Sky High for New Hampshire's Moose

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To better understand population trends of New Hampshire's moose, a Fish and Game research project takes to the air with infrared technology.

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Moose aren't that easy to see in New Hampshire's thick woods and mountainous terrain. To check the accuracy of the annual deer hunter's survey of moose sightings, Fish and Game has hired AirScan Inc. to find them by air. The company uses state-of-the-art infrared sensing equipment (inset) mounted on a wing of its Cessna 337. AirScan's Rick Makin (left) watches the infrared monitor for moose.

IF MOOSE COULD RESPOND to an official census, things would be a whole lot easier.

But since they don't, the New Hampshire Fish and Game Department is trying a high-tech and innovative way to better understand moose populations throughout the state: Count 'em by air using infrared sensing technology.

Now in its third year, the project is proving the accuracy of a less expensive way of estimating the moose population – namely the annual surveys of moose sightings by deer hunters.

"So far, we're really pleased with the results," says Kristine Bontaites, Fish and Game's moose project leader. "The preliminary results of the infrared flights suggest that changes in hunter observation rates of moose mimic changes in the moose population with good precision. It's giving us more confidence in our traditional ways of looking at the moose population."

Why Count Moose?

Before European settlement, moose were more common than deer in New Hampshire. But by the mid-1800s – after widespread land clearing and unregulated hunting – there were possibly less than two dozen moose left in the state. The moose herd really started rebounding in the early 1970s, when abandoned farmlands and changing forestry practices created a mosaic of mature and young re-growing forests, providing excellent moose habitat.

By Eric Aldrich and William Phippen

Today, thanks in part to the past two years' worth of aerial infrared surveys, we know there are approximately 7,000 moose in New Hampshire.

The presence of moose is a reminder that New Hampshire is still very much a wild place – and many folks want to be where the wild things are. Tourists – and hunters, who've pursued moose in New Hampshire since 1988 – spend loads of money to be near the wild things. Whether they return with an $18 T-shirt, a few good photos or a field-dressed moose, tourists and hunters add fuel to the economy and generally have fun doing it.

Aside from the economics, moose have an ecological value here. They're just as much a part of the Northern Forest's ecosystem as spruce-fir forests.

And there are all sorts of reasons to manage moose numbers. For instance, there's the habitat's capacity to sustain X number of moose. And there's the public's concern for moose/vehicle collisions, which has to be balanced with the public's desire to see and hunt moose.

With those concerns in mind, the Department has developed population goals for various parts of the state. In some parts of the state, for instance, the goals call for increasing the moose herd size; in others, the goals call for

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AirScan pilots (Lee Denham shown here) have extensive backgrounds in military flights. "It's exciting work, but it's also challenging," said Rick Makin, who monitors AirScan's infrared sensors. "The technology involved is advancing so quickly, and the equipment just keeps getting better and better."

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stabilizing or decreasing it. Adjusting the number of moose-hunting permits in each wildlife management unit has been the lever to reach those goals.

"Because the moose herd's charismatic and economic benefits have to be balanced with its potential negative impacts on people, automobiles and the habitat, we are asked to manage moose numbers within very small limits," says Steve Weber, chief of Fish and Game's Wildlife Division. "To do this, we need the best population information that we can get."

Managing Moose

To manage moose, biologists need information on growth and mortality rates, age structure, population size, adult sex ratios and reproductive performance of the herd. Historically, Fish and Game has used trends in the deer hunter observation rate of moose (expressed as "moose seen per 100 hunter hours") to measure the moose population's growth rate. To do this, the Department assumes that changes in the observation rate accurately reflect population changes.

"Because we know this may not be true, management initiatives have always been conservative, implemented over several years and monitored to make sure we're not exceeding goals," Bontaites says. "To make management more responsive, more accurate knowledge of how the moose observation rate relates to actual changes in the moose population is needed. In other words, does a 10 percent change in the observation rate correspond to a 10 percent change in the moose population?"

Bontaites points out that there are still many advantages with using the hunter observation rate. "It gives us good representation from most areas of the state, provides excellent information on adult sex ratios, fall recruitment, and relative density patterns – and does so at minimal cost." Scandinavian countries have found that their hunter observation rates are nearly as accurate in tracking population changes as aerial surveys.

So, the main purpose of the aerial infrared survey is to determine just how well the hunter observation rate is tracking changes in the moose population. To make sure biologists have sufficient sample size to test the relationship, the survey is scheduled to take place annually for five years.

Seeing Heat

To get this multi-year project off the ground, Fish and Game contracted with AirScan Inc., based in Titusville, Florida. The company specializes in its use of infrared surveillance sensors – mounted under the wings of its planes – for security surveillance of Air Force sites and companies. But infrared technology – which basically compares heat reflections from that of other objects — also gives AirScan environmental tasks, like oil spill cleanups and wildlife projects. For instance, AirScan has helped agencies pinpoint areas in Pennsylvania overpopulated with white-tailed deer. The company has also done census missions on wild burros in Arizona, bighorn sheep in Idaho, and wild turkeys in Missouri.

Infrared imaging works because certain objects, such as warm-blooded moose, deer and turkeys, emit heat. The warmer an object is relative to its surrounding environment, the more it stands out on an infrared camera's monitor. Large-bodied moose on cold November mornings are good subjects for infrared censuses. Cold-blooded fish in a body of water are not.

Infrared has many advantages over traditional aerial surveys. You can fly higher; you don't need snow or daylight (unless flying in mountainous areas); and they're not as restricted by weather. The cost is about the same. Among the restrictions: you can't fly infrared surveys during precipitation and you have to do it after the leaves fall.

Up In the Air

For New Hampshire's moose project, AirScan has used a Cessna 337, piloted by John Piowati (now retired), with Rick Makin at the equipment monitors in the back. AirScan's pilots and sensor operators

have extensive military experience. The infrared equipment is very sophisticated: a Westinghouse camera and a 10X Sony zoom lens capable of searching as far as 3 miles with instantaneous ground coverage.

Here's what it was like during one of last year's survey flights. Flying at nearly 80 mph, the twin-engine plane banks sharply to the left and descends to about 1,000 feet to begin its survey route. Behind Piowati, Makin in the observer's seat watches a computer monitor, seeing what the infrared camera sees from its position under the plane. Makin takes notes and calls out coordinates as he sees each new blip – a moose – on the monitor.

The flight is smooth this morning and much more comfortable than the ones Bontaites remembers from traditional low-altitude surveys. Makin and Piowati don't have to crane their necks for hours on end to make sure they see everything below. They also don't have to fly dipping and weaving just above the treetops in a way that makes seasoned aviators nervous...or sick.

"It's exciting work, but it's also challenging," said Makin, of his position at the controls of the infrared system. "The technology involved is advancing so quickly, and the equipment just keeps getting better and better." Their system now incorporates a better camera mount and upgraded monitor. "Almost every flight offers us something new to consider. We're constantly improving our techniques in doing wildlife surveys."

For the most part, the aerial infrared survey takes place in the state's North Country – where moose are concentrated. The survey area is divided into three blocks representing three differing levels of moose observation rates from the deer hunter survey: high, medium and low. Each block is broken into two additional levels of high and low observation rates for a total of six levels.

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Infrared monitors show the warm bodies of moose as white blotches. The infrared surveys also mark the exact location and number of moose in each of 48 survey units in New Hampshire's North Country.

In last year's infrared survey, AirScan flew 48 survey units, averaging six square miles each, for a total of 320 square miles. At least 10 survey units were assigned to each block, and the units were chosen by a computer-generated random pick.

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> *– Rick Makin*

Back to the Lab

After AirScan's flights, Bontaites and other Department biologists start crunching numbers. The work is pretty technical. There's a lot of talk about "regression relationships" "Y intercepts," and "sightability rates."

But the long and short of it is pretty simple. So far, the last two years' worth of aerial infrared surveys have shown that the data of moose sightings reported by deer hunters has fairly closely matched the data from the infrared surveys. In 1999, for instance, the infrared survey showed a moose density of 2.7 animals per square mile, or 3,640 in the entire infrared survey area. This decline – from a population of 4,100 in 1998 – was likewise revealed in the deer hunter survey.

Because of the close match, and because of the cost of the infrared surveys, Fish and Game may only use the infrared surveys every five years or so to see if hunter observations and other population techniques remain on target.

"We're becoming more assured that hunter observation rates are reflecting the true moose population and can be used to make management decisions with a good level of confidence," Bontaites says. Using the technology, she adds, "will pay off huge dividends in management of our moose resource." ■