

~~NATURAL RESOURCE
CONSERVATION
PRAIRIE AND NORTHERN REGION~~

Muskrat Survival Studies

Spring, 1974

AL SMITH

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Introduction

In the fall of 1973 an aerial and ground count of muskrat houses was conducted in the Peace-Athabasca Delta to determine the status of the muskrat population. It was assumed that all houses were active at this time. With the onset of winter, mortality of muskrats increases so dramatically that by spring many houses are no longer occupied. Fuller (1951) summed up the situation: "Winter frosts seal the lakes and sloughs containing the choicest foods and may turn the shallow ones to solid blocks of ice, forcing eviction of the muskrats living in them."

In the spring of 1974 a ground survey was conducted in the Delta to determine muskrat survival as indicated by the proportion of houses that were still active. A second purpose of the survey was to determine the causes of mortality; this would necessitate the taking of certain measurements including snow, ice and water depths.

Methods

Nineteen of the 37 water bodies surveyed from the ground in the fall of 1973 were surveyed in the spring of 1974 (Figure 1.) As far as was practical the number of houses surveyed was a constant proportion (about 10%) of the number of houses present on the lake in the fall of 1973. Two crews of two men worked on the survey: 1 crew in Wood Buffalo National Park and another in the Alberta portion of the Delta and the Chipewyan Reserve.

The activity of houses was checked using a six foot aluminum rod, a 'rat spear'. This was thrust into the house until it was determined whether or not the muskrats were keeping a hole open in the ice. The size of each house was recorded. A hole was drilled in the ice about 5' from

the house by a power auger. The snow depth, ice thickness and water depth were measured to the nearest 0.1 foot using a calibrated pole. The pole had a foot on it which would catch on the bottom of the ice allowing easier measurement of ice thickness. All results were tabulated on a standard form.

The study was conducted from April 3 to April 14, 1974. Although temperatures for the month were ~~above~~ ~~were~~ slightly above average, (Table 1) no real thaw occurred until April 12 when temperatures remained above the freezing point for most of the day. This made travel difficult or impossible in much of the Delta and severely curtailed the accumulation of additional data.

Table 1. Temperatures at Fort Chipewyan During Three Winters of Muskrat Survival Studies and the Long-term Averages.

Month	Mean Temperature, °F			
	70-71	71-72	73-74	Average (1962-72)
OCT.	33.2	36.4	35.9	32.3
NOV.	9.1	11.7	5.0	13.3
DEC.	-9.7	-13.0	-6.5	-1.6
JAN.	-19.8	-20.6	-21.2	-12.2
FEB.	-1.6	-15.3	-5.4	-6.8
MAR.	11.9	12.6	-1.3	3.0
APR.	33.6	23.6	18.9	16.0

Results and Discussion:

In comparison with two previous winters of muskrat survival studies on the Delta (Allison and Ambrock, 1973), survival over the winter of 1973-74 was rather high. In March 1971, 37 percent of 319 houses sampled were active, in March 1972, 51 percent of 557 houses were active, while in April 1974, 78 percent of 205 houses were active. The level of activity in 1974 varied from lake to lake (40 to 100 percent) and among jurisdictions (Table 2).

While part of the increase in house activity in 1974 over the two previous years of study could be due to the sampling of relatively more productive lakes in 1974, much of this increase can be attributed to more favourable environmental conditions in 1974. Two of the more striking environmental changes are discussed below; they are the relatively high water levels and the record snowfall on the Delta.

Table 2. Percent Activity of Houses by Governmental Jurisdiction,
Confidence Limits at 95% Level.

	Percent Activity	Sample Size
1. Wood Buffalo National Park	84.3 ± .06	134
2. Alberta Portion of Delta	40.0 ± .30	10
3. Chipewyan Reserve	68.9 ± .12	61
Total Delta	77.6 ± .06	205

The Effect of Water Levels on House Activity

By the fall of 1973, water levels in the Peace-Athabasca Delta had returned to near normal or pre-Bennet Dam Levels. This followed a period of some five years (1968-1972) during which water levels were several feet below normal. If one compensates for a biological time lag, the fortunes of the muskrat population are strongly correlated with water levels (Table 3, Figure 2).

As was done in previous years of muskrat survival studies the relationship between total water depth and house activity was studied. House activity appears to increase with water depth (Table 4, Figure 3), but because of small sample sizes in the shallower depth classes, this relationship could not be supported statistically by chi-square tests.

In comparison with the other two years, there was a much greater proportion of houses in the deeper depth classes in 1974 (Figure 3). There were no houses in water deeper than 3.0 feet in 1971 and none in water deeper than 4.0 feet in 1972, whereas many (51%) of the houses surveyed in 1974 were in water over 4.0 feet deep. Therefore, if survival is greater in deeper water this could account for the relatively high survival in 1974.

Table 3. *The Relationship between Water Levels and Muskrat Catches in the Peace-Athabasca Delta.

Year	Fall Water Level on Mamawi Lake (Ft. A.S.L.)	Muskrat Catch the Winter Following
60	689	91,000
68	684	38,000
69	685	32,000
70	683	8,000
71	684	< 2,000
72	687	25,000
73	688	40,000

* All data from the Technical Report of the Peace-Athabasca Delta Project except 1973 fall water levels and muskrat catches for 1972-73, 1973-74 which are preliminary estimates based on sales at the Hudson's Bay Store in Fort Chipewyan and Pelton's Store at Emberras.

Figure 2. The Relationship Between Water Levels and Muskrat Catches in the Peace-Athabasca Delta

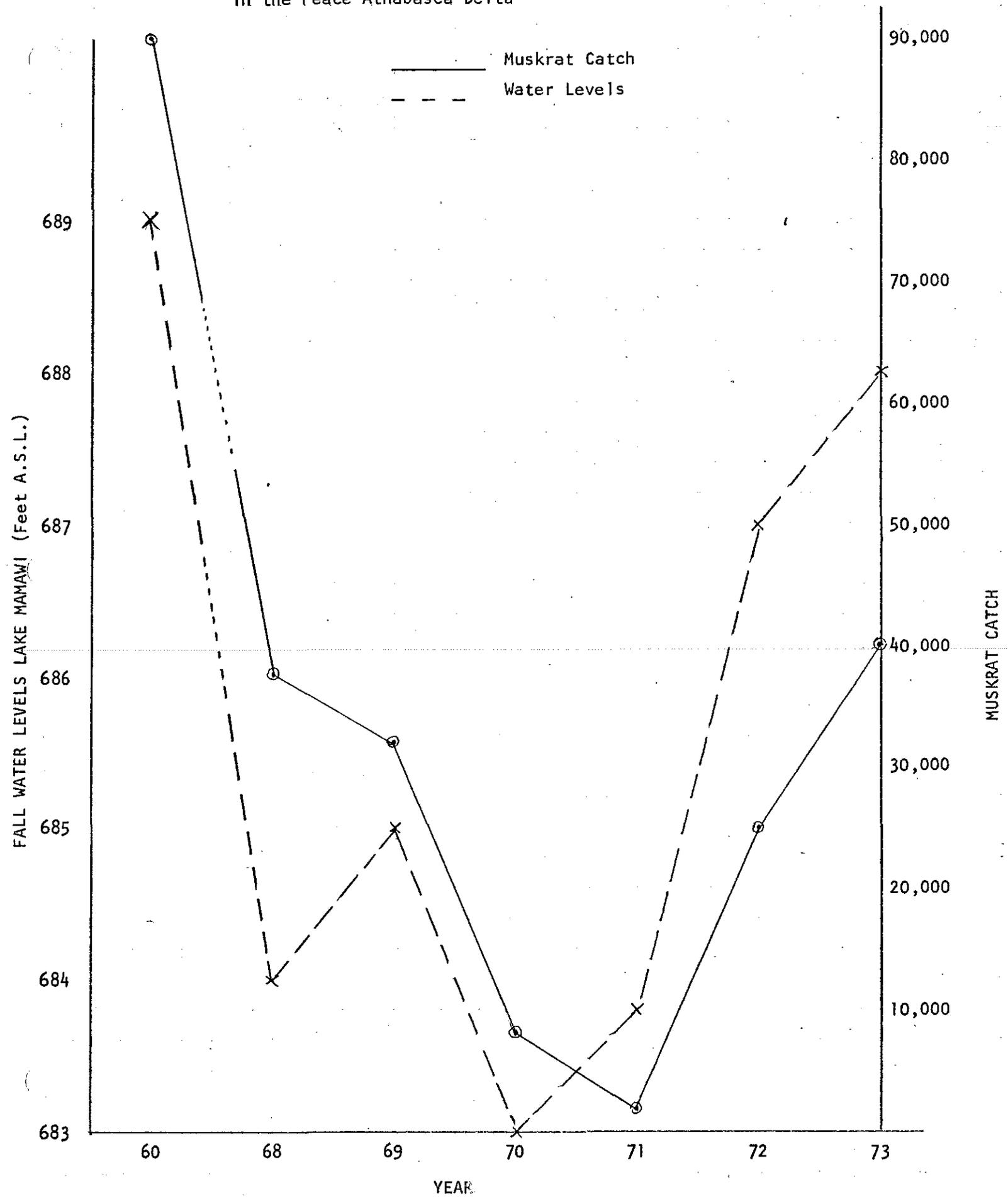
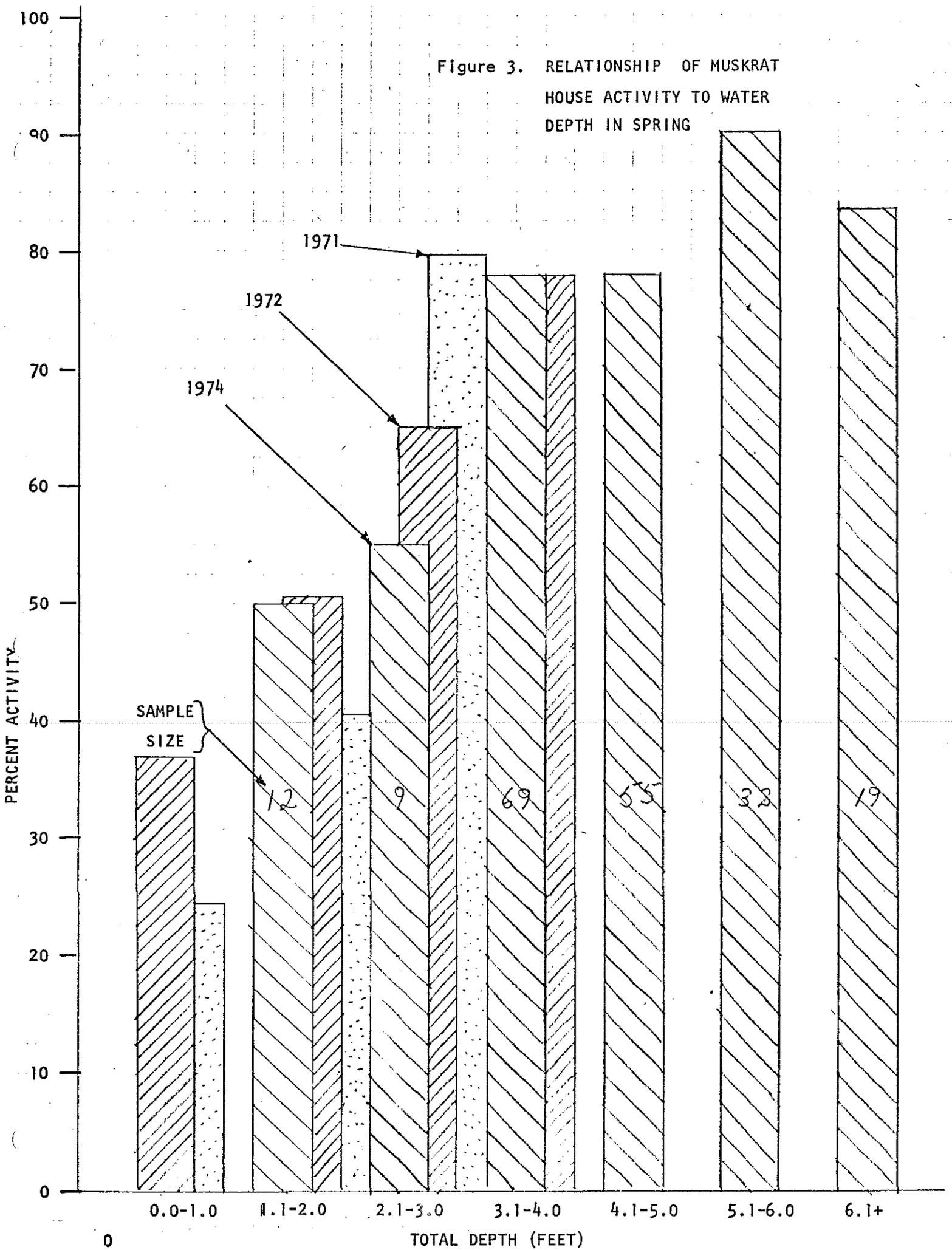


Table 4. Percentage of Houses Active at Various Total Water Depths,
Confidence Limits at 95% Level.

Depth Class	Percent Activity	Sample Size
0.0 - 1.0	0	1
1.1 - 2.0	50 ± .31	12
2.1 - 3.0	55 ± .38	9
3.1 - 4.0	78 ± .09	69
4.1 - 5.0	78 ± .11	55
5.1 - 6.0	90 ± .11	32
6.1 +	83 ± .18	19

Figure 3. RELATIONSHIP OF MUSKRAT HOUSE ACTIVITY TO WATER DEPTH IN SPRING



The Effect of Snow Depth on Ice Thickness and of
Ice Thickness on House Activity

The winter of 1973-74 was a record year for snowfall in Fort Chipewyan. Seventy-three inches fell that winter as compared to the average of 49 inches (Table 5). The high snowfall was probably partially responsible for the high percentage of house activity recorded. Fuller (1951) states: "If, however, frosts are light and snowfall heavy, even shallow lakes may be so well insulated that they do not freeze to the bottom and the muskrats may survive in them through most or all of the winter."

Because measurements were taken during the spring thaw there was no significant correlation between snow depth and ice thickness in 1974. However, measurements taken in March, 1971 reveal a significant correlation between snow depth and ice thickness ($r = -0.52$, $p < 0.01$). Therefore it is assumed the effect of snow depth on ice thickness would be the same in 1974 unless some sudden change in the physical properties of snow has taken place since 1971!

Increased snow depth should then have an indirect effect on muskrat survival by decreasing ice depth which would in turn allow the species greater access to food. On the basis of the rather small number of years of study there appears to be a correlation between snow depth and house activity (Table 6, Figure 4).

Allison and Ambrock (1973) found no significant correlation between ice and water ratio and activity (χ^2 , $p > 0.05$). In contrast, I found a significant correlation (χ^2 , $p < 0.05$) between the two. The average ice and water depths for active and inactive houses is shown in Table 7.

Table 5. Cumulative Snowfall at Fort Chipewyan During Three Winters of Muskrat Survival Studies and the Long-term Averages.

Month	Cumulative Snowfall, Inches			
	70-71	71-72	73-74	Average (1962-72)
OCT.	1.9	6.5	3.2	5.9
NOV.	10.1	11.5	15.7	15.3
DEC.	17.1	23.2	27.4	24.0
JAN.	27.5	32.4	40.7	31.6
FEB.	39.5	35.0	55.8	38.0
MAR.	45.0	39.2	66.6	44.4
APR.	48.5	43.4	73.7	49.3

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In summary it can be inferred that the record snowfall was partially responsible for the high rate of house activity by reducing ice thicknesses thereby relieving environmental stresses on the muskrats.

Table 6. Ground Snowfall and House Activity at Fort Chipewyan During Three Winters of Muskrat Survival Studies

Month	Ground Snow Depth		
	70-71	71-72	73-74
OCT.	1	3	TRACE
NOV.	5	13	9
DEC.	11	14	19
JAN.	21	23	31
FEB.	29	31	43
MAR.	32	34	34
APR.	NIL	NIL	NIL
AVERAGE (OCT-MAR)	17	20	23
PERCENT ACTIVITY OF HOUSES	37	51	78

Figure 4. The Relationship of Snow Depth to House Activity

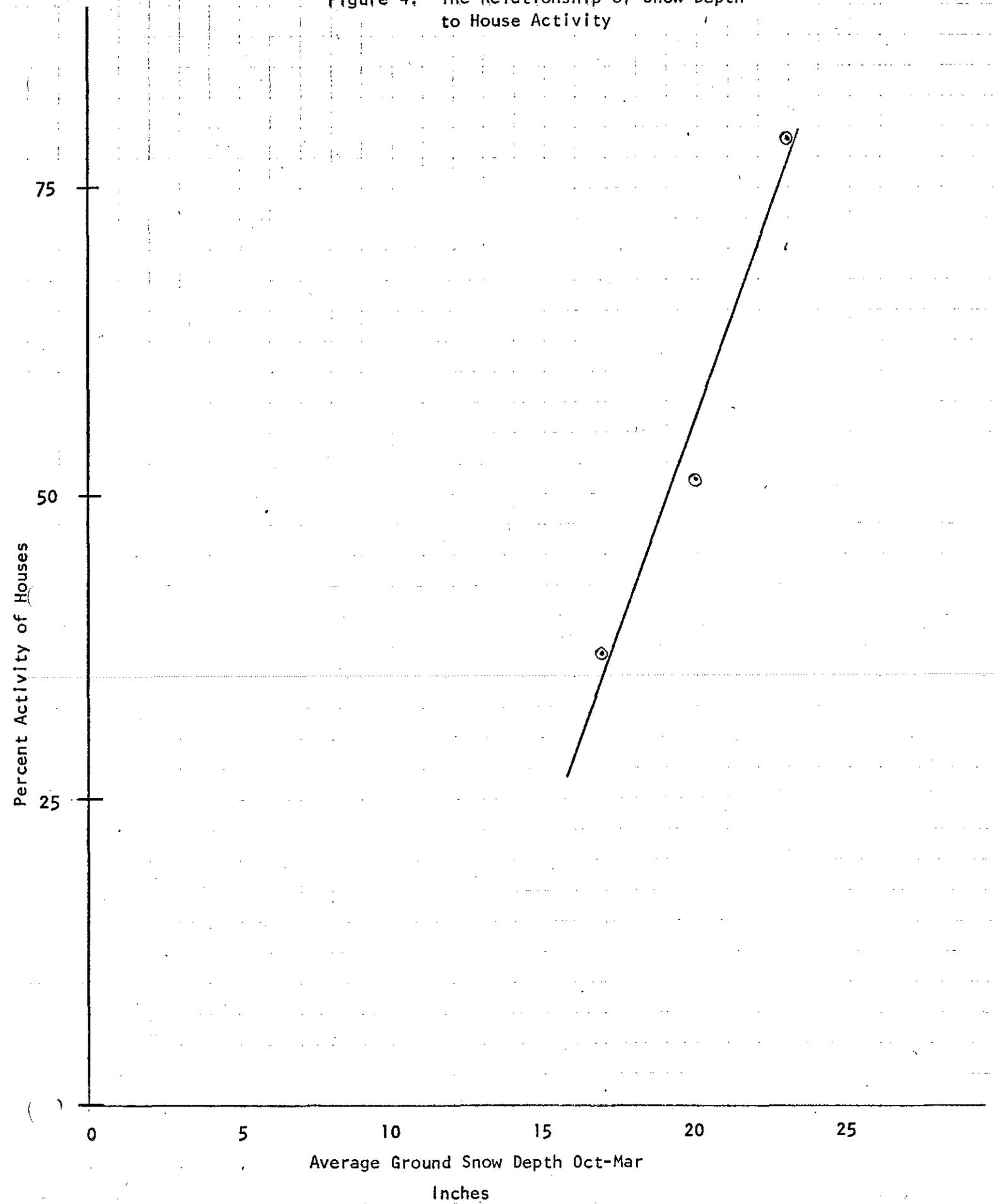


Table 7. Average Ice and Water Depths for Active and Inactive Houses,
Peace-Athabasca Delta,

April, 1974

DEPTHS IN FEET

	Ice	Water	Ice and Water	Ice-Water Ratio
Active	2.24	2.18	4.42	* { 1.03:1.00 1.98:1.00
Inactive	2.87	1.44	4.31	
Average	2.37	2.02	4.39	1.17:1.00

* Significant difference (χ^2 , $p = 0.05$)

Summary and Conclusions

On the basis of a sample of 205 houses, muskrat survival over the winter of 1973-74 was rather high (78%) when compared with the winters of 1970-71 and 1971-72 when survival rates were 37 and 51 percent respectively. The chief cause of this "high" survival was the fall water level, which was about normal for the Delta under natural conditions but high for the area under conditions modified by the Bennet Dam. Under natural conditions survival may have averaged 60-70 percent. This might have been the case in the winter of 1973-74 but the record snowfall of 74 inches probably increased survival somewhat by preventing the formation of thick ice. Deep water may be of no value in survival if there is little snowfall to prevent "freeze-outs."

Literature Cited

Allison L. and K. Ambrock 1973. The Status of the Muskrat in the Peace-Athabasca Delta. Section L. In The Ecological Appendices of the Peace-Athabasca.

Fuller W. A. 1951. Natural History and Economic Importance of the Muskrat In the Peace-Athabasca Delta, Wood Buffalo National Park, Can. Wildl. Serr. Wildl. Mgm't Bul. Ser. 1, No. 2. 80p.