

# WILDLIFE DATA CENTRE

## FEATURED SPECIES - THINHORN SHEEP

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That's right – thinhorn sheep. Many of us have seen bighorn sheep in British Columbia. Fewer of us have seen thinhorn sheep, even though about 80% of the world's Stone's thinhorn sheep (*Ovis dalli stonei*) occur in the province. In fact, both subspecies of thinhorn sheep occur in British Columbia. Stone's thinhorn sheep occurs in mountain ranges from about Williston Lake north and west to the Atlin and Tatshenshini region. Dall's thinhorn sheep (*O. d. dalli*) is restricted to the extreme northwest where the St. Elias Mountains extend into British Columbia west of Bennett Lake.

All wildlife species are worth the time it takes to find and watch them. Thinhorn sheep offer their own special pleasures. During the rut, the chaos is as dramatic as any that bighorn sheep offer. During lambing, it is difficult not to gambol a little yourself, as you watch the lambs frisk about, seemingly motivated by the sheer pleasure of leaping down rocks and climbing back up again. Lambing also is the time that draws out predators that normally are far more elusive and difficult to encounter. They gather, looking for an easy meal – Golden Eagles, wolves, grizzly bears, and wolverines. At any time of year you can simply ponder who is doing what. All wild sheep have relatively complex social structures and the activities of different sex and age classes vary in a way that keeps that social structure functioning.

### Wildlife Data Centre Provincial Status Designation

The Stone's sheep is **Not in Jeopardy** in British Columbia, but we bear considerable stewardship responsibility because most of the world's population occurs within the province. Dall's sheep also is **Not in Jeopardy** in British Columbia. Its highly restricted distribution in the province renders it vulnerable, but its range in British Columbia is little developed and not readily accessible by humans. Dall's sheep is far more abundant in Alaska and the Yukon Territory.

### At a Glance

*Dall's sheep – Adults* (Figure 1)

- **large, all white sheep**
- long, thin sharply pointed horns (shorter in female)

### *Dall's sheep – Lambs*

- **all white**
- no visible horns

### *Stone's sheep – Adults* (see cover image)

- **large light gray, gray brown to almost black sheep**
- long, thin sharply pointed horns (shorter in female)

### *Stone's sheep – Lambs* (Figure 2)

- **light gray to gray brown**
- no visible horns

Populations with colour intergrades between Dall's and Stone's sheep occur in both northwestern BC and the Yukon and Northwest Territories. These are not considered separate subspecies. Compared to bighorn sheep, the horns of thinhorn sheep are more triangular in cross-section, flare more widely from the head, and are rarely "broomed" or broken at the tips. Despite their variable colour, Stone's sheep never show the dull, medium-brown coat colour of bighorn sheep.



**Figure 1.** Adult male Dall's thinhorn sheep. Sheep Mountain, Yukon Territory. May 1977. (Fred L. Bunnell).

### **Where and When**

#### World range

Thinhorn sheep are endemic to North America, where they occur in the mountains of Alaska and northwestern Canada. Dall's sheep are found in Alaska, including the



**Figure 2.** Adult female Stone's thinhorn sheep with lamb near Muncho Lake, BC. August 1980. (R. Wayne Campbell).

Kenai Peninsula, the Yukon territories, western MacKenzie Mountains of the Northwest Territories and extreme northwest British Columbia. Stone's sheep are found in north-central British Columbia and south-central Yukon Territory.

#### British Columbia

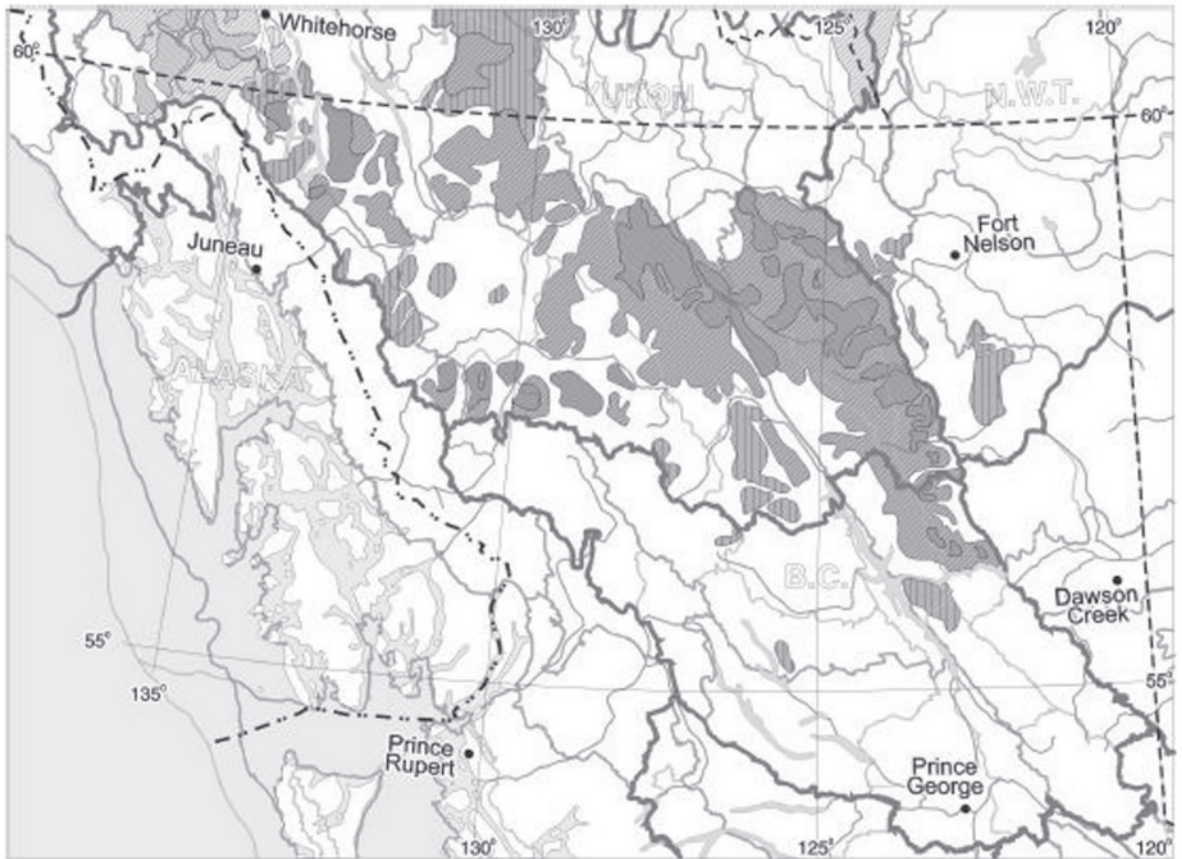
Stone's sheep occupy scattered areas in a swath of rugged, mountainous terrain running from the east side of Bennett Lake near the Yukon Territory border down to about Williston Lake (Figure 3).

The most recent estimates of Stone's sheep are about 12,000 in British Columbia and 3,000 in the Yukon Territory.

Dall's sheep are restricted to the southern extension of the St. Elias Mountains into the Haines Triangle west of Bennett Lake, in the extreme northwest of the province (Figure 3). The most recent (1997) estimate of Dall's sheep in British Columbia is about 500, which is less than 1% of the estimated global population. Because of its limited distribution in British Columbia, the subspecies is Blue-Listed by the British Columbia Ministry of Water, Air and Land Protection.

#### Habitat – nonbreeding

Dall's sheep are largely animals of the alpine, while Stone's sheep are less restricted and often venture into subalpine brushlands and even lower forested areas (Figure 4), sometimes relatively distant from the nearest mountain. Summer and winter ranges of both subspecies are often discrete. Summer ranges are typically at higher elevations, often remote, frequently near escape terrain, and always



**Distribution and relative abundance**

\* Thinhorn populations not rated outside of British Columbia.



**Subspecies delineation**



**Ecolines legend**



**Figure 3.** Distribution and relative abundance of the two subspecies of thornhorn sheep in British Columbia. Reproduced with permission from Demarchi and Hartwig (2004).



**Figure 4.** The Summer range of Stone's thorn sheep includes a variety of nutrient-rich forbs and grasses in remote subalpine regions frequently near escape terrain. Near Atlin, BC. August 1980. (R. Wayne Campbell).

support graminoid forage (grasses, sedges, and rushes), a variety of forbs, and low shrubs (e.g., *Dryas*, *Salix*, *Vaccinium*, and *Empetrum*). These areas are usually under deep snow during winter. During summer, nursery groups (ewes, lambs, and yearlings) may not venture as far from lambing areas as do rams. After the rut, about mid-November to mid-December, all sex and age classes congregate on the more localized winter range, which may be the lambing area. Winter ranges are lower in elevation, drier, and typically windswept (Figure 5). Less precipitation and higher winds on these ranges keep snow from accumulating and permit access to forage beneath the snow. Both subspecies enter forest edges during winter, but find most of the forage in adjacent open areas.



**Figure 5.** In winter, Stone's thorn sheep congregate in mixed sex and age classes in drier and more windswept mountainous habitats. Mount Mary Henry, BC. 26 February 1995. (R. Wayne Campbell).

### Habitat - breeding

Most lambs are born in May, but lambing extends into June. Lambing habitat differs from non-breeding habitat in that there is always escape terrain – steep rugged cliffs or rock outcrops to which ewes and lambs can flee. Because of the high energy demands of lactation, ideal lambing habitat has ample graminoid forage (grasses and sedges) in close proximity to escape terrain. During lambing, these areas are inhabited by nursery groups. Older rams often forage on the periphery of lambing areas and usually leave them for summer range before the nursery groups depart. Lambing areas are traditional and collared ewes have used the same small areas 7 years in succession. Ewes seek seclusion in the cliffs to give birth. Once lambs are more mobile (about 6 to 8 weeks of age) ewes, lambs and yearlings often move to summer ranges.

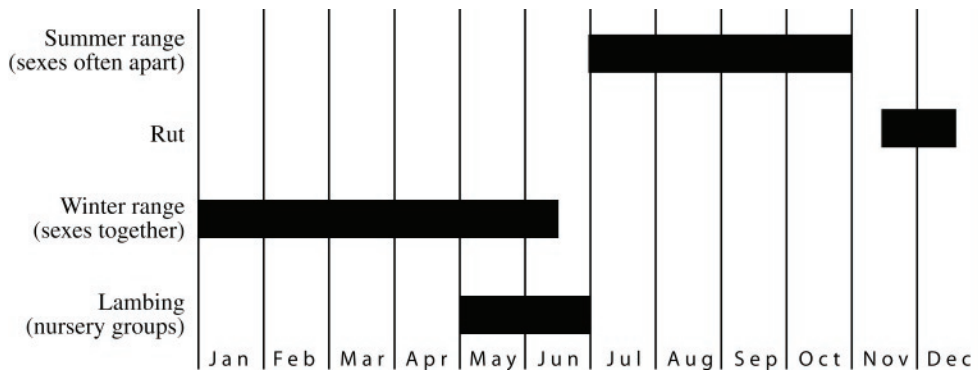
### **Family Life**

#### Social Organization

Social organizations in animals evolve to address three essential tasks: procure food, evade predation, and reproduce. Each task is treated in more detail below; here we consider the organization that facilitates those tasks. Thornhorn sheep are a herd animal, uncommonly seen alone, although they may become widely scattered during summer. When your food is concentrated and of largely uniform quality, it helps to form herds of many eyes to watch for predators. However, staying concentrated makes the predators' task easier, so it is better to spread out in smaller groups when you can (summer for thornhorn sheep). Rams and nursery groups usually are apart during the summer months (Figure 6).

The social organization of female groups involves ewe-yearling-lamb units. These are family groups, possibly loosely integrated by the lambs propensity to associate and play with other lambs. Ewes without lambs typically are nearby, but not as integrated until lambs have grown and the sheep are ready to depart to summer range. Groups of lambs are sometimes "baby sat" by other ewes as their mother feeds. This allows the mother to meet the intensive demands of lactation while others provide watchful eyes over the lambs. There are relatively few aggressive interactions among ewes over feeding or bedding sites, and usually the older ewe wins by virtue of a more aggressive horn threat.

Social organization among rams is more complex and less peaceful – oriented to establishing and maintaining dominance. Dominance helps determine access to ewes. Rams appear to associate the force of a horn clash with the size and curl of the horn delivering the blow, thus conflicts are limited and the most serious occur between rams of about equal size, who are unclear on the outcome. Contests may



**Figure 6.** Typical seasonal pattern of movement and social groups among thinhorn sheep.

last over 90 minutes, after which the rams will peacefully graze together. Nearly all older ram skulls I've examined have had broken frontal or parietal bones. Nonetheless, mutually known dominance status allows rams to continue grazing as a herd without great energy expenditure or the risk of serious injury through constant conflict. Struggles for dominance occur during summer, with no ewes to cheer the rams on. Dominance status helps rams through winter, because it makes the rut a less unruly and energy-draining affair. Sometime after their first year, young rams begin following ram groups, gradually gaining the weight, horn growth and experience to engage in the dominance struggles themselves.

### Food and Foraging

An animal's first task is to procure food. Thinhorn sheep inhabit a large area and thus encounter many plant species. Dietary analysis suggests that 50 to 120 species are eaten by any specific population. Some generalities include:

- 1) they are primarily grazers, consuming about 60 to 88% graminoids;
- 2) their diet shrinks dramatically during winter; and
- 3) they ingest far more lichen and mosses than do other sheep species, in both winter and summer, but primarily the former.

The high lichen intake may be attributed to their choice of dry, windswept slopes where lichens are abundant.

Thinhorn are our northernmost sheep where the period of digestible protein in forage is most limited. They extend the period of high-quality forage through their movements.

Direction of the movements depends on the location. Those wintering in the alpine, move down in the spring. As spring progresses, all herds tend to move up following the flush of younger, more digestible growth at higher elevations. This movement is necessary because crude protein in the diet drops below maintenance during winter and the period of weight gain and horn growth is limited.

Foraging by lactating ewes consumes most of their active time. Among Dall's sheep at Sheep Mountain, lactating ewes utilized 82% of the daylight hours available for foraging, versus 75% and 63% in nonlactating ewes and rams, respectively.

Thinhorn sheep also make purposeful lengthy movements to mineral licks (Figure 7), particularly (but not exclusively) during spring. Given the effort made (16 to 18 km in some instances), the licks must serve a clear dietary purpose. We do not know what that purpose is. Because much of licking behaviour occurs in spring, several workers have assumed that licks are replacing minerals lost over winter, with sodium and magnesium being the favourite candidates. There is another hypothesis. Although the chemical composition of licks is highly variable, they almost all have clay soils. Licks are sought most avidly during spring when the forage has suddenly become succulent and scours are prevalent. Clay would act nearly as well as immodium.

### Predation and Other Mortality

Wolves, coyotes, wolverines, black bears, and Golden Eagles have all been reported killing adults and lambs of thinhorn sheep. Some researchers have suggested red foxes as possible predators and listed the Common Raven and Black-billed Magpie as contributing to deaths of already wounded or crippled sheep. I have watched grizzly bears prowling opportunistically around lambing areas. It is likely that wolves are the major predator, but they do not seem



**Figure 7.** Stone's thorn sheep travel long distances to utilize mineral licks, but their purpose is not fully understood. Summit Lake, BC. 2 July 2005. (R. Wayne Campbell).

to be limiting. Mountain sheep invariably seek areas with some form of escape terrain nearby. There appears to be no difference in Dall's sheep demography in areas of high and low wolf density. Stone's sheep stray farther from escape terrain and enter timbered areas more commonly, so they probably are more susceptible to predation.

The primary factor limiting population size and growth in thorn sheep is the quantity and quality of forage, which in turn is limited by weather. On many thorn ranges, summer precipitation determines the nutrition of ewes entering pregnancy and the subsequent lamb crop. Thorn sheep use virtually all their fat reserves to survive winter shortages. Snow conditions can make winter shortages worse because sheep rarely attempt to dig for forage at snow depths > 30 cm. Many authors have reported severe winter kills or reduced lamb crops following severe winters.

Other mortality factors appear minor. Some deaths through accidents, particularly falls, have been reported. Neither parasites nor disease have been documented as major contributory factors to mortality in thorn populations, and interspecific competition with other native ungulates is minimal. Provided the sheep evade these mortality factors, their life expectancy is determined by tooth wear. They often are grazing near glaciers where silt is deposited on the vegetation they eat. Of 26 Dall's sheep skulls examined from Kluane Park's Sheep Mountain herd, no sheep older than 9 years had its full complement of incisors and no sheep older than 13 years was found. On other Yukon ranges, receiving less glacial dust and silt, maximum life expectancy rose to 14 to 15 years and a few Dall's rams 17 years of age have been legally killed by hunters. Generally, individuals older than 12 years are rare.

### Reproduction

Despite the ram's efforts at establishing dominance during summer, the rut remains a chaotic affair. Rut begins in about mid-November and extends to mid-December or longer among Stone's sheep. Rutting activity is induced by onset of estrus in ewes, which appears strongly controlled by photoperiod in all but desert populations of North American wild sheep. Rams move restlessly among ewes, detecting estrus by scent and behaviour. When a ewe enters heat, the chase begins and may involve all rams following a ewe into the cliffs. Early in rut, when few ewes are in estrus, the rams are wildly excited and the chases well attended. Eventually, the ewe stops and usually is claimed by the largest ram present, but on lengthy chases large rams may be out run by younger, smaller, and theoretically less dominant rams. There are scattered observations of rams attempting to form harems, but neither the ewe nor other rams appear to cooperate.

Estrus lasts 1 to 3 days and includes many copulations. Estrus periods in Dall's sheep are separated by 12 to 14 days and are probably similar in Stone's sheep. The mean lambing period is  $29.8 \pm 2.34$  days for 18 populations of North American mountain sheep (almost precisely two inter-estrus periods in length). Puberty in thorn sheep appears related to weight and nutrition, rather than age (much as in domestic sheep). Biologists report that Dall's ewes from the Sheep Mountain population first gave birth at 4 years, and that birth rate did not exceed 50% until ewes reached 5 years of age. However, 2 of 4 lambs from the same population captured and fed well, lambed at 2 years of age or were pregnant at 18 months. Although some Dall's sheep rams may be physiologically capable of reproduction at 18 months, the dominance hierarchy effectively excludes them from breeding. Both rams and ewes appear capable of reproduction throughout their adult lives, ewes 13 to 16 years old have been found pregnant or with a lamb at heel.

The lambing period appears tightly constrained. Lambs born too early are born before spring plant growth provides sufficient nutrition for lactation; those conceived much later are born too late for adequate growth prior to their first winter. Single lambs are born after a gestation period of about 171 days and weigh about 3 to 4 kg. As parturition approaches, thorn ewes seek isolation in the most rugged terrain available. The period of strict seclusion appears to be less than 24 hrs when they join other ewes with lambs. Ewes with lambs tend to remain separated from barren females and yearlings for several weeks after lambing, before the groups coalesce. Lambs typically stay with their mother until the following spring when they are displaced by new lambs.

### Growth and Development

From their birth weight of 3 to 4 kg, both thinhorn subspecies grow to about 25 to 30 kg by their first birthday. Even as yearlings, males are larger. Adult ewes attain their full body weight of about 50 kg by age 5 or 6 years. Adult rams continue to grow, often attaining a weight of 70 to 80 kg by age 7 or 8 years. The largest rams attain weights of about 90 to 110 kg.

Horns play a key role in the social organization of sheep. It is thus not surprising that growth in horn length and bottom weight are so highly correlated that linear horn measurements are a good predictor of body weight. During years of low forage availability, growth of horns in Dall's rams is depressed, and rams born in such years may never attain the horn size of rams born in better years. The horn length of adult ewes in both subspecies is about 25 cm. Ram horns are more massive and longer than those of ewes. "Full curl" horns have attained a 360° curl about their axis. Horns of "full curl" rams average about 90 cm in length. The longest recorded horns in the Boone and Crocket record standards are 123.5 cm for Dall's sheep and 131.6 cm for Stone's sheep.

### **How are they doing?**

The major threat to wildlife is loss of suitable habitat. Both thinhorn subspecies enjoy relative immunity from competing activities in their northern, commonly high elevation, habitat. Few other grazers compete with them on their range. They also appear to habituate readily to potential disturbances associated with human activity, such as low aircraft overflights and noise from other vehicles, construction or chainsaws. The forest cover that they use grows too slowly to attract harvest, and fire is their friend. Natural or prescribed burning of their range helps retain the productive graminoid growth that they seek.

Because their reproduction is tightly related to their nutrition, and there is only a narrow season of abundant digestible forage, thinhorn sheep show the classical density-dependent response of many large ungulates. That is, their numbers are largely self-limiting through pressure on their food supply, which is largely determined by winter and spring weather. During the present period of climate change, northern British Columbia is warming considerably more than are more southern regions. Such warming should benefit thinhorn sheep as it permits greater forage production, potentially shorter periods of deep snowpack, and more frequent fires that restore their range.

Thinhorn sheep apparently have no serious disease or parasite problems. One small group of Stone's sheep, wintering at uncommonly low elevations on the Peace

Arm of Williston Lake, has experienced significant hair loss associated with parasitization by the winter tick (*Dermacentor albipictus*) to the area. The relatively high numbers of ticks may have occurred because elk (*Cervus elaphus nelsoni*) have been introduced to the area. Elk host winter ticks but are affected less by them than are other large ungulates. The infected sheep showed no increase in mortality or decrease in lambing. Sheep wintering at higher elevations showed no effects by winter ticks.

Stone's sheep are killed by vehicle traffic on the Alaska Highway, particularly in the area around Toad River and Muncho Lake, which they regularly frequent (Figure 8). There is no record of the number of kills. In fact, the British Columbia Ministry of Transportation Wildlife Accident Reporting System shows no road kill for any sheep in northern British Columbia over the period 1983 to 2002, indicating the reporting system is incomplete. Both wolf predation and human harvest have caused declines when populations already were stressed by severe winter weather. None of these factors appear to be a persistent threat to thinhorn numbers.



**Figure 8.** Vehicle traffic along the Alaska Highway in northeastern British Columbia is a source of mortality for Stone's thinhorn sheep, especially lambs. Muncho Lake, BC. August 1980. (R. Wayne Campbell).

### **Mammal Musings**

#### *If you can't be a male, be a female*

Males that are defeated in battle, or of lower rank, are treated like females. Because high-ranking rams disregard the actual females, except for during the "rut", weaker and younger males can remain in the herd without being chased off.

### They don't really own them

The correct common names for thinhorn species are Dall's sheep and Stone's sheep. Dall's sheep was named for American zoologist W.H. Dall; Stone's sheep was discovered by the naturalist A.J. Stone.

### "Long in the tooth" is bassackwards

Teeth actually get more worn and shorter with age. The maximum longevity of large ungulates is determined by tooth wear. Eventually the teeth are too worn or broken to permit effective foraging. Dall's sheep have a shorter longevity than most large ungulates simply because their forage often is covered by wind-blown glacial silt.

### **Acknowledgements**

The opportunity to work on thinhorn sheep arose through luck, but I am none-the-less grateful. Anthea Farr helped collect some of the data reported here. Provincial biologists with the British Columbia Ministry of Water, Land and Air Protection provided assistance. Helen Schwantje graciously related the tale of Stone's thinhorn sheep and the parasite *Dermacentor*. Greg Jones tracked down the absence of road kill data for Stone's thinhorn sheep on the British Columbia Ministry of Transportation website, which is inaccessible to non-government personnel.

Raymond A. Demarchi provided the updated distribution map and reviewed the final draft of this account.

### **Useful References**

A comprehensive list of references for thinhorn sheep can be found in the provincial status report prepared by R. A. Demarchi and C. L. Hartwig. The list that follows contains major references used to prepare this species account.

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*They know the tundra of Siberian coasts*

*And tropic marshes by Indian seas;*

*They know the clouds and night and starry hosts*

*From Crux to Pleides*

Frederick Peterson (1859 - 1938), *Wild Geese*