Nicola Naturalist Society

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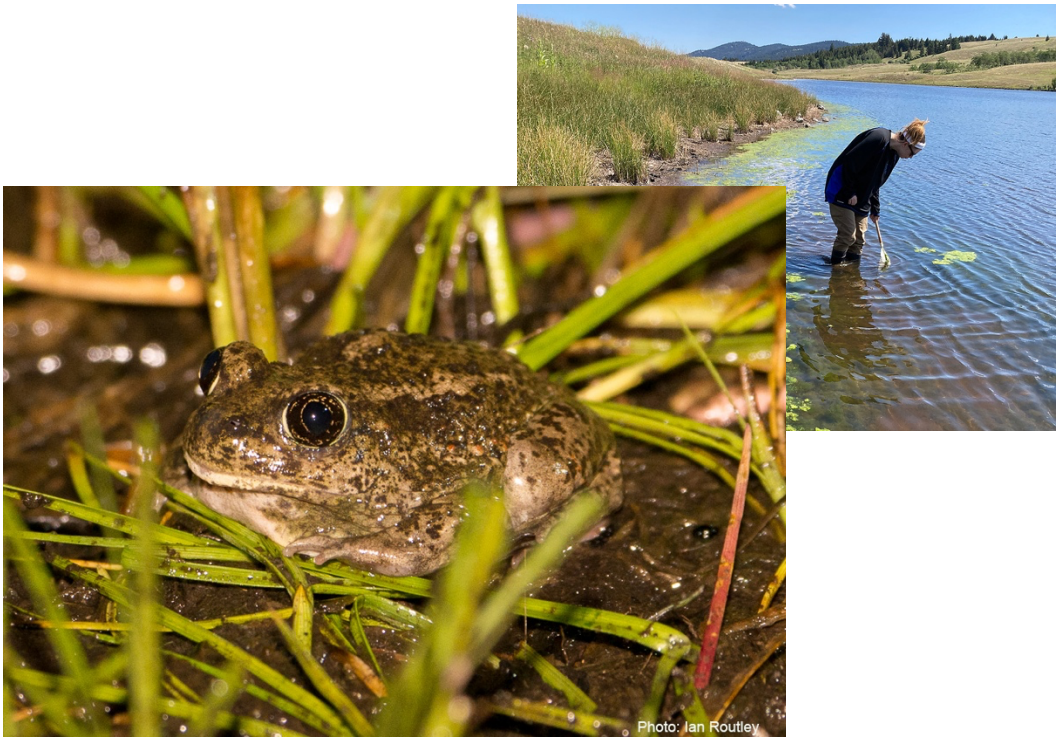
SURVEYS OF GREAT BASIN SPADEFOOTS IN THE DOUGLAS LAKE PLATEAU GRASSLANDS: 2023 PROGRESS REPORT



Report covering year 2 of funding from the BC Nature anonymous donation.
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ABSTRACT

This progress report covers year two of a five-year project to map and monitor Great Basin Spadefoots (*Spea intermontana*) in the grasslands of the Douglas Lake Plateau near Merritt, BC. This amphibian species is listed as Threatened in Canada. The Douglas Lake grasslands support one of the few breeding concentrations in British Columbia. The project, undertaken by the Nicola Naturalist Society, is an extension of the five-year amphibian monitoring project our club completed under the guidance of professional herpetologists in 2011-2015. The call survey method involves listening for the nocturnal calls of breeding Spadefoots and other amphibians for five minutes at roadside stations located 800 m apart. In 2023 we completed eight nights of surveys covering 94 listening stations on seven transects on public roads. Spadefoots were recorded at 19 stations (20.2%). We surveyed two new routes (20 stations) not systematically surveyed before, but found no new locations of Spadefoots there. We also report locations of other amphibians (Pacific Tree Frogs *Pseudacris regilla* at 15 stations, Western Toads *Anaxyrus boreas* at 2 stations) and several other species of interest (e.g., Common Nighthawks, Common Poorwill and owls). The results from our call surveys and daytime pond surveys indicate the need for better information on the chronology of calling and breeding by Spadefoots in our area, and this will be a feature of future work in this project. Information gathered in these surveys contributes to supporting Key Biodiversity Area (KBA) status for the Douglas Lake Plateau (already an Important Bird & Biodiversity Area; IBA).

A Great Basin Spadefoot. Photo: Alan Burger

INTRODUCTION

This report covers the second year (2023) of a five-year study focused on expanding our knowledge of the distribution and abundance of Great Basin Spadefoots (*Spea intermontana*; Amphibia) on the high grasslands of the Douglas Lake Plateau. The project aims to repeat and expand standardized surveys for Spadefoots that were undertaken in 2011-2015.

The Spadefoot is an enigmatic amphibian with a highly restricted range in British Columbia. The species is listed as Threatened in Canada (COSEWIC 2019) and is on the provincial Blue List of Special Concern (BC Conservation Data Centre 2002). The Douglas Lake Plateau grasslands are one of the few places in the province that support a reasonable breeding population of this little amphibian. These grasslands are within easy access (40-100 km) from Merritt where our club is based.

In 2011 the Nicola Naturalist Society, collaborating with professional herpetologists from Biolinx consultants (Dr. Kristiina Ovaska, Lennart Sopuck and Christian Engelstoft), initiated a five-year amphibian mapping and monitoring project centred on the Nicola Valley in the BC southern interior (Ovaska et al. 2016). Part of this project involved developing unique call survey methods for Spadefoots and applying these along public roads in the high grasslands. Details and reports of our 2011-2015 project are available online at: http://www.nicolanaturalists.ca/projects/amphibian-monitoring/

Great Basin Spadefoots spend much of their lives buried deep (up to 2 m down) in sandy soils. In late spring they emerge, begin feeding on insects and worms and move to shallow ponds where they breed. Adult males attract females to the breeding sites by emitting loud croaking calls, audible to humans for almost 1 km. It is these mating calls that our surveys monitor and tally in this project as indicators of the animals numbers and distribution (details under Methods below). Many of the breeding ponds are on private ranchlands and the roadside call surveys allow us to reliably map and monitor the Spadefoots without having to intrude on private lands.

The current project is funded by a grant to BC Nature from an anonymous donor plus additional funds from our club. All surveys were undertaken by volunteers. In this project's first year (2022) we focused on establishing methods and training, and surveyed 60 stations on five routes; we found Spadefoots at 16 stations, including 3 locations not previously reported in 2011-2015. In addition to expanded call surveys in 2023, we also undertook daytime surveys at selected ponds where Spadefoots were likely to be breeding.

RATIONALES FOR THIS PROJECT

Building a long-term database – Previous surveys by our club, done annually in 2011-2015, established a valuable baseline to track numbers and distribution of Spadefoots (Ovaska et al. 2016). Because conditions affecting amphibians, especially Spadefoots, change over time, surveys repeated at roughly 10-year intervals provide a much stronger timeline for understanding long-term trends and threats.

Changing environment and climate – The BC interior is experiencing substantial changes as a result of the global climate change. In particular, there are more frequent droughts, heat waves and wildfires. All of these changes affect Spadefoots and having long-term trend data will greatly help in

developing stewardship strategies for this vulnerable species. Studies at Thompson Rivers University have shown continued declines in available ponds in the interior grasslands, linked with climate change (Coelho 2015). The warm shallow ponds preferred by breeding Spadefoots are often the most vulnerable to drying up.

Expanding surveys into new habitat – In addition to re-sampling known breeding locations, the project also explores new areas on the Douglas Lake Plateau where Spadefoots might be breeding. We will thus develop a better understanding of the overall importance of these grasslands to the provincial population of Spadefoots.

Contributing to Key Biodiversity Area (KBA) status – The Douglas Lake Plateau is already an Important Bird & Biodiversity Area (IBA) and is being considered as a KBA. The KBA program is an international initiative to identify the most important areas for biodiversity, resulting in greater recognition and protection for such areas: https://kbacanada.org/
KBAs recognize all wildlife organisms and our surveys contribute quantified data on amphibians and birds.

Student mentoring – Our project aims to include students, especially those from the Environmental Resources Technology Program at the Nicola Valley Institute of Technology (NVIT). Most of these students are Indigenous. Gaining experience in wildlife surveys, data gathering and analysis will be of great value for their future careers. Part of our budget provides honoraria for participating NVIT students. We also encourage the participation of local high school students as part of their career mentoring program.

In 2023 Jasmin Hathway, a student from the University of British Columbia doing a co-op term in Merritt participated in several of our surveys to gain experience in the methods and animals involved.

METHODS

Call surveys – Following our 2011-2015 survey protocols, night-time call surveys follow pre-determined routes, each with listening stations 800 m apart. Surveys are undertaken during the early breeding season (May and June) when the males are calling. In 2023, surveys were done between 20 May and 11 June. At each station, the number, direction and approximate distance of Spadefoot calls were recorded for a 5-minute interval. Calls or sightings of Pacific Tree Frogs (*Pseudacris regilla*), Western Toads (*Anaxyrus boreas*), Common Nighthawks (*Chordeiles minor*), Common Poorwill (*Phalaenoptilus nuttallii*) and any owls were also recorded. Information on birds and amphibians contributes to the status of the Douglas Lake Plateau Important Bird & Biodiversity Area (IBA) which is transiting to a Key Biodiversity Area (KBA).

All surveys were undertaken by Nicola Naturalist Society members as volunteers. The project funding covered travel costs. Several observers had participated in the 2011-2015 and 2022 Spadefoot surveys. All observers were trained in the methods used, which included listening to recorded Spadefoot calls. In 2023 we had sufficient funds to hire a part-time coordinator (Loretta Holmes) to facilitate running the surveys and contribute to data entry.

Appendix 1 shows the standard form used to record data during the call surveys. The form explains the information recorded, including: names of observers; date and time; weather at the start and end of the survey; and comments on survey conditions. At each survey station the following information was collected during the 5-minute listening period (see Appendix 1 for details): station code (e.g.,

DL07 for station 7 along the Douglas Lake Road route); the UTM location determined from a GPS; numbers of passing cars; noise index; and records of other animals detected. When amphibian calls were detected we recorded the following (see Appendix 1 for details): species code (e.g., SPIN for Spadefoot); call index (coded as 1 to 3); proximity of the calling frogs (Near <400 m or Far >400 m) and the direction of the calls.

Pond surveys – In 2023 we undertook daytime surveys on 22 July at five ponds, four of which were selected because they were adjacent to call stations where we had recorded high Spadefoot activity in May and June (call index 2 or 3). At each pond, volunteers walked around the pond perimeter checking the nearshore water and the shoreline area for amphibians.

Data analysis and archiving – All data were collated in Excel spreadsheets and will be analysed with basic statistical software. All our data will be submitted to the BC Conservation Data Centre for archiving. Data are also uploaded to the iNaturalist and eBird online databases for open access.

Reporting – All reports will be publicly available on the Nicola Naturalist Society web-page, along with our initial 2011-2015 reports: http://www.nicolanaturalists.ca/projects/amphibian-monitoring/

RESULTS

Night call surveys

Tables 1 and 2 summarise the surveys undertaken in 2023. Appendix 2 provides the details of each survey station.

In total we undertook eight nights of survey, covering 10 road transects and 94 survey stations. Eleven volunteers participated including some new people who were trained to do future surveys. Calling Spadefoots were recorded at 19 of the 94 stations (20.2%) and at 9 of these stations there was a full chorus (call index 3) indicating a well-used breeding site. The three surveys that were undertaken in early June yielded no Spadefoots calling (Table 1). This might be because calling had ceased for the season, and we need better information on the timing of Spadefoot calling and breeding in our area (see proposed project work, below).

Table 1. Summary of Spadefoot survey effort in 2023. The number of survey stations at which various responses (Call Indices) were recorded is shown.

				Spadefoot Call Index (no. stations)						
Route	Station codes	Date	No. of stations sampled	0	1	2	3	# stations with response	% response	NOTES
Douglas Lake main	DL 01-10	20-May-23	11	7	1	2	0	3	27.3	Good conditions for detecting calling
Pennask Lake Road main	PEN 01-13	23-May-23	13	8	3	2	0	5	38.5	Rain earlier in the past 2 days
Douglas Lake main	DL 01-10	23-May-23	10	3	0	0	6	6	60.0	Rain earlier in the past 2 days
Douglas Lake English-Salmon	DL 12-27	25-May-23	16	16	0	0	0	0	0.0	SPIN calling at DL08 so there is activity this evening
Pennask Lake Road upper*	PEN 21x - 24x	26-May-23	5	4	0	1	0	1	20.0	Clear evening, good conditions for detecting calling
Minnie Lake Road*	MIN 01-04	26-May-23	4	3	1	0	0	1	25.0	Clear evening, good conditions for detecting calling
Hamilton Side Road*	HAM 01-03	26-May-23	3	0	0	0	3	3	100.0	Clear evening, good conditions for detecting calling
Lauder Road	LAU 01-12	02-Jun-23	12	12	0	0	0	0	0.0	Very quiet; PSRE at one station
Quilchena Creek Road	QC 01-10	07-Jun-23	10	0	0	0	0	0	0.0	Minor smoke, dry but good conditions, warm 20-21C
Lundbom	LUN 1-10	11-Jun-23	10	0	0	0	0	0	0.0	Rain off & on past 3 days
Totals			94	53	5	5	9	19	20.2	
* Sampled on the same night										

Table 2. Great Basin Spadefoot surveys 2023 - details on each survey

Route code	Route name	Date	No. of stations	Observer initials*	Start time	End time	Start Temp [C]	End Temp [C]	Start rain	End rain	Start cloud	End cloud	Start wind	End wind	Comments
DL	Douglas Lake Road	20-May-23	11	AB,LH,RJ,HA	21:26	23:26	20	16	0	0	5-50	5-50	1	2	Lightning in distance at 23:00
PEN	Pennask Lake Road	23-May-23	13	AB,JH	21:33	23:58	7	7	0	0	>95	>95	1	1	Rain earlier in day; puddles in road; cattle around PEN 01-06
DL	Douglas Lake Road	23-May-23	10	LH, LJ, CS, DS	20:55	22:04	12	10	0	0	>95	51-95	1	1	Rain for past 2 days
DL	Douglas Lake Road	25-May-23	16	LH, CG	21:34	23:44	9	10	0	0	<5	<5	0	1	Verified recent SPIN calls@ DL08 (not on this survey)
MIN/PEN/HAM	Minnie/Pennask/Hamilton	26-May-23	12	AB, VN	21:30	23:42	14	11	0	0	5-50	5-50	1	1	Clear evening - good conditions all evening
LAU	Lauder Road	02-Jun-23	12	LH, CG	21:38	23:12	15	12	0	0	<5	<5	2	1	Very quiet evening
QC	Quilchena Creek	07-Jun-23	10	AB, LH	21:53	23:28	21	20	0	0	<5	<5	1	1	Minor smoke
LUN	Lundbom	11-Jun-23	10	LH, CG	21:40	23:15	12	12	0	0	5-50	<5	1	1	Past 3 days raining off & on

* Observers: HA-Heather Avison; AB - Alan Burger; CG - Craig Gartner; JH-Jasmine Hathway; LH - Loretta Holmes; RJ-Roy Jantzen; LJ - Liis Jeffries; SN - Susan Newton; VN - Vic Newton; CS - Cathy Starr; DS - Don Starr.

We repeated surveys at 10 stations along Douglas Lake Road three nights apart (Table 3). There were notable differences in the results. One station (DL09) had Spadefoots calling on 20 May but not 23 May. Conversely, four stations had calling on 23 May but not 20 May and there were also generally higher call indices on 23 May at all stations. These results indicate the variability in calling activity and the need for repeated surveys to accurately record and map Great Basin Spadefoots.

Table 3. Comparison of surveys at the same stations on Douglas Lake Road three nights apart.

	Survey on 20 May 2023					Survey on 23 May 2023			
Station code	Species code*	Call index	Near (N) Far (F)	Direction (general or degrees)		Species code*	Call index	Near (N) Far (F)	Direction (general or degrees)
DL01	0	0	0	0	DL01	0	0	0	0
DL02	0	0	0	0	DL02	0	0	0	0
DL03	SPIN	1	F	150 deg	DL03	SPIN	3	F	SE
DL04	0	0	0	0	DL04	SPIN	3	F	S
DL05	0	0	0	0	DL05	SPIN	3	F	S
DL06	0	0	0	0	DL06	SPIN	3	F	S
DL07	0	0	0	0	DL07**	SPIN	1	F	SE
					DL07**	SPIN	3	F	S
DL08	SPIN	2	F	N	DL08**	SPIN	1	N	SE
					DL08**	SPIN	3	F	N
DL09	SPIN	2	F	NW 320	DL09	0	0	0	0
DL10	0	0	0	0	DL10	0	0	0	0

*SPIN = Great Basin Spadefoot

**Calling from two directions at this station

Considering other species of interest: Pacific Tree Frogs were recorded at 15 stations, Western Toads at two stations (and also found on the road between stations four times), Common Nighthawks at eight stations and Common Poorwill, Short-eared Owl, Long-eared Owl and Great Horned Owl each at one station (Appendix 2). More common birds were also recorded at numerous stations.

Daytime pond surveys

On 22 July 2023 we found no Spadefoots, adults, tadpoles or newly-metamorphosed froglets at the five ponds that we sampled (Table 4). Four of these ponds had reported high Spadefoot activity (call

index 2 or 3) in the spring surveys. Evidently we were too late in the season to find evidence of breeding. Spadefoot tadpoles grow very rapidly and once metamorphosed the froglets move away from their natal ponds.

Table 4. Surveys of ponds for amphibians - all surveys were done on 22 July 2023.

Location	Water body type	UTM zone	Easting	Northing	Amphibians found*	Location and notes
Pennask Lake Road	Pond - perimeter 750 m	10 U	693580	5549195	ANBO: 1 immature	Near station AM PEN21X which reported SPIN calling (index 2).
Hamilton Hill Commonage - Pond 01	Small lake - perimeter ~1.25 km	10 U	683337	5551352	ANBO : 5+ recently-metamorphosed toadlets, one 2-year old, 1 large adult	Near stations HAM02 and HAM03 which reported choruses of SPIN (index 3). Huge swarms of *Daphnia* crustaceans.
Hamilton Hill Commonage - Pond 02	Small pond - perimeter 410 m	10 U	683617	5551746	ANBO: 20+ toadlets & yearlings	Near station HAM02 which reported a chorus of SPIN (index 3).
Hamilton Hill Commonage - Pond 03	Small lake & side pond - perimeter ~1.56 km	10 U	683838	5552390	ANBO: 200+ recently-metamorphosed toadlets & 10+ young toads 1+ years old	Near station HAM01 which reported a chorus of SPIN (index 3)
Pennask Lake Road	Cow watering hole - perimeter 51 m	10 U	681013	5554713	None	Between stations PEN06 and PEN07 which did not report any SPIN in 2023. Small W Terrestrial Garter Snake in water

*ANBO = Western Toad (*Anaxyrus boreas*)

We did find ample evidence of breeding Western Toads (ANBO) at four of the five ponds (Table 4). These toads and Spadefoots share breeding locations.

DISCUSSION

The call survey method developed in 2011-2015 has proven to be an effective way of mapping and monitoring Great Basin Spadefoots. On the Douglas Lake Plateau nearly all the Spadefoot habitat is on private ranchland and First Nations Reserves. Because the call surveys use only public roads but provide information from the surrounding habitat this is the most effective way to locate breeding Spadefoots in this area. The calls of the Spadefoots are detectable by humans up to 1 km under optimal conditions.

We increased our survey effort considerably in 2023: 94 stations sampled compared with 60 in 2022. We expanded our coverage into two routes not sampled in 2022, namely Quilchena Creek and Lundbom, totalling 20 new stations. We did not record any Spadefoots on these routes but that might have been a result of surveys in early June being too late in the season. We need better information on the timing of calling in our area to plan more effective sampling.

Our repeat surveys of 10 stations on Douglas Lake Road (Table 3) indicate the variability of Spadefoot calling and the value of repeated surveys. Over the coming years we will do more repeated surveys, both within and among seasons, to improve the reliability of our detections.

Our 2023 daytime pond surveys on 22 July failed to find any Spadefoots – evidently any juvenile Spadefoots that were born there had moved away by this date. This is another indicator of the need for better information on the chronology of breeding for Spadefoots in our area.

PROPOSED WORK IN FUTURE YEARS

We are learning much about effective monitoring and mapping of Great Basin Spadefoots. It is clear from the results above that one priority is to get better information on the timing of Great Basin Spadefoot calling and breeding in our area. We propose to get funding to purchase several autonomous audio recorders and deploy these through the season at sites where Spadefoots are known to breed. Examples of such devices are those made by Wildlife Acoustics: https://www.wildlifeacoustics.com/

Such devices can be left running for weeks at a time and programmed to listen for sounds at specific times of day – in this case every night. The data collected will also give us valuable insights into the effects of weather on calling activity and this will improve the scheduling of our night call surveys. We are consulting with professional herpetologists and others experienced with these autonomous audio recorders to get the most suitable devices and effective deployments.

We will also continue and expand our night call surveys – both to repeat stations previously sampled to monitor persistence in breeding, and also to expand into new routes to locate previously unrecorded breeding sites. We will also undertake daytime pond surveys to locate eggs and tadpoles. Daytime pond surveys are also a more effective means of involving and educating volunteers and children, such as the Merritt NatureKids club.

Towards the end of our planned five year project we will also seek expert assistance in mapping our survey data with GIS, in a similar manner to that done in the 2011-2015 project (Ovaska et al. 2016). This will greatly enhance the management and conservation value of our study.

ACKNOWLEDGMENTS

The Nicola Naturalist Society is extremely grateful to the anonymous donor who provided the funding for this project via BC Nature. We thank BC Nature Office Manager Betty Davison for organizing this funding. This is a volunteer-driven project and we thank all those club members who participated in 2023: Heather Avison, Alan Burger, Craig Gartner, Jasmine Hathway, Loretta Holmes, Roy Jantzen, Liis Jeffries, Susan Newton, Vic Newton, Cathy Starr and Don Starr. Loretta Holmes coordinated surveys and did most of the data entry. Guidance in initiating this project was provided by herpetologists Dr Kristiina Ovaska and Lennart Sopuck of Biolinx Inc., Victoria BC.

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Appendix 1 – Spadefoot field data form

Nicola Naturalist Society - Spadefoot Surveys

Amphibian Call Survey Datasheet

Route name:

Date:	**Start time:**	**Start temp:**
Observers:	**End time:**	**End temp:**

Rain (start): **None drizzle light moderate** **Rain (end):** **None drizzle light moderate**
Cloud % (start): **<5 5-50 51-95 >95** **Cloud % (end):** **<5 5-50 51-95 >95**
Wind (start): 0 1 2 3 4 **Wind (end): 0 1 2 3 4**

Comments on conditions:

Call station #	WPT # or UTM	Species code[1]	Call index[2]	Near /Far[3]	Dir.[4]	# cars pass	Noise index[5]	Comments

[1]Columbia Spotted Frog: RALU; Western Toad: AMBO; Pacific Tree Frog: PSRE; Spadefoot: SPIN
[2] Call index: 1: individual calls distinct/not overlapping; 2: some overlapping calls; 3: full chorus
[3]Far (F) – if very faint; Near (N) – if clearly near (e.g., within 400 m); otherwise leave blank.
[4]Dir: approximate compass bearing (e.g., N, NE, ENE, etc. or give actual bearing in degrees – true not magnetic)
Use separate lines for calls coming from different directions at the same station.
[5]Noise index: 0: no effect (e.g. owl calling); 1: low (e.g. dog barking, distant traffic, 1 car passing, wind rustling leaves); 2: moderate (e.g. 2-5 cars passing); 3:high (continuous traffic nearby, 6-10 cars passing); 4: very high (e.g. continuous traffic passing, construction noise)
Record any changes in weather during the survey

Appendix 2. Great Basin Spadefoot surveys 2023 - details on each station (some stations used 2 or more lines).

Route code	Date	Station code	Survey sequence	UTM coordinates Zone	Easting	Northing	Species code*	Call index	Near (N) Far (F)	Direction (general or degrees)	# cars	Noise index	Comments, including other animals reorded. See next page for bird codes.
DL	20-May-23	DL01	1	10U	697837	5559973	0	0	0	0	1	1	MALL, CAGO, VESP, SPSA, Campsite
DL	20-May-23	DL02	2	10U	698379	5560557	0	0	0	0	0	0	WISN, BUFF
DL	20-May-23	DL03	3	10U	698831	5561177	SPIN	1	F	150 deg	0	0	WISN, KILL
DL	20-May-23	DL04	4	10U	699643	5560893	0	0	0	0	0	1	GHOW, WISN, Nicola River
DL	20-May-23	DL05	5	10U	700606	5560827	0	0	0	0	0	0	dog barking, horse, Nicola River, sprinklers, duck (unidentified)
DL	20-May-23	DL06	6	10U	701178	5560968	0	0	0	0	0	1	cow, plane
DL	20-May-23	DL07	7	10U	701933	5560911	0	0	0	0	0	1	cows, plane, raptor (unidentified)
DL	20-May-23	DL08	8	10U	702735	5560739	SPIN	2	F	N	0	0	timed lights in field x 3
DL	20-May-23	DL09	9	10U	703857	5560606	SPIN	2	F	NW 320	0	0	OSPR, river
DL	20-May-23	DL10	10	10U	703987	5561335	0	0	0	0	0	2	river, hydro pole buzzing
PEN	23-May-23	PEN01	13	10U	680200	5558771	0	0	0	0	0	0	nothing
PEN	23-May-23	PEN02	12	10U	680301	5557962	SPIN	1	F	230	0	0	nothing
PEN	23-May-23	PEN03	11	10U	680636	5557229	0	0	0	0	0	0	nothing
PEN	23-May-23	PEN04	10	10U	680315	5556494	0	0	0	0	0	0	nothing
PEN	23-May-23	PEN05	9	10U	680350	5555720	0	0	0	0	0	0	Deer mice x 2
PEN	23-May-23	PEN06	8	10U	680701	5555019	0	0	0	0	0	0	GHOW, Cows
PEN	23-May-23	PEN07	7	10U	681084	5554398	0	0	0	0	0	0	ANBO on road (large female); deer mouse (*Peromyscus sonoriensis*)
PEN	23-May-23	PEN08	6	10U	681186	5553612	0	0	0	0	0	0	ANBO on road; coyote calling
PEN	23-May-23	PEN09	5	10U	681316	5552804	0	0	0	0	0	0	ANBO on road
PEN	23-May-23	PEN10	4	10U	681808	5552239	SPIN	2	F	180	0	0	Jumping mouse (*Zapus* sp.) going across the road
PEN	23-May-23	PEN11	3	10U	682209	5551533	SPIN	2	F	210	0	0	KILL
PEN	23-May-23	PEN12	2	10U	682500	5550918	SPIN	1	F	210	0	0	KILL
PEN	23-May-23	PEN13	1	10U	682857	5550252	SPIN	1	F	45	0	0	Pond in direction of SPIN call, unidentified owl, KILL
DL	23-May-23	DL01	1	10U	697837	5559973	0	0	0	0	0	0	WEME, CAGO, VESP
DL	23-May-23	DL02	2	10U	698379	5560557	0	0	0	0	0	0	WEME, CAGO, VESP; cow; plane
DL	23-May-23	DL03	3	10U	698831	5561177	SPIN	3	F	SE	0	0	CAGO, WISN, BBMA, unidentified bird
DL	23-May-23	DL04	4	10U	699643	5560893	SPIN	3	F	S	0	0	CAGO, WISN, Nicola River, horses x 10
DL	23-May-23	DL05	5	10U	700606	5560827	SPIN	3	F	S	0	0	CAGO, WISN, MALL, ducks (unidentified)
DL	23-May-23	DL06	6	10U	701178	5560968	SPIN	3	F	S	0	0	CAGO, WISN
DL	23-May-23	DL07**	7	10U	701933	5560911	SPIN	1	F	SE	0	0	CAGO
DL	23-May-23	DL07**	7	SPIN calling from 2 directions			SPIN	3	F	S	0	0	SPIN calling from 2 directions
DL	23-May-23	DL08**	8	10U	702735	5560739	SPIN	1	N	SE	0	0	
DL	23-May-23	DL08**	8	SPIN calling from 2 directions			SPIN	3	F	N	0	0	SPIN calling from 2 directions
DL	23-May-23	DL09	9	10U	703857	5560606	0	0	0	0	0	2	very loud river
DL	23-May-23	DL10	10	10U	703987	5561335	0	0	0	0	0	0	cow
DL	25-May-23	DL12	16	10U	706719	5565281	0	0	0	0	0	0	SORA, MALL, CAGO
DL	25-May-23	DL13	15	10U	707393	5565707	PSRE	-	-	-	-	0	MALL, WISN, SORA, CAGO. No details on PSRE calls
DL	25-May-23	DL14	14	10U	707980	5566279	PSRE	2	-	-	-	0	CAGO. No details on PSRE calls
DL	25-May-23	DL15	13	10U	708709	556624	0	0	0	0	0	1	sprinklers
DL	25-May-23	DL16	12	10U	709485	5566795	0	0	0	0	0	1	SORA, irrigation sprinklers
DL	25-May-23	DL17	11	10U	709900	5567436	0	0	0	0	0	0	SORA
DL	25-May-23	DL18	10	10U	709859	5568223	0	0	0	0	0	0	bird (unidentified), cows
DL	25-May-23	DL19	9	10U	710064	5569031	0	0	0	0	0	0	owl (unidentified) cows
DL	25-May-23	DL20	8	10U	710186	5569819	0	0	0	0	0	0	duck (unidentified) coyote
DL	25-May-23	DL21	7	10U	710643	5570548	0	0	0	0	0	0	WISN, CAGO, cows, 4 beaver tail slaps (or gunshot?)
DL	25-May-23	DL22	6	10U	711186	5571087	PSRE	1	-	-	0	0	WISN, CAGO, cows. No details on PSRE calls
DL	25-May-23	DL23	5	10U	711747	5571662	PSRE	-	-	-	0	0	WISN, cows. No details on PSRE calls
DL	25-May-23	DL24	4	10U	712065	5572369	PSRE	-	-	-	0	0	WISN, cows. No details on PSRE calls
DL	25-May-23	DL25	3	10U	712723	5572826	0	0	0	0	0	0	MALL, COLO, WISN, LEOW, cows
DL	25-May-23	DL26	2	10U	713328	5573364	0	0	0	0	0	0	VESP,CAGO, LOON, RNGr, cows,
DL	25-May-23	DL27	1	11U	286825	5574047	0	0	0	0	0	0	RWBL, COLO, WISN, CAGO, LBCU, River
MIN	26-May-23	MIN01	4	10 U	685665	5544550	0	0	0	0	0	0	CAGO 2+, SORA 1.
MIN	26-May-23	MIN02	3	10 U	686424	5544769	0	0	0	0	0	0	CAGO 2+, WISN 1, SORA 1, SEOW circling overhead
MIN	26-May-23	MIN03	2	10 U	687061	5545198	SPIN	1	F	90	0	1	CAGO 2, WISN 1. Horses noisy nearby
MIN	26-May-23	MIN04	1	10 U	687725	5545604	0	0	0	0	0	0	WISN 3, VESP 4, SASP 2
PEN	26-May-23	PEN21x	9	10 U	683561	5549235	SPIN	2	F	140	0	0	WEME1
PEN	26-May-23	PEN22x	8	10 U	684007	5547676	0	0	0	0	0	0	WISN 3
PEN	26-May-23	PEN23x	6	10 U	684224	5546853	0	0	0	0	0	0	WISN 1, SORA 1, GADW 1
PEN	26-May-23	PEN24x	5	10 U	684530	5545808	0	0	0	0	0	0	nothing
PEN	26-May-23	PEN25x	7	10 U	684091	5547504	0	0	0	0	0	0	WISN 3, SORA 1
HAM	26-May-23	HAM01	12	10U	683986	5552269	SPIN	3	N	310	0	0	MAWR 3
HAM	26-May-23	HAM02	11	10U	683506	5551650	SPIN	3	F	190	0	0	ANBO on road. COPO flying off road
HAM	26-May-23	HAM03	10	10U	682845	5551252	SPIN	3	N	90	0	1	Trees rustling - minor noise
LAU	02-Jun-23	LAU1	1	10U	693061	5568405	PSRE	-	-	-	0	0	VESP, MALL. No details on PSRE calls
LAU	02-Jun-23	LAU2	2	10U	692466	5567641	0	0	0	0	0	0	Cicada
LAU	02-Jun-23	LAU3	3	10U	691975	5566962	0	0	0	0	0	0	coyote (more than 1)
LAU	02-Jun-23	LAU4	4	10U	691522	5566290	0	0	0	0	0	0	CONI(?)
LAU	02-Jun-23	LAU5	5	10U	690894	5565848	0	0	0	0	0	0	Coyotes, creek
LAU	02-Jun-23	LAU6	6	10U	690178	5565599	0	0	0	0	0	0	CAGO
LAU	02-Jun-23	LAU7	7	10U	689868	5565035	0	0	0	0	0	0	irrigation pump
LAU	02-Jun-23	LAU8	8	10U	689177	5564811	0	0	0	0	0	0	irrigation pump, coyotes
LAU	02-Jun-23	LAU9	9	10U	688775	5564028	0	0	0	0	0	0	nothing
LAU	02-Jun-23	LAU10	10	10U	668353	5563458	0	0	0	0	0	0	sprinklers, plane
LAU	02-Jun-23	LAU11	11	10U	688268	5562641	0	0	0	0	0	0	nothing
LAU	02-Jun-23	LAU12	12	10U	687812	5562228	0	0	0	0	0	0	river
QC	07-Jun-23	QC01	1	10U	677859	5559192	0	0	0	0	0	0	VESP 1, WIFL 1, CONI 1, RWBL 2, AMCR 1, MALL 2, WISN 2, Small bat 2
QC	07-Jun-23	QC02	2	10U	678541	5558937	ANBO	1	F	130	0	0	WISN 2, KILL 1, WIFL 2
QC	07-Jun-23	QC03	3	10U	678690	5558270	0	0	0	0	0	0	WISN 1, sprinklers very minor noise
QC	07-Jun-23	QC04	4	10U	678675	5557493	0	0	0	0	0	1	Trees rustling, sprinklers, creek
QC	07-Jun-23	QC05	5	10U	678885	5556945	0	0	0	0	0	1	CONI 1. Trees rustling, sprinklers, creek
QC	07-Jun-23	QC06	6	10U	678468	5556312	0	0	0	0	0	0	Nothing
QC	07-Jun-23	QC07	7	10U	678367	5555502	PSRE	1	F	190	0	0	nothing
QC	07-Jun-23	QC08	8	10U	678401	5554657	0	0	0	0	0	0	nothing
QC	07-Jun-23	QC09	9	10U	678387	5553906	0	0	0	0	0	0	2 unidentified birds
QC	07-Jun-23	QC10	10	10U	678435	5553109	0	0	0	0	0	2	creek noise
LUN	11-Jun-23	LUN01	10	10U	667748	5549203	PSRE	-	-	-	0	1	Coquihalla traffic, cows
LUN	11-Jun-23	LUN02	9	10U	668052	5549914	PSRE	-	-	-	0	1	Coquihalla traffic
LUN	11-Jun-23	LUN03	8	10U	668702	5550211	PSRE	-	-	-	0	0	nothing
LUN	11-Jun-23	LUN04	7	10U	669384	5550390	PSRE	-	-	-	0	0	nothing
LUN	11-Jun-23	LUN05	6	10U	669868	5550725	PSRE	-	-	-	0	0	CONI
LUN	11-Jun-23	LUN06**	5	10U	670465	5551203	ANBO	-	-	-	0	0	Two amphibian species at this station; CONI
LUN	11-Jun-23	LUN06**	5	Two species at this station			PSRE	2	N	-	0	0	Two amphibian species at this station
LUN	11-Jun-23	LUN07	4	10U	671170	5551591	PSRE	3	N	-	0	1	WISN, CONI, YHBL, Cows, coyotes, campers
LUN	11-Jun-23	LUN08	3	10U	671571	5552268	PSRE	3	N	-	0	0	YHBL, WISN, CONI
LUN	11-Jun-23	LUN09	2	10U	672284	5552241	0	0	0	0	0	0	CAGO, WISN, CONI,YHBL
LUN	11-Jun-23	LUN10	1	10U	672992	5552430	0	0	0	0	0	0	CAGO, RWBL, AMRO, GWTE, SWTH, MAWR, WISN, WWPE; Moose

* Species codes: SPIN - Great Basin Spadefoot (*Spea intermontana*); PSRE - Pacific Tree Frog (*Pseudacris regilla*); ANBO - Western Toad (*Anaxyrus boreas*).
**Two lines are used when calling is detected from 2 different directions at the same station, or if two species recorded at the same station.

Bird codes in Appendix 2

AMCR – American Crow
AMRO – American Robin
BBMA – Black-billed Magpie
BUFF - Bufflehead
CAGO – Canada Goose
COLO – Common Loon
CONI – Common Nighthawk
COPO – Common Poorwill
GADW – Gadwall
GHOW – Great Horned Owl
GWTE – Green-winged Teal
KILL - Killdeer
LBCU – Long-billed Curlew
LEOW – Long-eared Owl
LOON – Unidentified loon species
MALL - Mallard
MAWR – Marsh Wren
OSPR - Osprey
RNGR – Red-necked Grebe
RWBL – Red-winged Blackbird
SASP – Savannah Sparrow
SEOW – Short-eared Owl
SORA - Sora
SPSA – Spotted Sandpiper
SWTH – Swainson's Thrush
VESP – Vesper Sparrow
WEME – Western Meadowlark
WIFL – Willow Flycatcher
WISN – Wilson's Snipe
WWPE – Western Wood-pewee
YHBL – Yellow-headed Blackbird