to agricultural development and extensive commercial hunting to the north (Currier 1906) were probably factors in the moose's extirpation from the state. Moose were considered "extinct" in Massachusetts through the remainder of the 19th century (Samuels 1862, Allen 1869).

Post-extirpation

Three pair of moose from Manitoba were imported to the Whitney Game Preserve on October Mountain, Berkshire County, ca. 1896-1900 (Sargood 1914, Federal Writers' Project 1939). About 1911, 4 to 8 moose escaped following the sale of the preserve and the deterioration of boundary fences. Some moose survived and probably bred (Eaton 1919, Warfel 1937). Moose hunting was prohibited via legislation in 1913 but several were poached during the white-tailed deer hunting season of 1920 (DFW files). Some moose remained at least until 1925-26, including "a few" calves and some vagrants

wandering as far south as Connecticut (Div. Fisheries and Game 1923, Goodwin 1935). In the 1930's moose were reported from 8 towns of western and central Massachusetts (Crane 1931, Stone 1937, Warfel 1937, Parker 1939) and reports from the 1940's included 12 towns of these regions plus the state's northeastern corner (Anonymous 1943, Moore 1944, Snyder 1944, Poor 1945). All but 1 report occurred in September and October, and most of the animals were tracked through several towns, suggesting that these moose were northern vagrants. Occasional animals continued to occur through the 1960's and 1970's (Grayce 1957, Waters and Rivard 1962, Anonymous 1966, Lawrence and Lyman 1974), although record-keeping was imperfect.

Extirpation model

The following extirpation model for moose in Massachusetts is based on historical records and lack thereof, importation and escape of moose into Berkshire County and recent sightings and trends. Our resultant model encompasses 5 phases: (1) pre-colonial presence of moose, (2) a decline in moose numbers during colonization due to unregulated killing, northern market hunting and clearing of vast parcels of land for agriculture, (3) the eventual period of extirpation from ca. 1800 to the early 1900's, (4) a period of re-establishment via reintroduction and occasional transients and finally (5) the natural immigration, reproduction and growth phase since about the mid-1960's.

CURRENT STATUS AND TRENDS

Data types

Current data on moose in Massachusetts are compiled from reports to DFW in the forms of sightings, complaints, vehicle strikes, etcetera as reported by Massachusetts Environmental Police, state agencies (environmental, highway, etc.), police, and the general public. These reports (hereafter called "records") are sorted by the authors, reviewed to minimize duplication and entered into a computer database for retrieval and analyses. The data base contains reports from the 1700's through December 1992. Most (84%) records refer to 1 moose with about 5% having no number given, so each record is weighted equally for analyses. Zero records were reported for most years 1965 or earlier whereas post-1965 records are almost always ≥ 1 (mean = 6.7). Authors therefore determined 1966 as the first year of our "current phase" conditions with records prior being considered historic.

Record types and trends

Records are typed by category as either (in decreasing frequency) visual live sighting, vehicle kill, illegal kill, translocation, track/sign, nuisance kill, other mortality, legal hunting kill or literary reference. Visual sightings of live moose account for about three fourths of all records (Table 1). The proportion of vehicle kills and nuisance kills increased between 1966-87 and 1988-92 (6% to 9%, and 2% to 4% respectively) whereas that of translocations decreased (10% to 2%, all changes statistically non-significant; Table 1). Most moose (6 of 9) translocated from within Massachusetts have caused problems after relocation. Problems have included poaching loss (n=2), vehicle kill (n=1), repeat translocations (n=2) or agricultural depredation (n=1). One of the remaining 3 moose died within a few days of translocation leaving only 2 of the 9 for possible reassimilation into the wild.

Current status

There is a definite upward trend in the number of moose records received by DFW since 1966, and peak years for records have occurred 5 times (Fig. 1). To help interpret this growth trend we fit an exponential curve to these data. The finite annual rate of change (Hatter and Bergerud 1991) for this series is

Table 1. Distribution of Massachusetts moose records by category, 1966-1987, 1988-1992 and 1600-1992 (percent of total within period in parentheses).

Category	Recent Records 1966-87		Recent Records 1988-92		1600-1992 (all rec.)	
Visual Sightings	52	(76.5)	85	(74.6)	162	(73.0)
Vehicle Kills	4	(5.9)	10	(8.8)	14	(6.3)
Illegal Kill	2	(2.9)	3	(2.6)	10	(4.5)
Translocation	7	(10.3)	2	(1.8)	9	(4.1)
Track or Sign	1	(1.5)	5	(4.4)	8	(3.6)
Nuisance Kill	1	(1.5)	5	(4.4)	7	(3.2)
Other Mortality	1	(1.5)	4	(3.5)	5	(2.3)
Legal Harvest	0	-	0	-	4	(1.8)
Literary Reference	0	-	0	-	3	(1.4)
Total	68		114		222	

1.38 (R^2=0.47; Fig. 1). Although we recognize that such moose records are not directly akin to regulated (or unregulated) population growth rates, and that sociological factors as well as biological factors affect our records, the calculations demonstrate a substantial rate of increase in moose reported to DFW. We feel moose are dispersing into Massachusetts more frequently and that cow/calf groups are becoming more common.

TEMPORAL AND SPATIAL DISTRIBUTION

Temporal

Ninety percent of records (199 of 222) include a month, and a skewed frequency distribution among months is evident for recent phase data (Fig. 2). Records per month range from 2 in March to 78 in September for all years, and 2 in March to 69 in September for the 1966-92 phase (Fig. 2). Sixty five

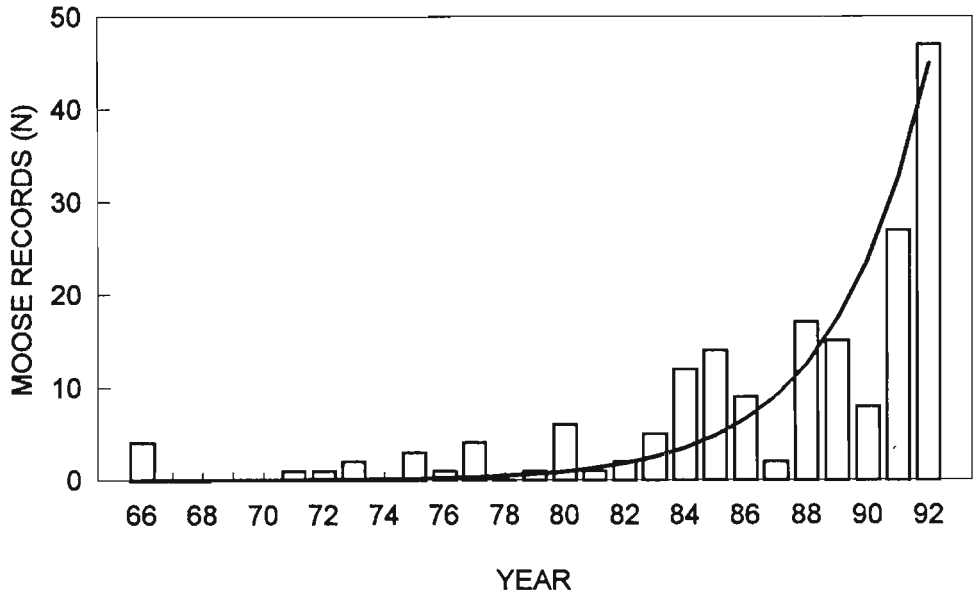

Fig. 1. Number of records of moose in Massachusetts, 1966-1992.

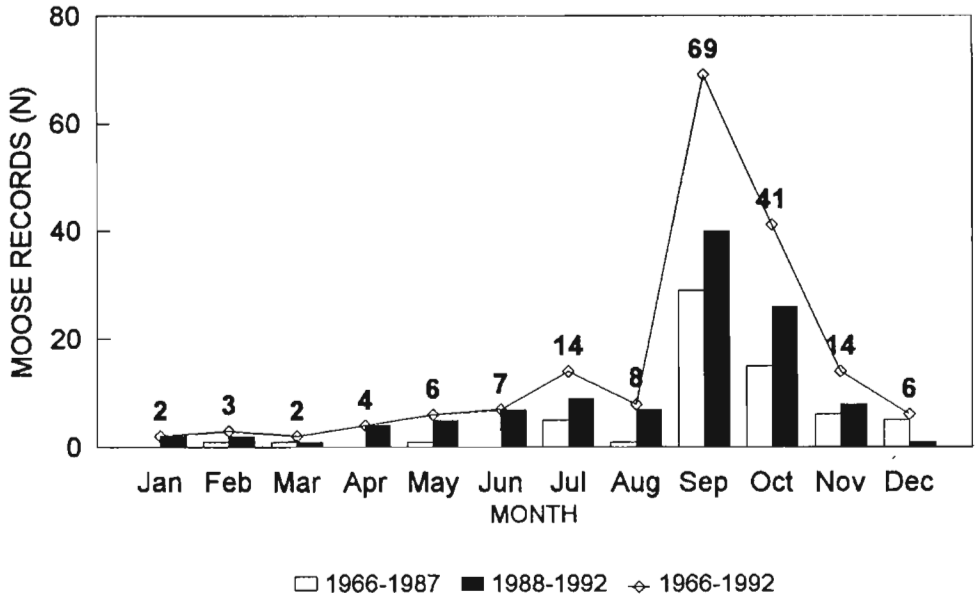

Fig. 2. Distribution of Massachusetts moose records by month, 1966-87, 1988-92 and 1966-92.

percent of all records occur in either September or October with 76% occurring from August to November; three-quarters of all records occur during one-third of the year. This fidelity of records within months has allowed for great predictability in our reactive management and readiness for moose incidents. These data allow us to predict that moose will begin to be sighted in Massachusetts in late August each year and that by the end of September we will probably have as many moose incidents as during the remainder of the year. Further, 8 of the 9 translocations have taken place in September with the other occurring in October.

Spatial

Since 1987, moose have been sighted throughout most of Massachusetts except for the urban Boston area and the five southeastern counties. The majority (62%) of all records have come from central or northeastern Massachusetts south of New Hampshire and Maine (Essex, Middlesex and Worcester counties; Table 2). These data may reflect a geographical pattern in the incursion of moose into Massachusetts from northern states. Analyses of most recent (1988-1992) data on a town basis reveal a clumped distribution with 3 major foci. These clumps are the northeast region from about 50 km due north to 40 km northwest of Boston, the mostly undeveloped central region surrounding Quabbin Reservoir, and a more loosely distributed patch of west-central Massachusetts. However, Massachusetts is a small state (about 80 km north to south) and movement of moose within, and probably even across the state is not unusual. Of the moose translocated within Massachusetts and released in a free-ranging manner (n=7), 4 were later seen or recovered in Vermont, 1 in New Hampshire and 1 in Connecticut.

MANAGEMENT PROCEDURES

Management constraints

By statute, the hunting of moose in Massachusetts is prohibited although DFW must appraise and remunerate agricultural producers for damage caused by moose. The General Laws also allow an owner or tenant of property to "take by other means, except by poison or snare...any mammal which he finds damaging his property...", with provisions for

Table 2. Distribution of Massachusetts moose records by County, 1966-1987, 1988-1992 and 1600-1992 (percent of total within period in parentheses).

State Region	Recent Records				1600-1992	
County	1966-87		1988-92		(all rec.)	
Western						
Berkshire	9	(13.2)	8	(7.0)	29	(13.1)
Central						
Franklin	6	(8.8)	11	(9.6)	21	(9.5)
Hampshire	5	(7.4)	12	(10.5)	19	(8.6)
Hampden	2	(2.9)	5	(4.4)	12	(5.4)
Worcester	28	(41.2)	37	(32.5)	71	(32.0)
Northeast						
Middlesex	10	(14.7)	25	(21.9)	42	(18.9)
Essex	8	(11.8)	15	(13.2)	26	(11.7)
Southeast*						
Plymouth	0	-	0	-	1	(0.5)
Norfolk	0	-	1	(0.9)	1	(0.5)
Total	68		114		222	

*Southeastern Counties with no records are Bristol, Barnstable, Dukes and Nantucket.

reporting and surrender of the animal thus killed. This statute was invoked in 1 instance to protect registered Holstein cows from a harassing moose. In the majority of such cases however, the owner or tenant would rather suffer the damage than destroy the moose and face the disapproval of the general public and media.

History of management

In the 1960's and 1970's when problem moose were infrequent, DFW immobilized and translocated moose to rural portions of the state. In the early 1980's increased numbers of incidents coupled with logistical problems and the realization that translocated moose cause subsequent problems gave DFW rationale to halt translocations in favor of moose euthanasia. However, in 1991 DFW was forced to again re-evaluate its strategy after a moose was euthanized in a Boston suburb while the public watched (Howard 1992). Although the incident was handled in accordance with policy, the ensuing media spectacle and subsequent public outcry for the non-lethal resolution of problem moose situations was such that DFW was forced to develop a new formal moose response protocol that included immobilization and translocation.

Current moose response protocol

Problem moose situations are currently resolved using an inter-agency protocol involving DFW, the Division of Law Enforcement (Environmental Police) and the Department of Public Safety (State Police). Chemical restraint, handling, and marking follows a standard protocol approved by DFW's Animal Care and Use Committee (Cardoza 1992). Once a moose is reported in an area where an actual or potential problem exists, DFW staff responds to the scene and determines appropriate action according to the protocol. The primary concerns are public safety, staff safety and animal welfare in priority order. If public safety is at stake, DFW personnel require a secure area and coordinate activities with law enforcement personnel prior to invoking any action.

In instances where a moose presents little or no concern for public safety, the appropriate course of action is to monitor the moose. If an escape route to forested or wetland cover is available, the next level of response is to monitor and haze the moose toward that cover. Moose are chemically immobilized for translocation only when there is an immediate public safety concern, when the area is secure (controlled from spectators, press and traffic), and when there is reasonable expectation that the moose will not harm the public or itself. Moose are euthanized in the event of injury during immobilization, a pre-existing sickness or injury, if they are a threat to public safety or if there is no possibility of relocation.

In the fall of 1992, DFW responded to 7 problem moose incidents. Of those, 2 were monitored and hazed, 1 was immobilized and translocated and 4 were euthanized. Of the 4 euthanized, 2 were previously injured by vehicles, 1 was sick and 1 was killed (by non-DFW personnel) outside of the protocol.

CONCLUSIONS

Massachusetts is a rapidly urbanizing state, where 6-million people inhabit 2-million hectares and where high speed roadways criss-cross the state. Given these facts, coupled with most citizen's urban or suburban lifestyle, we feel that our public's understanding of, and tolerance of moose is limited. DFW is in an untenable position where moose sightings are increasing rapidly, the killing of problem moose appears socially unacceptable and translocating them has economic and logistic constraints and results in problems elsewhere.

The collective ability for humans to accept the presence and consequences of any wildlife species will eventually define the wildlife acceptance capacity (Decker and Purdy 1988) for that species. In Massachusetts the public is just beginning to define our wildlife acceptance capacity for moose. If current trends continue, the authors expect (1) a reduction in the publics' capacity for moose given further conflicts, (2) a public education effort from DFW, (3) an increased public understanding of the role of lethal means during wildlife encounters to protect humans, and possibly, (4) proactive rather than reactive or "crisis" moose management in Massachusetts.

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