Summary of
"Are Bears and Wolves Responsible for Moose Declining in Northwest Wyoming?"
presented by Joel Berger, Senior Scientist, Wildlife Conservation Society on Wednesday, January 12th at 685 S Cache in Jackson
summarized by Eric Bond

Disclaimer-
This is an informal recreation of the presentation. It is simply an attempt to present the same information Joel Berger gave in the same order he gave it for the benefit of those who would have liked to gone to the presentation but were unable to attend. Although I contacted Joel to clarify some points, Joel has not reviewed this document for its correctness. Joel did an excellent job of presenting a great deal of information in a very short period of time. As a consequence some numerical data and several other very important details given in his presentation are absent from this summary. Hopefully, however, none of the information in this summary is "incorrect".

The Wildlife Conservation Society
The Wildlife Conservation Society was originally called the New York Zoological Society and was founded more than a century ago. Around the turn of the century it was responsible for reintroducing bison into parts of the West using animals from Bronx Zoo. Since then, the scope of WCS has extended into global projects including studies of the black rhino. From 1947 until 1973, WCS was responsible for operating the Jackson Hole Biological Station. This current project studies the moose populations within the Teton area and attempts to find cause for their recent declines.

THE STUDY

Introduction

In 1994, when this project was first starting, the Greater Yellowstone Ecosystem was essentially predator-free. Wolves were completely non-existent. Grizzly bears were extinct from many localities. Those grizzlies that remained were so few that they could essentially be considered to have no significant impact on the ecosystem. Yet wolves were about to be reintroduced and grizzlies populations would soon start to expand. One would expect the reintroduction of these carnivores might have an impact on prey, vegetation, and biodiversity, as well as other effects. The field work for this project ran from 1995 until 2004, and is now completed.

A caution against simplified population assumptions
In theory, one might expect a direct correlation between habitat condition and population. Habitat influences body condition, which in turn influences reproduction rates, which in turn influences population. However, there are so many other factors that play a role that it would be unrealistic to expect a truly direct correlation between habitat condition and population. Similarly, one should not realistically expect to find a direct correlation between the number of predators and the size of the corresponding prey populations; there are simply too many other factors at work within a system as complex as an ecosystem.

Assumptions of the study:
1) There were essentially no predators present within the study area at the start of the study.
2) Currently there are no significant predators in the ecosystem aside from grizzly bears and wolves.

Challenges of the study:

- Determining moose calf body weight.

A good correlation was found to exist between head size and body weight. Once this correlation was documented and quantified, a means of determining body weight indirectly based on head dimension measurements was enabled. Photometric measurements were conducted to establish both head width (from eye to eye) and muffle length (length of "nose") for this purpose.

- Conducting a study over lands controlled by several different entities.

Some logistical challenges resulted from the fact that the study area encompassed lands controlled by several different organizations. The study area included Grand Teton National Park, Bridger-Teton National Forest, Teton Wilderness Area, the National Elk Refuge, and occasionally the South boundary of Yellowstone National Park.

- Determining existence of moose pregnancy through non-invasive techniques.

The study devised a method of determining moose pregnancy by studying the steroidal content of moose scat. This method proved to be extremely accurate.

- Conducting studies of birthing events

It is difficult enough to witness an animal giving birth in the wild, but especially so for an animal that aggressively demands solitude while giving birth.

THE RESULTS

Pregnancy and calf survival statistics

Data was compared with Doug Houston's 1960's moose studies within Jackson Hole as well as with studies such as those performed in Alaska.

- Pregnancy rates are noticeably lower now than they were in the 1960's
- Jackson Hole moose pregnancy rates probably rank in the bottom 15th percentile of the country.
- Jackson Hole's calf survival rate is significantly higher than that of Alaska; until four years ago it was about three times higher. Since then it has been dropping due to increased moose calf starvation deaths.

Factors affecting Juvenile mortality

- Abortion

Abortion accounts for about 10% of juvenile mortality

- Perinatal mortality

(This is where predators kill a sick or defective newborn that would have died on its own in a few weeks anyway.) It accounts for very little of juvenile mortality

- Birth date

Despite being such a solitary animal, almost all moose births within GYE happen almost exactly at the same time. There is an 11 day period crossing from end of May into the beginning of June in which almost all moose births occur. Presumably this strategy evolved to over-saturate the predators. (In other words, if all births happen at once, the predators take only a limited number and be satisfied for a while. The next time they get an urge to take a newborn, there won't be any to be found. In contrast, if the births were spread out, a predator might be able to nearly make a living off of taking newborns.) In this manner, a moose born closer to the peak birth date will have a better chance of survival.

- Body weight
We might expect that heavier would be better, and initially the data showed that calves with particularly low body weight had a lower chance of survival. However, this data is misleading, since ALL of the calves that had a particularly low body weight were twins. Twins may have reasons for low survival rates other than body weight alone and were therefore discounted from the study. When twins were eliminated from the data set, body weight was found to have no significant impact on survival

- Orphans
Mothering turns out to play an enormous role for moose calf survival. Calves with mothers had a 75% survival rate whereas orphan calves had only a 5% survival rate.

Distinguishing scavenging from predation:
A popular criticism of this study is that deaths occurring by predation might be incorrectly attributed to other causes. However, this is not a valid concern. Predation deaths are highly distinguishable from other forms of death. With a grizzly kill there are always signs of a struggle. Even in cases where a predator was found with the carcass or where predator marks were found in the carcass, it was highly possible to distinguish whether the predator itself had made a kill or whether it was just scavenging an animal that had died from non-predatory causes such as starvation. With a predatory kill, there will always be signs of a struggle such as the following:
Trail of hair
Facial damage
Back & neck damage
tracks
trampled vegetation

Adult female deaths- breakdown by cause of death
Causes of adult female moose death in the study area:
60% malnourishment
14% bear attacks
10% hunting (human)
8% vehicle collisions
2% wolf attacks
6% unknown
0% cougars

survival rate: 80%
predation rate: 5%

CONCLUSION
Predators not responsible
Based on the cause of death statistics, we can conclude that predators are NOT responsible for the decline in moose populations.

Alternative explanation
What is responsible for the decline?
Theory: food resources cannot maintain the current population.

In a high population, low food environment, we would expect the following:
- decreased pregnancy rates
- decreased juvenile survival rates
- decreased calf / yearling survival rates

Today, we do have decreasing pregnancy rates and decreasing juvenile survival rates. (No conclusion can be made about whether calf / yearling survival rates are decreasing due to inadequate historical data on calf / yearling survival rates.)

OTHER INFORMATION

Statistics on the moose decline

When the first explorers arrived in Jackson Hole, moose were absent from this ecosystem. They were abundant in New England at that time as far south as far south as Virginia, but as far as the Rockies go they are relative newcomers. Starting in 1910, their population was firmly established and their numbers increased rapidly. In the last 15 years they have declined by 1/3. In the last 20 years 10,000 have been removed through hunting.

Moose reaction to predators- explaining the 1999 spike in predation

Although the wolves were introduced to Yellowstone in 1995, they did not spread to Grand Teton National Park until November 1997. As far as anyone can tell, however, they did not kill any moose until 1999. Berger can think of two possible reasons why there were no known moose kills in 1997 and 1998: 1) perhaps elk were plentiful in those years so wolves were not hungry enough to go after moose or 2) perhaps the wolves did not encounter moose until then.

The wolves had an enormous impact on moose populations during their first year of moose predation in 1999. Since then their effect has not been particularly great. Why were moose kills high only during that first year? Maybe it took a while for the Moose to recognize wolves as predators. A study was launched to determine whether or not naive prey can learn to re-recognize predators that have long been absent from their midst.

The reaction-to-predators study placed signs of wolves to determine whether the moose would react. Tape recordings were played which mimicked wolves, coyotes, tigers, ravens (which might be associated with carrion), and other noises. Olfactory cues were given of various urines, and even of potato. (The potato was a control; are the moose just reacting to the wolf urine because it is unfamiliar? If so they should react equally to the smell of potato.) The conclusion is that that naive prey do quickly adjust their behavior and movements in response to the predators; they can re-learn their fear of wolves. In conclusion the kill rate was high in 1999 because the moose did not initially recognize the wolves as predators. But they learned quickly and adjusted their movements and behavior, thereby reducing the kill rates subsequent to 1999. For more details and for an amusing photo, see:
http://news.nationalgeographic.com/news/2001/02/0208_moose.html

DATA COLLECTION FOR CAUSE-OF-DEATH STUDY

What is sampling bias?

Suppose we only used data from visitor-reported moose deaths. Such data might show that almost all moose deaths occur within close proximity to a road. One would be tempted to conclude that the deaths are therefore due to motor vehicle collisions. But maybe this data simply reflects that there a lot more visitors within close proximity to a road, and therefore deaths are much more likely to be reported in that vicinity. One might use data from studies using radio collars to determine that deaths are actually quite geographically distributed. So the visitor data is biased; it shows patterns that are misleading and are a reflection of a faulty data collection method. It proves not that moose *deaths* occur near roads, but rather that *visitor-sightings* of moose deaths occur near roads. If this biased data is included with the radio collar data then the incorrect pattern of deaths in the vicinity of the roads is preserved. So to make sure the study is not biased, all sources of data that might reflect a bias have to be ignored.

Preventing sampling bias in cause-of-death study - why use only collared females?
In a phenomenon similar to the sampling bias example given above, claims of predation might be inaccurately inflated if individual sightings were included in the cause of death study. Therefore, no data from individuals was used in the cause of death study. To further avoid sampling bias, only deaths of radio-collared adult females were considered in the analysis. Adults were chosen because of the difficulties in collaring newborns. Females were chosen because of their importance in being able to sustain populations through reproduction. Berger stressed that the fact that the cause-of-death study was limited to adult females should NOT be taken to mean that he believes predation death can occur only in adult females.

WHY THE POPULATION DECLINE?
Additional evidence that predators are not responsible
Graphs of population vs time for in the Greater Yellowstone Ecosystem shows that the moose population is indeed crashing in recent years. However, we find nearly identical population vs time graphs in the Greys River area, in Sublette county, and in the Kemmerer district (north of Evanston, WY) -- places where predation is still entirely absent! Therefore, there has to be something else effecting population other than predation.

Other factors which might affect population decline
- decline in vacant habitat

- no modern disturbances
Bill Romney has done studies which show there were massively devastating wild fires in Jackson Hole in 1858-1859. (Notice that before this period there were no moose in Jackson Hole. After this period the moose came in abundance.) Researchers at the Teton Science School have pointed out that in 1939 Shoshone meadows was documented to have lush vegetation supporting a great moose population. Just 12 years later the vegetation was documented to have overgrown to the point that the moose population had drastically declined. Maybe there are not enough disturbances in modern times to maintain adequate habitat.

- lag in vegetation response.

- changing weather
Moose don't tolerate warm weather that well. The past decade has been the warmest on record all over the world.

- Ticks / disease
Moose did have an increase in ticks and disease in the study area. However, it is difficult to distinguish here between cause and effect. Do the moose have ticks and disease because the population is suffering or is the population suffering because the moose have ticks and disease.

QUESTIONS:

Question: Why were there no moose here when the first settlers arrived?
Answer: Below a certain threshold, moose populations can't sustain themselves. Maybe hunting by Native Americans combined with predation by wolves and bears to cause the population to become extinct in this part of the country. This is purely speculation; Who knows?

Question: Where did the Jackson hole Moose come from- did they migrate down from canada?
Answer: Yes, from Canada down the rockies. In the 1700's and 1800's they were abundant in New England as is well documented from French trapper reports and other documents. Yellowstone reported its first moose in 1882. Had they been present well before that we would know about it from the superintendent reports because Yellowstone was established in 1872.

Question: Did most of the predation happen in winter?
Answer: Yes, most predations were during the time when Grizzlies were not hibernating but the snow was still deep. So late fall and early spring. We would see things like where a moose would get caught in those holes that form around trees, so the snow played a major role. And similarly for the wolves. Only in winter. Now that's not to say that predation doesn't happen to newborns in the late spring. We were only looking at collared adult females so we were not looking at predation on newborns. So far this winter, out of 29 collared moose there was 100% survival; that's really high.

Question: ?
Answer: Our female moose tend to be older than in other populations. Males tend not to live as long because they are preferentially removed by hunting. But we had a 15 year old moose cow give birth. It is encouraging to know that at least some of them are still at it at that age.

ADDITIONAL INFORMATION

More information on Joel Berger's research:

Joel notes that much of the information given in the presentation has been published and that GRTE's Office of Science and Resource Management has copies; contact Sue Wolff or Sarah Dewey.