CARMA 6 Saturday 5 December 2009

Managing populations with changing abundance

A Gunn 'setting the scene –three phases of declines'

Declines are largely the present state of many circumpolar caribou and wild reindeer herds. Declines followed by recoveries are part of the age old relationship between people and caribou or wild reindeer. Elders talk about showing respect for caribou during the declines to help recoveries and part of being respectful, is to be knowledgeable. Understanding how and why the decline is unfolding helps for recovery and is a step toward being knowledgeable. Declines are not just a reduction in the numbers of caribou or a change in the areas they use. Declines are also associated with other changes in the caribou – some of those such as changes in body size are more a topic for the frame size model and the synthesis. But other changes at the herd scale can affect both the rate of decline and then recovery. As a herd starts to decrease, typically pregnancy rates are lower and more variable which reduces recruitment. This shifts the age structure toward older animals which in turn can influence productivity and survival. 'Bad' years have a strong effect and one, two or three consecutive age classes may be few in number which also affects age structure. Even a small change in adult female survival can change the rate of decline – so the effect of age structure is to contribute to an increase in the rate of decline as the decline progresses.

Declines, like stories, have three parts; the beginning, middle and end. The beginning of the decline is during the peak in herd size. During the peak, there are changes in the caribou themselves which influences the subsequent decline and recovery. Subsequent generations become smaller bodied and at the herd scale, shifts in sex and age structure begin. Duration of peak (shape) appears to vary between herds and although census frequency is a factor, the status and size of the summer range is also apparently a factor. Infrequent censuses are slow to reveal what is happening. Monitoring survival rates, productivity and age structure are crucial as they will reveal as peak abundance shifts to a declining herd.

The Western Arctic herd in western Alaska is an example of peak and a slow decline underway. The herd grew rapidly 1976-1990 with an average annual rate of 13% and the herd reached 490,000 in 2003 then by 2007, the herd had declined at an annual rate of 1-3% to 377,000 (Dau 2007). Since the mid-1990s, adult survival is more variable and is decreasing. Since the mid-1990s, fall calf survival was also declining mostly due to reduced summer calf survival although pregnancy rates are lower and more variable. In other words, the beginnings of a decline were becoming evident before there was a measured decline in census size.

In the middle phase, the numbers of individuals is declining to the extent that censuses will measure the rate of decline. The changes in calf and adult survival are also measurable as a declining trend. Later in the middle phase, rates can change rapidly. For example in the Bathurst herd, the halving rate of herd size was 7 years between 1996 and 2006, then the halving rate dropped abruptly to 2 years between 2006 and 2009. One reason may be the shifts in age structure toward older animals which in turn can influence productivity and survival. Even a small change in adult female survival can change the rate of decline. In the absence of management intervention, harvesting and predation may lag in responding to the reduced abundance which can increase the rate of decline. We can learn about accelerated declines from turning to other species such as fisheries. The relationship between harvesting and effort to maintain a constant level of harvest is a key issue in many fisheries.

The third and last phase of a decline is when the rate of decline has stopped and a phase of low numbers precedes the recovery. However, declines may not necessarily halt in the absence of intervention. Although this was the typical pattern historically, times have changed and arguably, the increased efficiency of harvesting (access, technology) keeps the caribou 'within reach' of the harvesters whereas in earlier times, hunters could not always maintain their harvesting (and people

sometimes starved). One effect of an accelerated decline is low numbers and less is known about what happens when caribou herds reach extremely low numbers. And, based on experience with other animals such as in fisheries, an acceleration of a decline at low numbers leads to even greater problems. Migratory tundra caribou are especially vulnerable as many of their ways of thriving depend on being gregarious – safety in numbers to swamp predators and parasites and to travel and forage efficiently. When numbers especially on the calving grounds fall too low, there may be just not enough caribou for their own safety from predators (Allee effect).

In summary, declines begin during the peak census size and the recognizable signs are increased annual variation in adult survival and recruitment (as well as other signs such as increasing parasite burdens. The middle of a decline is revealed through declining abundance as measured through censuses as well as trends in calf survival and adult survival. The rate of decline can accelerate as a consequence of age structure shifted toward older individuals and harvesting and predation. Surprises cannot be ruled out such as collapses although with intervention, the end of a decline is recovery.