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Appendix 1

Supplementary results

Table A1.1. Number of scat samples, grizzly bear (GB) scat samples, kilometers of roads driven, total kilometers of roads, kilometers of gravel and other roads, percentage driven of total roads and of gravel roads, and number of samples and GB scat samples collected per kilometer of road driven per cell in the scat road surveys of the 2018 DNA inventory in Alberta, Canada.

Cell	Scat samples	GB scat samples	Roads (km)				% Driven of total roads	Scat samples per km driven	GB scat samples per km driven
			Driven	Gravel	Other	Total			
320	12	0	15	15	67	82	18	0.80	0
321	6	1	78	95	9	104	76	0.08	0.01
322	1	1	59	46	60	105	56	0.02	0.02
323	0	0	60	41	140	181	33	0	0
324	0	0	79	86	83	170	46	0	0
325	0	0	97	87	107	194	50	0	0
348	0	0	42	31	54	86	49	0	0
349	0	0	37	80	55	135	27	0	0
350	3	3	95	99	73	172	55	0.03	0.03
351	20	20	39	38	142	179	22	0.51	0.51
352	0	0	48	36	52	88	55	0	0
353	0	0	11	10	43	53	20	0	0
376	8	0	69	45	91	135	51	0.12	0
377	20	17	44	31	96	127	35	0.45	0.39
378	0	0	29	23	58	82	36	0	0
379	3	2	92	102	85	187	49	0.03	0.02
380	0	0	32	31	98	129	25	0	0
381	1	0	34	31	78	109	31	0.03	0
382	0	0	90	75	125	199	45	0	0
383	2	1	66	26	114	140	47	0.03	0.02
384	0	0	52	37	35	72	72	0	0
385	0	0	39	31	84	114	34	0	0

405	2	1	23	36	17	53	44	0.09	0.04
406	3	2	94	89	15	104	90	0.03	0.02
407	5	5	79	61	52	112	70	0.06	0.06
408	6	6	84	53	74	128	66	0.07	0.07
409	2	1	81	80	118	198	41	0.03	0.01
410	1	0	39	38	94	132	30	0.03	0
411	0	0	53	45	47	92	58	0	0
412	1	1	36	29	28	57	63	0.03	0.03
413	1	1	56	29	110	139	40	0.02	0.02
434	2	2	7	6	26	32	22	0.29	0.29
435	14	14	85	45	48	92	92	0.17	0.17
436	16	14	129	69	92	161	80	0.12	0.11
437	2	1	143	86	124	210	68	0.01	0.01
438	0	0	47	30	112	142	33	0	0
439	1	0	54	5	158	163	33	0.02	0
440	0	0	11	0	102	102	11	0	0
463	2	2	23	39	7	47	50	0.09	0.09
464	4	4	98	84	64	148	66	0.04	0.04
465	9	8	82	39	215	254	32	0.11	0.10
466	6	6	166	127	168	294	57	0.04	0.04
467	3	3	93	68	136	204	46	0.03	0.03
468	3	2	19	0	23	23	83	0.16	0.11
491	8	8	47	40	19	59	81	0.17	0.17
492	3	3	42	52	30	82	52	0.07	0.07
493	0	0	43	33	124	157	27	0	0
494	1	0	77	32	121	155	50	0.01	0
495	10	10	123	97	70	179	69	0.07	0.08
496	4	3	24	7	181	192	13	0.16	0.12
Averages	*4*	*3*	*61*	*48*	*82*	*131*	*48*	*0.08*	*0.05*
Totals	*185*	*142*	*3065*	*6552*	*2412*	*4121*			

Table A1.2. Counts of grizzly bear (GB) samples and individual bears identified per session for hair and scat sampling during the 2018 DNA inventory in Alberta, Canada.

Session	Date	Hair sampling technique		Scat sampling technique	
		GB samples	Individual bears	GB samples	Individual bears
1	5–13 June	1	1	56	5
2	19–27 June	12	7	49	2
3	3–11 July	7	6	22	2
4	17–25 July	8	4	15	1

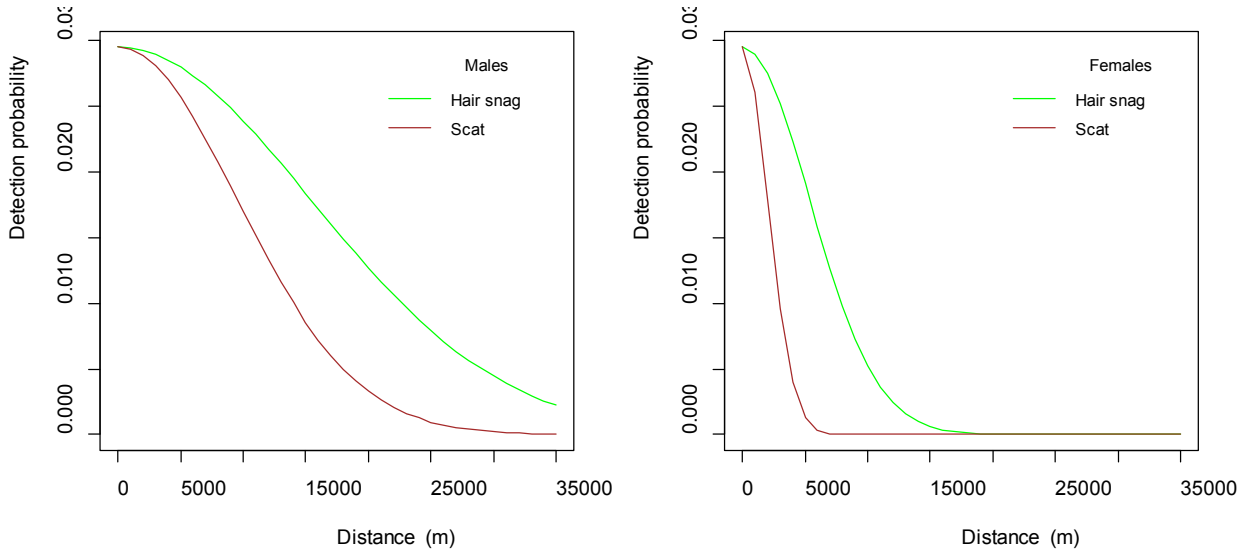
Table A1.3. Summary statistics for hair-snag sampling, scat sampling, and hair+scat sampling for the spatially explicit capture-recapture (SECR) analysis in the 2018 DNA inventory in Alberta, Canada.

Statistic	Session				
	1	2	3	4	Total
Hair-snag sampling (7×7 km cells)					
Detections	1	7	6	4	18
Unmarked bears	1	7	4	2	14
Cumulative individual bears marked	1	8	12	14	14
Detection frequencies	10	4	0	0	0
Total site visits	1	7	7	4	19
Detectors visited	1	6	6	4	17
Detectors available	50	50	50	50	200
Scat sampling (3.5×3.5 km cells)					
Detections	5	2	2	1	10
Unmarked bears	5	1	1	1	8
Cumulative individual bears marked	5	6	7	8	8
Detection frequencies	6	2	0	0	0
Total site visits	9	4	3	1	17
Detectors visited	8	4	3	1	16
Detectors available	153	153	153	153	612
Hair+scat sampling					
Detections	5	8	8	5	26
Unmarked bears	5	6	5	2	18
Cumulative individual bears marked	5	11	16	18	18
Detection frequencies	11	6	1	0	0
Total site visits	10	11	10	5	36
Detectors visited	9	10	9	5	33
Detectors available	203	203	203	203	812

Table A1.4. Details of individual grizzly bears identified through hair and scat sampling techniques including bear ID, sex and age during the 2018 DNA inventory in Alberta, Canada. Previously collared research bears are indicated by the G-number bear IDs.

Bear ID	Sex	2018 Age	Sampling technique
G151	M	11	hair and scat
G152	M	9	hair and scat
G153	F	9	scat
G166	M	13	hair
G172	M	5	hair and scat
G175	M	7	scat
G182	M	3	hair
AB_6196	F	adult	hair
Cuar120	F	unknown	scat
DNA_8557	F	subadult	scat
SAR2868	M	adult	hair
323D-1B-4	F	unknown	hair
408D-1A-3	F	unknown	hair
410-1A-1	F	>5	hair and scat
437D-3M-2	F	unknown	hair
492B-1A-3	M	unknown	hair
492B-1C-3	F	unknown	hair
548B-4B-1	F	>4	hair

Figure A1.1. Detection function plots for male and female bears for hair+scat sampling (model HS1; Table 2) during the 2018 DNA inventory in Alberta, Canada.



Appendix 2

Sampling approach cost comparison

We estimated the cost to conduct a hair-snag DNA inventory using a 50-cell grid system with full road access at $93 000, while the cost of a scat-based inventory was reduced by 30% to $68 000 (Table A2.1). In order to compare DNA inventory budgets between sampling designs in our project specific context, we estimated budgets based on the costs and samples collected in 2018.

Our scat-based DNA inventory occurred along roads and therefore, only within areas accessible by road, while other study areas may require remote helicopter access. The lack of helicopter costs here helps maintain comparability between methods. All-terrain vehicle (ATV) access costs are included in the hair sampling budget because while all cells are accessible by truck, getting to the hair snag sites can require ATV use depending on location and road conditions.

The staffing costs required for each method include the salary of one project leader (also serving here as a crew member). Hair sampling requires an additional crew member to conduct field work, while scat sampling needs only one person to drive roads and collect samples.

The costs are estimated for two office shifts (one for field preparation and one for wrap-up) and six field shifts (a training session, set-up session, and four sampling sessions). We estimate the hair crew would work ten hours per day for nine-day shifts, and the scat crew eight hours per day for six-day shifts, while office days would be seven and a half hours per day for both crews. In addition, overtime hours (e.g. ten hours per person) are expected for the hair crew due to high workloads required in site set-up and take down during the last sampling session.

The hair sampling method requires more field equipment (e.g. wire, bait, and sampling gear) and field preparation (e.g. site selection and bait preparation, including fermentation time), training prior to field work, data entry and wrap-up work post field work. Prior to field work, the scat crew only needs to assemble scat kits and prepare road survey maps. In the cost estimates, these differences are shown with the hair crew requiring two crew members for nine office days prior to fieldwork, nine days of training, and nine office days post fieldwork for field wrap-up, sample and data management. The scat crew would need an estimated six days prior to field work, six days for training, and six office days post field work.

In the field, truck costs would be higher per day for the scat crew due to mileage and gas. However, there would be fewer field days required for the scat crew which reduces the overall truck cost.

Laboratory analysis costs depend on the number of samples collected, the sub-selection criteria used, the total number of samples sent to the lab, and which tests are run on each sample (e.g. species or individual identity). Costs in this budget comparison are estimated based on samples collected and prices in 2018: 94 hair samples and 183 scat samples at an average cost of $65 per hair sample and $110 per scat sample in addition to lab set-up fees.

The statistical analyses and final report costs differ between sampling techniques, especially depending on the extent of the report and the type of report (e.g. single DNA inventory versus monitoring report). In this budget comparison we have included report costs for DNA inventories, where both methods require the same amount of time for statistics and report assembly.

Table A2.1. Comparison of project costs in Canadian dollars using a hair sampling versus scat sampling approach to conduct a grizzly bear population inventory with spatially explicit capture-recapture (SECR) in a 50-cell grid sampling system.

Item	Details	Hair sampling costs	Scat sampling costs
Project leader	1 person (45 field and 27 office days for hair crew and 30 field and 18 offices for scat crew)	$14 700	$8300
Additional crew salary	1 person for hair crew (45 field and 27 office days)	$13 400	$0
Training	Safety courses (project leader and crew members)	$300	$200
Accommodation	Crew accommodation (field and office days)	$12 500	$4200
Food	Crew meals (field and office days)	$8400	$2800
Trucks	Rental, maintenance, damage, insurance, mileage	$5600	$6000
Gas	Gas for trucks (more driving for scat but few field days)	$5000	$5300
Other access costs	All-terrain vehicle use (1 for hair crew) and gas	$4900	$0
Field equipment	Crew and truck gear (e.g. communications, safety and sampling gear)	$7300	$5,000
Lab analysis	Hair or scat sample analysis (depends on number of samples, e.g. 100 hair and 200 scat samples)	$7000	$22 500
Statistical analysis	Statistician (depends on extent of report, inventory versus monitoring, e.g. 13 days)	$9800	$9800
Report	Project supervisor (depends on extent of report, inventory versus monitoring, e.g. 20 days)	$4500	$4500
	Total costs	*$93 400*	*$68 600*