

**STONE'S SHEEP IN NORTHEASTERN BRITISH
COLUMBIA**

**MARCH 2004 AERIAL STONE'S SHEEP SURVEY WITHIN THE
SULPHUR EIGHT MILE PRE-TENURE PLAN AREA**

**SUBMITTED TO:
MUSKWA-KECHIKA TRUST FUND
Project # MK-2003-2004-02**

**MINISTRY OF WATER, LAND AND AIR PROTECTION
PEACE REGION
Fort St John Regional Office**

1.0 Introduction

Through the approval of the Fort Nelson and Fort St John Land and Resource Management Plans (LRMPs) the Muskwa-Kechika Management Area (M-KMA) was established in 1997 (Fig 1). In 2001, a portion of the Mackenzie LRMP was adjoined to the M-KMA. Provincial parks comprise 1.6 million hectares of the management area and the remaining 4.7 million hectares are special management zones. The M-KMA is comprised of undeveloped boreal plateau to mountain ecosystems and is one of the few remaining, intact and largely unroaded areas south of the 60th parallel. The management area supports an intact predator-prey system and the greatest combined abundance and diversity of wild mammals in North America.

The majority of existing oil and gas activities in Northeast British Columbia (BC) has concentrated between the Alberta border and east of the M-KMA. However, recent gas reserve forecasts include sizeable areas of the special management zones within the MKMA where geologists project a high to very high potential for major accumulations of natural gas.

The delineation of special management zones, as determined within the LRMP's, individually or collectively define a "pre-tenure plan area". During the last several years, pre-tenure plans have been developed within the M-KMA for a number of pre-tenure plan areas notably: Halfway-Graham, Besa-Prophet, Muskwa-West and Sulphur Eight Mile.

The *Muskwa-Kechika Management Area Act* outlines the management intent for the M-KMA including, prior to the disposition of petroleum and natural gas rights, the requirement for pre-tenure planning for oil and gas activities (excluding geophysical activities) within the special management zones. A pre-tenure plan attempts to optimize the social, economic and environmental value within each pre-tenure plan area. The management direction for oil and gas activities contained in a pre-tenure plan are legal binding caveats for any oil and gas tenures sold.

An integral process to pre-tenure plan development was incorporating input from a wide variety of interests/stakeholders to discuss what was required in a pre-tenure plan and review draft plan documents. This stakeholder group was referred to as the Public Advisory Group (PAG).

In recent years there is a general consensus among biologists, guide outfitters and others that the M-KMA Stone's sheep (*Ovis dalli stonei*) population has declined significantly. Possible reasons for the decline include: adverse weather conditions, disease, hunting and predation.

2.0 Stone's Sheep and the Muskwa-Kechika Management Area

Stone's sheep are the rarest of North American wild sheep and endemic to Canada. Stone's sheep inhabit the most remote and untouched wilderness areas, occurring only in the south-central Yukon and BC.

Stone's sheep mature slowly and have low reproductive rates. Ewes normally reach breeding age at three years and produce only one lamb per year. Rams breed when their horns are large

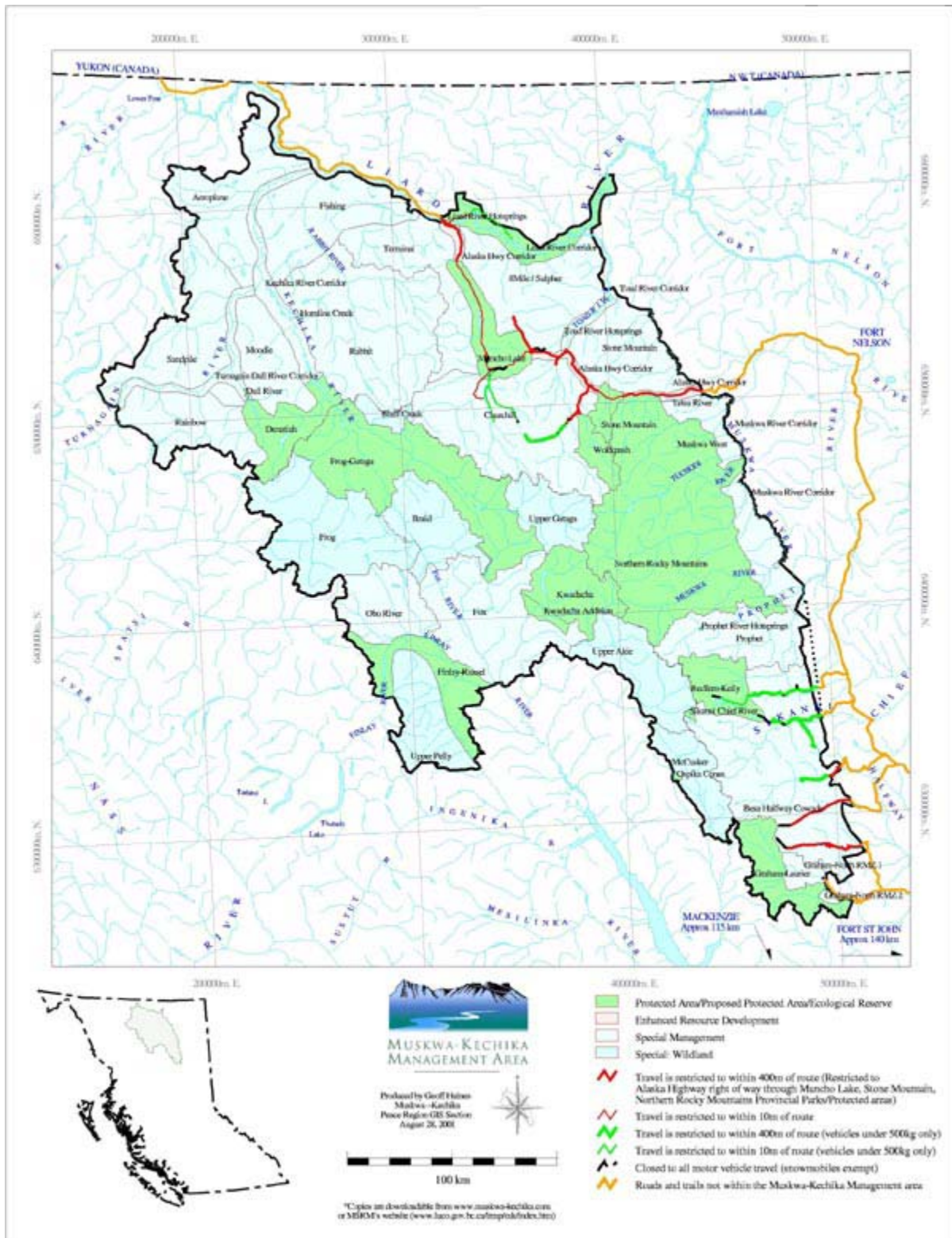


Figure 1. Muskwa-Kechika Management Area.

enough for them to establish a dominant position in the ram hierarchy, usually at seven to nine years.

The rut extends from mid-November to mid-December followed by a gestation period of about 180 days. For protection from some predators, ewes seek out steep terrain to give birth. About a week after the lambs are born, ewes and lambs group together in nursery bands, which remain in the lambing area for 3 to 4 weeks before moving to the summer range. With the onset of winter, sheep seek areas of minimal snow accumulation close to adequate escape terrain.

In 1998, the BC Wildlife Branch estimated 12,000-14,000 Stone's sheep reside in BC or approximately 75% of the world's population. At that time, approximately 7,000 Stone's sheep inhabited the M-KMA.

Now as in the past, guided Stone's sheep hunts provide a substantial portion of annual revenue for guide outfitters operating within the M-KMA. Furthermore, there are both direct and indirect economic benefits to local communities regarding consumptive and non-consumptive (e.g. photography) activities associated with Stone's sheep

To date, little research has been conducted directly on Stone's sheep. Wild sheep studies have focused on bighorn sheep (*Ovis canadensis*) since bighorns have traditionally attracted more attention due their location and dramatic die-offs. There is general consensus among various bighorn sheep studies regarding the impacts of non-physical (e.g. terrestrial and aerial traffic) and physical (e.g. habitat fragmentation) disturbances. Impacts include smaller sheep, greater expenditures of energy, poorer nutrition, shorter lives, lower reproduction rates, increased susceptibility to climate extremes, disease and predation and ultimately, population declines.

Stone's sheep ecology is similar to bighorn sheep and preliminary research suggest that Stone's sheep are as sensitive as bighorn sheep (if not more so) to both human induced physical and non-physical disturbances.

Pre-tenure plan PAG workshops in late fall 2003 and winter 2004 focused on a variety of ecological, economic and social issues. At the Fort Nelson February 2004 PAG workshop, it was made clear to the Government Working Group, a key concern is potential adverse impact(s) to an already declining Stone's sheep population across the M-KMA, particularly in the Sulphur Eight Mile Pre-tenure Plan (S8M PTP) area.

3.0 Sulphur Eight Mile Pre-tenure Plan Area Biophysical Description

The S8M PTP area is the most northerly of the M-KMA pre-tenure plan areas (Fig. 2). The boundaries of the plan area are delineated by the amalgamation of several special resource management zones: Eight Mile/Sulphur, Toad River Corridor and Stone Mountain.

Topography of the 435,000 hectare S8M PTP area is characterized by rolling terrain along the eastern boundary and increasingly rugged terrain moving toward the west boundary. Elevation ranges between 420m in the northern and eastern portions of the plan area and 2380m to the west

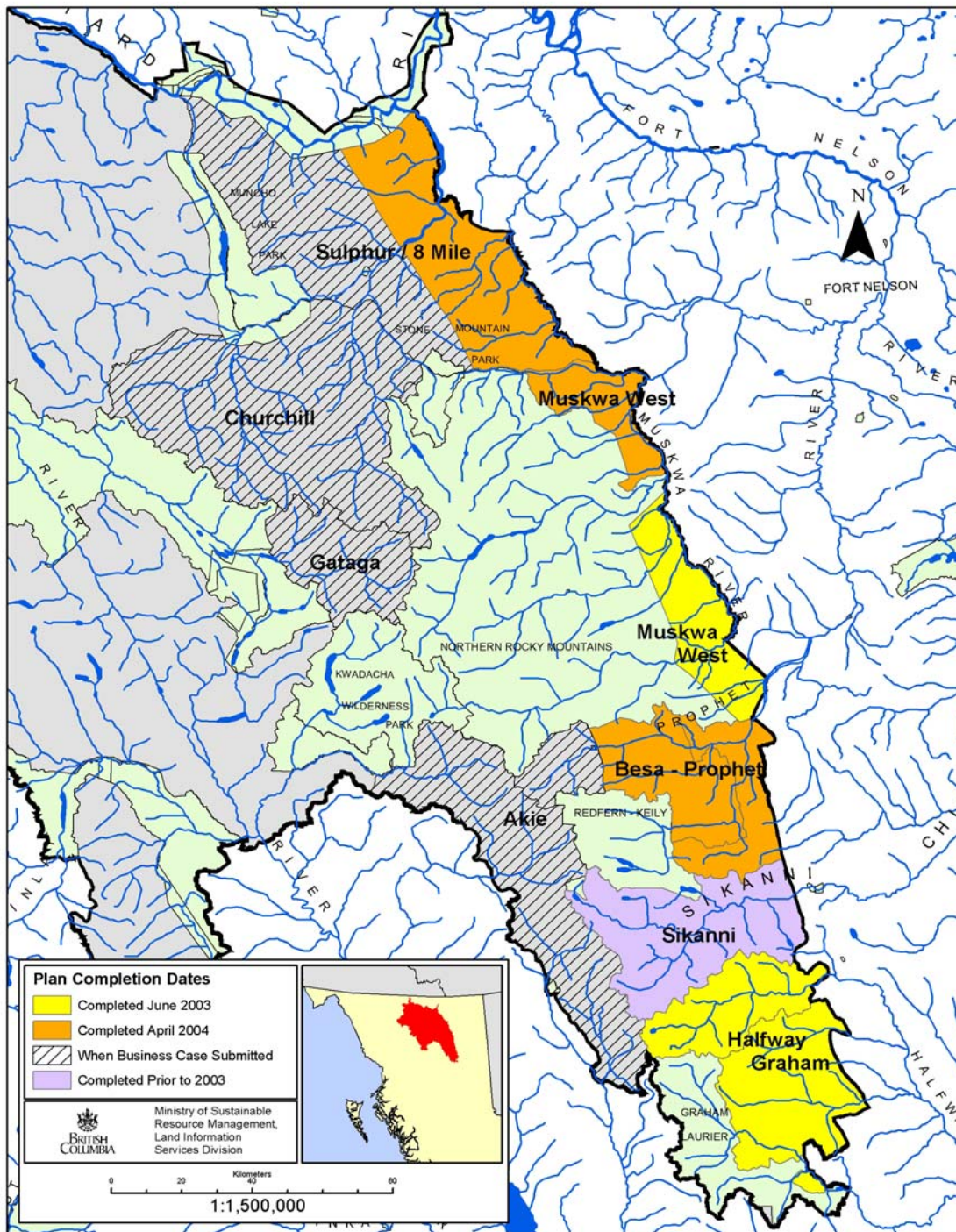


Figure 2. Pre-tenure plan areas within the Muskwa-Kechika Plan Area.

in the mountains. Mountain ridges are aligned in a general north-west/south-east orientation and portions of the Dunedin, Toad and Snake drainages are within the plan area.

Three biogeoclimatic zones cover the plan area: Boreal White and Black Spruce, Spruce Willow Birch and Alpine Tundra. The plan area encompasses portions of three ecosections: Muskwa Upland, Muskwa Foothills and Eastern Muskwa Ranges.

Vegetative cover in the eastern low lying region of the plan area is dominated by trembling aspen and white/black spruce. Valley bottoms in the mountains are primarily composed of a non-forested mosaic of willow species, scrub birch, wetlands and dry to moist grasslands. Lower to mid-slope elevations include closed to open canopy forests of white spruce and localized lodgepole pine.

Climate throughout the S8M PTP area is characterized by long, cold winters and brief summers. Lowland areas and valley bottoms provide winter habitat for many species of wildlife including: caribou, black/grizzly bear, moose, elk and furbearers. In the steeper, mountainous areas mountain goat are found year-round and Stone's sheep on moderate to steep slopes associated with rugged terrain.

Wetlands and lakes support large numbers of waterfowl such as mallard, northern pintail, blue-winged teal and northern shoveller.

Much of the area is suited to providing food and cover requisites for Stone sheep. Figures 3 and 4 show the Ministry of Sustainable Resource Management's (MSRM) recent delineation of Stone's sheep winter habitat suitability within the S8M PTP area. Readers should visit the MSRM website (<http://srmwww.gov.bc.ca/wildlife/whr/essentials.html>) for detailed description of the methodology and rating system used for this delineation.

4.0 Stone's sheep in the Sulphur Eight Mile Pre-tenure Plan Area

The S8M PTP area is comprised of two parts: the western *Higher Elevation Zone* and the eastern *Lower Elevation Zone* which approximates the break in slope to mountainous topography (Fig. 5). The Higher Elevation Zone comprises critical winter Stone's sheep habitat and the Lower Elevation Zone has minimal importance to Stone's sheep. Furthermore, both zone delineations approximate "high" gas potential (as determined by the Ministry of Energy and Mines).

Oil and gas industry representatives informed the PAG, interest in the S8M PTP area is not to occur until at least 2007-08 as there are presently vast areas to the east of the plan area, outside of the M-KMA, that have yet to be explored.

Presently, there is a lack of accurate information regarding seasonal habitat use by Stone's sheep in the plan area. The lack of sheep habitat use information combined with the forecasted little or no oil and gas activity in the Higher Elevation Zone, resulted in a staged approach to tenure disposition being recommended from the PAG and accepted by the pre-tenure plan Government Working Group.

Tenure disposition in the Higher Elevation Zone has been postponed for 5 years to allow a Stone's sheep study to be initiated and completed within that timeframe. Key elements of the

study have not been finalized but may include: seasonal habitat use, identification of suitable habitat not presently utilized, disease, impacts by disturbance of man, present population

MSRM Winter Stone Sheep Suitability

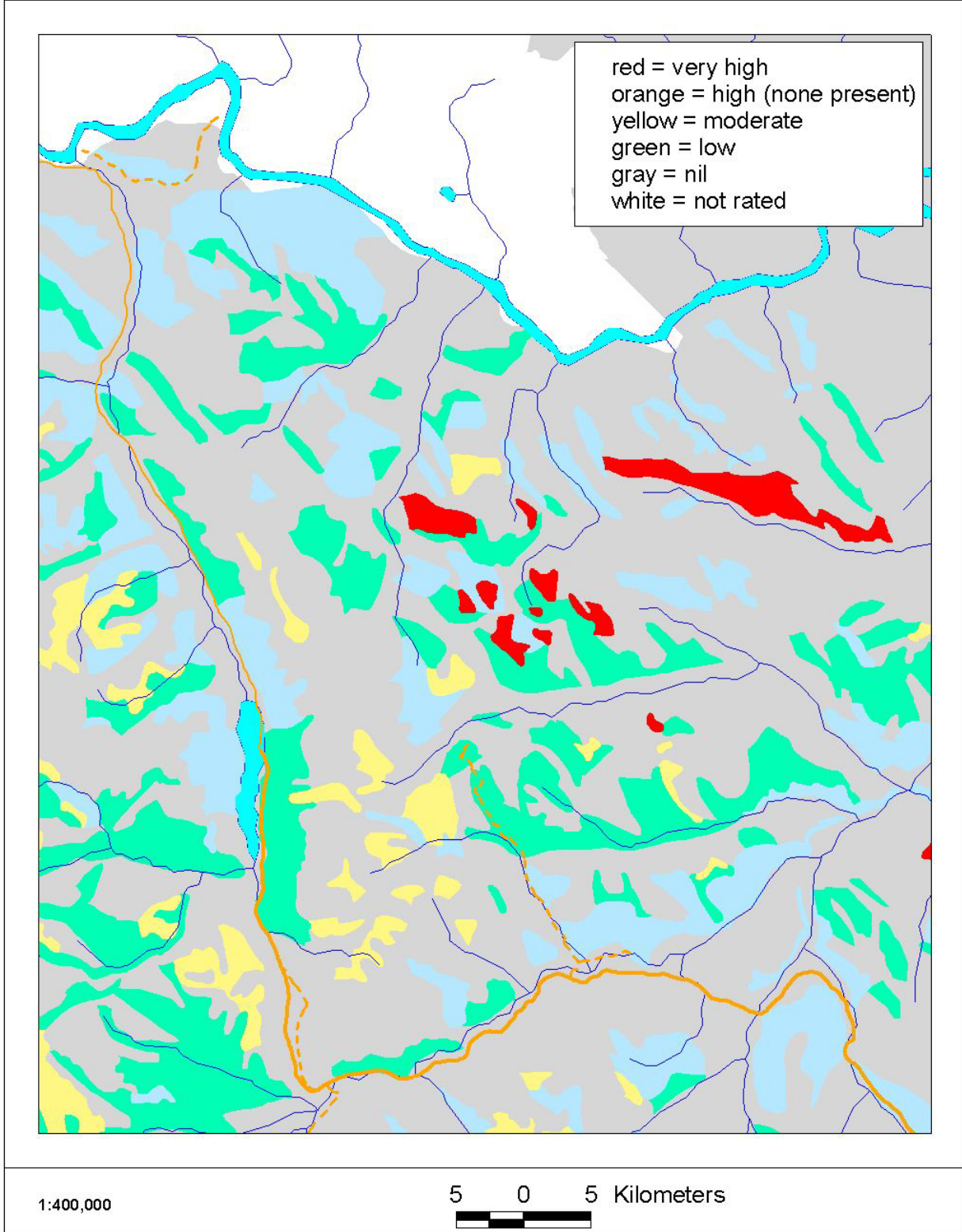


Figure 3. MSRM Winter Suitability for Stone Sheep of the Western S8M PTP

MSRM Winter Stone Sheep Suitability

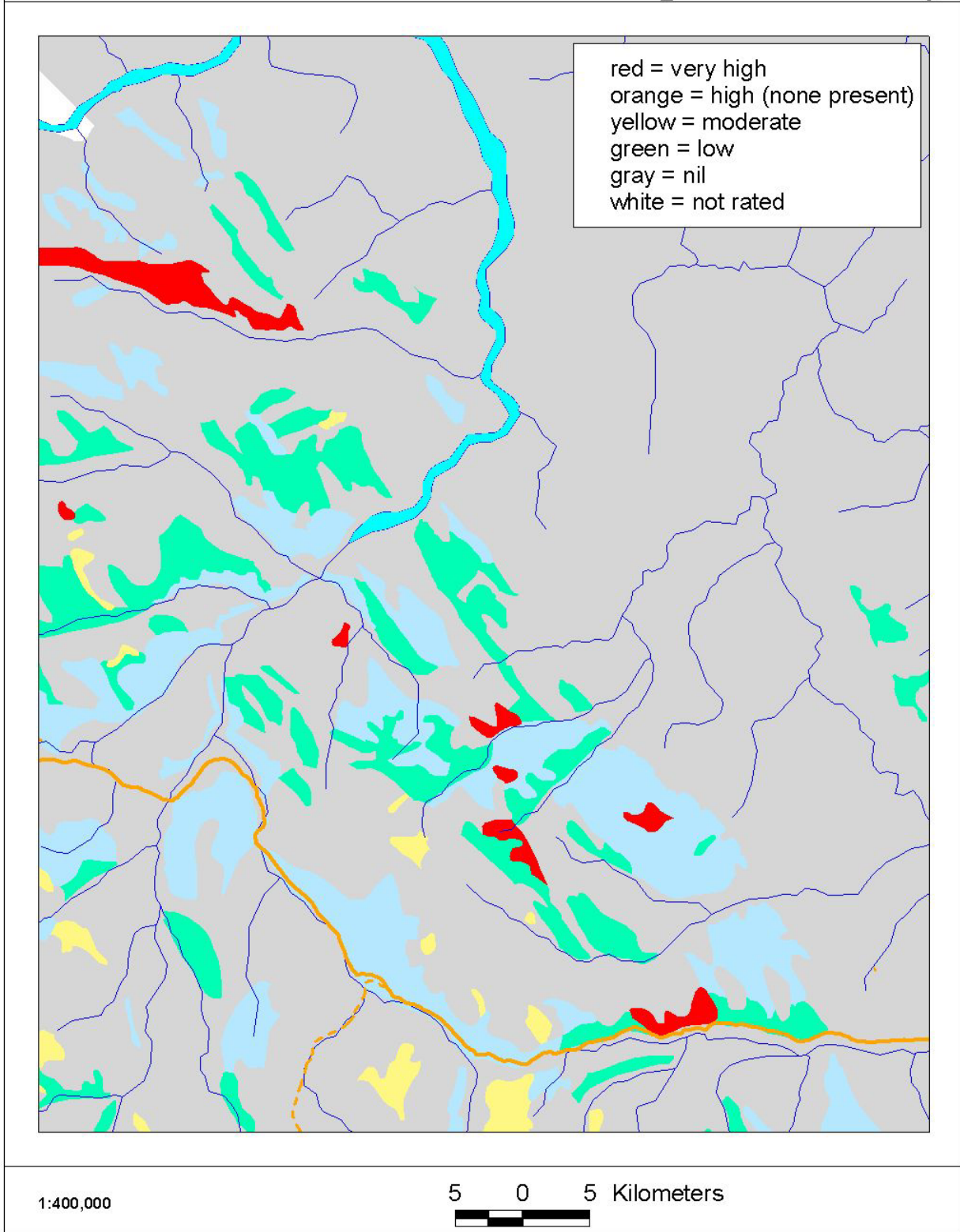


Figure 4. MSRM Winter Suitability for Stone Sheep of the Eastern S8M PTP

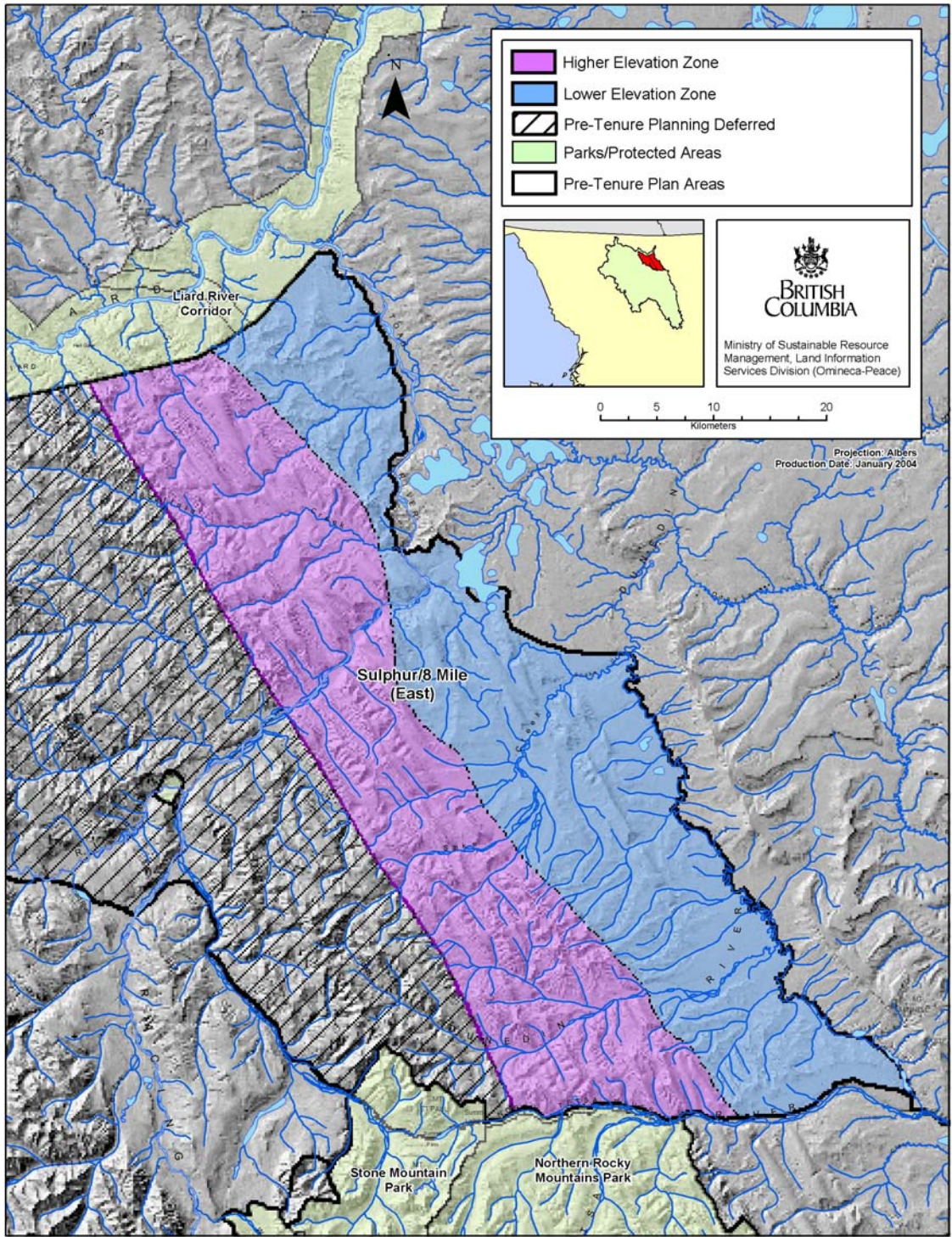


Figure 5. High and Low Elevation Zone delineation within the Sulphur Eight Mile Pre-tenure Plan Area.

numbers and distribution, enhancement opportunities, inter-specific forage competition and sheep predation.

Subsequent to the sheep study, sheep management direction to guide oil and gas activities in the Higher Elevation Zone will be written and approved in the pre-tenure plan by December 2009. Following approval of the management direction, opportunities for oil and gas tenure disposition should take effect by January 2010.

A preliminary contributing step in the Stone's sheep study was a late winter 2004 aerial sheep population survey conducted in the S8M PTP area.

5.0 Stone's sheep aerial 2004 winter survey in the Sulphur Eight Mile Pre-tenure Plan Area

A key element of the proposed Stone's sheep study, is collection of baseline data which are fundamental in developing applicable sheep management direction. An initial step to acquire these data was a mid March 2004 aerial Stone's sheep population survey within the S8M PTP area.

Results of the 2004 survey were compared to an earlier 1977 Stone's sheep aerial survey conducted in the same area.

5.1 Aerial survey methodology

The March 2004 aerial survey used a Bell 206 helicopter carrying a pilot and two experienced sheep observers. The helicopter was equipped with a GPS guidance system and bubble rear windows to maximize rear observer functionality. As funding was limited, procedure was restricted to an attempted total count without the benefit of marked animals for mark-recapture or other options to measure sightability.

Four thousand square kilometers of the S8M PTP area were aerially searched for approximately 25 hours. There was snow cover which optimized detection of the dark sheep. To refine subsequent analysis of aerial survey results, the Sulphur Eight Mile plan area was divided into 7 subunits (Fig. 6).

Sub unit boundaries were river valleys or straight lines beyond the area suitable for winter sheep. Sub unit polygons represent boundaries across which little movement by sheep would be expected during mid-late winter.

All suitable winter habitat was searched, comprising predominantly windswept ridge crests and treeless ranges located near steep terrain where sheep can escape predation. When searching probable sheep habitat, air speeds were approximately 30 knots and probable sheep habitat generally searched with 2 vertically displaced passes with an occasional third lower pass if warranted.

To minimize disturbance to sheep, aircraft distances were limited to 150m and in most cases limited to one pass per sheep group.

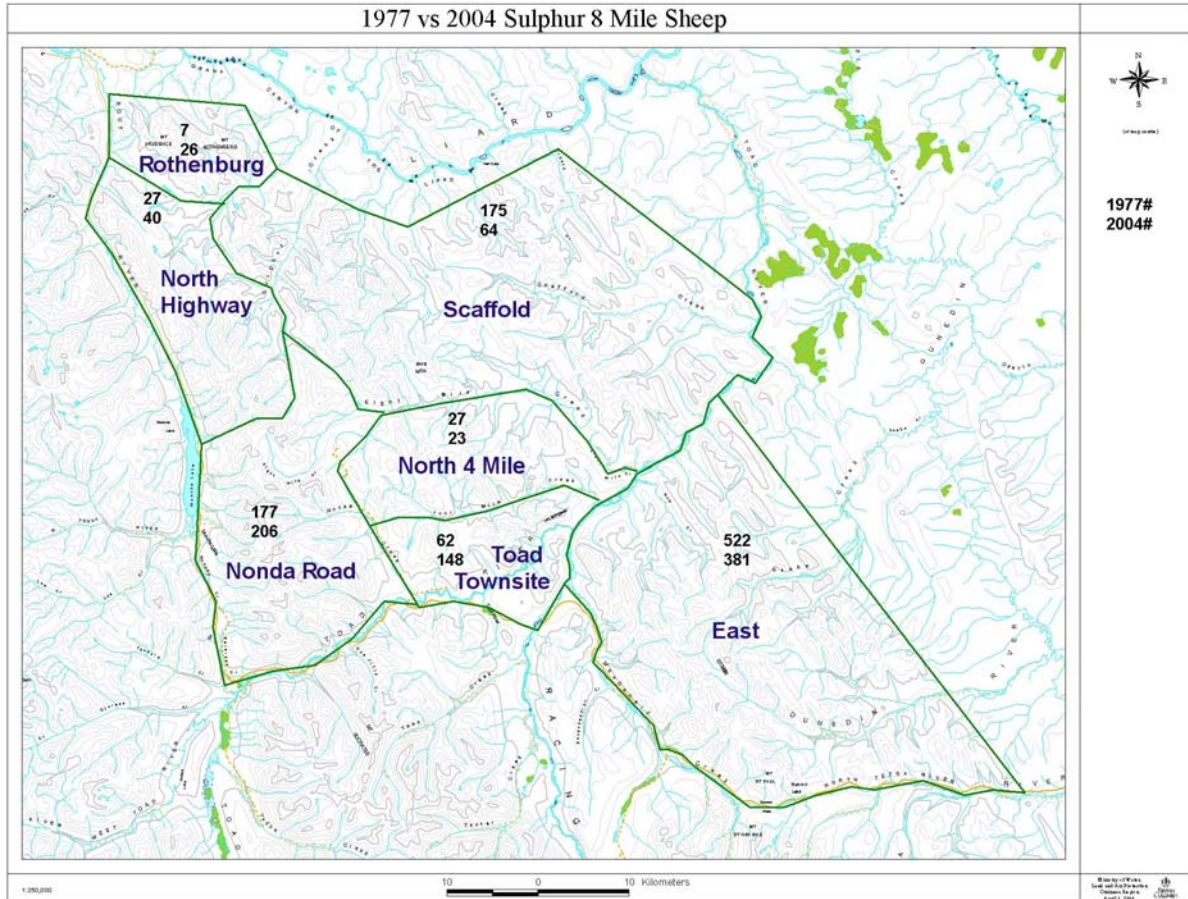


Figure 6. Sulphur Eight Mile Pre-tenure Plan Area depicting sub unit polygons and 1977 and 2004 aerial sheep counts.

In 1977, the S8M PTP area was searched under similar winter conditions and methodology excepting the portion east of the Racing-Toad Rivers (East subunit) where a fixed wing aircraft was substituted for a rotary wing aircraft. The fixed wing observation platform may have resulted in some sheep being missed.

5.2 Comparison of 1977 and 2004 aerial Stone's sheep survey results

While the 2004 survey results are a stand alone product, the existence of 1977 data allows for some analysis. Figure 6 shows the results of the 1977 and 2004 total counts and Table 1 presents the same information as well as a conversion to density.

SULPHUR EIGHT MILE SUB UNIT	OBSERVED NUMBER (both sexes and all ages)		DENSITY (animal/sqkm)*	
	1977	2004	1977	2004
	Rothenburg	7	26	0.05
North Highway	27	40	0.08	0.11
Scaffold	175	64	0.13	0.05
Nonda Road	177	206	0.35	0.41
North 4 Mile	27	23	0.09	0.08
Toad Townsite	62	148	0.31	0.74
East	522	381	0.44	0.32

Table 1. Stone's Sheep observed in Sulphur Eight Mile Pre-tenure Plan Area: 1977 and 2004.
* When calculating sheep density, the total within each sub unit was used.

Reviewing historical harvest statistics suggests that the Stone's sheep regional population declined for a decade by 1977, increased during the mid to late eighties and subsequently declined for 15 years. The present data sets do not allow exploration of S8M PTP specific changing trends over that period.

Based on the March 2004 survey, the S8M PTP area Stone's sheep population experienced an overall 11% population decline (both sexes and all age classes) compared to the 1977 census. A decline that is less than the believed recent regional decline of 50%.

6.0 Discussion

If the distribution of Stone's sheep is driven by habitat quality, then a correlation between these two variables is expected. Table 2 provides a composite habitat winter habitat suitability rating (see figures 3 and 4 for the precise ratings) for each of the listed subunits in Table 1. This is determined by taking the combined area of each rated habitat category, for each subunit and multiplying it by the middle percentage of maximum for that category. The resultant numbers are only meaningful when related to each other, but measure quantitatively the relative habitat quality of each subunit. Figure 7 graphically compares 1977 and 2004 density ratings to the mapped habitat quality.

SULPHUR EIGHT MILE SUB UNIT	COMPOSITE HABITAT RATING
Rothenburg	3.93
North Highway	2.20
Scaffold	5.95
Nonda Road	5.66
North 4 Mile	4.56
Toad Townsite	1.27
East	4.43

Table 2. Sulphur Eight Mile Pre-tenure Plan habitat rating by sub unit.

Figure 7 reveals that the 2004 sheep density tends to be highest in lower habitat ratings and conversely, lowest in the higher habitat ratings. In contrast, observed sheep in the 1977 aerial survey were neutrally distributed by subunit relative to habitat quality. This suggests that habitat quality is not the prime factor in determining an optimal Stone's sheep foraging strategy.

There is a large literature on the ecology of fear. While death from predation could be considered the ultimate stress, it is generally accepted that stress from the risk of death alters optimal foraging strategy from maximizing the rate of food intake to minimizing the ratio of mortality rate to feeding rate. Since the sheep distribution was not found to match the habitat (food) quality of the subunits, it may be that the numerator of the optimal foraging ratio has the larger effect. S8M PTP area has considerable variation in the level of fear landscape for sheep. Partially this results from a front country versus backcountry situation due to the Alaska Highway bounding the south and west sides of S8M PTP area. However; it is magnified by the community of Toad River, approximately located at the mid point of the bounding highway, becoming actively involved as wolf shepherds in order to help the sheep. The shepherding concept is widely used for shepherding bears away from people and livestock and is itself based on the ecology of fear – in this case a reinforced fear of humans by bears such that the bears are discouraged from utilizing high conflict areas. With wolves, the process is simplified due to the behaviour of wolves to be naturally wary of humans and the large land base involved.

Volunteers from the Toad River community modify their winter activities such as bird watching, cross country skiing, snow machining, trapping, and fishing so that it primarily occurs adjacent to Stone's sheep winter ranges. Consequently, wolves shy away from those sheep areas frequented by humans and relocate their hunting activities where moose and elk are the main prey. Therefore the landscape of fear is reduced for the sheep. We can assign a crude wolf shepherd rating to the S8M PTP area sub units based on the level of shepherd (including ambient human) activity (Table 3) and then compare those to the 2004 sheep distribution (Fig. 8). There is indeed a tendency for subunits with higher wolf sheperding to have more sheep.

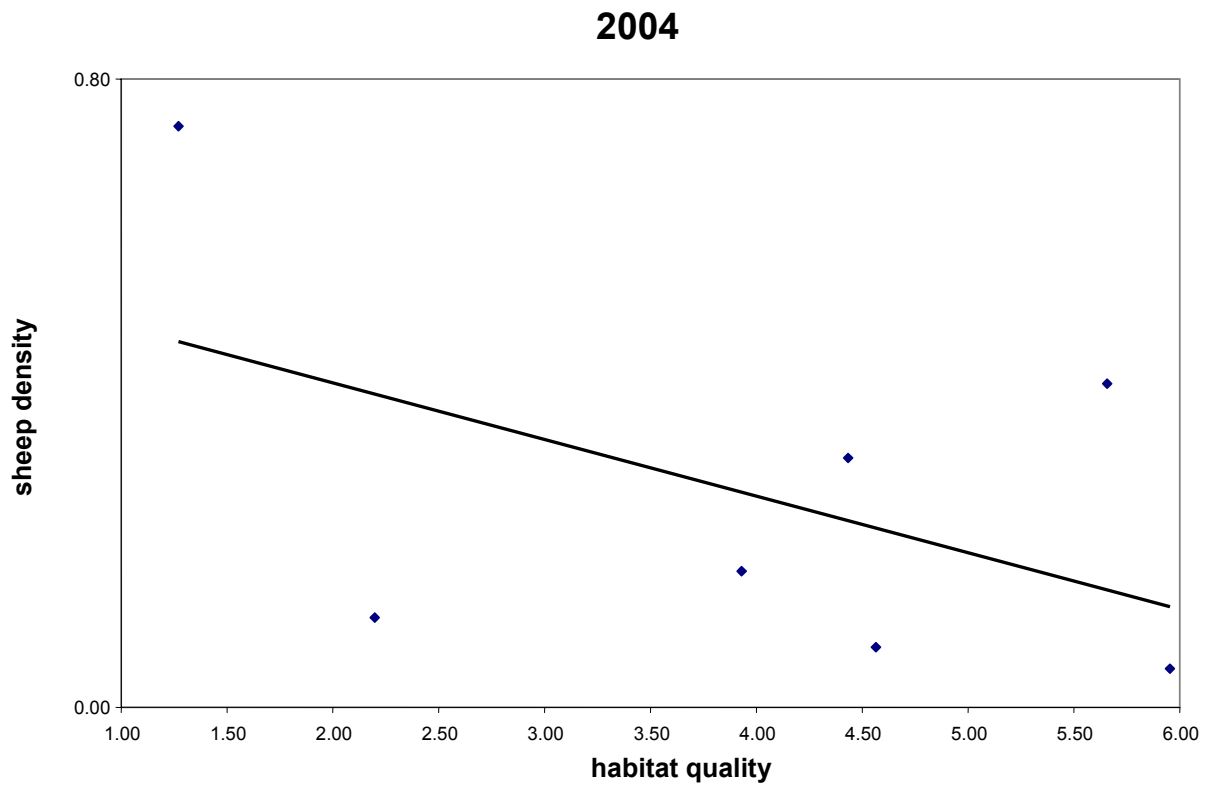
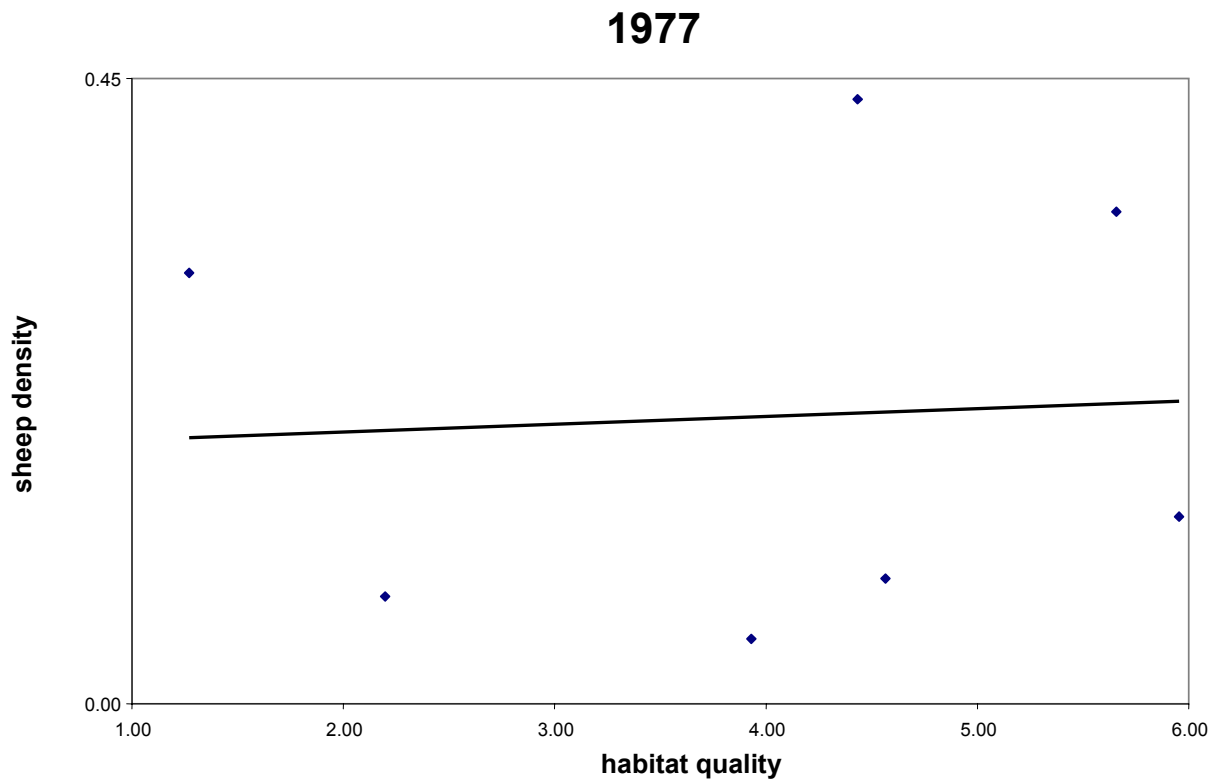


Figure 7. Comparison of 1977 and 2004 Stone's sheep density rating as a function of habitat quality

Sulphur Eight Mile Sub Unit	Shepherd Rating
Rothenburg	1
North Highway	1
Scaffold	0
Nonda Road	1
North 4 Mile	1
Toad Townsite	2
East	1

Table 3. Sulphur Eight Mile Shepherd Rating by subunit.
 (0=no human presence; 1 equals intermediate human presence; 2 equals high human presence)

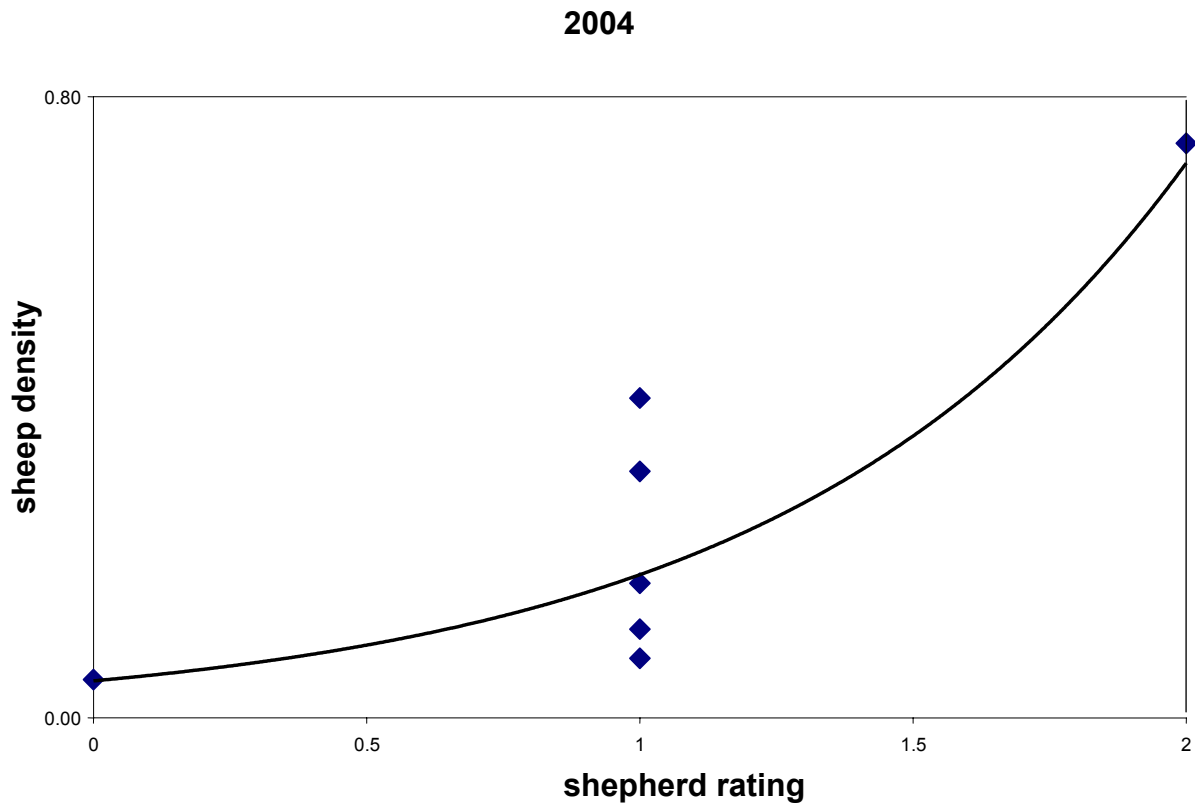


Figure 8. 2004 Stone's sheep density compared to the shepherd rating

7.0 Management Implications

The S8M PTP area was designated as a planning area for oil and gas activities. Such activities will cause adverse physical (eg. habitat suitability/capability) and non-physical (auditory/visual) disturbances to Stone's sheep. Various mitigative and compensatory activities can minimize such impacts however non-physical disturbance impact is a greater challenge as it adds to the fear landscape. While the ongoing low intensity front country human activity around Toad River townsite and along the highway has been of benefit to the sheep, the sudden high intensity impact of backcountry petroleum exploitation will be additive to the disturbance impact of natural predators and further lower the sheep viability and distribution. Reducing the natural fear landscape and careful conditioning (a topic unrelated to this report) of Stone's sheep in areas to be disturbed by oil and gas exploitation can mitigate the disturbance impact.

8.0 Related Initiatives

Action has been initiated by the Ministries of Sustainable Resource Management and Water, Land and Air Protection to determine the reasons for the decline of stone sheep populations in the northeast of British Columbia. Part of this initiative is to develop a set of recommendations for the Sulphur 8 Mile Pre-Tenure planning committee that will address potential impacts of oil and gas activities on Stone's Sheep. All of this has to be completed by 2009 as referenced earlier in this report. This report is one of the supporting documents to that initiative.

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