OPINIONS ABOUT MOOSE AND MOOSE MANAGEMENT AT THE SOUTHERN EXTENT OF MOOSE RANGE IN CONNECTICUT

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ABSTRACT: Increasing moose (*Alces alces*) populations in the northeastern United States present new challenges for wildlife managers who must balance beneficial and adverse aspects of moose populations. It is important that managers understand stakeholder attitudes and values about moose and incorporate such into outreach and management programs. The objective of this research was to assess landowner and hunter perceptions about status, management, and concerns associated with a small moose population in Connecticut. The majority of landowners and hunters correctly believed that <100 moose existed in Connecticut, half believed that the population was increasing but had no opinion about appropriate size, and few had ever observed a moose in Connecticut or been involved in a moose-vehicle accident (MVA). Landowner support for viewing areas was high and moose hunting low unless MVAs increased; support for hunting moose was high among hunters. If human-moose conflicts increase, principally MVAs, we expect reduced public support for the resident moose population. Proactive education and management are suggested to reduce human-moose conflicts, MVAs, and increase acceptance of hunting as a possible population management tool.

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Moose (*Alces alces*) populations have increased throughout northern New England over the past 30 years presenting management challenges to balance their beneficial and potentially adverse aspects (Wattles and DeStefano 2011). Moose provide intrinsic economic value to both consumptive and non-consumptive users (Schwartz and Bartley 1991), with watching and hunting as major revenue generators (Wolfe 1987, Timmermann and Rodgers 2005), especially in northern New England. Populations reaching levels sufficient for recreational opportunities may result in higher levels of adverse consequences in the form of moose-vehicle accidents (MVAs) and ecological damage (Mirick 1999, Timmermann and Rodgers 2005), although such conflicts can also occur in small populations and suburban areas (McDonald et al. 2012).

Assessing attitudes of various stakeholder groups toward a wildlife species is useful to understand societal support and opposition about current and potential management decisions (Bath and Enck 2003), and importantly, incorporating stakeholder attitudes into outreach and management programs (Teel et al. 2002). Natural resource agencies increasingly emphasize stakeholder participation in decision-making (Lauber and Knuth 1997) and management of human-wildlife interactions (Ericsson 2003) to implement plans (Flanigan 1987, Hartig and Thomas 1988, Pinkerton 1991, Landre and Knuth 1993), strengthen public relationships (Landre and Knuth 1993), and reduce conflict (Erickson 1979, Twight and Patternson 1979, Nelkin 1984, Blahna and Yonts-Shepherd 1989).

Relative to other big game species, human dimensions (HD) research with moose was initially limited in North America (Wolfe 1987). An evaluation of articles from 1974-2001 in *Alces* indicated that the majority of early HD research pertained to hunting of moose or MVAs, with less attention to public values and attitudes towards moose (Ericsson 2003). In the northeastern United States, states have used HD research to evaluate public opinion about their initial moose management programs in Vermont (Alexander 1993), New Hampshire (Donnelly and Vaske 1995), and New York (Lauber and Knuth 1997, 1999). Relative to non-consumptive recreation in New Hampshire, Silverberg et al. (2001) measured knowledge level, attitudes, and motivation of wildlife viewers at a moose viewing site. And recently, HD research was used to evaluate public opinions about moose to provide effective educational strategies to reduce human-moose conflicts, principally MVAs, in Prince George, British Columbia (McDonald et al. 2012).

However, similar HD information is non-existent in Connecticut, the southern extent of moose range in New England. Although the potential for moose populations to continue expanding in Connecticut is unclear, developing management strategies and programs that are both effective and acceptable to the public is important relative to managing human-moose conflicts. Our objective was to survey landowners and hunters about the status, management, and associated concerns with the moose population in Connecticut.

STUDY AREA AND BACKGROUND

Connecticut (12,548 km^2) was the fourth most densely populated area (3,500,000 people, 278 people/km^2) in the United States at the time of this research (Connecticut Economic Resource Center 2006, 2010). Located in southern New England, it is bounded on the south by Long Island Sound, and by the states of Rhode Island to the east, Massachusetts to the north, and New York to the west. Connecticut is about half forested (55.6%), 20% developed or barren, 16.7% turf, grass, or agricultural field, 4.4% wetlands (non-forested, forested, and tidal), and 3.2% water (Hochholzer 2010).

Historic accounts suggest that moose existed in Connecticut prior to the 18th century (Trumbull 1797, DeForest 1964); however, Goodwin (1935) noted that at the beginning of the 18th century there was no record of moose in Connecticut. Further, the lack of archaeological deposits of moose suggests that they likely existed in low numbers, if at all (N. Bellantoni, Connecticut State Archeologist, pers. commun.).

A few reports of transient moose occurred between 1916 and 1956 (Connecticut Wildlife 2000), and on 18 September 1956, the Board of Fisheries and Game (currently the Department of Energy and Environmental Protection, DEEP) passed an emergency regulation that gave full protection to moose in Connecticut. Sporadic reports of moose occurred until the early 1990s (Kilpatrick et al. 2003), and in 1992 the DEEP began documenting all credible sightings and MVAs. In 1996 a question was added to the annual deer hunter questionnaire asking them to report any moose observation during the deer (*Odocoileus virginianus*) hunting season. In 1998, the Wildlife Division of DEEP adopted a directive (DEEP2431-D1) that outlined procedures for responding to problem moose situations that included hazing, capture and relocation, and euthanasia. Since 2000, observations of cows with calves confirmed the establishment of a small resident population (Kilpatrick et al. 2003). An empirical model based on public sightings of moose reported to the DEEP conservatively estimated the population at ~64 in 2004 (LaBonte and Kilpatrick 2006) with ~75 present at the

time of this survey in 2008 (LaBonte 2011). Despite low moose numbers, Connecticut was experiencing 2–4 MVAs annually (DEEP, unpublished data) and DEEP staff were exploring options to implement a moose management strategy to address increasing MVAs. However, it was unknown if the general public or hunting community would support a management strategy that included moose hunting given the minimal population. Understanding public and hunter opinions about moose and moose management is essential for developing an effective moose management plan in Connecticut.

METHODS

Based on the distribution of moose sightings by the public (Kilpatrick et al. 2003), hunters (LaBonte et al. 2008), and reported MVAs (DEEP, unpublished data) (Fig. 1), northern Connecticut was selected as the study area for the landowner survey. Based on geographic features and an assessment of human population densities, towns in northern Connecticut were delineated into 3 groups for the landowner survey (Fig. 1) and were used for landscape level comparisons. Towns were grouped as Central (n = 13), Eastern (n = 16), and Western (n = 20) (Table 1, Fig. 1).

Landowner Survey

A database containing the names and addresses of landowners in the 49 study towns was obtained from municipal town offices. We set a sampling rule to include private landowners and removed all identifiable outliers (e.g., limited liability companies, corporations, companies, schools, churches, trustees, towns). We deleted duplicate landowner records (i.e., multiple ownerships) to compile a list of landowners with an equal likelihood of being randomly selected and receiving a single survey.

We calculated minimum sample sizes required for each landscape based on a stratified random sampling approach (Scheaffer et al. 1996). A mail survey was chosen because it can include complex questions, access geographically dispersed groups, and recipients can reply at their convenience with low potential for social desirability bias (Decker et al. 2001). We used a 3-wave survey with a variation of the repeated mailing technique (Dillman 1978). Surveys were mailed to randomly selected landowners stratified among the 3 landscapes (Eastern, Central, Western) in January 2008; 2 follow-up surveys were mailed to non-respondents about 4–8 weeks apart. After 3 attempts to contact landowners by mail, we contacted a sub-sample of non-respondents by telephone to assess non-response bias.

We used Likert-scale questions in the surveys (Likert-scale numbers indicated by each response were used to calculate mean response scores) to assess beliefs and experiences about wildlife (5-point scale), concerns about moose, support for hunting (5-point scale), and acceptability of situations involving moose (6-point scale). There were 3 general types of questions with 3 response categories: 1) landowner beliefs and experiences (agree, neutral, disagree), 2) landowner opinions about management (support, neutral, oppose), and 3) landowner concerns (acceptable, not acceptable/no action, not acceptable/action).

The study protocol and survey were reviewed and approved by the Connecticut Wildlife Division, the Northeast Wildlife Damage Management Cooperative, and the Institutional Review Board (IRB), Office of Research Compliance at the University of Connecticut; the IRB Chair deemed the survey exempt from IRB status. Surveys were conducted in accordance with federal guidelines in which minors (<18 years of age) were excluded, results were not identifiable to individuals, and surveys involved no risk to individuals.

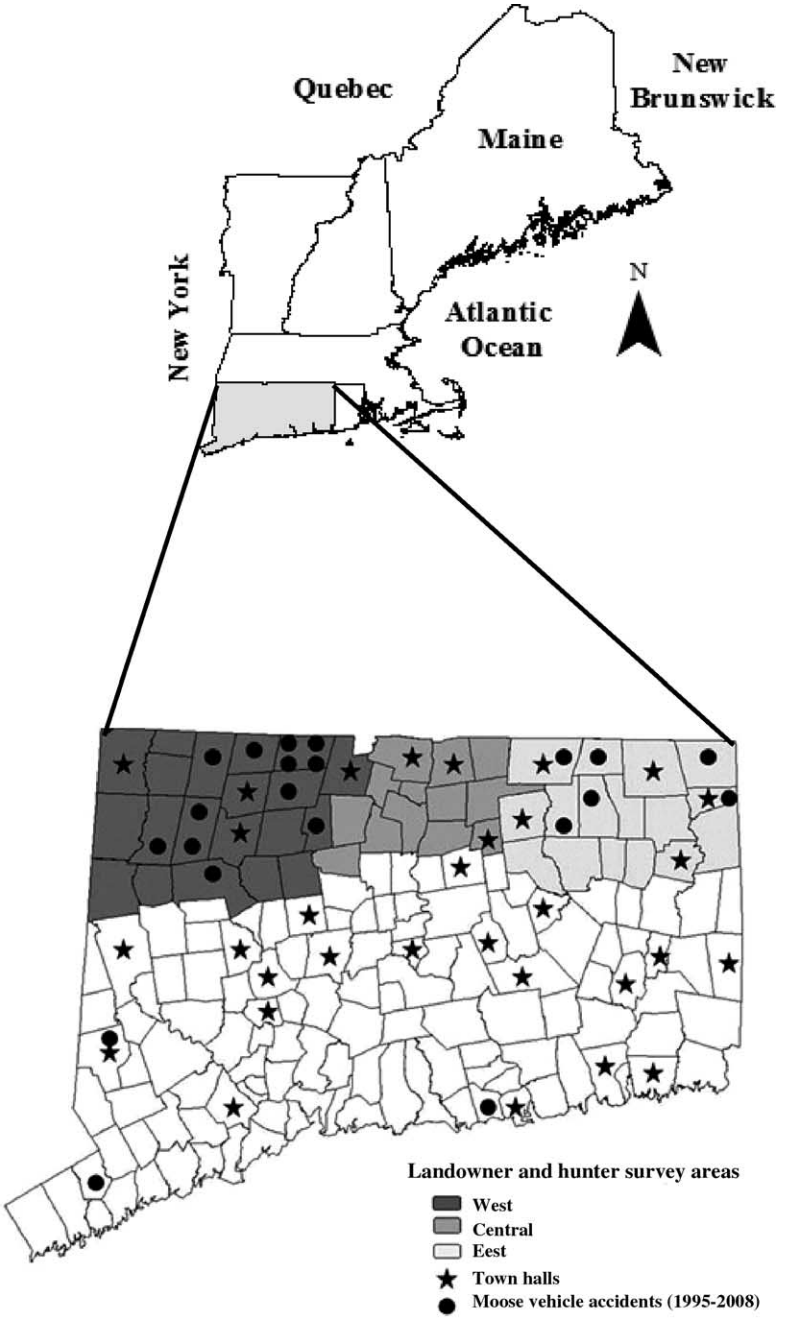

Fig. 1. The study area was in the state of Connecticut located in the northeastern portion of the United States. Landowner surveys were conducted in 2008 in the northern portions of Connecticut (shaded areas) where most moose-vehicle accidents (●) occurred, while hunter surveys were conducted at town halls (★) located throughout the state.

Table 1. Human densities and landscape level (Eastern, Central, Western) characteristics in Connecticut, 2008.

Location	Eastern	Central	Western
Number of towns	16	13	20
Population	79/km^2	185/km^2	71/km^2
% Forest	65.4	29.8	67.9
% Commercial/ residential	14.2	43.2	11.7
% Turf/agriculture	12.4	21.1	12.6
% Wetlands	4.6	2.8	3.8
% Water	2.3	1.8	3.3
% Other	1.1	1.3	0.7

Hunter Survey

We selected 31 of 169 (18%) town clerks to distribute the survey to any resident or non-resident hunter purchasing a Connecticut firearms hunting license or combination hunting/fishing license; towns and sampling period were selected based on the highest volume of hunting license sales in 2004. Surveys were distributed during 3 sampling periods (January, April, and October 2008) which were chosen to obtain a representative sample of each hunter group; many hunters purchase a license to pursue game during a specific season and the timing coincided with peak issuance. Packets containing an instruction letter, return envelope, and specific number of surveys were mailed to the town clerks before each sample period; the number of surveys per town was based upon the respective volume of 2004 license sales. Town clerks were instructed to provide a survey to every other individual that purchased a hunting or combination hunting/ fishing license; upon completion, they collected the survey and mailed all after each sampling period.

We generated questions to evaluate hunting activity, participation in outdoor-related activities, and perceptions and opinions about Connecticut's moose population. We used a 5-point Likert-scale question to assess support for hunting and grouped responses into 3 categories: support, neutral, or oppose. The review and approval of the study protocol and survey were identical to the Landowner Survey.

Analysis

We treated ordinal-level (Likert Scale) data as interval-level data as previous studies have validated the use of such data in survey research (Nunnally and Bernstein 1994, Zinn and Andelt 1999, Daley et al. 2004). We calculated Levene's Test ($P < 0.05$) for Equality of Variances and the Kolmogorov-Smirnov test of normality; based on these results we used the Kruskal-Wallis test ($P < 0.05$) for all analysis at the landscape level, and the Mann-Whitney U test ($P < 0.05$) for comparisons between landowners and hunters. Pearson Chi-square tests ($P < 0.05$) were used to examine nominal level variables and compare responses between respondents and non-respondents. All analyses were conducted using SYSTAT 12.0 (SYSTAT 2007).

RESULTS

Respondent demographics

Landowner survey — Surveys were returned from 622 of 2,023 landowners (35.7% Eastern, 31.3% Central, 37.9% Western); proportionally, 66% from the first, 20% from the second, and 14% from the final mailing. There was no difference among landscapes in gender ($\chi^2 = 3.44$, $P < 0.178$) and age of respondents ($\chi^2 = 0.410$, $P < 0.999$); 56.4% were male and the mean age of all respondents was 54.4 (SD = 14.7) years. After 3 attempts by mail, we contacted 51 non-respondents by telephone to assess non-response bias for specific questions. Hunting was not commonly allowed in any landscape but was higher in the Western (16%, $\chi^2 = 13.6$, $P < 0.001$) and Eastern (14.7%, $\chi^2 = 20.3$, $P < 0.001$) than the Central landscape (3%).

Table 2. Landowner and hunter opinions about the moose population in Connecticut, USA, 2008. Lower case n refers to # of respondents.

	Percent of respondents	
Survey question	Landowner	Hunter
Number of moose (n)	590	408
0	3.0	6.9
<10[a]	18.5	27.7
<100[a]	63.9	67.4
100–499	28.0	29.0
>500	8.0	3.5
Status of moose population (n)	606	430
Increasing	51.8	67.6
Decreasing	7.8	<1.0
Stable	10.0	11.6
No opinion	30.4	20.0
Opinion of moose population (n)	604	427
Too high	3.0	3.9
Too low	25.9	40.6
Just right	15.7	19.2
No opinion	54.9	36.1
Activities would participate in (n)	626	404
Watching moose	62.1	33.8
Photographing moose	50.7	27.5
Hunting moose	10.7	50.8
Other	2.0	1.0
None	20.0	19.0

[a]Includes all respondents who indicated 0 or <10.

Hunter Survey — Surveys were completed by 446 of 485 hunters (91.9%) and due to this high response rate, we did not assess non-response bias. Gender of hunters was primarily male (97.6%) and the mean age was 48.1 (SD = 12.5) years; the majority had harvested deer (65.2%) and a few bear (7.0%) and moose (3.6%). The majority (>60%) would participate in non-consumptive moose recreation (watching, photography) and half (50.8%) would hunt moose (Table 2).

Landowner beliefs and experiences with wildlife

Most landowners believed that wildlife and management were important, and the mean response scores were similar across all landscape levels except for hunting-related questions. In general, the majority of landowners were not unsupportive of hunting, but 30-60% were neutral/or disagreed with some aspect of hunting (Table 3).

Knowledge about moose

Landowner survey — Landowners were asked to identify the moose from 3 sketches depicting a deer, moose, and bear. Responses were combined as no differences existed among landscapes ($\chi^2 = 1.562$, $P = 0.458$); most (90.3%) correctly selected the image of the moose with the remainder selecting the deer. Respondent and non-respondent opinions about the number of moose existing in Connecticut were not different ($\chi^2 = 2.316$, $P = 0.128$) and no adjustments were made. All responses were combined because no differences ($\chi^2 = 4.315$, $P = 0.634$) among landscapes existed in perceptions about how many moose exist in Connecticut. The majority (64%) correctly estimated that there were <100 moose in Connecticut, and >90% estimated <500 moose (Table 2).

Landowner-Hunter comparisons — A similar proportion of landowners (63.9%) and hunters (67.4%) believed that <100 moose existed in Connecticut ($\chi^2 = 1.31$, $P = 0.253$) (Table 2). More hunters (27.7%) than landowners (18.5%) believed that <10 moose existed in Connecticut ($\chi^2 = 11.9$, $P = 0.001$); although both were <10%, conversely, more landowners than hunters believed that >500 moose existed ($\chi^2 = 8.6$, $P = 0.003$). The primary source of information influencing opinions about the size of the moose population was from other

Table 3. Landowner beliefs and experiences about wildlife in Connecticut, USA, 2008.

	% Response[a]																	
	Agree			Neutral			Disagree			No opinion			Mean response scores[b]					
Beliefs and experiences about wildlife	C	E	W	C	E	W	C	E	W	C	E	W	C	E	W	H^c	P^c	n
I notice birds and wildlife around me daily	98	99	96	1	0	2	1	1	1	0	0	1	1.65	1.77	1.70	4.60	0.101	626
Observing and learning about wildlife is important to me	88	92	89	10	7	7	2	1	3	0	0	1	1.34	1.47	1.40	3.12	0.210	624
Hunting animals for any purpose should not be permitted	19	12	22	22	16	12	58	71	65	2	2	1	−0.54	−0.89	−0.68	7.66	0.022	623
It is important to manage some wild animal populations	84	86	86	9	5	9	6	8	4	1	1	1	1.08	1.16	1.18	3.09	0.214	622
Wild animal populations should be managed for the benefit of all people	68	69	74	16	16	13	14	13	13	1	3	1	0.78	0.84	0.81	0.38	0.826	620
Participation in hunting helps people appreciate wildlife and natural processes	36	53	44	23	23	15	36	22	37	4	3	4	−0.01	0.40	0.03	8.62	0.013	623
If wildlife populations are abundant, it is ok to use them as a natural renewable resource	53	65	55	22	15	24	19	17	17	6	3	5	0.45	0.71	0.49	5.13	0.077	613
Regulated hunting is an acceptable use of a natural resource	65	76	69	15	9	12	16	13	17	4	2	3	0.63	0.94	0.70	9.88	0.007	621

C = Central, E = Eastern, W = Western.

[a]Likert scale ranged from −2 ("Strongly disagree") to 2 ("Strongly agree"). To evaluate percentages, responses were truncated into "Agree, Neutral, Disagree."

[b]Not included in analysis are the number of respondents who choose "No opinion."

[c]*H* and *P* values for Kruskal-Wallis Test Statistic comparison between Eastern, Central, and Western groups.

sources (33.1%) for landowners and personal experience (37%) for hunters.

Opinions about moose

Landowner survey — Respondent and non-respondent opinions about the status of Connecticut's moose population (χ^2 = 5.997, P = 0.112) and the number of moose in Connecticut (χ^2 = 6.374, P = 0.095) were not different and no adjustments were made. No difference among landscapes (χ^2 = 0.835, P = 0.659) existed between the proportion believing that the moose population was either increasing (about half) or decreasing, or that believed it was too high (~3%) or too low (~25%) (χ^2 = 2.71, P = 0.257); therefore, responses were combined (Table 2). Likewise, no landscape differences existed (χ^2 = 2.68, P = 0.262) and responses were combined for the proportion of landowners (~70%) who would support designating viewing areas for moose watching.

Landowner-hunter comparisons — About half (51.8%) of landowners and 2/3 of hunters believed that Connecticut's moose population was increasing, but few (3 and 4%, respectively) believed the population was too high (Table 2). More hunters (68%) than landowners (52%) believed that the population was increasing, and fewer that it was decreasing (χ^2 = 33.1, P <0.001). There was no difference (χ^2 = 0.559, P = 0.455) in the proportion of landowners and hunters who believed that the population was too low or too high; although, measurably more hunters thought the population was too low (40.6 vs. 25.9%; Table 2).

From a list of 3 potential moose-related activities if moose were common in Connecticut, landowners favored watching and photography (62.1 and 50.7%), and hunters favored hunting and watching (50.8 and 33.8%). The proportion of landowners and hunters who would participate in watching (χ^2 = 60.8, P < 0.001), photographing (χ^2 = 41.9, P < 0.001), or hunting moose (χ^2 = 247.6, P < 0.001) was different. The proportion of landowners and hunters who would not participate in any moose activity was similar (~20%; χ^2 = 0.057, P < 0.811) (Table 2).

Interactions with moose

Landowner survey — A minority (15%) of landowners observed moose in 29 towns and differences existed among landscapes (χ^2 = 14.3, P = 0.001). Twice as many landowners observed moose in Western (27.0%) than Central (12.0%, χ^2 = 13.6, P < 0.001) and Eastern landscapes (12.6%, χ^2 = 6.07, P = 0.014) which were not different (χ^2 = 0.031, P = 0.860) (Table 4). An additional 51 landowners reported moose tracks or other sign with the same landscape differences (χ^2 = 13.3, P = 0.001); more moose tracks and sign were observed in Western (21.8%) than in Central (7.8%, χ^2 = 13.2, P < 0.001) and Eastern (10.0%, χ^2 = 3.99, P = 0.046) landscapes which were not different (χ^2 = 0.464, P = 0.496) (Table 4).

Only landowners in western landscapes had been in a MVA (n = 4) in Connecticut. Although the rate of MVA experiences in any landscape was low over all (<5%), landscape differences existed (χ^2 = 8.29, P = 0.016) (Table 4). Landowners in western landscapes (4.9%) were in more MVAs than those in Central landscapes (<1.0%, χ^2 = 7.45, P = 0.006); there was no difference between Western and Eastern (1.0%, χ^2 = 2.71, P = 0.100) or Eastern and Central (χ^2 = 0.001, P = 0.979) landscapes (Table 4).

Hunter survey — Moose were observed by 20% of hunters (n = 91) in 36 towns, with 71 others observing tracks or scat in 14 towns where sightings occurred, as well as in 13 other towns.

Landowner concerns about moose

Landowner concerns were not different among landscapes regarding health, safety,

Table 4. Landowner interactions with moose in Connecticut, USA, 2006–2007.

	% Response							
	Yes			No				
Moose-human interactions	C	E	W	C	E	W	χ^2	P^a
Observed Moose	12.0	12.6	27.0	88.0	87.4	73.0	14.30	0.001
In Yard	1.5	4.6	5.3	98.5	95.4	94.7	5.56	0.062
Outside Yard	3.8	3.4	13.7	96.2	96.6	86.3	13.55	0.001
Crossing Road	5.8	2.3	13.7	94.2	97.7	86.3	9.88	0.007
Other	3.5	5.7	5.3	96.5	94.3	94.7	1.26	0.531
Observed Tracks/scat	7.8	10.0	21.8	92.2	90.0	78.2	13.30	0.001
Moose-vehicle accident	1.0 (0.0[b])	1.0 (0.0[b])	4.9 (4.0[b])	99.0	99.0	95.1	8.29	0.016

E = Eastern (n = 87), C = Central (n = 343), W = Western (n = 95).
[a]χ^2 and P values for Pearson Chi-square comparison between eastern, central, and western groups.
[b]MVA reported just in Connecticut.

Table 5. Landowner concerns about moose interactions in Connecticut, USA, 2008.

	% Response						
Concerns about moose	No concern	Some concern	Very concerned	No opinion	Mean response scores[a]	H^b	P^b
Encountering a moose	67.4	24.9	4.0	3.7	1.47	1.263	0.532
The cost of residential property damage caused by moose	57.2	30.9	4.9	7.1	1.61	2.115	0.347
Being injured in a motor vehicle accident that involves a moose	28.0	50.7	18.6	2.8	2.33	1.385	0.500
Potential problems that moose may cause to the ecosystem	52.5	31.3	4.9	11.3	1.66	0.596	0.742
Overall current level of concern related to moose	57.3	34.6	3.4	4.7	1.58	0.662	0.718

[a]Likert scale ranged from 1 ("Not concerned") to 4 ("Very concerned"). To evaluate percentages, "slightly concerned" and "somewhat concerned" responses were truncated into "Some concern."
[b]H and P values for Kruskal-Wallis Test Statistic comparison between Eastern, Central, and Western groups.

or damage-related issues (H = 0.059–2.115, 0.742 >P >0.347), and were combined for analysis (Table 5). The majority were only concerned about MVA, with <20% very concerned (Table 5).

Moose Population Management

Landowner survey — Responses were combined because mean scores were not different among landscapes (H = 1.44–5.59, 0.487 > P > 0.061) for any scenario regarding moose population management (Table 6). A minority (31%) of landowners supported hunting as a method to control moose populations in Connecticut based on their current level of concern; their support was highest if hunting was carefully regulated and controlled by the state, or if the moose population and number of MVAs were increasing (both 54%). Conversely, the vast majority of hunters (83-88%) supported hunting under all scenarios (Table 6). The proportion of landowners and hunters who supported hunting was different "if it was carefully regulated and controlled by the state" (U = 53,194, χ^2 = 211.53,

Table 6. Landowner and hunter opinions about managing moose populations using hunting in Connecticut, USA, 2008.

	% Response						Mean response scores[a]						
	Support		Neutral		Oppose				H^b	P^b	U^c	P^c	χ^2
Concerns about moose	Land	Hunt	Land	Hunt	Land	Hunt	Land	Hunt	Land	Land			
Based on your current level of concern?	31	*NA*	29	*NA*	40	*NA*	−0.23		2.05	0.35			
If your level of concern increases?	47	*NA*	25	*NA*	29	*NA*	0.20		3.98	0.13			
If hunting were carefully regulated and controlled by the state?	54	88	22	6	24	6	0.34	1.41	2.82	0.24	53,194	0.00	211.5
If you knew that the moose population would be maintained at its current level?	41	83	30	8	29	9	0.09	1.23	2.69	0.26	49,524	0.00	206.2
If you knew that hunting is currently allowed in other New England states?	41	*NA*	30	*NA*	29	*NA*	0.10		5.59	0.06			
If you knew the likelihood of a human fatality was greater [d]?	54	85	26	8	21	7	0.44	1.37	1.44	0.48	18,731	0.00	268.0

[a]Likert scale ranged from −2 ("Strongly oppose") to 2 ("Strongly support"). To evaluate percentages, "strongly support" and "support" were truncated into "support," and "oppose" and "strongly oppose" were truncated into "oppose."
[b]*H* and *P* values for Kruskal-Wallis Test Statistic comparison between Eastern, Central, and Western groups.
[c]*U* and *P* values for Mann-Whitney U test between landowners and hunters.
[d]If you knew the likelihood of a human fatality was greater for a moose-vehicle accident than a deer-vehicle accident and that the moose population and number of moose-vehicle accidents were increasing in Connecticut?
NA = Not asked on survey.

Table 7. Landowner responses regarding reasons why they primarily supported or opposed hunting to control moose populations in Connecticut, USA, 2008.

Primarily supported hunting	n	% Respondents
Regulated hunting is a legitimate method to control moose population growth	306	18.1
Moose threaten human safety	254	15.1
DEEP officials are well trained to handle problems associated with moose	252	14.9
Moose population is too high or may become too high	244	14.5
Moose cause damage to crops or property	244	14.5
Want the opportunity to hunt moose	222	13.2
Don't know	101	6.0
Other	63	3.7
Primarily opposed to hunting		
Moose are not a threat to human safety at their current level	211	16.3
Moose do not cause enough damage to warrant management	205	15.8
Moose population is too low and does not warrant management	198	15.3
Do not support hunters killing moose	190	14.6
Disagree with hunting	181	14.0
Do not support DEEP killing moose	176	13.6
Do not know	85	6.6
Other	51	3.9

$P < 0.001$), "if they knew that the moose population would be maintained at its current level" (U = 49,524, $\chi^2 = 206.22$, $P < 0.001$), and "if the moose population and number of MVAs was increasing in Connecticut" (U = 18,731, $\chi^2 = 268.01$, $P < 0.001$) (Table 6).

The range of responses was evenly distributed (13–18% per response, n = 6 responses) for those either primarily supporting or opposing hunting moose in Connecticut (Table 7). In general, those supporting hunting of moose wanted to either hunt moose or linked human-moose conflicts with need for hunting. Conversely, those opposed to hunting moose were either unsupportive of hunting or believed that the population/conflict rate was too low (Table 7).

Landowner opinions about roadside sightings and moose-vehicle accidents

No differences existed at the landscape level in opinions about roadside sightings ($H = 3.7–5.8$, $0.15 > P > 0.054$), MVAs ($H = 0.61–2.8$, $0.23 > P > 0.73$), or fatalities resulting from a MVA ($H = 2.2 – 3.0$, $P > 0.22$). The proportion of landowners who deemed "it not acceptable and some action should be taken" increased substantially in all categories if the overall problem of MVAs rose (Table 8).

DISCUSSION

Although few landowners hunted or permitted hunting on their property, observing and learning about wildlife was important to most landowners and they were supportive of designating viewing areas for moose. Hunting activity, beliefs, and experiences with wildlife if hunting was involved, and direct interactions with moose and MVAs were influenced by landscape. But, knowledge, opinions about moose and moose management, and concerns about moose were similar across landscapes despite landscape differences in moose experiences, albeit experiences were low (<20%) in all landscapes.

We found that landowner and hunter knowledge about moose abundance was limited, as in Massachusetts 20 years ago (Vecellio et al. 1993). A small number (<50) of landowners and hunters combined believed no moose existed in Connecticut. The main source of information about moose for landowners was from non-DEEP sources,

Table 8. Landowner opinions about roadside sightings and moose-vehicle accidents in Connecticut, USA, 2008.

	% Response													
	Acceptable			Not acceptable/no action			Not acceptable/ action			Mean response scores[a]				
Concerns about moose	C	E	W	C	E	W	C	E	W	C	E	W	H^b	P^b
A moose is on or near a busy highway occasionally	35.6	39.2	23.7	13.9	13.4	19.6	50.5	47.4	56.7	3.31	3.29	3.60	3.742	0.154
Moose are frequently on or near busy highways	14.6	19.8	10.2	10.9	14.6	9.2	74.5	65.6	80.6	4.13	4.01	4.36	5.837	0.054
1 Moose-vehicle collision occurs each year statewide	38.1	34.4	31.6	21.5	36.5	34.7	40.4	29.2	33.7	3.16	3.05	3.11	0.618	0.734
2-5 Moose-vehicle collisions occur each year statewide	26.5	26.6	20.4	15.5	18.1	18.4	58.0	55.3	61.2	3.80	3.78	3.93	1.009	0.604
6-10 Moose-vehicle collisions occur each year statewide	18.1	21.3	10.5	15.4	7.9	14.7	66.5	70.8	74.7	4.14	4.26	4.40	2.878	0.237
>10 Moose-vehicle collisions occur each year statewide	13.2	17.8	9.4	12.4	7.8	8.3	74.4	74.4	82.3	4.39	4.49	4.68	2.746	0.253
A human fatality results from a motorist hitting a moose in Connecticut	16.7	20.0	10.5	21.0	24.4	23.2	62.4	55.6	66.3	4.08	3.82	4.23	2.964	0.227
2-5 human fatalities result from a motorist hitting a moose in Connecticut	10.8	13.3	6.3	14.2	10.0	10.4	75.0	76.7	83.3	4.52	4.56	4.69	3.069	0.216

E = Eastern, C = Central, W = Western.
[a]Likert scale was 1 (“Acceptable”), 2 (“Not acceptable/no management action taken”), 3 (“Not acceptable/action should be taken”).
[b]*H* and *P* values for Kruskal-Wallis Test Statistic comparison between Eastern, Central, and Western groups.

whereas hunters were most influenced by personal experience and DEEP communications. It is not surprising that ~25% of landowners and hunters believed <10 moose existed (Table 2), because few ever observe a moose in Connecticut.

Many landowners and hunters had no opinion about the moose population status (20–30%) or how many moose should exist in Connecticut (35–55%) (Table 2). The low response rate probably reflects their lack of experience, familiarity, and interest in moose. Riley and Decker (2000) also found a large portion of people lacked opinions about cougars in Montana, presumably for the same reasons. They suggested that lack of opinion may indicate 1) a lack of general concern in the everyday lives of residents, 2) stakeholder perceptions that managers do not listen to stakeholder concerns, or 3) distrust in delegation of decision-making to managers.

Overall, the majority of landowners had few concerns about moose except MVAs. Less than half supported using hunting as a method to control moose populations in Connecticut based on their current knowledge of population levels, as opposed to hunters who were strongly supportive. More than half of landowners were supportive of moose hunting if it was carefully regulated and controlled by the state. Although all forms of hunting are controlled by state fish and wildlife agencies, Kilpatrick et al. (2007) found that landowners often are unaware of regulations or requirements that govern wildlife resources and expressed increased support for certain regulations or requirements although they already existed. Predictably, if the number of roadside sightings, MVA, or the number of related human fatalities increased, the proportion finding such unacceptable also increased.

Given that the first reported MVA in Connecticut occurred in 1995 and the annual rate remains low (2.3 MVA per year), it is not surprising that residents are minimally concerned about moose. Overall, few landowners (<1%) had ever been involved in a MVA in Connecticut. If the frequency of moose sightings along roads increases substantially, support for controlling moose populations will presumably increase regardless of the number of MVAs or human fatalities. About 50% believed that a moose near a busy highway was unacceptable requiring action, and 58% believed action was required at 2–5 MVA per year, the current reported MVA rate (Table 7). A similar situation occurred with elk (*Cervus elaphus*) in urban areas of Flagstaff, Arizona (Lee and Miller 2003), where most respondents were concerned about being in an automobile accident involving an elk or seeing one along a roadside.

The collective ability for humans to accept the presence and consequences of any wildlife species will eventually define the wildlife acceptance capacity (WAC) for that species (Decker and Purdy 1988). In Anchorage, Alaska where moose populations exceed habitat carrying capacity (WAC is either higher or lower), only half of residents supported moose hunting (Whittaker et al. 2001). In British Columbia, McDonald et al. (2012) found that most respondents suggested reducing attractants or relocating moose to alleviate moose-human conflicts, presumably over hunting, however sample size was small (n <100). Acceptance of hunting among certain stakeholders may be influenced more by basic beliefs about hunting which are based on fundamental value orientations toward use or protection of wildlife (Fulton et al. 1996, Zinn et al. 1998). In Connecticut, because moose are of such low numbers and few residents have any direct experience with moose, an associated WAC is probably not measurable or is exceedingly high.

We expect a reduction in WAC if moose-human conflicts increase measurably and

advocate for a proactive management strategy that would increase public education about moose, MVAs, and the potential role of hunting to help protect human safety. Educational efforts should improve public awareness through posted warnings about local moose on Department of Transportation Variable Message Boards (VMBs), erecting moose-crossing signs in appropriate areas, and meeting with stakeholder groups. The effectiveness of VMBs and signs to reduce MVAs is unknown, but they should alert drivers otherwise unaware about moose in Connecticut. A multi-faceted strategy should increase public awareness and education about moose in Connecticut and aid in developing a long-term moose management program beyond simply minimizing MVAs.

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