By Dr. Charles Kay

Do Mule Deer Populations Cycle?

The thing to remember about cycles is that they generally occur in very simple systems, such as one main prey and one main predator. If you have multiple herbivores and multiple predators, as with most systems in the western U.S., cycles will not occur.

As defined by population ecologists, a cycle is where the numbers of a particular animal rise and fall at regular intervals. It was once thought that wolves and moose cycled on Isle Royale, but that has turned out not to be the case. The best known population cycle in the Americas is the lynx-snowshoe hare cycle of northern Canada and Alaska. Based on Hudson Bay Company fur records that go back to the 1700's, the numbers of lynx and snowshoe hares have risen and fallen at roughly ten-year intervals. First, snowshoe hares increase followed by an increase in the hare's primary predator, lynx. Then after four or five years of increasing populations, snowshoe numbers plummet followed by a decline in the lynx population. Numbers go from high, highs with hares everywhere, to low, lows with hardly a hare or lynx to be seen. If you have ever lived in the far north, it is hard not to notice how snowshoe hares, commonly but incorrectly called rabbits, can go from super abundant to practically non-existent all in the space of a few years, and then do it all over again in another ten years.

> "Although mule deer populations do fluctuate, that is different from a regular, predictable cycle."

A number of hypotheses have been proposed to explain this cyclic behavior including food, predation, parasites, disease, and physiological stress, among others. To separate between these competing explana-

Photo ~ Mike Jensen

tions, the Kluane Project was initiated at a research site southeast of Kluane Lake in the Yukon Territory. If you have ever driven the Alcan or Alaska Highway, as I have, you have gone right through the study area west of Haines Junction. The site is primarily boreal forest and in terms of animal biomass per unit area, snowshoe hares are the most abundant herbivore and lynx are the most abundant carnivore.

Several 250 acre exclosures were built to serve either as controls or manipulations and then the following experiments were performed. At some locations, fertilizer was added to increase plant production, while in others, predators, that is lynx, were eliminated. Supplement food for snowshoe hares was added at some sites, while at others the hares themselves were excluded. All experimental manipulations were conducted at the same time, and the experiments ran for ten years, or one lynx-hare cycle. It is important to note that this is the largest manipulative experiment of this type that has ever been conducted. The project included nine professors from three Canadian universities, 26 graduate students, and 93 technicians, who spent 156 man-years on the study. Compared to most two or three year research programs, this work in Canada was a massive undertaking.

Photo ~ Vic Schendel

A number of hypotheses have been proposed to explain cyclic behavior; including food, predation, parasites, disease, and physiological stress, among others. However, the Kluane Project, (as close to a controlled scenario as humanly possible), proved that predation was the leading cause to cyclic behavior.

The study's main conclusion was that lynx predation drove the system. In other words, the system was under top-down control with bottom-up factors; that is vegetation, playing a much reduced secondary role. To repeat, lynx predation drove the cycle. Without lynx, snowshoe hares do not cycle. Other studies on other cycles have reached similar conclusions. Predation creates the cycle. Here is how it works. At the start of a

cycle, lynx numbers are very low and lynx predation cannot keep the hares from increasing—and increase they do as only lagomorphs can! But as hare numbers rise, there is more food for carnivores, and the lynx population begins to grow until a point is reached where lynx are killing hares faster than the hares can increase. There is also evidence of surplus killing, where individual lynx kill more hares than the predators can eat. This causes snowshoe numbers to plummet, but the lynx keep hammer ing the hares, until snowshoe hares become so rare that lynx begin starving to death, due to a lack of prey. Lynx numbers fall so low that the hare population can once again begin to increase, and the cycle repeats.

The thing to remember about cycles is that they generally occur in very simple systems, such as one main prey, snowshoe hares, and one main predator, lynx. If you have multiple herbivores and multiple predators, as is true in most systems in the western U.S., cycles will not occur. This is also why true cycles have been observed primarily in northern latitudes. Not only is it colder as one nears the arctic, but there is less plant production per unit area compared to warmer areas, which in turn supports fewer species. There are fewer herbivores and, in turn, there are fewer predatory animals.

I am not a fan of modeling but it is very easy to get a predator-prey model to cycle because most models only involve one predator and one prey due to the mathematical complexity of adding more species. The reason the models cycle is because of the time-lag built into the predator population. And the same is true of the lynx-hare cycle. It is the time-lag in the lynx numerical response that causes the cyclic behavior. Finally, it should be noted that where lynx and snowshoe hares occur in the continental United States, those populations do not cycle because there are multiple small mammal herbivores, as well as multiple species of small predators, such as coyotes, bobcats, and foxes. The thing about the lynx-hare cycle that is still unknown, however, is why, or how, those cycles are synchronized throughout the length and breadth of the sub-arctic? Some scientists believe that long-distance movements by lynx may be the "key element causing synchrony within the boreal region." One radio-collared lynx traveled over 600 miles, while others have dispersed 300 miles, or more.

Having reviewed the lynx-hare cycle, we can return to our original question...do mule deer populations cycle? No, mule deer populations do not cycle. Now, mule deer populations do fluctuate, but that is different from a regular, predictable cycle. In theory it might be possible to get a mule deer population to cycle, if mule deer were the only available prey species and there was only one predatory species, such as mountain lions; and then only if the area was large enough so that neither the prey nor the predator went extinct. I know of no such place, except perhaps inside a computer model.

Photo ~ Sam Carpenter

Due to the fact that mule deer live in an environment that hold multiple prey species, multiple herbivores, and multiple predators, it has been concluded that while their numbers do fluctuate, they do not regularly cycle.