Distribution and Abundance of Dall's Sheep in the Richardson Mountains, August 1991

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ABSTRACT

Aerial block surveys (blocks established in 1984) were conducted on 1 and 3 August 1991 to document the number and distribution of Dall's sheep (*Ovis dalli*) in the Richardson Mountains, Northwest Territories (NWT) and Yukon Territory (YT), Canada. We counted and classified 1,374 sheep including 675 nursery sheep, 289 lambs, 373 rams (99 half curl, 92 three-quarter curl and 182 full curl) and 37 unclassified sheep. The annual rate of increase for the non-lamb portion of the population was 14% per year during 1986 to 1991; the number of full curl rams nearly tripled (increasing from 67 to 182) during this period. There were 43 lambs per 100 nursery sheep; this was exceptional given the survey was done in early August. The majority of lambs and nursery sheep were found in the Goodenough, Lick, Sheep, Rat, and Cache blocks; the majority of rams were found in the Rat block. Overall 70% of the sheep were observed in the NWT.

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INTRODUCTION

The Dall's sheep in the Richardson Mountains are part of an island population at the northernmost extent of their distribution in Canada (Barichello et al. 1987). These sheep and those in the British Mountains, Yukon Territory (YT) are the only populations in Canada that inhabit ranges north of the Arctic Circle and are exposed to rigorous Arctic environments (Barichello et al. 1987). The Richardson Mountains Dall's sheep population is largely unhunted. Gwich'in and Inuvialuit harvest a small number of sheep, primarily ewes and lambs, each year. Some residents of Aklavik have expressed an interest in conducting guided sheep hunts for non-resident hunters since the late 1980s. The Gwich'in Renewable Resources Board, the Department of Environment and Natural Resources, Government of the Northwest Territories, and the Department of Environment, Yukon Territorial Government currently survey this population every three to five years to monitor population trends and productivity.

A number of surveys of this population were conducted by biologists between 1971 and 1986 (Simmons 1973, Hoffman 1974, Nolan and Kelsall 1977, Hoefs 1978, Males 1980, Latour 1984). Population estimates obtained during these surveys suggested that the population had declined from 447 in 1972 (Nolan and Kelsall 1977) to 68 in 1983 (Latour 1984). Barichello et al. (1987) estimated that there were 543 sheep in the area in 1984. As a result, the suspected decline in sheep numbers between 1972 and 1983 may have been a function of survey methods or area surveyed, or both. Barichello et al. (1987) re-surveyed the area in 1985 and 1986 and found that the population had increased to an estimated 617 sheep in 1985 and 802 in 1986, indicating a period of rapid population growth.

In August 1991, we surveyed the study area established in 1984 by Barichello et al. (1987). There were three primary objectives of this survey:

1. Obtain current estimates of the numbers of lambs, nursery sheep, and rams (half, three-quarter, and full curl) in the populations.
2. Document the distribution of rams in the population during mid to late summer.
3. Obtain information that is required to determine the number and distribution of hunting permits within management zones allowable if limited entry sport hunts occur in the future.

This survey was conducted by the Department of Environment and Natural Resources, Inuvik, NWT, in cooperation with the Department of Environment, Whitehorse, YT.

STUDY AREA

The northern Richardson Mountains (67°30' to 68°30' N, 135°30' to 137° W) are in the “Northern Mountains and Coastal Plain” ecological region (Oswald and Senyk 1977) also called the “Cordillera” ecological region in the NWT (Ecological Classification Group 2010) (Figure 1). The central portion of the area is characterized by sharp ridges, rocky slopes and deep V-shaped valleys, and is surrounded by gently rolling terrain. Most of the study area is over 1,500 m above sea level and is composed primarily of sedimentary rock. Permafrost is continuous, temperatures average -9°C annually, and annual precipitation is about 500 mm (Barichello et al. 1987).

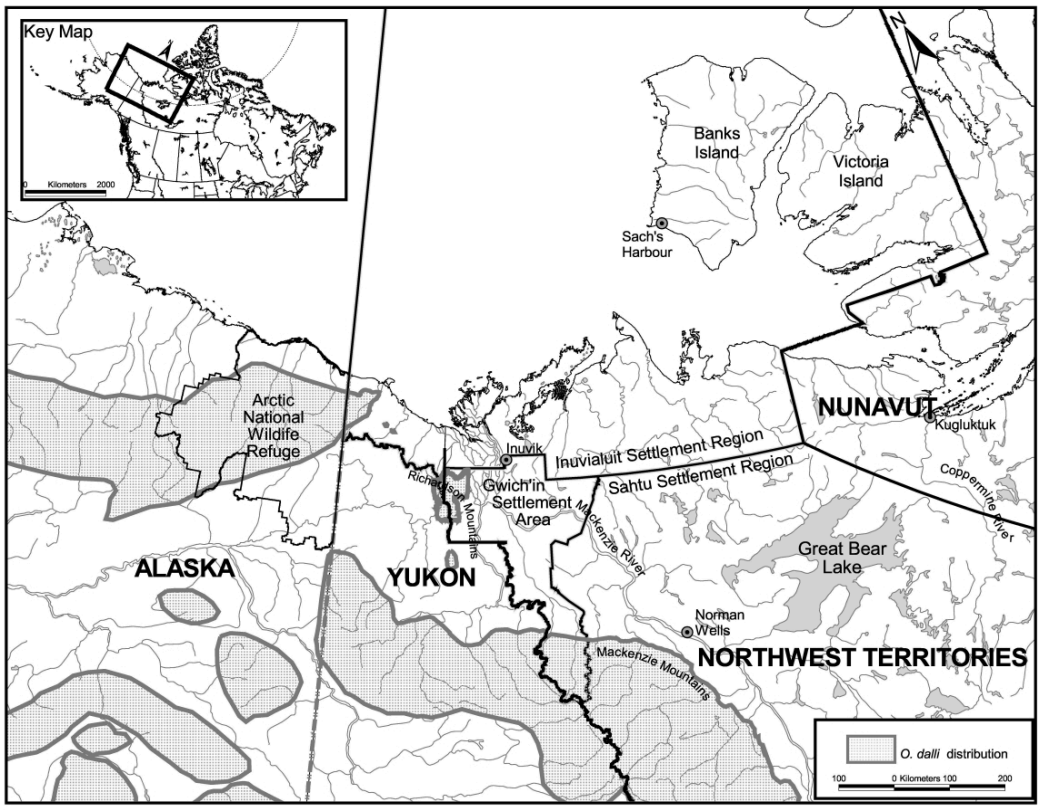

Figure 1. Location of the northern Richardson Mountains Dall's sheep study area.

The study area is approximately 3,000 km^2 (Figure 2). Black spruce (*Picea mariana*) and balsam poplar (*Populus balsamifera*) occur in protected valleys. Tussock tundra (*Carex* spp. and *Eriophorum* spp.) dominates valley bottoms to mid-slopes (Barichello et al. 1987). Alpine vegetation dominates ridge tops at higher elevations. Barichello et al. (1987) suggested that 50% of the area could be considered potential sheep habitat with most of this occurring above the treeline where forage and escape terrain are available.

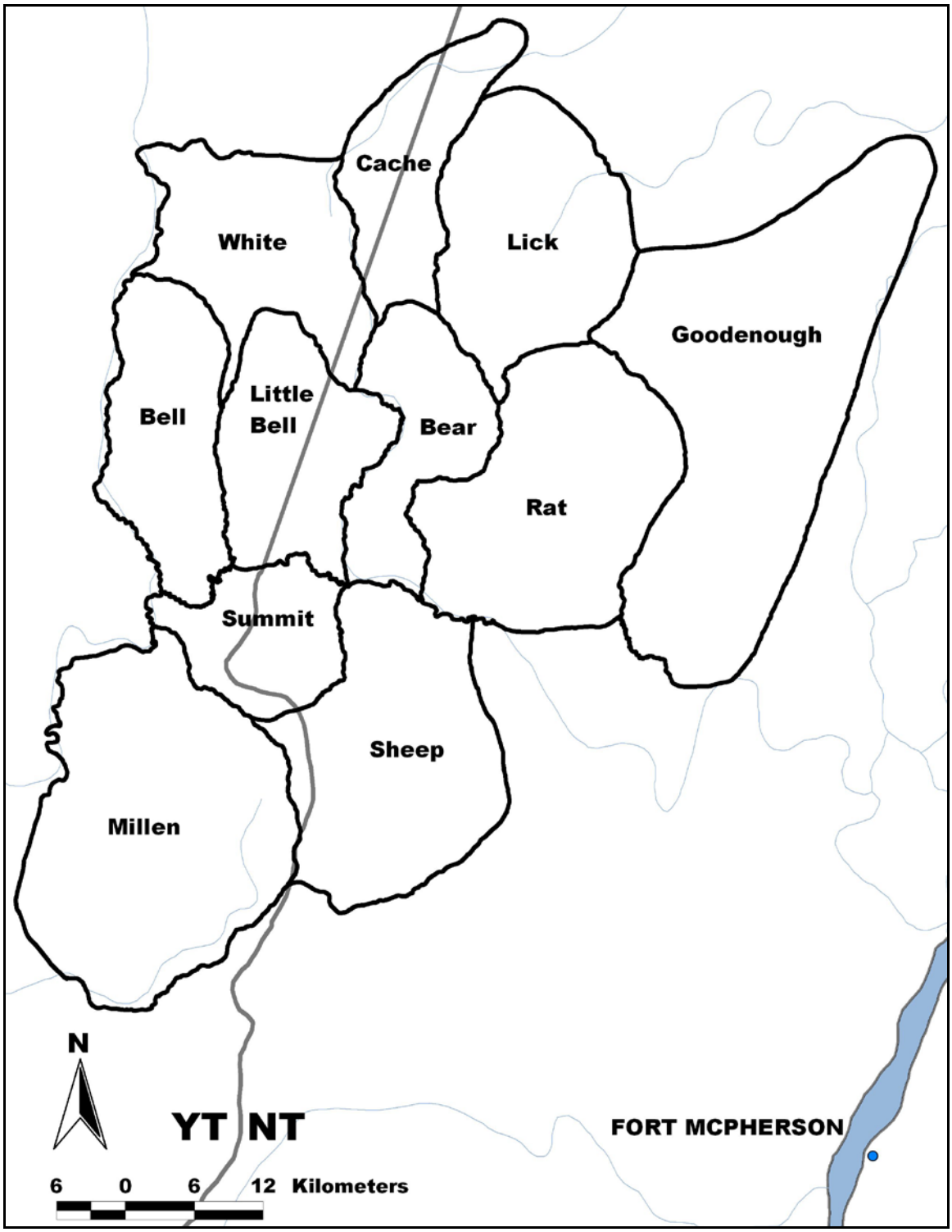

Figure 2. Blocks surveyed in the northern Richardson Mountains, August 1991.

Moose (*Alces americanus*) occur in low numbers throughout the eastern portion of the study area but are generally found along valley bottoms. The Porcupine caribou

herd (*Rangifer tarandus granti*) migrates through the area during spring and autumn (Porcupine Caribou Technical Committee 1993). In some years, a portion of this herd summers and winters in the area. A few muskoxen (*Ovibos moschatus*) have been observed. Grizzly bears (*Ursus arctos*), wolves (*Canis lupus*), wolverine (*Gulo gulo*), and golden eagles (*Aquila chrysaetos*) are relatively common.

METHODS

The survey blocks delineated by Barichello et al. (1987) were systematically surveyed (Figure 2). Complete coverage was obtained by contouring mountain blocks and river drainages using a helicopter flying at approximately 100 km/h and 200 m above ground. Sheep were counted and classified by sex and age class as follows: nursery sheep (ewes, yearlings, and two-year-old rams), lambs, and rams (half, three-quarter, and full curl). Nursery groups were classified as yearlings, young rams, and ewes whenever possible. The location of each observation was recorded on 1:250,000 NTS topographic maps. These were digitized to obtain longitude and latitude coordinates for each location. The results of the survey were summarized by survey block and for the population. The exponential rate of change of the population was estimated as follows (Caughley 1980):

$$\log_e e^r = r$$

The number of lambs per 100 nursery sheep was calculated for each survey block and for the study area. We determined the number of lambs, nursery sheep, rams and all sheep that occurred in the NWT and YT during the survey. Maps showing the distribution of lambs, nursery sheep, rams, and all sheep were created in ArcView 3.2 (Environmental Systems Research Institute).

RESULTS

This survey was completed on 1 and 3 August 1991. Weather conditions were generally favorable. On 1 August, the weather was calm and clear when we started the survey but became high overcast during the day. We had overcast conditions during the day and scattered showers late in the day on 3 August.

Population Size and Trend

A total of 1,374 sheep were counted and classified in the study area. This included 675 nursery sheep, 289 lambs, 373 rams (99 half curl, 92 three-quarter curl and 182 full curl), and 37 unclassified (Table 1, Appendix A). We did not correct our total count for observer bias as it was not measured during the survey. The non-lamb portion of the population increased from 657 in 1986 to 1,085 in 1991, (Figure 3) giving an annual rate of increase of 14% per year during this five-year period (Figure 4). The full curl ram portion of the population increased from 67 in 1986 to 182 in 1991, giving an annual rate of increase of 34% per year during this five-year period (Figure 5).

Table 1. Classification of Dall's sheep by survey block in the northern Richardson Mountains, 1 and 3 August 1991.

Survey Block	Nursery Sheep				Lambs	Rams				Unclassified	Total Sheep
	Ewes	Yearlings	Unclassified	Total		Half curl	Three-quarter curl	Full curl	Total		
Millen	2	2	39	43	23	10	6	30	46	0	112
Sheep	8	1	82	91	42	8	9	6	23	0	156
Summit	3	0	25	28	9	2	3	1	6	0	43
Bell	2	0	47	49	9	6	5	11	22	0	80
Little Bell	2	0	23	25	11	6	11	25	42	0	78
White	4	0	18	22	11	12	12	21	45	0	78
Cache	18	1	53	72	33	1	0	0	1	0	106
Lick	12	0	87	99	44	2	0	0	2	0	145
Bear	0	0	28	28	9	11	12	16	39	0	76
Rat	3	4	63	70	33	31	23	49	103	0	206
Goodenough	7	3	138	148	65	10	11	23	44	37	294
Total	**61**	**11**	**603**	**675**	**289**	**99**	**92**	**182**	**373**	**37**	**1,374**

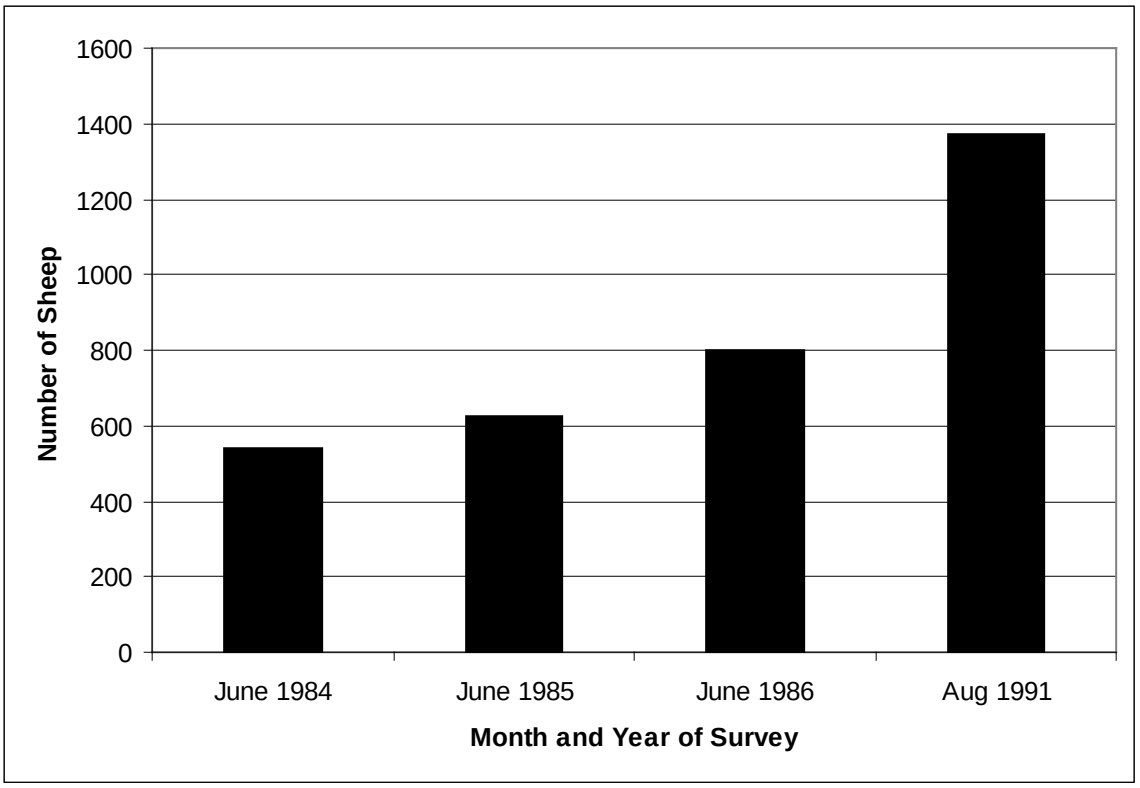

Figure 3. The number of Dall's sheep in the Richardson Mountains population during surveys conducted during the period 1984 to 1991.

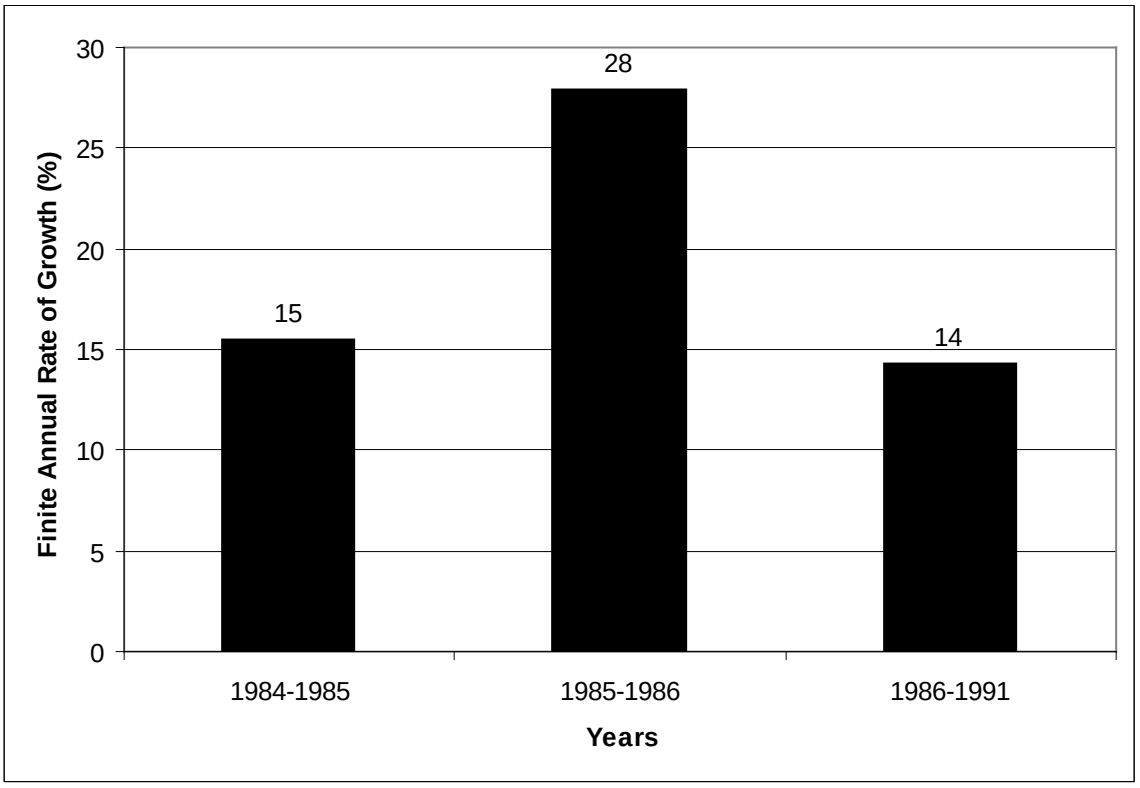

Figure 4. Finite annual rate of population growth for the Dall's sheep population in the Richardson Mountains during the period 1984 to 1991.

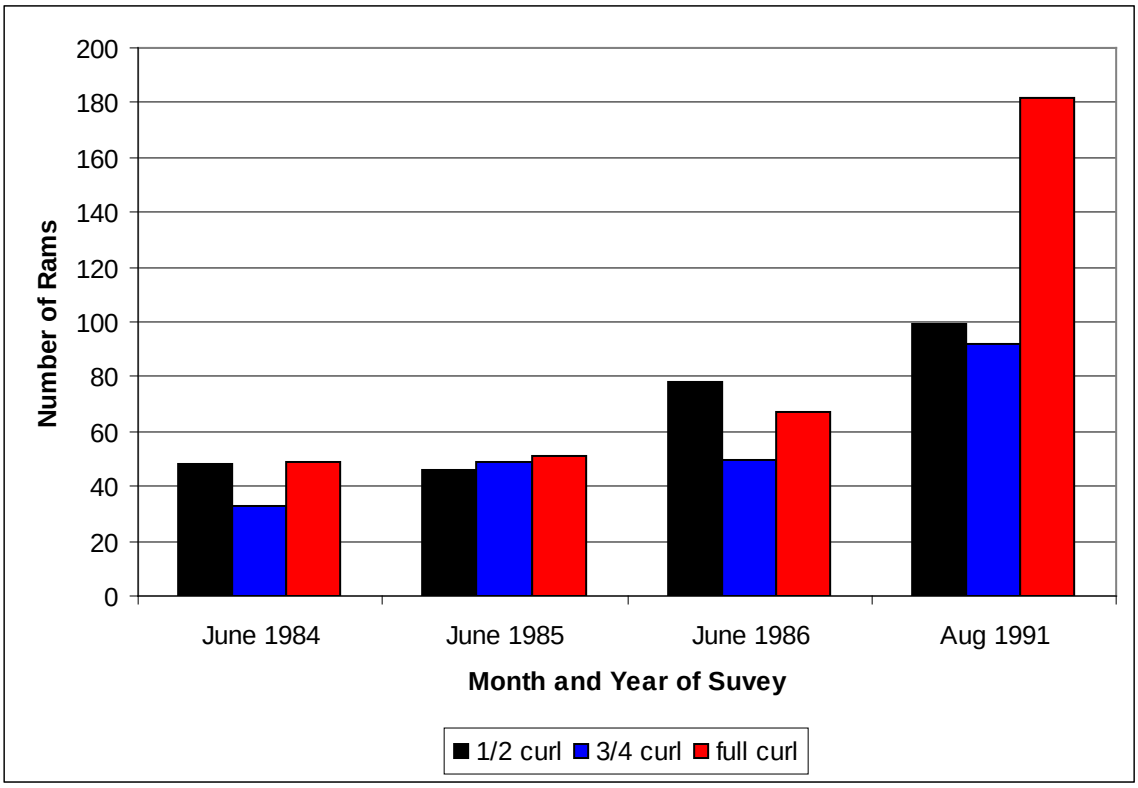

Figure 5. Number of half curl, three-quarter curl, and full curl rams in the Richardson Mountains population, 1984 to 1991.

Productivity and Recruitment

The lambs to nursery sheep ratio of 43 lambs per 100 nursery sheep was exceptional given that the survey was conducted in early August (Table 2, Figure 5). Such high rates of lamb production would allow for the 14% average annual growth rate of the non-lamb portion of the population.

The number of rams increased from a total of 197 in 1987 to 373 in 1991. The number of full curl rams increased from 67 to 182 during this period.

Table 3 gives the composition of sheep in the study areas during surveys conducted during 1984 to 1991.

Table 2. Some demographic characteristics of the Dall's sheep population by survey block in the northern Richardson Mountains study area, 1 and 3 August 1991.

Survey Block	Lambs per 100 Nursery Sheep	Total Non-lamb Sheep	Percentage Full Curl Rams of Total Rams	Rams per 100 Nursery Sheep
Millen	53	89	65	107
Sheep	46	114	26	25
Summit	32	34	17	21
Bell	18	71	50	45
Little Bell	44	67	60	168
White	50	67	47	205
Cache	46	73	0	1
Lick	44	101	0	2
Bear	32	67	41	139
Rat	47	173	48	147
Goodenough	44	229	52	30
Total Area Surveyed	**43**	**1,085**	**49**	**55**

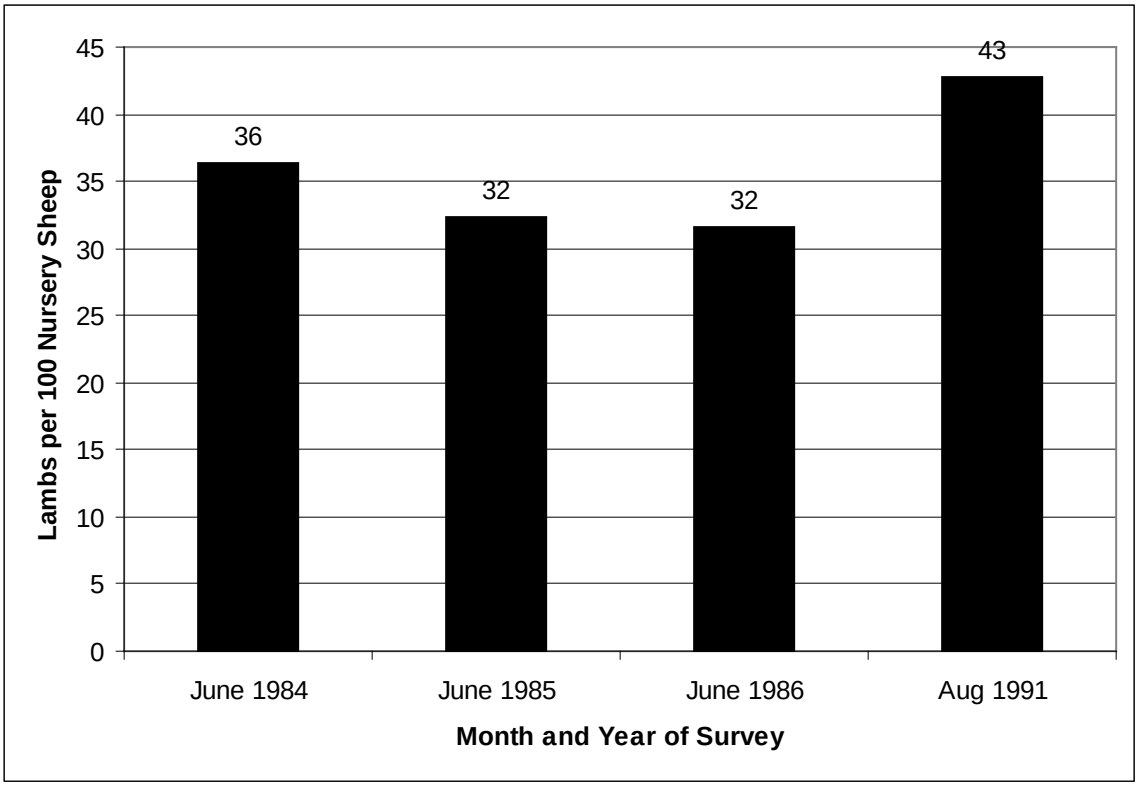

Figure 6. Number of lambs per 100 nursery sheep in the Richardson Mountains Dall's sheep population, 1984 to 1997.

Table 3. Demographic characteristics of the Dall's sheep population during years when all survey blocks were flown.

Year[1]	No. by Class			All Sheep	Number per 100 Nursery Sheep		Percentage of Rams		
	Lambs	Nursery	Rams		Lambs	Rams	Half Curl	Three-quarter Curl	Full Curl
1984[2]	110	302	131	543	36.4	43.4	36.6	25.2	37.4
1985[2]	117	362	148	627	32.3	40.9	31.1	33.1	34.5
1986[2]	145	460	197	802	31.5	42.8	39.6	25.4	34.0
1991	289	675	373	1374	42.8	55.3	26.5	24.7	48.8

[1] The Bell, Millen, and White blocks were not surveyed in 1997. As a result the 1997 data were not included in this table.

[2] Barichello et al. 1987

Distribution of Lambs, Nursery Sheep, and Rams

The sites where we located lambs, nursery sheep, and rams in the Richardson Mountains during the survey are shown in Figures 7 through 10.

The majority of the lambs and nursery sheep were in the Goodenough, Lick, Sheep, Rat, and Cache blocks (Figures 10 and 11). Rams were essentially absent from the Cache, Lick, and Summit blocks (Figures 9 and 12). The majority of the rams were found in the Rat block, with the remainder distributed among the remaining blocks.

The majority of the nursery sheep (73%) and lambs (75%) and half curl (66%), three-quarter curl (63%), and full curl rams (52%) occupied areas in the NWT and overall, 70% of the sheep observed were observed in the NWT (Table 4).

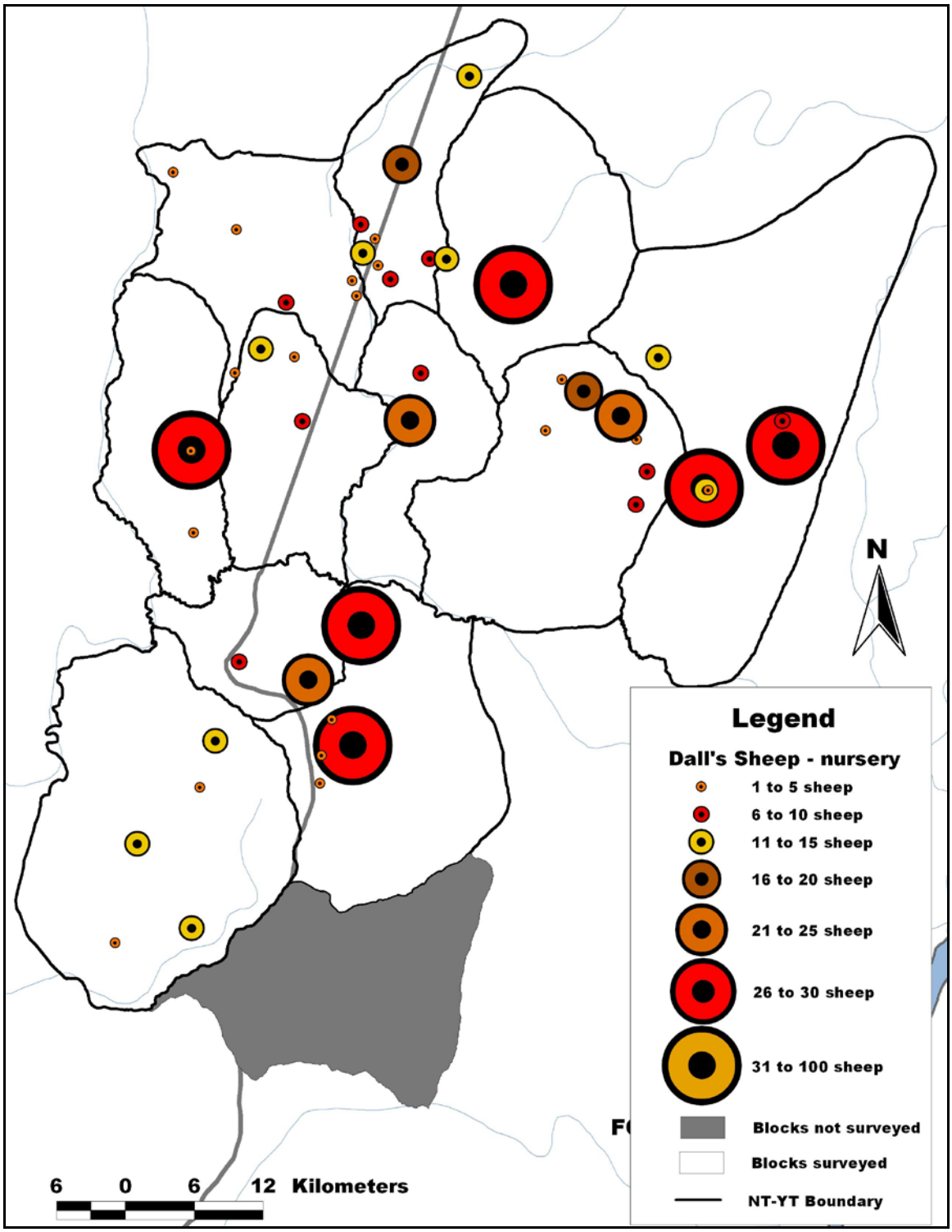

Figure 7. Distribution of nursery Dall's sheep in the northern Richardson Mountains, 1 and 3 August 1991.

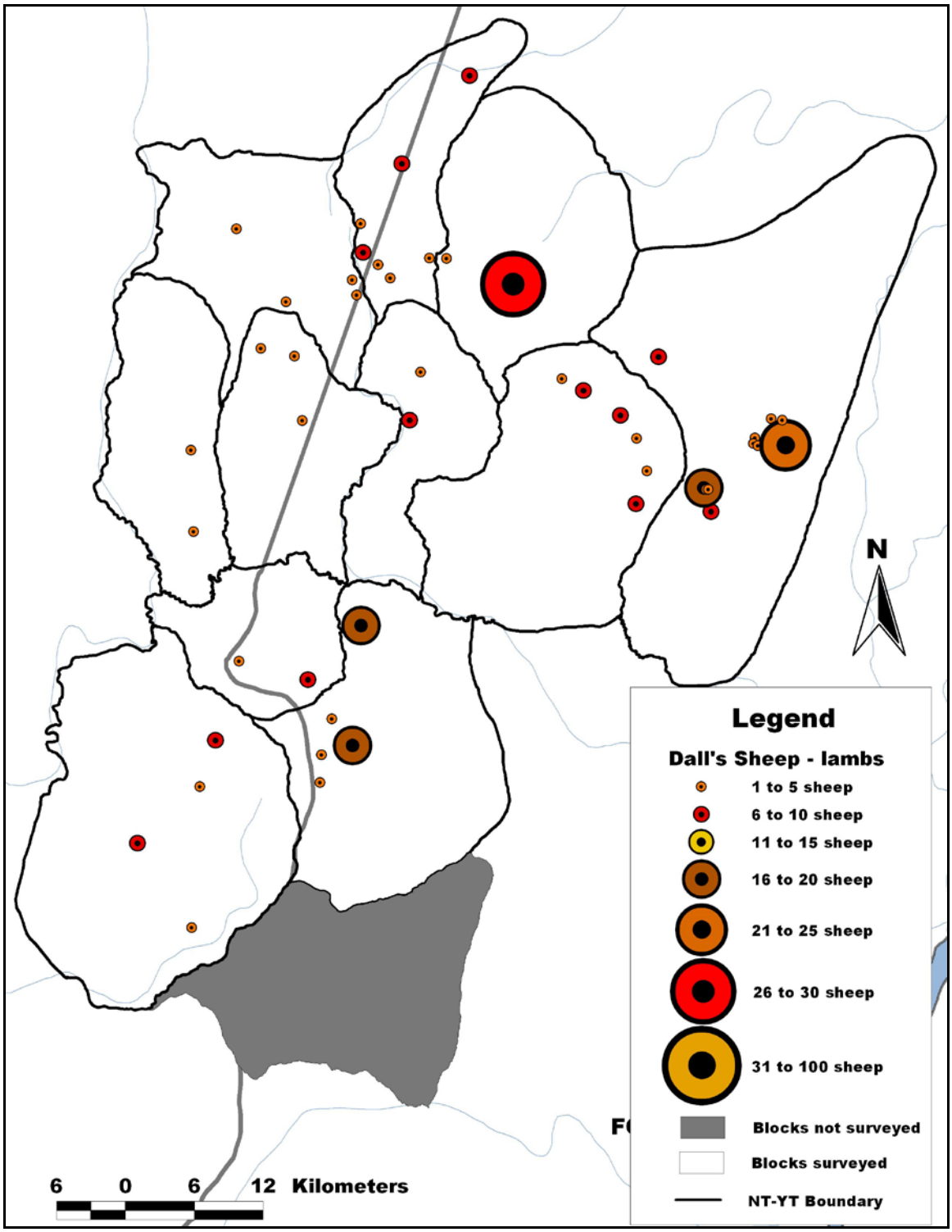

Figure 8. Distribution of lamb Dall's sheep in the northern Richardson Mountains, 1 and 3 August 1991.

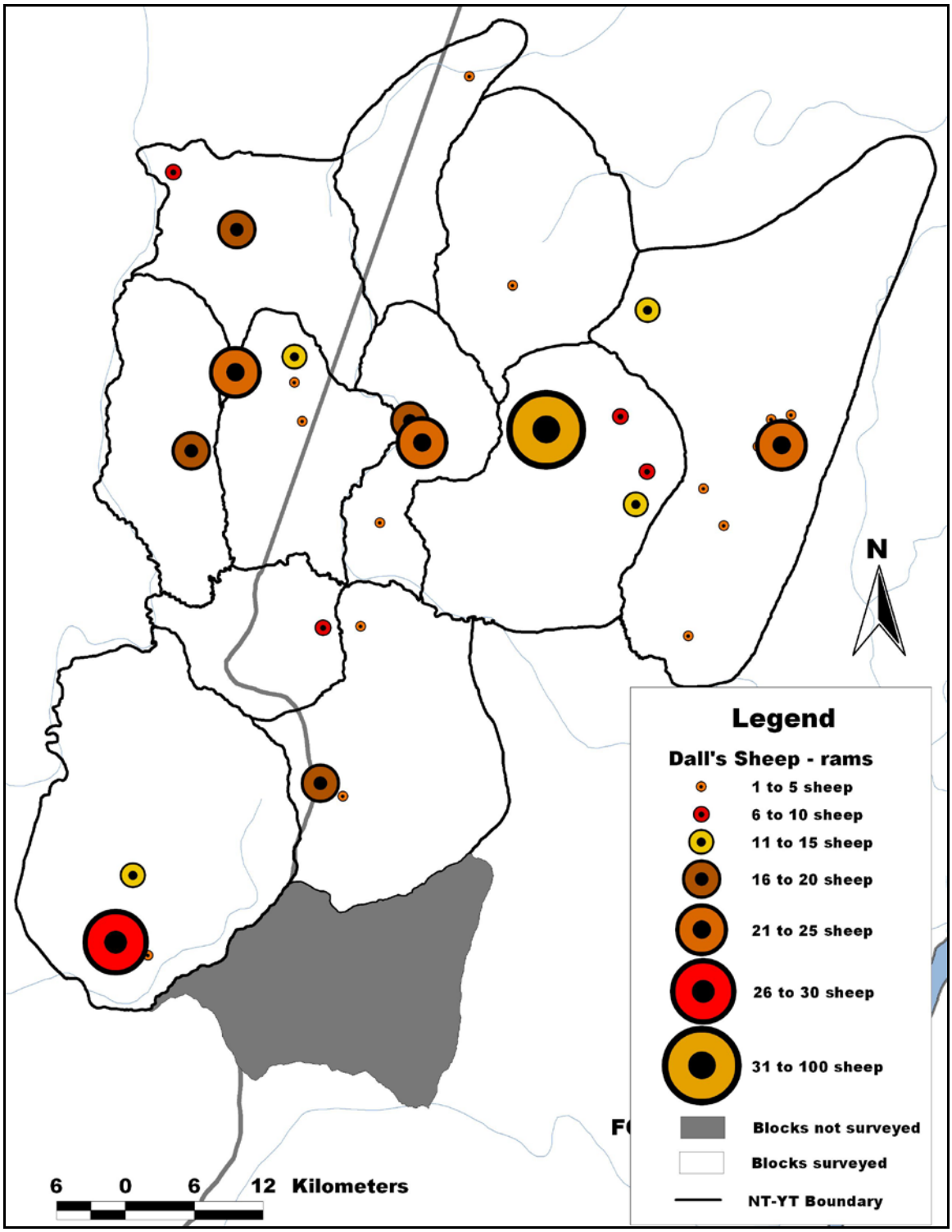

Figure 9. Distribution of ram Dall's sheep (half curl, three-quarter curl, and full curl) in the northern Richardson Mountains, 1 and 3 August 1991.

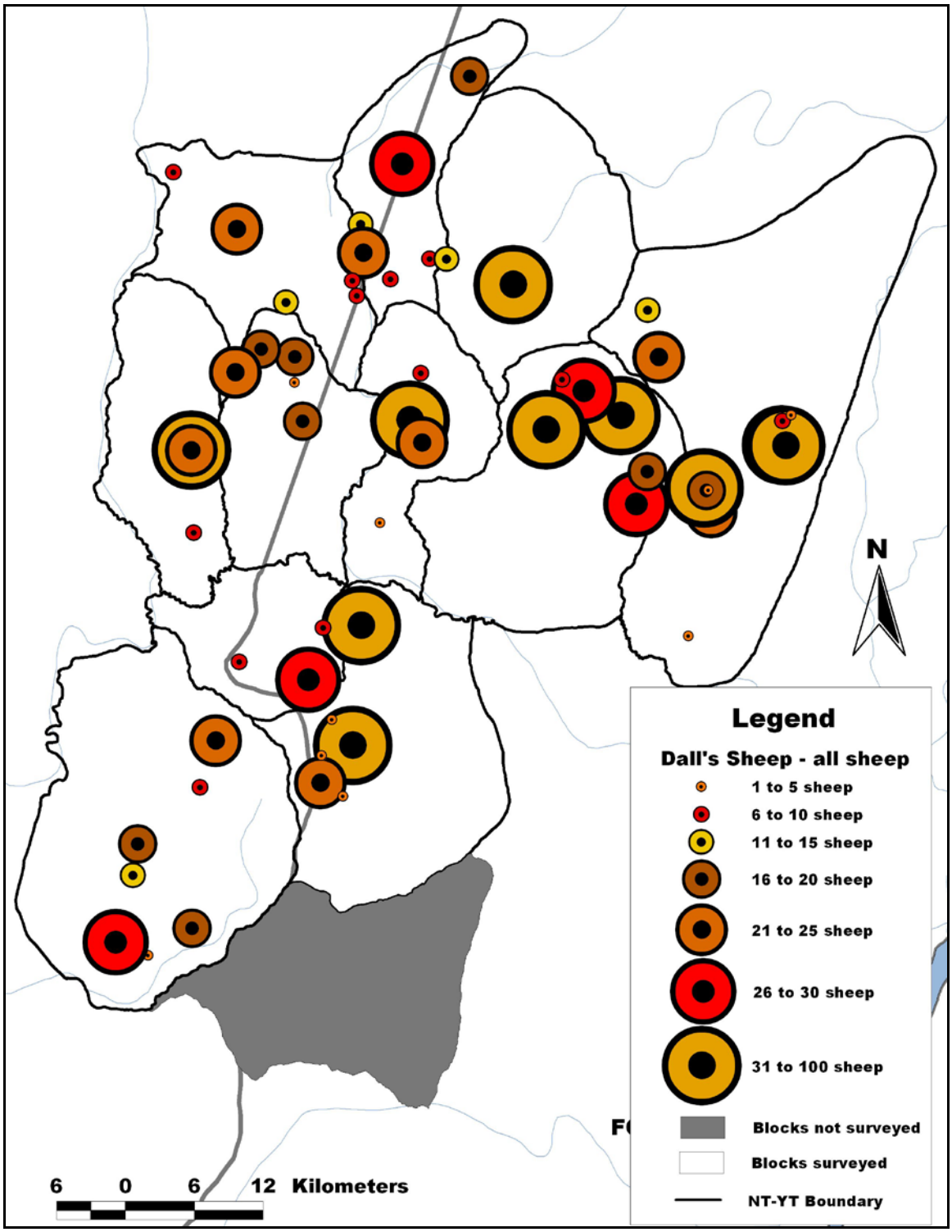

Figure 10. Distribution of Dall's sheep (nursery, lambs, and rams) in the northern Richardson Mountains, 1 and 3 August 1991.

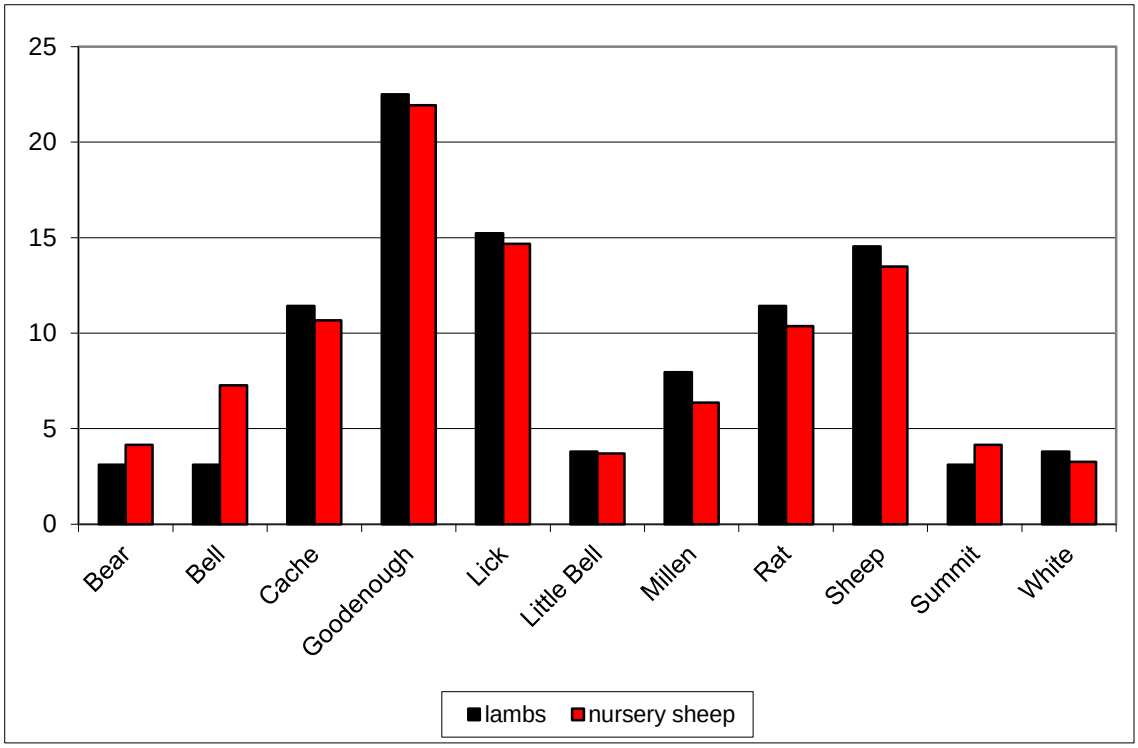

Figure 11. Percentage of the total number of lambs and nursery sheep found in each block surveyed during August 1991.

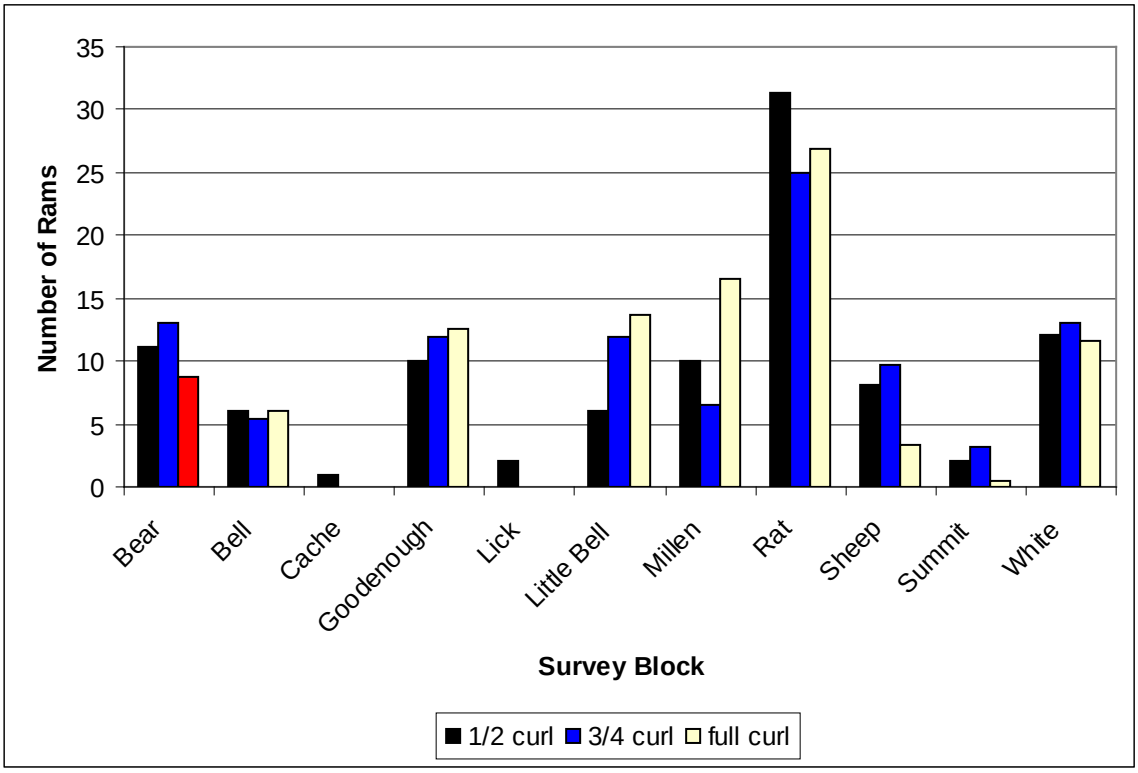

Figure 12. Percent of the total number of half, three-quarter, and full curl rams found in each block surveyed during August 1991.

Table 4. Number of Dall's sheep by class in the NWT and YT, August 1991.

Year	Class of Sheep	NT		YT		**Total**
		#	Percentage	#	Percentage	
1991	Nursery	494	73	184	27	**675**
	Lambs	215	75	71	25	**289**
	Half curl ram	65	66	34	34	**99**
	Three-quarter curl ram	58	63	34	37	**92**
	Full curl ram	95	52	87	48	**182**
	Total	**964**	**70**	**410**	**30**	**1,374**

DISCUSSION

The Dall's sheep population continued to increase between 1986 and 1991. Lamb to nursery sheep ratios were exceptional, indicating high productivity and lamb survival to late summer. The number of full curl rams in the population nearly tripled during this five-year period. Most of the sheep observed during the survey were in the NWT.

ACKNOWLEDGEMENTS

Ricky Joe (Aklavik) and Cliff Cook (GNWT RRO, Aklavik) assisted as observers during the survey. Jim Hodges (Sunrise Helicopters, Inuvik) provided excellent flying skills.

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APPENDIX A. Classification of Dall's sheep by observation location and survey block in the northern Richardson Mountains, 1 and 3 August 1991.

				Nursery Sheep					Rams					Total
Block	Sighting	Latitude	Longitude	Ewes	Yearlings	Unclassified	Total	Lambs	1/2 curl	3/4 curl	4/4 curl	Total	Unclassified	Sheep
Bear	32	67.90	-136.27	0	0	6	6	1	0	0	0	0	0	7
Bear	33	67.86	-136.26	0	0	22	22	8	10	4	3	17	0	47
Bear	34	67.85	-136.22	0	0	0	0	0	1	8	12	21	0	21
Bear	50	67.78	-136.25	0	0	0	0	0	0	0	1	1	0	1
Bell	30	-	-	0	0	43	43	5	2	0	0	2	0	50
Bell	71	67.73	-136.60	1	0	4	5	3	0	0	0	0	0	8
Bell	72	67.78	-136.66	1	0	0	1	1	4	5	11	20	0	22
Cache	11	68.13	-136.37	8	1	3	12	6	1	0	0	1	0	19
Cache	12	68.05	-136.44	3	0	17	20	9	0	0	0	0	0	29
Cache	13	67.99	-136.48	0	0	8	8	3	0	0	0	0	0	11
Cache	14	67.99	-136.45	0	0	1	1	0	0	0	0	0	0	1
Cache	15	67.97	-136.42	0	0	3	3	2	0	0	0	0	0	5
Cache	16	67.96	-136.39	0	0	7	7	3	0	0	0	0	0	10
Cache	17	67.97	-136.46	4	0	10	14	7	0	0	0	0	0	21
Cache	20	67.99	-136.33	3	0	4	7	3	0	0	0	0	0	10
Goodenough	1	67.95	-135.55	1	1	0	2	1	0	1	0	1	0	4
Goodenough	2	67.94	-135.57	1	0	0	1	1	0	0	0	0	0	2
Goodenough	3	67.93	-135.57	0	1	3	4	1	0	0	0	0	0	5
Goodenough	4	67.93	-135.56	0	0	4	4	2	1	0	0	1	0	7
Goodenough	5	67.94	-135.52	0	0	1	1	0	0	0	0	0	0	1
Goodenough	6	67.94	-135.51	0	0	0	0	5	0	4	17	21	37	63
Goodenough	7	67.94	-135.50	2	0	41	43	21	0	0	0	0	0	64
Goodenough	8	67.96	-135.53	1	0	6	7	3	0	0	0	0	0	10

				Nursery Sheep					Rams					Total
Block	Sighting	Latitude	Longitude	Ewes	Yearlings	Unclassified	Total	Lambs	1/2 curl	3/4 curl	4/4 curl	Total	Unclassified	Sheep
Goodenough	9	67.96	-135.51	0	0	0	0	0	0	0	1	1	0	1
Goodenough	10	68.00	-135.86	0	0	0	0	0	6	2	3	11	0	11
Goodenough	37	67.77	-135.57	0	0	0	0	0	1	2	1	4	0	4
Goodenough	38	67.86	-135.57	0	0	0	0	0	1	0	1	2	0	2
Goodenough	39	67.87	-135.61	0	1	12	13	8	0	0	0	0	0	21
Goodenough	40	67.89	-135.64	1	0	60	61	17	1	2	0	3	0	81
Goodenough	41	67.89	-135.63	0	0	11	11	5	0	0	0	0	0	16
Goodenough	42	67.89	-135.63	1	0	0	1	1	0	0	0	0	0	2
Lick	21	67.99	-136.29	0	0	11	11	2	0	0	0	0	0	13
Lick	22	67.99	-136.14	7	0	63	70	29	2	0	0	2	0	101
Lick	25	-	-	1	0	3	4	3	0	0	0	0	0	7
Lick	26	-	-	4	0	10	14	10	0	0	0	0	0	24
Little Bell	51	67.84	-136.46	0	0	10	10	5	2	0	0	2	0	17
Little Bell	52	67.86	-136.51	0	0	0	0	0	0	0	2	2	0	2
Little Bell	53	67.88	-136.52	1	0	0	1	1	3	4	8	15	0	17
Little Bell	54	67.88	-136.59	0	0	13	13	4	0	0	0	0	0	17
Little Bell	73	67.85	-136.63	1	0	0	1	1	1	7	15	23	0	25
Mt Millen	63	67.58	-136.42	0	0	13	13	9	0	0	0	0	0	22
Mt Millen	64	67.54	-136.42	0	0	4	4	3	0	0	0	0	0	7
Mt Millen	66	67.43	-136.34	0	0	12	12	4	0	0	0	0	0	16
Mt Millen	67	67.40	-136.41	0	0	0	0	0	0	0	5	5	0	5
Mt Millen	68	67.40	-136.48	0	0	1	1	0	6	3	18	27	0	28
Mt Millen	69	67.46	-136.49	0	0	0	0	0	4	3	7	14	0	14
Mt Millen	70	67.48	-136.50	2	2	9	13	7	0	0	0	0	0	20
Rat	43	67.86	-135.76	1	2	7	10	6	4	5	4	13	0	29
Rat	44	67.88	-135.76	0	0	9	9	3	1	1	4	6	0	18
Rat	45	67.91	-135.80	0	0	5	5	3	0	0	0	0	0	8
Rat	46	67.92	-135.85	0	0	21	21	8	3	2	1	6	0	35

				Nursery Sheep					Rams					Total
Block	Sighting	Latitude	Longitude	Ewes	Yearlings	Unclassified	Total	Lambs	1/2 curl	3/4 curl	4/4 curl	Total	Unclassified	Sheep
Rat	47	67.93	-135.93	1	2	13	16	10	0	0	0	0	0	26
Rat	48	67.93	-135.98	1	0	4	5	3	0	0	0	0	0	8
Rat	49	67.89	-135.98	0	0	4	4	0	23	15	40	78	0	82
Sheep	55	67.61	-136.15	3	0	49	52	20	0	0	0	0	0	72
Sheep	56	67.57	-136.19	1	0	0	1	3	4	7	6	17	0	21
Sheep	57	67.57	-136.14	0	0	0	0	0	1	2	0	3	0	3
Sheep	58	67.59	-136.20	1	0	0	1	1	0	0	0	0	0	2
Sheep	59	67.62	-136.21	0	1	2	3	2	0	0	0	0	0	5
Sheep	60	67.70	-136.21	3	0	31	34	16	3	0	0	3	0	53
Summit	61	67.69	-136.29	0	0	0	0	0	2	3	1	6	0	6
Summit	62	67.65	-136.28	3	0	19	22	7	0	0	0	0	0	29
Summit	65	67.64	-136.42	0	0	6	6	2	0	0	0	0	0	8
White	18	67.95	-136.46	1	0	4	5	3	0	0	0	0	0	8
White	19	67.94	-136.44	0	0	5	5	2	0	0	0	0	0	7
White	27	67.92	-136.58	1	0	8	9	4	0	0	0	0	0	13
White	28	67.98	-136.89	0	0	1	1	0	4	3	1	8	0	9
White	29	67.96	-136.72	0	0	0	0	0	0	5	13	18	0	18
White	31	-	-	2	0	0	2	2	8	4	7	19	0	23