2002 DAWSON MOOSE SURVEY SUMMARY

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2002 Dawson Moose Survey Summary

We completed a moose survey south and east of Dawson between November 28 and December 6, 2002. The survey area extended from the Klondike Highway south to the Stewart River and from the Yukon River eastward to Australia Mountain (see attached Map 1). It includes Game Management Subzones (GMSs) 3-07, 3-08, and 3-10 through 3-12. It covers a total area of about 5983 square kilometers (km^2), of which 5913 km^2 (2283 square miles) is habitable moose range. The entire survey area is of relatively low elevation (<1500 meters), and with the exception of those portions of the Yukon River falling within the survey boundary, all is considered moose habitat.

This survey was part of the Yukon Governments' ongoing monitoring of high priority moose populations throughout the Yukon (i.e. those experiencing relatively high harvest and/or threats to habitat). The western portion of the area (GMS 3-07 and 3-10) is recognized as a popular moose hunting area with an extensive road network. Exploration and mining activities have also resulted in widespread habitat modification. Moose counts of this portion of our 2002 survey area were previously conducted in 1989 (see Larsen and Ward 1991), and 1997 (Map 1).

Survey Methods

We used a survey technique recently developed by Jay Ver Hoef, with the Alaska Department of Fish and Game, during our 2002 Dawson survey. The technique involves a series of four steps. First, the survey area is divided into sample units based on a latitude and longitude grid. Each sample unit is delineated by 2 minutes of latitude and 5 minutes of longitude and encompasses between 15 and 16 km^2. The 2002 Dawson survey area contains 390 sample units (see Map 2). The area is then "stratified" to determine whether each unit is likely to contain many or few moose. This is accomplished by flying quickly over each sample unit and assessing expected moose abundance on the basis of local knowledge, habitat and moose sign observed. Map 2 shows the distribution of high and low moose abundance units throughout the survey area. Stratification of the Dawson survey area was done in 2000. We assume that relative moose abundance in the sample units did not change significantly between years.

We can not afford to count moose in every sample unit, so the third step is to select a sample of the units where we expect to see lots of moose, and a sample of those where we expect to see few moose. Most units are selected randomly, but about 10% are arbitrarily selected to fill in geographic holes in our sampling. During the 2002 Dawson survey we selected and counted moose in 69 of the 390 blocks in the entire survey area. We search selected units intensively using a 2-person team (pilot and observer) in a small maneuverable aircraft (Piper PA 18 Super-Cub or similar). Global Positioning System (GPS) receivers are used to identify sample unit boundaries and determine whether moose seen are in, or outside our selected sample units. On average we use about 30 to 35 minutes to search each unit and attempt to count every moose present. We do not develop a sightability correction factor (SCF) to make allowance for moose not seen during our intensive searches. Whenever possible, moose observed are classified as calves, yearlings, mature cows, or mature bulls. From the sample counts, we then estimate the total number of moose in the entire survey area.

We use a combination of standard Stratified Random Block (SRB; Gasaway et al. 1986, Reed 1989) and the recently developed Finite Population Block Kriging (Ver Hoef 2001) methods to estimate moose population size and composition for the entire survey area. We use the Stratified Random Block method to calculate interim population size, composition and confidence interval estimates while in the field. After the survey is completed, the survey data are sent to Dr. Ver Hoef in Alaska for analysis using the kriging method. The kriging method has the advantages of generally providing more precise estimates of population size and composition for the entire area or sub-portion of the survey area, and does not require that sample units be selected randomly for the census portion of the survey.

We used two-tailed "Student's *t*" or "standard normal" (z) tests to check for significant changes in moose population abundance. Chi-square contingency tables with Yates correction were used to test for differences in population composition between years and between sub-portions of the survey area in the same year. An alpha level of 0.10 was used in all analyses.

Several differences in survey technique, timing, and weather conditions make it difficult to directly compare the 2002 results with those of earlier surveys. The 1989 and 1997 surveys used

modified Gasaway SRB survey techniques (see Ward et al. 2000). These involved using a helicopter with a pilot and 3 observers, in place of the small fixed-wing aircraft with a pilot and one observer used in 2002. Although past comparisons of the number of moose missed using these two techniques have provided mixed results, it is clear that the workload on the crew of two in the fixed-wing aircraft is much higher than on the crew of four in the helicopter. It is therefore likely that as survey conditions deteriorate, more moose are missed by the fixed-wing crew than by the helicopter crew.

In contrast to the 1989 and 1997 surveys, snow conditions during the 2002 survey were predominately poor to marginal. Although snow conditions at the start of the 2002 survey were adequate, unseasonably warm weather shortly after the survey began resulted in the loss of much of the snow cover, and produced many patches of bare ground throughout the survey area. This may have reduced sightability and resulted in a higher than normal number of moose being missed during the survey.

Survey timing may also have influenced the results of the 2002 survey. The 1989 and 1997 surveys were conducted in late October and early November, whereas the 2002 survey was conducted in late November and early December. The later timing of the 2002 survey could have had several significant effects. First, the post-rutting aggregations that are normally found on open, sub-alpine habitats may have started to break up and move down into denser cover where they would be more difficult to see. This could have resulted in more moose than usual being missed during the survey.

In addition, some of the large bulls would have already lost their antlers by early December, making it difficult to accurately determine their age and sex. Misidentification of bulls as cows would result in cows appearing to make up a larger proportion of the population than is actually the case. This, in turn, would lower the estimated ratios of calves, yearlings and mature bulls to mature cows.

Population Abundance, Composition and Distribution

We counted 259 moose in the 69 sample units that were searched during the survey and estimate that there were about 974 moose in the 2002 Dawson study area (see Table 1). This population estimate is the mid-point of the 90% confidence range, which means that we are 90% sure that there were between 790 and 1157 moose in the area. This represents an average density of approximately 165 moose for every 1000 km^2 of habitable moose range (163 moose per 1000 km^2 over the total survey area), slightly higher than the Yukon-wide average moose density of about 150 moose for every 1000 km^2. The western portion of the survey area (GMS 3-07 and 3-10) generally had higher moose abundance than the eastern portion (GMS 3-08, 3-11, and 3-12). This is reflected in a higher average moose density; 179 moose/1000 km^2 in the west versus 154 moose/1000 km^2 in the east.

There were an estimated 214 mature bulls (22% of the total population), 520 mature cows (53%), 92 yearlings (9%), and 149 calves (15%) in the 2002 Dawson study area. Note - the sum of these population component estimates (978 moose) is slightly more than the total population estimate of 974 moose given in Table 1. The difference is due to the nature of the population estimation method used. We couldn't determine the sex and age of one individual seen during the survey. We saw only one cow with twins during the survey for an estimated twinning rate of 2% (Table 1).

Mature cows appeared to make up an unusually high proportion (53%) of the Dawson moose population. Cows generally represent between 35% and 45% of estimated moose populations in Yukon. As noted in the methods section this may be, in part, due to the late timing of the survey because mature bulls, which have already dropped their antlers, may be misidentified as cows. Differences in mature bull to mature cow ratios throughout the survey area, however, suggest that high hunting pressure may also be partially responsible.

There were 41 mature bulls for every 100 mature cows in the 2002 survey area. The ratio in the more heavily hunted western portion of the survey (GMS 3-07 and 3-10; see Harvest discussion below) was only 38 bulls per 100 cows, significantly lower ($P<0.1$) than the 44 bulls/100 cows

recorded for the more remote eastern portion of the area (GMS 3-08, 3-11 and 3-12). The Yukon Moose Management Guidelines (1996) set 30 mature bulls for every 100 mature cows as the minimum acceptable to ensure that all the cows are bred during the rut.

Recruitment rates of 18 yearlings and 29 calves for every 100 mature cows were calculated for the 2002 survey area (Table 1). These are near or below the minimum ratio of 25 calves and yearlings per 100 mature cows we generally consider necessary to maintain a stable moose population. Calf and yearling recruitment rates ($P>0.1$) were similar in the eastern and western portions of the survey area.

Harvest

Between 1997 and 2001, an average harvest of 34 moose per year was reported for the survey area (GMS 3-07, 3-08, 3-10, 3-11 and 3-12; see Table 2). This represents an average annual harvest rate of 3.4% of the 988 moose estimated to be in these game management subzones, close to the 4% maximum allowable harvest rate normally set for stable moose populations of average density in Yukon. This 3.4% harvest rate does not include moose shot by first nations' members for whom we do not have reliable harvest figures. In the absence of reliable harvest information for first nations' hunters, we generally assume that their harvest equals that of resident non-first nation hunters. Using this assumption, the average total harvest would be about 68 moose each year, or 6.9% of the total estimated moose in these GMSs. No big game outfitting concessions overlap the survey area, and with the exception of an occasional moose shot by a special-guided non-resident, the entire harvest is by resident non-first nations' and first nations' hunters.

Recognizing that our 2002 moose abundance, and resulting density estimate for the area may be low (see survey methods discussion) we also compared the assumed average harvest of 68 moose per year with our 1989 density estimate of 238 moose per 1000 km^2 (Table 1). Extrapolating this density to the entire 2002 survey area still results in an average harvest rate of 4.8%. The harvest in GMS 3-07 south of Dawson is even more of a concern. Using the 1989 density estimate, and assuming that the harvest by first nations' equals that of non-first nations, the harvest rate is

7.8%. The 2002 density estimate of 179 moose per 1000 km^2 for the western portion of the area would produce a harvest rate of about 10.4% for this GMS.

Population Trend

Only the western portion (GMS 3-07 and 3-10) of the 2002 Dawson area had been previously surveyed in 1989 and 1997 (Map 1). Assessment of past population trends is therefore based primarily on changes in moose population parameters in this area (see Table 1).

Moose population estimates for the western portion of the survey area declined 24% from 610 moose in 1989, to 464 in 2002 (Table 1). Despite the fact that these estimates are not statistically different (P>0.10), it seems likely that moose abundance in the area has declined over the last decade. The consistent downward trend in our 1989, 1997, and 2002 population estimates and recruitment rates (calves and yearlings/100 mature cows) supports this contention, as does the relatively low proportion of calves and yearlings observed in 2002. In addition, harvest rates over the past five years have been at or above generally sustainable limits. The observed low ratio of mature bulls to mature cows is indicative of a heavily harvested and possibly declining population. Depressed bull:cow ratios have been seen in other areas experiencing high hunting pressure, and on the verge of moose population decline (e.g. Whitehorse south 1981-82, Haines Junction 1981-83, Aishihik 1990). Finally, reports from local residents and hunters also indicate that moose abundance in the area has dropped over the past decade (Martin Kienzler, pers. comm.).

Summary and Recommendations

Although population estimates from 1989, 1997 and 2002 are not statistically different (P>0.10), the evidence suggests that moose abundance, at least in the western portion of the survey area has declined. Recruitment rates and the proportion of mature bulls in the population are now near or below the minimum levels considered necessary to maintain a stable moose population. The reported harvest is also near, and in some parts of the survey area exceeds our maximum allowable rate of 4%. This is especially true in the northwestern portion of the area (GMS 3-07) where an extensive network of roads provides easy access. The addition of harvest by first

nations' members would likely mean that the harvest rate exceeds 4% over most or all of the survey area.

Given the high harvest rates, weak recruitment, low proportion of mature bulls, and possibly declining population abundance, we recommend careful management of the moose population in this region. This should include re-surveying the area within the next three to five years to confirm the moose population trend, and to further assess recruitment rates and the mature bull to mature cow ratio. In addition, serious consideration should be given to implementing a management system that will ensure that the harvest does not exceed the sustainable limit.

Other Wildlife Sightings

In addition to moose, we noted sign of several other species during the 2002 survey. Although no wolves were observed during the survey period, tracks were identified along a number of creeks throughout the area. Deer tracks were seen on open south-facing slopes along the Indian and Yukon rivers, and on Tenderfoot Creek in the southwest corner of the survey area. Caribou tracks and/or feeding craters were recorded in several areas, including Henderson Dome, south of Rosebute Creek, along the Yukon River in the southwest, and in the northeast corner of the survey area near the headwaters of Flat Creek.

Finally, a cow moose with antlers and two calves was observed near the junction of the Indian River and Ruby Creek. This is the third report of cow moose with antlers in the Dawson area. A hunter reported shooting a cow moose with antlers in the late 1960s along the Yukon River near Swede Creek (YTG internal files). A second cow with antlers was shot north of Dawson (GMS 2-24) in 2001.

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Table 1. Summary of the 2002 Dawson moose survey, and comparison with results from 1989 and 1997 surveys of the western portion (GMS 3-07, 3-10) of the 2002 study area.

	Entire Area	Dawson Comparison Area (GMS 3-07, 3-10)		
POPULATION CHARACTERISTICS	**2002**	**1989**	**1997**	**2002**
Estimated Abundance[1]				
Total Moose (90% Confidence Range)[2]	974 (790-1157)	610 (513-708)	574 (490-659)	464 (358-570)
Density (moose per 1000 km^2 of habitat)	165	238	224	179
Estimated Composition (90% Confidence				
Mature Bulls ($\geq$ 30 months)	214 (154-273)	141 (103-180)	162 (124-199)	96 (62-131)
Mature Cows ($\geq$ 30 months)	520 (399-640)	217 (177-257)	237 (198-276)	251 (182-319)
Yearlings (Approx. 18 months)[3]	92 (52-132)	88 (65-112)	91 (53-130)	41 (18-65)
Calves ($\leq$ 12 months)	149 (115-183)	164 (125-203)	85 (61-108)	74 (54-95)
Unknown	3 (0-6)	-	-	2 (0-4)
Estimated Population Ratios (90% Conf. Range)				
Mature Bulls per 100 Mature Cows	41 (26-56)	65 (46-85)	68 (48-88)	38 (21-56)
Yearlings per 100 Mature Cows	18 (9-26)	41 (27-54)	39 (20-57)	16 (6-27)
Calves per 100 Mature Cows	29 (19-38)	76 (62-90)	36 (27-44)	30 (18-41)
Mature Bulls: Percent of Total Population	22 (16-28)	23 (18-28)	28 (23-33)	21 (13-28)
Mature Cows: Percent of Total Population	53 (44-63)	35 (31-40)	41 (35-47)	54 (42-66)
Yearlings: Percent of Total Population	9 (5-14)	14 (11-18)	16 (10-22)	9 (4-14)
Calves: Percent of Total Population	15 (11-19)	27 (23-30)	15 (12-18)	16 (11-21)
Unknown	<1 (0-1)	-	-	-
Twinning Rate (%)[4]	2 (0-6)	28 (23-34)	6 (2-11)	5 (0-13)
SURVEY CHARACTERISTICS				
Stratification[5]				
Survey Dates	Nov.27-29, 2000	Oct. 23-27	Nov. 4-6	Nov.27-29, 2000
Total Survey Area (Km^2)	5983	2565	2565	2647[6]
Habitable Moose Range in Survey Area (Km^2)	5913	2565	2565	2595
Total Flight Time used during Stratification	852	2119	1629	N/A
Survey Time used during Stratification (min.)	704	1702	1328	N/A
Search Intensity (min. per Km^2)	0.12	0.66	0.52	N/A
Number of Moose Seen	311	317	294	126
Moose Seen per Minute	0.44	0.19	0.22	N/A
Census				
Survey Dates	Nov.28–Dec.6/02	Oct.27-30	Nov. 6-10	Nov.28-Dec.6/02
Number of Sample Blocks Searched	69	30	30	26
Area Searched (Km^2)	1059	930	933	398
Percentage of Habitable Moose Range	18	36	36	15
Total Flight Time used during Census (min.)	4401	2664	2645	not avail.
Survey Time used during Census (min.)	2640	1796	1913	1037
Search Intensity (min. per Km^2)	2.49	1.93	2.05	2.61
Number of Moose Seen	259	346	309	111
Moose Seen per Minute	0.10	0.19	0.16	0.11

[1] To allow for comparison across years, no sightability correction factor is included in estimates provided. Any differences between the total estimated moose abundance and the sum of the estimated composition numbers for the 2002 results is due to the nature of the kriging or spatial population estimation method.

[2] This means that we are 90% sure that the true number of moose in the area lies within the range of moose numbers given in the brackets.

[3] To account for yearling cows that cannot be identified from the air, the total number of yearlings is assumed to equal 2x estimated number of yearling bulls in the population.

[4] Twinning Rate = the number of cows with 2 calves divided by the total number of cows with calves.

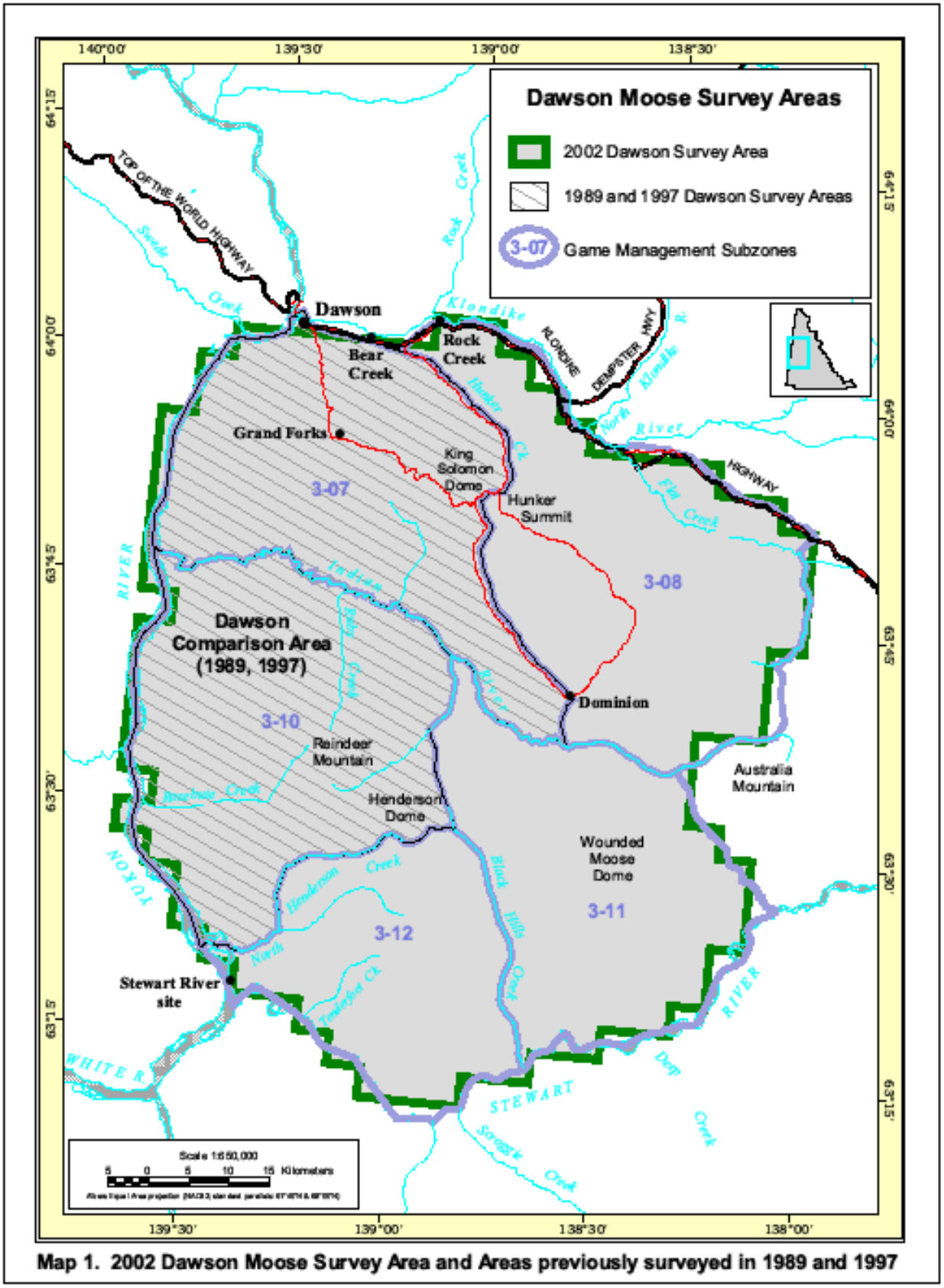
[5] 2000 stratification data used to stratify 2002 Dawson survey area.

[6] Dawson Comparison area was slightly larger in 2002 than in past years because of the lat/long grid used.

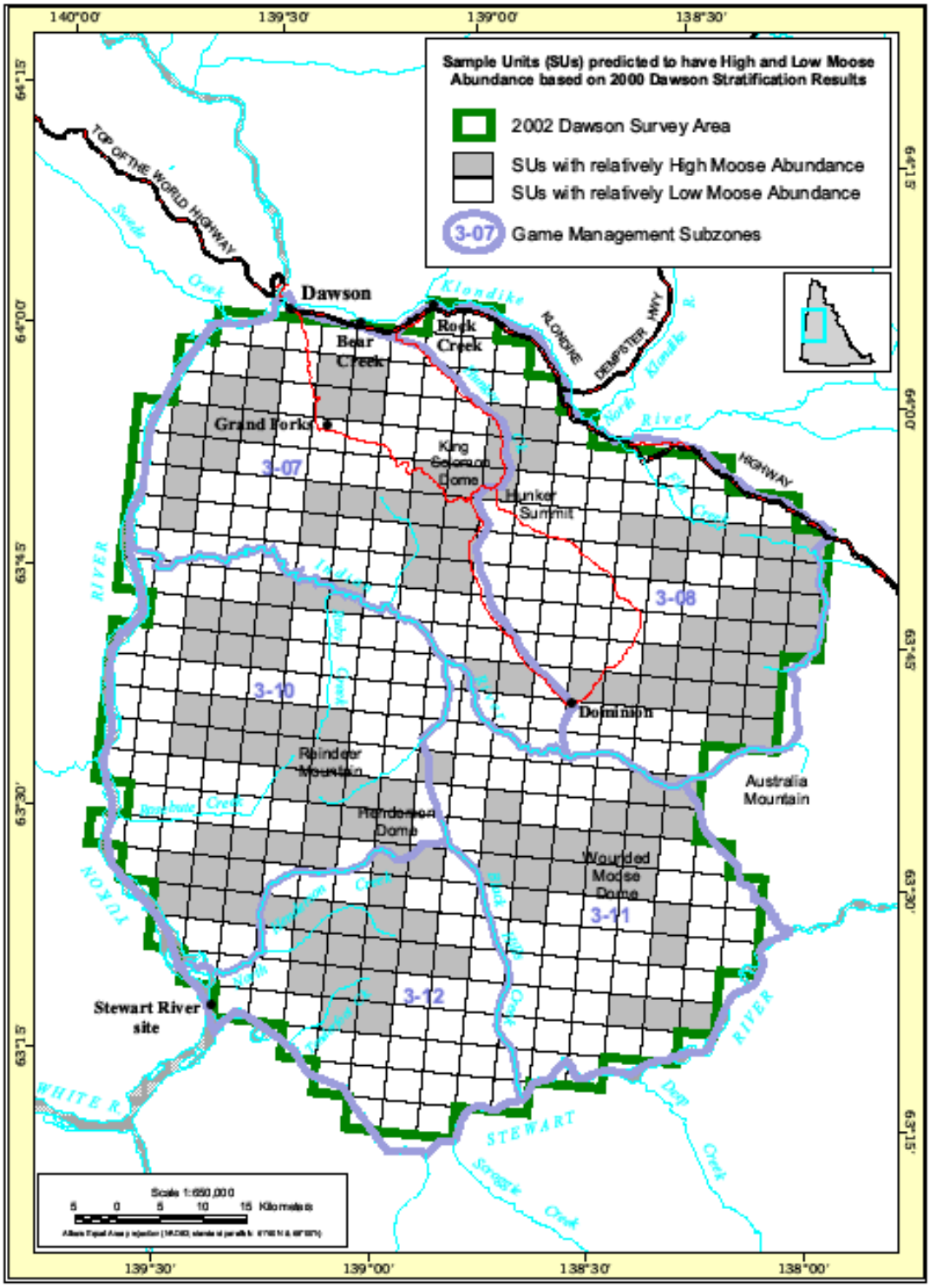
Table 2. Average annual (1997-2001) reported moose harvest and allowable harvest summary for the 2002 Dawson survey area (GMS 3-07, 3-08, and 3-10 through 3-12). Does not include harvest by first nations' members.

Game Management Subzone (GMS)	GMS Area (km^2)	Estimated Density[1] (moose/1000 km^2)	Total Estimated number of Moose	Average Annual Reported Harvest[2]	Average Annual Harvest Rate (% of total estimated moose harvested)[3]	Allowable Annual Harvest at 4% of moose population
3-07	1244	179	223	11.6	5.2	9
3-08	1382	154	213	7.2	3.4	9
3-10	1403	179	251	5.6	2.2	10
3-11	1124	154	173	4.2	2.4	7
3-12	834	154	128	5.4	4.2	5
Total[4]	5987	165	988	34.0	3.4	40

[1] Based on 2002 moose survey results.
[2] Average annual moose harvest for years 1997 through 2001. Does not include harvest by first nations' members.
[3] Includes only reported harvest. Does not include harvest by first nations' members.
[4] Small differences in total area, average moose density, and total number of moose presented in Tables 1 and 2 are due to slight difference in game management subzone and survey area boundaries (see map 1).



Map 1. 2002 Dawson Moose Survey Area and Areas previously surveyed in 1989 and 1997



Map 2. Moose Distribution in the Dawson Area based on 2000 Stratification Survey Results