

# ILLEGAL MOOSE KILL IN NORTHEASTERN ONTARIO: 1997 – 2002

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**ABSTRACT:** Conservation Officers found 793 illegally killed moose in the Ontario Ministry of Natural Resources Northeast Region during the period of 1997–2002. Of these illegally killed moose, 365 were abandoned. The majority of abandoned moose were a result of illegal harvesting, as 68% of all abandoned moose had signs of positive human interaction with the carcass. Three hundred and twenty moose (40%) spoiled and were unsuitable for human consumption. Bulls were illegally killed at a significantly higher proportion, and calves at a significantly lower proportion, than their respective availability in the herd structure. Cow moose are illegally killed proportional to their availability. Illegal moose kills were positively and significantly correlated with moose populations, the number of applicants for adult validation tags, and the number of hunters checked by Conservation Officers. The illegal moose kill has both an immediate and a long-term impact on the regional herd population. An estimated 613 moose were not recruited into the regional herd as a result of illegal harvesting. Moose Watch, a program to reduce the region's illegal moose kill was initiated in 2000, and was expanded province-wide in 2001. A toll-free 24-hour violation reporting line was established, and received 387 calls over 3 years regarding illegal hunting violations for a wide variety of wildlife species. During the 6 years, Conservation Officers in the region contacted over 108,000 hunters, issued 3,064 warnings, and laid 2,580 charges while conducting moose hunt enforcement duties.

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**Key words:** *Alces*, illegal kill, Moose Watch, poaching

Based on a perceived increase in the number of illegally killed and abandoned moose (*Alces alces*) in the mid 1990s, Ontario Ministry of Natural Resources (OMNR) Conservation Officers began data collection in Northeastern Ontario. Initial data collection was started in 1995, and became standardized across the Northeast Region (NER) in 1997.

The objective of this initiative was to collect intelligence on the distribution and impact of the illegal harvest of moose, and to deliver a planned enforcement response to deal with the problem. In 2000, the NER developed and launched the “Moose Watch 2000” program. This program was aimed at reducing the illegal moose kill through public awareness, a 24-hour toll-free violation reporting line, and increased enforcement

effort. The Moose Watch program was expanded provincially in 2001.

The focus of this report is on the number of illegally killed and abandoned moose throughout the region from 1997 – 2002.

## STUDY AREA

The NER is a large (441,122 km<sup>2</sup>) and diverse land base, comprised of a variety of geographic and physiological features. It extends from the north shores of Lake Huron and Lake Superior to the James Bay and Hudson Bay Lowlands (Fig. 1). There are 2 forest regions located within the NER, the Boreal Forest in the northern portion of the region and the Great Lakes – St. Lawrence Forest in the south (Hosie 1979). Boreal Forest tree species are of fire origin, consisting of white spruce (*Picea glauca*),

black spruce (*Picea mariana*), jack pine (*Pinus banksiana*), balsam fir (*Abies balsamea*), white birch (*Betula papyrifera*), and trembling aspen (*Populus tremuloides*). The Great Lakes – St. Lawrence forest is comprised of conifers such as red pine (*Pinus resinosa*), white pine (*Pinus strobus*), eastern white cedar (*Thuja occidentalis*), and tolerant hardwoods such as red maple (*Acer rubrum*), sugar maple

(*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and red oak (*Quercus rubra*).

Within the region, there are 9 OMNR Districts – Chapleau, Cochrane, Hearst, Kirkland Lake, North Bay, Sault Ste. Marie, Sudbury, Timmins, and Wawa (Fig. 1). There are 5-10 Conservation Officers stationed in each district, and they patrol 28 Wildlife Management Units (WMUs),



Fig. 1. Ontario Ministry of Natural Resources Northeast Region and Districts.

including some that are extremely remote with little to no road access. Most WMUs have a moose archery season commencing from the Saturday closest to September 17 to the third following Friday, and a firearm season over the period from the Saturday closest to October 8 to November 15. Three WMUs have extended firearms seasons until December 15.

### METHODS

Conservation Officers patrolling in the region collected data on illegal moose kills from 1997–2002. All unlawfully killed and all abandoned moose encountered were classified as illegally killed moose.

Standardized data report sheets were completed for each illegal kill and included information on age/sex, whether the moose was seized or abandoned, date of kill, and general comments regarding the moose. When abandoned moose were encountered, indications of human interaction with the carcass were recorded in order to estimate the number of abandoned moose that may be a result of wounding mortality. Human interaction with moose carcasses included gutting, concealment, and location of kill in relation to roads or waterways. Wildlife Management Unit data have been collected for each illegally killed moose since 1998. Only verified kill data were used, meaning that if a Conservation Officer “didn’t see it or didn’t touch it” the data were not included. The data in this report are considered to be a conservative estimate of illegally killed moose for the NER.

In order to determine the impacts on herd recruitment in the NER, a population model was designed using the age/sex structure of the illegal kill, a low in-utero productivity rate (0.95), and an annual mortality rate of 10% (G. Eason, V. Crichton, personal communication). This model produces conservative estimates. Moose population estimates in each WMU were ob-

tained from the OMNRs “Ontario Moose Harvest Planning System” computer program. The number of adult validation tags (AVTs) issued to hunters for harvesting bull and cow moose were obtained from copies of “Ontario Hunting Regulation Summary” for 1997-2002.

Enforcement statistics were derived from the OMNRs “Compliance Activity Violation Reporting System” (CAVRS) computer program. This program is utilized by all Conservation Officers to record their enforcement efforts, violation statistics, and violator information. A standard calculation of non-compliance rates was used (number of charges + number of warnings / field contacts).

Statistical analysis of illegal harvest data included correlation analysis and for availability – utilization analysis, a chi-square goodness-of-fit test and a Bonferroni z-test were used (Neu et al. 1974, Byers et al. 1984). Regression analysis was completed using the number of hunters contacted by Conservation Officers and the number of illegally killed moose to produce an estimate of the total number of illegally killed moose.

The Moose Watch program promotional efforts were initiated through the production of posters, violation reporting cards, pens and pencils, and licence holders imprinted with the Moose Watch logo and the violation reporting line number (1–866–34 MOOSE). In the 3 years of operation, 10,000 each of posters, contact cards, pens and licence holders were distributed across the province to hunters and the general public through businesses or places of employment, field contacts, outdoors shows, and presentations. Moose Watch was promoted in the “Ontario Hunting Regulation Summary” and all AVT holders were shipped a Moose Watch promotion note with their tags.

During the period of September 15 – December 15, media releases and inter-

Table 1. Illegally killed moose in Northeast Region 1997 – 2002.

	1997		1998		1999		2000		2001		2002		Total	
	ABAN.	TOTAL												
Chapleau	10	12	6	11	6	13	5	11	4	10	14	21	45	78
Cochrane	5	7	2	10	0	2	3	5	2	5	3	10	15	39
Hearst	11	16	1	3	5	18	5	11	4	5	7	13	33	66
Kirkland Lake	8	14	7	19	3	10	7	13	10	14	9	13	44	83
North Bay	7	14	2	16	2	13	11	20	4	8	7	16	33	87
Sault Ste. Marie	5	15	3	17	10	35	10	25	4	8	6	14	38	114
Sudbury	10	12	3	8	7	19	2	11	4	10	5	10	31	70
Timmins	4	8	4	13	8	17	8	16	12	16	7	11	43	81
Wawa	18	31	11	23	17	41	5	25	11	26	21	29	83	175
Total	78	129	39	120	58	168	56	137	55	102	79	137	365	793

views were held with television, radio, and newspaper reporters promoting the program and releasing enforcement statistics. Public service announcements were prepared and were run by radio and television stations. News releases dealing with convictions as a result of the Moose Watch program were released to all media sources.

Ministry of Natural Resources enforcement staff located at the Provincial Coordination Centre (PCC) in Sault Ste. Marie answered all calls to the Moose Watch violation line. All Conservation Officers in the province report at the start of their shift to the PCC, and PCC staff are able to pass violation complaints to on-duty officers or to the next officer starting their shift in the district from where the complaint was received. The traditional partnership with Crime Stoppers (a North American wide violation reporting system) has been maintained, and allows for anonymous violation reporting by those that choose to do so.

**RESULTS**

**Unlawful Trends**

There were 793 verified illegally killed moose in the NER over the period of 1997 - 2002, of which 46% were abandoned (Table 1). Wawa district had the highest illegal kill and the highest rate of abandonment each year since 1997. Six districts (Chapleau, Kirkland Lake, North Bay, Sault Ste. Marie, and Wawa) accounted for 78% of all illegal kills in the NER. Abandonment rates were also highest in those districts as well. Illegal moose kills in the NER peaked in the 1999 hunt, declined in 2000 and 2001, and rebounded in 2002.

Abandoned moose declined in the NER from 1997 – 1998, remained relatively constant from 1999 – 2001, and increased in 2002 to levels initially observed in 1997 (Table 2). Of the 365 abandoned moose, 251 (68%) showed positive signs of human interaction with the carcass. There was a

Table 2. Abandoned and spoiled moose observed in Northeast Region 1997 – 2002.

	1997	1998	1999	2000	2001	2002	Total
Abandoned	78	39	58	56	55	79	365
Human Interaction	52	29	31	23	48	68	251
Spoiled	58	33	60	50	51	68	320

strong, but not significant ( $P > 0.05$ ), correlation between the number of abandoned moose and the number having human interaction ( $r = 0.78$ , tabular value = 0.811, 4 df) Conservation Officers located 114 abandoned moose with no signs of human interaction. A total of 320 abandoned moose spoiled, resulting in approximately 64,000 kg of meat becoming unsuitable for human consumption (assuming 200 kg meat/moose).

### Wildlife Management Units

The total estimated moose population in the 28 WMUs steadily increased over the study period (Fig. 2), although the moose populations in WMUs 35 and 36 steadily declined over the 5 years. The illegal kill in each of the WMUs was significantly correlated ( $P < 0.05$ , tabular value = 0.374, 26 df) to the population in the WMUs for 1998 ( $r = 0.587$ ), 2001 ( $r = 0.548$ ), and 2002 ( $r = 0.413$ ) (Table 3). The illegal moose kill was significantly correlated to the number of hunter applicants (Pool 1 – Choice 1) who applied for AVTs in WMUs in 1998 ( $r = 0.761$ ), 2000 ( $r = 0.510$ ), 2001 ( $r = 0.547$ ), and 2002 ( $r = 0.503$ ). The illegal moose kill was significantly correlated to the number of AVTs issued for only 2 years, 1998 ( $r = 0.554$ ) and 2001 ( $r = 0.479$ ). Illegal kill data were not collected on a WMU basis in 1997.

The illegal moose kill in 7 WMUs (21B, 28, 29, 32, 35, 36, and 41) accounted for 50% of the NER verified illegal kill from 1998 – 2002. Five of these WMUs (28, 29, 35, 36, and 41) have the major urban centres of Kirkland Lake, Timmins, Sault Ste. Marie, Sudbury, and North Bay located in or adjacent to these respective units. Four WMUs (21B, 28, 29, 41) have the highest average

moose populations, available AVTs, and AVT applicants. Of interest, WMU 32 had 49 illegal kills over the 5-year period. This WMU has 63% of its total area (11,424 km<sup>2</sup>) closed to hunting by the Chapleau Crown Game Preserve, resulting in a high illegal kill confined to a relatively small geographic area.

In making AVT decisions for each WMU, a 10% non-hunt mortality estimate is used to account for losses to predation, disease, accidents, lawful harvest by aboriginal people, and illegal kill. Annual illegal kills do not exceed the 10% threshold in any WMU; however, these kills constitute the only verified component of the non-hunt mortality estimate.

### Illegal Kill Structure

Based on aerial survey data for the NER over the study period, the regional moose herd structure is comprised of 33% bulls, 48% cows, and 19% calves. The structure of the illegal moose kill has remained constant and with 1 exception (cows 2001), has not fluctuated by more than 5% over the period of 1997 – 2002 (Table 4). Overall, cows constitute 49% of the illegal kill, bulls 40%, calves 7%, and moose that could not be identified 4% (Fig. 3).

The composition of the regional illegal kill is significantly different ( $P < 0.05$ ) than the regional moose herd structure

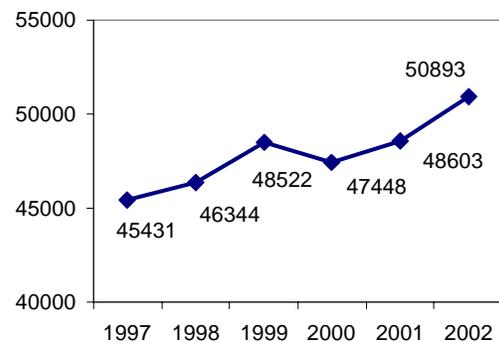


Fig. 2. Estimated Northeast Region moose population 1997 – 2002.

Table 3. Moose populations, Adult Validation Tags (AVT), Adult Validation Tag applicants, and illegal moose kills in Northeast Region 1998–2002.

1998					1999				
WMU	Moose Pop.	AVT	AVT App.	Ill. Moose	WMU	Moose Pop.	AVT	AVT App.	Ill. Moose
18B	528	104	199	0	18B	528	109	186	2
19	1690	291	677	0	19	1690	291	742	0
21A	3105	815	1906	1	21A	3205	790	1994	9
21B	3105	845	2891	11	21B	3105	845	3216	11
22	2600	115	719	1	22	2600	130	804	9
23	1200	177	937	1	23	1300	176	730	6
24	1400	154	1006	5	24	2074	164	1184	5
25	597	130	109	0	25	1656	130	132	1
26	675	45	458	0	26	675	45	434	0
27	1834	250	1341	6	27	1834	140	873	2
28	3545	662	4341	14	28	2762	561	4485	6
29	2018	601	3475	7	29	1629	357	2464	16
30	2827	265	1772	1	30	2827	265	1872	1
31	1877	156	1399	8	31	1877	151	1491	3
32	1173	91	684	7	32	1187	30	466	9
33	768	45	317	3	33	1266	47	337	6
34	252	25	234	2	34	801	25	220	2
35	1867	215	1823	8	35	1431	159	1531	18
36	1601	190	1344	5	36	1601	191	1338	13
37	730	45	460	1	37	993	59	564	9
38	2352	480	2939	9	38	2564	375	2989	14
39	1200	175	1731	3	39	1200	175	1714	4
40	2767	295	3061	9	40	2693	295	2962	9
41	2322	490	4094	9	41	2322	490	4198	4
42	2473	171	1578	2	42	2844	241	1973	3
46	349	48	355	1	46	349	48	413	0
47	389	230	2067	0	47	389	230	2138	3
48	1100	350	2696	6	48	1150	345	2861	2
Total	46344	7460	44613	120	Total	48552	6864	44311	167

2000					2001				
WMU	Moose Pop.	AVT	AVT App.	Ill. Moose	WMU	Moose Pop.	AVT	AVT App.	Ill. Moose
18B	528	109	178	1	18B	285	72	161	0
19	1690	338	903	1	19	1690	364	1044	0
21A	3205	790	2345	0	21A	3220	790	2371	3
21B	3105	735	3058	7	21B	3105	735	2726	11
22	2600	159	844	8	22	2300	231	1086	5
23	1803	200	900	2	23	1755	186	791	1
24	2090	187	1126	4	24	2090	201	1156	2
25	1656	130	145	1	25	1656	147	165	0
26	1404	45	403	2	26	1404	50	442	2
27	1113	140	1054	1	27	1113	140	990	1
28	2762	511	4454	10	28	2970	500	4344	11
29	1629	357	2793	7	29	1727	302	2160	7
30	1586	220	1805	4	30	1586	220	1763	4
31	1964	170	1433	9	31	1964	192	1556	10
32	1187	37	479	8	32	1706	139	752	11
33	1266	45	352	2	33	1330	45	300	0
34	869	25	219	0	34	869	25	196	0
35	1431	159	1458	6	35	1431	144	1350	5
36	1081	92	1169	13	36	1081	92	1029	5
37	993	59	575	10	37	993	66	664	1
38	2564	375	2557	5	38	2132	290	2301	1
39	1200	175	1775	2	39	1200	125	1663	1
40	2693	295	2885	8	40	3236	407	3133	4
41	2322	490	4281	16	41	2998	541	4312	7
42	2844	241	2168	3	42	2844	278	2463	6
46	302	48	430	0	46	302	58	422	1
47	411	230	2138	0	47	925	262	2179	3
48	1150	133	2637	7	48	691	133	2348	0
Total	47448	6495	44564	137	Total	48603	6735	43867	102

Table 3 (continued). Moose populations, Adult Validation Tags (AVT), Adult Validation Tag applicants, and illegal moose kills in Northeast Region 1998–2002.

WMU	Moose Pop.	2002		
		AVT	AVT App.	Ill. Moose
18B	285	72	278	1
19	1861	360	1112	0
21A	3220	744	2397	0
21B	3105	685	2874	10
22	2300	207	1045	2
23	1755	187	800	7
24	3080	261	1265	4
25	1715	147	149	0
26	1404	50	415	1
27	1269	140	1068	6
28	3037	500	4278	13
29	1727	221	2329	9
30	2873	200	1741	8
31	1964	154	1639	7
32	1650	132	899	14
33	1330	40	291	2
34	869	25	187	1
35	1431	88	1282	7
36	1081	50	879	6
37	899	35	632	6
38	2132	184	2286	10
39	1200	110	1614	1
40	3236	386	3452	4
41	2998	262	4076	9
42	2430	145	2499	7
46	426	50	443	0
47	925	145	2263	1
48	691	9	1413	1
Total	50893	5589	43606	137

(Table 5). Using adjusted data for known age and sex ratios, moose were not killed proportional to their availability. Bull moose were illegally killed at a higher proportion than they occurred in the herd structure, and calves were illegally killed at a lower proportion than they occurred in the herd. Cow moose were illegally killed proportional to their availability.

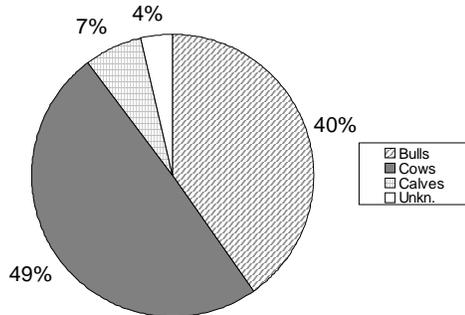


Fig. 3. Northeast Region illegal moose kill age and sex structure.

Table 4. Northeast Region illegal moose kill structure.

	1997	1998	1999	2000	2001	2002	Total
Bulls	53	47	65	57	39	59	320
Cows	60	59	83	69	58	64	393
Calves	12	11	14	6	4	10	57
Unknown	4	3	6	5	1	4	23
Total	129	120	168	137	102	137	793

**Recruitment Loss**

The illegal moose kill has an immediate impact on the NER moose herd, as well as a long-term impact regarding potential recruitment that did not occur. Using a basic but conservative population model, an estimated 613 moose were not recruited into the regional herd over the 6-year period. This would result in a total loss of 1,406 moose in the NER from 1997 – 2002 (Fig. 4).

**Enforcement Effort**

Moose enforcement effort by NER Conservation Officers steadily increased from 1997 – 1999 and peaked in 2000 (the first year of the Moose Watch program) (Table 6). Conservation Officers checked over 108,000 hunters, with the highest number of hunters being checked in 1999. The overall non-compliance rate was 5.2%, with the highest non-compliance rate (6%) occurring in 2000.

Conservation Officers issued 3,064 warnings and laid 2,580 charges while completing field moose enforcement duties during the 6-year period. Penalties assessed through tickets or by the courts as a result of trials amounted to \$822,186. Fines are paid into the “Fish and Wildlife Special

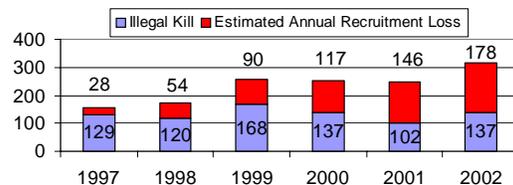


Fig. 4. Northeast Region illegal moose kill and estimated annual recruitment loss.

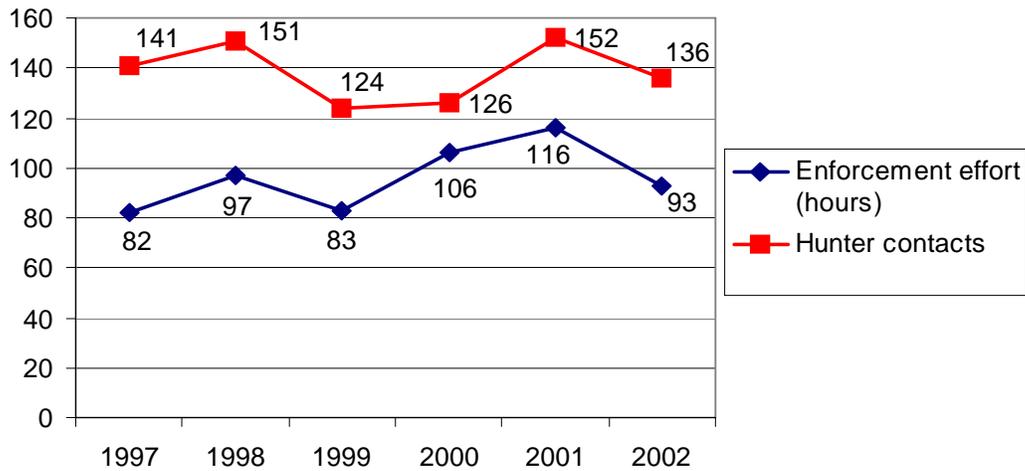


Fig. 5. Hunter contacts and enforcement effort per illegal moose in Northeast Region 1997 – 2002.

Purpose Account” and, along with hunting and fishing licence revenues, are used to fund fish and wildlife management and enforcement programs.

The number of illegally killed moose was positively, but not significantly ( $P > 0.05$ , tabular value = 0.811, 4 df) correlated to the number of hours spent in the field by Conservation Officers ( $r = 0.599$ ). The number of illegally killed moose was positively and significantly ( $P < 0.05$ , tabular value = 0.811, 4 df) correlated to the number of hunters contacted by Conservation Officers ( $r = 0.919$ ). Enforcement effectiveness was assessed by examining the number of hours of enforcement effort and the number of hunters contacted per illegal moose over the 6 years (Fig. 5). The number

of hunters contacted per illegal moose was variable, but remained close to the 6-year average of 139 hunters contacted per illegal moose. Enforcement efficiency appeared to be steadily improving over the period of 1997 – 2001 as a result of increased violation detection, but declined sharply in 2002.

Using the number of illegally killed moose and the number of hunters contacted by Conservation Officers, a regression equation ( $r^2 = 0.85$ ,  $Y = - 77.517 + 0.01158 X$ ) was derived. This equation was used with the estimated number of moose hunters in the NER obtained through postcard surveys (1999 – 2002 data only available, P. Davis, personal communication). The annual illegal moose kill estimate was calculated to range from 557 to 577 (Table 7). Using the

Table 5. Occurrence of observed and expected illegally killed moose in the Northeast Region.

	NER Proportion	Observed	Expected	Proportion Legally Killed	Bonferroni intervals	Preference
Bull	0.33	319	253	0.417	$0.362 < P1 < 0.472$	+
Cow	0.48	393	367	0.514	$0.459 < P2 < 0.570$	0
Calf	0.19	53	145	0.069	$0.0409 < P3 < 0.098$	--
Total		765	765			

(Chi-square = 77.43, Tabular value,  $P < 0.05$ , 2 df = 5.99).

Table 6. Northeast Region enforcement efforts 1997 – 2002.<sup>1</sup>

	1997	1998	1999	2000	2001	2002	Total
Enforcement Effort (hrs)	10,588	11,635	13,892	14,569	11,835	12,780	75,299
Hunter Contacts	18,167	18,132	20,805	17,369	15,471	18,674	108,618
Charges	322	458	559	454	381	406	2580
Warnings	565	562	493	586	459	399	3064
Non-Compliance Rate (%)	4.9	5.6	5.1	6	5.4	4.3	5.2
Penalties (\$)	93,290	163,176	203,120	157,215	100,055	105,330	822,186
Illegal Kills	129	120	168	137	102	137	793

<sup>1</sup> (Period - September 1 – December 31).

average of 139 hunters contacted per illegal moose and the NER projected numbers of moose hunters, the annual illegal kill estimate ranges from 394 to 406. Based on these estimates, Conservation Officers may only be locating 20 – 40% of all illegally killed moose in the NER.

### Moose Watch Program

The Moose Watch violation reporting line received the highest number of calls in 2001, the year when the program was expanded province-wide (Table 8). The NER accounted for 50% of all calls to the violation reporting line in 2001 and 54% of all calls in 2002. Wawa and Sault Ste. Marie districts received the most Moose Watch violation calls in the region.

Over the 3 years that the Moose Watch violation-reporting line was in operation, a total of 392 calls were received (Table 9). Violation reports of illegal or abandoned moose constituted 57% of all calls received, and overall, only 4% of calls received were from hunters reporting that they had killed an animal that they were not licenced for. Calls about illegal night hunting accounted for 7% of violations reported. In the absence of a general OMNR violation reporting line, calls were also received regarding illegal poaching of deer, elk, fish, and turkeys, as well as other resource related infractions.

Calls to the Moose Watch violation reporting line were consistent over the 3 years

where the majority of calls provided violation information that did not require an immediate enforcement response. Less than 20% of the calls received were of a nature requiring an immediate response by Conservation Officers.

### DISCUSSION

The number of illegally killed moose in the NER is of concern to enforcement staff, wildlife managers, and stakeholders, especially as the numbers in this report are considered to be minimum estimates. Wolfe (1987) broadly defined illegal harvest as the “taking of protected wildlife contrary to conditions prescribed by provincial / state / territorial or federal wildlife statutes”, and that most wildlife agencies consider reports of illegal kill by enforcement staff as a minimum estimate. Furthermore, the illegal moose kill has a direct socio-economic impact through reduction of hunting opportunities and lost licensing revenue.

Table 7. Northeast Region verified and estimated illegal moose kill 1999 - 2002.

	1999	2000	2001	2002
Verified Illegal Moose Kill	167	137	102	137
Projected Illegal Moose Kill – from Regression Equation	573	557	577	560
Projected Illegal Moose Kill – from CO Contact	404	394	406	396
Projected NER Moose Hunters	56,152	54,790	56,491	55,026

The reduced illegal moose kill in 2000 and 2001 appeared to be a response to the Moose Watch program; however, the 35% increase in verified illegal kills in 2002 indicates an apparent decrease in hunter compliance. A similar trend was observed in north central Ontario in the late 1970s – early 1980s by Timmermann and Gollat (1984) when hunting regulations were changed to prohibit party hunting. Charges laid by Conservation Officers during the moose hunting season declined following the first 2 years of regulation change, and sharply increased in the third year as a result of enforcement efforts and a less cautious approach taken by hunters. Ontario reported high non-compliance during the first year of the moose selective harvest system in 1983 (Wolfe 1987), and the illegal harvest of moose continues to be a serious compliance issue in northeastern Ontario 20 years later.

The high number of abandoned moose is of great concern, and the majority of the NER abandoned moose were killed with unlawful intent, rather than by accident, based on human interaction. In a similar study, Beattie et al. (1980, citing Hardin and Roseberry 1975) reported that 20% of abandoned deer carcasses on the Crab Orchard National Wildlife Refuge in Illinois had been intentionally abandoned. High abandonment rates of moose offend law abiding hunters and the general public, and resulted in 85 complaints to the Moose Watch violation reporting line. Increased promotion of hunter ethics and increased enforcement effort are required to deter this behavior.

Approximately 1/3 of the NER abandoned moose showed no sign of human interaction, and may be a result of wounding mortality. Moose hunter shooting proficiency was studied by Timmermann (1977) and Buss et al. (1989) and they estimated that potential wounding loss based on shooting exercises at life-sized moose targets by

Ontario hunters could be in the magnitude of 25 – 30%, and close to 40% on moving targets. Wolfe (1987) reported that crippling loss of moose in Ontario was considered to be of moderate concern. It is also possible that these moose were killed as a result of illegal activity. Pursley (1977) observed a 25% wounding mortality rate in unlawfully killed deer in New Mexico. Higher wounding mortality rates have been observed for night hunted deer, ranging from 27% in Manitoba (Bessey 1984) to as high as 50% on Manitoulin Island, Ontario (I. Anderson, personal communication). Little information exists on wounding rates in unlawfully hunted moose; however, it would be reasonable to assume that similar rates as observed in deer would apply to moose.

Illegal harvesting of moose in the NER is a function of moose populations and hunter pressure. The 7 WMUs that comprise 50% of the regional kill are located near urban centres, have high hunter preference, and high competition for available AVTs. Perceived availability of animals is a primary consideration for those that are predicated to unlawfully taking wildlife (Bessey 1984,

Table 8. Moose Watch violation report line calls 2000–2002.

	2000	2001	2002
Chapleau	3	2	9
Cochrane	1	3	0
Hearst	2	4	2
Kirkland Lake	7	7	10
North Bay	8	13	10
Sault Ste. Marie	9	21	7
Sudbury	10	18	6
Timmins	6	15	10
Wawa	13	17	17
Total Northeast Region Calls	61	100	71
Total Provincial Calls	61	200	131

Glover 1982 as cited by Bessey 1984, Gregorich 1992). Strategic enforcement effort needs to be focussed on these 7 WMUs.

Competition for declining levels of AVTs and opportunities to harvest adult moose may be pressuring some hunters to violate moose hunting regulations. For the 1999 and 2000 hunting seasons, the NER had the highest number of moose hunters in the province, and the second lowest number of AVTs (Bisset 2002). Hunter satisfaction is influenced by the ability to harvest an animal, and in areas with high hunter densities, hunting techniques are selected to avoid losing preferred hunting locations to other hunters (Crête 1987). Hall et al. (1990) found a perception among migratory bird hunting violators that the temptation to violate was enhanced by the belief that more waterfowl were being killed elsewhere along the flyway. These situations lead to increased competition among hunters, and may influence some individuals to take increased risks in order to harvest a moose. Benson (2000) stated that in hunting “Opportunity elicits actions that sometimes would not be considered”. In Sweden, where high moose populations and strictly regulated hunting occur (Cederlund and Markgren 1987), losses to poaching are considered to be negligible (Boer 1991). If moose populations and the availability of AVTs increase, the incidence of illegal harvesting of moose may decrease based on an improvement in hunter satisfaction.

The relatively stable sex structure of the NER illegal kill indicates that there is differential vulnerability to poaching. It is reasonable that bull moose constitute a higher than expected percentage of the illegal kill based on their increased availability to hunters resulting from rut and post-rut activity. Calves are under-represented in the illegal kill as all licenced hunters in Ontario can lawfully harvest them in any

WMU with an open moose season. Crête (1987) observed that when hunters can choose, vulnerability is determined by hunter preference for “large bulls, small bulls, large cows, small cows, and calves” in decreasing preference. Moose are being killed opportunistically as they become available to poachers. Bessey (1984) assumed that the majority of deer poachers were opportunists who violated hunting legislation when opportunities were presented. The NER data suggest that moose are being killed opportunistically as they are encountered and abandoned if an adult validation tag is not affixed in a reasonable period of time. If the NER illegal moose kill were solely based on cow moose being mistaken for calves, the proportion of cows in the illegal kill would be significantly higher. An assumption may be made that the verified annual illegal kill does not constitute a sustainability issue, as it does not exceed the 10% non-

Table 9. Violations reported to Moose Watch line 2000–2002.

Violation Reported <sup>1</sup>	2000	2001	2002	Total
Moose Poaching	17	60	60	137
Abandoned Moose	15	37	33	85
Turning Self In	6	5	5	16
Night Hunting	5	16	5	26
Aircraft Hunting	5	2	0	7
Deer Poaching	3	37	13	53
Fish Poaching	1	10	1	12
Elk Poaching	0	3	1	4
Turkey Poaching	0	1	0	1
Non-violations	9	29	13	51
Total	61	200	131	392

<sup>1</sup> NER only 2000, Province-wide 2001-02.

hunt mortality estimate in any WMU. Of all of the contributing non-hunt mortality factors, the only verified data that exists for any of these factors is the illegal moose kill data. Poaching is the only non-hunt mortality factor that is actively managed or only factor that can be reasonably controlled at this time in the NER. Individual WMU moose population models and harvest levels may have to be adjusted in WMUs where known estimates approach or exceed the 10% non-hunt mortality estimate.

There is little information on the impact of illegal kills on moose populations in North America (Wolfe 1987). Illegal kills may have a significant impact on moose populations when combined with other non-hunt mortality factors. Illegal harvest and brainworm (*Parelaphostrongylus tenuis*) are cited as contributing factors in moose population declines in Nova Scotia (Timmermann 1987). Poaching and collisions were the highest cause of all known moose non-hunt mortality in Maine, Minnesota, Nova Scotia, and New Brunswick in 1970, and the illegal kill accounted for an average of 31% of the non-hunt mortality in these jurisdictions (Karns et al. 1974).

The illegal kill has a recruitment impact on the NER moose herd, which will reduce the availability of moose for law-abiding hunters. There are 2 ways of looking at this loss in terms of hunting opportunities. One assumption would be that all illegally harvested moose and recruitment loss constitutes the total loss of opportunities to the hunting community. Wolfe (1987) stated that every illegally killed moose could support an additional 6 resident hunters or 3 non-resident hunters in North America. Using the verified illegal kill and estimated recruitment loss of 1,404 moose being unavailable for lawful harvesting, this would represent a loss of opportunities to 8,424 resident hunters or 4,212 non-resident hunters to hunt within the NER.

The other viewpoint would be that the illegal kill and recruitment would have accrued into the NER moose population and been apportioned to hunters using the current allocation methods. In this example, the verified illegal kill and estimated recruitment loss would represent approximately 240 AVTs over the 6-year period (assuming a planned harvest level of 10% and a 50% success rate of filling an AVT). Each AVT has a multiplier value in terms of hunter opportunities. Provincially, 58% of all hunters apply for AVTs in groups (average group size 4.25), and 42% apply as individuals. These 240 AVTs would have permitted an opportunity for a minimum of 643 individuals to legally hunt an adult moose. As all hunters can harvest calf moose in Ontario, the loss of approximately 175 calves has an extremely high multiplier effect. Regardless of the viewpoint taken, any reduction in illegal harvest would have a compensatory value in reducing the non-hunt mortality estimate for wildlife managers, and allow for an increase in moose hunting opportunities.

Estimates of illegal moose kill fluctuate across North America, ranging from 5-100% of the legal harvest level, with a mean of 30% (Wolfe 1987). Wolfe (1987) reported that Ontario's estimated illegal moose kill was 10% of the legal harvest based on a 1983 questionnaire. Mercer and Manuel (1974) estimated that the illegal moose kill accounted for 5 – 10% of the moose population in accessible areas of Newfoundland in the early 1970s. Violation simulation studies indicate low detection rates (< 1%) of violations by enforcement staff and low violation reporting rates (< 10%) by the public to enforcement agencies (Vilkitis 1971, Pursley 1977, Bessey 1984, Boxall and Smith 1987). While estimates of the number of violators and the number of illegally killed wildlife using these violation simulations have poor statistical precision,

the estimates are useful in that they suggest a higher incidence of illegal kill than previously assumed (Wolfe 1987).

Illegal moose kill estimates documented here are likely overestimated using the regression analysis, as the relationship is probably more curvilinear than linear. However, in the absence of any violation simulation exercises or other substantive estimates in Ontario for illegal moose harvesting, the 2 estimates derived in this report on annual illegal kill provide a baseline on which further testing can be made. Wolfe (1987) states “additional research is necessary to improve means of quantifying the magnitude of illegal kill and of separating out the relative contribution of various components”.

Efficiency and effectiveness of wildlife enforcement programs are difficult matters to assess and enhance to ensure violation deterrence and compliance with legislation (Cowles et al. 1979, Bessey 1984, Hall et al. 1990, Gregorich 1992). Hunter compliance with legislation is directly related to favorability of attitude towards the legislation (Bessey 1984). While overall moose hunting non-compliance rates of hunters checked by Conservation Officers are less than 10% in the NER, there are limitations on the relevance of simple compliance estimations (Cowles et al. 1979). This is best illustrated by the 2002 statistics which had the lowest overall non-compliance rate, and a 35% increase in illegal moose kills from the previous year.

Condonation of illegal wildlife harvesting occurs in many jurisdictions across North America (Vilkitis 1971, Bessey 1984, Hall et al. 1990, Gregorich 1992), and can limit the effectiveness of wildlife enforcement. The elimination of public acceptance of illegal wildlife harvesting and the imposition of penalties that are severe enough to provide deterrence are required to reduce the illegal harvest of moose. One of the primary purposes of the Moose Watch pro-

gram was to increase public and stakeholder awareness, and to provide a general deterrence through their involvement in compliance monitoring and violation reporting. The Moose Watch program has been effective in dealing with illegal harvesting activities and has received close to 400 calls since its inception, especially as other jurisdictions have noted low rates of violation reporting by the public (Vilkitis 1971, Pursley 1977, Bessey 1984, Boxall and Smith 1987). Despite calls that deal with non-enforcement matters or lead officers to investigate occurrences in which no charges are laid, the favorable public response to the program indicates the effectiveness of the promotional program and acceptance by the hunting and non-hunting community.

Efficient enforcement action can be initiated by Conservation Officers investigating timely and accurate complaints. In 2000, the Moose Watch program had a \$25,000 budget for initial start up costs and promotional materials. One call to the violation reporting line in October 2000 regarding 2 illegal moose led to the discovery of a third illegal moose, and resulted in the conviction of 6 poachers, fines totaling \$34,500 and 29 years of hunting suspensions. This case alone paid for the entire Moose Watch program.

The Moose Watch program is not the panacea for enforcement in the NER, but rather another tool available to Conservation Officers. The illegal moose kill is not uniformly distributed across the NER WMUs, and strategic enforcement initiatives are required in problem districts, including enhanced promotion and education, increased uniformed officer presence, and special investigations. Hall et al. (1990) state that “actions to reduce violations of recreational hunting regulations can be as effective as those that limited commercial hunting”. Continued hunter and public support, and adequate and efficient law en-

forcement presence will be required to reduce the illegal harvesting of moose in the NER.

### CONCLUSIONS

Illegal harvesting of moose in the NER is an issue affecting the general public, hunters, wildlife managers, and Conservation Officers. The verified illegal kill of 793 moose from 1997 – 2002 represents a loss of viewing and hunting opportunities, a recruitment loss to the moose herd, and tarnishes the image of lawful hunters. These verified kills represent a bare minimum number of illegally killed moose and demonstrate a non-compliance issue in localized areas within the NER. The actual level of illegal harvest is not known and modeling systems to determine the appropriate level of enforcement effort to suppress and deter this activity have not been developed. In order to continue reducing the illegal moose kill, stakeholder involvement and effective enforcement actions need to continue in the NER, using a blend of education, promotion, field enforcement, and appropriate penalties for those few that choose to violate.

### REFERENCES

- BEATTIE, K. H., C. J. COWLES, and R.H. GILES JR. 1980. Estimating illegal kill of deer. Pages 65 – 71 in R.L. Hine and S. Nehls, editors. White-tailed deer population management in the north central states. Proceedings of a Symposium held at the 41st Midwest Fish and Wildlife Conference, Urbana, Illinois, USA, 10 December 1979.
- BENSON, D. E. 2000. Hunting ethics and the 6 R's: Relevance, Reasoning, Resources, Respect, Restraint and Responsibility. Pages 78 – 84 in W.D. Mansell, editor. Proceedings of the 2000 Premier's Symposium on North America's Hunting Heritage, Ottawa, Ontario, Canada.
- BESSEY, K. M. 1984. Analysis of the illegal harvest of white-tailed deer in agro-Manitoba: Implications for program planning and management. M.Sc. Thesis, University of Manitoba, Winnipeg, Manitoba, Canada.
- BISSET, A. 2002. 1999 and 2000 Moose Harvest in Ontario. Ontario Ministry of Natural Resources, Northwest Science and Information. NWSI Technical Report TR-131. Thunder Bay, Ontario, Canada.
- BOER, A. 1991. Hunting: A product or tool for wildlife managers? *Alces* 27:74–78.
- BOXALL, P. C, and L. C. SMITH. 1987. Estimates of the illegal harvest of deer in Alberta: A violation simulation study. Occasional Paper #2. Alberta, Forestry, Lands, and Wildlife, Fish and Wildlife Division, Resource Economics and Assessment Section. Edmonton, Alberta, Canada.
- BUSS, M. E., R. GOLLAT, and H. R. TIMMERMANN. 1989. Moose hunter shooting proficiency in Ontario. *Alces* 25:98-103.
- BYERS, C. R., R. K. STEINHORST, and P. R. KRAUSMAN. 1984. Clarification of a technique for analysis of utilization – availability data. *Journal of Wildlife Management* 48:1050-1053.
- CEDERLUND, G. N., and G. MARKGREN. 1987. The development of the Swedish moose population 1970-1983. *Swedish Wildlife Research Supplement* 1:55–62.
- COWLES, C. J., K. H. BEATTIE, and R. H. GILES JR. 1979. Limitations of wildlife law compliance estimators. *Wildlife Society Bulletin* 7:188–191.
- CRÊTE, M. 1987. The impact of sport hunting on North American moose. *Swedish Wildlife Research Supplement* 1:553–563.
- GLOVER, R. L. 1982. Characteristics of deer poachers and poaching in Mis-

- souri. M.Sc. Thesis, University of Missouri, Columbia, Missouri, USA.
- GREGORICH, L. J. 1992. Poaching and the illegal trade in wildlife parts in Canada. Canadian Wildlife Federation, Ottawa, Ontario, Canada.
- HALL, D. L., J. G BONNAFFONS, and R. M. JACKSON. 1990. The relationship of enforcement, courts and sentencing to compliance with waterfowl hunting regulations. *Journal of Wildlife Law Enforcement* 2:1-15.
- HARDIN, J. W., and J. L. ROSEBERRY. 1975. Estimates of unreported deer loss resulting from a special deer hunt on Crab Orchard National Wildlife Refuge. *Conference Proceedings of the Southeast Association of Fish and Wildlife Agencies* 29:460-466.
- HOSIE, R. C. 1979. *Native Trees of Canada*. Fitzhenry & Whiteside Limited. Don Mills, Ontario, Canada.
- KARNS, P. D., H. HASWELL, F. F. GILBERT, and A. E. PATTON. 1974. Moose management in the coniferous-deciduous ecotone of North America. *Naturaliste Canadien* 101:643-646.
- MERCER, W. E., and F. MANUEL. 1974. Some aspects of moose management in Newfoundland. *Naturaliste Canadien* 101:657-671.
- NEU, C. W., C. R. BEYER, and J. M. PEEK. 1974. A technique for analysis of utilization - availability data. *Journal of Wildlife Management* 38:541-545.
- PURSLEY, D. 1977. *Illegal harvest of big game during closed season*. New Mexico Department of Game and Fish, Santa Fe, New Mexico, USA.
- TIMMERMANN, H. R. 1977. The killing proficiency of moose hunters. *Proceedings of the North American Moose Conference and Workshop* 13:13-25.
- \_\_\_\_\_. 1987. Moose harvest strategies in North America. *Swedish Wildlife Research Supplement* 1:565-579.
- \_\_\_\_\_, and R. GOLLAT. 1984. Sharing a moose in North Central Ontario. *Alces* 20:161-186.
- VILKITIS, J. R. 1971. The violation simulation proves as reliable as field research in estimating closed-season illegal big game kill in Maine. *Transactions of the Northeast Section of the Wildlife Society* 28:141-144.
- WOLFE, M. L. 1987. An overview of the socioeconomics of moose in North America. *Swedish Wildlife Research Supplement* 1:659-675.