

Winter 2013-14

# Kenai Peninsula Moose News



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## Welcome to the Kenai Peninsula Moose News

**O**n the Kenai Peninsula, where the destinies of game and people have intertwined closely for thousands of years, state wildlife managers are working to increase and sustain one of the region's most valuable natural resources: moose. Kenai moose are cherished as a core wild food source and as icons of a region world famous for its abundant, healthy populations of game.

Interestingly, moose were not common on the Kenai prior to 1890. Early miners and settlers altered the landscape, creating exceptional moose habitat along the way. With these habitat changes moose numbers boomed. The area became known for its moose and in 1941 the federal government actually established a national moose range with the primary goal of conserving these world-class moose herds.

Today, moose numbers are low in many parts of the Kenai Peninsula. Given their importance to Alaskans and our constitutional mandates to manage for sustained yield, state wildlife managers have initiated a multifaceted research and management program aimed at increasing and sustaining the Kenai's moose herds. This effort includes a research program to increase our understanding of the factors affecting moose, as well as an adaptive ecosystem management program focused on increasing Kenai moose numbers.

As we embark upon our efforts, we are building partnerships. We are working with private landowners to manipulate habitat to favor moose. We are working with state foresters to allow for carefully monitored and managed controlled fires. We are working with transportation officials to reduce road kills. We are also working on state and private lands to manage predator numbers given data that show high predation rates on moose calves. We are partnering when we can with federal land managers, but conflicting mandates complicate the issue. Despite this, we will continue our outreach efforts given the importance of the area's moose to Alaskans.

Managing moose in a region larger than the state of Massachusetts and far more geographically varied is complex. In this issue of *Kenai Peninsula Moose News*, we share a look into the complexities of managing moose in this part of the state.

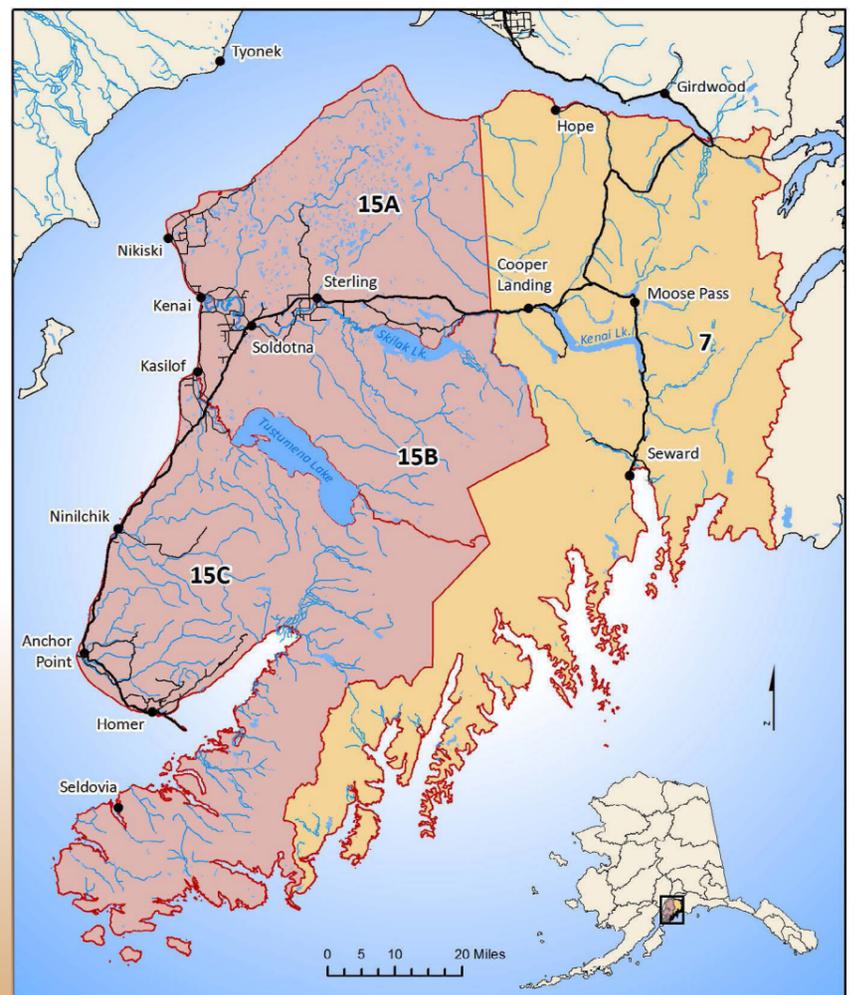
Feel free to stop by our Soldotna, Homer, or Anchorage offices if you have any questions or want to discuss our efforts. Happy reading.

– *Doug Vincent-Lang, Director, Division of Wildlife Conservation*



## Kenai Peninsula Game Management Units

For wildlife management purposes, the Kenai Peninsula is divided into two primary game management units covering 8,400 square miles. Game Management Unit (GMU) 15 covers much of the Kenai Peninsula's western two thirds and is further divided into Subunits 15A, 15B, and 15C. The eastern third of the Peninsula, from Hope south to Seward, falls into GMU 7. Find detailed information about moose in each of these game management units and subunits on pages 8-9.



# Moose, People and Fire on the Kenai Peninsula

## The Timeline

**1870s** – Miners arrive on Peninsula; large human-generated wildfires are subsequently ignited.

**Prior to 1890** – Caribou are common, moose uncommon on the Kenai Peninsula.

**1900** – Caribou decrease as mature forest habitats are altered by wildfires.

**Pre-1910** – Kenai Peninsula grows famous for large, numerous moose.

**1912** – Last recorded sighting of a native caribou on the Kenai Peninsula (prior to 1965 reintroductions).

**1915** – Wolves extirpated from Peninsula.

**Mid-1920s** – Severe winters, overuse of winter range cause moose numbers to decline.

**1941** – The Kenai National Moose Range is created.

**1947** – Wildfire ignited by campfire burns 308,000 acres in northwestern Kenai Peninsula, fueling moose population increase in subsequent years.

**1950 - 1960s** – Moose population increases steadily.

**1961** – Wolves reappear on the Kenai Peninsula.

**1969** – Wildfire, again started by a campfire, burns 86,450 acres in Subunit 15A, creating quality moose browse and subsequent population increase.

**1970** – Moose on Kenai National Moose Range are estimated to number as high as 9,000.

**1975** – Moose on Kenai National Moose Range decline to 3,500 following series of hard winters beginning in 1971 and overbrowsing as range quality deteriorates in burns that occurred prior to 1969.

**1980** – The Kenai National Moose Range is renamed Kenai National Wildlife Refuge, to include all wildlife species.

**Early-1980s** – Moose numbers decrease in Subunit 15A as forests mature and habitat quality declines.

**Early 1990s** – Moose counts conducted in 1990 and 1992 suggest moose number about 6,000 Peninsula-wide.

**1990s** – Large spruce beetle outbreak concentrated in Subunit 15C.

**Today** – Wildfire suppression efforts to protect growing human population and infrastructure in and around the Kenai Peninsula decrease new-growth availability and further fuel moose decline in many areas.

## Looking to the Past to Explain the Present

When miners first flocked to the Kenai Peninsula a little more than a century ago, the region's common ungulates were caribou, not moose. "Caribou were plentiful and wolves numerous," old-time Tustumena Lake hunting guide Andrew Berg once said of the years prior to 1890; "there were practically no moose."

That balance changed when large swaths of mature forest burned in wildfires caused by miners and early settlers. As caribou-friendly habitats were supplanted by moose-friendly shrubs and young hardwoods, caribou numbers decreased while moose numbers increased. With most of their former habitat altered, the remaining caribou were wiped out by unregulated hunting. The last recorded sighting of an indigenous caribou on the Kenai Peninsula was in 1912.

Wolves disappeared from the landscape a few years later. "Wolves were reportedly common on the Kenai Peninsula before 1900, but early miners, fearing rabies, immediately set out to eradicate them," according to a 1982 paper co-authored by the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game titled "Effects of Increased Human Populations on Wildlife Resources of the Kenai Peninsula, Alaska." A combination of hunting, trapping and the use of poison to kill wolves led to their extirpation on the Peninsula by 1915.

Meanwhile, the generation of new habitat beneficial to moose and a series of relatively mild winters allowed the ungulates to flourish. By 1910, the Kenai Peninsula had become famous for its uniquely large, numerous moose.

As early successional growth matured into forests in older, turn-of-the-century burn areas, moose numbers outpaced available food sources, which led to overbrowsing. Moose numbers then decreased by 50 percent by the mid-1920s after a series of severe winters.

In 1941, at the urging of hunters and other conservationists, President Franklin Roosevelt authorized the establishment of the Kenai National Moose Range "for the purpose of protecting the natural breeding and feeding range of the giant Kenai moose." A few years later, in 1947, moose caught a break when new habitat was created after a wildfire ignited by a campfire burned 308,000 acres in what is now Game Management Subunit 15A. Thanks mostly to that event, Peninsula moose numbers increased steadily throughout the 1950s and 1960s.

Wolves reappeared on the Kenai Peninsula in 1961 and quickly began repopulating their former range. That same decade, in 1969, another large-scale, moose habitat-generating wildfire on the Kenai Peninsula occurred in Subunit 15A. Again sparked by a campfire, the blaze consumed 86,450 acres. In 1970, the Kenai National Moose Range estimated its moose population to be as high as 9,000. Only five years later, after harsh winters and overbrowsing of areas outside the 1969 burn, moose numbers on the range fell to roughly 3,500.

Today, vegetation over much of the northern and eastern portions of the Peninsula has matured well beyond its peak quality for moose. Wildfires in many areas are rigorously suppressed to protect increasing human populations and infrastructure on and adjacent to the Kenai Peninsula. As a result, moose densities fell, and wildlife managers face perhaps more challenges than ever to maintain high moose densities, quality moose habitat, and high levels of harvest.



**Mixed Blessings:** Wildfires set the stage for prime moose habitat, but can jeopardize people and property. The 2007 Caribou Hills wildfire burned 56,000 acres, destroying 88 homes and cabins along the way. Photo courtesy of Toni Jabas, Homer News



"Second Annual Hunt, Kenai Peninsula, Seward, Alaska, Nov. 1, 1911," Seward Community Library Association, Sylvia Sexton Collection, SCL-1-546.

**It's a Big Country:** The Kenai Peninsula's game management units encompass 8,400 square miles of mountains, muskegs, ice fields, boreal forests, lakes, streams and coastal fjords – a landmass larger than Massachusetts.

# Moose Management Today

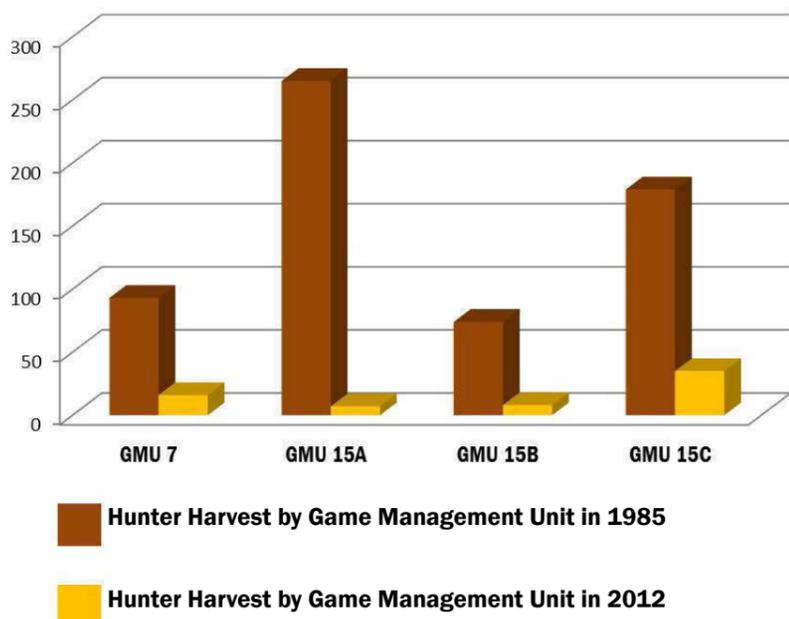
## Moose Harvests Shrink with Population Declines, Hunting Restrictions

Kenai Peninsula moose succumb to predation, disease, malnutrition, poaching, and a host of other causes. Two of the most visible human-related causes of Peninsula moose deaths are road kills and hunting. Today, many more moose are killed in collisions on Peninsula roads than by hunting.

Moose have declined in many parts of the Peninsula, along with their available habitat. Combined with other factors – including more restrictive hunting regulations to conserve moose – this has led to a dramatic decrease in hunter harvests. For perspective, the following graph represents two harvest extremes.

### Comparing Moose Harvests:

Moose Harvests by Game Management Units, 1985 and 2012

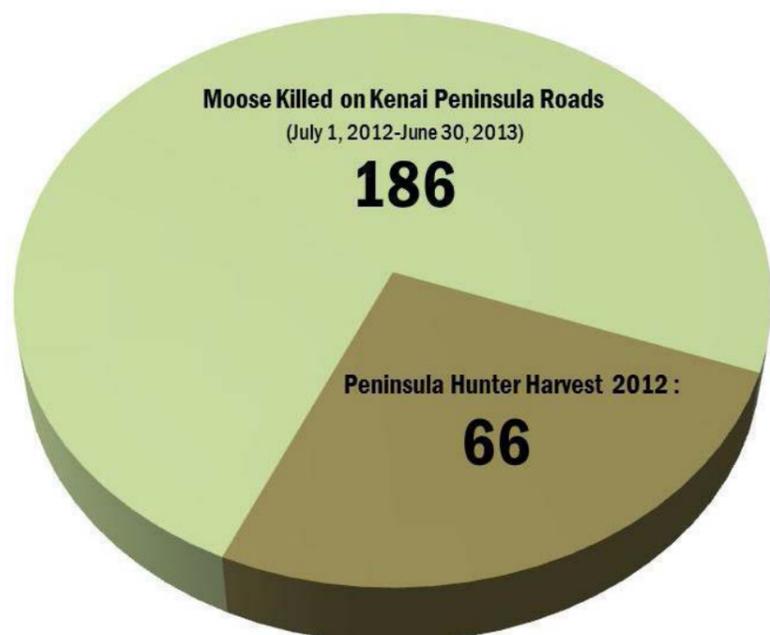


## The Road Kill Factor

Since 2011, when additional antler restrictions were adopted, more Kenai Peninsula moose have been killed by motor vehicles than by hunters. Even before the Board of Game imposed the new antler restrictions, known road kills accounted for about a third of all moose killed by humans.

Road kills occur throughout the year, but moose are particularly vulnerable in winter when daylight is fleeting, roads icy, and deep snows cover food sources and make movement difficult. Cleared roadways make for easy walking, and young trees and shrubs growing along highway margins can be attractive food sources. The Alaska Department of Fish and Game and the Department of Transportation are working together to address this issue by clearing roadways in the fall, widening cleared rights-of-way to improve visibility, and educating drivers about slowing down and scanning roadsides for moose.

## Annual Road Kills Outpace Hunting Harvest



**Legal Bull:** Antler restrictions help conserve moose and have been in place on the Kenai Peninsula since 1987.

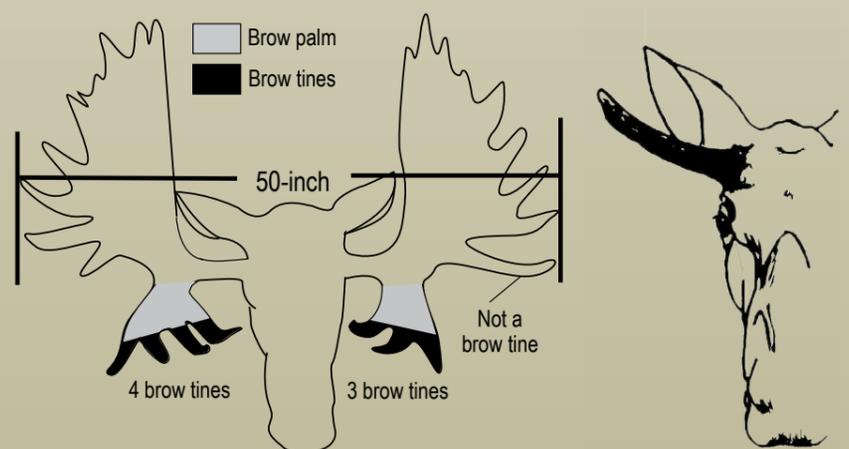
## Antler Restrictions as a Conservation Tool

Antler restrictions protect breeding bulls by restricting harvest to younger and older animals. At the same time, the restrictions provide hunting opportunity while limiting the number of bulls harvested to sustainable levels.

Without antler restrictions, a hunt might last only a few days, be restricted by access, or be limited to a permit hunt. With antler restrictions in place, seasons can remain open longer and allow opportunity for more people to hunt.

Antler restrictions to conserve moose have been in place Peninsula-wide since 1987. The following provides a look at adjustments that have been made to these restrictions to sustain moose populations and provide harvest opportunity:

- **1987** – Hunters participating in general moose hunts are restricted to one bull per season with a spike or fork on at least one antler, or antlers with minimum spreads of at least 50 inches, or antlers with three or more brow tines on at least one side.
- **2011** – When bull numbers in many parts of the Peninsula decline below the desired bull:cow ratio, antler restrictions are tightened further to bulls with antler spreads of at least 50 inches, or antlers with four or more brow tines on at least one side.
- **2013** – Following improved bull:cow ratios, restrictions are eased slightly to one bull with a spike on at least one side, antler spreads of at least 50 inches, or antlers with four or more brow tines on at least one side.



The drawing above and on the left shows a bull with an antler spread of at least 50 inches, plus four or more brow tines on at least one side. This is a legal bull on the Kenai Peninsula. Current hunting regulations allow the harvest of bulls with antler that span at least 50 inches or that have four or more brow tines on at least one side, or bulls with a spike (shown on right).

# Kenai Peninsula Intensive Management

## Kenai Peninsula Intensive Management Timeline

**1994** – Alaska State Legislature passes the Intensive Management Law requiring the Board of Game to identify game populations that are important food sources for Alaskans, and to ensure those populations are managed to allow for adequate and sustained harvest.

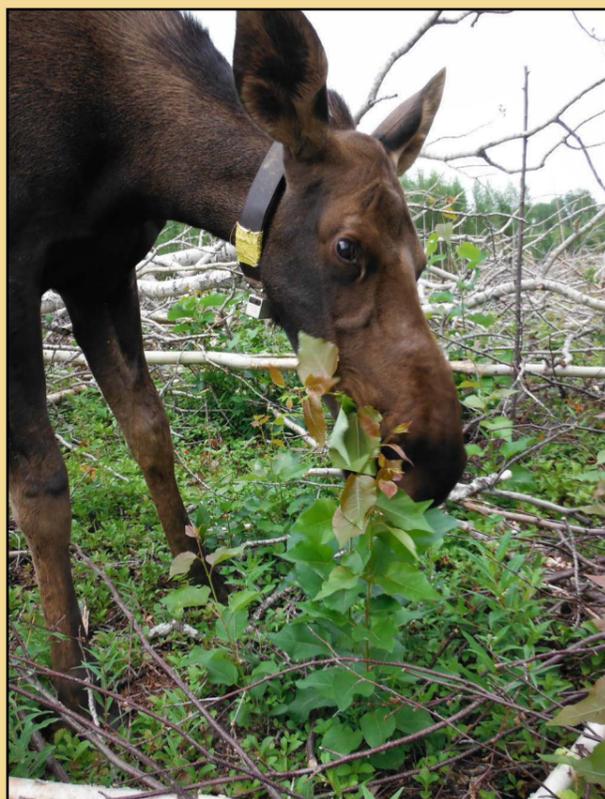
**2000** – The Board of Game sets population and harvest objectives based on department data for intensive management populations, including moose in Subunits 15A and 15C. For Subunit 15A, the population objective is set at 3,000-5,000 moose, with a harvest objective of 180-350 moose. In Subunit 15C, the population objective is set at 2,500-3,500 moose with a harvest objective of 200-350 moose.

**2009** – The Board of Game considers two intensive management proposals establishing predator control areas on the Kenai Peninsula, but defers action.

**2011** – The Board of Game again considers intensive management plans for Kenai Peninsula Subunits 15A and 15C, but postpones a decision. The board also considers a proposal to reduce objectives for Subunit 15A, but rejects the proposal.

**2012** – The Board of Game approves intensive management for Subunits 15A and 15C.

**2013** – The Board of Game revisits intensive management plans for Subunits 15A and 15C, allowing the department to hire a trapper to take predators in 15A. Population and harvest objectives are again considered, but are not changed. Intensive management is not currently active in 15C because the subunit has consistently met its moose population objectives.



**Creating Better Moose Habitat:** A yearling moose eats a sapling in a 25-year-old forest that was mechanically cleared to improve moose habitat.

## What is Intensive Management?

In Alaska intensive management is more than biological concept, it is law. Enacted in 1994, the intensive management statute requires the Alaska Board of Game to identify areas where human consumptive use of wildlife is of highest priority and then set prey population and harvest objectives – for moose in this case – for these areas. Testimony from department wildlife biologists and the public is an important part of this process.

If population and harvest objectives are not met, the board must consider actions such as restricting moose hunting opportunities, habitat improvement, liberalized hunting regulations to encourage increased predator harvests, and possibly predator control.

On the Kenai Peninsula, only Game Management Subunits 15A and 15C are identified as intensive management areas. Of the two areas, Subunit 15A has not met moose population and harvest objectives approved by the board in 2000. Because of this, the board has authorized intensive management treatment.

Moose population objectives have been met consistently in Subunit 15C, though harvest objectives have fallen short since 2010. Treatment there is not currently active.



Efforts to implement large-scale habitat enhancement and predator control in Subunit 15A are limited by land ownership constraints. The Kenai National Wildlife Refuge oversees the majority of the subunit, and many lands outside the refuge are privately owned. As a result, the department's efforts to implement moose habitat enhancement and predator control are currently limited. Efforts to work with federal land managers and private landowners to promote better conditions for moose in Subunit 15A are ongoing.

## Team Effort Needed to Rebuild Moose Numbers

By Larry Van Daele, ADF&G Regional Supervisor, Region II

We Alaskans love our moose. We love to brag about them, watch them, photograph them, hunt them, and eat them. They sometimes get on our nerves when they are in our gardens, hanging around schools, or stepping onto dark roadways when we are driving home, but like any good friendship, we are willing to tolerate these challenges because we know they really mean us no harm – they're just moose being moose.

It is also a hallmark of Alaskans that we help a friend in need. We pride ourselves in finding ways to assist others who are down on their luck, threatened by someone, or don't have enough to eat. The same holds true for our moose – when we see populations that are not doing well we want to do whatever we can to help increase and sustain them into the future.

Kenai Peninsula moose are among the largest, most famous, and at one time were the most abundant in Alaska. This was recognized even before statehood when the federal government set aside a huge portion of the Kenai Peninsula as the Kenai National Moose Range (later renamed the Kenai National Wildlife Refuge). Unfortunately, the years have not been kind to this moose population, and in many areas hunting is severely restricted.

Everyone wants to know why this happened and what can be done to help the population. The most commonly cited reasons are: habitat loss (fewer fires and more fire suppression are resulting in less moose food), predation (bears and wolves), and people (through road kills and hunting). Research biologists have found that all of these factors are important and we have learned that they all interact. This means the best way to help moose populations may not be the most simple or straightforward.

For instance, it seems logical that if wolves, bears, and people are killing moose, the simple solution is to eliminate predation by all of these factors. This may work if there is unlimited food, but in situations like we have on the northern Peninsula where a lack of fires has drastically reduced moose food, less predation may actually hurt the moose population in the long run because higher moose populations would cause the habitat to be used up faster.

The challenge is to find a balance between maintaining the "right" number of moose on the range while we do everything practical to improve that range for future generations. If you have too many moose, the remaining habitat might be destroyed and the population could crash; if moose are too few, you won't have enough to repopulate the range when conditions improve.

Finding the "right" number takes research and adaptive management. Everyone has to work together to improve moose habitat while managing, but not totally eliminating, predation. This may at times be frustrating, but if we all lend a hand we will raise moose numbers and show yet again that the cooperative Alaska spirit can prevail.

# Kenai Peninsula Intensive Management

## Intensive Management in 15A

Intensive management to address declining moose numbers in Game Management Subunit 15A was most recently authorized by the Board of Game in March 2013 and work to increase these populations is already under way. Here's a look at what's being done:

**Moose Habitat Enhancement** – Habitat enhancement is a cornerstone of the Subunit 15A intensive management program. Wildfires produced excellent habitat in the 1950s, '60s, and '70s, but are too dangerous and unpredictable to be relied upon as a management tool. Controlled burns have been limited on the Kenai because of its proximity to urban population centers – smoke bothers residents and could disrupt air travel and commerce at Anchorage Ted Stevens International Airport, and fire could threaten people, homes, and businesses. Also, resources needed for controlled burns are often in use on wildfires in other parts of the state when conditions are good for burning. Nevertheless, fire can be a cost-efficient tool to improve moose habitat and the Alaska Department of Fish and Game will continue to work with landowners to use this tool in some areas.

Clearing trees is an expensive alternative, but is much safer and more predictable than fire. As with controlled burns, these treatments must include willing landowners as partners. Most recently, work to create more moose browse began in April 2013 through a partnership with the department and the Kenai Natives Association. Money for the effort was provided by an appropriation from the Alaska State Legislature.

Although small in terms of creating the amount of browse needed to significantly bolster moose populations, the project represents an important first step in evaluating existing habitat and considering other collaborative ways to improve browse availability across Subunit 15A.

**Predator Management** – The Peninsula has healthy populations of black bear, brown bear, and wolves and, while predator control does not hold the long-term key to increasing Kenai moose populations, reducing predation may allow more calves to survive in the short term while work to find solutions to habitat limitations continues. The Board of Game, with the department's assistance, is working to address predation as follows:

- **Wolf control.** Wolves normally take a smaller percentage of newborn moose calves on the Peninsula than do bears. However, wolves prey on moose of all age groups year-round, especially during winter. Recently, the board approved a predator control program for wolves because trapping and hunting have only maintained populations at stable levels.

Efforts are scheduled for winter 2013-2014 to try and reduce wolves in a limited control area on Native and state lands in Subunit 15A. As part of the wolf reduction program, a professional trapper has been hired to implement ground-based wolf removal in the control area.

Trapping may be supplemented by limited aerial monitoring and wolf control. Department-sponsored wolf control will be limited to the control area and removing wolves from this small area – roughly 6 percent of the landmass – is unlikely to affect the viability of the unit-wide wolf population.

- **Managing black and brown bear populations.** Bear predation on moose tends to be most intense in the springtime, when newborn and young calves are easily caught. Bear control is not part of the intensive management plan on the Kenai. Hunting regulations were liberalized by the board in 2013 to stabilize or reduce brown bears.



This two-pronged intensive management approach – including habitat enhancement and predator control – must work in tandem to truly benefit the moose population in Subunit 15A. Habitat must be improved and is the real key to supporting more moose. Reduction in predation is aimed at maintaining a source population from which moose can rebound after new habitat is created and it may also have a side benefit of providing a few more moose for hunters. Reallocation of moose to hunter harvest will require changes in current harvest strategies by managers and hunting regulations by the Board of Game.



**Quick Results:** This clearing in a 25-year-old birch and aspen stand has sprouted back in one growing season. Mechanical clearing is one option for creating quality moose habitat.

## Working Together to Enhance Moose Habitat

With respect to forest succession, moose forage in the mixed hardwood forests of the northern Kenai Peninsula is generally best in the early stages following a fire or other disturbance. These stages feature the pioneer hardwood species – typically birch, willow, aspen, and cottonwood – favored by moose. In the decades that have passed since the extensive burns of 1947 and 1969, stands of young hardwoods have matured and grown out of reach for moose to use as browse.

Unfortunately, the extent to which large wildland fires modified Kenai Peninsula habitats and provided for significant moose population increases can't be duplicated by a single agency within a short timeframe. Rather, a collaborative approach to forest management among many landowners is needed to reset forest succession and allow hardwoods to regenerate.

Harvesting trees to serve as firebreaks and managing wildland fires and prescribed burns could serve habitat enhancement and fire mitigation objectives. The Alaska Department of Fish and Game has discussed this approach with the Kenai National Wildlife Refuge, Kenai Peninsula Borough, and with several private landowners. While all support the concept and recognize the long-term benefits of habitat enhancement, operational costs may limit near-term progress.

Wildland fire threats to Peninsula communities can be mitigated through managed fire and forest harvesting to limit "fuels." This can also benefit moose. Coordination requires public trust and strategic planning among all agencies involved. Multi-agency efforts can be highly effective, as demonstrated during the Peninsula's spruce bark beetle epidemic where the borough, refuge, Alaska Division of Forestry, U.S. Forest Service, and others teamed up to manage tree harvests while successfully mitigating wildfire danger. In some cases, these past treatments also enhanced moose habitat.

Mechanical clearing of mature forests to enhance moose habitat is another option. Recently, the Alaska State Legislature appropriated funds to support moose habitat enhancement on the Kenai Peninsula and in the Matanuska-Susitna Borough. The department partnered with the Kenai Natives Association to harvest 85 acres north of Sterling for \$100,000. A local contractor was hired to clear-cut mature aspen and spruce, thereby allowing hardwood species to re-establish the site. Mature birch trees were left on site as seed trees. In addition to natural regeneration, the department bought native-stock birch seedlings from the Cook Inlet Society of American Foresters. With help from the Chugachmiut fire crew, under contract with the Kenai National Wildlife Refuge, 1,000 birch seedlings were planted.

When mature aspen are cut, the root system responds by sending up new sprouts. When the mineral soil is exposed after harvest, birch and cottonwood seeds have an adequate bed in which to germinate. In sampling the site in early October, foresters found hardwood seedlings plentiful, including the birch, aspen, cottonwood, and willow needed by moose.

This success demonstrates that partnerships with large, private landowners can work, and suggests that local enterprises can benefit. By treating vegetation to enhance forage quality and quantity, moose populations may increase over time to again support hunter interests and viewing opportunities at viable levels.

# Moose Ecology and Health

## Moose Food, Fire, and Overbrowsing

Spring and summer are times of relative plenty for moose. During Alaska's short growing season, moose eat a variety of vegetation, from sedges, grasses, forbs, and aquatic plants to the leaves of shrubs and trees. Preferred trees, shrubs, and forbs include willow, aspen, birch, and fireweed. In winter, moose shift from leafy green vegetation to woody twigs. This woody material is lower in nutritional value, but moose survive by drawing upon body stores accumulated during the previous summer.

Fire is a natural part of the forest ecosystem and is critical for creating quality moose habitat. Forestry research has shown that prior to Western settlement wildfires occurred in intervals of 25 to 185 years in the black spruce forests of the Kenai Peninsula's northwestern portion (in what is now Subunit 15A). In the white/Lutz spruce forests of the Peninsula's southwestern reaches (now 15C), fires occurred in intervals of 400 to 600 years. Wildfire rates increased during the settlement period of 1849-1953.

Moose habitat is usually best 5 to 15 years after a fire when trees and shrubs have grown large enough for moose to browse, but have not yet grown out of reach. Moose populations thrive during this time, and then eventually decrease as greater moose densities increase competition for food. At the same time, trees and shrubs grow out of reach or become compromised from excessive browsing.

Today, a walk through some areas of Subunit 15A during late winter would reveal that many of the trees and shrubs low enough for moose to eat appear branched or bushy-looking. This kind of growth is known as "brooming," and is a response to chronic browsing by moose. When widespread, brooming indicates there may not be enough food to keep the moose population stable. Some plants defend against browsing by producing chemical compounds that make them less digestible. In areas where food is limited, moose have difficulty finding enough food, and what they do find is often less nutritious because of these adaptive plant responses.

## Moose Health Indicates Habitat Quality

Moose typically gain weight in summer and then lose as much as 25 percent of their body weight in winter. But good summer food availability is not enough; moose need quality summer and winter habitat to thrive. How do biologists assess habitat conditions? One method is to measure the amount of moose food and its nutritional content. Another way is to study the health of the moose themselves.

## Body Condition and Malnutrition

Biologists can assess the general nutritional cycle of a moose population by measuring the body fat and body condition of adult cow moose captured in fall (typically in November), when moose are near peak condition, and again in spring (typically in March), when moose are in poorer condition. These measurements help biologists understand the severity of winter conditions and the ability of the summer habitat to replenish losses.

When compared to moose elsewhere in Alaska, cow moose in Subunit 15C overall appear to be in good condition in fall and spring. Cows in Subunit 15A on the northwestern portion of the Peninsula have relatively low fat reserves in both the fall and spring, with as many as 15 to 20 percent of these cows being in poor condition with less than 6 percent body fat by late winter. This suggests that moose in some areas of Subunit 15A are likely limited by habitat conditions.

## What Twinning Rates Tell Us

Moose generally give birth to one or two calves. Cow moose in better condition are more likely to give birth to twins. Twinning rates are a measure of a moose population's level of productivity, post-summer condition, and are an indicator of summer habitat quality. When moose food in Subunit 15A was plentiful in the early 1980s, the rate of twins born was as high as 72 percent. Now, with moose food scarce, twinning rates average about 25 percent. By comparison, Subunit 15C averages a twinning rate of about 40 percent. This and other data suggest good habitat conditions in 15C.

It's important to remember, however, that twinning rates alone don't tell the whole picture. When twinning rates in Game Management Unit 15 are compared to other regions, such as the Tanana Flats in Interior Alaska where twinning has recently ranged from 2 percent to 35 percent, current rates in Unit 15 appear high. Wildlife managers must consider multiple lines of evidence to assess a moose population's condition.



**Testing for Health:** A biologist uses ultrasonography to measure rump fat thickness in a cow moose. These measurements help biologists understand the severity of winter conditions and the ability of summer habitat to replenish losses. *Photo courtesy of P. Barboza, UAF.*



**Collecting Data:** Biologists learn about habitat by studying the moose themselves. They look at factors such as twinning rates, body condition, and the age of female moose (cows) when they first give birth.

## What Clues Indicate Moose May Not Be Getting Adequate Food in Subunit 15A?

- **Declining Twinning Rates:** Twinning rates now average about 25 percent in Subunit 15A, compared to rates as high as 72 percent in the early 1980s.
- **Overbrowsing:** Overbrowsing has occurred throughout most of the subunit. A high proportion of willow, young birch, and aspen are cropped at around three to eight feet – the typical feeding range of moose – and after chronic overbrowsing, the plants sometimes die.
- **Low bone marrow fat content:** Necropsies have documented calves with excessively low bone marrow fat content in Subunit 15A starting in midwinter. Bone marrow fat is the last vestige of fat after other reserves are depleted. When the fat content in bone marrow is low, moose are considered malnourished.
- **Declining population:** The moose population in Subunit 15A has declined by about 60 percent since the early 1980s. This decline was predicted by the relationship between moose density and forest age in the 1947 burn.
- **Declining calf weights and increased age of first birth:** When habitat is limiting, cows are typically older when they first give birth. Calf weights also decrease. Biologists are currently gathering data to measure these traits.

# Tracking and Counting Moose

## Aerial Tracking of Moose Numbers and Trends

Game management areas are typically broken into survey units and moose systematically counted only in a sample of those units. Before counting, the game management units are first surveyed from the air to categorize survey units into high- or low-moose density areas. Then an adequate number of units of each type (high- and low-density areas) are randomly chosen and flown over for a more detailed count.

Within each unit pilots with observers in small fixed-wing aircraft fly at low levels in regular, consistent back-and-forth patterns, called transects, looking for and counting moose. Inevitably, however, they miss seeing some moose. To partially correct for this, biologists fly a part of the survey unit intensively to see if they missed any moose during their standard census flights. Based on this information, biologists can calculate a “sightability correction factor” that helps determine a more accurate population estimate. For example, if biologists calculate a “sightability correction factor” for those limited, intensive surveys as 1.2, then it means they estimate 1.2 moose are on the ground for every moose actually spotted by the flight crew.

In addition to conducting a census to assess population size, biologists also fly a different type of survey most fall seasons where the goal is to determine the proportions of age and sex classes. This information helps determine population demographics, such as bull:cow and cow:calf ratios, both of which can be helpful in predicting population trends and assessing sustainable harvest levels.

## Bull:Cow Ratios

The bull:cow ratio is the number of bulls in a population compared to the number of cows. For Kenai moose, bull:cow ratios are generally managed for 20 bulls for every 100 cows to ensure there are adequate bulls in the population to breed with available cows. When bull:cow ratios fall below this level, some cows may not get bred.

Too few bulls in the population can also lead to some cows being bred late. Late breeding may result in calves that are born late and these late-born calves have less time to grow before winter, are smaller than calves born earlier, and may be less likely to survive.

## Calf:Cow Ratios

Calf:cow ratios indicate the number of calves in a moose population compared to the number of cows. When measured over time, these ratios help biologists determine whether there are adequate calves in the population to become breeding adults, a concept known as recruitment. Adequate recruitment of new moose into the population ensures a stable or growing moose population and will determine sustainable harvest rates.

Calf numbers, and subsequent recruitment, have been relatively low in Subunits 15A and 15C, contributing to a low sustainable harvest and, in the case of 15A, population declines. Low recruitment can be related to a variety of factors, from poor habitat conditions to high levels of predation.



**Hard to See:** This is what a moose looks like from the air during a survey. They can be hard to spot, particularly in forested areas where visibility is limited due to lack of light and shadows from trees.

## Survey Conditions

Conditions must be just right for surveys to be flown. These conditions include:

- Adequate snow cover: White background makes moose more visible.
- Adequate light: Days are shorter in winter and there must be enough light to see well.
- Antlered bulls: The best time for a survey is in November when most bulls still have their antlers.
- Wind and Temperature: Winds should be less than 20 miles per hour and not turbulent. Temperature should be warmer than  $-30^{\circ}$  F.



**Summer to Winter:** Moose eat a variety of green vegetation in summer and shift to woody twigs that are lower in nutritional value in winter.



**Learning from Newborns:** Biologists race to capture a moose calf during a recent research effort. *Photo courtesy of G. Lee.*

# Game Management Unit Updates

## Game Management Subunit 15A

### The Lay of the Land

Subunit 15A encompasses a generally flat, low-lying 1,314 square miles of the northwestern Kenai Peninsula. The communities of Kenai, Soldotna, Sterling, and Nikiski lie within this unit and most undeveloped land belongs to the Kenai National Wildlife Refuge. The checkerboard of habitats found here consists of poorly drained black spruce and open muskeg lowlands and, in drier areas, mixed forests of white spruce, aspen, birch, and willow.

### The State of Moose in 15A

Moose in Subunit 15A have seen better days. The population likely peaked most recently around 1971 when estimates placed numbers as high as 5,300. Since then, aside from some smaller peaks and valleys, moose numbers have remained relatively low and declining since the early 1990s. Almost 2,100 moose were estimated in the subunit in 2008. By February 2013, a survey found about 1,600 moose, well short of the population objective of 3,000 to 3,500 set by the Alaska Board of Game in 2000.

The current harvest objective – the number of animals to be made available for hunters – of 180 to 350 was set by the Board of Game in 2000 based upon harvests achieved when habitat was in excellent condition. The objective has been reached only once – in 2001, when hunters harvested 231 moose. More recently, in 2012, eight moose were reported harvested by hunters in 15A, and only four were taken in 2011. These lows reflect not only fewer moose, but the effects of more restrictive hunting regulations.

### Wildfires Forge Habitat

Since the late 1800s, wildfires burned across 15A with some regularity and, although no significant blazes have occurred since 1969, the multi-successional forests found here today were created largely by past wildfires. Mixed spruce, aspen, and birch forests are prevalent on the subunit's western side where the large 1969 burn occurred. In 15A's eastern reaches, dense, mature spruce forests are common in areas swept by the 1947 burn. Overall, important moose browse has been reduced as early successional growth has matured.

### Road Kill

Road kills influence Subunit 15A moose numbers, an impact likely amplified as the subunit's moose population has decreased. Between 1998 and 2007, automobiles killed an average of 85 moose each year in Subunit 15A. Between 2008 and 2012, that number increased to an average of 94 moose per year, despite a decrease in overall moose numbers. The majority of moose killed on area roads are cows and calves, which amplifies the impact to the overall moose population.

### The Predation Equation

Adequate browse is the primary limiting factor for moose in Subunit 15A, but predation can contribute by holding moose at low, declining numbers. The region's major predators include wolves, black bears, and brown bears. Bears prey heavily on newborn and young moose calves. Research in the 1970s and 1980s identified black bears as major predators of moose calves in Subunit 15A. Today, biologists believe brown bears in the subunit are likely significant predators of young calves.

Predation by wolves places pressure on struggling moose populations year round, most notably in winter. A February 2013 census counted 45-50 wolves in Subunit 15A. Objectives in the department's intensive management plan for the subunit call for reduction of wolves through trapping, hunting, and wolf control while retaining a minimum of 15 wolves in the area. Wolf censuses will continue periodically to monitor population changes.

### What Now for 15A Moose?

Subunit 15A moose were identified as an intensive management population in 2000. While current predator control efforts are aimed at arresting the decline of moose in Subunit 15A, these efforts alone cannot be expected to increase moose numbers to intensive management objectives. Only a major habitat-altering event, such as a large wildfire or series of fires, will allow moose populations in this unit to attain current intensive management objectives.

**The Heyday of Subunit 15A:** Estimates in 1971 placed Subunit 15A moose numbers as high as 5,300. In February 2013, surveys counted about 1,600 moose, well short of the population objective of 3,000 to 3,500 set by the Alaska Board of Game.

## Game Management Subunit 15B

### The Lay of the Land

Nestled between Subunits 15A and 15C in the Kenai Peninsula's west-central portion, Subunit 15B includes 1,121 square miles south of Skilak Lake and north of Tustumena Lake. The western portion of 15B contains habitat similar to 15A with poorly drained black spruce and open muskeg lowlands, drier areas, and mixed forests of spruce and birch; moving east, the land gains elevation, eventually opening into alpine tundra. The majority of Subunit 15B falls within the boundaries of the Kenai National Wildlife Refuge.

### The State of Moose in 15B

Moose in Subunit 15B have gradually declined since the mid-1970s as indicated by population and composition surveys. Population estimates in the 1990s and early 2000s reported about 1,000 moose in Subunit 15B. In recent years, numbers have ranged from 700-1,000.

The eastern and western portions of Subunit 15B are managed for two different objectives. Subunit 15B East was established as a trophy area in the 1970s and placed under a draw permit system. The objectives for this area are to maintain a high bull:cow ratio and provide opportunities to harvest large-antlered bulls under aesthetically pleasing conditions. In Subunit 15B West, moose are managed to maximize hunting opportunity while maintaining a minimum bull:cow ratio.

Moose harvests have remained fairly constant in western 15B since the mid-1980s up until recent antler restrictions were established in 2011 and hunter participation dropped. Moose harvests in eastern 15B have declined because success rates declined, smaller bulls were being harvested, hunter satisfaction diminished, and the department subsequently reduced permit numbers.

### Habitat

Habitat issues in Subunit 15B are similar to those in 15A. Few wildfires have occurred within the last 60 years and quality browse is a limiting factor for moose.

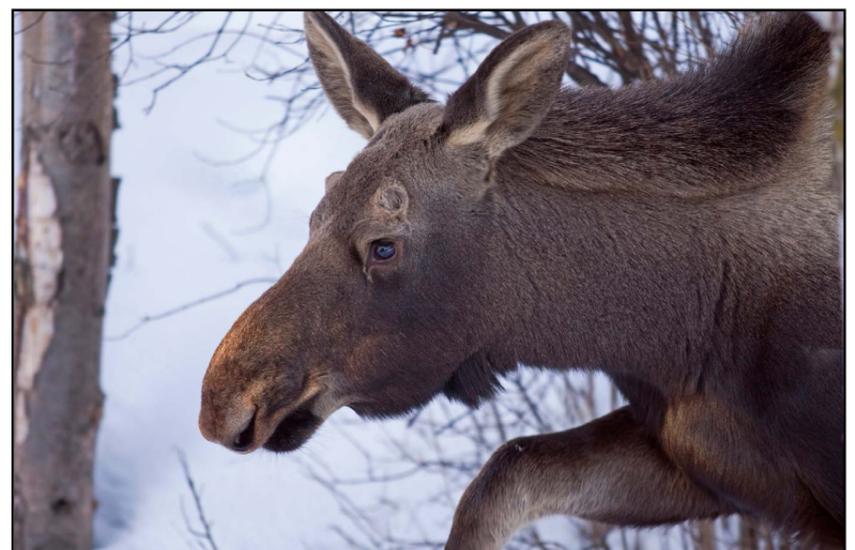
### The Predation Equation

Predation on moose in Subunit 15B has not been studied, but is likely similar to other regions of the Peninsula. Wolf numbers were estimated in 2011 at 40 to 46 animals in seven different packs. Hunting and trapping regulations for predators have been liberalized in 15B to match regulations across the Peninsula.

### What Now for 15B Moose?

Moose in Subunit 15B have not been identified as an intensive management population. The main goal for moose in Subunit 15B is to prevent further decline. The primary limiting factor in the western portion of the subunit is habitat, and state biologists hope to team with federal land managers to develop a long-term plan that includes habitat enhancement. For the eastern portion, management options are limited because this area is all designated wilderness inside the Kenai refuge. The department is working with the Board of Game to address harvest concerns and moose management strategies.

**Different Objectives in Subunit 15B Management:** The eastern and western portions of Subunit 15B are managed for different objectives. Subunit 15B East was established as a trophy management area in the 1970s to provide opportunities to harvest large bulls under aesthetically pleasing conditions. In 15B West, moose are managed with the objective of maximizing hunting opportunity while maintaining a minimum bull:cow ratio.



# Game Management Unit Updates

## Game Management Subunit 15C

### The Lay of the Land

Subunit 15C spans 2,441 square miles and includes the Kenai Peninsula's southwestern reaches from Tustumena Lake south and west to Cook Inlet and Kachemak Bay. The subunit is bordered to the east by Kenai Fjords National Park. The topography may be loosely described as an enormous hill that flows gradually down to the beaches of its saltwater boundaries. The southern portion of the subunit is heavily forested, mountainous, and holds few moose.

### The State of Moose in 15C

Moose in Subunit 15C were identified as an intensive management population by the Board of Game in 1994 and in 2000 a population objective of 2,500-3,500 and harvest objective of 200-350 were established. Counts conducted in 2013 found 3,200 moose in Subunit 15C. Intensive management has been approved for Subunit 15C but is not currently active because the subunit has consistently met its moose population objectives.

### Habitat

Much of Subunit 15C is high elevation, upland willow habitat. In lower areas, forests have been struck by widespread spruce-bark beetle infestations and logging efforts to remove beetle-killed trees have largely negatively affected moose habitat. Post-logging site work, including plowing to expose mineral soil, can encourage regeneration of shrubs and hardwoods important for moose and has been conducted on some sites with success.

Much of the habitat in Subunit 15C differs from that in 15A and 15B in that aspen is largely absent in the south and blue joint grass – which grows thick and up to five feet high – is common. This grass sprouts quickly in open, disturbed areas, crowding out hardwood and spruce seedlings, slowing forest succession and creating less desirable moose habitat. Since 2004, human-caused wildfires have burned more than 87,000 acres in Subunit 15C. Portions of these fires occurred in areas not considered winter habitat, so food for moose is available only during snow-free months.

Subunit 15C is subject to deep snowfall, particularly in the high country. Moose tend to move to lowland areas in winter where browse is more accessible. Important winter habitat exists along the Ninilchik River, Stariski Creek, Anchor River, Fritz Creek, the lower reaches of Fox River and Sheep Creek, and the Homer Bench.

### The Predation Equation

The Board of Game has authorized predator control and the department will implement treatment in the future if the moose population fails to meet objectives. This could include aerial wolf removal in the subunit's northern reaches, north of Kachemak Bay. A November 2011 survey estimated 44 to 52 wolves in the 1,171-square-mile area. Black and brown bears prey on Subunit 15C moose, particularly newborn and young calves. Bears are largely managed through general and permit hunting.

### What Now for 15C Moose?

Even as harvest objectives continued to be met in Subunit 15C prior to 2011, concerns over low bull:cow ratios were raised. Antler restrictions for hunters were implemented in an effort to boost bull numbers. Harvest is currently below intensive management objectives, but population estimates are within objectives. Slightly lower than optimal calf:cow ratios have been observed; these and other factors will be monitored as biologists work to bring the Subunit 15C moose harvest within objectives.

**An Intensive Management Population:** Moose in Subunit 15C were identified as an intensive management population by the Board of Game in 1994 and in 2000 a population objective of 2,500-3,500 and harvest objective of 200-350 were established.

**The Kenai Peninsula is divided into Game Management Units 15 and 7, with Game Management Unit 15 broken into subunits 15A, 15B, 15C. State, federal and private landholdings are included within these units and the nearly two-million-acre Kenai National Wildlife Refuge, shown here in green, spans portions of all. Habitats, predation, carrying capacities, winter conditions and resulting moose populations vary widely, creating unique challenges for wildlife managers.**

## Game Management Unit 7

### The Lay of the Land

Game Management Unit 7 spans the Kenai Peninsula's eastern third from Hope south to Gore Point. The unit encompasses 3,520 square miles, some 78 percent of which is federal lands.

### The State of Moose in GMU 7

A comprehensive moose population census has never been conducted in GMU 7 primarily because the region's mountainous terrain and dense forests limit the effectiveness of census techniques. However, composition counts, harvest data, and anecdotal reports indicate moose numbers were once strong, but have declined over the past half-century.

During the moose season of 1963-64, GMU 7 hunters harvested 251 bulls. By the end of that decade, harvests began to taper, though hunters continued to harvest more than 100 moose each season until the mid-1970s. Annual harvests since 2006 have averaged only 28 moose, though only nine moose were taken in 2011, one in 2012 and two in 2013. By comparison, automobiles kill an average of 25 moose per year in GMU 7. It is important to note that restrictive hunting regulations to conserve moose have also reduced hunter participation and harvest.

### Habitat Shortfalls

Habitat varies in this region of mountains, ice fields, and rugged coastline, ranging from subalpine high country to large areas of dense spruce timber. Little ideal moose habitat exists in GMU 7. Biologists believe wildfires and clearing associated with mining, roads, and other development 50 to 100 years ago in GMU 7 provided successional growth, which supported greater moose densities up to the 1960s and early 1970s. As mining and large-scale development in the region wound down, and with no significant wildfires in recent years, early successional growth has matured forests and moose numbers have declined.

### What Now for GMU 7 Moose?

The department's main goal for moose in GMU 7 is to prevent further decline. The primary limiting factor is habitat, and state biologists hope to team with federal land managers to develop a long-term plan that includes habitat enhancement. The department is also working closely with the Board of Game to address harvest concerns and moose management strategies.

**GMU 7 Moose Harvest History:** Moose harvests in 1963-64 totaled 251 bulls. In recent years, annual harvests have plummeted; only two moose were taken in 2013.



# Moose Research on the Kenai

## The Role of Moose Research

Science alone does not dictate whether intensive management is implemented. That decision is based upon a public process that is informed by biological data, but also considers human values. The Board of Game weighs both factors and makes decisions using ongoing studies to evaluate and refine the department's intensive management programs. Moose on the northwestern Kenai Peninsula have been periodically studied since the 1920s. Only recently has research taken place on southern Kenai Peninsula moose.

When the Board of Game authorized intensive management for Subunits 15A and 15C in January 2012, the department launched a coordinated research program aimed at better understanding the variety of factors affecting Peninsula moose, as well as the potential effects of intensive management. Research began in 2012 and will continue for the life of the intensive management plan on five general topic areas:

- Moose condition and productivity of adult cows.
- Survival and seasonal causes of mortality in cows and calves.
- Seasonal movement patterns, migratory patterns, distribution and range of adult cows.
- Population size of moose and wolves, plus age and sex composition for moose.
- Modeling to forecast effects of management actions and harvest strategies.

## Productivity and Health

Adult female moose and their reproductive rates are the focus of current research efforts. In 2012, 100 cows were captured and fitted with radio collars – half in Subunit 15A and the other half in 15C. At the time of capture and in subsequent captures, various tests and measurements are taken and each animal is followed over time. A tooth is pulled to determine age, blood is collected to determine pregnancy status, and body condition is assessed.

So far, researchers during fall (November) and spring (March) capture efforts have found cows in Subunit 15A to be in relatively poorer condition than those in Subunit 15C. Birth rates – also called parturition rates – have been about the same in Subunits 15A and 15C, with birth rates over the past two years slightly exceeding 70 percent and pregnancy rates between 80 and 90 percent.

## Survival and Mortality

Captured cows were also fitted with transmitters to determine the exact time calves were born and to help assess early calf survival when the greatest level of mortality occurs. Aerial monitoring of collared cows and calves occurs frequently during and after the calving season.

In 2012, biologists captured and radio-collared newborn calves in Subunit 15C and monitored their causes of death. Of the calves that died, brown bears were found to have killed about 50 percent and also accounted for the deaths of several radio-collared adult cows. Wolves also killed several collared cows. Biologists caution that yearly variation can be high and more data must be collected over several years for proper assessments.

Calf production and survival varies from year to year for many reasons. During the winter of 2011-2012, the Peninsula received record snowfall. Deep-snow winters greatly reduce moose calf survival. These impacts can last for more than a year. For example, while adult moose can survive severe snow depths, the body condition of cows is often poor coming out of a severe winter. This can reduce their productivity or the health and survival of calves during the next year. Indeed, during the calf mortality study in Subunit 15C, newborn calves were weighed and had very low birth weights. Low birth weights typically equate to low survival, which appeared to be the case as only about 12 percent of the monitored calves in Subunit 15C survived through the year. Calf mortality rates were similar in Subunit 15A. Biologists will continue to monitor survival and measure the variability in these traits from year to year.



**Studying Moose Productivity:** Adult female moose are the focus of current research efforts. Biologists captured and fitted 100 cows with radio collars in Subunits 15A and 15C.

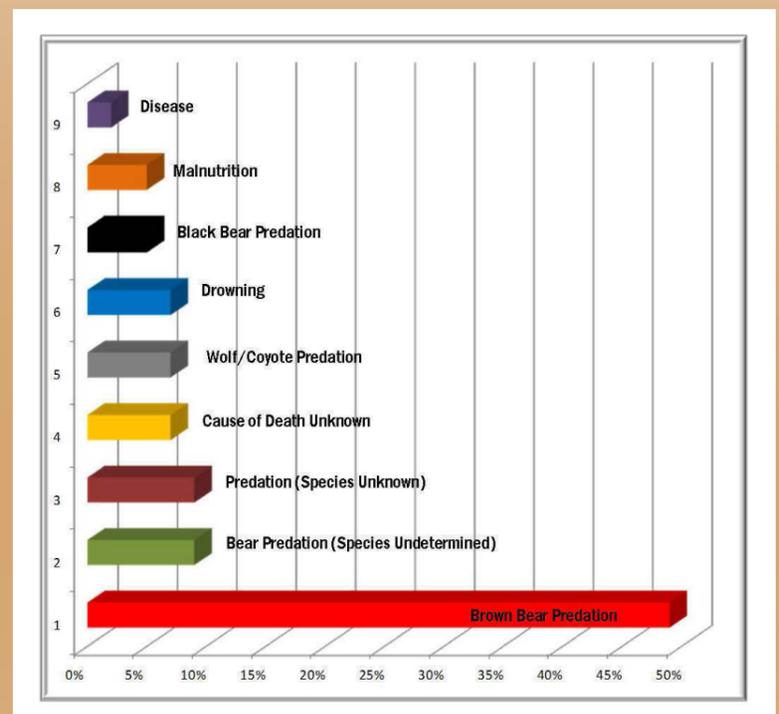
## Tracking, Survey Efforts, and Modeling

Movements of collared cows will be analyzed to determine distribution in relation to season and environmental variables such as snowfall. This information will help guide potential harvest strategies. Less comprehensive surveys that also classify moose by age and sex composition are conducted annually, given adequate weather conditions. For example, a composition survey in November 2012 discovered that bull:cow ratios were increasing faster than expected in Subunit 15C. After only two years of restricted hunting opportunity, ratios had increased to 22 bulls for every 100 cows, surpassing the department's objective of 20 bulls for every 100 cows. Weather permitting, population estimates will be conducted every two to three years and surveys for sex and age composition will continue yearly.

## Calf Mortality in 15C

Newborn moose calves within the first few weeks of life are especially susceptible to predation by bears. In 2012, researchers collared 54 newborn moose calves in Subunit 15C and also monitored the uncollared calves of collared cows. A year later, about 12 percent of the calves had survived. Seven calves (13 percent of the captured calves) that died due to research-related causes are not included in natural mortality causes listed here.

Biologists caution that this study offers a glance at causes of calf deaths in one area during a given time period. Studies in areas closer to roads and urban centers might encounter road kill, among other causes of death not seen here. Because these survival statistics tend to fluctuate annually, biologists warn that more research is needed for consistent patterns to emerge.



# ADF&G's Kenai Moose Research Center

## Providing a Leading Edge in Moose Research

Biologists who study moose at the Alaska Department of Fish and Game's Kenai Moose Research Center, a 4-square mile facility located on the Kenai National Wildlife Refuge about an hour's drive from Sterling, have tackled questions essential to understanding moose biology for more than four decades. The center is currently home to about two-dozen hand-raised moose. By training animals and familiarizing them to human activities, biologists can closely approach moose in their natural environment to observe and record behavior; measure food intake; and collect samples of blood, urine, and feces.

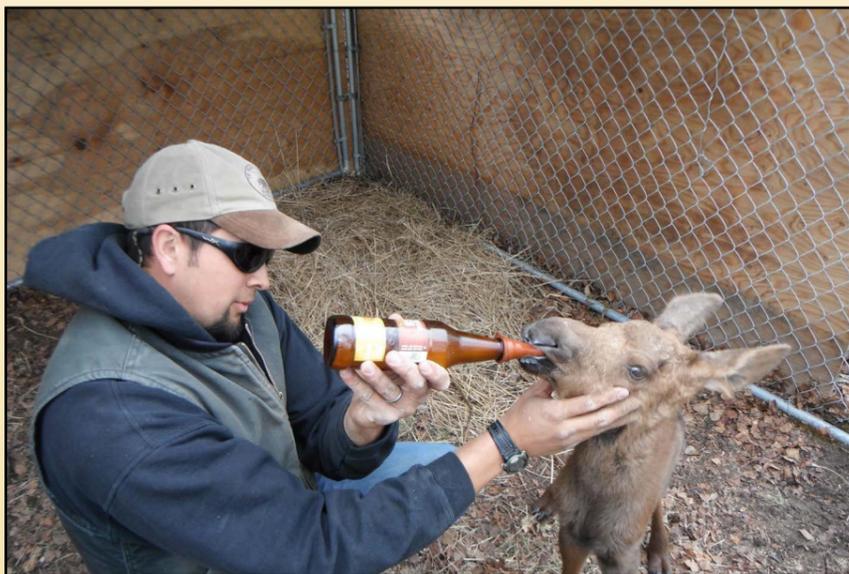
Understanding what moose need to maintain health is a regular line of questioning at the center. What do moose prefer to eat, particularly in summer when it's harder for biologists to detect plants browsed by moose? How many moose can the available forage support? How do moose diets change as forests age? Working with captive moose, biologists at the Moose Research Center have gained many invaluable insights to these and other questions.

"The Moose Research Center has long been utilized for testing new techniques applicable to moose management, in particular, those that can provide managers with quantitative evidence in formulating decisions," said Moose Research Center Director John Crouse.

Today, partly because of studies conducted at the Kenai Moose Research Center, Alaska is considered a world leader in moose research. Center studies have ranged from reproduction and predator-prey dynamics research to a large volume of work aimed at better understanding the metabolism and nutritional needs of moose.

And what, specifically, have biologists learned from all those studies? Because reporting all the interesting findings could fill a book, the following are just a few highlights:

- **Better Ways to Capture Moose:** Biologists have evaluated the safety and effectiveness of many drugs used to chemically immobilize moose and have determined normal body temperatures and heart and respiration rates so field personnel can ensure animal safety by evaluating vital signs during handling procedures.
- **What Makes a Healthy Moose Population?** Within a moose population, variation in body condition can determine which animals reproduce, survive, or die. Center researchers pioneered a technique using ultrasonography to assess a moose's overall body condition. By measuring the thickness of the fat layer beneath the skin over the rump of a moose, biologists can now estimate total body fat. A moose with at least 15 percent body fat will be in good shape for most winters, according to Crouse.
- **The Importance of Protein:** Body protein is used in late winter as an energy source when fat reserves are depleted and available nitrogen from the diet is low (nitrogen is the building block for proteins). Body protein is also used for fetal growth in pregnant cows and is in high demand during late winter. Recent research is aimed at developing techniques to determine the timing and use of body protein stores in moose and relating these measures to habitat quality.
- **New Technologies:** Advances in electronic sensors built into wildlife collars can provide detailed measurements of activity, temperature, and GPS locations. Further, small cameras have been incorporated to capture events such as birth, predation events, and forage selection. These new technologies are currently being tested at the Moose Research Center to determine their feasibility for field research.



**Bottle-fed:** Moose are hand-raised by biologists at the Moose Research Center. This allows the biologists to work closely with center moose, even when they are adults.



**Close Observation:** Working with captive animals, biologists can closely follow moose and examine their forage choices in a variety of conditions. *Photo courtesy of P. Barboza, UAF.*



**New Technologies:** Biologists test an expandable collar that will increase in size to accommodate neck swelling in this Moose Research Center bull during the fall rut.



**Research Subjects:** These bull moose are research animals at the Alaska Department of Fish and Game's Moose Research Center. Captive moose are used to evaluate forage utilization and body condition.

# How You Can Get Involved

## Moose Habitat Tips for Private Landowners

Improving moose habitat on the Kenai Peninsula will require a community effort; public and private landowner support will be needed. Landowners with small and large acreages alike can enhance habitat with the browse and cover needed by moose.

Managing private woodlands for our own aesthetic objectives can also accommodate moose habitat needs. When considering what can be done on your property, first evaluate the parcel size and the location of your home. Maintaining clear access along driveways is a priority. Also, since moose can be dangerous when approached too closely, it is wise to keep browse species away from high-traffic areas.

Moose need a variety of plants to eat throughout the year. Like humans, their dietary needs can't be met by any single food source. While moose generally prefer willow, species such as paper birch, aspen, and cottonwood are also commonly browsed. Other shrub species including high-bush cranberry and wild and domestic rose serve as browse as do forbs like fireweed.

In open areas with full sun, birch seedlings can be planted in spring and protected for 3 to 4 years to establish trees. Plant seedlings 5 to 10 feet apart and water regularly for the first two seasons. Fencing around the entire planted area is most effective, but netting or chicken wire can be used to protect the foliage.

Trees can be started from seed, bought from local garden stores, or transplanted from other locations on your property. Local seed sources or seedlings are likely to provide better results than plants from different latitudes. Transplants provide hearty seedlings that need care during the replanting process, but often yield better results in the long term. For more information, the University of Alaska Fairbanks Cooperative Extension Service has three guides for "Managing Your Trees and Shrubs in Alaska" that are available through their website [www.uaf.edu/ces/pubs/](http://www.uaf.edu/ces/pubs/).

Transplanting willows provides another viable option for growing moose browse. Cuttings from existing plants 1/4 to 3/4 inches in diameter can be made in March or April, stored in the snow until spring, and then planted in the desired location usually before July 1. These two-foot sections of willow can be planted with just a few inches containing buds left above ground. Again, fencing or other protection will allow plants to develop before moose find it. For more information, visit [www.adfg.alaska.gov](http://www.adfg.alaska.gov) and click on the "Lands and Waters Tab." Habitat enhancement on private property should be consistent with Firewise Alaska principles. For more information, visit [www.forestry.alaska.gov/pdfs/firewise09.pdf](http://www.forestry.alaska.gov/pdfs/firewise09.pdf).

More backyard forestry resources are available through the Alaska Division of Forestry's Stewardship Program [www.forestry.alaska.gov/stewardship/](http://www.forestry.alaska.gov/stewardship/).



**Assessing Change:** An Alaska Department of Fish and Game habitat biologist measures regenerating hardwoods and shrubs in a treated area north of Sterling.

## How Wildlife Regulations Are Made

ADF&G does not create the rules within the hunting regulations book. The Board of Game actually makes the decisions about wildlife management based on proposals submitted by the public, local advisory committees, and/or ADF&G. ADF&G also provides management and research data to the board to help them make their decisions.

