Chauncey Ridge rams. Photo: I. Teske

East Kootenay bighorn sheep inventory January-February 2019

Prepared for:

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Executive summary

To support management of bighorn sheep (*Ovis canadensis*) in the East Kootenay we conducted aerial sheep surveys within 8 Population Management Units (PMUs) during January-February 2019. We used 38.9 hours of helicopter time and flew 27.6 hours on survey. We observed 1,246 bighorn sheep in 151 groups during surveys. Using the standardized 80% sightability correction factor to the aerial survey count then added additional animals from ground counts not accounted for during aerial surveys, a total of 1,596 sheep were estimated within the survey area. Estimated lamb:ewe ratios were >30 lambs:100 ewes in all PMUs and averaged 41:100 overall. Estimated ram ratios ranged from 35–85 rams:100 ewes and averaged 50:100 overall. We used a sightability model to obtain an estimate of 1,648 (±150][90% CI]) sheep. The model calculated an overall average sightability of 0.77; sightability was lowest for Class IV rams (0.68). These inventory data fed into the Kootenay Region bighorn sheep management plan process being completed in 2019.

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Introduction

Periodic inventories of harvested ungulates are required for population and harvest management. We conducted aerial surveys for bighorn sheep (*Ovis canadensis*) in the East Kootenay during late January to late February 2019 to update population estimates and provide current abundance data for the concurrent regional bighorn sheep management planning process. Teck Coal Ltd. did not conduct wildlife inventories within the Elk Valley East this winter, however in support of the Sparwood and District Fish and Wildlife Association's wildlife programs did contribute funding towards this inventory.

Study area

Many of the known winter ranges in the East Kootenay were included in the study, including the following Population Management Units (PMU): 2 Wigwam Flats-Elko-Phillips, 3 Elk Valley East, 4 Elk Valley West, 5 Bull River, 6 Premier-Wildhorse, 7 Whiteswan-Sharktooth, 8 Columbia Lake-Radium, and 9 Assiniboine (Fig. 1). Ground counts were used to supplement aerial survey data in several areas, and Alberta survey data from January 2018 were used for estimates at Crowsnest Pass (PMU 3; M. Didkowsky, Alberta Environment and Parks, unpubl. data).

Bighorn sheep in the Kootenay Region are generally divided into those that use lower elevation winter ranges within the Rocky Mountain Trench – escaping deep snow at higher elevations by using grassland or open forested habitats on flat or southerly aspects associated with rocky escape terrain – and those that use higher-elevation winter ranges – using mid- to high-elevation grassland habitats on windswept, southerly facing slopes again associated with escape terrain (Kuzuk et al. 2012, Stent et al. 2013). The study area included low elevation slopes along the east side of the Rocky Mountain Trench and mid to high elevation slopes (alpine and open subalpine habitat) within the Rocky Mountains. These areas cover a range of biogeoclimatic zones: Interior Douglas Fir, Engelmann Spruce Subalpine Fir, Montane Spruce, Ponderosa Pine, Interior Cedar Hemlock and Alpine Tundra (Braumandl and Curran 2002).

Potential predators of bighorn sheep in the study area include grizzly bear (*Ursus arctos*), black bear (*U. americanus*), cougar (*Puma concolor*), wolverine (*Gulo gulo*), wolf (*Canis lupus*), coyote (*C. latrans*), and golden eagle (*Aquila chrysaetos*). The area also supports a high density and diversity of other ungulates, including large numbers of elk (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*), scattered mountain goat (*Oreamnos americanus*), and smaller numbers of moose (*Alces alces*) and white-tailed deer (*O. virginianus*). Mountain goat and elk were often observed during winter on the same ranges utilized by sheep.
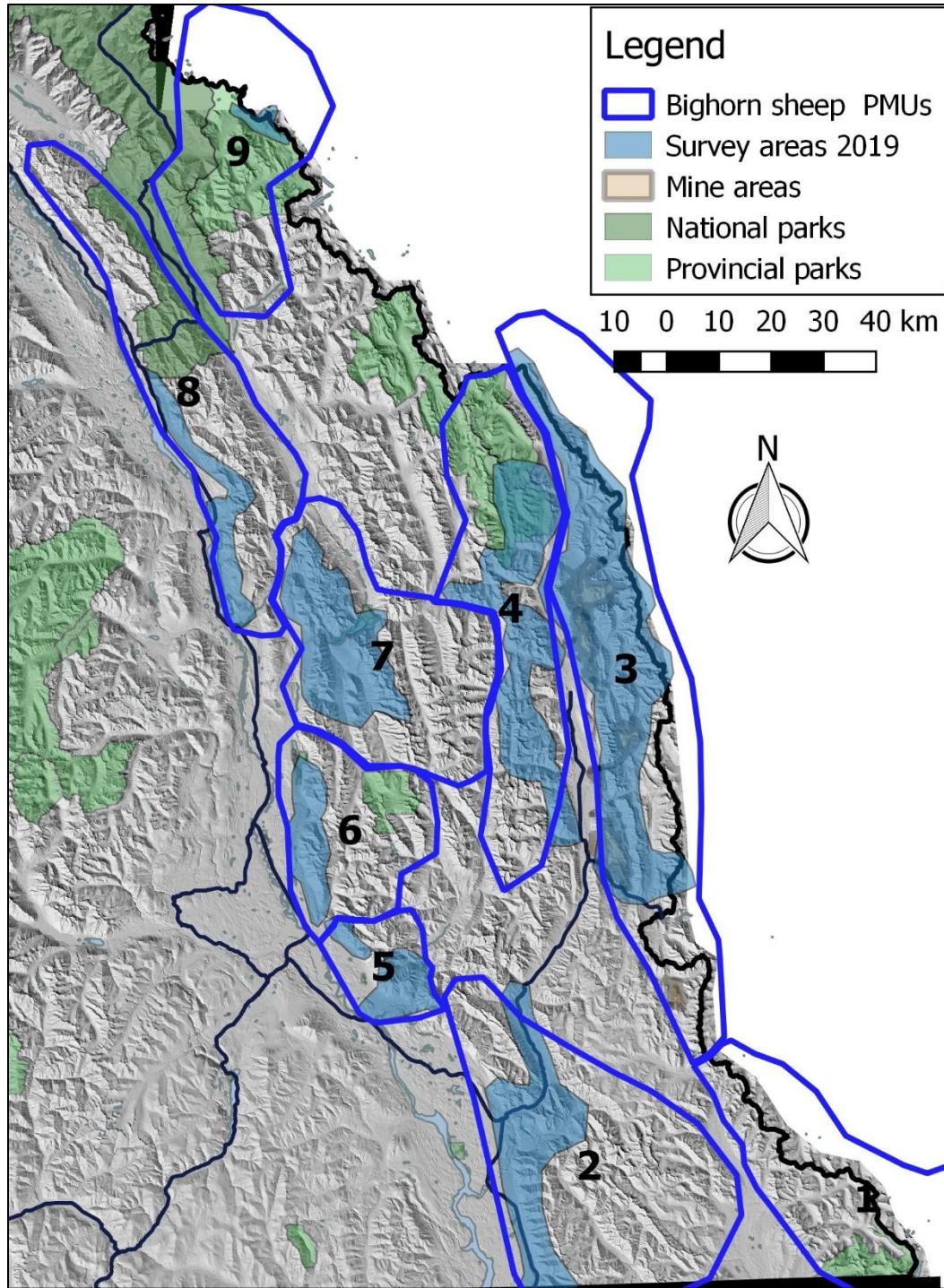
Figure 1. Population Management Units (PMUs) surveyed during bighorn sheep surveys in the East Kootenay, January-February 2019. Surveys were conducted within all PMUs shown with the exception of PMU 1 (Flathead-Waterton).

Study design and methodology

We conducted the aerial surveys using a Bell 206B helicopter equipped with rear bubble windows, following general standards for aerial inventories (RISC 2002). All surveys were conducted with 3 observers plus the pilot, all with extensive survey experience. The data recorder usually sat behind the pilot on the right rear side of the machine. The observer in the front of the machine was responsible for navigating while the secondary observer was located on the left rear of the machine. We surveyed all recent and historical known wintering areas for sheep, using an iPad loaded with background locations for navigation. We flew roughly 125–150 m (400–500 foot) contour lines at 80–100 km/hr, 75–100 m from the hillsides. Animal locations and flight track were recorded with a hand-held GPS unit, which was later downloaded to a computer. We recorded elevation of groups observed from the helicopter's altimeter (to the nearest 100 feet). We classified sheep to Level 4 classification (RISC 2002), which consisted of lambs, ewes, and Class I, Class II, Class III, and Class IV rams. Sightings of other large ungulates and wildlife were also recorded (primarily mountain goat, elk and deer), although little effort was used to record detailed composition.

To obtain data to fit into an existing sightability logistic regression model developed for California bighorn sheep in Idaho (Bodie et al. 1995, Unsworth et al. 1998), we also classified groups when first observed for activity (moving or not moving), estimated percent snow cover in the general area and percent vegetation cover (perhaps best described as screening cover) around the first animal seen in the group, and recorded broad habitat type (up to 8 habitat types could be recorded, which were collapsed into flats/open slopes or other habitats; Unsworth et al. 1998). We estimated population size and sightability correction using the Idaho sheep model in program AERIAL SURVEY (Unsworth et al. 1998). We also calculated abundance estimates of bighorn sheep using a sightability of 80% for aerial surveys, a standardized correction factor used during many of the recent surveys carried out by BC FLNRORD (I. Teske, BC FLNRORD, pers. comm.) and which has been calibrated with sightability of collars individuals (Teske and Forbes 2002, Poole 2013). Ground counts were used in a few areas to supplement aerial survey results and added to the estimates but were not corrected for sightability.

Winter 2018-19 had significantly lower snow accumulation – generally 20–25% below the historical median – at high and low elevations compared with normal. Snow depths at high elevation were below average for much of winter 2018-19 especially in the mid-winter (Fig. 2). Snow depths at the Cranbrook airport (an index for valley bottoms) were much shallower than average through to mid-February and slightly above average from mid-February to mid-March (Fig. 3).
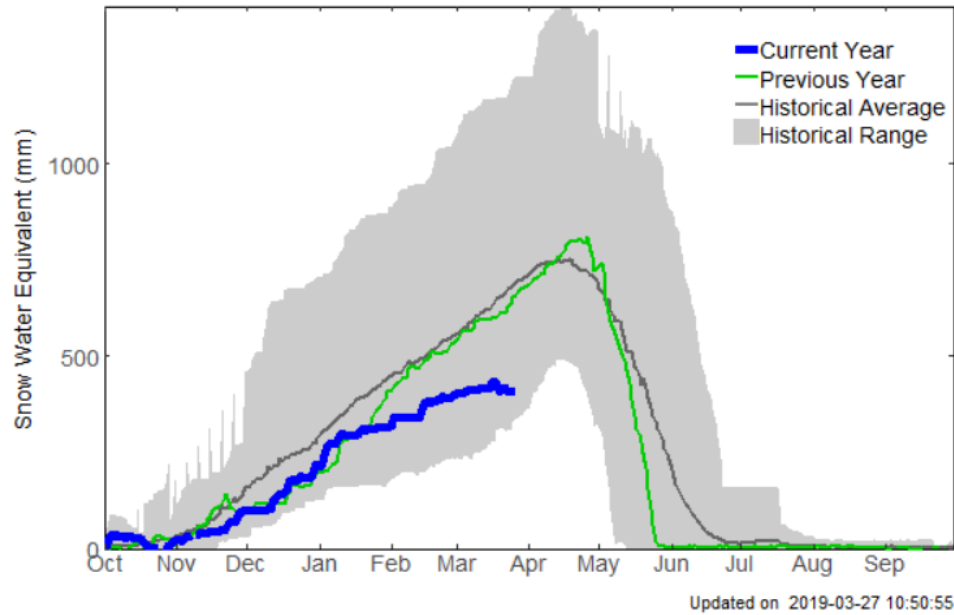
Figure 2. Snow pillow data (snow water equivalent) obtained from the Morrissey Ridge site at 1,860 m southeast of Fernie. Winter 2018-19 is current year shown in blue. Downloaded 27 March 2019. (http://bcrfc.env.gov.bc.ca/data/asp/realtime/asp_pages/asp_2C09Q.html)
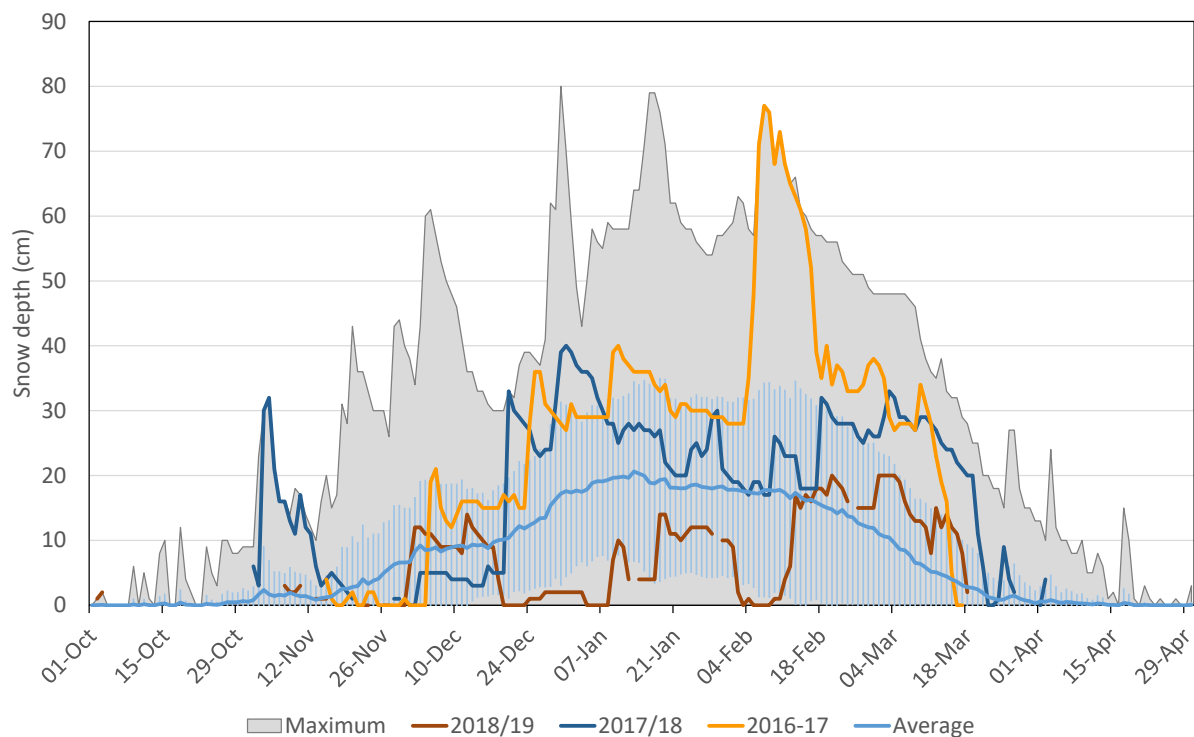
Figure 3. Cranbrook airport (YXC) snow on the ground data for winter 2018-19 compared with winters 2016-17 and 2017-18, the historical average (±1 SD) and the maximum recorded prior to winter 2018-19 (http://cranbrook.weatherstats.ca/download.html).

Results

Surveys were conducted between late January and late February 2019. Snow cover ranged from complete to thin. Temperatures ranged from –10 to –20°C and visibility was good to excellent. We used 38.9 hours of helicopter time and flew 27.6 hours on survey (Table 1). We observed 1,246 bighorn sheep in 151 groups during surveys, including 639 ewes, 264 lambs, 317 rams and 26 unclassified adults (Fig. 4; Table 2). Mean group size was (8.3 ± 0.86 SE; range 1–73). Six of the unclassified sheep were added to the count for Bingay Creek in the Elk Valley West, where a group of 14 sheep was observed on an unrelated helicopter flight the day after we saw a group of 8 sheep.

Table 1. Areas surveyed during the East Kootenay bighorn sheep surveys, January-February 2019.

Date	PMU	Survey area	Survey time (hr:min)
28 Jan 2019	9	Assiniboine	0.46
28-29 Jan 2019	7	Whiteswan-Sharktooth	3:53
28 Jan 2019	8	North of Columbia Lake	0:18
5 Feb 2019	4	Elk Valley West	3:25
5-6 Feb 2019	3	Elk Valley East	7:52
21 Feb 2019	2	Wigwam Flats-Elko-Phillips	4:21
27 Feb 2019	5	Bull River	2:45
27 Feb 2019	6	Premier-Wildhorse	2:43
28 Feb 2019	8	Columbia Lake East	1:50
Total			**27:35**

Elevations of observed sheep groups ranged from 900 to 2,750 m ($\bar{x}$ = 1,851 ± 46.3 m) with a bimodal distribution representing low and high-elevation wintering herds (Fig. 5). Most sheep groups were observed on open slopes (51%) and dissected cliffs (42%), with the remaining groups observed in timber, near towns, or in a cave. Percent snow cover averaged 91%, with 91% of groups in ≥80% snow cover. Percent vegetation cover (screening cover) ranged from 0–60% ($\bar{x}$ = 4.2%) with 81% of groups in areas with no cover.

PMU estimates incorporated ground sightings in several areas to supplement aerial population counts. Using the standardized 80% sightability correction factor to the aerial survey count then added additional animals from ground counts not accounted for during aerial surveys, a total of nearly 1,600 sheep were estimated within the survey area (Table 3). Estimated lamb:ewe ratios were >30 lambs:100 ewes in all PMUs and averaged 41:100 overall. Estimated ram ratios ranged from 35–85 rams:100 ewes and averaged 50:100 overall.
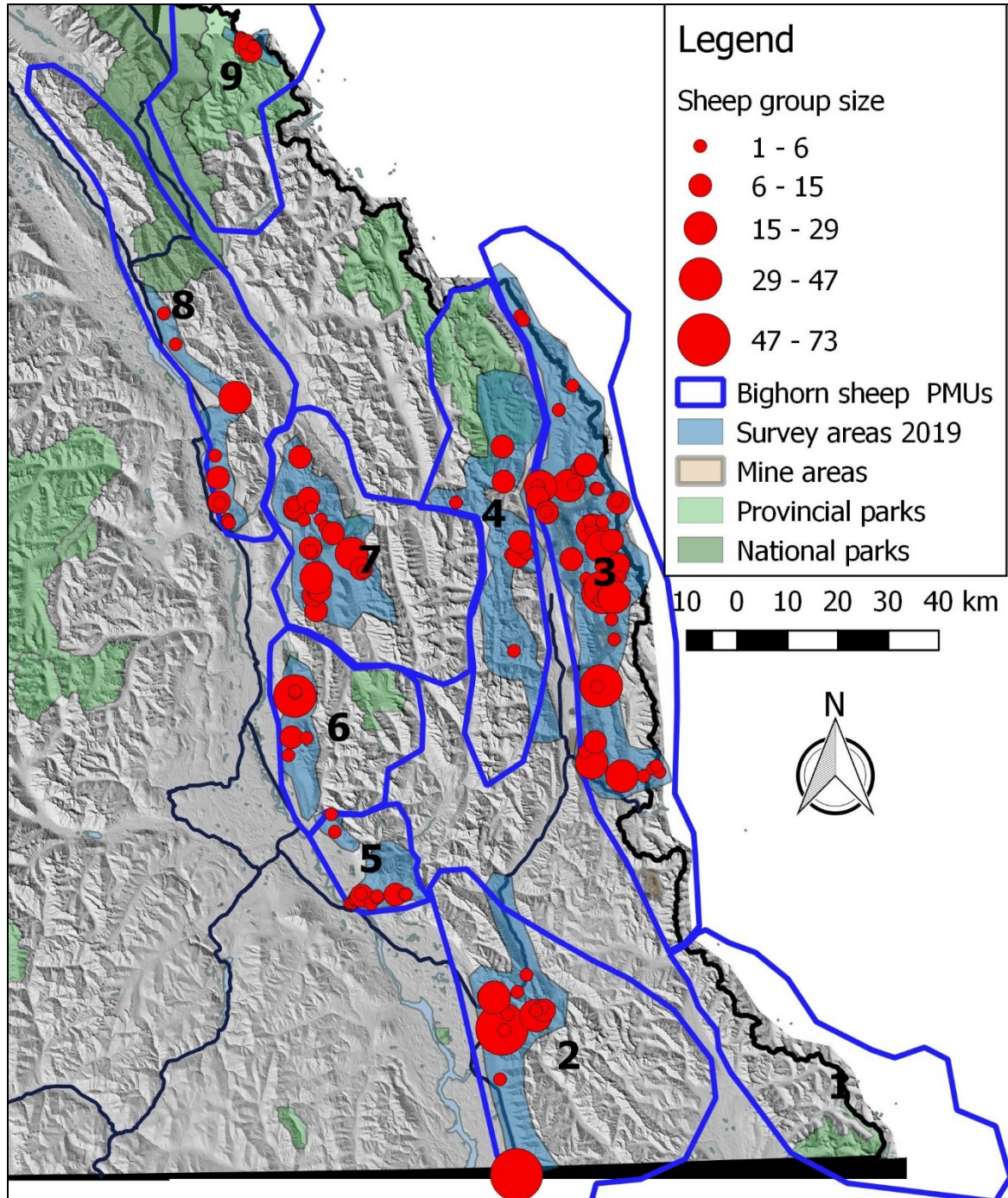
Figure 4. Location of bighorn sheep observed during January-February 2019 surveys within the East Kootenay.
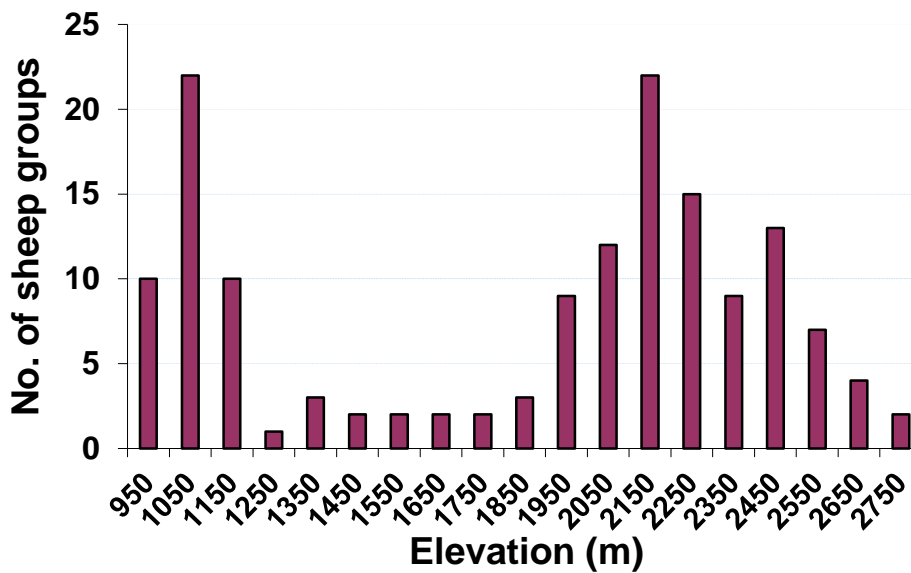
Figure 5. Elevation distribution of bighorn sheep groups observed during aerial surveys in the East Kootenay, January-February 2019. The y-axis label represents the midpoint of 100 m classes.

We estimated a total of 1,648 (±150) sheep using program Aerial Survey to estimate sightability for individual sheep groups (Table 4). Lamb and ram ratios estimated using the Aerial Survey model were 43 (±7) and 52 (±7), respectively, slightly higher than ratios observed and estimated using a standardized 0.80 sightability correction (Table 3). Overall sightability averaged 0.77 and was not far off 0.80 in most PMUs except for Whiteswan-Sharktooth (0.72) and Assiniboine (0.57). Among sex and age classes, Class IV rams had the lowest average sightability (0.68) compared to the other classes (0.75–0.79).

Table 2. Bighorn sheep observations during aerial surveys within the East Kootenay, January-February 2019.

PMU	Total	Lambs	Ewes	U/C[1] male	Ram Cl I	Ram Cl II	Ram Cl III	Ram Cl IV	U/C	Lambs: 100 ewes	Rams: 100 ewes
2 Wigwam Flats-Elko-Phillips	297	53	175		18	23	18	3	7	30	35
3 Elk Valley East	473	95	249	1	29	41	43	15		38	52
4 Elk Valley West[2]	59	9	28		3	7	4	2	6	32	57
5 Bull River	65	14	27		3	10	8		3	52	78
6 Premier-Wildhorse	54	15	28		4	5	2		0	54	39
7 Whiteswan-Sharktooth	199	55	92	1	12	23	14	2		60	57
8 Columbia-Radium	64	10	27		6	7	4		10	37	63
9 Assiniboine	35	13	13		1	2	4	2		100	69
Total	**1,246**	**264**	**639**	**2**	**76**	**118**	**97**	**24**	**26**	**41**	**50**

[1] U/C = Unclassified.
[2] Six unclassified sheep added from a helicopter survey the following day of one herd north of Bingay Creek (A. Oestreich, FLNRORD, pers. comm.).

Table 3. Bighorn sheep estimates from aerial surveys within the East Kootenay, January-February 2019. Estimates obtained using standardized 80% sightability correction factor to the aerial survey count then added additional animals from ground counts not accounted for during aerial surveys.

PMU	Total	Lambs	Ewes	U/C[1] male	Ram Cl I	Ram Cl II	Ram Cl III	Ram Cl IV	U/C	Lambs: 100 ewes	Rams: 100 ewes
2 Wigwam Flats-Elko-Phillips[2]	380	68	224		24	29	23	4	10	31	35
3 Elk Valley East	591	119	311	1	36	51	54	19		38	51
4 Elk Valley West	74	11	35		4	9	5	3	8	32	57
5 Bull River[3]	87	18	36		5	15	10	1	4	49	85
6 Premier-Wildhorse[4]	72	19	35		5	6	3		4	54	39
7 Whiteswan-Sharktooth	249	69	115	1	15	29	18	3		60	55
8 Columbia-Radium[5]	99	16	41		10	11	9	1	13	38	74
9 Assiniboine	44	16	16		1	3	5	3		100	69
Total	**1,596**	**335**	**813**	**3**	**99**	**152**	**125**	**32**	**38**	**41**	**50**

[1] U/C = Unclassified.
[2] Galtons: added 4 from ground count: 1 juv, 2 ewes, 1 U/C ram; Wigwam added 5: 1 juv, 3 ewes, 1 Cl I ram.
[3] Mause Ck. added 6 from ground count: 2 ewes, 1 Cl I, 2 Cl II and 1 Cl IV rams.
[4] Bradford ground count added 4 U/C sheep.
[5] Columbia Lake East: Added 18 from ground count in town (3 juv, 7 ewes, 2 Cl I, 2 Cl II and 4 Cl III rams); also ground count in Prov Park which added 1 Cl IV ram (19 in total).

Table 4. Bighorn sheep estimates (± 90% confidence interval) from aerial surveys within the East Kootenay, January-February 2019. Estimates corrected for incomplete sightability in the program Aerial Survey, with additional animals from ground counts added after correction as noted.

PMU	Total	Sight-ability	Ewes	Lambs	Ram Cl I-III	Ram Cl IV	U/C	Lambs: 100 ewes	Rams: 100 ewes
2 Wigwam Flats-Elko-Phillips[2]	365 ± 80	0.83	214 ± 48	66 ± 16	75 ± 15	3 ± 2	10 ± 7	31 ± 10	35 ± 11
3 Elk Valley East	606 ± 97	0.78	315 ± 57	123 ± 26	148 ± 23	21 ± 6	-	39 ± 11	53 ± 13
4 Elk Valley West	73 ± 23	0.81	34 ± 10	11 ± 4	19 ± 9	3 ± 1	7 ± 3	32 ± 16	64 ±43
5 Bull River[3]	93 ± 22	0.75	39 ± 12	19 ± 7	30 ± 10	1	4 ± 4	52 ± 26	74 ± 95
6 Premier-Wildhorse[4]	72 ± 24	0.80	34 ± 13	20 ± 7	13 ± 5	-	4	59 ± 31	38 ± 21
7 Whiteswan-Sharktooth	276 ± 61	0.72	127 ± 30	75 ± 18	71 ± 17	3 ± 2	-	60 ± 20	58 ±20
8 Columbia-Radium[5]	98 ± 23	0.81	40 ± 10	17 ± 6	29 ± 6	1	11 ± 5	41 ± 28	64 ± 41
9 Assiniboine	62 ± 29	0.57	22 ± 10	20 ± 9	13 ± 10	6 ± 8	-	93 ± 59	87 ± 87
Total	**1,648 ± 150**	**0.77**	**811 ± 84**	**346 ± 39**	**385 ± 37**	**35 ± 11**	**32 ± 11**	**43 ± 7**	**52 ± 7**

[1] U/C = Unclassified.
[2] Galtons: added 4 from ground count: 1 juv, 2 ewes, 1 U/C ram; Wigwam added 5: 1 juv, 3 ewes, 1 Cl I ram.
[3] Mause Ck. added 6 from ground count: 2 ewes, 1 Cl I, 2 Cl II and 1 Cl IV rams.
[4] Bradford ground count added 4 U/C sheep.
[5] Columbia Lake East: Added 18 from ground count in town (3 juv, 7 ewes, 2 Cl I, 2 Cl II and 4 Cl III rams); also ground count in Prov Park which added 1 Cl IV ram (19 in total).

Additional ungulates observed included elk (the vast majority which were seen within the Elk Valley East), mule deer, mountain goat (mainly in Elk Valley West but also in Elk Valley East and Whiteswan-Sharktooth) and moose (primarily with Wigwam Flats-Elko-Phillips; Table 5). Six coyotes were observed, at low elevation in the Bull River (2 separate individuals), and at nearly 2,300 m elevation in the Elk Valley East (2 pairs). Six golden eagles and one bald eagle were also observed. Numerous snowshoe hare (*Lepus americanus*) tracks were observed at and above treeline during the survey in many areas, which coupled with lower overall snow depths may have encouraged coyote access to the high elevation.

Table 5. Other wildlife observed within Population Management Units during surveys for bighorn sheep in the East Kootenay, January-February 2019.

Population Management	Elk	Mule deer	Mt goat	Moose	Coyote
2 Wigwam Flats-Elko-Phillips		1		9	
3 Elk Valley East	124	5	41		4
4 Elk Valley West		4	240		
5 Bull River				1	2
6 Premier-Wildhorse				2	
7 Whiteswan-Sharktooth			27	2	
8 Columbia-Radium	10				
9 Assiniboine			8		
Total	**134**	**10**	**316**	**14**	**6**

Discussion

The East Kootenay bighorn sheep surveys were successfully conducted during January-February 2019. Survey effort in most PMUs was high compared to past surveys and provided full coverage of all areas of potential bighorn sheep range. Survey pilots and core observers had extensive experience conducting surveys for bighorn sheep and other ungulates in the East Kootenay, and outfitters with detailed local knowledge were used in several areas. Even though snow depths and coverage were comparatively low in most areas, survey conditions were good to excellent and sightability was higher (0.77) than observed during comparable surveys in 2012 (0.73, excluding Elk Valley East; Phillips and Stent 2012).

These 2019 survey results and trends over time fed directly into PMU population trend and composition data within the Kootenay Region bighorn sheep management plan (Poole and Ayotte 2019 in prep.), and the reader is referred to that plan for discussion of trends. The Elk Valley population, the largest within the region, has arguably been the most surveyed over time. Results of the Elk Valley portion of the survey are briefly summarized here. The 2019 survey was the second highest number of sheep observed to date, only 14% lower than the highest count in 2010 (Table 6).

Table 6. Bighorn sheep observed on winter ranges within the Elk Valley East population during aerial surveys, 1975 to 2019. Herd numbers were obtained from digital BC FLNRO data (I. Teske, BC FLNRO, unpubl. data) except for 2015 and 2016, which were from Teck mine survey data (except for 2016 Deadman Pass, Chauncey, and Tobermory-Aldridge from FLNRO survey). All data were checked spatially using GIS. Blank values signify no survey of that area conducted. Totals (right column) may not be comparable among years.

Date	Tobermory, Aldridge	Brownie, Turnbull, Henretta	Greenhills Range	Chauncey, Todhunter, Imperial Ridge	Ewin Ridge, Line Creek	Sheep Mountain	Erickson Ridge-EVO	Deadman Pass	Crowsnest Pass	Total
Mar 1975				7	109	44				160
Mar 1976				21	87	53				161
Mar 1979				24	72	14				110
Mar 1981		20		70	179	74				343
Feb 1983				25	144	62				231
Mar 1985		19		76	100	18				213
Mar 1986		17		28	89	31				165
Jan 1987		14		40	95	47				196
Mar 1988		16		14	52	26				108
Mar 1990		19		30	69	40				158
Mar 1991		10		36	92	28				166
Feb 1998		41	26	32	62	53	11	27	1	253
Feb 2002	29	58	18	44	74	46	27	5	26	327
Feb 2003	30	70	29	43	63	33	13	7	20	308
Feb 2005	28	69	48	44	91	52	11	10	23	376
Feb 2008	50	65	77	47	110	43	20			412
Feb 2010		118	98	57	154	59	45	8	57	596
Feb 2011	27 (Aldridge)	59	63	92	128	46	39			454
Mar 2015	7 (Aldridge)	51	60	41	108	48	28			343
Feb 2016 [1]	17	47	61	51	127	46	44	1		394
Feb 2019	6	61	65	84	127	51	63	16	37 [2]	510

[1] 2016: Teck saw no sheep on Chauncey and FLNRO saw 13, which were added to the Teck total since movement among winter ranges during winter was not observed during the collaring study. Teck saw 1 sheep in Aldridge and FLNRO saw 4, so latter used.
[2] Alberta observed 37 sheep in Crowsnest Pass during January 2018 survey.

Number of sheep in the Elk Valley West have steadily declined since the early 2000s, concurrent with increasing numbers of mountain goats (Fig. 6). Although there is potential for overlap in food and habitat use by sheep and goats (Laundre 1994), simulation models suggest that sheep will be affected much more than goats (Gross 2001).
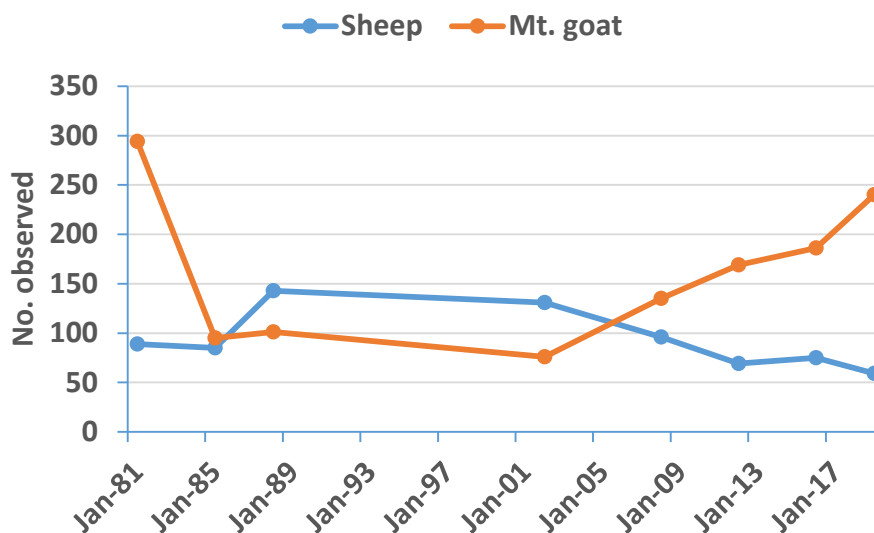

Figure 6. Number of bighorn sheep and mountain goats observed during aerial surveys in Elk Valley West from 1981 to 2019.

All PMUs had estimated lamb ratios ≥30 lambs:100 ewes, a level targeted by the Bighorn Sheep Harvest Management Procedure (2014[1]) and one that Demarchi et al. (2000) suggest must be maintained to have the potential for at least a stable population. The lowest lamb ratios occurred in Wigwam Flats-Elko-Phillips (31:100), with a high and stable population, and Elk Valley West (32:100), with a declining population trend. Ram ratios in all areas were above the recommended ≥30 rams:100 ewes (Bighorn Sheep Harvest Management Procedure 2014[1]).

Acknowledgements

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[1] http://www.env.gov.bc.ca/fw/wildlife/policy_procedures/index.html

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