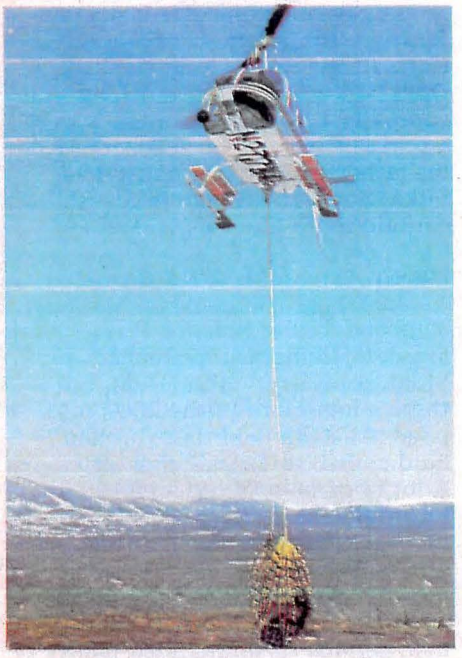
By Warren B. Ballard
Photos by author, except as noted

The case of the disappearing moose

Conclusion of three parts

Editor's note: *This is the last of three accounts by state game biologist Warren Ballard describing the research steps followed in determining why moose in Alaska's Nelchina Basin were declining.*



Weights of the bears were determined by slinging them from a helicopter which was equipped with a computerized scale.

Moose calf mortality was best researched by studying the calves themselves, but this required radio-collaring each calf. At the time no collar had been developed that would expand as the calf grew.

Fortunately, Mike Schlegel, an Idaho biologist, had been working with elk calves and had built and tested an experimental collar. It was modified to fit moose calves, and by 1977 Ted Spraker and Ken Taylor, both ADF&G management biologists, and I were ready to try it.

Each collar held a small radio which emitted a pulsed signal similar to that used on adult moose and wolf radio-collars. In addition, the radio was designed so that once the calf wearing it stopped moving — and was presumably dead — the signal would triple its pulse rate to alert a biologist.

Capturing newborn calves in thick spruce vegetation was the final hurdle. Cow-calf pairs were located from a fixed-wing plane, and a nearby helicopter called by radio. The helicopter would drop down on the cow with her calf, forcing the cow to separate from the calf. The chopper would fly as close to the calf as trees would permit, and the tagging crew would leap from the machine and grab the calf. Once the calf was caught, the radio-collar was slipped over its head and its sex was determined.

Sometimes that was the only information collected because the cow quickly returned and drove the tagging crew away. Usually the helicopter had to hover above the ground crew to keep the cow away long enough to allow them to radio-collar the calf. If the cow did not press the defense of her calf, blood samples, measurements, and weights were also taken. Results indicated that the calves were generally healthy.

Cow moose are dangerous, and while handling the calves we had to be constantly on guard. We always had a rifle for last-resort defense. Once when working a calf with John Westlund, an assistant on the project, we were measuring the calf when John, who carried the rifle and was watching the cow, began shaking me vigorously, yelling, "She's coming, she's coming!" When he stopped shaking me I knew the cow was *very* close because I heard John's footsteps receding, fast. I dropped the calf and followed.

We could radio-collar about 20 calves a day. During the spring of 1977 we put radio collars on 48 newborn moose calves in the areas

The author takes body measurements of an immobilized wolf as Bush pilot Al Lee looks on. (Russ Dixon)

where moose and wolves had been studied. The radio signal from each calf was monitored twice a day to see if the signal remained constant. In some cases we tried to observe the calf to learn something of moose movements.

When a calf radio signal was detected on fast pulse, indicating the animal was probably dead, we tried to observe the calf from an airplane, and, at the same time, we searched for predators in the area. After this the plane would search for radio-collared wolves in the general area to check their activity in relation to the suspected calf death.

Usually within three or four hours of the time the increased pulse was detected, a biologist returned to the site in a helicopter for ground examination to determine, if possible, cause of the calf's death. If it appeared that the calf had died from disease or some cause other than predation, the entire calf was taken back to the laboratory for in-depth examination.

Newborn moose calves are cute, helpless, and appealing, and I always regretted that we couldn't somehow spend more time with individuals — get better acquainted, as it were. This would have been foolish, and could cause a "tilt" in our study, and of course I resisted the temptation. I remember some calves better than others. Once as biologist Ted Spraker and I chased a calf we noticed it seemed to have an abnormal wobble. As we processed and collared it I wondered what chance it had of living. We nicknamed this calf Wobbly. He lasted about a week before dying of pneumonia.

When we found a dead calf by following the triple-pulsed radio signal, and if death was from predation, the area near the carcass was searched for predator tracks, scats, and hair. In many cases the predator was observed at the site, and the ground examination was made to confirm what seemed apparent and to determine if two species of predators might have been involved. We made every attempt to take nothing for granted.

Approaching a just-killed moose calf, not knowing what had killed it, or where the killer might be, is sometimes a tense business, especially if it is in thick brush. I was especially alert with our first dead calf. Ted Spraker and I slowly approached the site. We had no idea what had killed it. The radio signal indicated we were close, but we still couldn't see the calf. As we removed our headphones so we could hear, a gray jay flew off, causing both of us to jump.

The tattletale sign of scats, hair, and the big-clawed tracks of a brown bear left little doubt about the cause of death. Fortunately for us the bear was gone.

Of the 48 calves radio-collared in 1977, 30 were dead by mid-July. This fit the pattern of loss we had suspected. Most of these calves (24) had been killed by brown bears.

Although it had always been known that bears killed moose calves, this was the first study that

A Nelchina Basin grizzly, recently darted, staggers across the terrain on the verge of collapse.

Biologists must approach drugged animals cautiously, for it's difficult to determine just how tranquil these animals are. Bears often do not become immediately immobile, but, if undisturbed, they will gradually doze off into heavy sleep.

demonstrated that bears might be a major predator on moose.

Of the remaining six mortalities, one was due to wolf predation, one died from unknown causes, one from an unidentified predator, one from pneumonia, one was stepped on by the cow, and one drowned while trying to swim a river.

During the period when bears were killing moose calves, the radio-collared wolves were preying largely upon adult and one-year-old moose. It therefore appeared that the high mortality of very young calves could be attributed to bear predation.

Sometimes a cow moose will attempt to defend her calf from a grizzly. Pilot Al Lee and I saw such a contest in 1977. We arrived in the plane just as the sow with two yearlings had killed a calf moose. The cow was frantically circling the three bears, stomping down willows, apparently in frustration. Soon the two yearling bears began chasing the cow while the sow fed on the brains of the calf. After 15 or 20 minutes the cow apparently gave up, for she left.

A number of new questions arose. Were bears preying upon adult moose as well? If so, in what magnitude? Were the study results applicable only to a small area, or could they be applied to the entire Nelchina and Susitna basins, and perhaps elsewhere? If wolves weren't preying upon newborn moose, how important was wolf predation to the overall moose population?

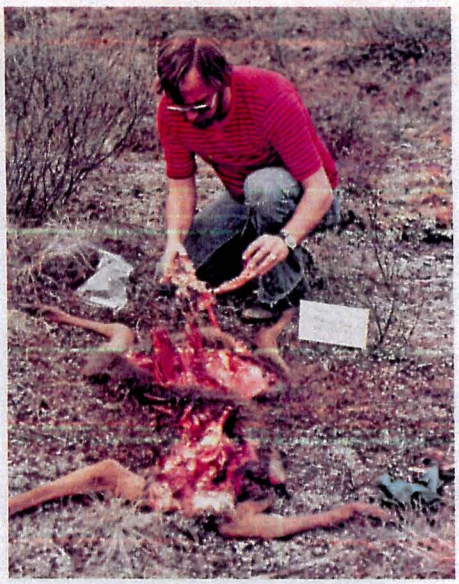
To partially answer some of these questions, the calf mortality study was repeated in 1978 and one new study area was added. The study was broadened to include the big bears, and 23 adult brown/grizzly bears were captured and equipped with radio-collars in the areas where calf moose and wolves were being studied.

While moose calves were being captured and monitored, spotter planes sought brown/grizzly bears, which were captured and processed with the same helicopter methods used with moose and wolves, except that bears were weighed by hanging a scale under the helicopter and lifting the animals in a sling. Average males weighed about 550 pounds, while females averaged about 275 pounds. Although of the same species, Nelchina bears are smaller than coastal brown bears, which may weigh in excess of 1,000 pounds. The bears appeared healthy, with 52% of them being less than five years old.

We approached the big bears with caution: they are powerful, quick, and dangerous. Once John Westlund and I had just finished ear-tagging, weighing, and radio-collaring a tranquilized young sow bear and were picking up our equipment when the bear came to its feet.

She looked at both of us as we fell backwards in the four-foot deep snow, frantically reaching for our pistols. Then she ran off. It took us — and probably the bear — an hour to stop shaking.

During 1978, 72 newborn moose were captured and radio-collared. Results obtained were similar to those of 1977: of the 72 calves, 36 were dead within six weeks



The author examines the little that remains of a days-old moose calf that fell victim to a brown bear.

following birth. Of these, 28 were killed by brown/grizzly bears, and only one was killed by a wolf. The remaining seven deaths were due to miscellaneous factors, except that three were killed by unidentified predators.

In summary, during the two years of study, slightly more than half (55%) of the 120 radio-collared moose calves died within the first six weeks of study, with predators of all types accounting for 86% of the deaths. Overall, however, brown/grizzly bears were responsible for 79% of the deaths.

During spring and summer 1978 while the survival of newborn moose was being monitored, Ted Spraker, Ken Taylor, and I monitored the 23 radio-collared brown/grizzlies on the same flights we made to monitor the calves. From late May until the first of November when bears began to den up, the 23 bears were observed on 78 kills, most (69) of which were moose (88%). Moose calves comprised nearly half of the kills (47%). All of the kills of moose calves were observed between late May and mid-July, which corresponded precisely with the timing of mortality of the radio-collared calves. After that, bears preyed mostly on adult moose and caribou. Thus, not only were bears significant predator of moose calves,

but the limited data suggest they were a significant predator on adult moose as well.

Having radio-collars on wild animals and tracking them from an airplane with direction-finding equipment is, in a way, something like tapping someone's telephone: it gave us brief peeks into interesting and intimate moments in their lives. Once, pilot Al Lee and I watched a battle between a brown/grizzly bear and a wolf pack. We had been led to the animals by radio signals.

As we watched, the battle became almost humorous. The bear would return to a moose kill that both it and the wolves wanted, only to have three wolves facing him. A fourth wolf would sneak around behind the bear and nip him in the rear. The bear would then whirl to chase the wolf that had nipped him, which allowed the other wolves to feed on the carcass. Sometimes the bear caught a wolf, and that ended his part in the fray. Such wolves either limped slowly away from the battle or were left lying motionless.

The 23 bears killed a moose or a caribou at an average of once every six observation days. Not all of the bears were observed on kills, but a few of them made a kill every two days. Although it couldn't be proven statistically, it appeared that single adult sow bears were killing moose and caribou more often than single boars, and even more often than sows with one or more cubs or yearlings.

There did not appear to be a difference in kill rates between older and younger bears. If bears were preying upon adult moose at the rate of one kill every six days, then each adult bear was killing at a rate nearly equivalent to that for a wolf pack, which average a kill about once every five days.

The question then arose: how many bears were there, and what, if anything, could be done to reduce bear predation on moose? Would reducing the number of bears cut down early losses of calf moose, or would some other mortality factor intervene? Since our data suggested that most calf losses were due to bear predation during the first six weeks of the calf's life, we decided to test the hypothesis that reduction in bear density would result in a significant increase in moose calf survival.

This resulted in the bear experiment. The most efficient method for reducing bear numbers would have been through a combination of hunting and control by state biologists, as described earlier for wolves. However, the brown/grizzly bear is an animal with high status, considerable value, and with a lower reproductive rate than the wolf. We decided to live-capture and remove bears from a selected study area.

The author reads the calipers after measuring the teeth of a brown bear that is in no condition to object. *(Russ Dixon)*

Experience in Alaska and elsewhere has demonstrated that live-capturing and removing a garbage-feeding and/or nuisance bear from an area rarely solves the problem: the bear simply returns. However, the time needed for it to return, and the percentage of bears that do return to the point of capture had been poorly documented.

In May and June 1979, Sterling Miller, a wildlife biologist with extensive experience in analyzing field data, joined me in directing and participating in an attempt to capture and transplant as many bears as possible from a part of the area where wolf numbers had earlier been reduced. Bears were caught in the usual manner by darting with a tranquilizer from a helicopter. Each was then slung under the helicopter and flown to a field station where it was measured, weighed, and samples collected. From there the bears were moved by truck and airplane to release sites from 87 to 160 miles distant.

As part of the experiment, 27 newborn moose were captured and radio-collared in the bear removal area to see if the removal effort had any effect. It was impossible to find all the bears, so not all bears were removed from the study area. The 47 that were removed made up about 60% of the estimated bear population.

Results?

The calf mortality study suggested that bear removal *did not* result in a significant improvement in calf survival.

Fifteen of the 27 radio-collared moose calves, radio-collared while the bears were being captured, died; 80% of them were killed by brown/grizzly bears. Based on these results alone at first look it appeared that the bear removal experiment was a flop. However, while the calf mortality study was in progress, three bears which had not been removed were individually identified as being responsible for killing most of the radio-collared calves. *Thus the radio-collared calves did not represent the survival of all calves within the 1,300 square miles from which bears had been removed.* The real evaluation came in the fall, when moose cow-calf counts told us how many calves had survived. More on this later.

While radio-collared calf studies were in progress, the fate of the

47 transplanted bears was monitored by a radio-finder-equipped airplane. About 7 out of 10 radio-collared bears returned to the capture area within an average of 58 days. From this it was clear that the objective of keeping most bears out of the area during the first six weeks following the birth of calf moose was accomplished. Further, the high rate of return of the bears documented that transplanting of brown/grizzly bears for any reason is only a temporary measure — a significant conclusion for bear management throughout Alaska.

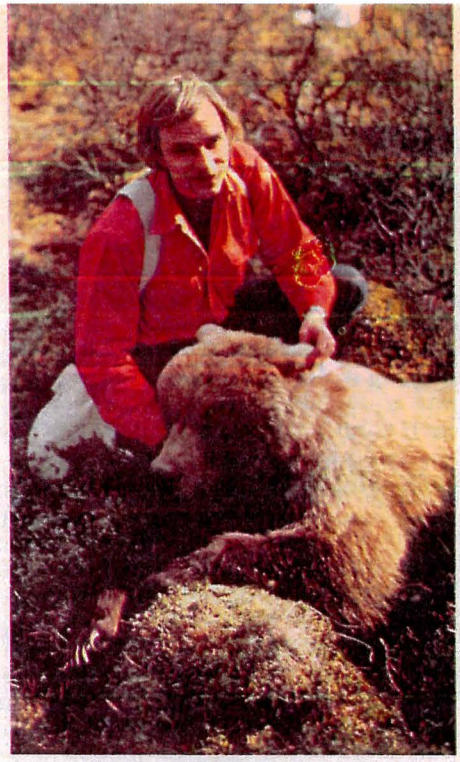
For the purpose of this study, removal of brown/grizzly bears proved highly effective, for when we made our moose surveys during the following November, we found there were 52 calves per 100 cows in the study area, the highest ever recorded for that area.

When the figure was corrected for observability (biologists never see all calf-cow pairs during aerial surveys) and for young moose which were not sexually mature, the ratio was about 70 calves for every 100 cows. Clearly, the removal of bears for six weeks reduced calf mortality to a low level, and confirmed the findings of earlier studies — that brown/grizzly bears were the main predator on newborn calf moose in the study area.

But when dealing with wildlife, things are seldom as simple and straightforward as they might seem to be. Although the results of the bear transplant were good, if their survival was to have real meaning, the calves that were saved by the bear removal had to live through the next two years until they reached maturity and became reproductive members of the population. If a large number died before reaching maturity, reducing bear predation would only be postponing death for a short time, and there would be no gain for the moose population.

The next step of the study was to measure for the succeeding two years survival of the young moose in the study area where bears had been removed. We radio-collared 34 calf moose after the November moose counts that showed 52 calves per 100 cows.

One year earlier, during the severe winter of 1978-1979, we had learned that at least 30% to 40% of the calves present in November had died of starvation. We also found through studies of radio-collared wolf packs that 9% to 24% of the surviving calves in November might be preyed upon by wolves. Because the bear removal area had been recolonized by wolves it was essential that we determined how many of the calves would die from causes other than bears, such as wolf predation and starvation. If most calves lived, the experiment would be a smashing success.



Game technician Dennis McAllister supports the head of an immobilized brown bear.

During the first winter following the bear transplant (1979-1980), only 6% of the radio-collared calves died due to winter kill. During the second winter (1980-1981) the same group of moose suffered four percent mortality. Therefore during the two years following the bear transplant only 10% of the calves had died. Both winters were relatively mild.

From this part of the study it became apparent that if the moose calf population was relieved of predation by brown/grizzly bears during their first six weeks of life, the moose population could increase during mild winters.

It took a while, but many pieces of the biological puzzle fell nicely into place.

Wildlife populations and environmental factors are ever changing. The results of this intensive research program might have been quite different with different levels of populations of moose, wolves, bears, caribou, snowshoe hare, beaver; and even with a different weather pattern. Man's influence through different hunting and trapping pressures on these species could have also changed some of the answers.

What happens in the Nelchina Basin now largely depends upon the management approach chosen by the Alaska Board of Game, the Alaskan public, and ADF&G management biologists. Should the brown/grizzly population be reduced by setting larger bag limits and longer hunting seasons in an attempt to increase moose? Would the public prefer a high bear population and few moose? If bears are reduced would wolves become a more important predator on the moose of the area? Would a moderate decrease in bears produce a moderate increase in moose?

Some biologists suggest that the latter approach could backfire and result in a larger bear population comprised of smaller individuals on the theory that most hunters select large bears, which are suspected of killing large numbers of bear cubs.

Possible solutions obviously are complex. At this point we have learned that brown/grizzly bears killing moose calves during their first six weeks of life had a profound effect on Nelchina moose. The wolf, which we first suspected to be the most important predator on the moose (the "butler" in our whodunit) turned out to be only slightly guilty — an accomplice, as it were.

The step-by-step solving of the unknown — what was happening to cause the moose decline in the Nelchina Basin — with the answers slowly wrung out after years of work with moose calves, yearlings, and adults, as well as with wolves and brown/grizzly bears, gives us some insight into the intricate workings of predator-prey relationships.

It would be wonderful if the answers we have unraveled to the Nelchina puzzle could be directly applied to other regions of Alaska where moose have declined. Unfortunately, the answers we have found, although they will provide valuable clues and good basic information for other parts of Alaska, apply only to the Nelchina Basin and our study area, and for the years 1975 through 1981.□