Assessing depletion of wolf numbers from trends in wolf numbers killed, cost per wolf taken, and age structure of wolved killed, 1952-1961, by poisoning in northern Canada. Summary in Kelsall, J. P. 1968. The Migratory Barren-Ground Caribou of Canada. Queen's Printer, Ottawa, Ontario. Pages 253-261.

The summary in Kelsall's 1968 book on barren-ground caribou is fairly brief, and it describes a wolf poisoning program in the 1950s and early 1960s across a large area in northern Canada. While it is unlikely that there would ever be a return to poisoning as a way of reducing wolf numbers in the NWT, the measurements provided suggest that the program was quite successful in reducing wolf abundance. The effects on caribou are not clear, as this period predated widespread aerial caribou surveys and the recognition of migratory herds based on their calving grounds by biologists, let alone measurements of vital rates like adult survival and calf survival. The approach taken may provide an example of how the effectiveness of a wolf reduction program can be demonstrated based solely on the wolf kill and associated numbers, without the benefit of actual wolf surveys. The text states at the outset that a way of counting wolves reliably did not exist at the time, and no effort was made to count wolves. The measurements and trends used can be considered empirical data and do not rely on any modeling with assumptions that may be difficult to verify.

1. **Number of wolves killed over time**

The first graph on the following pages is Figure 14 from Kelsall's book, and it shows the total numbers of wolves killed by year from 1951-1952 to 1961-1962. It shows an initially increasing trend to a peak in 1955-1956, and then a steadily decreasing number of wolves killed. Note that this program was widespread across the NWT (which included Nunavut then), Manitoba and Saskatchewan, and the numbers of wolves killed annually approached and exceeded 2,000/year. Given that the poisoning effort did not decline over the period 1955-1956 to 1961-1962, it seems reasonable to conclude that the steady decline in wolves killed after 1955-1956 resulted from a widespread and progressive decline in wolf abundance over that time.

2. **Cost per wolf killed**

The second pair of graphs on the pages following is Figure 15 in Kelsall's book. The top graph shows the cost in dollars per wolf killed. The trend is a steady increase from $10-20 per wolf to about $70/wolf in 1961-1962, the last year of the program, when the number of wolves taken was the lowest over the 9 years of the program. This would be the equivalent of a present-day catch-per-unit-effort measurement. The second graph is the number of wolves killed in the NWT over this period, which shows a trend similar to Figure 14, possibly with the SK and MB wolf kill numbers included in Figure 14 but not in Figure 15. The combination of Figure 14 and Figure 15 seems to be clear evidence that the wolf population was progressively depleted after 1955-1956, where it became more and more expensive to kill an ever smaller number of wolves.

3. **Age structure of wolves killed**

The third graph on following pages is Figure 16 in Kelsall's book. It shows the proportion of young wolves in the annual kill, which shows a clear trend from mostly adults to mostly young wolves. Beside it

is a graph that shows what the expected theoretical wolf age structure should be in an exploited and a heavly exploited wolf population, which indicates that there should be a shift from a wolf kill of mostly adults to mostly young wolves. This provides further evidence that the wolf kill was effective at reducing the wolf population by depleting the adults and skewing the wolf population towards young wolves.

4. Lessons for the wolf reduction program in NWT in 2020 on Bathurst and Bluenose-East caribou ranges

Although this program from the 1950s and 1960s is from a long time ago, the measurements carried out and trends demonstrated may have application in 2020. Even with no attempt to estimate wolf numbers before the program or at any point later on, the numbers of wolves killed over time, in combination with the cost per wolf killed and the age composition of the killed wolves, appear to show clear evidence of large-scale depletion of wolf numbers.

In 2020 and in following years, there will be caribou population estimates and estimates of caribou cow survival and calf survival that may provide "caribou-centric" evidence that wolf reduction is effective. However, there is no control in the "experiment", thus any changes over time in calf or adult survival rates or in herd trend may reflect other factors, including natural ones. Collar-based adult cow survival rates in the Bathurst and Bluenose-East herd have shown a positive trend, especially in the Bathurst herd, since about 2014. These trends began well before the first significant effort at wolf reduction in early 2020 on the two herd ranges, thus while very encouraging, cannot be tied to wolf reduction to this point. However, it may be possible to assess whether the wolf population associated with the two herds has been depleted, based only on "wolf-centric" measurements.

1. **Reduction over time in wolf numbers killed**: if there is a steady decrease in the numbers of wolves killed that is not tied to reduced effort, this should be an indicator of a depleted wolf population. If on the other hand there is no clear declining trend in numbers of wolves taken, then it may be that the wolf kill is sustainable and the reduction in wolf population is at best seasonally transient and largely ineffective. There is abundant published evidence that low rates of wolf removal (30, 40 or even 50% wolf removal rates) are ineffective at increasing caribou or moose survival rates, due to rapid replacement of dead wolves by local transient wolves, young wolves growing up or wolves immigrating from outlying areas.
2. **Cost per wolf killed or other catch-per-unit-effort metrics (CPUE)**: if there is a steady increase in cost per wolf killed, hours flown to find a wolf, or hours on skidoo to find a wolf (or related metrics), this should be evidence that wolves are becoming more scarce, particularly if combined with a clear decline in numbers of wolves taken (above). If on the other hand there is no clear trend in CPUE, this suggests that the wolf population is overall stable and has not been depleted.
3. **Age structure of wolves killed**: if there is a shift over time from wolves killed being mostly adults to mostly young wolves, this should be further evidence of the wolf population being depleted, particularly if combined with an overall decline in wolves taken and a clear CPUE trend. If on the other hand no such trend in proportion of young wolves killed is evident, this may be evidence that the wolf population is not being depleted.

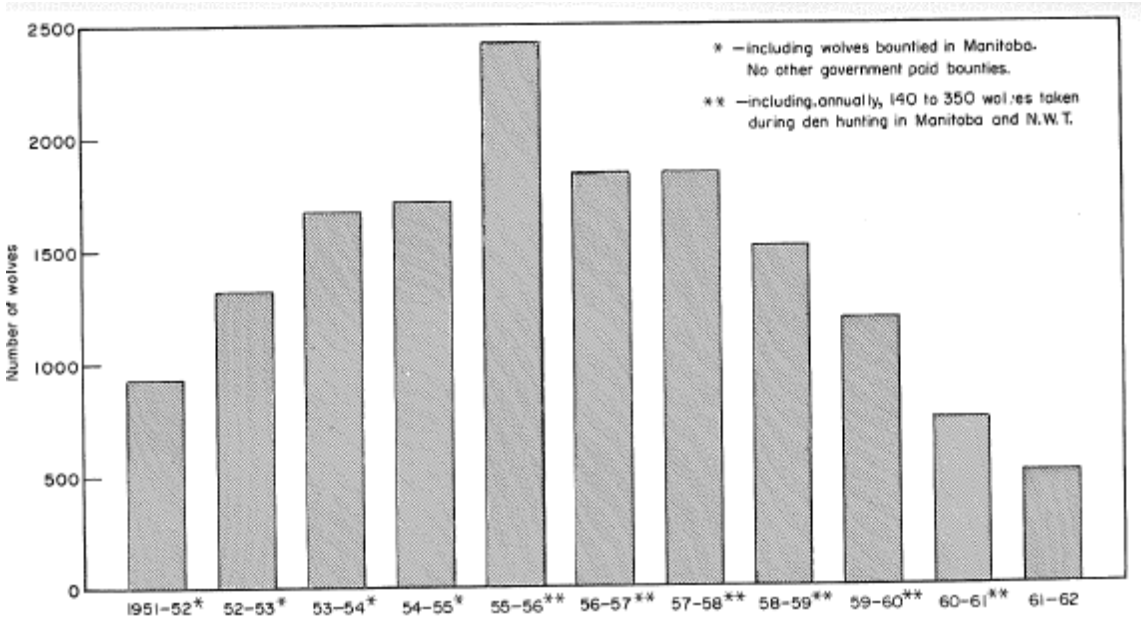

Figure 14. Number of wolves taken from barren-ground caribou ranges in the Northwest Territories, Manitoba, and Saskatchewan, 1951 to 1962. Data from Northwest Territories Council (1961), Manitoba Game Branch (pers. comm., 1964), Tech. Comm. for Caribou Preservation (1959). Figure for 1961–62 estimated from incomplete reports.

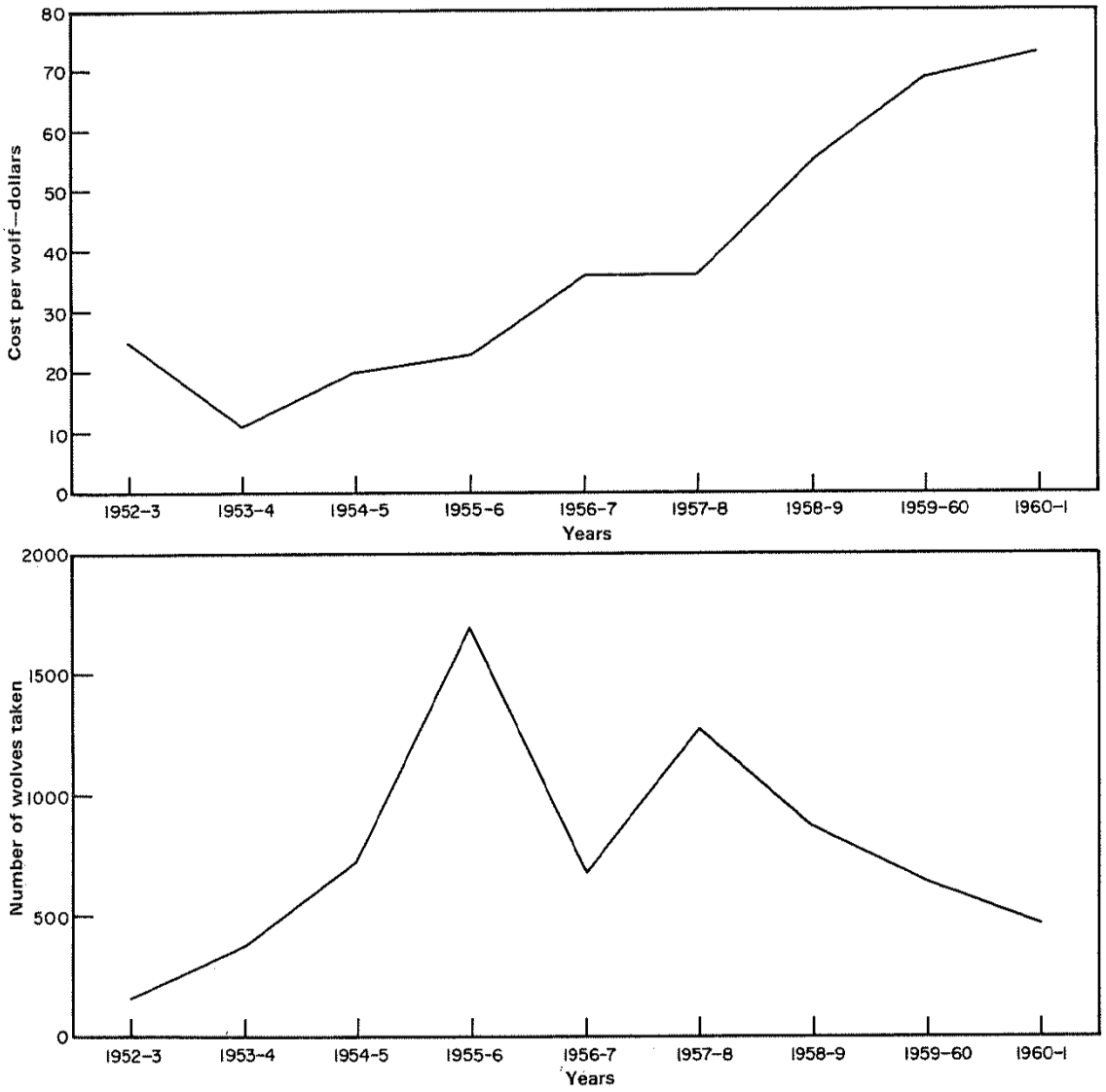

Figure 15. Comparison of numbers of wolves taken and cost per wolf during predator control in the Northwest Territories, 1952 to 1961. Data from Northwest Territories Council (1961).

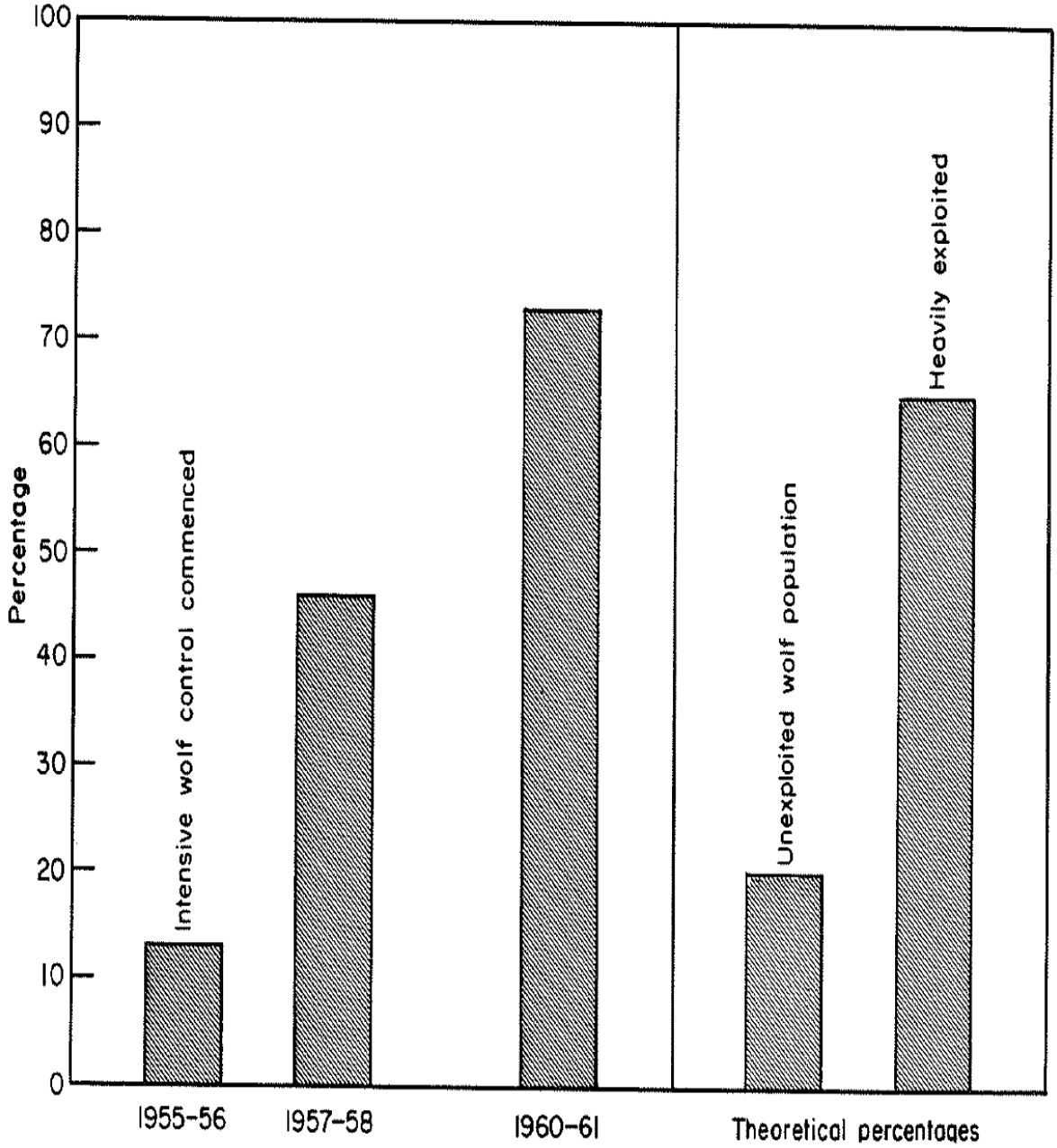

Figure 16. Progressive increase in percentage of young wolves among total taken north and east of Great Slave Lake 1955–61, compared with theoretical percentages for unexploited and exploited populations developed by Fuller and Novakowski (1955).