

1.1 Stone Sheep (*Ovis dalli stonei*)

SPECIES NAME: Stone sheep

SCIENTIFIC NAME: *Ovis dalli stonei*

SPECIES CODE: M-OVDA

STATUS: Blue-listed (MELP, 1997); not at risk (COSEWIC, 1998)

DISTRIBUTION

Provincial Range

In BC, Stone sheep are found from the Yukon border to just south of the Peace Arm of Williston Reservoir (Nagorsen, 1990).

Provincial Benchmark

Ecoprovince: Northern Boreal Mountains

Ecoregion: Northern Canadian Rocky Mountains

Ecosection: Muskwa Foothills (MUF)

Biogeoclimatic zone: SWBmk in winter; AT in growing

Broad Ecosystem Units: BA/1 – Boreal White Spruce-Trembling Aspen/RO – Rock in winter; SM – Subalpine Meadow in growing

Project Study Area

Ecoprovince: Northern Boreal Mountains

Ecoregion: Northern Mountains and Plateaus and Northern Canadian Rocky Mountains

Ecosection: Cassiar Ranges (CAR), Western Muskwa Ranges (WMR), Eastern Muskwa Ranges (EMR) and Missinchninka Ranges (MIR)

Biogeoclimatic zone: BWBSdk1, ESSFmv4, SWBmk1, SWBmks1, ESSFmvp4 and AT

Elevational range: Valley bottom to alpine

ECOLOGY AND HABITAT REQUIREMENTS

The world population of Stone sheep inhabits mountainous areas of northern British Columbia and the southern Yukon (Seip, 1983; MELP, 1978). Populations occur on the Yukon and Stikine plateaus, the Skeena, Cassiar and Omenica Mountains from the Pine River to the Liard River, and the Boundary Ranges of the Coast Mountains (Fish and Wildlife Branch, 1978). Good sheep habitat is described as narrow linear ridges, talus slopes and nearly vertical cliffs interspersed with gently sloping saddles and alpine meadows with abundant vegetation (Seip 1983). They eat primarily grasses and sedges, but also supplement their diet with several kinds of herbs in the summer and woody plants in the winter (Banfield, 1977).

Stone sheep generally have two distinct ranges: summer and winter with corresponding spring and fall migrations (Chapman and Feldhamer, 1982). During summer, they inhabit alpine slopes and plateaus, moving higher with the green-up of succulent grasses and forbs (Scotter and Ulrich, 1995, Seip 1983) and always on or adjacent to precipitous terrain. In a summer survey of the Russel Range, Watts and Child (1986) found almost all sheep above 1800 m.

In winter, snow cover limits the availability of forage and Stone sheep select habitats that have less snow, either at lower elevations or in wind-blown areas. They are known to use lower, drier, southern-facing slopes (Banfield, 1977) however, they commonly use mountain peaks and ridges at elevations up to 2200m, as documented by Seip (1983). They may also move up and utilise the often sparse vegetation of the upper slopes as wind clears the snow off after storm events (Luckhurst, 1973). Seip (1983) found that in the Yedhe, Delano, and Racing River areas, Stone sheep were using mountain peaks and ridges as winter range. These were at elevations between 1500 to 2200 m and the primary characteristic of these

areas appeared to be their tendency to be blown free of snow. The average snow depth used by the sheep was 16.5cm and the depth where they ceased digging for food was 32.4 cm (Seip 1983).

Wood (1994) reports Stone sheep using southwest facing ridges in the Pesika drainage (WMR Ecosection) in winter, but suggested their numbers in this area would be low because of the high snow depth. Stone sheep were sighted in the Russel Range (CAR Ecosection) on south facing windblown slopes within the TEM Mackenzie Study Area (unpublished winter ungulate flight, 1997).

Luckhurst (1973) found that the *Elymus – Agropyron* vegetation community provided almost 60 percent of the forage utilised by wintering Stone sheep in the Nevis Creek area. Other important plant communities used in winter were the *Elymus-Festuca*, and *Dryas-Festuca* communities. *Calamagrostis-Hierochloe*, *Betula-Vaccinium vitis-idaea* and *Festuca-Dryas* communities were used most in summer.

Specific requirements for escape terrain are not well documented for Stone sheep. Bighorn sheep (*Ovis canadensis*) escape terrain has been much better characterised and we assume that escape terrain requirements are similar between the two species. Van Dyke *et al.* (1983), in a review of California bighorn sheep (*O. canadensis californiana*) escape areas, reports that steep broken cliffs with traversible terraces are most desirable; where steep cliffs are lacking, steep slopes and talus are used. Escape terrain must be higher than 8 m and larger than 0.16 ha but must be larger than 2 ha to suffice as lambing habitat. Van Dyke *et al.* (1983) also reports that optimal bighorn foraging habitat lies within 1 km of suitable escape terrain and few bighorns forage more than 1.6 km from escape terrain. Smith *et al.* (1991) report more restrictive distances: generally only 300 m but as much as 500 m if escape terrain is available on more than one side.

Although cliffs contain only sparse vegetation, they may be important for feeding in winter as the steep slopes readily shed snow and are often warmer, thus providing easier access to forage (Van Dyke *et al.*, 1983).

The breeding season extends from about mid-November to mid-December, and the gestation last about 175 days, with lambing in May. Pregnant ewes leave the band and go to the most rugged place in there summer range to give birth (Scotter and Ulrich, 1995, Seip 1983, Chapman, and Feldhamer. 1982).

Mineral licks appear to be an important habitat requirement of Stone sheep, and may be a means of replenishing mineral reserves depleted during the winter (Scotter and Ulrich, 1995, Seip 1983). Mineral lick use occurs primarily between April to July (Seip 1983). Stone sheep were observed in the Mackenzie study area at the Pesika mineral licks on September 1, 1997 (incidental sighting, 1997).

LIFE REQUISITES/SEASONAL USE PATTERNS

Stone sheep life requisites are divided into security, food, reproduction, migration and living (Table 36).

Table 1. Stone sheep seasonal life requisites.

Rank	Life Requisite	Season	Months
1.	Security	All seasons	Year-round
2.	Food	Winter	October-May
3.	Food	Growing	June-September
4.	Reproduction	Growing	June-September
5.	Migration	Growing	June-September
6.	Living	Year-round	Year-round

Security

In general, Stone sheep are restricted to semi-open, precipitous terrain with rocky slopes, ridges, cliffs or rugged canyons. Specific Stone sheep security requirements must be inferred from those requirements documented for California and Rocky Mountain bighorn sheep. We assume that optimal security habitat is provided by slopes greater than 60° (133%), moderately high security provided by slopes between 40 and 60° (90-133%), moderately low between 30 and 40° (67-90%) and no security provided in polygons with slopes less than 30° (67%).

Food

Stone sheep range in the growing season has been characterized by Seip (1983) as natural subalpine clearings including streamsides, rockslides, talus slopes and avalanche chutes. Natural clearings in the Spruce-Willow-Birch (SWB) zone and high alpine peaks and ridges were also being used by Stone sheep in the Mackenzie TEM Study Area. Seip (1983) observed that Stone sheep made extensive use of burned areas in the spring and fall.

Reproduction

Stone sheep lambing habitat is usually part of their winter range or as an intermediate between winter and summer range (Chapman and Feldhamer, 1982). Preferred lambing range is in the most precipitous, inaccessible cliffs near forage, and generally has a dry, southern exposure (reviewed by Chapman and Feldhamer, 1982; Seip, 1983; Scotter and Ulrich, 1995). Habitat for reproduction is not rated in this model.

Living

Habitat that provides general living requirements are food habitats in close proximity to habitat that provides security. We assume that optimal foraging habitat occurs within 300 m of adequate security, moderate foraging can be provided in areas between 300 and 500 m, low foraging provided by habitat between 500 and 1000 m and no forage opportunities occur more than 1.0 km from security habitat.

HABITAT USE AND ECOSYSTEM ATTRIBUTES

The relationship between Stone sheep habitat use and TEM ecosystem and terrain attributes are described in Table 37.

HABITAT RATINGS

Rating Scheme/Modelling Theme

A 6-class rating scheme is used to rate Stone sheep habitat for food (FD), security (SH) and living (LI) in growing (G) and winter (W).

This model considers only three of many possible life requisites that could be considered for Stone sheep. However, we assume that food, security and living represent the most important and if these are satisfied, other life requisites are also satisfied.

Living encompasses all of the requirements necessary for survival and is a function of the spatial arrangement of FD and SH in the landscape.

Food (FD) Habitat Use Assumptions

The ratings table assigns a suitability rating for FD to each ecosystem unit. An ecosystem unit is a combination of site series and structural stage. The relationship between Stone sheep life requisites and the ecosystem attributes are defined by a degrading score relative to the optimal value for the attribute (Table 38). For example, the optimal structural stage for food (herbaceous) has a degrading score of "0"—no degrading effect. However, a sub-optimal structural stage (such as pole-sapling) has a degrading score of 4, which would result in a maximum rating of 5 on a scale of 1 to 6. By summing the degrading scores over all of the

ecosystem attributes, a final rating is calculated. See Section 2.5 for a full description of the methodology used to generate the ratings table.

Polygon Food (FD) Habitat Use Adjustments

Adjustments are used to modify the ratings in order to account for Stone sheep habitat attributes that are not inherent features of the ecosystem unit. There is one adjustment:

- Cool aspects (285-135°) rated down 1 for FD in winter.

Table 2. Stone sheep habitat use related to TEM ecosystem and terrain attributes.

TEM Attribute	Habitat Use
Ecosection	Stone sheep occur in all four Ecosections. Greater snow depths in the WMR, EMR and MIR results in generally poorer Stone sheep habitat than the CAR where less snow, shorter more rounded mountains and a greater number of south facing ridges provides more productive winter habitat. Habitat in the CAR Ecosection is rated up to 50-75% of the best habitat in the province (moderately high or 2) and habitats in the WMR Ecosection is rated up to 25-50% of the best habitat in the province (moderate or 3). These ratings represent maximum year-round suitabilities for Stone sheep and ratings for individual life requisites in particular seasons may be higher.
Biogeoclimatic Zone	In the Mackenzie TEM Study Area, Stone sheep habitat occurs in the AT, ESSFmv4, ESSFmvp4, SWBmk1 and SWBmks1. Stone sheep may also be present in the BWBSdk1 if they are travelling to or are at a mineral lick. However, since this zone does not provide significant Stone sheep habitat, it is generally rated low. The AT primarily provides habitat in the growing season however, wind-blown cliffs and ridges with south and west facing aspects may also provide suitable winter habitat. The ESSFmvp1 and SWBmks1 provide sheep habitat year-round. Sheep use in the ESSFmvp4 and SWBmks1 is highest in winter when sheep may descend to seek out lower snow depths on wind blown south or west facing ridges.
Site Series	Mesic and moister site series (soil moisture regimes sub-mesic to sub-hygric) provide better feeding habitat than drier site series.
Structural Stage	Stone sheep are most often found in areas consisting of few trees, some low-growing shrubs and either natural or burned grasslands. Structural stage 02 (herb) provides optimal foraging and structural stages 01 (non-vegetated/sparse), 03 (shrub/herb) and 3a (low shrub) provide the next best. Structural stages 3b (tall shrub), 04 (pole/sapling) and 05 (young forest) generally provide little feeding habitat with one exception— structural stage 3b in the ESSFmvp4 and SWBmks1 are usually composed of open, often krumholtz forest that provides suitable forage. In winter, structural stages 06 and 07 (mature forest and old-growth forest respectively) provide low-level feeding in the SWBmk1 and ESSFmv4 and better quality winter feeding in the SWBmks1 and ESSFmvp4.
Slope	We assume that optimal security habitat is provided by terrain units with surface expressions moderately steep (60-78%) and steep (>78%). Moderate security is provided by terrain units with the surface expression moderate slope (35-60%). No security is provided by slopes less than 36%.
Aspect	Warm aspects provide better winter habitat for Stone sheep. Therefore, cool aspects (285-135°) are rated down for use in winter.
Proximity effects	Areas used for feeding must be adjacent to escape terrain. We assume that feeding habitat must occur within 500 m of escape terrain.

Table 3. Stone sheep food habitat use assumptions. Each number represents a degradation score. A rating for an ecosystem unit is generated by summing the degradation scores over all attributes.

Attribute	Value	Degrading Score		
		FD-G	FD-W	
1. BEC Unit	CAR	BWBSdk1	4	4
		ESSFmv4	2	2
		SWBmk1	2	2
		ESSFmvp4	1	1
		SWBmks1	1	1
		AT	1	1
	MIR	ESSFmv4	3	3
		ESSFmvp4	2	2
		AT	2	2
	EMR	SWBmk	3	3
		SWBmks	2	2
		AT	2	2
	WMR	BWBSdk1	4	4
		ESSFmv4	3	3
		SWBmk1	3	3
		ESSFmvp4	2	2
SWBmks1		2	2	
AT		2	2	
2a. Site Series (SMR)	Xeric	1	1	
	Subxeric	0	0	
	Submesic	0	0	
	Mesic	0	0	
	Subhygric	0	0	
	Hygric	0	0	
	Subhydric	1	1	
	Hydric	2	2	
2b. Site Series (SNR)	Very poor- poor	0	0	
	Medium-very rich	0	0	
3. Structural Stage	Sparse (1a)	0	1	
	Bryoid (1b)	0	1	
	Herb (2)	0	1	
	Low shrub (3a)	0	1	
	Tall shrub (3b)	3	2	
	Pole/sapling (4)	3 (0) ^a	2 (0) ^a	
	Young forest (5)	3	3	
	Mature forest (6)	3 (0) ^a	1 (0) ^a	
	Old forest (7)	3 (0) ^a	1 (0) ^a	
4. Stand Composition	Broadleaf	0	0	
	Mixed	0	0	

^a Conditional rating: if zone is ESSFmvp4 or SWBmks1, then down-rating adjustment equals 0.

Security Habitat (SH) Use Assumptions

Security ratings were applied using site series and terrain surface expression slope classes:

- Polygons classified as cliff (CL) rated 1 SH;
- Polygons classified as rock outcrop (RO) rated 2 SH;
- Slopes 80-100% (surface expression code "s") and structural stage 1-3, rated 3 SH.
- Moderately steep ("k", 60-78% slope) and structural stage 1-3, rated 4 SH;
- All other surface expression codes) rated 6 SH.

Living (LI) Habitat Use Assumptions

The LI rating is a combination of the FD and SH rating and is generated using a GIS algorithm. Since a given habitat can generally only be as good as the most limiting life requisite, LI is calculated as the lower rating between the polygon FD rating and the best SH rating within 500m.

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