But also

Wayne Kasworm
Chris Servheen
Tom Radandt
Bruce McLellan

A Canadian story,
the international Selkirk
story is coming

Canadian Grizzly Bear Management Series
Threatened population recovery

Trans-border Grizzly Bear Project
Integrated Ecological Research
Wildlife Genetics International

EVALUATING GRIZZLY BEAR CONSERVATION MANAGEMENT: quantifying recovery in the Canadian South Selkirk population unit in southeast British Columbia

Michael Proctor
Grant MacHutchon
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David Paetkau

Trans-border Grizzly Bear Project
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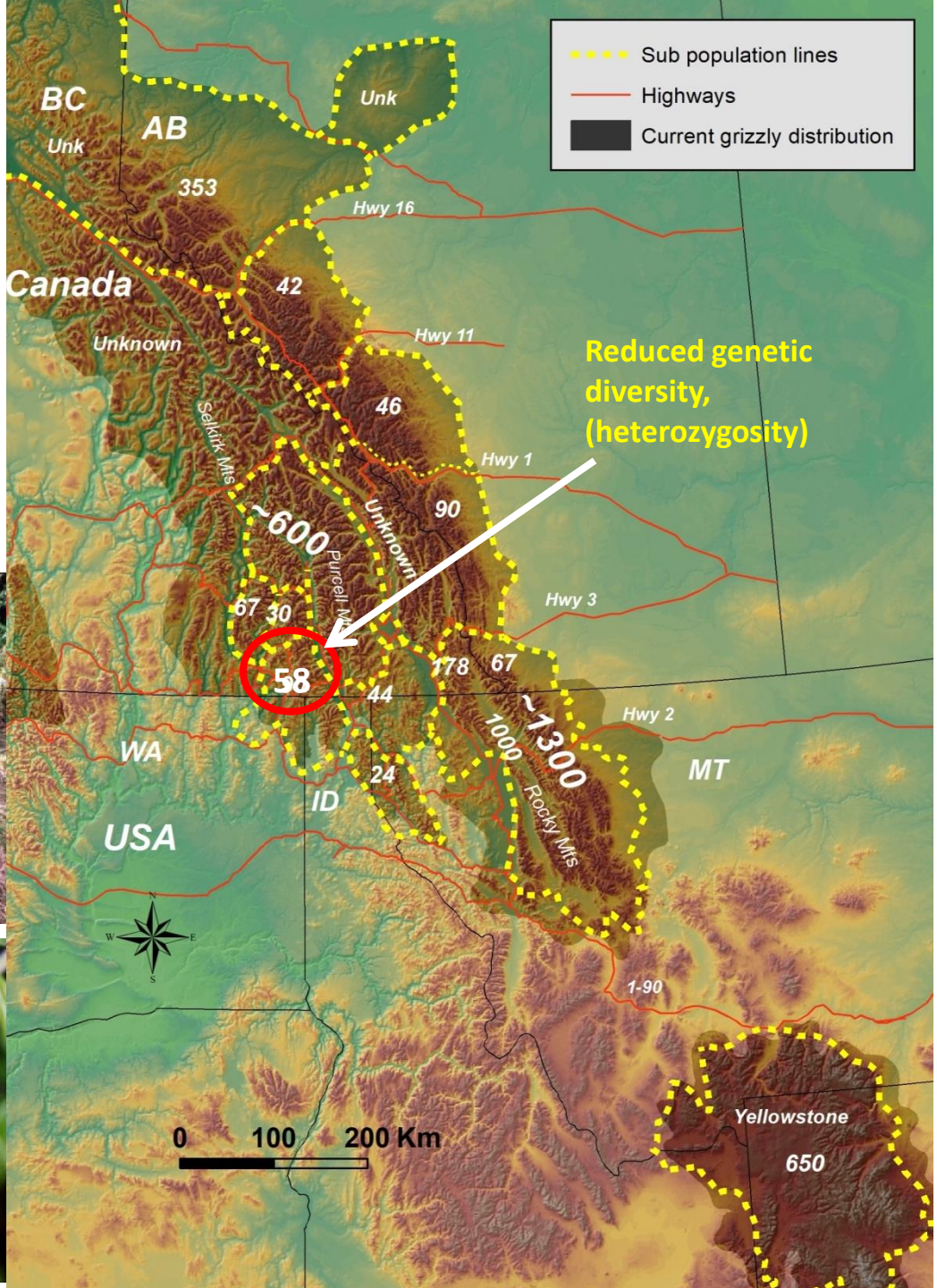
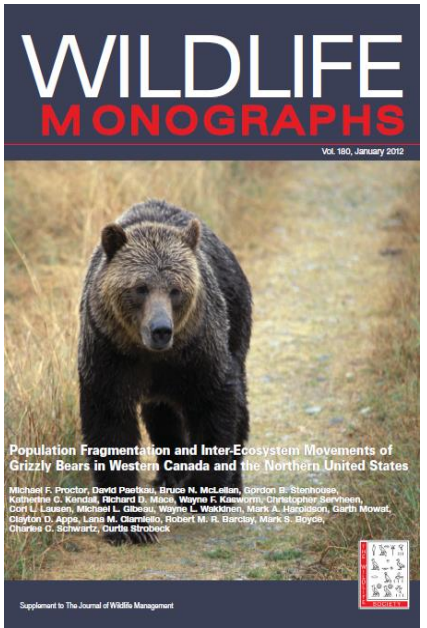
November 2022
Kaslo, British Columbia

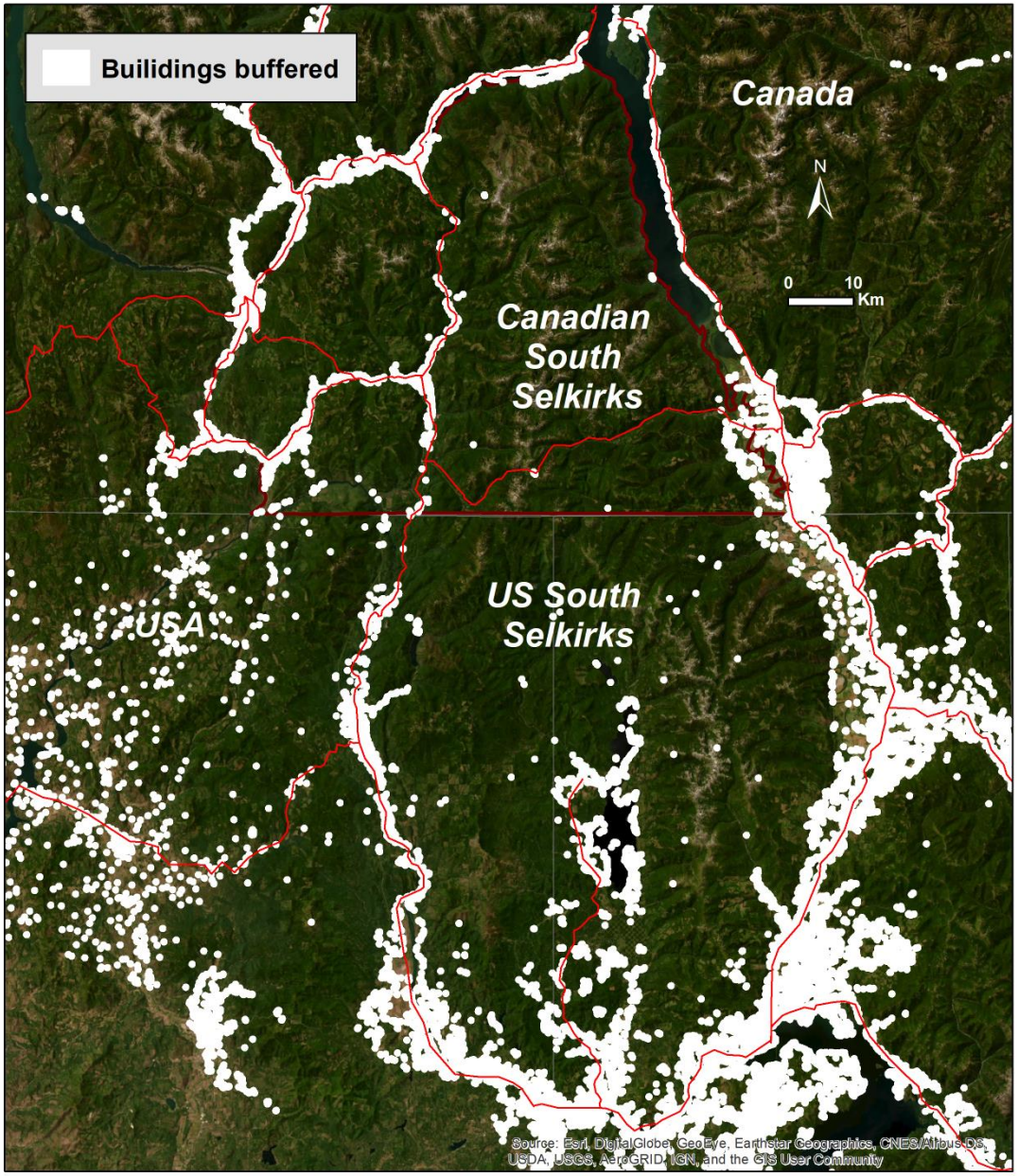
Fragmentation landscape



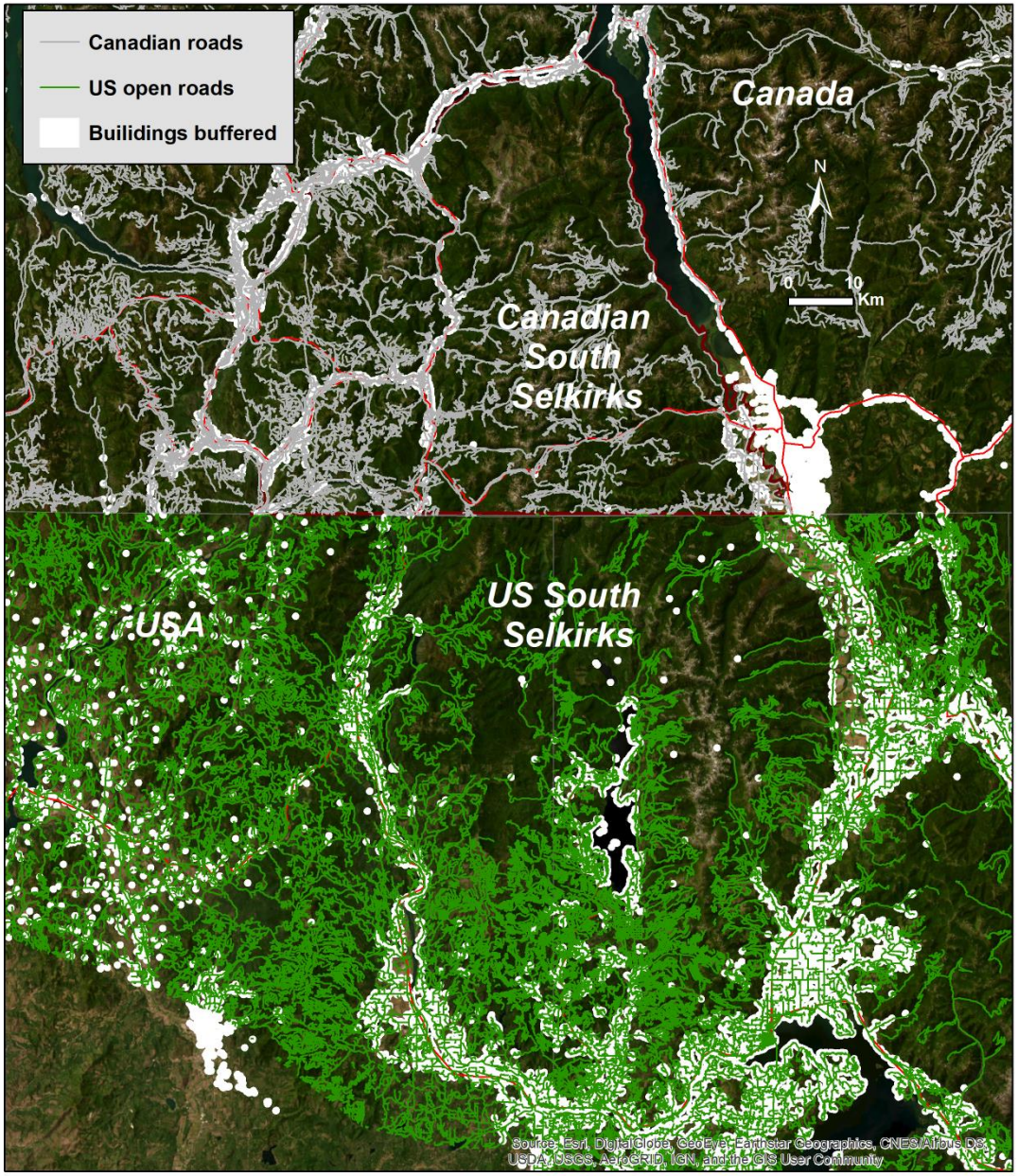
Proctor et al 2012

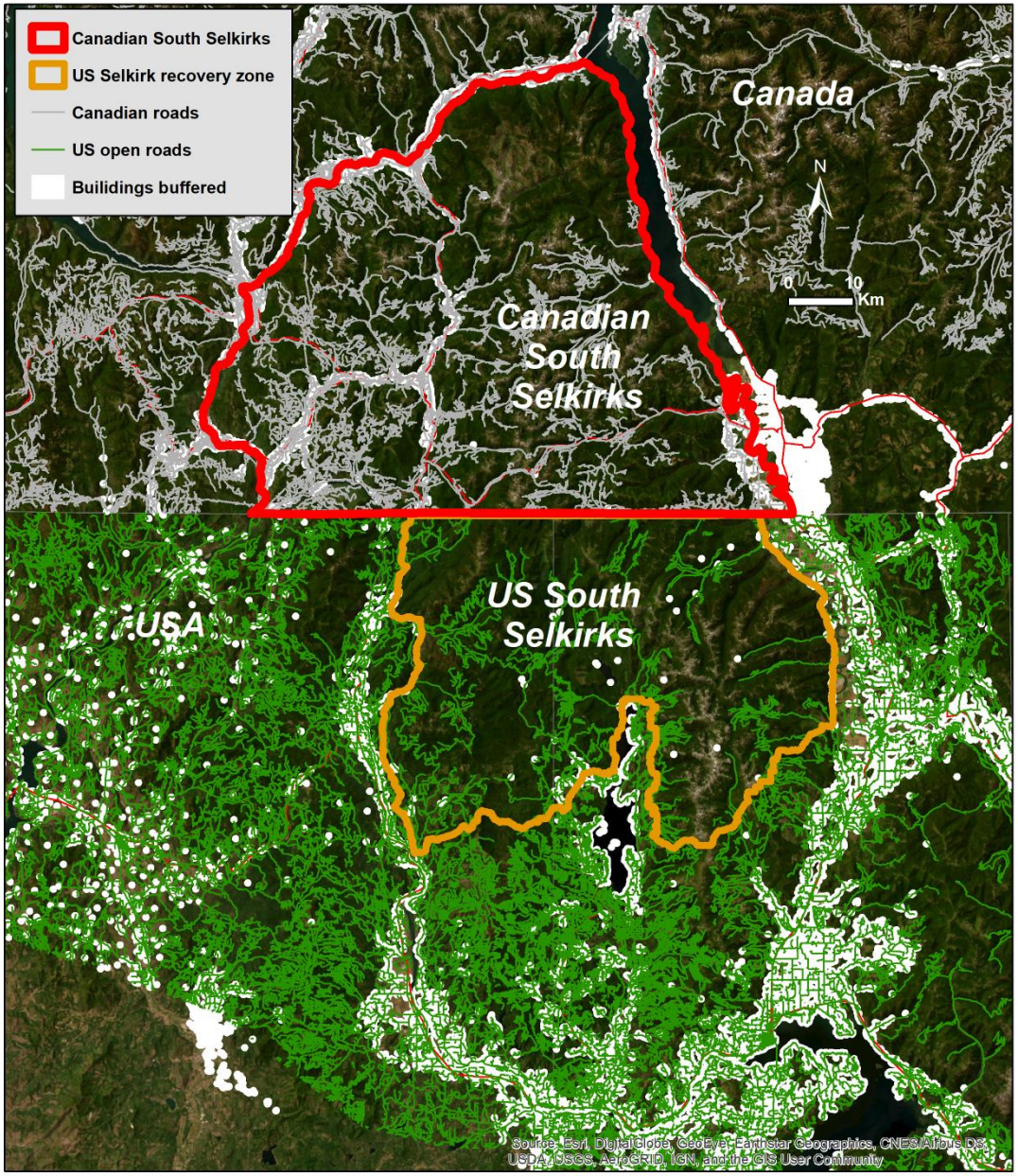


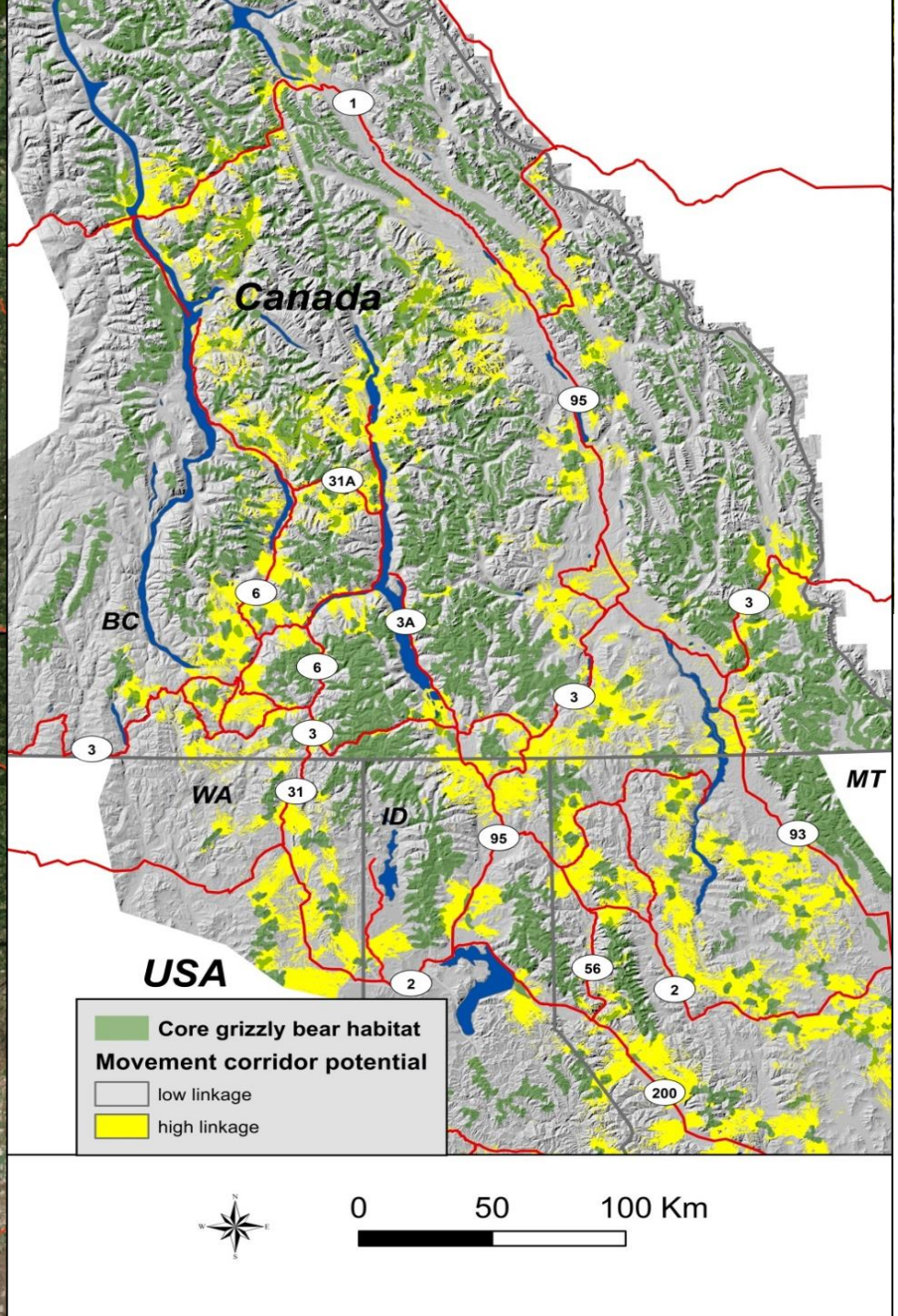
Isolated by humanity



Isolated by humanity & forestry roads




Canadian South Selkirks
US Selkirk recovery zone
Canadian roads
US open roads
Builidings buffered
Canada
N
0
10
Km
Canadian South Selkirks
USA
US South Selkirks
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



GPS collared bears

Corridor prediction

Proctor et al 2015

Grizzly bear connectivity mapping in the Canada-US trans-border region

MICHAEL F. PROCTOR[1], Birchdale Ecological Ltd., P.O. Box 606 Kaslo, British Columbia, V0G 1M0, Canada
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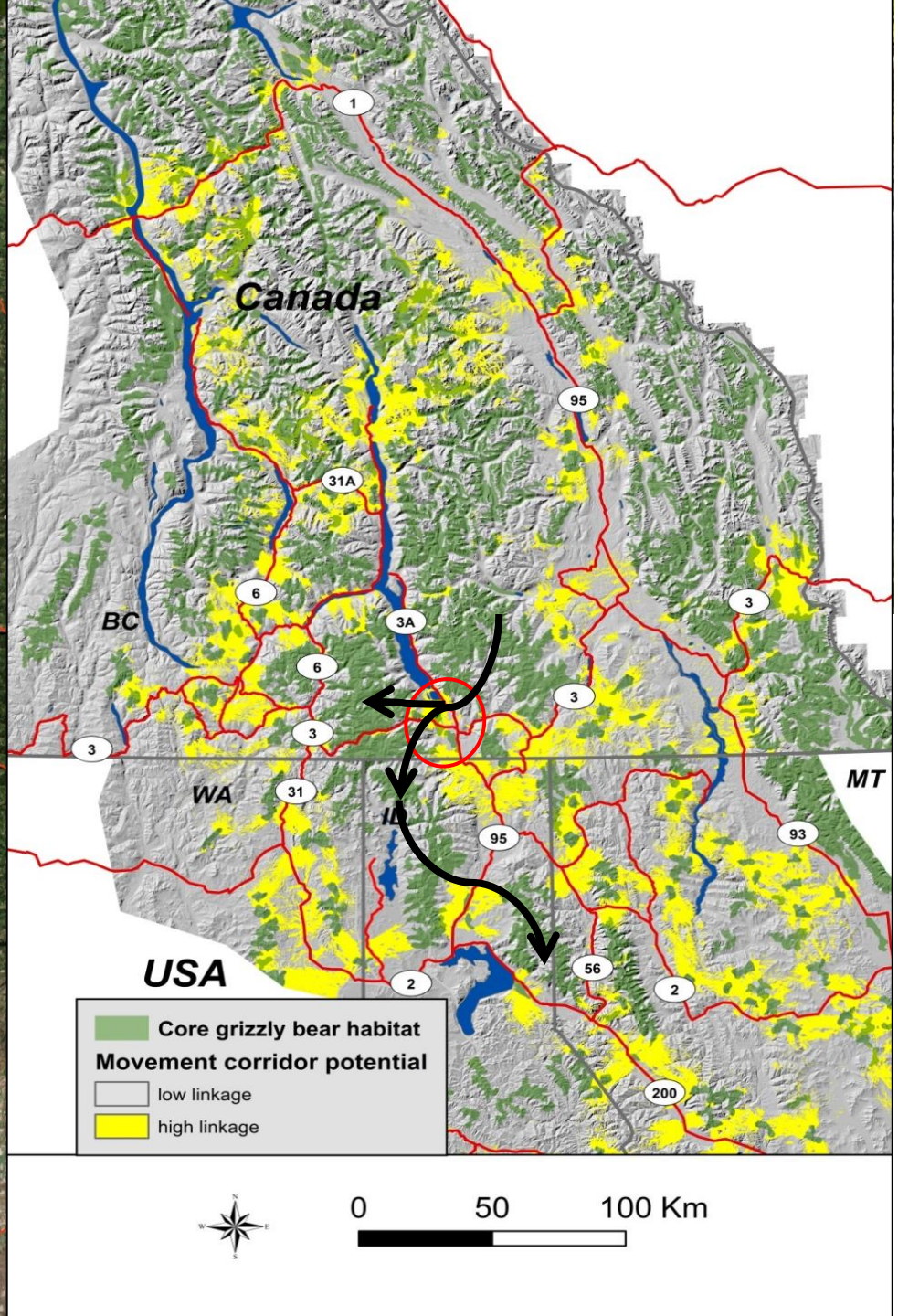
MARK S. BOYCE, Department of Biological Sciences, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada



GPS collared bears

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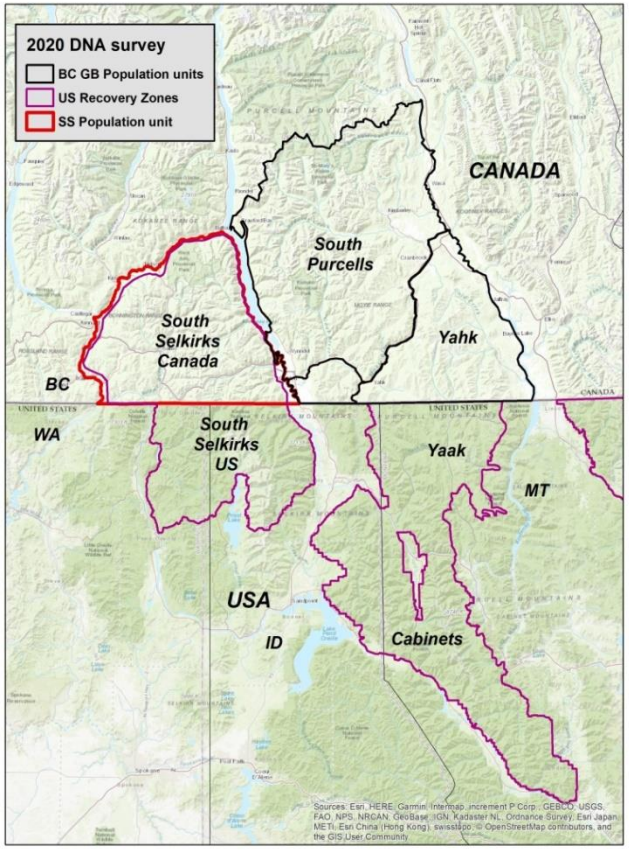


Figure 1a) South Selkirk grizzly bear population unit in trans-border population context

1b). South Selkirk population unit in context of the North American grizzly bear distribution

Conservation status in BC

The old system

Figure 2a) Past map of threatened grizzly bear population units in British Columbia (Hamilton and Austin 2004). This was the understanding and policy when the Trans-border Grizzly Bear Project formed in 2004.

New improved system

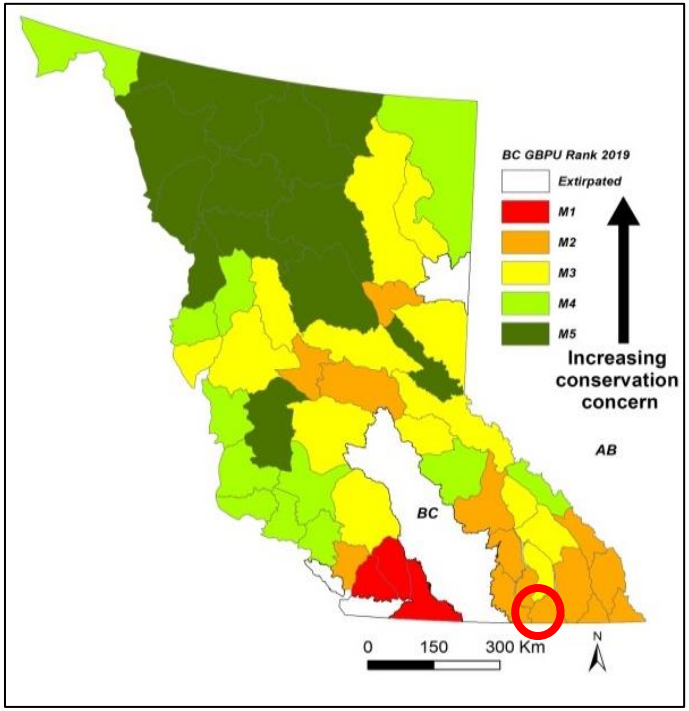


Figure 2b) Current map of conservation ranking of grizzly bear population units in British Columbia (Morgan et al. 2020).

Step 1: Identify the classification of the population in question and the scale of the area you are managing

PROCTOR VERSION

Extreme | High | Moderate | Low | Very Low

Step 2: Identify the issues facing the population in question

- Low population size, well below expected?
- Declining population trend
- Expanding population into human environments
- Excessive human bear conflicts
- Excessive conflict mortalities
- Fragmentation or isolation
- Other?

Step 3: Identify the causes or primary limiting factors and the spatial arena of the above conservation issues

- Habitat Loss (Human developments)
- Habitat degradation
- Low habitat security (high road density)
- Direct adult mortality
- Cub mortality
- Reduced fecundity (low reproductive rate)
- Food Limitation
- Poor attractant management (residential or commercial)
- Poor attractant management (agricultural or ranching)
- Highway or rail mortalities
- Mining related mortalities
- Wildfire, natural disasters
- Disease / pollution
- Climate Change & Severe Weather

Step 4: Identify management objectives for the grizzly bear population

- Increase population
- Reduce bear population
- Exclude Bears
- Improve coexistence
- Minimize Human-Bear Conflict
- Reduce human risk
- Re-establish Connectivity
- OTHER?

Step 5: Identify, prioritize, and implement the management actions to solve the problems to meet management objectives (e.g., sources of human bear conflicts)

Reduce conflicts

- Bear Hazard Assessment (Bear Smart Program in communities and Wildsafe BC in rural areas)
  - Identify attractive sinks (e.g., ungulate dumps along Hwy)
  - Education (BC Wildsafe)
    - Workshops
    - Presentations
  - Enforcement (BC COS Regional Districts)
    - Bylaws
    - Fines
- Attractant Management, (e.g., programs with expertise & funding support)
  - Cost-share electric fencing
  - Bear resistant garbage containers
  - Livestock feed containment
  - Livestock protection, (e.g., calving pens, , livestock dogs
  - Deadstock disposal (e.g., fenced or composted
  - Ag crop protection, (orchards, corn)

Conflict response

- BC COS Non-Lethal Management
- Lethal Removal

Reduce backcountry mortality and habitat displacement

- Identify best GB habitats for access reduction, identify critical foods,, habitat mapping
- Community consultation
- Seasonal or permanent road closures or vehicle hunting exclusions
- Hunter education, Species ID, camp attractant mgt

Connectivity management

- Identify corridors
- Implement conflict reduction measures
- Implement non lethal conflict response
- Strategic land trust acquisitions & easements & trades
- Access mgt in corridors
- Consider crossing structures

Step 6: Foster public stewardship to encourage voluntary compliance

- Land Use Plans
- Recreation Plans
- Critical foraging habitat plans

Step7: Monitoring effectiveness of management to meet objectives

- Sustainable mortality rates
- Sustainable conflict rates
- Monitor bear population, (e.g., periodic population survey
- Monitor connectivity if relevant

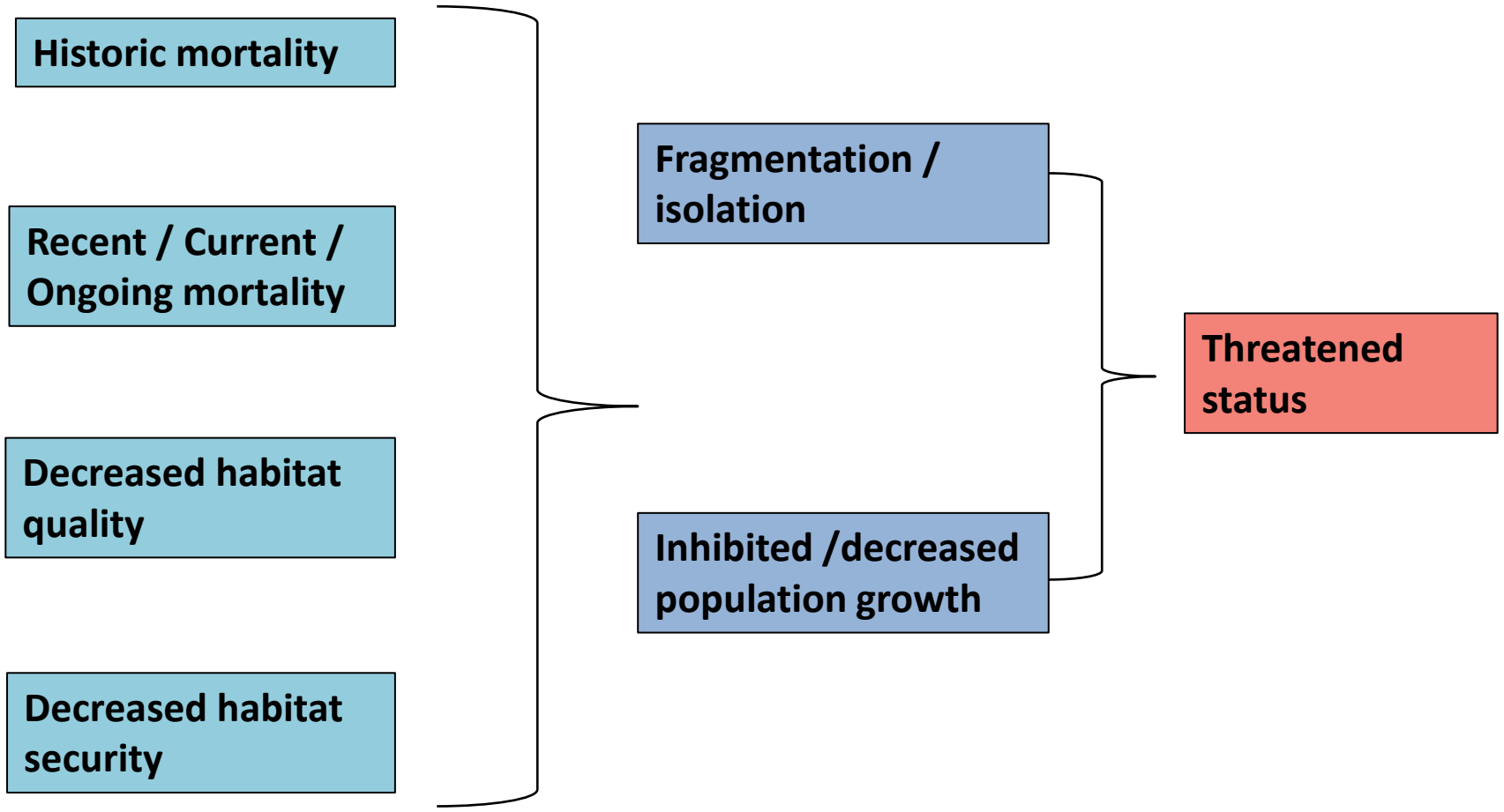
Management Plan for the Yahk and South Selkirk Grizzly Bear (*Ursus arctos*) Subpopulations, British Columbia

© Grant MacHutchon

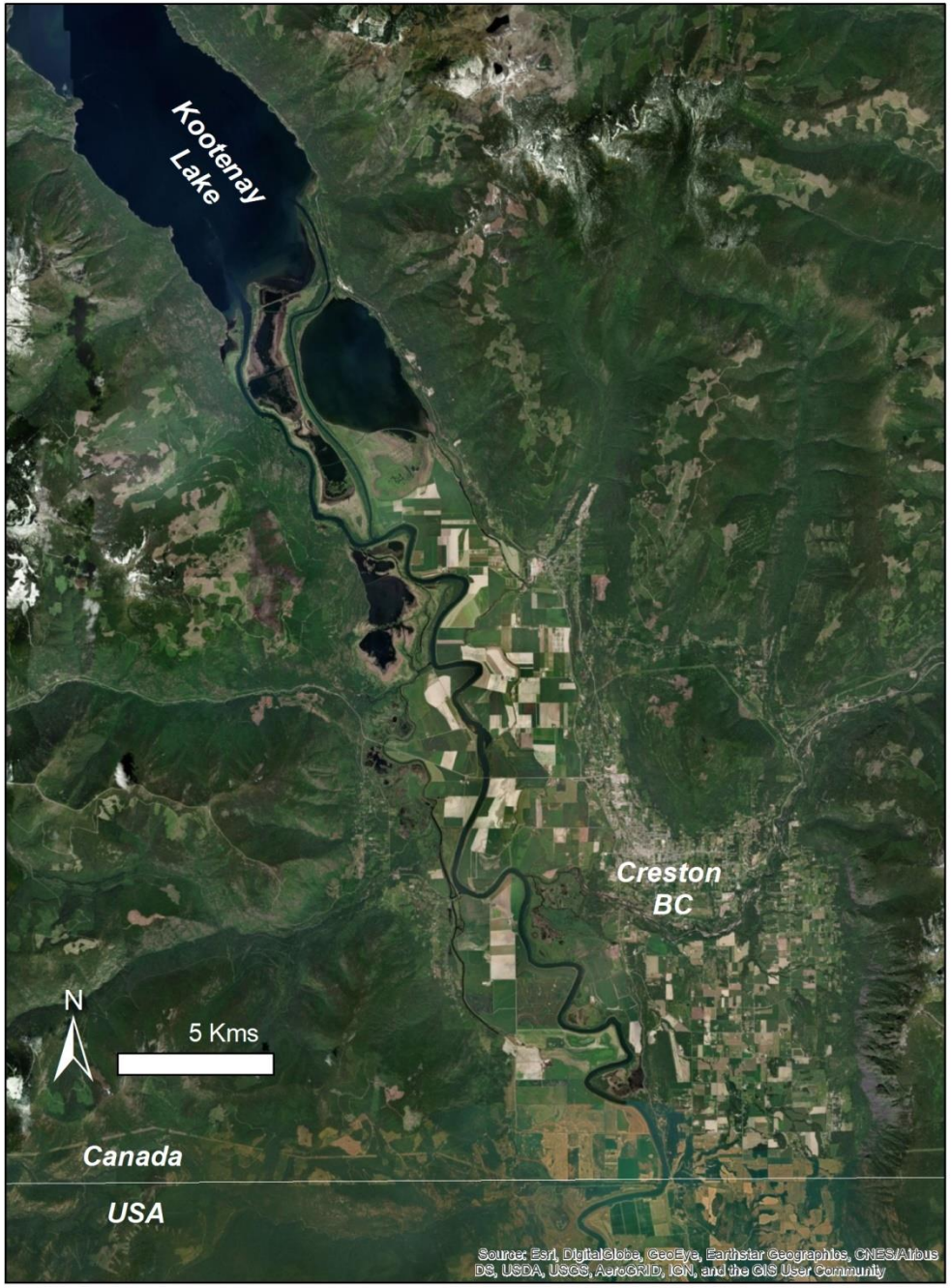
Grant MacHutchon and **Michael Proctor**
Trans-Border Grizzly Bear Project
Kaslo, B.C.

March 2016

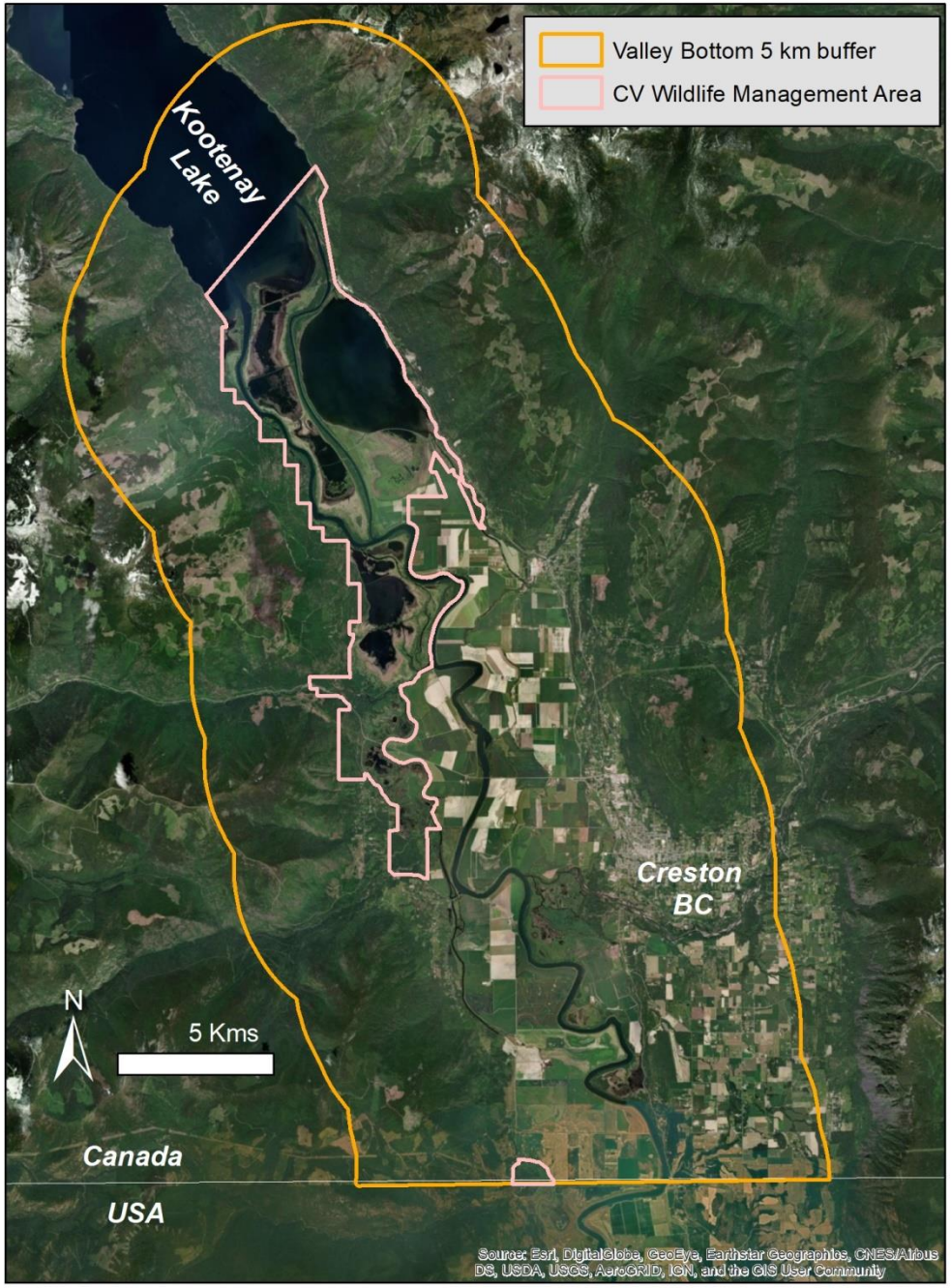
Potential causes of threatened status



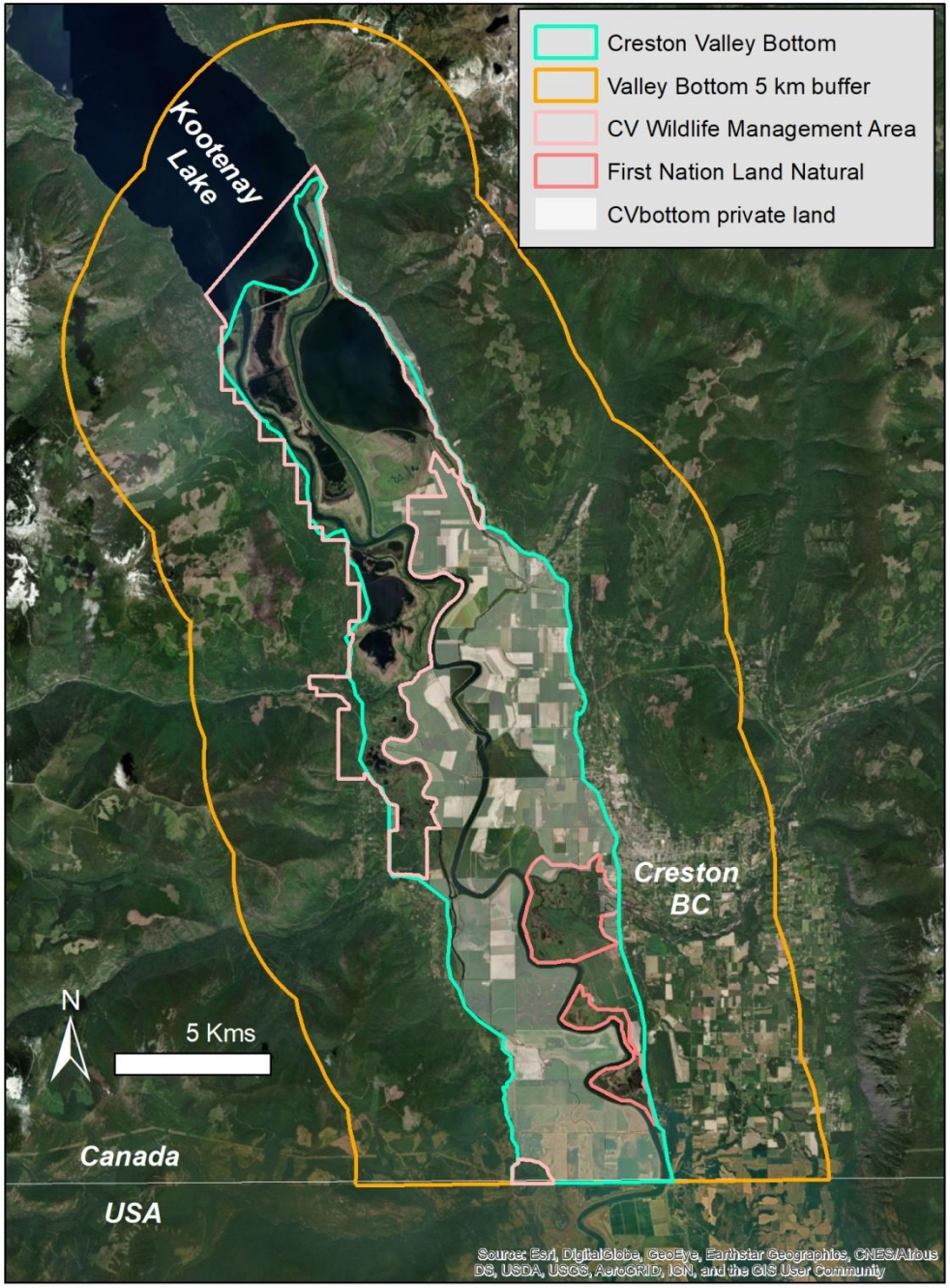
Creston Valley separating the South Selkirk & Purcell Mts



Creston Valley separating the South Selkirk & Purcell Mts



Creston Valley separating the South Selkirk & Purcell Mts



Conserved connectivity lands in Creston Valley corridor

Nature Conservancy Canada (NCC)

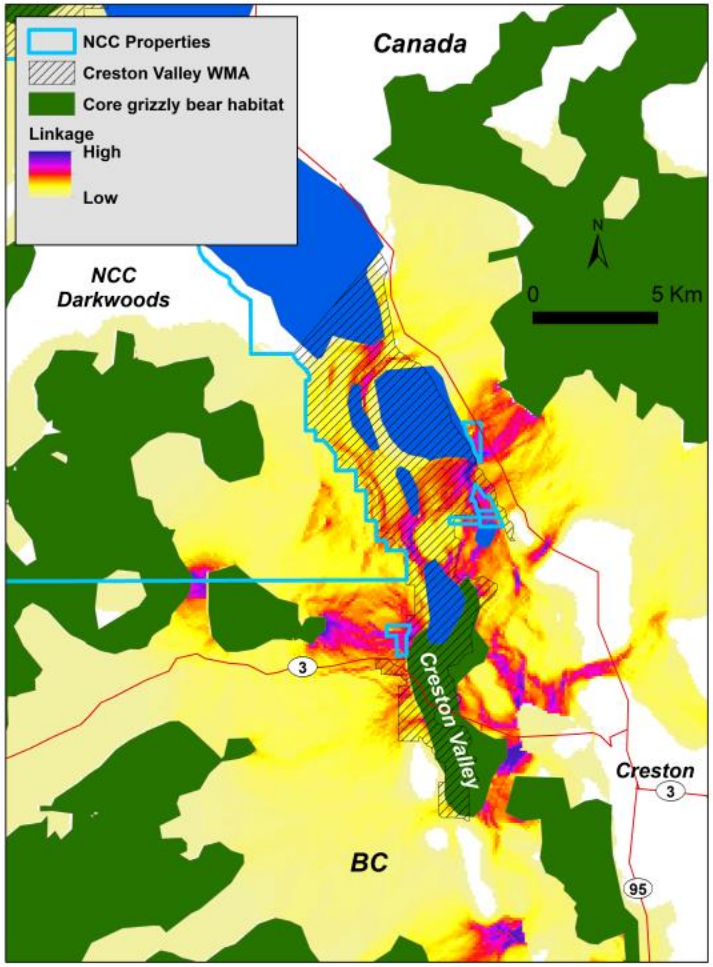


Figure 19. A close up view of Creston Valley, B.C. connectivity predictions (Proctor et al. 2015) juxtaposed with Nature Conservancy of Canada (NCC) purchased properties and the Creston Valley Wildlife Management Area.

Non-lethal conflict response when appropriate – with BC Conservation Officers

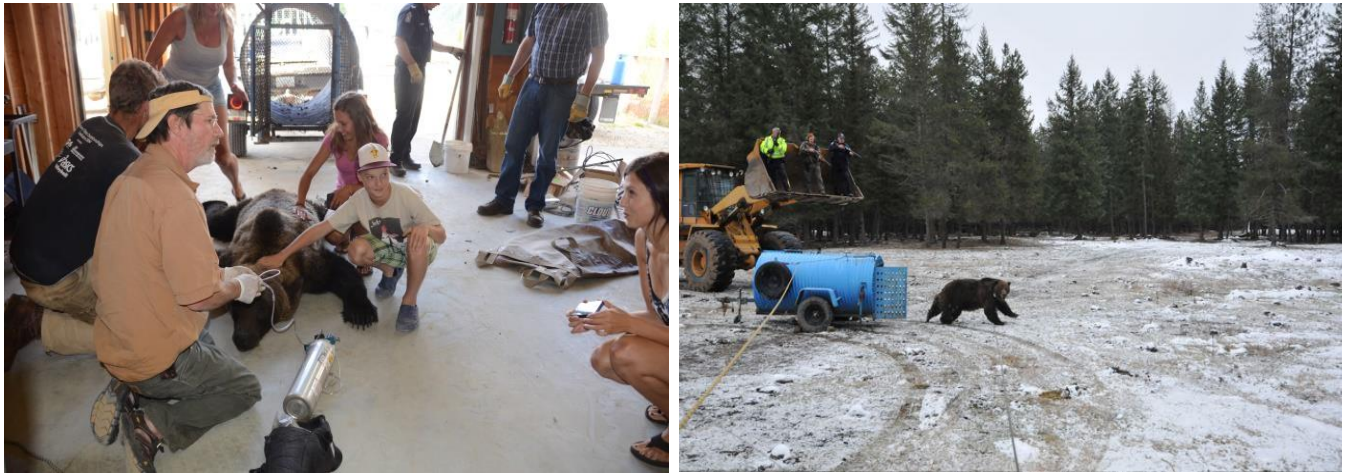


Figure 20. Radio collaring a grizzly bear that was about to escalate its pattern of conflicts. These events can be an excellent opportunity to educate local people and build appreciation for the bears. And providing a measure of negative reinforcement to a bear that has come into a farm looking for food, can often teach them to avoid people in the future (right panel).

Figure 21. An electric fence set-up around a cherry orchard in the Creston Valley funded through our cost- share program and, a bear safety course with bear spray training in the Creston Valley.

Cost-share electric fencing

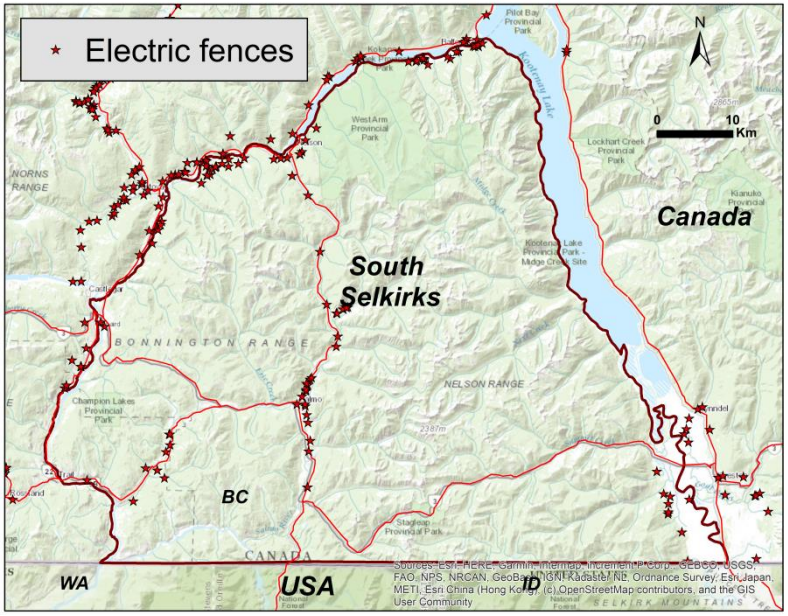


Figure 22. An electric fence within and on the periphery of the South Selkirk GBPU. Fences were planned, organized and overseen by Grizzly Bear Coexistence Solutions

Access management on NCC lands near huckleberry patches

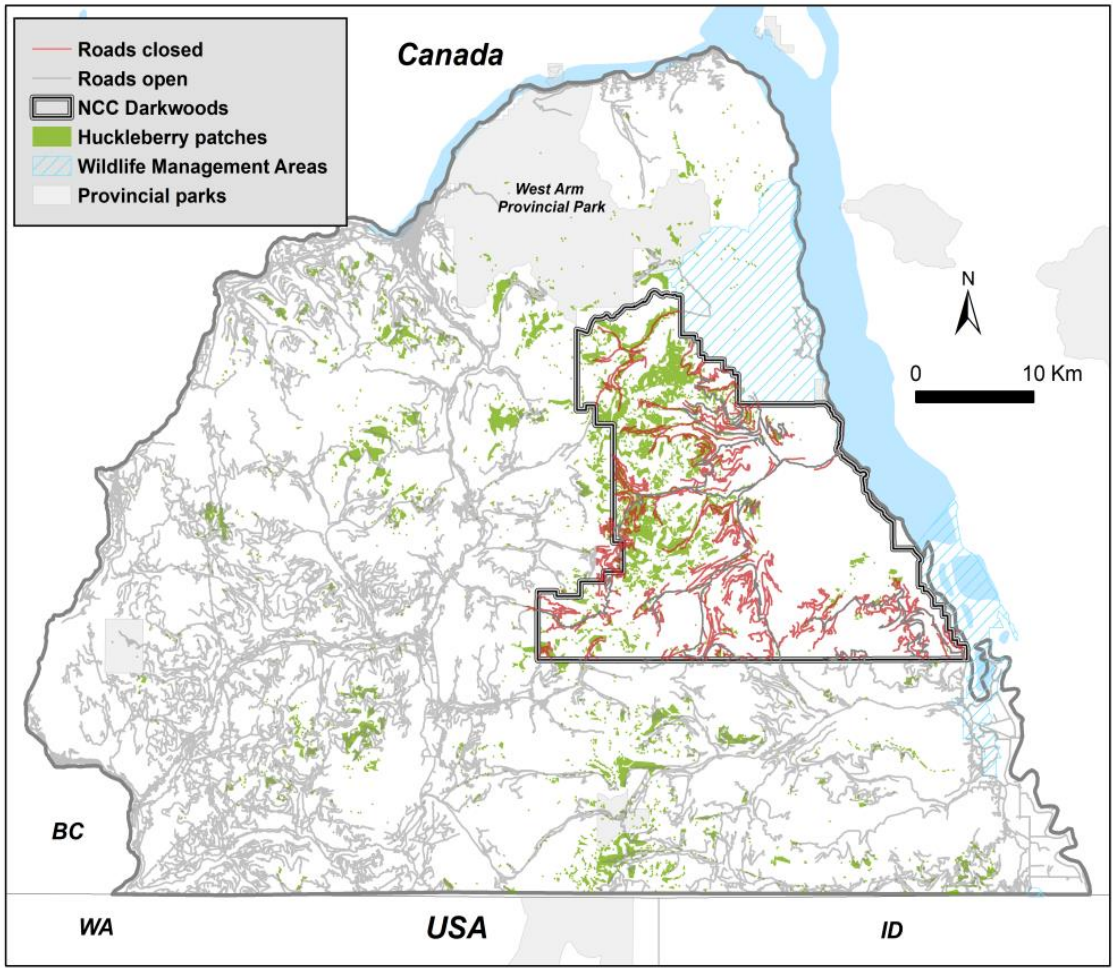


Figure 23. Access management applied with Nature Conservancy Canada's Darkwoods property with high overlap with productive huckleberry patches.

2020-2021 survey

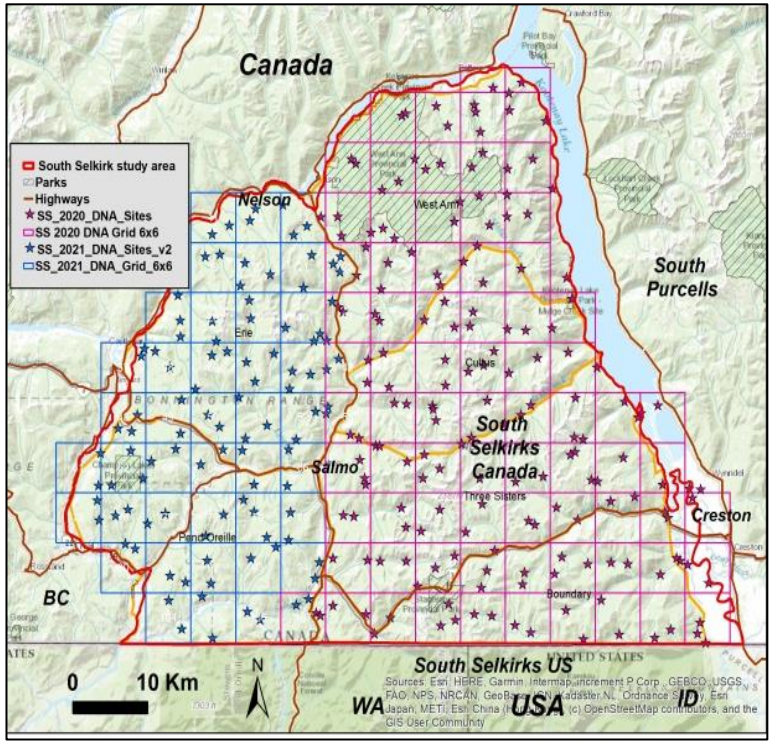


Figure 5a) DNA grid and sampling sites 2020 in the eastern 2/3 and 2021 in the western 1/3 of the South Selkirk Grizzly Bear Population Unit.

2005 survey

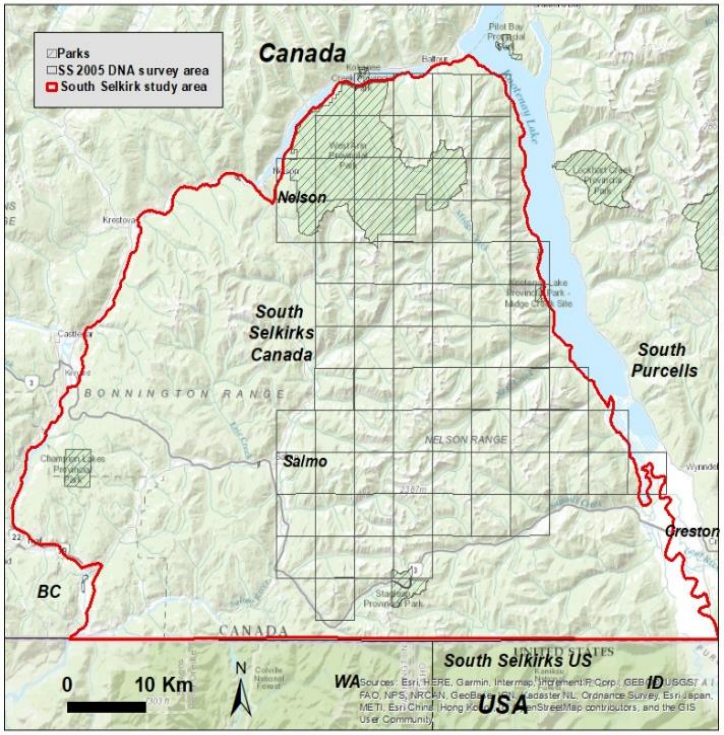


Figure 5b) The 2005 grizzly bear DNA survey carried out by the Trans-border Grizzly Bear Project.

Both sex detections

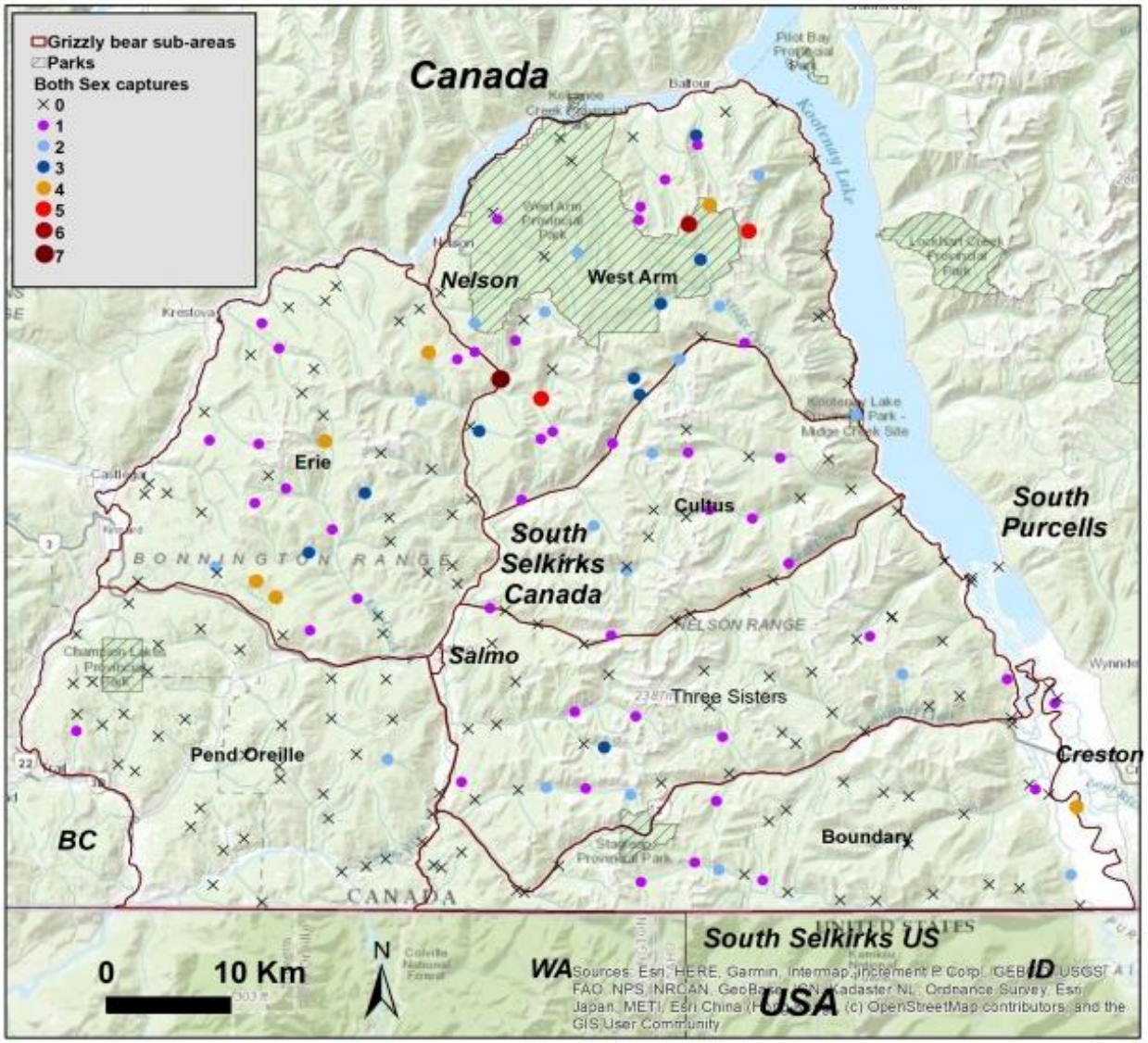


Figure 7. Both sex detections at hair sampling sites of grizzly bears in the South Selkirk GBPU in 2020-2021 in southeastern British Columbia.

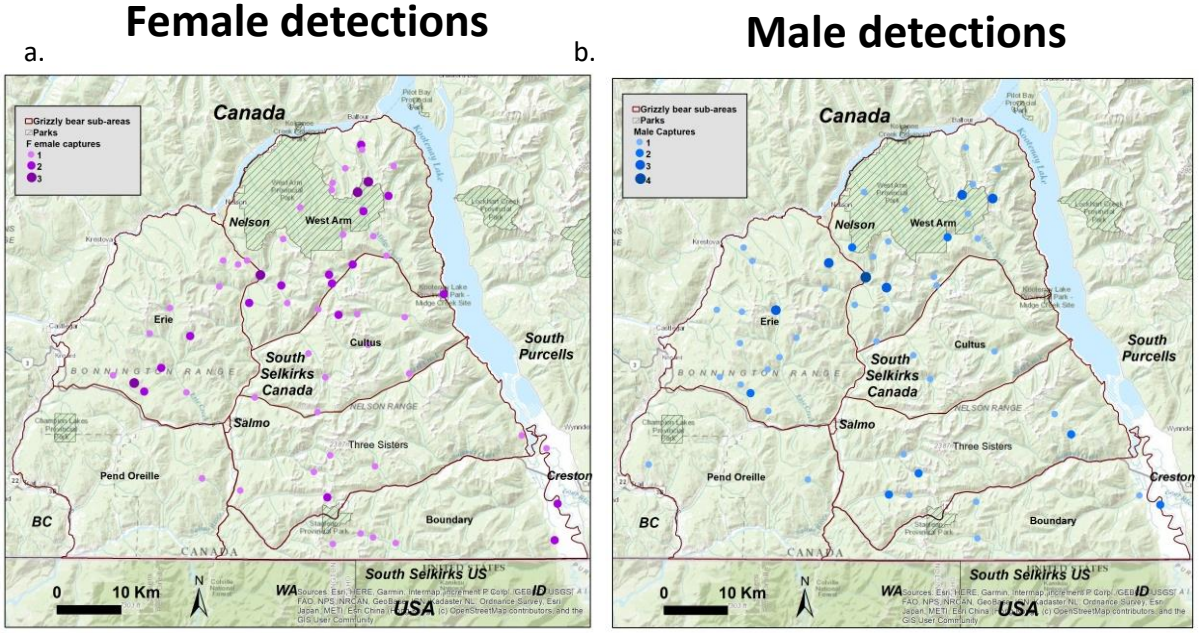


Figure 8a) Female and **b)** male grizzly bear detections in the South Selkirk GBPU of southwest British Columbia 2020-2021.

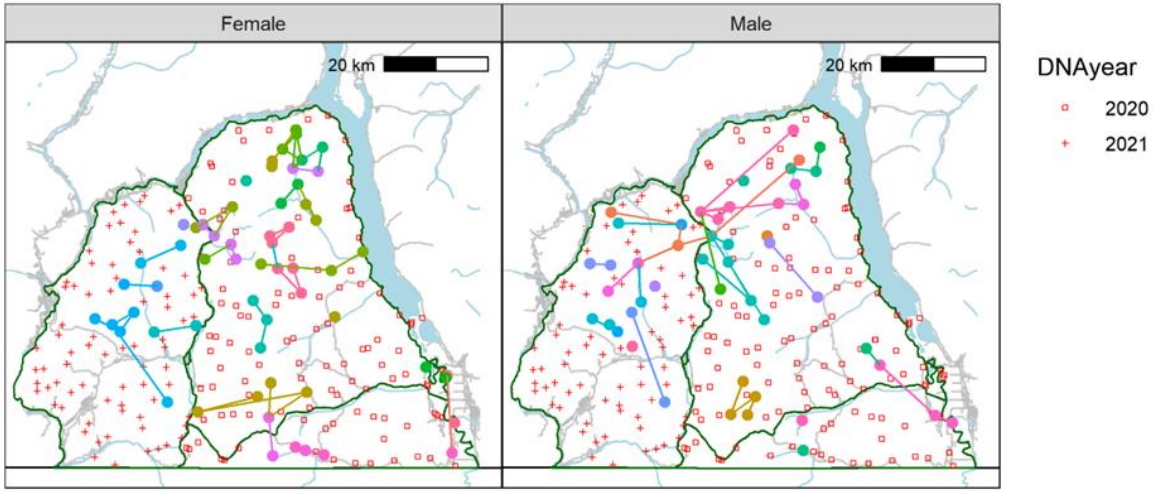


Figure 9) Grizzly bear recaptures (detections at different sites) across years. Different colors represent different individuals. Small open circles and +s are sites with no detections.

Closure corrected estimate - average abundance & density at any one time

SECR estimates	Ind	Ave Abundance	Abundance L 95%CI	Abundance U 95% CI	Abundance CV	Ave Density	Density L 95%CI	Density U 95% CI
2020	55	51.5	40.2	65.9	12.6%	14.3	7.1	29.1
2021	21	17.7	11.8	26.6	21.1%	11.7	7.2	18.8
Overall	76 (73)	**69.2**	56	85.5	10.8%	**17.2**	13.5	21.8
2020N (2005 equivalent)	44	44.2	33	59.1	15%	21.9	16.4	29.3
2005	30	32	22.3	46	19%	15.1	10.5	21.7

Open abundance estimate

Closed estimates	Ind	Chao	L 95%CI	U 95% CI
2020	55	67.1	59.3	88.7
2021	21	27.3	5.2	22.5
Overall	76 (73)	**90.4**	73	106.2
Proctor et al 2007		58	50	70

SECR model with “explanatory” covariates

No	Model	AICc	ΔAICc	wi	K	logLik
1	Huckleberry 3k + greenness 3k + road density 3k + alpine 8k	1299.7	0	0.44	11	-636.8
3	Huckleberry 3k + road density 3k	1306.3	6.6	0.02	9	-642.8
4	Huckleberry 8k + greenness 3k + road density 3k	1306.4	6.7	0.02	10	-641.5
5	Huckleberry 8k + secure habitat	1306.9	7.2	0.01	9	-643.1
6	constant	1315.5	15.8	0	7	-649.9

Detections vs road density

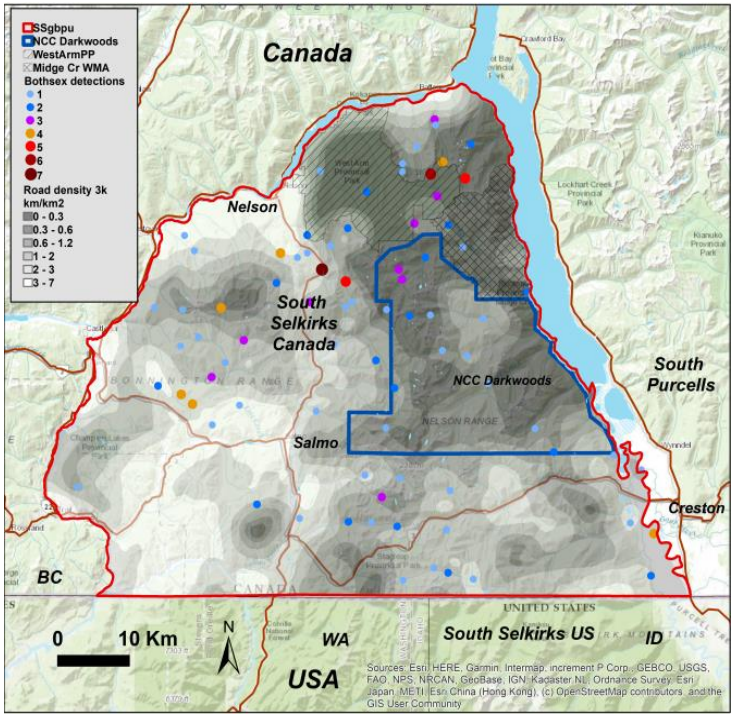


Figure 10a) Road density average over a 3k radius with both sex grizzly detections in the South Selkirk GPBU in southeastern B.C. 2020-2021.

GB Density vs secure habitat & huckleberry

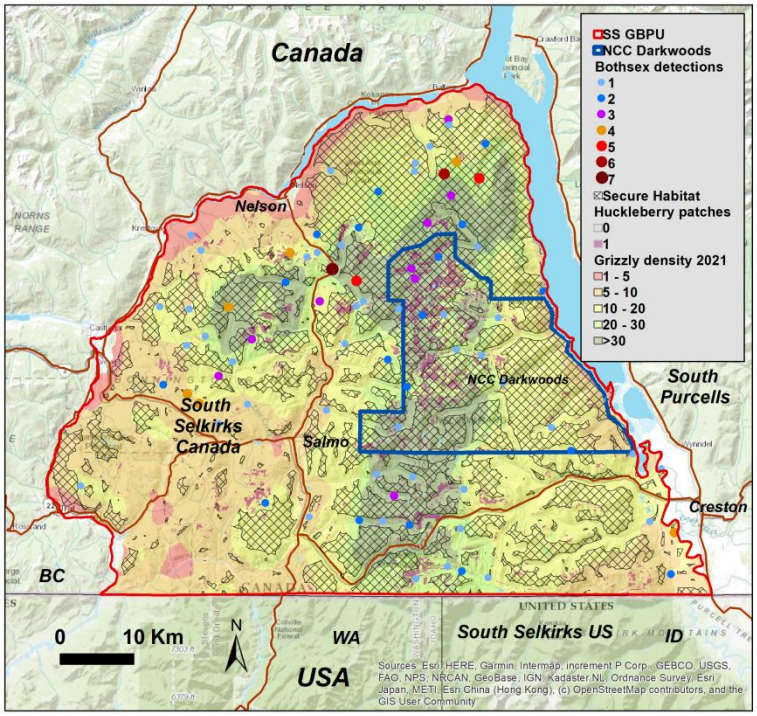


Figure 10b) Grizzly density relative to secure habitat & huckleberry patches.

GB Abundance & Density in Sub Areas

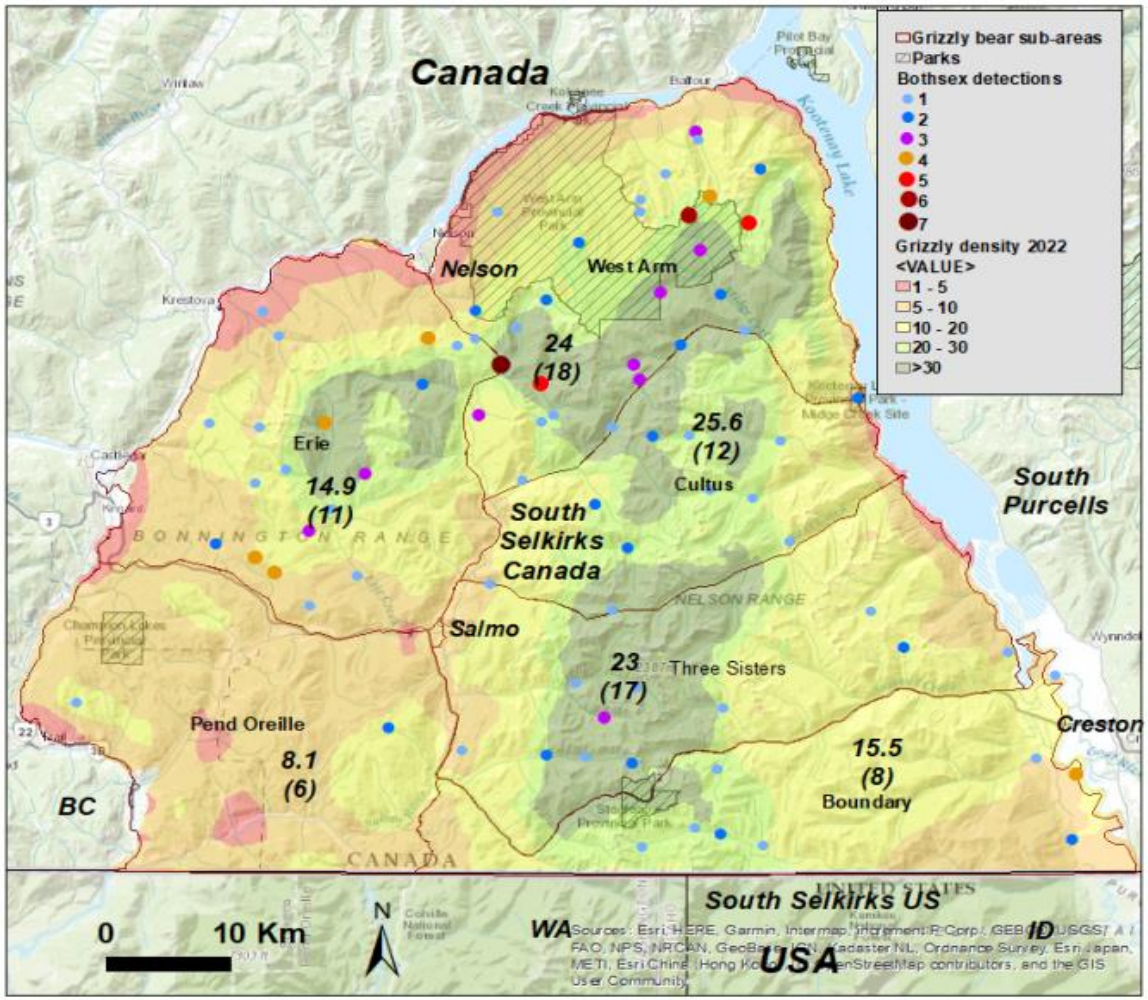


Figure 11. Grizzly bear both sex grizzly density surface based on the most supported model in Table 5 in the South Selkirk GBPU of southeast British Columbia 2020-2021. Detections and the number within sub-areas is the density with the population (abundance in parentheses).

Mothers & offspring detected during survey

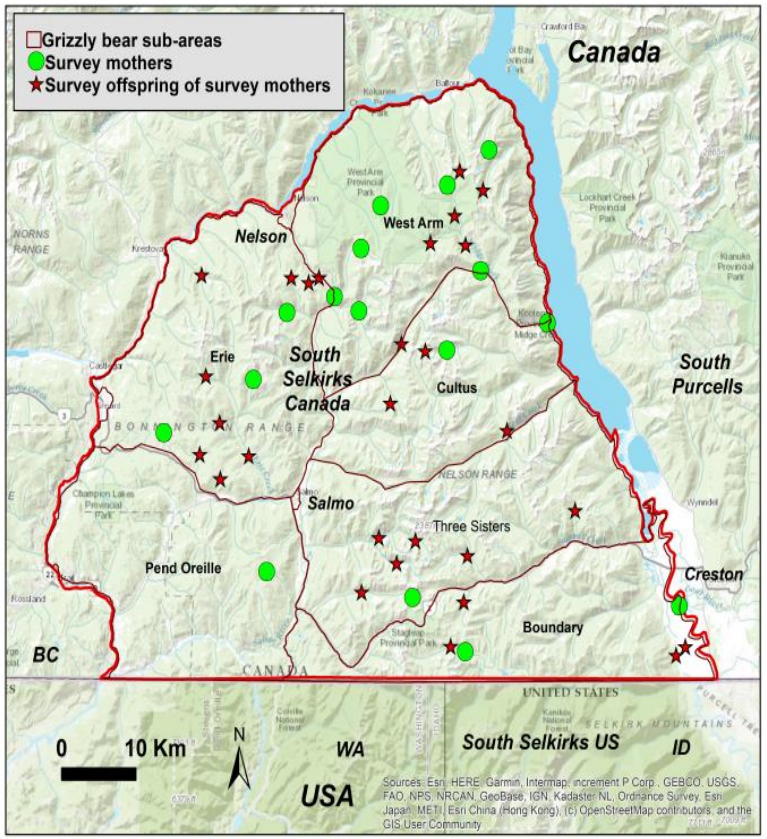


Figure 12a) Mothers and offspring detected during 2020-2021 grizzly bear survey in the South Selkirk GBPU 2020-2021.

Mothers & offspring detected long-term

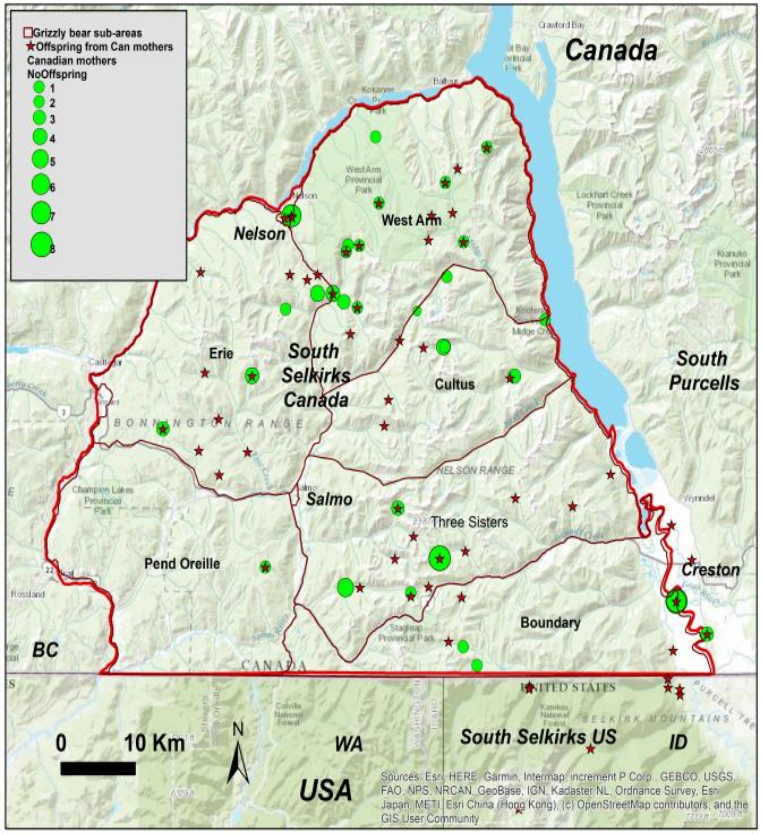


Figure 12b) All Canadian grizzly bear mothers and offspring detected in our long-term genetic data set.

Population assignments – evidence of migrants

Prior to 2006

After 2006 to 2021

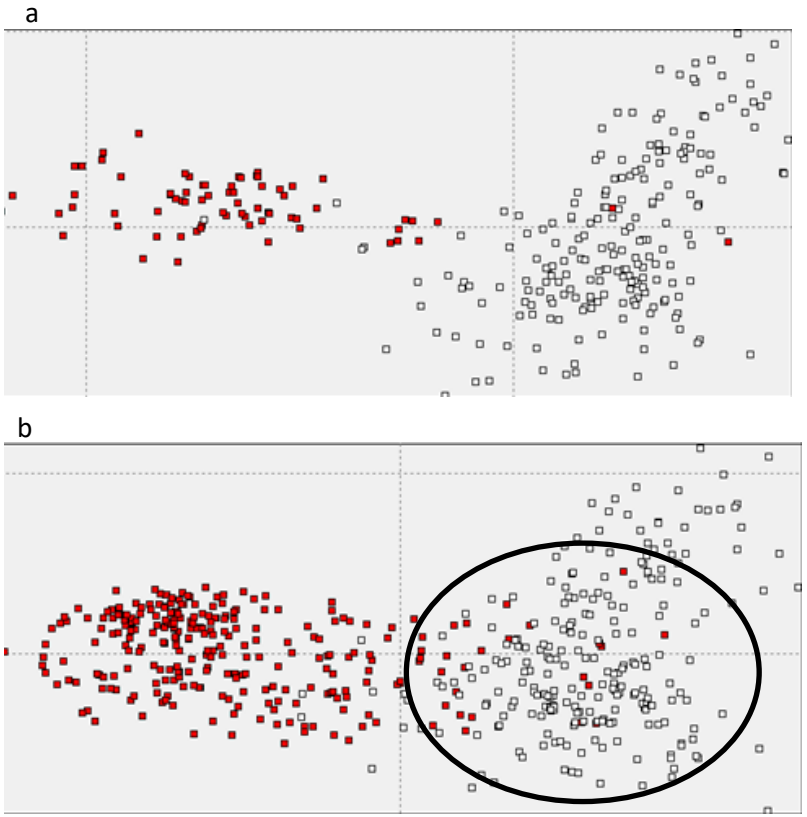


Figure 14. Assignments of population of origin for grizzly bear genotypes in the South Selkirks **a)** prior to 2006 and **b)** up through 2021. Both South Selkirk grizzly bears are compared to grizzly bears in the Purcell Mountains to the east. Immigrants into the South Selkirks are represented by the red dots (detected in the Selkirks) within the cluster of white dots (assign to the Purcells their likely population of origin) to the right within each panel. Note the very few immigrants into the South Selkirks in the top pre 2006 panel and the many more immigrants in the right panel (red dots within the black oval) with bears up through 2021. This demonstrates that we had detected very few immigrants into the South Selkirk population before 2006 (Proctor et al. 2005, 2012, 2018) and many more currently.

Breeding after immigration – family pedigrees

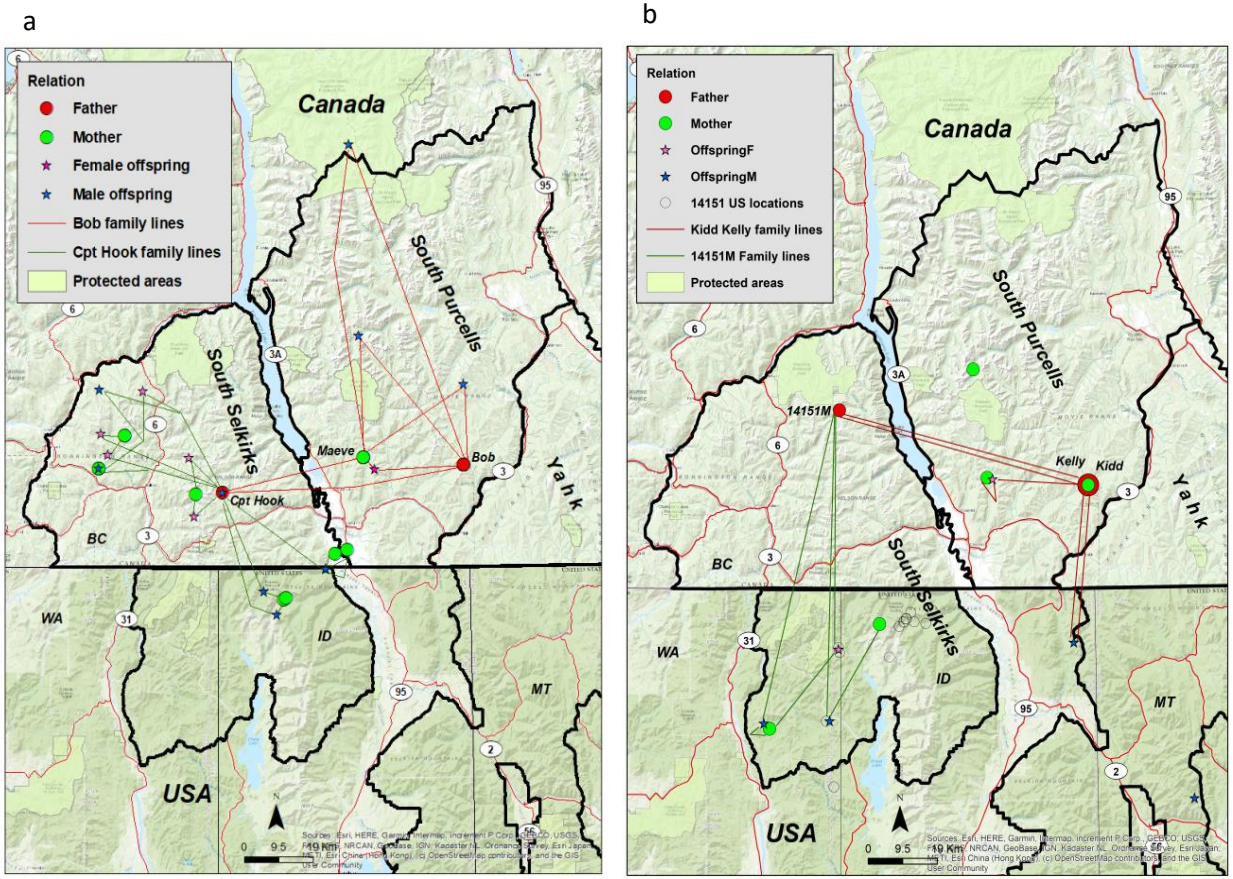


Figure 15a. Grizzly bear family pedigrees showing immigrants from the Purcell Mts. into the South Selkirk population. Panel **a)** depicts immigrant Cpt Hook, an offspring of Maeve and Bob from the Purcell Mts. and eventually had 13 offspring (5F, 8M) 8 different females in the South Selkirks. Panel **b)** shows Immigrant male 14151 an offspring of Kelly and Kidd from the Purcell Mts. and eventually had 3 offspring (1F, 2M) with two mothers. Bears with names were live captured and radio collared. 15141 was also detected in the U.S, open circles)

9 immigrants that bred 27 offspring (12F, 15M)

Prior to 2006

a

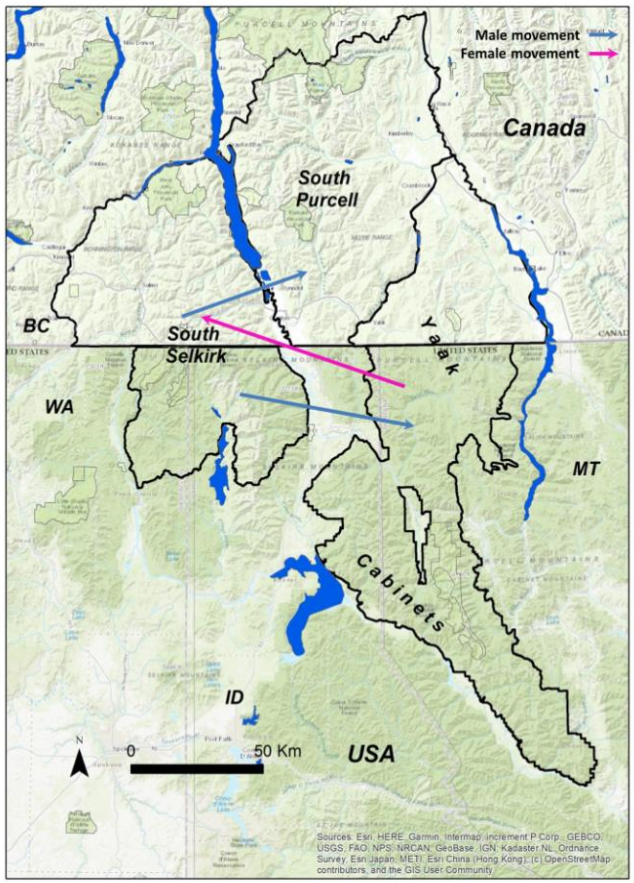


Figure 13a) Grizzly bear immigrants into the South Selkirk GBPU in southeast British Columbia prior to 2006. Adapted from Proctor et al. (2018)

Post 2006

b

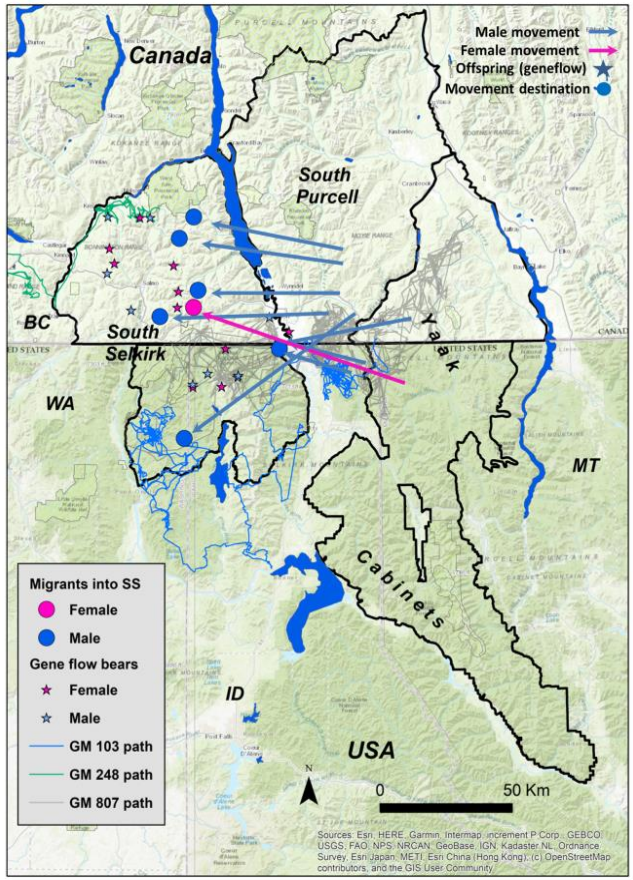


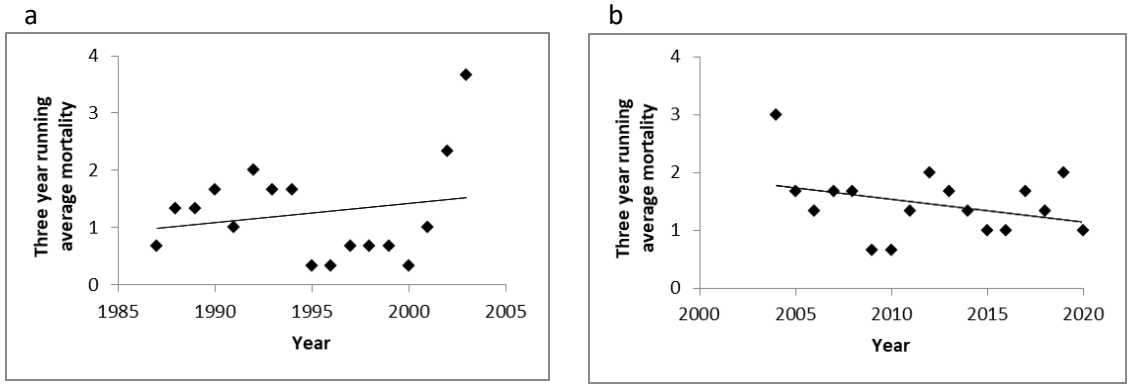
Figure 13b) Grizzly bear immigrants into the South Selkirk GBPU (9) and 27 offspring representing gene flow in southeast British Columbia as of 2021.

A decrease in human-caused non-hunt mortality

Prior to 2006

Post 2006

South Selkirks



The adjacent South Rockies

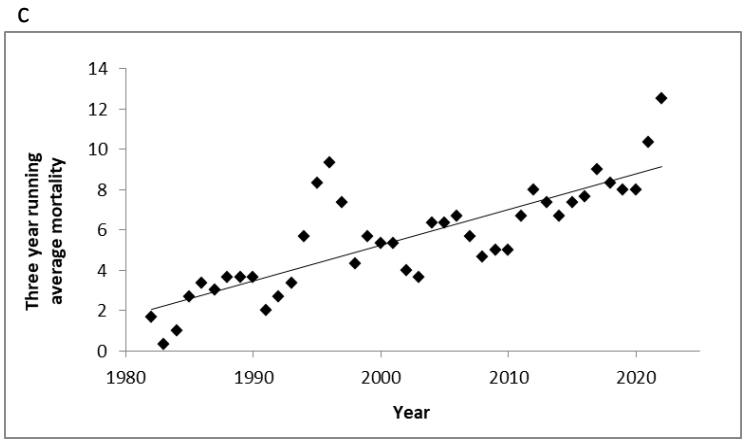


Figure 16. Updated grizzly bear mortality graphs from Proctor et al. (2018), data extended to 2021. **a)** The Canadian South Selkirk population between 1984-2003 (raw data regression, P = 0.45) and **b)** the South Selkirk between 2004-2021 (raw data regression, P = 0.10), and **c)** the control population that received no enhanced conflict management, B.C. South Rocky population between 1980 and 2021 (raw data regression, P < 0.001).

Human-caused non-hunt mortality relative to population size – that was increasing

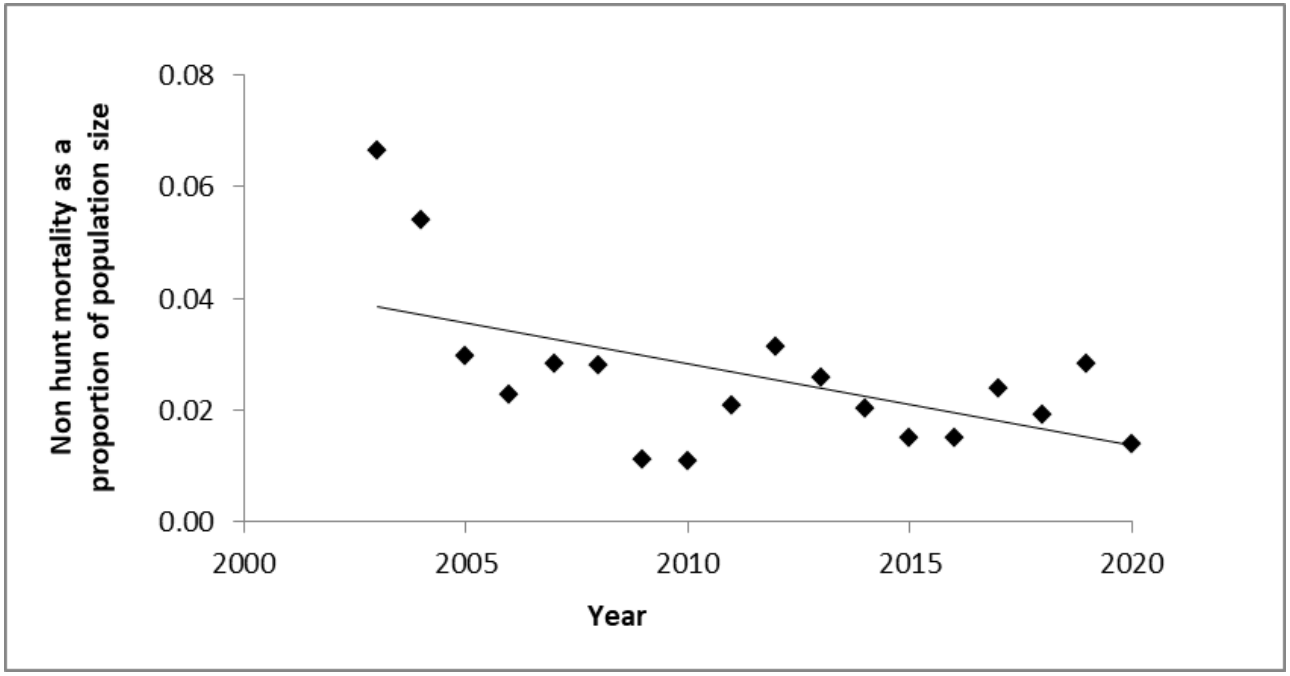


Figure 17. Grizzly bear mortality rate as a proportion of population size over almost 2 decades in the Canadian South Selkirk GBPU. We estimated annual population size by using our 2005 estimate and applying a 2.9% annual increase as measured by Kasworm et al. (2022) data presented is a 3 year running average, raw data regression, P = 0.07).

Recovery targets from MacHutchon and Proctor (2016) and results from the 2020-2021 grizzly bear DNA-based survey.

Recovery metric	M&P 2016	2020-21 DNA survey SECR	equivalent to 2007 estimate Not closure corrected	Proctor et al 2007 Not closure corrected
SS Abundance	80	69 (56-85)	90 (78-128)	58 (50-70)
East SS abundance 2005 vs 2020		44 (33-59)	32 (22-46)	
Population trend	stable to increasing	2% annual increase		
Females, 50% of pop	40	44 detected		
Reproductive females	20	17 detected (21 estimated)		
F Reproduction distribution	5 of 6 subareas	6 of 6 subareas		
Female mortality	1 reported / year	0.5 reported / year		
Periodic immigrants	2 / 10yrs	1 F, 11 M		
Immigrant breeding - geneflow	periodic	12 F 15M offspring from immigrant parent		

Would these patterns have happened naturally, with the status quo as it was in the early 2000s?

Other populations have been increasing, in BC, Alberta, & the US

We never have perfect matched case controlled studies

My answer is "to some degree, yes"
International population was increasing from
1983- 2002: ~1.9%
1983 – 2021: ~3.1%

But we have detected some profound improvements, particularly in connectivity. When I started, any bear in the Creston Valley had a life span of about 3 days.

Think beyond bears to the wider ecosystem

This work inspired “Kootenay Connect” a region-wide Ecological Corridors project.
Now in year 4 of 7

Figure 18. A Nature Conservancy Canada display in the Creston Valley describing an Ecological Corridor inspired by the overlap of B.C’s endangered northern leopard frog habitat within a grizzly bear corridor between the Purcell and South Selkirk Mountains.