

Moose Management Report
January 2021



Report from the Department of
Inland Fisheries & Wildlife

To The Joint Standing Committee on Inland Fisheries & Wildlife

As required by Title 12 Section 11552



2020 Annual Report on Moose Management

130th Legislature – First Regular Session

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Proposed Actions for Moose Management Regarding the Number of Permits Issued, Length, and Timing of the Annual Moose Hunting Season

In response to the requirements set forth in Title 12 MSRA, 11552, subsection 2, the Department of Inland Fisheries and Wildlife submits the following report on the actions taken and proposals for the management of moose relative to the number of permits, season timing, and the areas open to hunting.

Moose Management Highlights

- Overview
 - Aerial surveys of moose abundance, composition of population (bulls, cows, calves)
 - Survival studies using GPS-collared moose
 - Indications that winter tick (*Dermacentor albipictus*) has impacted moose survival and reproduction
 - Permits are allocated based on management objectives, particularly healthy sustainable moose population; hunting and viewing opportunities
- Review of 2020 moose hunt
 - Harvest: 2,365 moose
 - 2020 season framework: four seasons (September, 1st, 2nd October; November in southern Maine)
- Proposed 2021 season framework: similar, with four seasons-note Adaptive Hunt in WMD 4
- Selected Management Issues
 - Hunting Access in North Maine Woods (hunter traffic in working forest)
 - Controlled hunt in NE Aroostook County (reduction of crop depredation and moose/vehicle collisions)
 - 2020 was 12th successful control operation, with 18 moose harvested
 - Management of winter tick impacts: Adaptive Hunt Proposal–WMD 4
 - Increased cow harvest to reduce moose densities and winter tick infestations – assess impacts on reproductive success and juvenile survival
- Adult Cow and Calf Moose Survival Study – Project Update January 2021
 - Study began in WMD 8 in 2014: expanded to WMD 2 in 2016
 - 521 moose have been GPS-collared over the seven-year study
 - Moderate to high overwinter juvenile mortality; low adult mortality
- MDIFW’s leadership in moose management across North America

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Moose Management Goals

MDIFW has publicly derived management goals and objectives for many of the species it manages, including moose. Current moose management goals and objectives, developed as part of the 2017 Big Game Management Plan, include:

- 1) Maintain a healthy, sustainable moose population while providing hunting and viewing opportunities
- 2) Continue researching the relationships between moose, parasites, habitat condition, climate, and management
- 3) Ensure public satisfaction with Maine's moose population and increase the public's understanding of moose biology, ecology, and management

Moose management goals and objectives shifted from moose density objectives to that of overall moose health given the findings from the seven-year Adult Cow and Calf Survival Project. Health is defined by increased survival of neonate and overwintering calves, increased productivity of adult cows and reduction in prevalence of disease and parasites.

Management Actions

Population Assessment: For over a decade Department staff have conducted aerial surveys (flights to estimate moose numbers and flights to determine composition of bulls, cows and calves) in the majority of our state's prime moose range. In collaboration with the Maine Forest Service Ranger Pilots, the Department conducted aerial surveys to estimate moose abundance across 83% of this area (WMDs 1-6, 8, 9, 11 and 19; see map in Appendix 1). This technique provides the Department with a reliable method for tracking changes in moose abundance. The moose population in the WMDs that were surveyed represents Maine's core moose population. Surveys are not conducted in WMDs 7, 8, and 10 because the mountainous terrain creates hazardous flying conditions, but biologists estimate moose densities in these WMDs by modeling moose population parameters including harvest rates, survival rates, age distributions, and productivity.

In conjunction with the density estimates, we have also completed aerial composition counts to determine proportions of bulls, cows, and calves in these units. To date, composition surveys have been completed in WMDs 1-9, 11, 14, 19, 27 and 28 (see map, Appendix 1). The bull/cow ratios derived from the surveys are important population attributes for moose management. The Department strives to maintain a certain percentage of mature

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or prime bulls in most core range WMD's, and harvest regulations can be adjusted as necessary to address adult sex ratios as well as bull age composition. This includes ensuring minimum ratios of mature bulls to cows and a minimum proportion of mature bulls among all bulls in the population. The aerial composition surveys also provide reliable data on the number of calves per adult cow. Calf /cow ratios give Department biologists insight on changes in moose population growth, survival, and productivity of cows.

In WMDs within southern, central and Downeast Maine (outside of the core range) moose populations are less dense and there are much less empirical data to inform management decisions. Consequently, permit allocations for these WMDs are very conservative and are determined based on the amount of available habitat and hunter densities, set to minimize crowding during the hunts. Reproductive data based on ovaries collected from hunter-harvested cow moose are combined with the aerial survey data to reliably assess moose abundance, population composition, and reproduction. The Adult Cow and Calf Survival Study has demonstrated that impacts from winter tick (*Dermacentor albipictus*) including depressed reproduction in pregnant cows and subsequent over-winter calf losses (mostly occurring in May to early June) are the drivers behind slow or stalled population growth. However, there is more to understand regarding factors that influence moose survival.

Department staff have been evaluating the roles of winter ticks and other parasites (e.g., lungworm (*Dictyocaulus sp.*)) in moose mortalities. Heavy winter tick loads on moose, especially on calves, can be debilitating and is a significant factor in spring moose mortalities. In a year of high tick infestation, not only will there be higher than normal overwinter losses of calves, but winter ticks exert additional energetic/nutritional stress on cows that can result in compromised newborn calves that have reduced survival during the first weeks of life. The Department continues to work closely with the University of New Hampshire to assess the level of winter tick infestation that will predict an overwintering calf epizootic (>50% mortality). In addition, we are working with the University of Cincinnati (Smith Fellowship) to investigate how questing winter tick larvae in the fall react to various climatic conditions.

2020 Moose Season Summary

Each Maine moose permit holder could hunt moose for six days within the structure of a three-season framework (September/October/October) during 2020. The September season, which occurred in WMDs 1-6, 10, 11, 18, 19, and 27/28, ran from September 28 to October 3; the first October season, which occurred in WMDs 1-14, 17-19, 27, and 28, ran from October 12 to 17; and the second October season in WMDs 1-6 ran from October 26 to 31. In addition, 2020 marked the 14th southern Maine moose hunt. The southern hunt occurred in WMDs 15 and 16 (Appendix 1) and ran concurrent with the November deer season from November 2 to 28 and opened for Maine residents on October 31. By combining moose and deer hunting into a single season, the Department provided

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additional moose hunting opportunity while alleviating landowner concerns about creating another separate hunt in southern Maine.

The annual allocation of moose permits is guided by publicly derived management goals for each WMD. Permit levels may change over time if significant changes occur in moose population trends, population composition, or if management objectives have been reached. Over the past decade, the Department's moose management program has been strengthened considerably through implementation of aerial surveys, collection of reproductive data, and research on adult cow and calf survival, all of which contribute to improved decisions.

Registration data indicate that the 3,135 permit holders and their sub-permittees harvested 2,366 moose in 2020 (763 in September, 1,026 in the first October season, 573 in the second October season, and four in southern Maine). Thus, hunter success rates averaged 80%, 74%, 77%, and 10% for the September, first October season, second October season, and southern Maine hunt respectively. The low overall success of 10% in southern Maine's hunt was expected given the low moose densities in this region. To ensure that hunters understand why the success rate for moose hunters in southern Maine is low, the Department provides information on its website on hunting conditions, land access issues, and moose hunting success rates.

2021 Moose Season Framework

In 2021, MDIFW again proposes four separate moose hunting periods in Maine – a September hunt, two October hunts, and the southern Maine hunt in November (Appendix 1). The September season will run from September 27 to October 2 in WMDs 1-6, 10, 11, 18, 19 and 27/28; the first October season from October 11 through the 16 and include WMDs 1-14, 17-19, 27, and 28. The second October season will run from October 24 to 30 in WMDs 1-6. In WMDs 15 and 16, the southern Maine moose hunt will coincide with the November firearms deer season running from November 1 through November 27. Opening day for Maine residents will be Saturday, October 30.

Selected Management Issues

Management of Hunting Access in Northern Maine: In our most northern WMDs (1, 2, 4, and 5), the Department recognizes the cooperation and responsibilities of landowners within the North Maine Woods where current infrastructure can be stressed by the additional hunting-related traffic on private roadways during a six-day moose hunt. The Department continues work with these stakeholders to better understand issues between moose hunters and the operations within the working forest. Opportunities to improve the season structure and framework to better address the needs and issues with the North Maine Woods remains a critical part of the Departments' big game planning.

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Controlled Hunt in Eastern Aroostook County: Since 2009, the Department has conducted a localized moose hunt in eastern Aroostook County to control the number of moose and 1) reduce the incidence of crop depredation in selected towns (commercial broccoli fields), and 2) reduce the incidence of moose/vehicle collisions along the Route 1 and Route 161 corridor. **The controlled hunt is not a recreational hunt.**

Public input helped to shape the size and location of the controlled hunt; it has occurred in nine towns from 2009 to 2020; additional towns have been added or subtracted over time due to crop field rotations and where crops are being grown in the current year. Hunters harvested 81, 72, 60, 32, and 31 moose annually from 2009-2013 when the hunt included both public and landowner permittees. Since 2014, the hunt has been conducted entirely with Disabled Veterans through the hard work and generosity of Dave Hentosh and Smoldering Lake Outfitters. Since the inception of the Disabled Veterans-only permittees, hunters have taken between 18 and 25 moose annually.

Each year, following the controlled moose hunt, MDIFW biologists and wardens have discussed the hunt results and associated issues with representatives of the Smith and Ayer Farms, with the focus on possible improvements for future controlled hunts in eastern Aroostook County. The Disabled Veteran hunt has proved to be effective in fulfilling the controlled hunt objectives; therefore, the recommendation stands for the coming 2021 hunt as well. The Department recommended reducing controlled hunt permit levels to 20-25 in 2021, as we have achieved the desired population reductions in WMD 3 and 6 and management objectives have been met; reduced permit allocations in WMD 6 (while maintaining 2020 permit levels in WMD 3) will ensure that current moose numbers are maintained.

Adaptive Unit Hunt: Maine has experienced a significant recolonization of moose since the spruce budworm epidemic of the 1970s. To salvage budworm-killed trees, vast swaths of the North Woods were clear-cut, creating expanses of young, regenerating forests that provided prime moose habitat. Although moose numbers have ebbed since the early 2000s, Maine maintains moose densities that are higher than most of the world's moose range, with few exceptions.

While the moose harvest has generally increased over the past several decades, hunting mortality remains low and has had little to no impact on the overall increase/decrease of the moose population. Rather, high mortality of both newborn calves and overwintering calves coupled with lower reproductive rates have generated stagnant or declining moose populations in several WMDs. Infestations of winter tick have been driving this change, and the Department plans to assess whether lowered moose densities can disrupt the cycle of repeated winter tick infestations and thus improve reproduction and overwinter calf survival.

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When animal densities exceed the capacity of the habitat to support them, typically food shortages and/or increased incidence of parasites and/or disease occur. In Maine, food in regions with high moose densities has remained stable but parasites like lungworm, tapeworm (*Echinococcus granulosus canadensis*), and winter tick are prevalent and can be found in/on almost every moose, signifying a population that is too high. Lower densities of animals tend to have higher reproductive rates and lower loads of parasites resulting in much healthier individuals and populations.

The winter tick is a single-host tick that spends all its life stages (larva, nymph, and adult) on one animal, taking blood meals at each stage. Individual moose that are infested with winter ticks lose a significant amount of blood that is not easily replaced on a winter/spring diet, generally resulting in death in young animals and decreased condition in adults. The tick-induced reduction in body condition of pregnant adult cows over the course of winter can result in their production of calves with low birth weights in May. In addition, surviving yearling cows typically are in poorer physical condition when hosting tick infestations, and they do not gain enough body mass to breed until a later age (first calves produced at three years of age, instead of two years for healthy cows) and are much less likely to have twins as they get older. Maine's short summers do not provide enough time for these animals to regain body condition before the tick feeding cycle starts again in the fall.

The impact of winter ticks on moose has been documented in other states and provinces but never in so many consecutive years as we see in the northeast. While adult survival remains high, overwintering mortality of calves (~10-11 months old) has been greater than 50% in six out of seven years in WMD 8, driven by mass infestations of the winter tick. Researchers have looked at ways to control winter ticks, but they are impractical or simply will not work at the scale necessary to control ticks across the Maine's North Woods. Spraying pesticide on moose or across the commercial forestlands are not viable solutions, for they would require treating thousands of moose across thousands of acres. Prescribed burns have potential but burning large acreages across commercial forestlands is socially and economically unacceptable.

A reduction in moose numbers, by harvesting a larger number of cows, may not be an intuitive approach to establishing a more productive moose population in Maine. However, a lower density population that contains fewer, healthy cows, each producing stronger calves every year, would result in higher numbers of calves surviving their first year, creating a vibrant healthier moose population.

To assess the validity of this management approach, MDIFW proposes to increase cow harvest on the west side of WMD 4 for five years, starting in the fall of 2021. The area chosen for the adaptive hunt represents ~6% of the entire core range of moose; it is large enough for a rigorous evaluation of the effects of a reduction in moose

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density, but it will not impact existing moose hunts and management practices throughout the vast majority of Maine's moose range. WMD 4 is well suited for this study: it contains a high concentration of moose, commercial forest landowners support a reduction in moose numbers, and impacts by winter tick are prevalent.

MDIFW continues to put GPS collars on overwintering calves in WMD 4 to assess survival (130 calves were collared here in January 2020 and January 2021), conduct annual helicopter surveys to determine moose numbers and sex/age composition, and monitor health and reproduction from the harvest. We also continue to monitor winter tick numbers.

ADULT COW AND CALF MOOSE SURVIVAL STUDY - PROJECT UPDATE JANUARY 2021

In the 1990s, winter tick infestations were recognized as having potential impacts on the population dynamics of moose. A moose may experience anemia and increased energy expenditures as the result of numerous ticks feeding on its blood and from the loss of its hair as a result of its attempt to rub ticks off. Young moose are highly susceptible to high tick loads. Normally, calves entering their first winter have no fat reserves and may be in negative energy balance over winter (Schwartz 2007). In winters that have deep snow and extreme cold temperatures, calf energetic demands increase. Thus, the combination of severe weather and both external and internal parasite loads lead to increased winter mortality.

In January 2014, New Hampshire Fish and Game (NHFG) and the Maine Department of Inland Fisheries and Wildlife (MDIFW) initiated parallel studies of adult and calf moose survival. NHFG captured and fitted 43 moose (21 adults, 22 calves) with GPS collars and MDIFW captured and collared 60 moose (30 adults, 30 calves). Moose in both states are monitored daily for mortalities. Upon death, moose are recovered in the field and necropsied to determine cause of death. In Maine, this work follows over a decade of winter tick surveys on moose and necropsy work. This work has provided insights on winter tick abundance, the occurrence of lungworm (*Dictyocaulus sp.*), and the prevalence of tapeworm (*Echinococcus granulosus canadensis*) cysts in moose.

The influence of winter ticks on moose may be governed by a variety of factors including annual winter tick abundance, moose densities, habitat, and environmental conditions (fall/spring temperatures, winds, and snow depth; Samuel 2007). MDIFW continues to work with New Hampshire to understand the dynamics of tick populations, moose and climatic conditions. This study compared relative moose densities and environmental conditions between moose in Coos County, New Hampshire and the Jackman-Moose River area in Maine (WMD 8). In December 2015/January 2016, MDIFW expanded the moose survival project into WMD 2 in northern Maine (see map, Appendix 1). The addition of this northernmost study area was critical to understanding the dynamics of

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environmental conditions (e.g., snow, temperatures, and first snowfall), moose population parameters, and winter tick ecology. Over the seven-year study, MDIFW has GPS-collared 521 moose.

Health and Parasite Loads

At capture and mortality sites, blood was drawn from moose and collected as both whole blood and serum. Blood was used to assess pregnancy status and establish and assess a wide variety of chemical and physiological parameters. This collection of blood, when examined over the course of the project, established baseline values for moose condition and identified pathogens or abnormal values that may affect Maine's moose. We are continuing blood assessment with the University of Maine at Orono to analyze blood parasites of moose.

At the time of capture and mortality, moose fecal and organ/tissue samples were collected. Examination of these samples determine parasite type, parasite load, and whether the parasite load impacted the health of the moose. Lungworm and winter tick have been identified as common and potentially significant stressors to moose health.

Mortality Surveillance

We receive daily GPS locations on all moose until time of death. Department staff have recovered and necropsied 99% of all deceased moose using a protocol adapted from the Minnesota Department of Natural Resources and further refined by our partners at the MDIFW first responders. This protocol includes assessment of cause of death at the mortality site, winter tick counts, field necropsy, aging, and collection of blood and tissue samples for diagnostics and analysis.

From 2014-2018, blood and fecal samples collected at capture and at death were sent to the University of Maine Animal Health Lab, now known as the University of Maine Diagnostic Veterinary Lab (UMVDL). UMVDL has catalogued and processed all tissue samples. Blood samples were analyzed for internal parasites, hormones indicative of pregnancy, general blood chemistry, and heavy metals. Results from this work were published in the Canadian Journal of Zoology (Jones et al. 2019).

Cow/calf Walk-Ins

The Department's moose survival project included examining productivity and survival of calves. In May, MDIFW biologists monitored the status and fate of GPS-collared adult female moose and their potential calves. Biologists monitored these cows using traditional VHF telemetry to determine whether the cow had a calf at heel or not. Biologists would walk-in to the location of the collared female moose several times a week until a calf was

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documented with the cow or until the biologist was certain a calf was not born. After a calf was documented, walk-ins were reduced to once per week for the calf's first three months of life, unless the calf died sooner. Calf vulnerability is highest during the first month after birth; by ~12 weeks of age calves' chances of survival greatly increase until their first winter.

Status of Analyses

To date, staff have summarized data on winter tick counts comparing information between tick loads of moose from recreational hunts (2006-2020), tick loads of GPS-collared moose at capture, tick loads of GPS-collared moose at necropsy, and tick loads of harvested moose in both New Hampshire and Vermont. Ultimately, this project, in collaboration with NHFG and the Vermont Department of Fish and Wildlife (VDFW), will identify critical thresholds of winter tick loads on moose and predict risk of mortality. Preliminary analyses suggest that total counts of winter ticks on a moose exceeding 40 ticks within shoulder/rump counts may signify increased risk of overwinter mortality for that individual (P. Pekins, University of New Hampshire, personal communication). These analyses are ongoing by a post-doctoral fellow at the University of New Hampshire. This work has resulted in five peer reviewed scientific publications to date (Musante et al. 2007, Jones et al. 2017, Healy et al. 2018, Yoder et al. 2018, Jones et al. 2019).

MDIFW'S LEADERSHIP IN MANAGEMENT OF MOOSE IN NORTH AMERICA

The Department has moved into a very positive position where it can reliably and effectively assess moose population trends in Maine and provide a high level of management for the people of the state. With financial support and our continued partnerships, including assistance by the Maine Forest Service, MDIFW staff will continue to move Maine to the forefront of moose management. Our collaborations with other jurisdictions and organizations have continued to increase. We have long-standing associations with the University of New Hampshire and New Hampshire Fish and Game, continued work with the University of Maine at Orono, and most recently we are collaborating with the University of New Brunswick and Laval University in Quebec.

The Department hosted the 53rd North American Moose Conference and Workshop in Carrabassett Valley, Maine at the Sugarloaf Resort from June 10-14, 2019. This annual gathering of biologists, managers, researchers, students, and stakeholders is the premier clearinghouse for scientific presentation of information on moose research and management.

The conference theme was "The Research and Management Nexus: Integration and Synergy", highlighting both the power of harnessing research and management as well as a reminder of the importance of understanding and

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melding these two aspects of wildlife biology together. Moose management relies on understanding population dynamics, habitat relationships, impacts of disease, and a host of other complicating elements. Research dedicated to quantifying and elucidating these complexities is vital to the manager who must provide empirical evidence and the “best available” data to make informed decisions on behalf of the public interest. Managers often find themselves challenged by perceptions and observations that, without evidence to the contrary, weakens their credibility and ability to adapt to short- and long-term changes. Researchers must consider the needs of the manager, the social-political pressures, and demands that complicate management decisions. Research projects that address the needs of managers as well as regional phenomena strengthen area knowledge while bolstering the collective wisdom of agencies responsible for managing moose. Managers gain immensely from regional research and researchers gain as well from understanding the pitfalls and benefits that managers face in the absence/presence of current information.

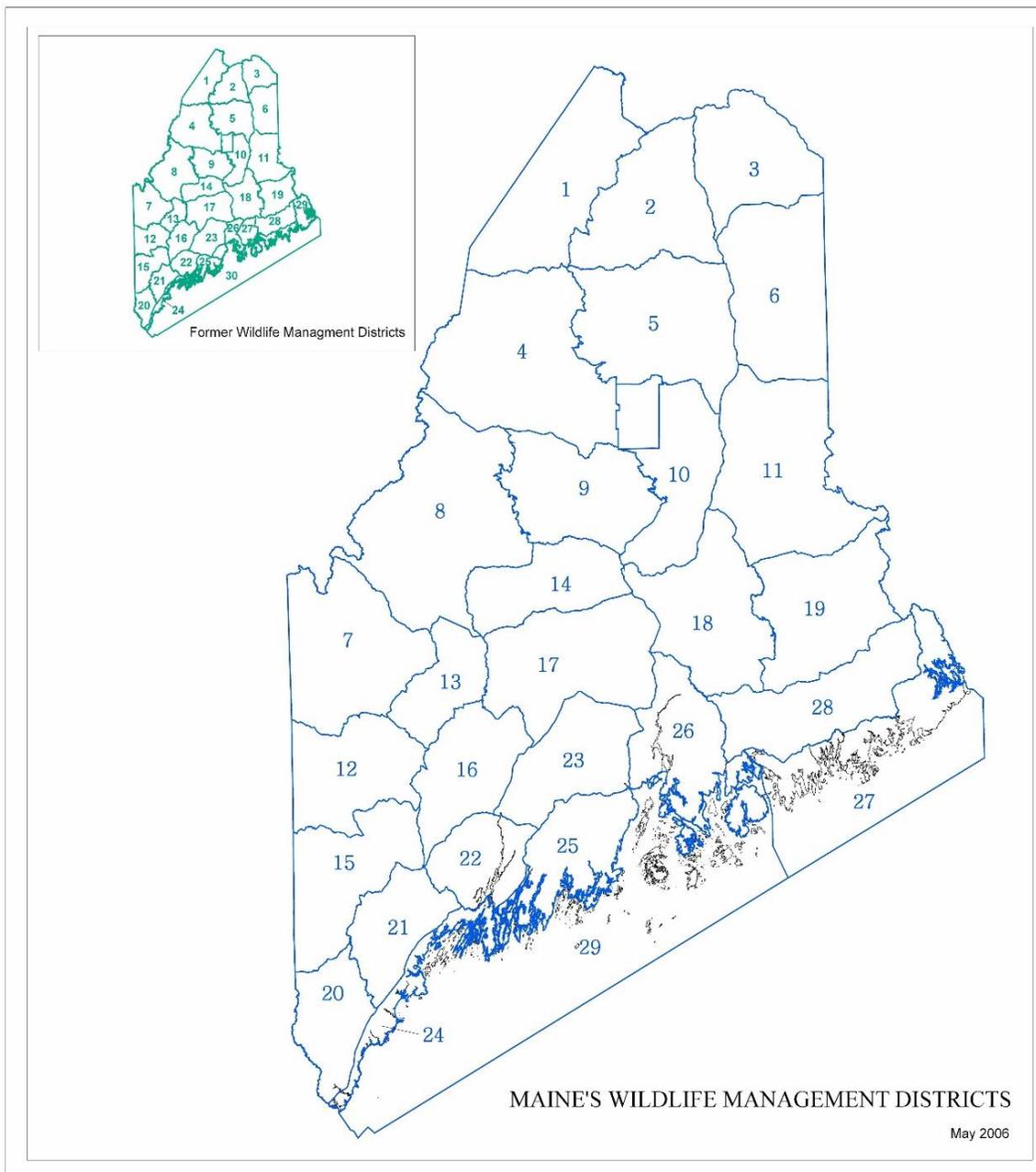
During the conference, Lee Kantar, State Moose Biologist for the Maine Department of Inland Fisheries and Wildlife received the Distinguished Moose Biologist Award for 2019. “The Distinguished Moose Biologist Award was established in 1981 to honor, and bring to public attention, the outstanding contribution of an individual to our understanding and management of moose.”

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APPENDIX 1. Maine Wildlife Management Districts.



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Literature Cited

- Healy, C., P.J. Pekins, **L. Kantar**, R.G. Congalton., and S. Atallah. 2018. Selective Habitat Use by Moose During Critical Periods in the Winter Tick Life Cycle. *Alces* 54:85-100.
- Jones, H., P. J. Pekins, **L. Kantar**, M. O'Neal, D. Ellingwood. 2017. Fecundity and summer calf survival of moose during 3 consecutive years of winter tick epizootics. *Alces* 53:85-98.
- Jones, H., P. Pekins, **L. Kantar**, I. Sidor, D. Ellingwood, A. Lichtenwalner, and M. O' Neal. 2019. Mortality assessment of moose (*Alces alces*) calves during successive years of winter tick (*Dermacentor albipictus*) epizootics in New Hampshire and Maine (USA). *Canadian Journal of Zoology* 97(1):22-30.
- Musante, A.R., P.J. Pekins, and D.L. Scarpitti. 2007. Metabolic impacts of winter tick infestations on calf moose. *Alces* 43:101-110.
- Samuel, W.M. 2007. Factors affecting epizootics of winter ticks and mortality of moose. *Alces* 43:39-48.
- Schwartz, C.C. 2007. Reproduction, natality and growth. Pages 141-171 In A.W. Franzmann and C.C. Schwartz, eds., *Ecology and Management of the North American Moose, Second Edition*. University Press of Colorado.
- Yoder, J.A., P.J. Pekins, C.J. Dobrotka, K.A. Fisher, **L.E. Kantar**, S. R. McLellan, M. O'Neal, and H. Klompen. 2018. Tick development on sexually-active bull moose is more advanced compared to that of cow moose in the winter tick, *Dermacentor albipictus*. *International Journal for Parasitology: Parasites and Wildlife* 9:56-59.