## Average Age of Harvest: What is it Really Telling Us?

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*Abstract*: The average age of harvested Dall sheep rams (*Ovis dalli dalli* )has been used as a measure of the effectiveness of harvest regimes and as an indirect measure of sheep population status. We examined the relationships between the average age of harvest and the population size in a population in the southwest Yukon. In areas where the harvest is a random selection of full curl rams, such as this, the average age of harvest is a reflection of the existing age distribution of the harvestable rams and gives no indication of harvest intensity or population status. Some cohorts were strongly represented in many years of the harvest and as these cohorts aged, the average age of harvest increased; contrary to our expectation the average age of harvest did not decline as the population declined.

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### INTRODUCTION

The Ruby Range mountains of the southwest Yukon have been the focus of sheep management efforts for many years. The Government of Yukon has monitored the area since 1974 and it is one of the few areas in the Yukon for which there is long term population information. The area has always been an important hunting area for First Nations people of the region. Non-resident hunters have come to the Ruby Range since the 1920s in search of trophy rams; with the building of the Alaska Highway in 1942 the area became more accessible to all hunters, including Yukon residents. Continued access improvements and local concerns about the sheep population have both served to focus our attention and heighten our concerns about this area.

To address concerns such as these in days of decreasing financial resources, wildlife managers have come to rely more and more on indirect monitoring methods, especially over vast areas such as in the Yukon. Rather than relying on actual aerial counts, managers have sometimes relied on statistics developed from harvested animals. For example, the number and average age of harvested Dall sheep (*Ovis dalli dalli*) have been used in many jurisdictions (Hoefs and Barichello 1985; Poole and Graf 1985; Alaska Department of Fish and Game 1993; R. Marshall, pers. comm. 1997) as a measure of the effectiveness of different management regimes or to set harvest quotas. In the Yukon, the rationale behind aging each harvested ram has been the belief that the average age of harvest in each year provides indications of such potential problems as over-harvest through increased effort or a decline in local sheep populations. It has been expected that either of these situations would be reflected in a trend toward a lower average age of harvest over several years. As well, Yukon outfitters have adopted a high average age of harvest as a marketing tool and hold an annual competition for the highest average age.

In the Yukon, 85% of rams attain full curl status by their eighth year (Barichello et al. 1987). Management goals are to attain an average age of harvest of at least 8 years. If the average age

is 8 or less, it is seen as an indicator that rams are being cropped as soon as they become legal i.e. that harvest intensity is too great.

Average age of harvest has come to be seen as a very important piece of information, but does it really tell us what we think it does? In this paper, we examine the relationships between the average age of harvest and the number of sheep in the population.

**Methods**

The horns of all rams taken by licensed hunters are submitted for inspection by a conservation officer or wildlife technician and are aged using the horn annulus technique (Hemming 1969); various horn growth parameters are measured, a side-view photograph is taken and a uniquely numbered metal plug is inserted.

To obtain population estimates, sheep are counted from a helicopter in June or July when the white sheep are most visible against the green or brown vegetation. A drainage technique is used, whereby each mountain block is contoured at approximately 100 kph at about 150 m above ground level (Hoefs and Barichello 1985). Often, more than one pass is needed to achieve total coverage. It is assumed that close to 90% of the sheep are counted (Hoefs and Cowan 1979) and no allowance is made for missed animals.

All sheep seen are counted and classified as lambs, ewes, yearlings and rams having half, three-quarter or full curl horns. When yearlings cannot be easily distinguished from ewes, the group is termed nursery sheep, which can include ewes, yearlings and some 2-year-old rams. Locations are recorded on a 1:250,000 NTS mapsheet.

**Results and Discussion**

Population fluctuations observed in the mid-1980s were, in retrospect, a population decline (Figure 1). Numbers went from about 775 in 1974 to almost 1000 in 1985, to less than 500 in 1993 (YTG unpubl. data). Local First Nation residents also noted the decline in the early 1990s, and the overwhelming sentiment was that outfitter and resident overhunting was the cause of the decline.

Faced with the evidence of a population decline, and the contention that overhunting was the cause, we first examined the average annual reported harvest. In years where survey information was available the reported licensed harvest ranged from 1.0 to 4.2 per cent of the non-lamb population (mean=2.5, n=13) (YTG unpubl. data) and was limited to full curl rams. This level of harvest is considered to be within sustainable limits, based on the demographic work done at nearby Sheep Mountain (Hoefs and Cowan 1979, Barichello and Hoefs 1984). However, it was simply not sufficient to tell the local people that hunting was not the cause of the decline. In an attempt to gain a better understanding of the population processes behind this decline, we began to look at the available information in more detail.

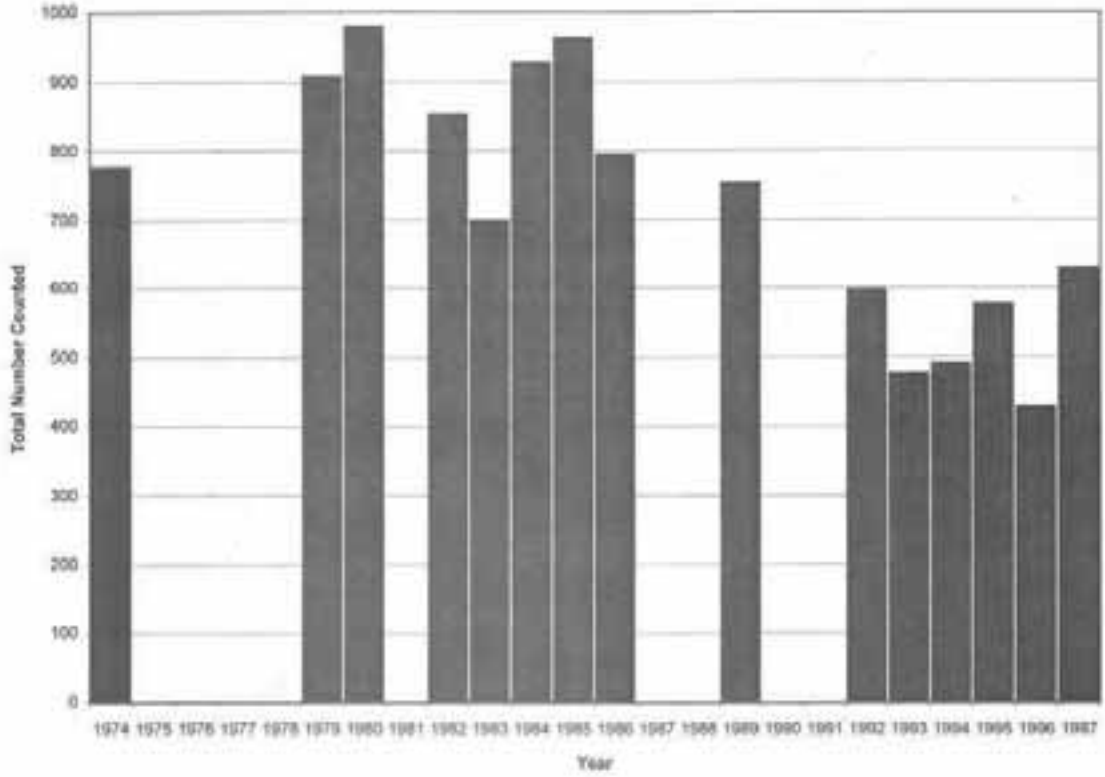


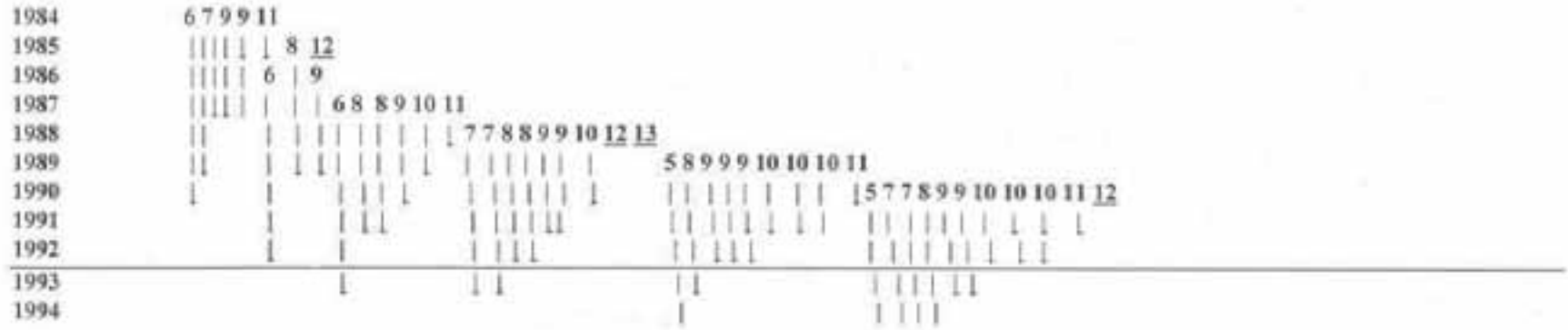

Figure 1. Total number of sheep counted in the Ruby Range mountains, Yukon, 1974 to 1997.

A simple model showed that even if there had been no licensed hunting, a dramatic decline in the huntable population would probably have occurred anyway (Figure 2). At this point, the potential effect of a strong cohort pulse became apparent. Based on the lifetable developed at Sheep Mountain (Hoefs and Cowan 1979) many of the animals in the harvest were "scheduled" to die in the same year.

A frequency distribution chart of the number of rams harvested from each cohort was generated to determine if strong cohorts had a general effect on the harvest as well as the specific effect originally identified. Data from the surrounding region (YTG unpubl. data) was included in this analysis to increase the sample size. Some cohorts were strongly represented in the harvest (e.g. 1979 and 1980, Figure 3) and when we looked at the cohorts represented in each harvest year, it was apparent that a few strong cohorts are heavily represented in many years (Figure 4). Therefore, as these cohorts age, the average age of harvestable rams increases no matter what is happening to the population.

The precise connection between average age of the harvestable population and the average age of harvest depends on how hunters select rams from the pool of full curl rams. We believe the licensed harvest is a random selection of full curl rams for three reasons. First, although some hunters may prefer older, broomed rams as trophies, others are known to select younger ("meat")

Figure 2. Representation of a simple model showing the effect of a cohort pulse in a portion of the Ruby Range mountains, Yukon.



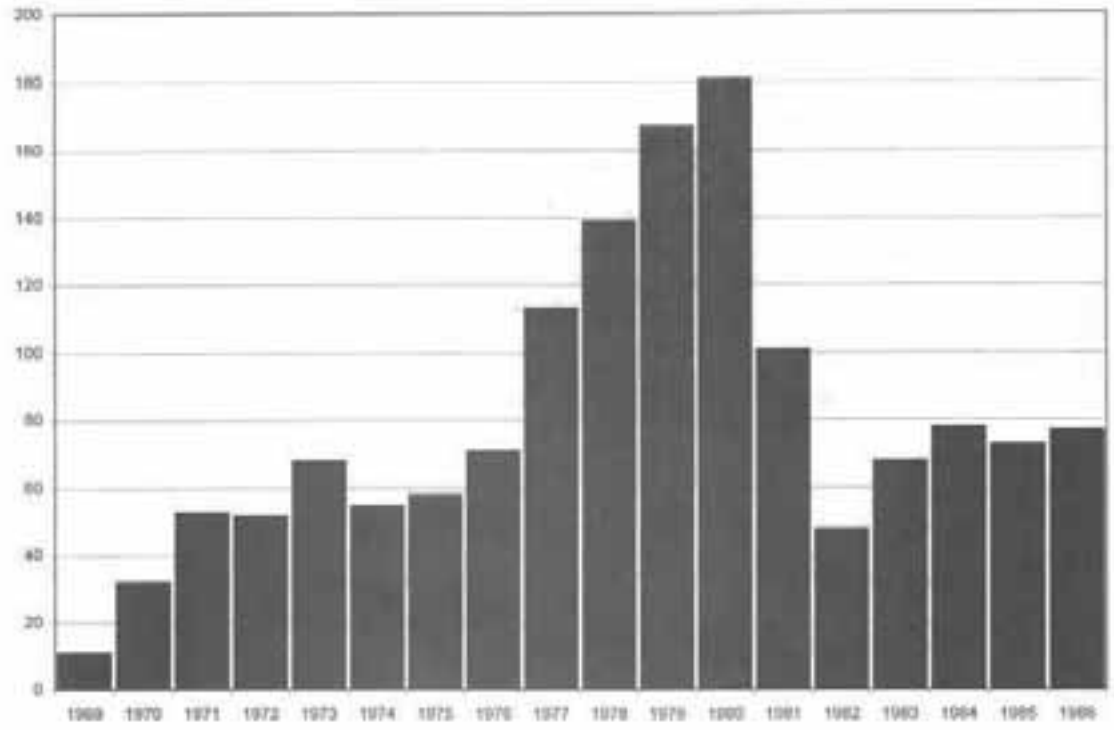



Figure 3. Number of rams harvested 1980 to 1997, from each cohort.

animals. Over large areas, such as this one, preferential selection made at the band level or over a small geographic area must be considered random over the broader area. Second, even for those hunters who do select for large-horned rams, larger horns are not necessarily the oldest animals because all horns do not grow at the same rate, nor are horns broomed at the same rate. Third, the cohort representation in the harvest mirrors the strength of respective lamb crops for all years for which we have data.

Because the average age of harvestable rams increases due to cohort pulses rather than population changes, the average age of harvest will also increase. Because of this the average age of harvested rams provides no indication of the intensity of the harvest. If the harvest were more intense, we would only expect that each of the bars (Figure 4) would be taller but that the proportional representation of each cohort would remain the same. Therefore, the average age would be the same no matter what the harvest intensity. This is an important point because it means that the average age of harvest cannot be used as a reliable indicator of either harvest intensity or population status.

When we looked at the average age of harvest (Figure 5) compared to the population information it was obvious that, contrary to our original expectations and management guidelines, the average age of the rams harvested from this population did not decline as the population declined. In fact, when harvest data from the surrounding area were also included to increase the

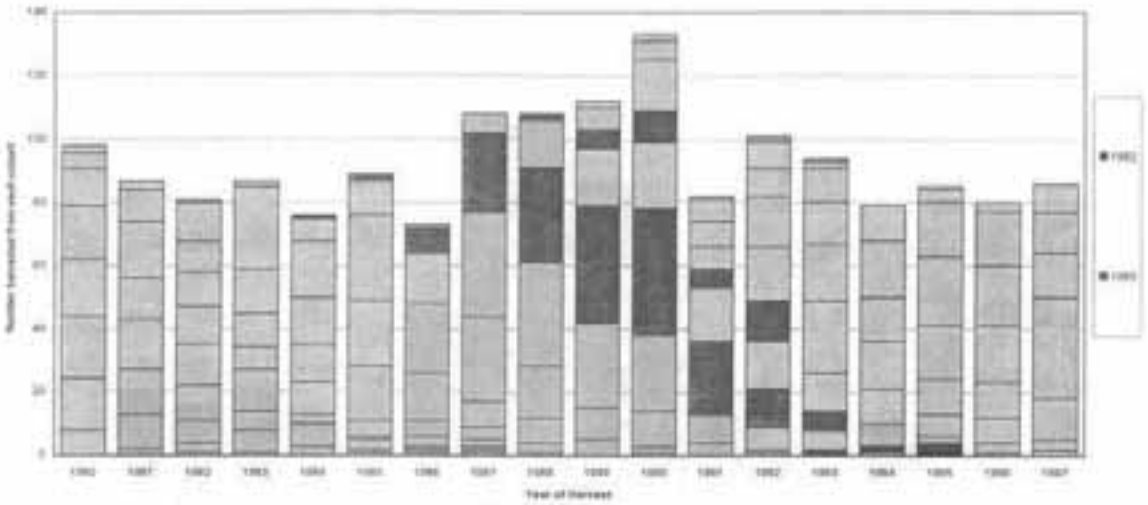


Figure 4. Relative representation of two cohorts of rams in the Ruby Range harvest, 1980 to 1997.

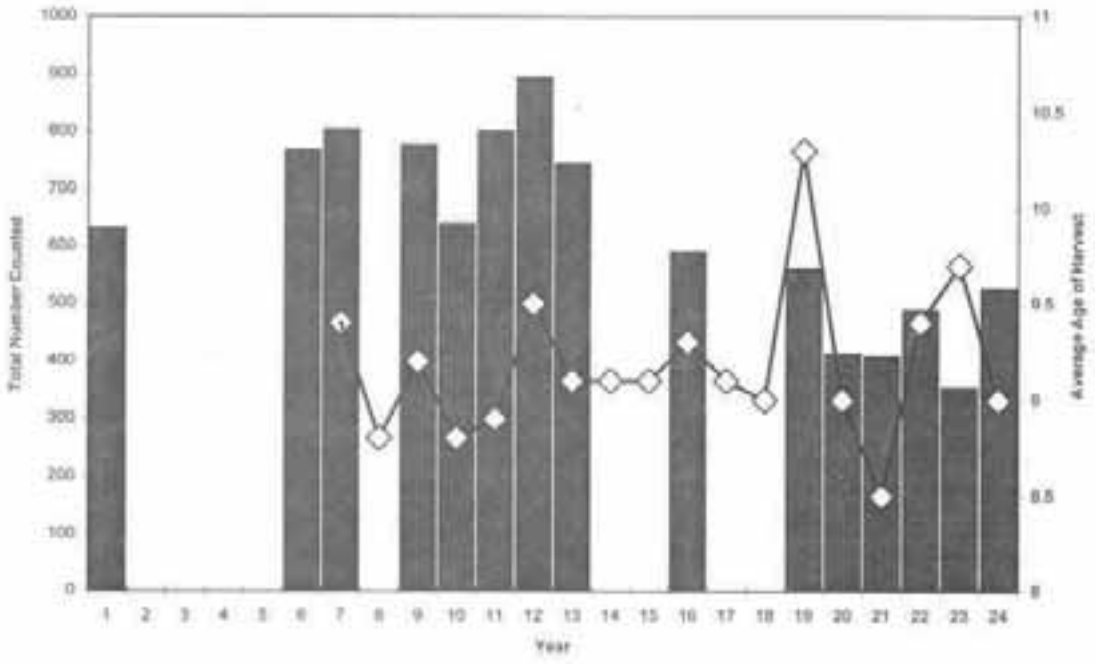



Figure 5. Total number of sheep counted and the average age of reported harvest. 1974 to 1997.

sample size, the average age of harvest clearly increased as the population declined and the strong cohorts of 1979 and 1980 worked their way through the system (Figure 6).

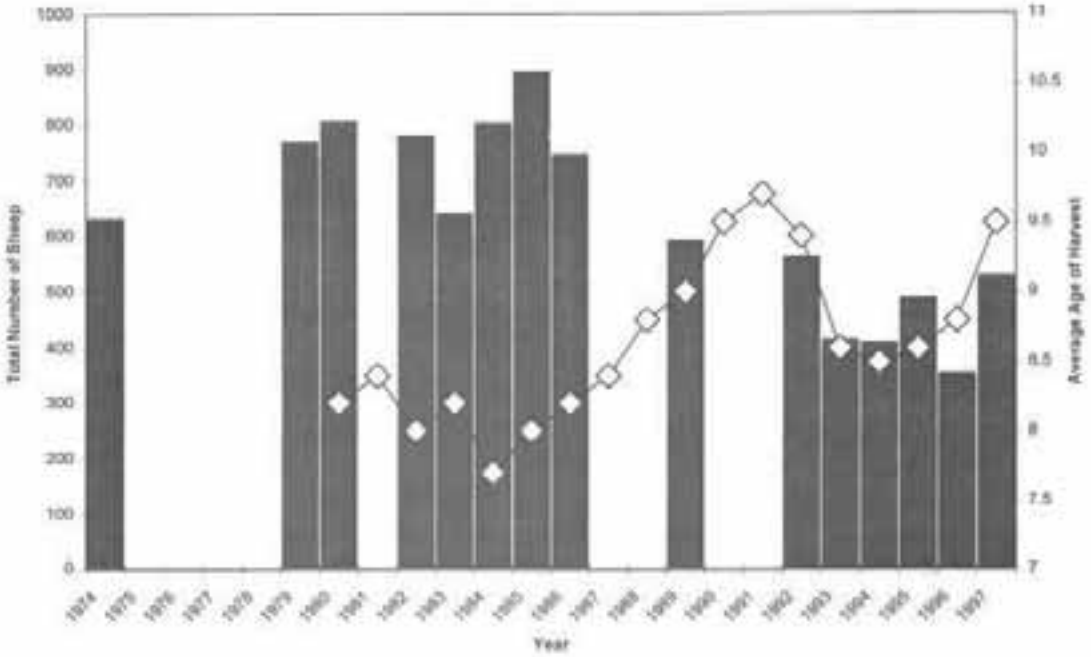



Figure 6. Total number of sheep counted in the Ruby Range mountains, and the average age of harvest in the study area and surrounding region.

Should the observed decline have been anticipated, based on survey results? Certainly having population information without any estimate of confidence or reliability limited our ability to assess the situation. Typically, if the expected number of animals was seen on a survey, the results were accepted, and if fewer animals were found, there were many explanations as to why the survey did not provide a true picture of the population, and we had a tendency to discount those surveys.

We believe that the lamb/nursery sheep ratio may be a good predictor of population levels well ahead of any observable changes in the overall census results. For example, 1982, 1983, 1985 and 1986 had nearly total lamb crop failures which led to a population decline in the early 1990s. But the total number of sheep counted was well within the range of previous results (Figure 7). The importance of these lamb crop failures may seem obvious now, but it was certainly not obvious in the early 1980s when we didn't have the benefit of the subsequent 10 years of data, or of a historical perspective. For example, should the good lamb crop of 1984 have been sufficient to counteract the previous 2 cohort failures? And when we went back in 1989, we found the

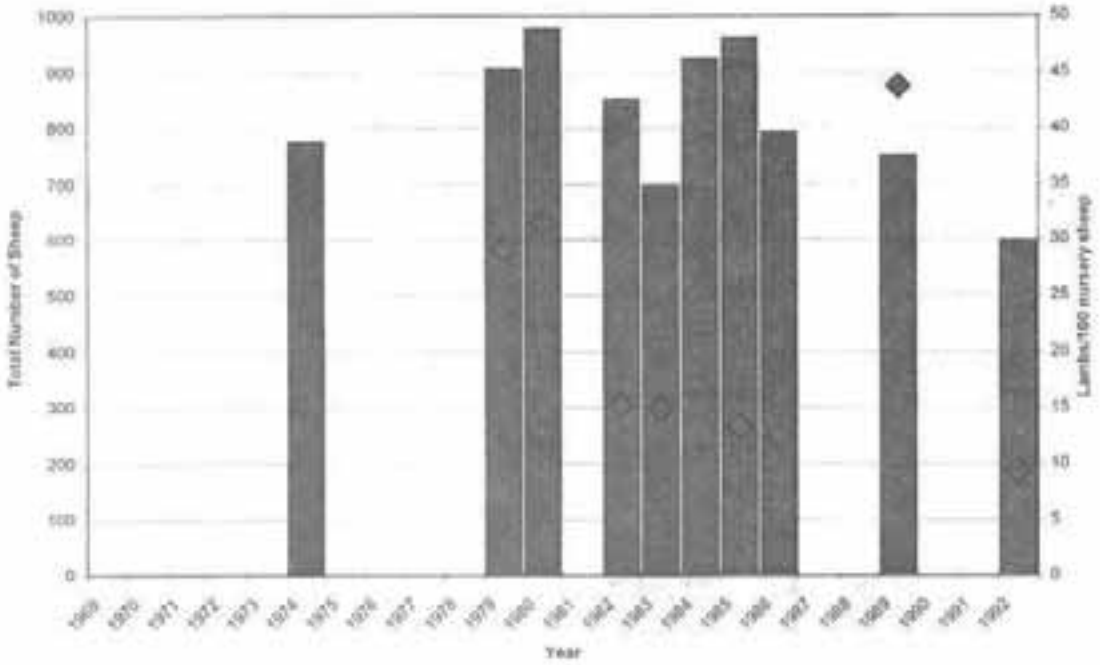



Figure 7. Total number of sheep counted in the Ruby Range mountains, Yukon 1974 to 1997 and the lamb/100 nursery sheep ratio in those years.

highest productivity we'd seen in this population. How should these results have been interpreted? Further modeling has demonstrated that those years of low lamb recruitment clearly led to a population decline, even if it was not the ultimate cause of the decline. We have been surprised at how simple the model can be and still provide accurate results. Clearly, in this population, the number of lambs produced, and not the number of animals harvested, determines the population trends.

## Conclusions

In the Yukon, we have found that the average age of harvest is a reflection of the existing age distribution of the harvestable rams, not the status of the population or the harvest rate. In fact, as long as the harvest is a random selection of the available legal rams, harvest monitoring cannot be used as a substitute for population monitoring. The challenge remains to devise a program to monitor large populations spread over half a million square kilometers where both ground access and budgets are extremely limited.

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