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LAMB PRODUCTION & LAMB MORTALITY RATES
IN THE VASEUX BAND OF CALIFORNIA BIGHORN SHEEP

To: L. Dunsford
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Date: 88/06/11

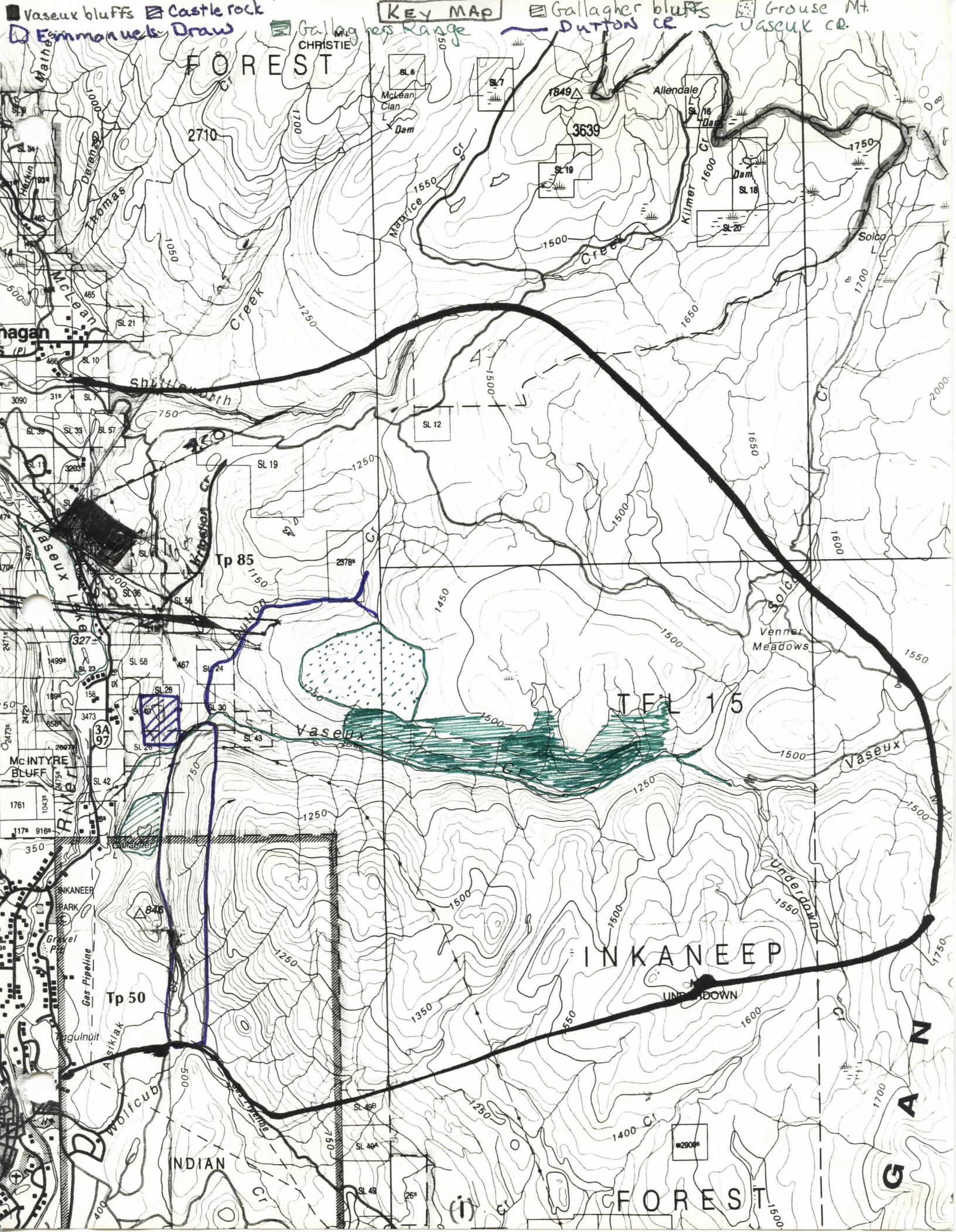
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SUMMARY

The Vaseux band of California bighorn sheep is part of the largest herd in Canada (620 to 800 head) and consists of approximately 350 sheep. The band inhabits winter and summer ranges in the Vaseux Lake area, 20 km south of Penticton, B.C. Few studies have been conducted on the band despite its large size and significance to other bighorn sheep bands of North America.

Access to the Vaseux lake range for forest harvest operations and its influence on the future of the sheep band has led the Wildlife Branch and concerned groups to collect more information which will be used in the protection of the California bighorn sheep.

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LAMB PRODUCTION AND LAMB MORTALITY RATES IN THE
VASEUX BAND OF CALIFORNIA BIGHORN SHEEP.

This report contains the results of a telemetry project which began on April 25, 1988 and involved locating sheep and determining their lamb production and mortality rates.

The Vaseux band includes approximately 350 sheep and ranges from Shuttleworth to Wolfcub creek. The status of the band is found by determining production and mortality rates. This information is pertinent to the sound management of the band and the ensurance of a healthy future. In addition, critical habitat found through research may be protected.

The objectives of this project are as follows:

- monitor radio tagged and collared ewes to determine the location of lambing sites.
- determine lambing and mortality rates by observing sheep.
- describe habitat types used for lambing.

1.0 LOCATION AND AREA DESCRIPTION

Vaseux lake is located approximately 20 km along highway 97 south of Penticton, B.C. Elevation ranges from 360 to 1500 M. A combination of bluffs, canyons, and grassy slopes provides ideal terrain for California bighorn sheep. Vaseux creek drainage is the center of the bands distribution (Spalding, 1969), and is located southeast of Vaseux lake.

1.1 CLIMATE

Precipitation in the area is low to moderate. Summers are dry with high temperatures (25 to 40° C), and winters are mild. Mean annual precipitation and temperature for the Okanagan Valley are 55 cm and 15 degrees celsius.

1.2 VEGETATION

Biogeoclimatic zones include Ponderosa pine Bunch grass, Interior douglas fir, and Engleman spruce Sub-alpine fir. The Vaseux band tends to concentrate in the PPBG and IDF zones (Spalding 1969).

Overstory vegetation includes Douglas fir, Ponderosa pine, larch, Lodgepole pine, and Engleman spruce.

Understory vegetation consists of pinegrass, blue wild rye, blue bunch wheat grass, fescue, and sedges. Common shrubs are saskatoon, bear berry, ninebark, squaw current, soopolallie, and oregon grape. Species restricted to the winter range include sagebrush, rabbit-bush, and greasewood (Spalding 1969). Mock orange is also very common at lower elevations, and choke cherry is found throughout the range.

1.3 TERRAIN AND RANGE BOUNDARIES

Terrain is mountainous with many rock outcrops and bluffs. Grassy slopes are found below rock bluffs to provide safe feeding areas. Numerous ledges and

benches provide bedding sites for the sheep. Water is provided by springs, Dutton, Irrigation, and Vaseux creeks. Water troughs for cattle, Vaseux and Gallagher lake may also be utilized as water sources.

The study area includes 281.4 km² of range utilized by the Vaseux band. The north and south boundaries include Shuttleworth and Wolfcub creeks. The east and west boundaries include Venner meadows, McIntyre creek and Mt. Underdown (east) and highway 97 (west) (see key map).

Major bluffs include Vaseux bluffs, Castle rock, Gallagher bluffs, Grouse mountain, Emmanuels draw, and Gallaghers range (see key map).

2.0 METHODS

The study area was defined on a topographic map. Data collected on previous flights was examined, and locations were coded using the UTM grid system and marked on air photos and maps. These were clearly labelled to indicate the ewe represented. Flights continued on a weekly basis throughout this project. Major bluffs were scanned for sheep using binoculars and at random times. A Bushnell spotting scope with a zoom lens (15x) was used to identify and observe sheep.

Ewes with lambs were indicated by the lamb suckling. Lamb mortalities were indicated by ewe behavior and the absence of a previously sighted lamb.

Collared and radio tagged ewes were located using a Telonics receiver antenna, and headphones. Areas at which multipathing was minimized were chosen to first receive signals. At each area the frequencies were selected and signals located. The direction of the signal was first determined by decreasing the volume and finding the strongest signal. Also, the antenna was turned around for a null reading to indicate direction and aid in identifying multipathing. Three to four positions were chosen to receive the signal and locate the ewe. One of these positions was chosen behind the ewe's suspected location to more accurately triangulate and select the location. Homing in on the ewes was accomplished by following the strongest signal.

Data was collected in table format (see appendix A) and included the following information: location number, date, animal, hour, drainage, X and Y coordinates, observation type, observation accuracy, activity collar, slope, elevation, aspect, habitat, animal sex, young present, unknown sex and age, juvenile, snow (if present), activity of the sheep (i.e. run, stand, feed, bed, walk), weather, and temperature. Brief comments were included in the table, while long comments were numbered and written on the back of the form. Location numbers began with the first flight. Each day of work was considered a location number. Unclassified and unmarked sheep were also recorded in the table. Locations were marked on air photos and maps for each radio tagged and collared ewe. Feeding habits, vegetation, predator

sighted, and other valuable information were recorded under comments. Working hours were varied to provide data collected in the evening and early morning.

3.0 RESULTS

3.1 LAMB PRODUCTION.

Data indicates that a ratio of 89:45 exists for sighted ewes to lambs. Ewes radio tagged RM and RJ have lambs. Ewes collared and tagged GN and LS likely have lambs; however, suckling was not observed to prove this. These two ewes were sighted in a group of 14 ewes and 13 lambs. Ewes tagged PP and DW do not have lambs, and TZ was last sighted without a lamb on May 9th. Following that sighting, her transmitter ceased functioning and recent sightings have not occurred. The signal of the ewe tagged HS has not been received on the ground, and she has never been sighted. Non-radio tagged ewes sighted with lambs include BS, VM and PP. Table 1 contains the percent calculated for radio tagged and collared ewes with and without lambs.

Table 1.

<u>% With Lambs</u>	<u>% Without Lambs</u>	<u>% No Suckling</u>	<u>% Not Known</u>
25	25	25	25

Table 2 contains the percentage of sighted ewes only with or without lambs. Ewes never or not recently sighted are not included.

Table 2.

<u>% With Lambs</u>	<u>% Without Lambs</u>	<u>% Not Definite (no suckling)</u>
33	33	33

Table 3 contains the total number of different ewes sighted and the total number of lambs sighted.

Table 3.

<u># Ewes Sighted</u>	<u># Lambs Sighted</u>
89	45

3.2 LAMB MORTALITY

(A) Ewes identified by tags or distinguishing characteristics were followed throughout a 7 week period.

Table 4 on page 7 contains the dates ewes were sighted with or without lambs.

On June 2, a dark ewe was seen bleating and running from ledge to ledge on Vaseux bluffs.

3.3 AREAS UTILIZED

The drainages in which sheep are located include Dutton creek, Vaseux Lake, Vaseux creek, and Irrigation creek. Table 5 contains the number of locations per drainage. Table 6 contains the number of locations with lambs per drainage. These tables are found on page 8.

Calendar Table

Table 4. Dates sighted with or without lambs

April						May
25	26	27	28	29	30	1
2	3	4 Annuli-y	5 RM-y Annuli-y	6	7 RM-y	8
9 RM-y PP-y (tagged) y	10	11 RS-y RM-y dark spot-y	12	13 RM-y right broke-y dark spot-N	14	15
16	17 VM-y	18 dark back-y RM-y	19 RM-y	20	21	22 RM-y RS-y
23	24	25 VM-y BS-y	26 VM-y BS-y	27	28	29
June						
30	31	1 right broke-y annuli-y	2 RS-y BS-y dark-N	3	4	5
6 BS-y	7 BS-y	8	9	10	11	12
13 BS-y right broke-y annuli-y						

☒ - with lamb
☐ - without lamb

y = yes
 N = No

Table 5.

<u>Drainage</u>	<u># Locations</u>
Vaseux creek	47
Dutton creek	28
Irrigation creek	10
Vaseux lake	97

Table 6.

<u>Drainage</u>	<u># Locations</u>
	<u>With Lambs</u>
Vaseux creek	5
Dutton creek	5
Irrigation creek	4
Vaseux lake	23

Aspect of the locations ranges from 100° to 300°, and elevation ranges from 360 to 1410 meters, while slope ranges from 10 to 60 percent. Many of the locations are on ledges or bluff tops.

3.4 MOVEMENT PATTERNS

Major movements of radio tagged and collared ewes are as follows: 1. DW and HS have moved between Gallaghers range and Vaseux bluffs. DW and PP have moved from Vaseux bluffs to Dutton creek meadows. HS has been located in these meadows by fixed wing.

2. GN and LS have been located most frequently in Gallaghers range. These ewes do not move as far or as frequently as the other ewes.

3. RJ, RM, and TZ utilize Vaseux bluffs, Irrigation creek bluffs, and Dutton creek most often. These ewes have not been located in the Vaseux creek drainage.

3.5 FEEDING HABITS

Ewes have been observed feeding on oregon grape, mock orange, choke cherry, saskatoon, green knapweed, and a variety of grasses. In addition, ewes lick rock walls and sandy banks.

3.6 PREDATORS

Two coyotes have been sighted on Vaseux bluffs. One coyote seemed to be stalking an ewe and lamb. The other coyote did not attempt to approach the group of ewes and lambs. These sightings took place on May 4 and May 30.

Four golden eagles have been sighted at Vaseux bluffs and Grouse mountain. On two occasions, the eagles flew very close to the lambs. The ewes and lambs utilized shrubs and overhangs for cover.

A black bear was sighted at Dutton creek on June 7. A female black bear and cub were sighted in Gallaghers range on June 8.

3.7 SHEEP INJURIES

Two injuries have been noted. One lamb has a swollen right hind fetlock and hoof and appeared quite lame when sighted. This lamb was last seen on May 22. ?P has a swollen right hind leg which appears to have been broken and not set. She is quite lame and was most recently sighted on June 13 at Vaseux bluffs.

4.0 DISCUSSION

Data indicates a 50% production rate and a 4% mortality rate (2 out of 45 lambs have been lost). A total of 89 ewes have been sighted with a total of 45 lambs sighted between April 25 and June 13.

The lambing period, lambing location, and lamb mortality are determined by following identified ewes (refer to table 4). RM was sighted on May 5 with a lamb and twice weekly for 21 days. She was last sighted on May 22 with a lamb. At this point, her signal was not received. In addition, signals have not been received by aircraft to indicate her transmitter is no longer functioning. RM was not sighted by aircraft from February 19 to May 5; however her signal was located at Vaseux bluffs throughout this period. Her sighting on May 5 at Vaseux bluffs and the fixed wing locations indicate that she lambbed at Vaseux bluffs. RJ was sighted with a lamb on May 11 at Irrigation creek bluffs. She had not been sighted by aircraft or ground from February 19 to May 11, but her signals were located at Vaseux bluffs. From May 5 to May 11 her signals were located at Irrigation creek bluffs. This indicates that RJ

lambled at Irrigation creek bluffs. RJ has been sighted with a lamb on May 22 and June 2 to indicate no mortality. RJ's transmitter ceased functioning at this point.

The ewe tagged PP was sighted on May 9 with a lamb. She has not been sighted more than once. It is likely that PP was incorrectly identified, since ?P is very similar and easily mistaken for PP. ?P has been sighted frequently. If this mistake occurred, then a mortality is evident. ?P was sighted without a lamb on May 17.

VM was sighted on May 17 with a lamb at Vaseux bluffs and again on May 25 and 26 to indicate no mortality. BS was sighted on May 25 at Vaseux bluffs and has been sighted again on May 26, June 2, June 7, and June 13 with her lamb.

The ewe (Annuli) identified by dark annuli was sighted on May 4, June 1, and June 13 with her lamb, and the ewe identified by a broken right horn was sighted with a lamb on May 13, June 1, and June 13. Repeated sightings of these ewes indicate lamb survival and mortalities.

The ewe identified by a dark spot on her face was sighted on May 11 with a lamb and May 13 without a lamb to indicate a lamb mortality.

The mortality rate is quite low, and few predators have been sighted. Actual attacks have not been observed. One

mortality is indicated by the disappearance of a lamb, and the other by the ewes behavior. Ewes exhibit excess traveling and very frequent vocalizing when lambs are not present. The behavior ceases when the lamb returns (Harper, 1984).

The majority of locations with lambs have occurred in Vasuex lake drainage; however, many of these locations included the same lambs of previous sightings. Ewes and lambs seem to remain in a certain group for some periods of time. RM has been sighted with the same group in Vaseux lake drainage for approximately two weeks. The ewe tagged BS has been sighted frequently on Vaseux bluffs with the same group of ewes and lambs. GM and LS have most often been located in Gallaghers range. PP and DW are often sighted together with a large group of ewes.

The habitat most utilized includes bluffs with overhangs and ledges that are inaccessible to predators. Shrubs and ponderosa pine provide cover on many of these ledges. Scree slopes with shrubs and grasses and grassy bluff tops are utilized as feeding areas for ewes and lambs. These groups have not been observed feeding in open grass slopes that are not close to bluffs.

Areas utilized are of a south to south west aspect. No sightings have been made on north aspects. Slopes and bluffs with a south east aspect are also utilized (as in Dutton creek).

Some sheep seem to travel a circuit through the range, while others seem to remain in the same area for long periods of time (as with GN and LS). The circuit includes Gallaghers range, Vaseux lake, and Dutton creek (see appendix B).

Limitations include the difficulty of locating ewes due to multipathing. Rock bluffs and mountains cause the signals to rebound, thus making the direction of the signal difficult to determine. In addition, tracking all the ewes is difficult due to the large area to be covered by one person.

Some of the areas provide excellent sites for hiding, so that fewer sightings may result in these areas. Areas such as Vaseux bluffs are open and allow more sightings to occur.

The location of Vaseux bluffs near the highway and the ease of access and sightings results in biased results towards these bluffs.

5.0 CONCLUSION

A low production and mortality rate has occurred in the Vaseux band of California Bighorn sheep. Further studies are necessary to determine the causes of low production. Vaseux bluffs and Gallagher range bluffs are most often utilized as lambing grounds. Lambing has also occurred at Irrigation creek bluffs as indicated by the sighting of RJ and a very young lamb. Dutton creek and the meadows in that drainage are often frequented by sheep. Few

sightings have occurred at Castle rock and no sheep have been located at Gallagher bluffs.

6.0 RECOMMENDATIONS

1. Vaseux creek, Dutton creek, Irrigation creek, and Vaseux lake drainages are critical habitats to bighorn sheep and should be protected to ensure the stability of the population. Buffer zones must be established and maintained around these areas to avoid the loss of habitat and reduce stress on the sheep population.
2. Studies should be conducted to determine the causes of low lamb production and the influence of harvesting practices and cattle grazing on lambing in the Vaseux area.
3. A study on the effects of the winter feeding program should also take place. This may include determining the mortality rate and incidence of predation during this time.
4. Access to critical areas should be limited to avoid excess stress on ewes and on the environment
5. Tags should be labelled with distinct letters to avoid confusion between tags (as with ?P and PP).

Work Cited

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Appendix A

VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	YYMMDD	HR	DRAINAGE	X-Coord	Y-Coord	OBType	ORAC	ACT	SLOPE	ELEVft	ASPECT	HABITAT	HW97	M	F	YOUNG	UNKN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
1	LS	02/19	12	Dutton Cr.	3216	54622	FW	FA		36	3500	210		4.8								CLEAR		
1	GN	02/19	12	Vaseux Lake	3168	54634	FW	FA		48	1800	220		0.5			9					"		with HS and TZ
1	RS	02/19	12	Vaseux Cr.	3212	54609	FW	FA		48	4100	260		4.3								CLEAR		
1	PP	02/19	12	Vaseux LK.	3169	54642	FW	FA		24	1900	275		1.0			15					"		with RM, DW
1		02/19	12	Vaseux LK.	3180	54597	FW	SI		48	2500	180		1.3			12					"		
1		02/19	12	Vaseux LK.	3169	54625	FW	SI		6	1400	190		0.4			21					"		
1		02/19	12	Vaseux LK.	3160	54642	FW	SI		6	1200	200		0.2			12					"		
1		02/19	12	Vaseux LK.	3168	54648	FW	SI		30	1800	210				2						"		
1		02/19	12	Vaseux LK.	3169	54649	FW	SI		30	1800	210				2						"		
1		02/19	12	Vaseux LK.	3169	54644	FW	SI		36	1900	200				4		2				"		
1		02/19	12	VASEUX LK.	3167	54633	FW	SI		48	1700	210					5					"		
2	GN	02/29	12																					No signal
2	LS	02/29	12	Dutton Cr.	3207	54626	FW	SI		24	3700	180		4.0			30					CLEAR	+10	with HS
2	PP	02/29	12	Vaseux LK.	3173	54653	FW	SI		36	2100	200		2.0		2						CLEAR	+10	
2	DW	02/29	12	Vaseux Cr.	3234	54593	FW	FA		48	3800	190		6.8			30					CLEAR	+10	
2	RM	02/29	12	Vaseux LK.	3164	54638	FW	FA		36	1600	210		0.3			5					CLEAR	+10	

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VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	YYMMDD	HR	DRAINAGE	X-Coord	Y-Coord	OBType	OBAC	ACT	SLOPE	ELEVft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKWN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
2	RS	02/29	12	Dutton cr.	3198	54625	FW	FA		36	3400	200		3.3				5				CLEAR	+10	
2	TZ	02/29	12	Vaseux LK	3175	54626	FW	FA		36	1700	190		1.0				13				CLEAR	+10	
3	GN	03/15	8	Vaseux cr.	3218	54597	FW	SI		61	3700	190		5.5								CLEAR	+02	
3	LS	03/15	8	Vaseux cr.	3221	54596	FW	SI		48	3700	190		5.5								CLEAR	+02	with DW.
3	PP	03/15	8	Dutton cr.	3213	54624	FW	SI		42	3600	170		4.6								CLEAR	+02	
3	RM	03/15	8	Vaseux LK.	3164	54630	FW	FA		12	1200	200		0.1								CLEAR	+02	
3	RJ	03/15	8	Vaseux LK	3170	54619	FW	FA		12	1300	210		0.5								CLEAR	+02	
3	HS	03/15	8	Dutton cr.	3212	54628	FW	FA		36	3000	180		4.7			!					CLEAR	+02	
3	TZ	03/15	8	Vaseux LK	3162	54638	FW	FA		24	1200	220		0.1			!					CLEAR	+02	
4	GN	03/23	11	Vaseux cr.	3225	54596	FW	VA		48	3800	200		5.8								CLOUDY	+05	
4	LS	03/23	11	Vaseux cr.	3252	54586	FW	FA		61	3400	196		8.5				10				CLOUDY	+05	
4	PP	03/23	11	Vaseux LK	3165	54631	FW	FA		48	1300	260		0.2				6				CLOUDY	+05	
4	TZ	03/23	11	Vaseux LK	3164	54628	FW	FA		10	1200	190		0.1								CLOUDY	+05	
4	HS	03/23	11	Dutton cr.	3221	54594	FW	FA		48	3700	190		5.2				5				CLOUDY	+05	
4	RJ	03/23	11	Vaseux LK	3164	54628	FW	FA		10	1300	200		0.2				11				CLOUDY	+05	with R.M
4	DW	03/23	11	Vaseux cr.	3233	54592	FW	FA		48	3500	190		6.8								CLOUDY	+05	

LOG#	ANIM	YYMMDD	HR	DRAINAGE	X-Coord	Y-Coord	OBType	OBAC	ACT	SLOPE %	ELEVft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKW	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
4		03/23	11	Vaseux Lake	3165	54631	FW	SI		24	1300	250		0.2				6						
4		03/23	11	Vaseux Cr.	3222	54593	FW	SI		61	2900	220		5.5				4						
4		03/23	11	Vaseux LK.	3164	54633	FW	SI		36	1300	255		0.2				5						
4		03/23		Vaseux Cr.	3232	54591	FW	SI		48	3300	190		6.5				12						
5	GN	04/08	12	Vaseux Cr.	3229	54594	FW	FA		54	3600	195		6.3				5				CLEAR CALM		WITH DW
5	LS	04/08	12	Vaseux Cr.	3228	54597	FW	FA		36	3900	210		6.1				30				CLEAR CALM		
5	RJ	04/08	12	Vaseux LK.	3165	54631	FW	FA		24	2300	240		1.2				27				CLEAR CALM		WITH RM + HS
5	PP	04/08	12	Vaseux LK.	3166	54637	FW	FA		36	1700	265		0.5								CLEAR CALM		
5	TZ	04/08	12	Vaseux LK.	3165	54640	FW	FA		30	1800	255		0.4								CLEAR CALM		
5		04/08	12	Vaseux Cr.	3234	54592	FW	SI		48	4100	200		6.7				2				CLEAR CALM		
5		04/08	12	Vaseux LK.	3170	54633	FW	SI		12	2000	230		0.7				3				CLEAR CALM		
5		04/08	12	Vaseux LK.	3165	54640	FW	SI		36	2100	265		0.5				5				CLEAR CALM		
6	GN	04/20	12	Vaseux Cr.	3220	54597	FW	SI		42	3900	200		5.3								CLEAR		
6	LS	04/20	12	Vaseux Cr.	3252	54585	FW	FA		42	3300	195		8.8								CLEAR		
6	PP	04/20	12	Vaseux LK.	3168	54636	FW	FA		12	2100	230		0.8								CLEAR		
6	DW	04/20	12	Vaseux Cr.	3220	54597	FW	FA		36	4000	200		5.3								CLEAR		

4

[illegible]

VASEUX TELEMETRY LOCATIONS

[illegible]

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VASEUX TELEMETRY LOCATIONS

[illegible]

VASEUX TELEMETRY LOCATIONS

[illegible]

* Coyote sighted on Vaseux bluffs 200 m.

1. Ewe and lamb on face of Vaseux bluffs. Utilizing ledges. E. we with dark annuli. Dark at shoulder
2. on top of Vaseux bluffs. Unidentified ewes.
3. ewe keeps eye on coyote. Eagle Flying over ledge. Coyote 20 m from ewe and lamb. Coyote attempting to find ewe with sheep. Sighted sheep from top of bluffs as sheep were watching eagle.
4. PP bedd on bench of Vaseux bluffs. bunchgrass, sage, rabbitbrush. Sparse Py. No lamb. With 9 adults, 5 juv. One 1st yr PS. (missing left horn)
5. PP on edge of knoll with bunchgrass. Feeding in Saskatoon. Scattered Py.

VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	YR-MO	HR	DRAINAGE	X-Coord	Y-Coord	OBType	OBAC	ACT	SLOPE	ELEV ft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKWN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
15	RM	05/05	11	Vaseux Lake	3165	54640	GR	SI		15	1800	100	bluff bench			2	2				Feed	Clear	21	RM with lamb and uncl. ewe and lamb (see #1)
15	TZ	05/05	17	Vaseux LK.	3165	54641	GR	SI		vert.	1800	260	ledge								FEED	OVERCAST SUNNY BREAK	24	TZ with RYAN see #2
15		05/05	17	Vaseux LK.	3164	54639	GR	SI		vert.	1800	250	ledge			1	1				FEED	"	24	with TZ and Ryan. Same Ewe as 14-14. (see #2)
16		05/05		V. LK.	3163	54639	GR	SI		40	1700	250	scree slope			1			1		FEED	OC	24	Saskatoon feed on grass near cliff edge.
16		05/07		IRRIGATION CR	3190	54617	GR	SI		vert.	2600	270	ledge			1	Nil				STAN.	Partly cloudy	28	rocky ledge with Ry
16		05/07		IRRIGATION CR	3190	54617	GR	SI		vert.	2600	270	ledge			1	1				BEDD STAN		28	Same as above (16) 05/07. See #3
16	RM	05/07		VASEUX LK	3165	54641	GR	SI		30	1800	260	ledge			2	2				FEED	✓	28	RM & lamb w/ ewe, lamb and uncl. (see #4)
16	GN	05/07		IRRIGAT. CR.	3190	54617	GR	VA	Y															Triangulation and signal strength indicates location.
17	HS	05/09		VASEUX CR	3223	54592	FW	FA		48	2000	200										CLEAR	25	
17	GN	05/09		VASEUX CR	3223	54592	FW	FA		48	2000	200										CLEAR	25	
17	LS	05/09		VASEUX CR	3223	54592	FW	FA		48	2000	200										CLEAR	25	
17	RS	05/09		IRRIG. CR.	3191	54617	FW	FA		vert.	2600	190										CLEAR	25	
17	PP	05/09		VASEUX LK.	3175	54626	FW	SI		24	1800	190										CLEAR	25	
17	DW	05/09		VASEUX LK	3175	54626	FW	FA		24	1800	190										CLEAR	25	
17	RM	05/09		VASEUX LK	3165	54641	FW	FA		48	1900	260										CLEAR	25	

* Golden Eagle at Vaseux Bluffs. 05/05.

1. Bench with bunchgrass, sage, rabbit bush. 2 py. Animals feeding on edge of bench.
2. Ledge with shale on one side. Grass/cramé, rabbit bush. Eating grass. Share ledge with Ewe and lamb. Ewe with Lamb has dark horn annuli, fairly large horns. Possibly same one as loc. 14.
3. LAMB APPEARED WOBBLY. SUCKLED FREQUENTLY POSSIBLY BLOOD ON HIND END.
4. Small bench or ledge with grasses, py, and shrub. Lamb with unidentified ewe is light in colour compared to RM's.

VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	YYMMDD	HR	DRAINAGE	X-Coord	Y-Coord	OBType	ORAC	ACT	SLOPE	ELEVft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKWN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
17	DW	05/09	5	VASEUX LK	3170	54628	GR	SI		9	1600	220	grassy slope			10	N11					Partly cl. windy	25	DW with 10 adults. one only has one horn see #1
17	PP	05/09	5	VASEUX LK	3164	54637	GR	SI		vert.	1600	200	ledge (upper)								FEED		25	
17	TZ	05/09	5	VASEUX LK	3164	54637	GR	SI		VERT	1600	200	LEDGE (upper)								FEED		25	with PP.
17	RM	05/09	12	VASEUX LK	3163	54641	GR	SI		vert.	1600	260	ledge			1	2				FEED STAN			RM with lamb and uncl ewe with lamb.
18		05/10	16	VASEUX LK	3165	54640	GR	SI			1800	260	Top of cliff			6	4				STAN BEDD	CLEAR		Ewe tagged PP with lamb 4 lambs + 5 ewes total
19	FS	05/11	10	IRRIG. CR.	3190	54617	GR	SI		vert.	2600	180	ledge (mid)				1				STAN	CLEAR	28	see #2
19	PP	05/11	11	VASEUX LK	3177	54622	GR	SI		10	1800	180	bench (top)			10					BEDD STAN	CLEAR	28	see #3. PP with 10 adults
19	RM	05/11	13	↓	3163	54641	GR	SI		vert. 45% slope	1600	260	ledge (lower)				1				FEED			with the 10 adults and 2 juvs
19		05/11	13	VASEUX LK	3163	54641	GR	SI		↓	1600	260	ledge (lower)			10	5		2		FEED			see 4
19	DW	05/11	14	VASEUX LK	3167	54617	GR	SI		6	1100	240	Field			9			1		FEED	CLEAR	30	DW Feeding with 9 other adults + one juv. (see 5)
18	DW	05/10	17	VASEUX LK	3167	54617	GR	SI		6	1100		Field			10			1		FEED	CLEAR		Selecting alfalfa shoots + bitter brush - sighted by A1.

TZ transmitter!! IF not working is part of RM's group.

1. one sheep with one horn missing, the other is deformed - very wide, looks broken possibly
grassy slope with bunch grass, orchard grass, Saskatoon, choke cherry, rabbit bush, mock orange, squaw current, sage.
2. RS on irrigation cr. bluffs with Lamb. Hiding behind shrub on ledge midway up bluffs, No other ewes and lambs present.
3. Bench with bunchgrass, rabbit bush, sage. P.
4. Three adults are tagged PP, T2, VM. ^{VM} PP with both ears and T2 in eye. Ryan also with the group. These don't appear to have lambs. One ewe with lamb is very dark around the eyes and in the middle of her face there is a dark spot.
Ledge with grass (orchard?), sage, and rabbit bush. Ledge is very low and connects with ground below bluff.
T2 transmitter is possibly not working. with 30% slope
Group allowed me to get within 30 m. → Saskatoon & choke cherry.
5. Feeding in field in front of Vaseux (Al's) house. → Alfalfa, -

PP tagged ewe is probably ?P.

VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	YMD	HR	DRAINAGE	X-Coord	Y-Coord	OBType	OBAC	ACT	SLOPE	ELEVft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKW	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
20	RM	05/13	15	IRRIW CR	3100	54617	GR	SI		VERT.	2600	190	ledge				1				STAND WALK	OVERCAST	20	See #1
20		05/13	15	IRRIW CR	3190	54617	GR	SI		VERT	2600	190	LEDGE			2	2				STAND WALK	OVERCAST	20	WITH RM.
20	PP	05/13	16		3100	54617	GR	FA				250												probably located on irrigation creek bluff - general location of RM.
20		05/13	16	VASEUX LK	3164	54641	GR	SI		vert.	1700		ledge			2	1				FEED	OVERCAST		See #2
21	GN	05/16	14	VASEUX CR	3233	54601	GR	SI		40	4700	200	ledge			4	13				FEED	OVERCAST WINDY		grass slope on top of bluff.
21		05/16	14	VASEUX CR	3226	54602	GR	SI		VERT.	4600	210	ledge		1						WALK	↓		
22	VM	05/17	11	VASEUX LK	3164	54639	GR	SI		VERT	1700	220	ledge								BEDD		22	See #3
22	PP	05/17	11	VASEUX LK	3164	54639	GR	SI		VERT	1700	220	ledge								BEDD		22	#3
22		05/17	11	VASEUX LK	3164	54639	GR	SI		35	1700	240	ledge base			5	3		1		BEDD FEED	overcast clear break	22	with PP + VM #3
23	RM	05/18	13	DUTTON CR	3201	54617	GR	SI		vert	2500	100	ledge				1				BEDD	PARTLY SUNNY	22	RM with cyb others
23	CY	05/18	13	DUTTON CR	3201	54617	GR	SI		vert	2500	100	ledge				NIL				BEDD FEED	↓	22	
23		05/18	13	DUTTON CR	3201	54617	GR	SI		vert	2500	100	ledge			10	3				BEDD	↓	22	See #4 (with RM + cy)
23	VM	05/18	16	VASEUX LK	3165	54640	GR	SI		60	1800	240	Top of Bluff			5	3				BEDD	OVERCAST	23	Part of same group as 05/17. Some feed on grass.
24	GN	05/19		VASEUX CR	3251	54584	FW	SI		48	3100	190				8	7							GN with 8 ewes and 7 lambs
24	LS	05/19		VASEUX CR	3251	54584	FW	SI		48	3100	100												LS with GN + group
24	RM	05/19		DUTTON CR	2202	54618	FW	SI		61	2500	100				9	8							RM with 8 lambs and 9 ewes

Signals from all bad

DVI, RM + HS (#21)

1. RM with 2 ewes and 3 lambs sharing ledge with P.Y. RM began to walk along ledge of bluff, followed by the other ewes and lambs. Note the change of location. RM was sighted on the Vaseux bluffs usually. Weather has changed. Storms and heavy rains the night before and A.M. Possible reason for change of location? Also, Golden Eagles sighted over Vaseux bluffs.
2. Ewe with lamb has the tip of right horn ^{horns quite short at at shoulder height.} broken off or it is rounded as compared to others. Also, she is dark in colour. Feeding on grass. Lamb also. *Other ewe with dark spot in middle of face. This ewe had a lamb in prunus sighting.
3. First observed bedding on ledge. Then lambs, 4 females and juvenile moved to rock (scree) slope at base of bluffs. Fed on philadelphus (mock orange), one rockier (saskatoon), prunus virginiana (chokecherry), ginseng. Eventually moved back up to ledge.
4. RED + FEED ON GRASSY LEDGE (Lower to mid). One lamb has an extremely swollen pastern and ankle. and appears quite lame. Mother is dark on back has thin horns with fine dark annuli.

VASEUX TELEMETRY LOCATIONS

[illegible]

1. RP, DW + 12 others were bedded on rock outcrop in grassy meadow. (aspect 210°). They moved west and began feeding (aspect 180°) Slope with bunch grass, sage, balsam root, narrow leaved parsley, squaw current, milkfolium, hieracium? Strawberry, Py, Fd, saakatoon, lupin.
Fed on grass, a little squaw current.

2. Lamb with swollen foot + ankle sighted again. Group ran away so unable to determine if Ryan's with lamb. Very possible since 8 lambs were seen with 9 ewes. The 5 ewes 20 meters east of RM's group joined with the group when ran away.

VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	YMD	HR	DRAINAGE	X-Coord	Y-Coord	OBType	ORAC	ACT	SLOPE	ELEVft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS	
27		05/25	18	VASEUX LK	3165	54642	GR	SI		VERT	1700	240	ledge (mid)			3	—					FEED	Partly cloudy	23	on large grassy ledge with Py grass + sage.
27	VM BS	05/25	19	VASEUX LK	3165	54642	GR	SI		VERT	1750	240	ledge (mid)			8	8					FEED BED	Partly cloudy	23	on ledge above 3 ewes VM + BS with lambs
	1P BS	05/26	18	VASEUX LK	2167	54633	GR	SI		VERT	1700	190	slope ledge			8			1			FEED		22	Feed on rock-grass slope. See #1
28		05/26	16	DUTTON	3205	54618	G.	SI		25	2200	300	grass slope		4							RUNN		22	Run from field into trees and bluff.
29	FF	05/27	15	VASEUX LK	3169	54622	GR	SI		30	1800	200	grass slope			—						FEED		24	
29		05/27	15	VASEUX LK	3169	54633	GR	SI		30 VERT	1800	200	bench			4	5		1			FEED		24	Feeding on bench ledges above PP-grass slope #2
30	EC	05/30	10	VASEUX LK	3165	54642	GR	SI		VERT	1700	240	ledge (current)			12	9					BED STAND		22	See #3
30	PP	05/30	13	VASEUX LK	3161	54640	GR	SI		25	1300	300	grass slope			9			1			FEED		26	See 4
30		05/30	13	VASEUX LK	3162	54640	GR	SI		160	1350	300	scree slope			1	1					WALK		26	Cue + lamb walking up slope + watching me.
31		05/30	14	VASEUX CC	3233	54601	GR	SI		30	4700	170	bluff top			2	1					Feed walk.	overcast windy		FA of GW + LS. but not sighted.
32		06/01	14	VASEUX CC	3182	54591	GR	SI		10	1700	180	bluff top			5	5					STAND RUN	rain wind	18	See #5
32		06/01	19	VASEUX LK	3165	54640	GR	SI		60	1800	230	scree			5	6					FEED	Partly cloudy	18	Mahonia sagebrush.
33	RJ	06/02	11	VASEUX LK	3165	54639	GR	SI			1800	200	ledge scree			4	4		1			BED	overcast	18	See 6 RJ with BS + 4 ewes + 5 lambs total
	BS	06/02	11	VASEUX LK	3166	54638	GR	SI		VERT 60	1800	200	ledge scree			1	1								
33	?P	06/02	11	VASEUX LK	3161	54636	GR	SI		60	1200	240	scree + slope			3	—					FEED	↓	↓	See 6.
33		06/02	11	VASEUX LK	3165	54637	GR	SI		VERT	1600	240	ledge			2	2					BED FEED	OVER CAST	18	See 6

feeding site located N. East of loc. 32.
on 06/02 two Golden Eagles sighted but didn't circle over the lambs. Flew along edge of bluff

1. 2 Golden Eagles swooped towards lambs + circled overhead. One ewe bleated 8 times. Lambs at ewe's side and near overhang of ledge. Shortly after Eagles left, ewe + lambs began feeding again. 5 ewes and lambs remain on ledge.
PP signal but no sighting

Slope at base of bluff with sage, rabbit bush, chokeberry, Saskatoon, blue & grass. P₂

2. The juv. in this group appears quite stunted in growth. It's not much larger than lambs, but has horns approximately 4 cm in length and is shedding.
3. Did not see VM with this group. Coyote was seen in vicinity but it didn't seem to try to approach the group. It was at a different part of the bluff but it appeared to be looking. The ewes watched the coyote until he disappeared. A golden eagle flew very close to the group once and then periodically appeared overhead for a few minutes. The group remained bedded at the sight.

The ledge is the commonly used triangular section of bluff ^{just} north of feeding site (S24)

By 12:15 the group moved to lower ledges in front of bluffs at end

4. Group spread out over slope by highway + below Vaseux bluffs. Originally sighted on ledge + followed movement to slope. Stood within 10 meters of highway. One appeared to be ready to cross highway. Vehicle pulled over + ewes moved back up slope.

Feeding on b. grass, ^{young} *Acetaria* sp, *mahonia aquifolium*. Also in area w cherry, Saskatoon, rabbit bush, sage, mockorange, *Fescue*, wild oat.

5. Vegetation in area includes rabbit bush, balsam root, spear grass, P₂, Fa. Located directly below powerline tower

6. Moved from scree where feeding to ledges. One ^{dark, shed out} ewe appears to have lost lamb. However when she reached ledge a stunted juvenile she quit bleating. Group includes broken right horn, + curled dark annuli. (ie seen them before)

PP + 2 other sheep feeding by road. Moved up grass slope to scree slope. Eating mock orange, young knapweed, and licking rocks. Ended up feeding by 2 ewes and 2 lambs. These two were separate from RS + BS group.

Lambs were not playing. One has very dark shoulders where she is shed out.

- * PP is lame (not limping excessively) and points her right hind leg. a large swelling (round) is visible on her right hock.
The leg appears thinner than the other.

VASEUX TELEMETRY LOCATIONS

LOG#	ANIM	Y/M/D	HR	DRAINAGE	X-Coord	Y-Coord	OBType	OBAC	ACT	SLOPE	ELEV ft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
33		06/02	15	DUTTON	3202	54648	GR	SI		60	2700	100	scree slope			3	3				FEED	ORRANT RAIN		lame lamb not sighted
34	BS	06/06	12	VASEUX CR	3165	54638	GR	SI		vert	1800	190	ledge			3	3				BED STAND	/		
34	PP	06/06	12		3165	54636	GR	SI		60	1600	200	scree			3					FEED WALK	/		Feed on Mock orange on scree slope. Walked off slope.
35	BS	06/07	9	VASEUX CR	3165	54638	GR	SI		vert	1800	200	ledge (upper)			6	6				BED	/		BS with lamb & 3 cubs with lambs
35		06/07		VASEUX CR	3166	54634	GR	SI		10	1900	220	bluff top			1					WALK	/		walked out of sight
35		06/07	14	DUTTON	3204	54606	GR	SI		25	2900	220	ppbg grass slope			7					STAND RUN	✓		1 full curl, 1 3/4 curls & 1 1/2 curls
37		06/09	12	DUTTON	3208	54621	GR	SI		30	3100	180	grass slope			4	1		1		RUN STAND			slope right above bluff cubs run & spread out seen
36	LS	06/08	12	VASEUX CR	327		FW	SI			3													
36	PP	06/08	12	VASEUX CR	3220	54506	FW	SI		54	3600		grass slope											
	UN	06/08	12	VASEUX CR	3220	54506	FW	FA		54	3600		grass slope											
36	HS	06/08	13	VASEUX CR	3167	54662	FW	Vague		20	1700													
36	LS	06/08	12	VASEUX CR	3261	54580	FW	SI		24	4700	170												
36	GN	06/08	12	VASEUX CR	3221	54598	FW	Vague		36	4100	190												
36		06/08	12	VASEUX CR	3221	54598	FW	SI		36	4100	190	bluff			1	1							
36		06/08	12	VASEUX CR	3224	54595	FW	SI		48	3800	190	grass slope			18					RUN			
36		06/08	12	DUTTON CR	3204	54598	FW	SI		36	2400	240				2								

06/07. Black bear sighted in fields at Dutton Cr. on road.

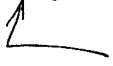
x cord = 3206 y cord = 54618

1. Cattle approaching and vocalizing. May have caused ewes to run.
The stunted juvenile and the dark ewe are still 'hanging' out together.

VASEUX TELEMETRY LOCATIONS

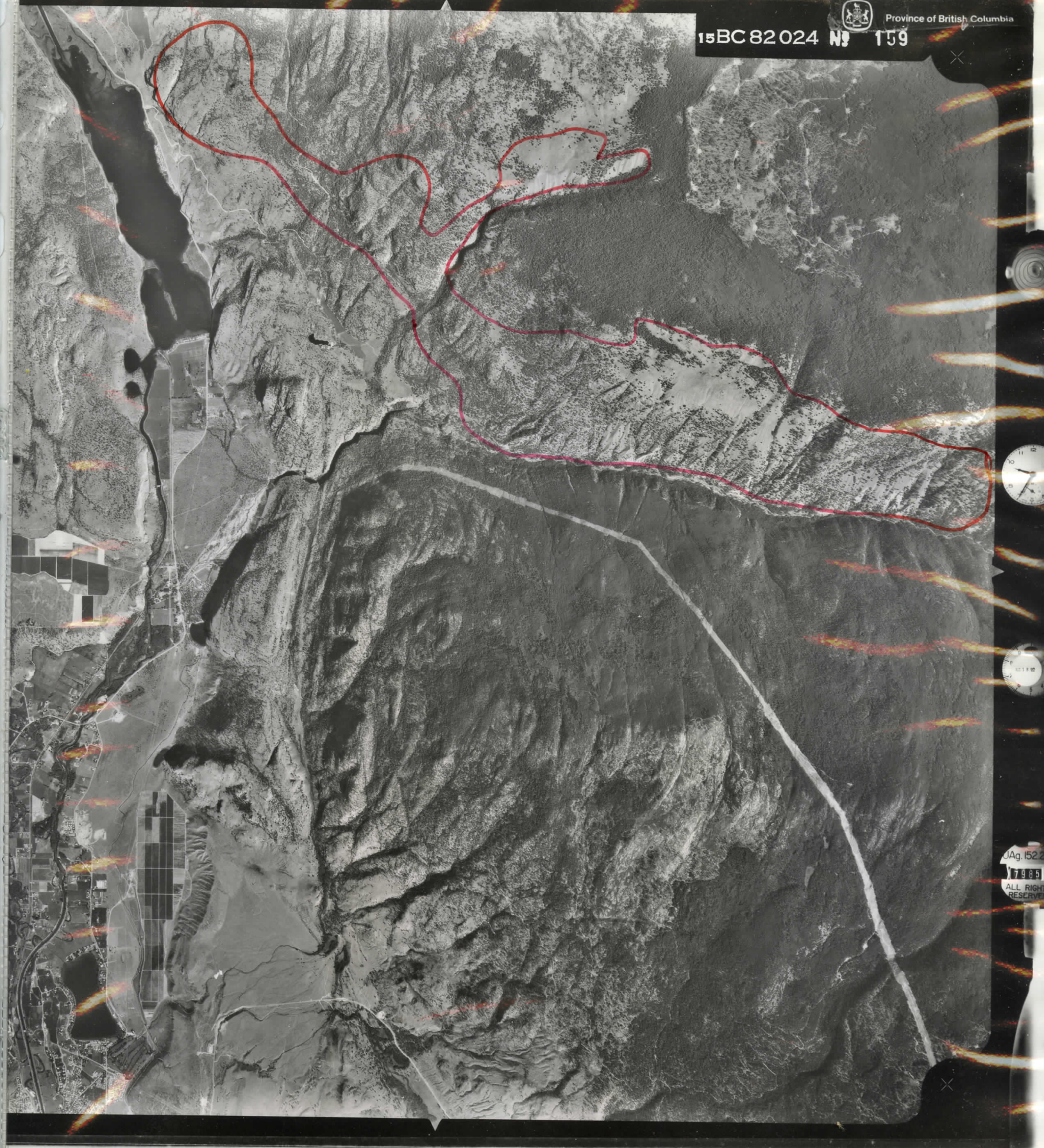
LOG#	ANIM	Y/M/D	HR	DRAINAGE	X-Coord	Y-Coord	OBType	ORAC	ACT	SLOPE	ELEV ft	ASPECT	HABITAT	HWY97	M	F	YOUNG	UNKN	JUVN	SNOWcm	ACTIVITY	WEATHER	TEMP	COMMENTS
36		06/08	12	VASEUX CR	3261	54589	FW	SI		24	4700	170				2	1					overcast		
36		06/08	12	VASEUX CR	3221	54595	FW	SI		48	3600	100	grass slope		8						Run			
36		06/08	12	VASEUX CR	3248	54589	FW	SI		48	4100	100	grass slope		10						Run			
36		06/08	12	VASEUX CR	3253	54589	FW	SI		48	4200	100	grass slope		4						Run			
36		06/08	12	VASEUX CR	3234	54592	FW	SI		36	3800	200	grass slope		11						Run			
38	PP	06/11		VASEUX CR	3238	54591	GR	SI		35	3700	200	grass slope			12					STAND RUN	CLEAR	27	with 12 other ewes.
38	DW	06/11		VASEUX CR	3238	54591	GR	SI		35	3700	200	grass slope								STAND RUN	CLEAR	27	with PP. + the 12 ewes. See #1
38	GN	06/11		VASEUX CR	3247	54587	GR	VA		vert.	3700	200	bluff									CLEAR	27	See #2
39	BS	06/13		VASEUX LK	3164	54640	GR	SI		60 to 40	1700	250 to 300	scree to treads			15	11				FEED WALK	CLEAR	20	See #3
39		06/13		VASEUX LK	3171	54631	GR	SI		10	1800	100	bluff top			2	2				BEDD	CLEAR	20	See #4
40		06/17		VASEUX LK	3167	54639	GR	SI		48	1700	270	rocky slope			4					BEDD	overcast	26	one ewe has right horn missing.
40		06/17		VASEUX LK	3167	54637	GR	SI		48	1800	270	bench			4	4				WALK	overcast	26	WALK out of sight from bench up bluff face to top
40		06/17		VASEUX LK	3165	54638	GR	SI		48	1600	270	rocky slope			6	6		1		WALK FEED	overcast	26	broke fight with lamb. See #5

9-06/17 Golden Eagle over Vaseux bluffs not circling. just passing by.

1. PP + DW with 12 ewes + No lambs. Slope with bunch grass, bitterroot, balsamroot, Py, Fd. rock outcroppings. Springs with trembling aspen.
2. GW not sighted due to overhanging rock + steps of bluff. Location known by signal directions from various points and signal strength.
3. BS with 15 other ewes including ?P + 11 lambs. Moved from scree slope, along trail to ledge and into treed portion of Vaseux bluffs (300° aspect 3166, 54642). The lambs + ewes were there and ?P + 2 ewes joined later.  near vineyard.

Feeding on Mock orange, grass.

4. Bedding in shade under Py.
5. rocky slope with ledges F, Py, mock orange, squaw current. Observed feeding on squaw current. Came out of gully and continued moving south. One of the ewes had short thin horns in comparison to the others. Were also sighted bedding at 3165 54643 on trail 3/4 way up Vaseux bluffs.



APPENDIX C



1. Vaseux Lake with Gallagher and McIntyre bluffs in the background.



2. Vaseux bluffs, northwest aspects with grassy ledges utilized as feeding sites



3. Vaseux bluffs, southwest aspect. Bedding ledges and frequently used draw and scree slope.



4. Irrigation Creek bluffs with overhangs and trees on ledges to provide cover.



5. Irrigation creek bluffs with a more southern aspect than above.



6. Ewes at the base of Vaseux bluffs. They were feeding on the open slope and then ran up the bluffs to escape.



7. Ewes Feeding in pasture located between occupied house and highway.



8. Feeding at grassy slope below bluffs.



9. A typical feeding site found near escape terrain.



10. Ewes and lambs at a typical feeding site. This is located at the base of Vaseux bluffs.



11. Ewes and lambs travelling along ledges of Vaseux bluffs.



12. Ewes and lambs on Face of Dutton Cr. bluffs. Notice how well camouflaged these sheep are.



13. Ewes and lambs travelling and feeding on ledge of Vaseux bluffs.



14. A wide variety of Vegetation is found at sites frequented by sheep



15. Winter Feeding site. The winter Feeding program is operated by the South Okanagan Sports Association.



16. Winter Feeder.



17. Large grassy slopes are found throughout the Sheep's range. Cattle also utilize this area.

APPENDIX E

EQUIPMENT LIST

Telonics receiver
antenna
headphones
Bushnell spotting scope
zoom lens (15x)
binoculars (7 x 35)
compass
clinometer
altimeter
35mm camera
air photos
plant and bird identification books
Mazda pick-up