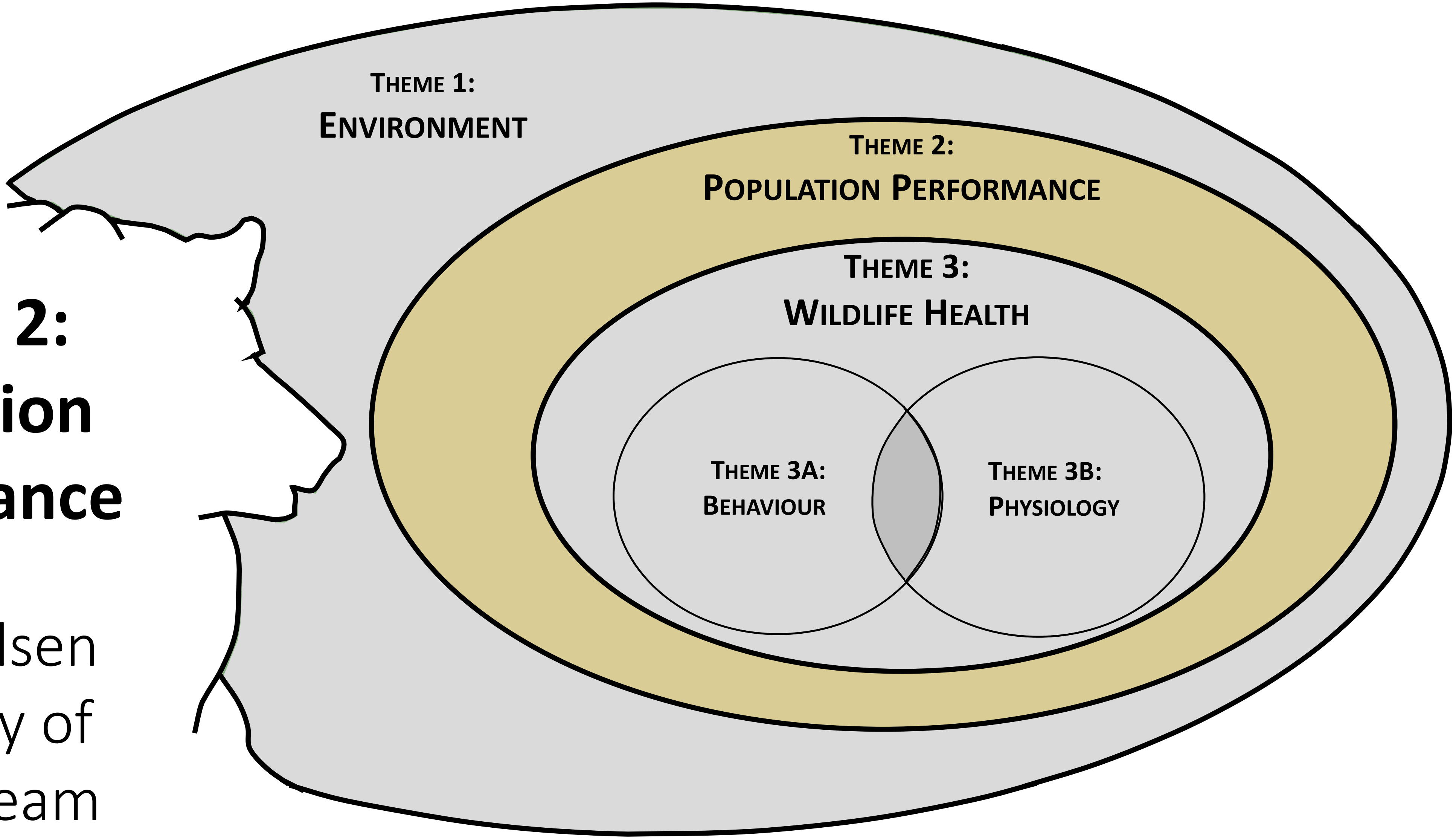
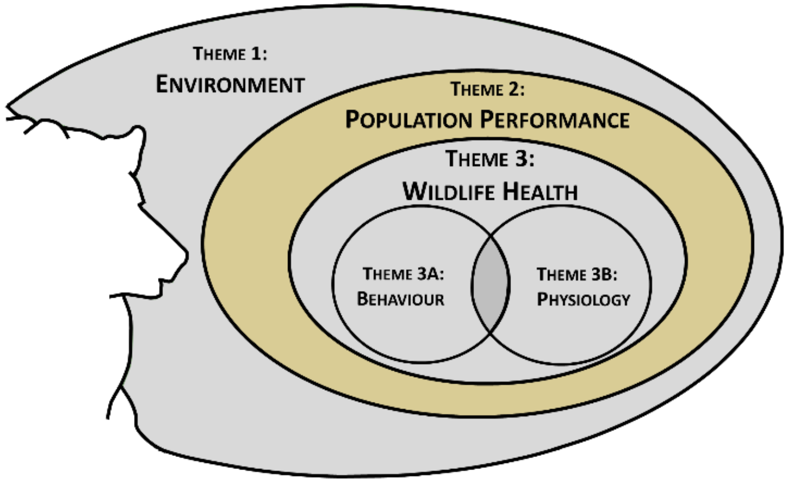
Theme 2: Population performance

Scott Nielsen
University of Alberta Team



Theme 2 – Population performance (ecology)

Q1: Have **road density** thresholds influenced abundance & distribution (recovery) of bears?
Q2: Has **landscape change** (natural & anthropogenic) resulted in changes in population size/trends?
Q3: Can **carrying capacity** work be evaluated in terms of predicting densities & distribution of bears to inform land use/forest planning?
Q6: Do **existing models** used by resource managers continue to provide useful surrogates for habitat quality in changing landscapes?



Nutritional Landscape

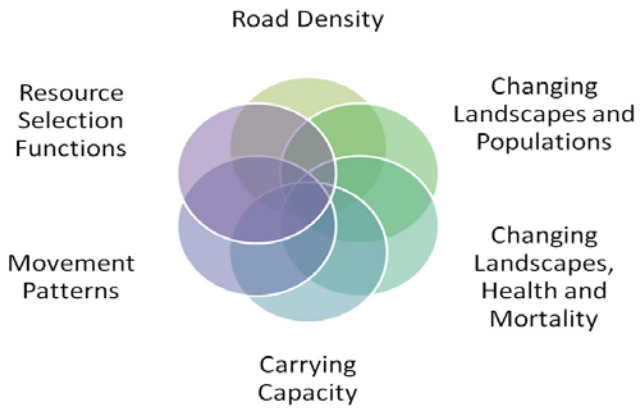
Bottom-up

N & Density

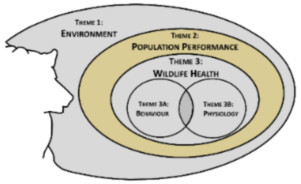
but also behaviour & health

Top-down

landscape change→ roads→human activity→ survival



Theme 2: personnel & key topics

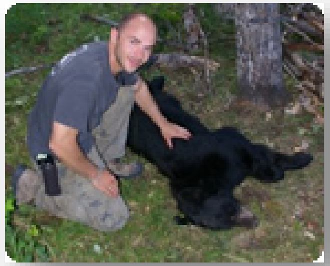


Sean Coogan *(post-doctoral fellow):*

- What are the population trends (demographics) in the Yellowhead between 2004 & 2014 & can these changes be related to changes in landscape condition?
- What are the nutritional constraints or trade-offs in our population & how does that relate to habitat change, behaviour & health?

Chris Souliere *(PhD student):*

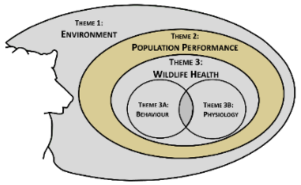
- How does food supply change as a function of landscape change & how can this be incorporated into forest harvest planning?
- Do existing models used by resource managers continue to provide useful surrogates for habitat quality in changing landscapes?



Sean Coogan
(PDF)

Chris Souliere
(PhD student)

Theme 2: personnel & key topics



Sean Coogan *(post-doctoral fellow):*

- What are the population trends (demographics) in the Yellowhead between 2004 & 2014 & can these changes be related to changes in landscape condition?
- What are the nutritional constraints or trade-offs in our population & how does that relate to habitat change, behaviour & health?

Chris Souliere *(PhD student):*

- How does food supply change as a function of landscape change & how can this be incorporated into forest harvest planning?
- How well do existing RSF functions compare to the landscape carrying capacity approach for the Yellowhead grizzly bear population?

Sean Coogan
(PDF)

Chris Souliere
(PhD student)

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PRACTITIONER'S PERSPECTIVE

Journal of Applied Ecology
BRITISH ECOLOGICAL SOCIETY

Towards grizzly bear population recovery in a modern landscape

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brown bear, conservation, grizzly bear, large carnivore, nutritional ecology, population recovery, remote sensing, wildlife management

THE APPLIED ECOLOGIST'S BLOG
Bridging the gap between researchers, and practitioners, and policymakers

PERSPECTIVES

The bear necessities of grizzly bear population recovery in Alberta, Canada

Journal blog:
https://appliedecologistsblog.com/2018/10/02/the-bear-necessities-of-grizzly-bear-population-recovery/

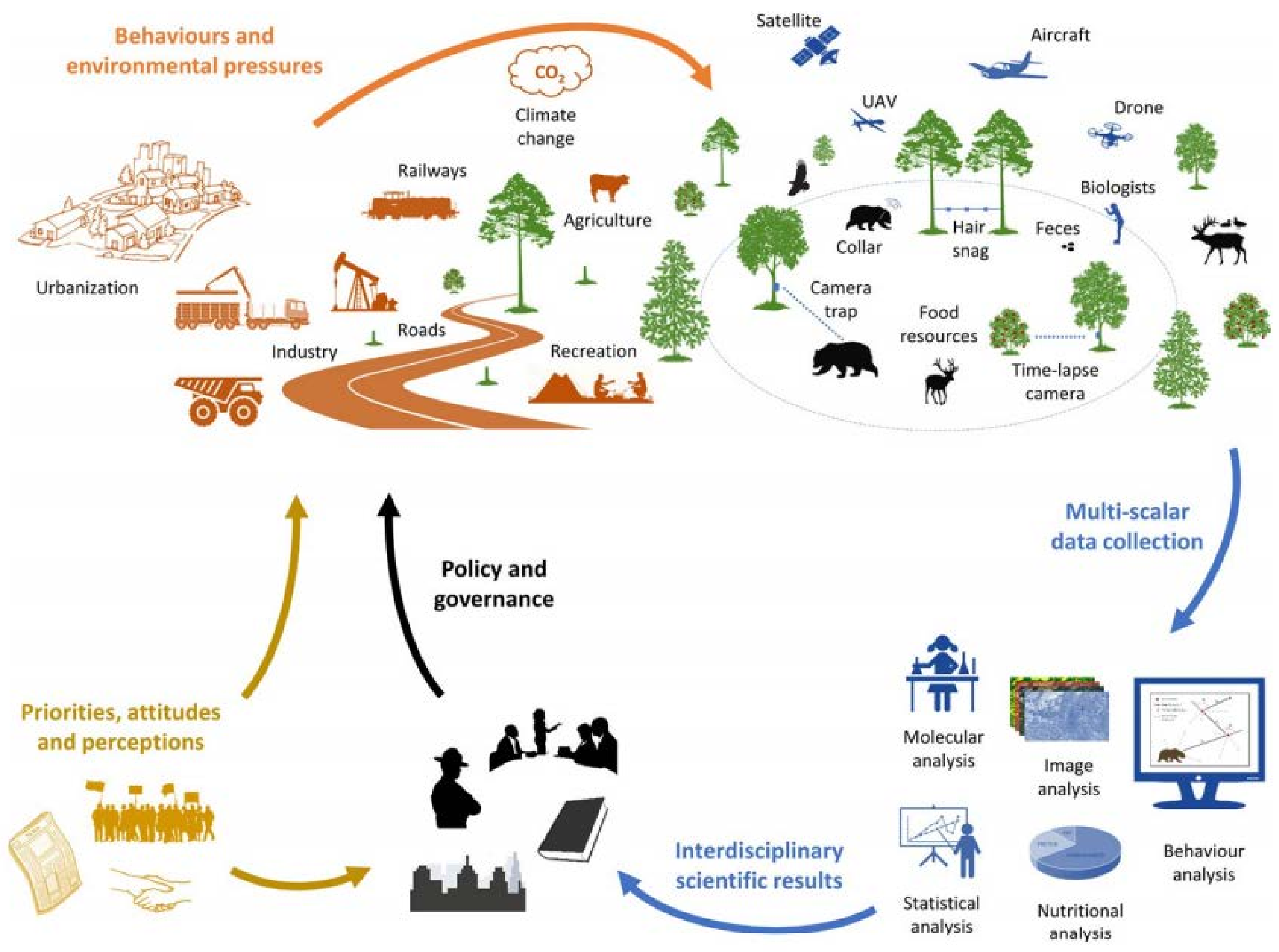
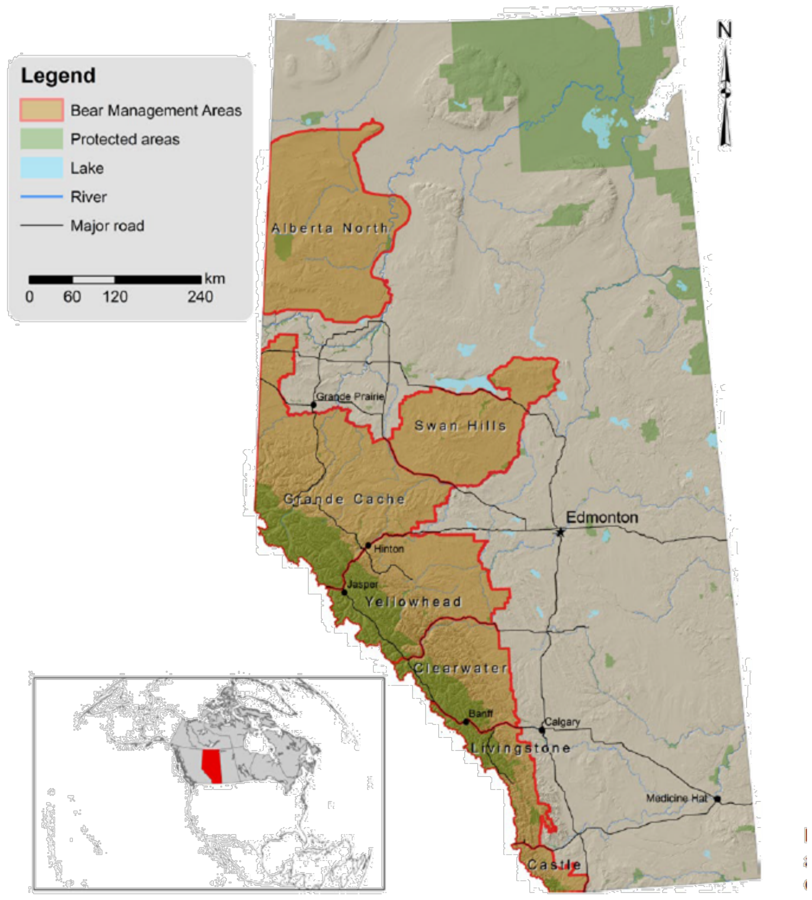
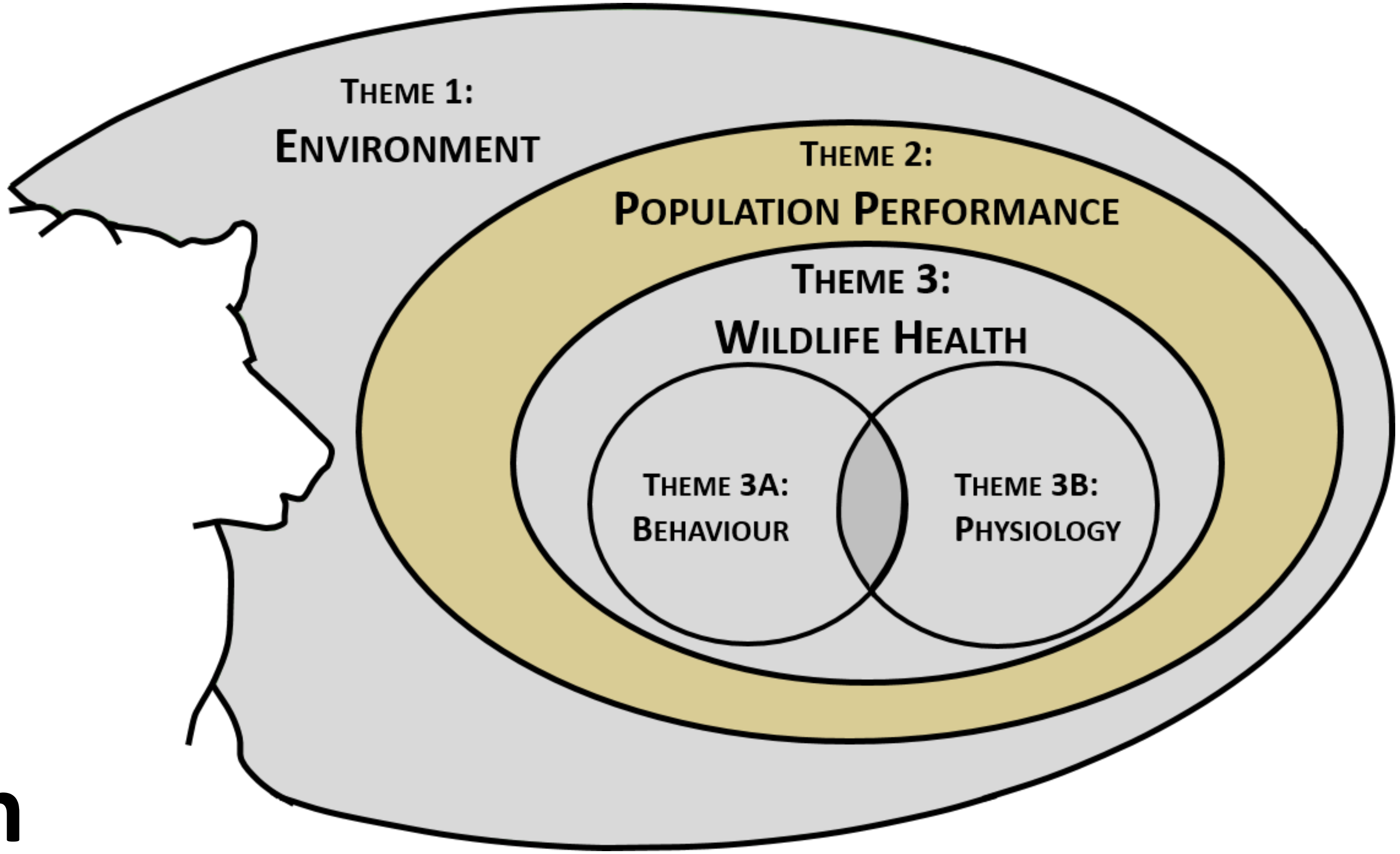


FIGURE 2 Representation of the multidimensionality of recovering the grizzly bear population in Alberta, Canada. Multi-scalar and interdisciplinary data collection, from remote sensing to molecular biology, is being undertaken by biologists to better understand bear behaviour, population dynamics, natural resources, and the impacts of anthropogenic stressors on the provincial population, including the effects of industrial activity (e.g., forestry, mining, and oil and gas). Data are analysed and reported to provide recommendations for policy and management towards recovery of the provincial population





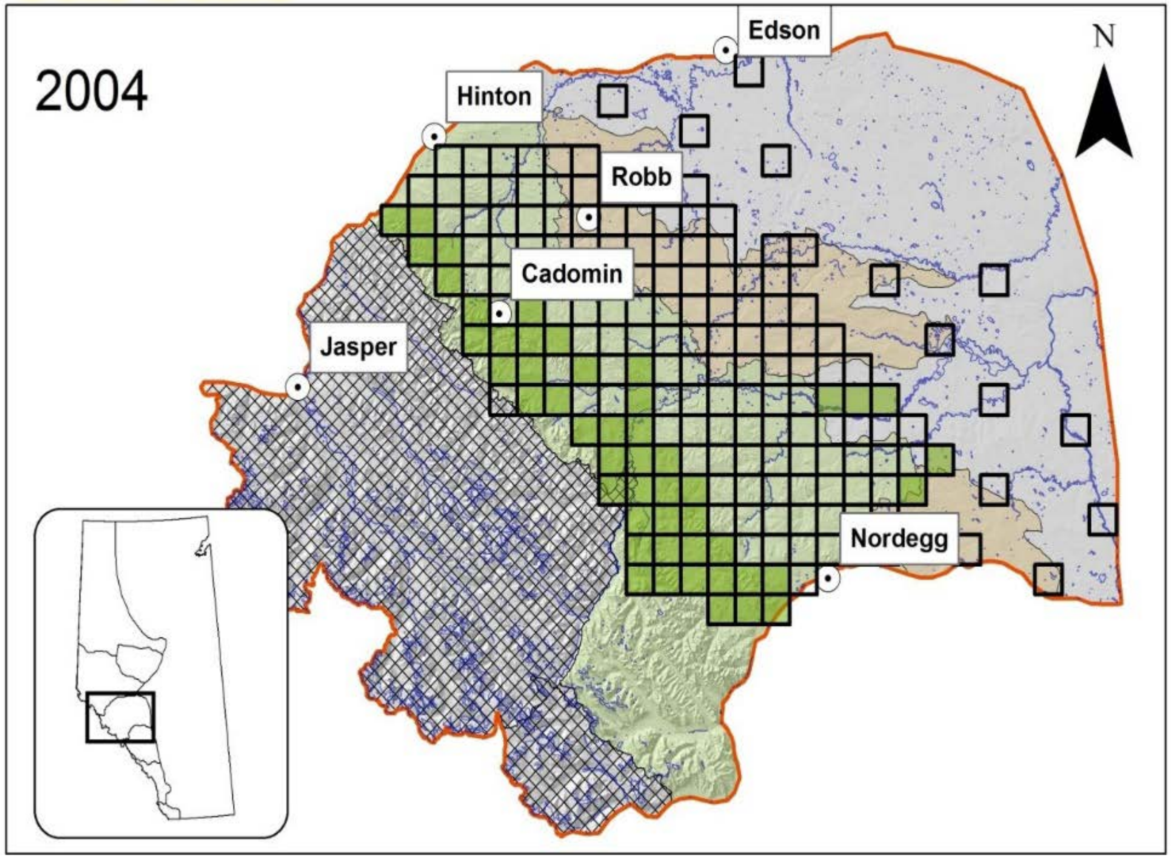
Research question

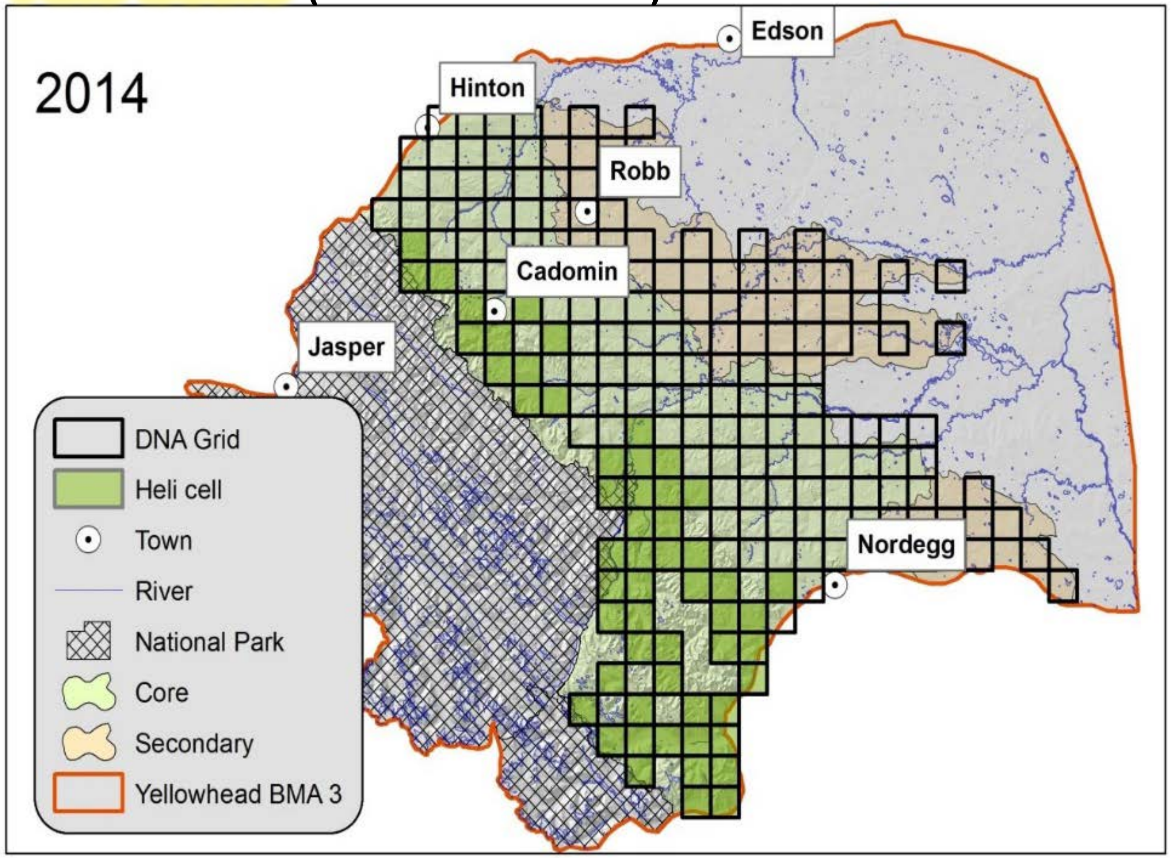
What are the ***trends in population*** demographics ***between 2004 & 2014*** for the Yellowhead grizzly bear population & can these changes be related to ***road density*** or other ***changing landscape conditions***?

2004 & 2014 DNA surveys: what are the trends?

Annual increase of ~7% (higher than usual; nearly doubled population in 10-years)

36.0 bears (CI: 28.6-45.3) → **71.3 bears** (CI: 53.9-94.2)

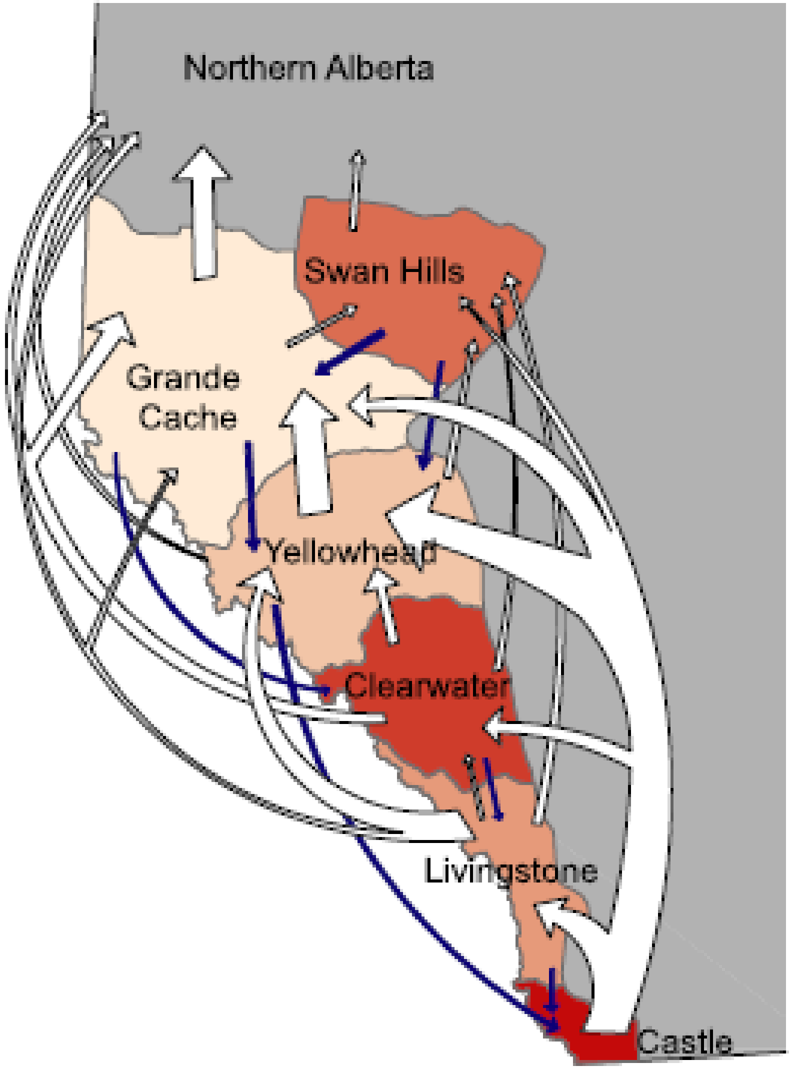




Stenhouse et al. 2015. Estimates of grizzly bear population size and density.

One source of trends: translocations

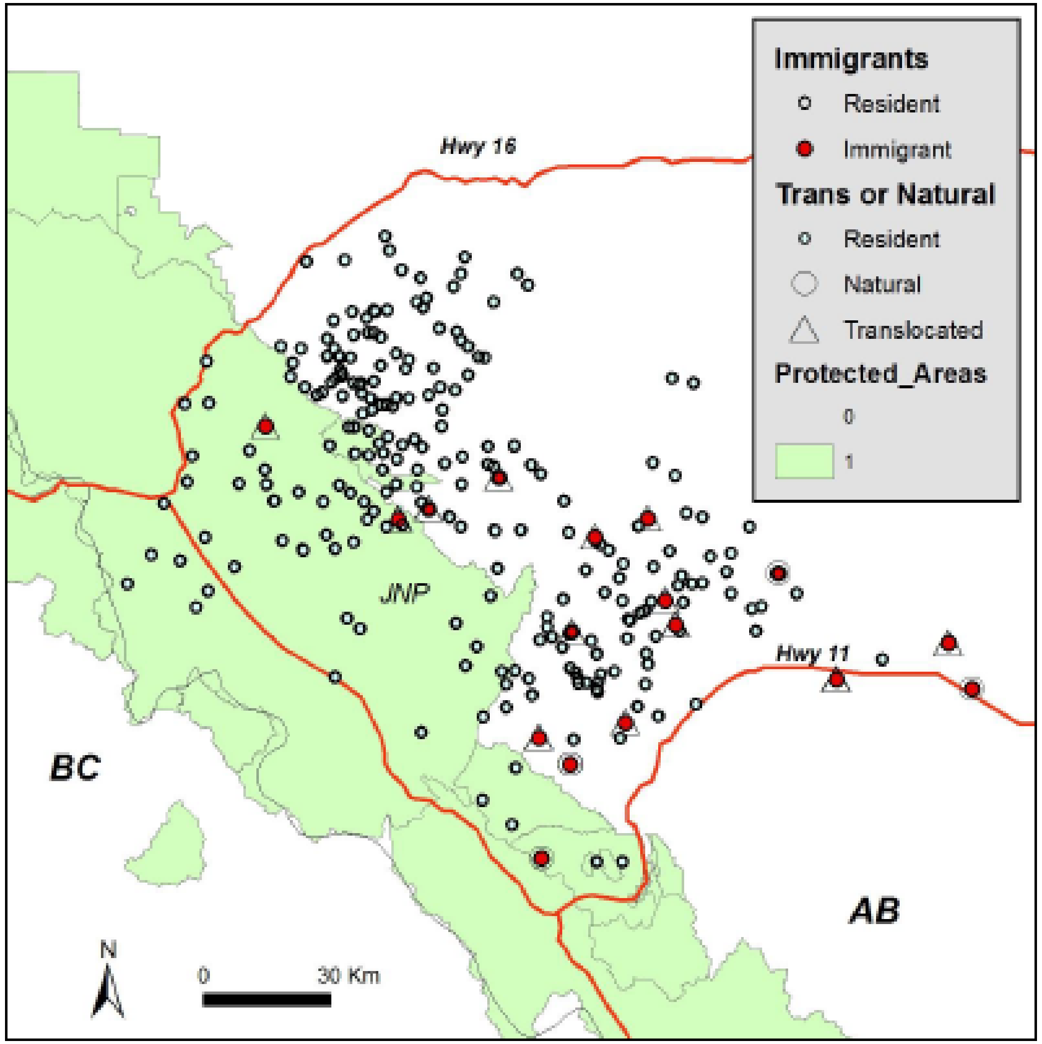
- A significant number of bears have been translocated into BMA 3 from other management units between 2004 – 2014
- Although not all are successful, this has contributed to part of the population increase
- From records:
  - ➢ 37 bears were translocated in
  - ➢ 9 were moved out (Proctor and Stenhouse 2017).



Shafer et al. (2013) *Evolutionary Applications* 7, 301-312

Update: all detected migrant/translocated bears

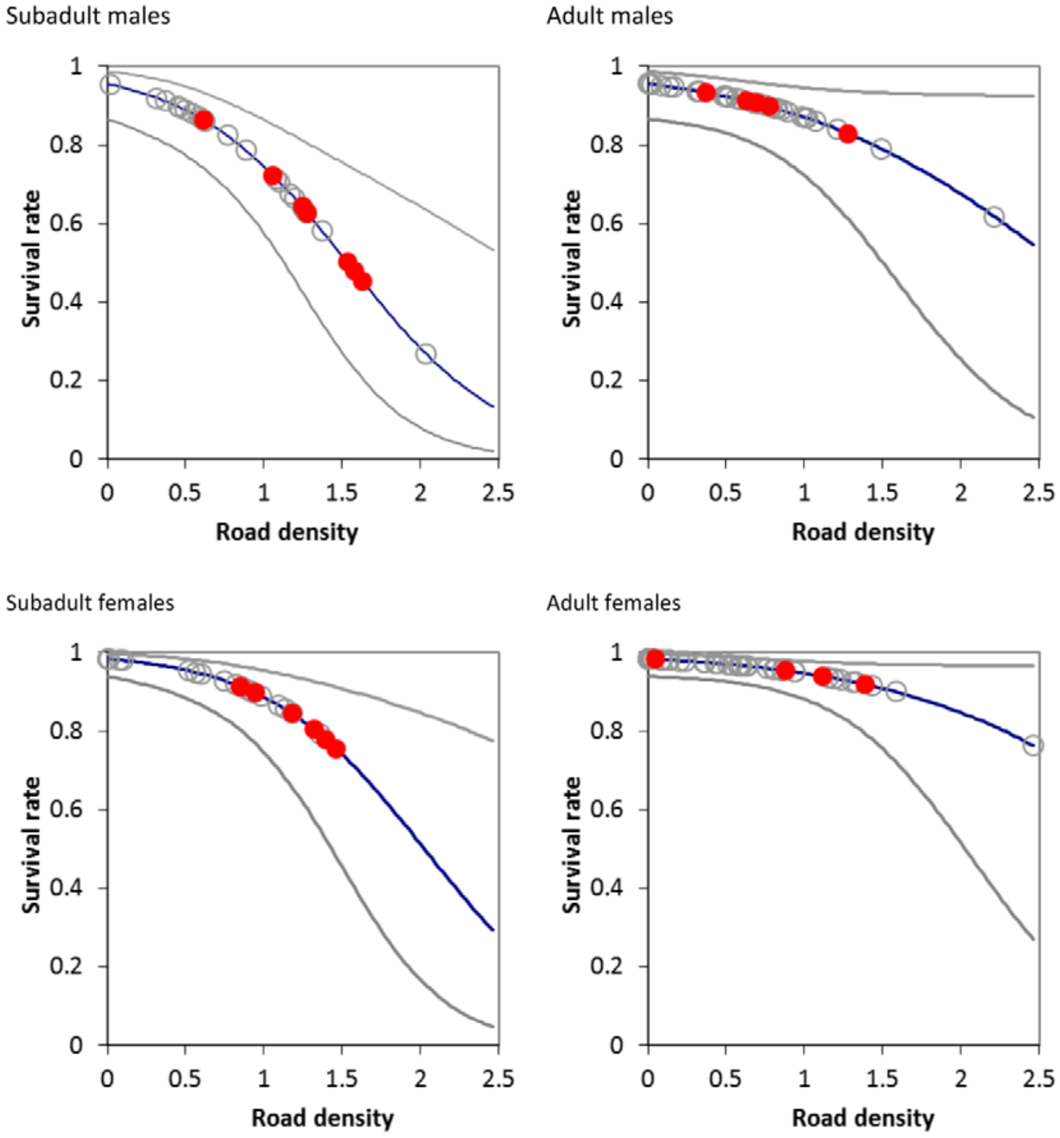
- Genetic analyses have identified ~12 immigrants between 2004-2014 (Proctor and Stenhouse 2017)
- This represents 28-34% of the population increase
- 67% of immigrants known or likely translocated
- 33% of immigrants from natural dispersal



Proctor and Stenhouse (2017) Internal Report.

Top-down factors
(road density as proxy)

- Relationship between road density & human-caused bear mortalities (Nielsen et al. 2004)
- Roads high priority for management (Boulanger & Stenhouse 2014)
- In the foothills, ♀ grizzly bears (with cubs & sub-adults) selected low-traffic roads (Graham et al. 2010)



Nielsen et al. 2004. Biological Conservation, 120:101-113.
Boulanger and Stenhouse. 2014. PLoS ONE, e115535.
Graham et al. 2010. Ursus, 21:43-56

Bottom-up factors (food supply)

- Nutrition critical for grizzly bears: e.g. hibernation, birth & survival of cubs (López-Alfaro et al. 2013)
- Anthropogenic disturbances can increase food supply (Nielsen et al. 2004)
- Cutblocks — herbs, ants, fruit, moose
- Roadsides — herbs (especially legumes - clover)

Lopez-Alfaro et al. 2013. Ecol Model 270, 1-10.
Nielsen et al. 2004. For Ecol Manage 199, 67-82.

Grizzly bear foraging behaviour

- Improved understanding of grizzly bear foraging behaviour
- Prefer specific ratios of protein, carbohydrate & fat (Erlenbach et al. 2014)
- Optimized mass gain
- Will mix their diets by consuming different foods (Coogan et al. 2014; Costello et al. 2016)

Erlenbach et al. 2014. J. Mammal 95, 160-168.
Coogan et al. 2014. PLoS ONE 9, e97968
Costello et al. 2016. PLoS ONE 11, e0153702

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REVIEW ARTICLE

WILEY Ecology and Evolution Open Access

Functional macronutritional generalism in a large omnivore, the brown bear

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[2]Faculty of Life and Environmental Sciences, and the Charles Perkins Centre, University of Sydney, Sydney, NSW, Australia

Abstract

We combine a recently developed framework for describing dietary generalism with compositional data analysis to examine patterns of omnivory in a large widely distributed mammal. Using the brown bear (*Ursus arctos*) as a model species, we collected

- Coogan et al. (2018) review of macronutritional diets of brown bears
- Nutritional geometry methods
- Seasonal shifts in protein, carbohydrate & fat

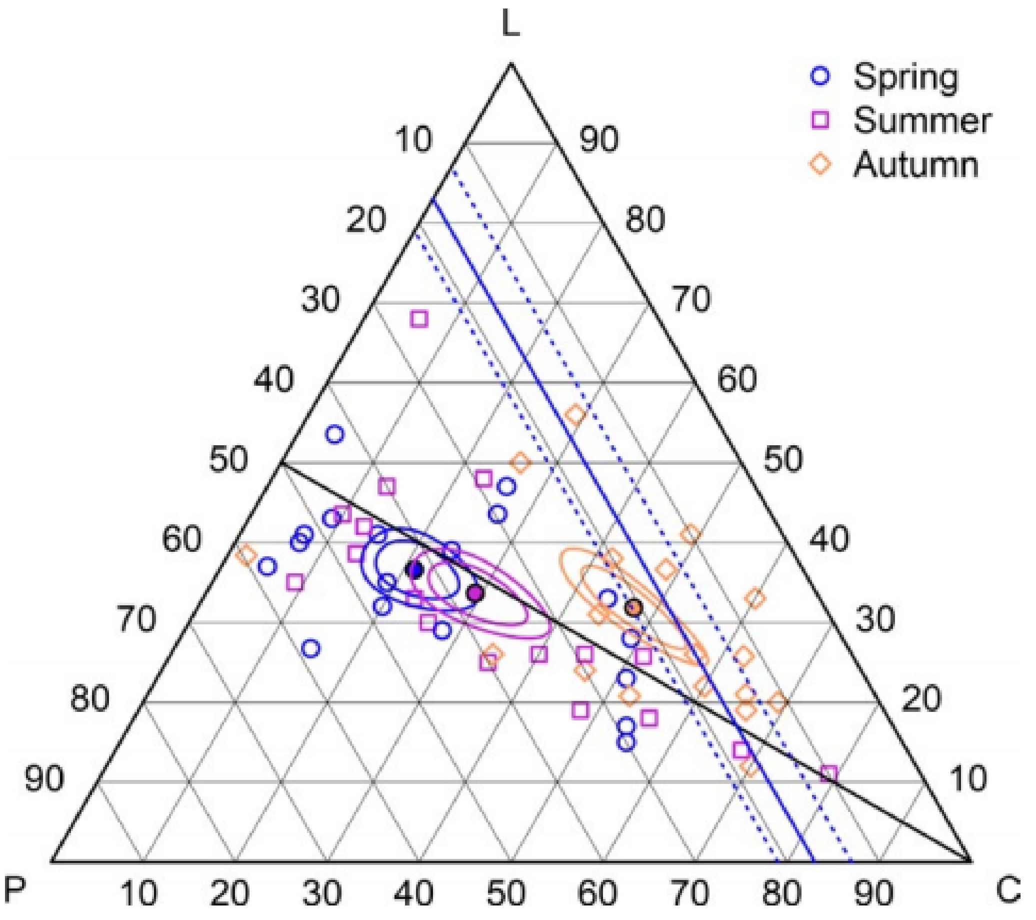
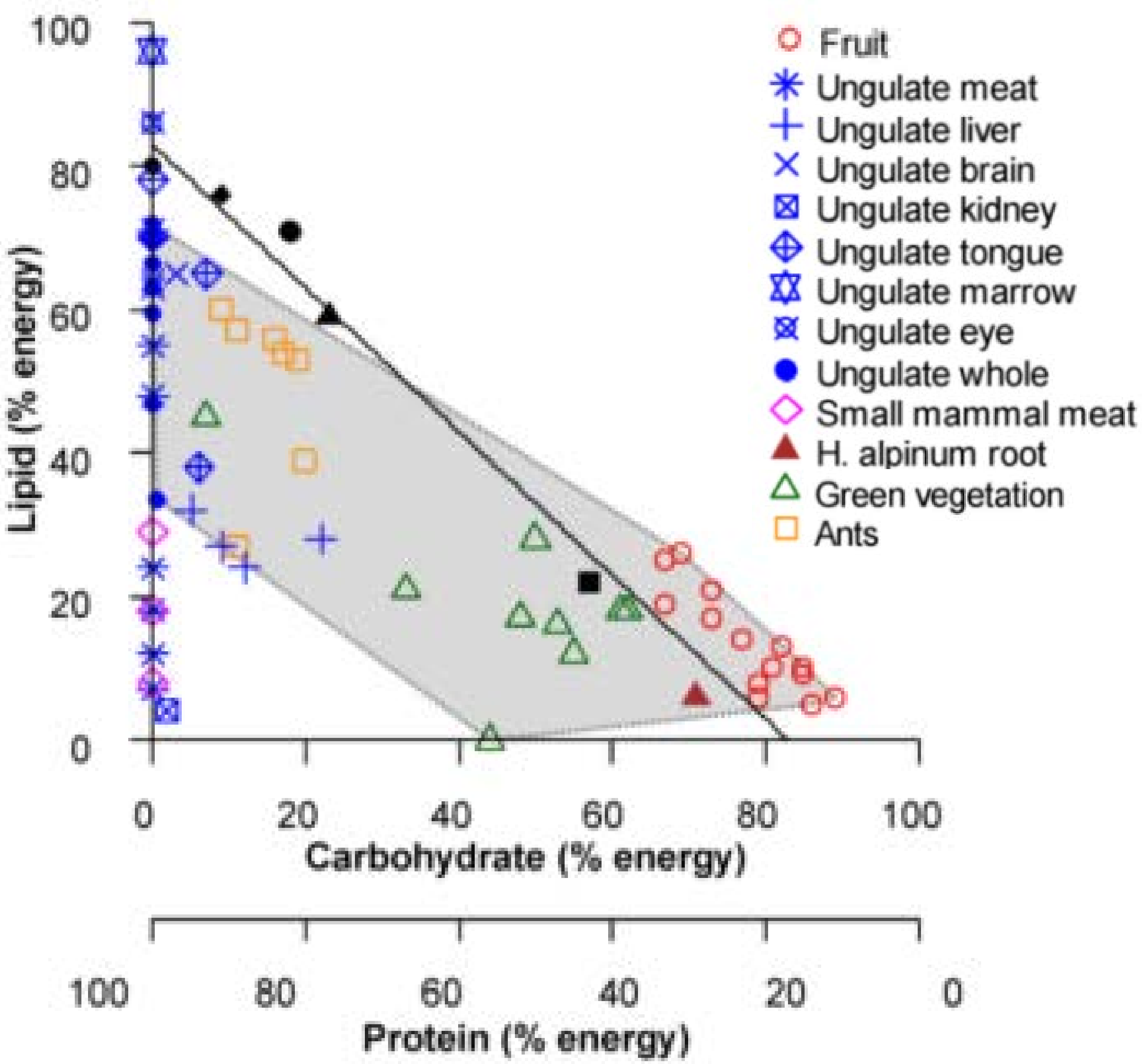


FIGURE 4 EMT of the proportions of macronutrients (protein = P, carbohydrate = C, and lipid = L) in seasonal brown bear diets. The geometric mean for each season is shown by a filled symbol surrounded by 90% and 99% confidence regions. For reference, the blue line represents the preferred optimal proportion of protein (17% ± 4) selected by captive bears. A black isoproportion line represents 1:1 proportions of protein and lipid

Why focus on ungulates & fruit?



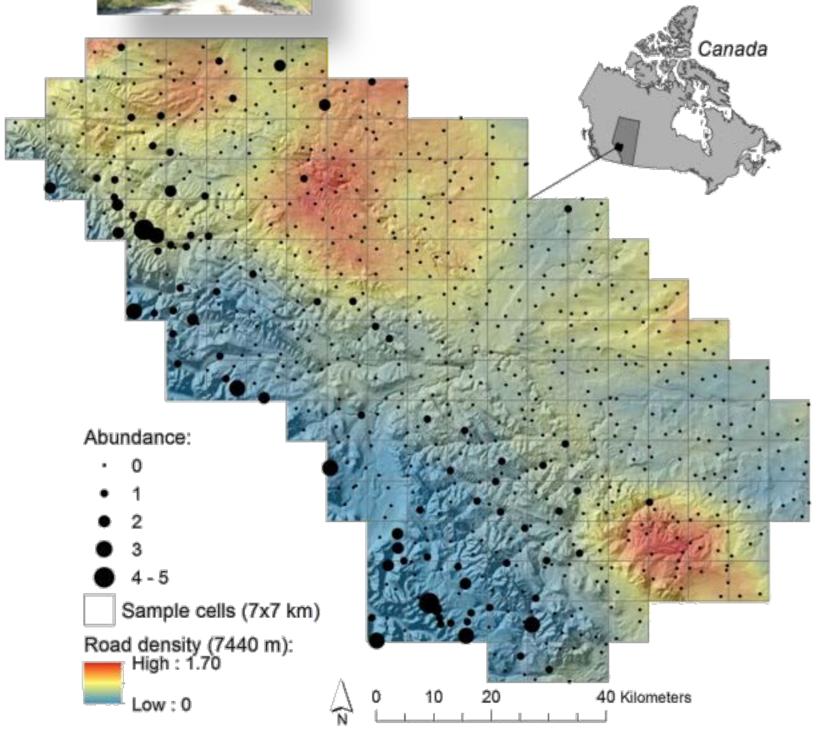
- They are highly complementary in their macronutrients
- Ungulates are high in protein energy & variable in lipid energy
- Fruit is high in carbohydrate energy
- A mixture of these two provides an optimal diet
- A number of papers promoting one or the other, but not both

Coogan *et al*. (2014) PLoS ONE

Relationships to grizzly bear abundance in 2004

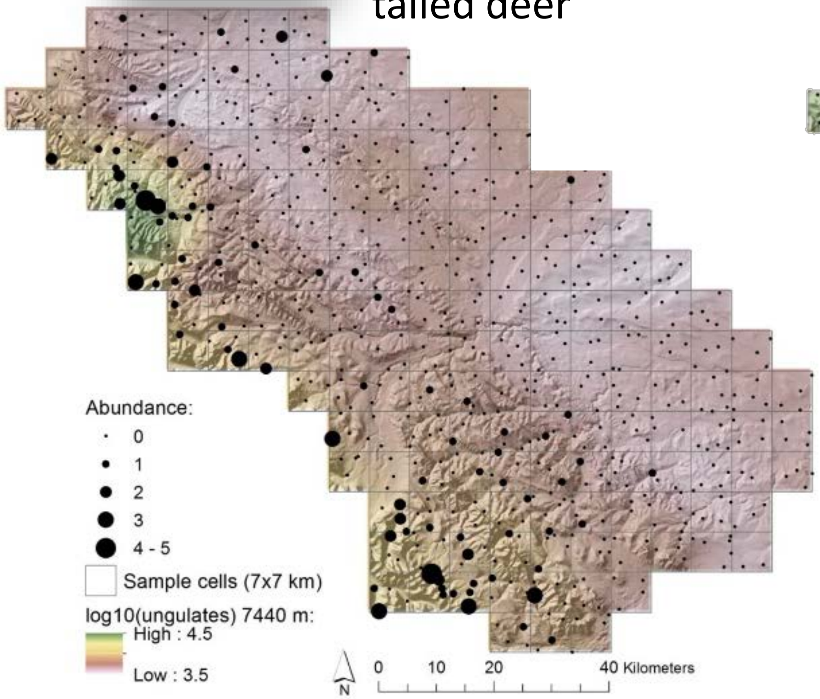
Top-down

Road density

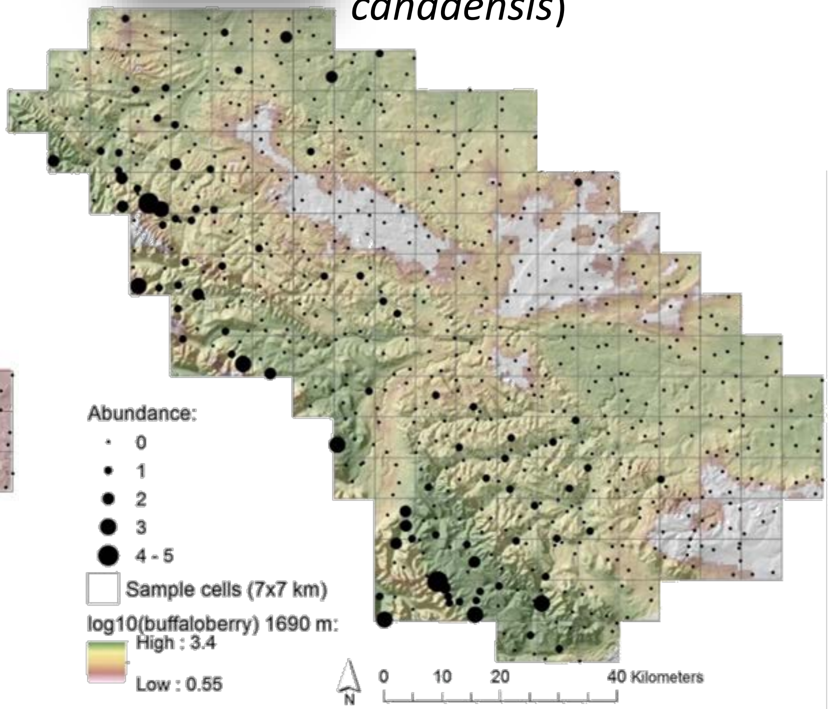


Bottom-up

elk, moose, bighorn sheep, mule & white-tailed deer



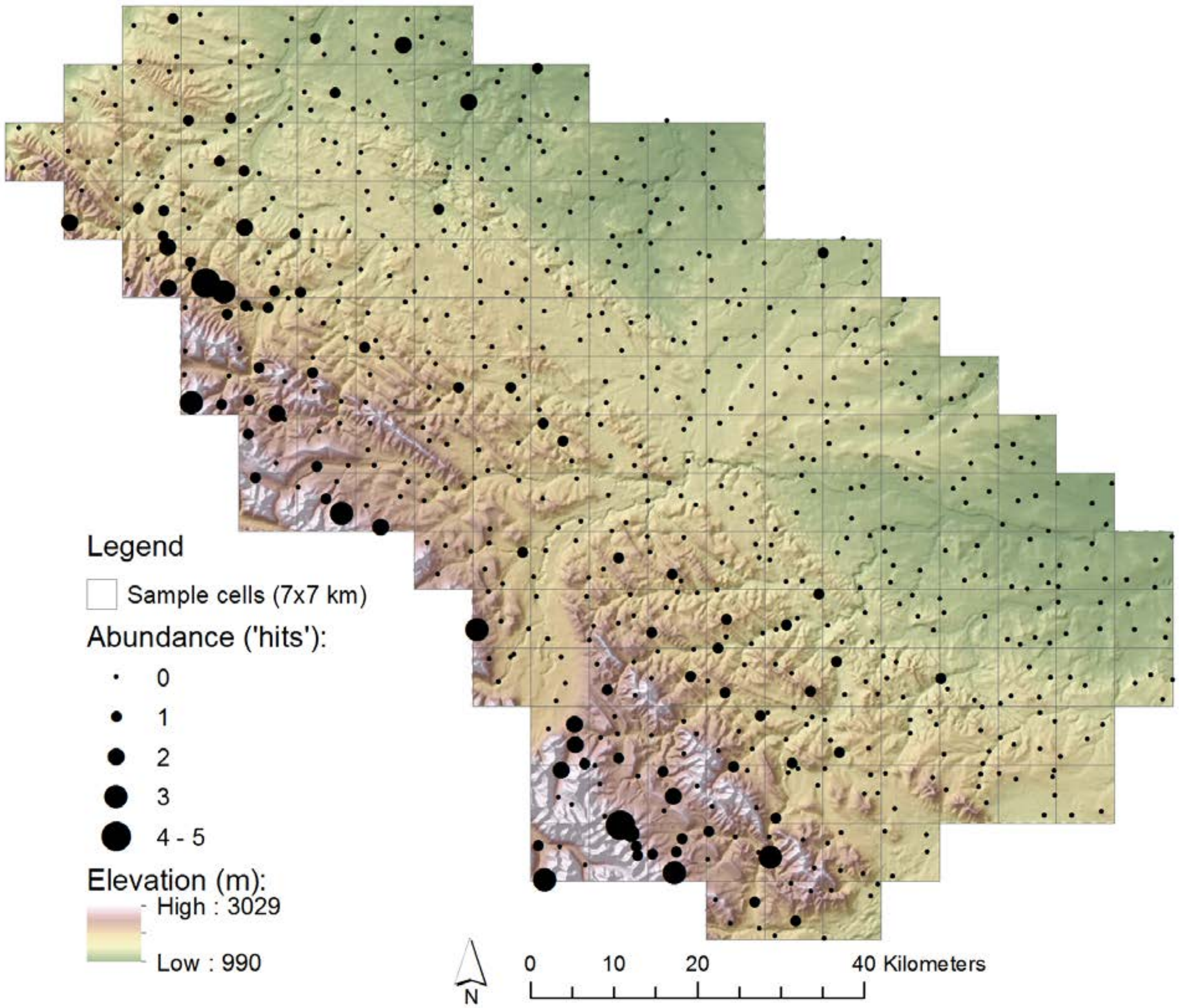
Canada buffaloberry (*Shepherdia canadensis*)

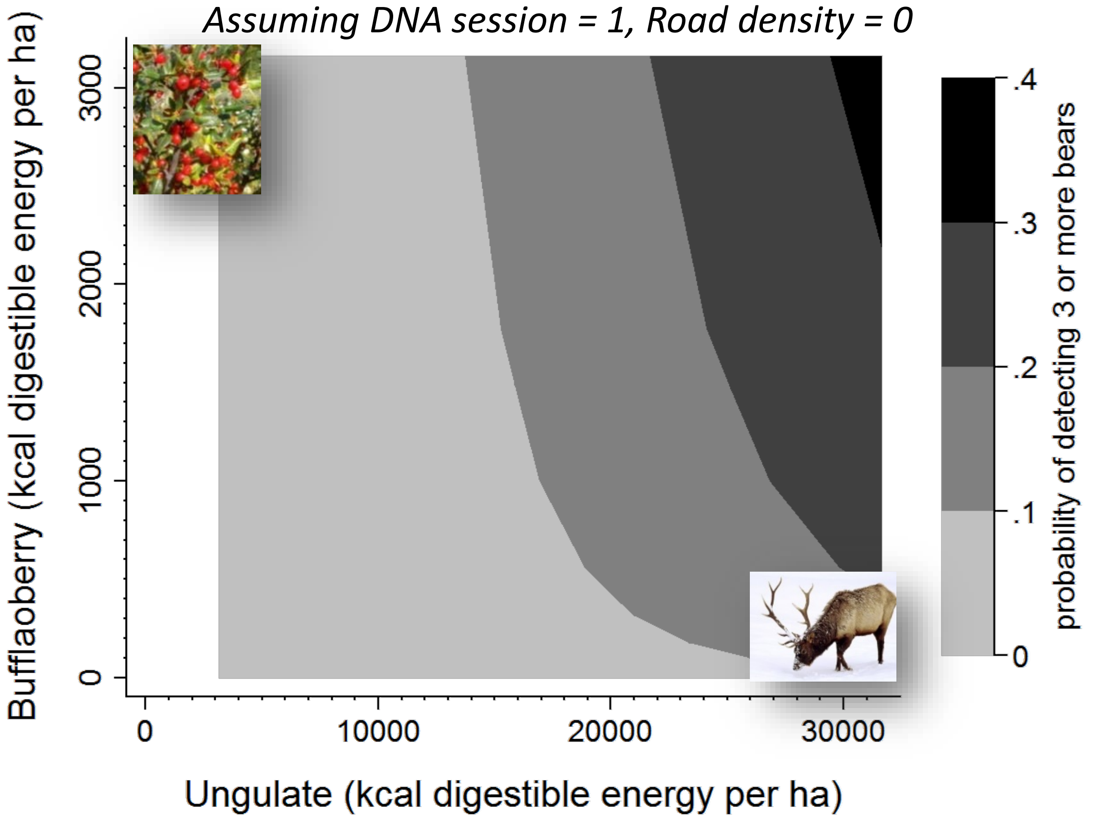


Nielsen et al. 2017. *Oikos* 126, 369-380

Meat, berries & bears

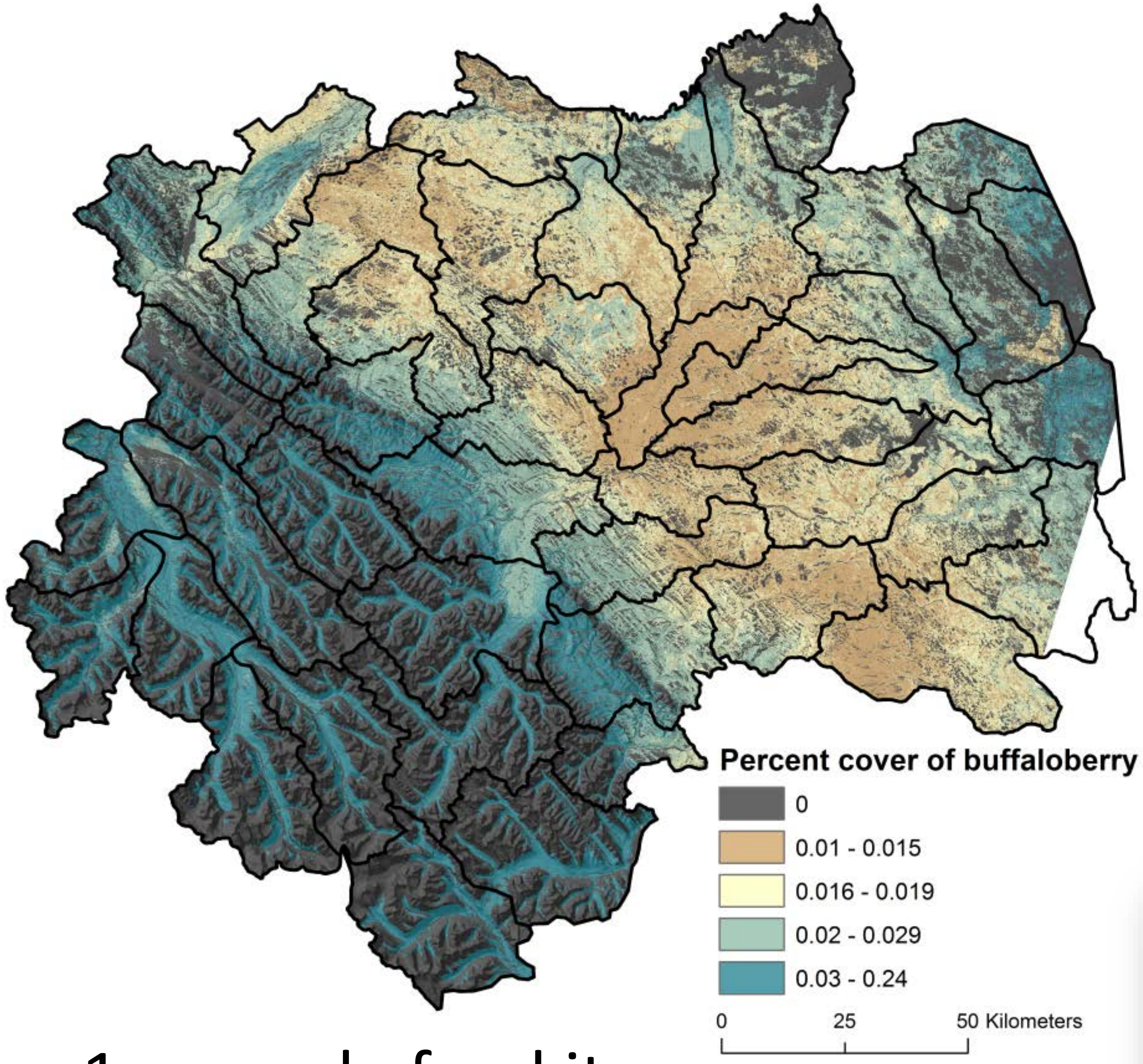
Variable	β	SE	e^β	e^βStdX
Session	-0.364	0.111	0.695	0.688
Road density (7440 m radius)	-0.662	0.420	0.516	0.761
log10(buffaloberry kcal w/in 1690 m)	0.754	0.273	2.125	1.994
log10(ungulate kcal w/in 7440 m)	4.080	0.520	59.12	1.998

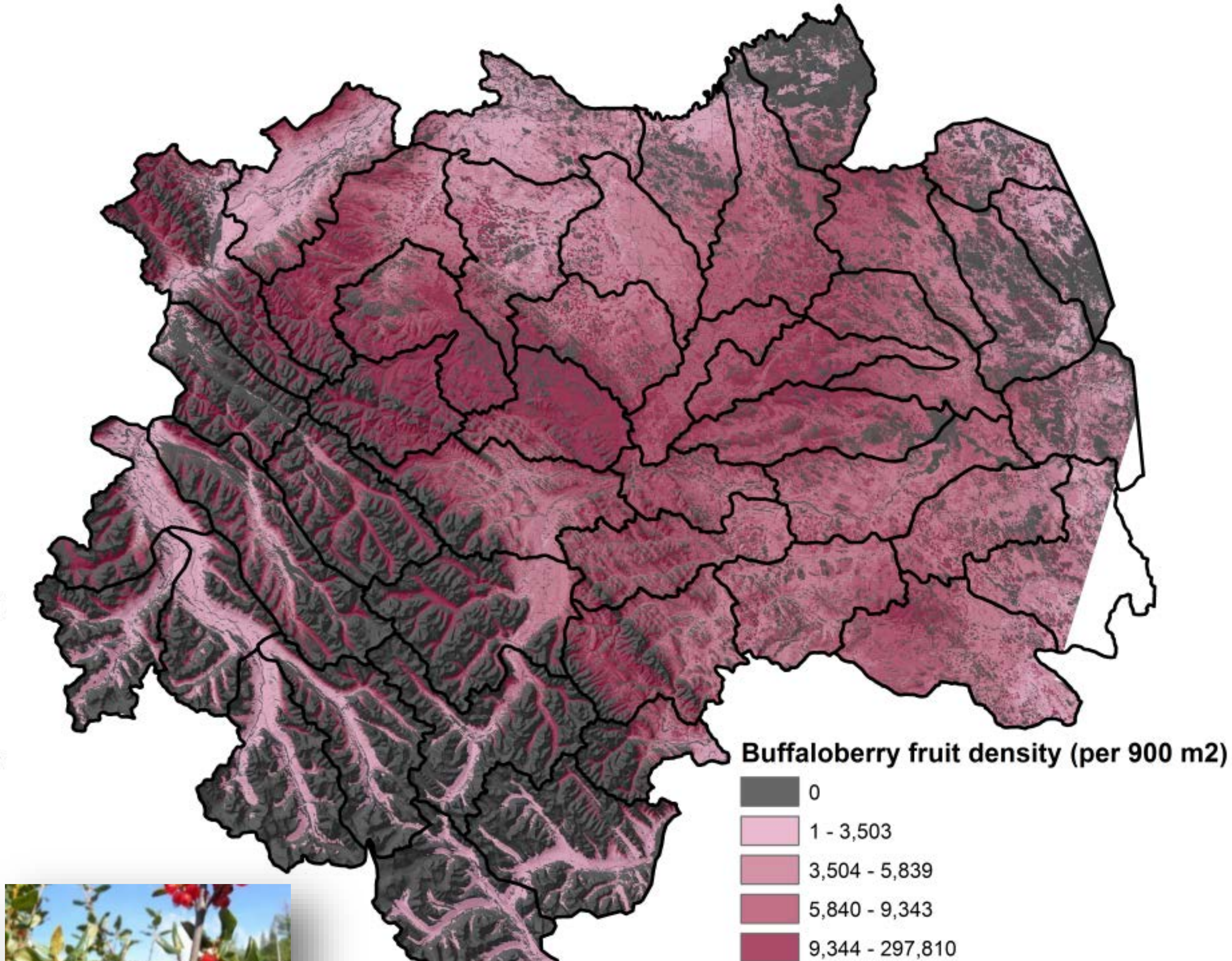




Nielsen et al. 2017. *Oikos* 126, 369-380

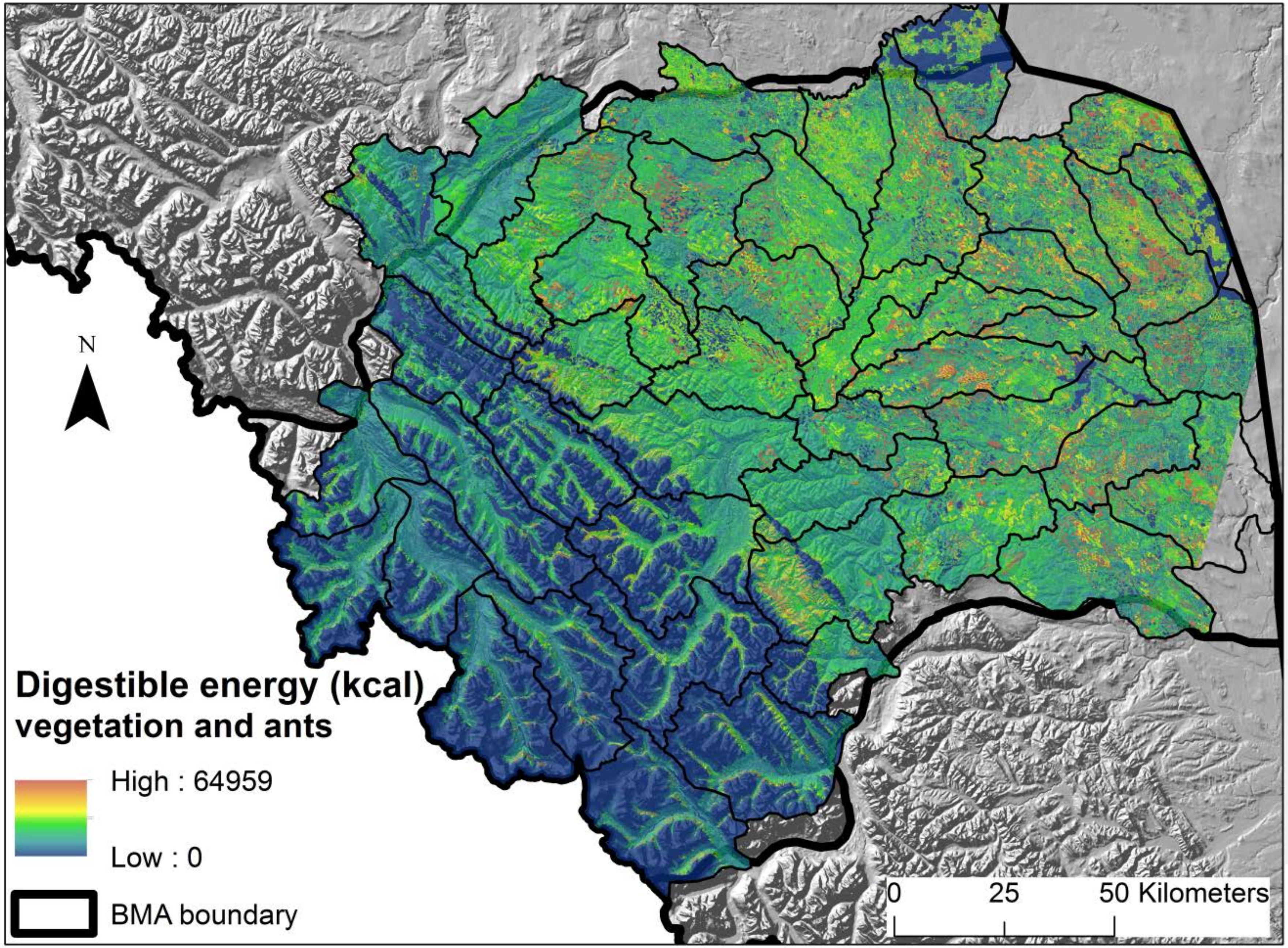
Estimating carrying capacity





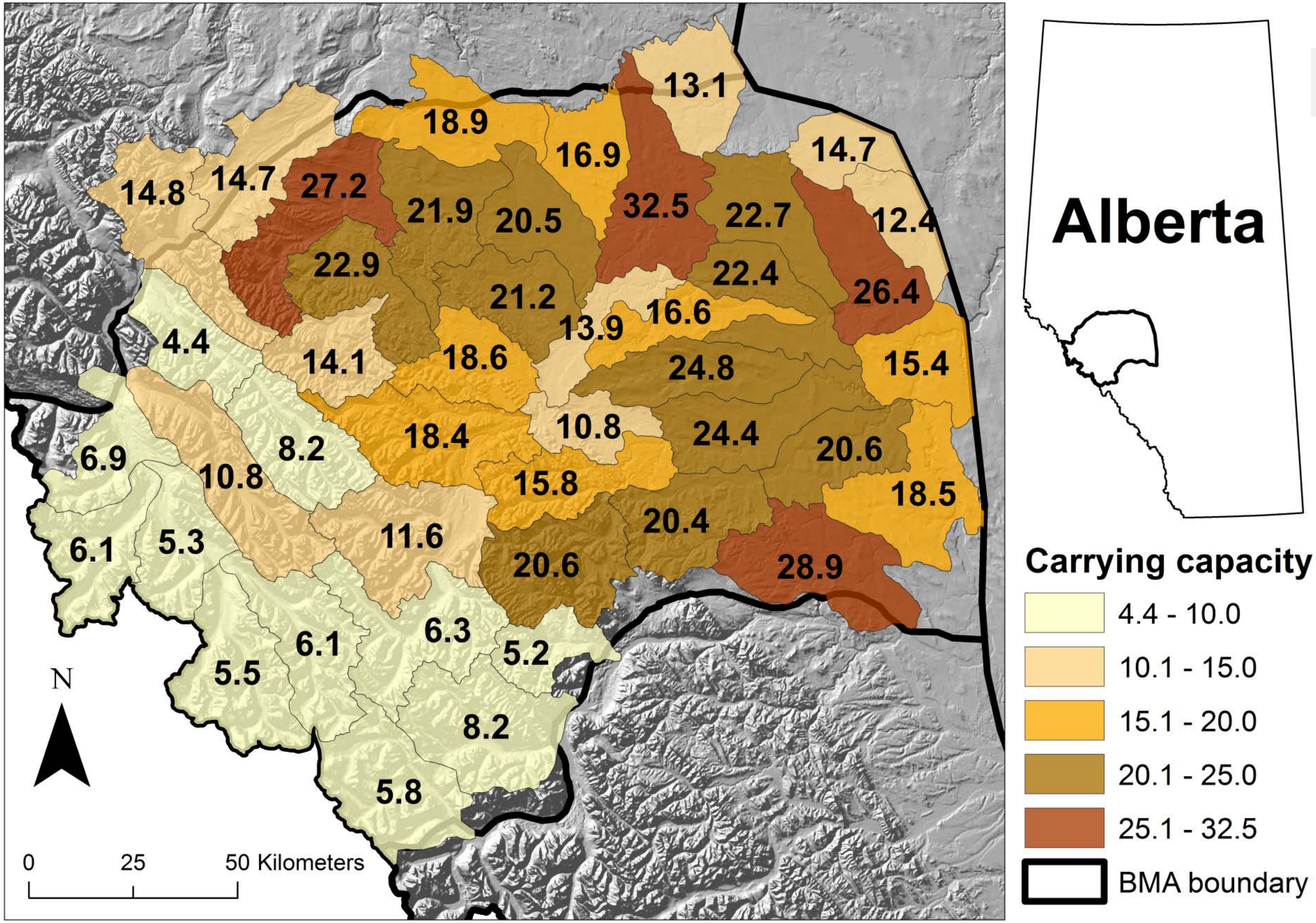
1 example food item

Denny et al. (in prep)



- Sum of kcal among key dietary components
- Use of a reference population at carrying capacity (Willmore Wilderness)
- Relate total energy in reference population to estimate bears per unit energy
- Estimate relationship for adjacent area of interest (Yellowhead)

Denny et al. (in prep)



Preliminary results:

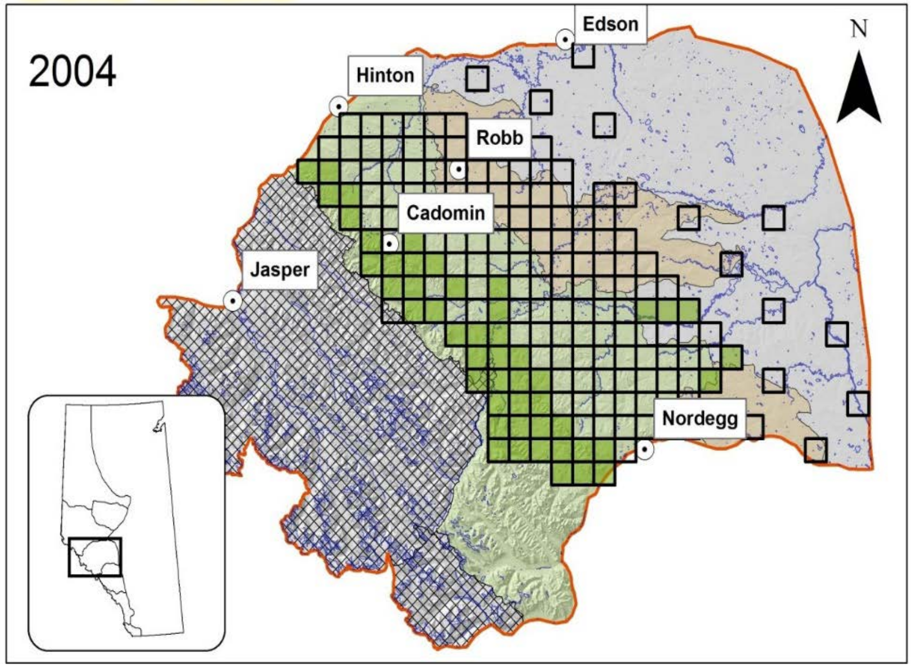
- Carrying capacity assuming no sources of mortality
- Estimate based on fruit, herb, root, ant & meat resources
- BMA 3 = 695 bears
- 24 bears/1000 km^2
- This is not a recovery target, but rather an estimate of the biological maximum

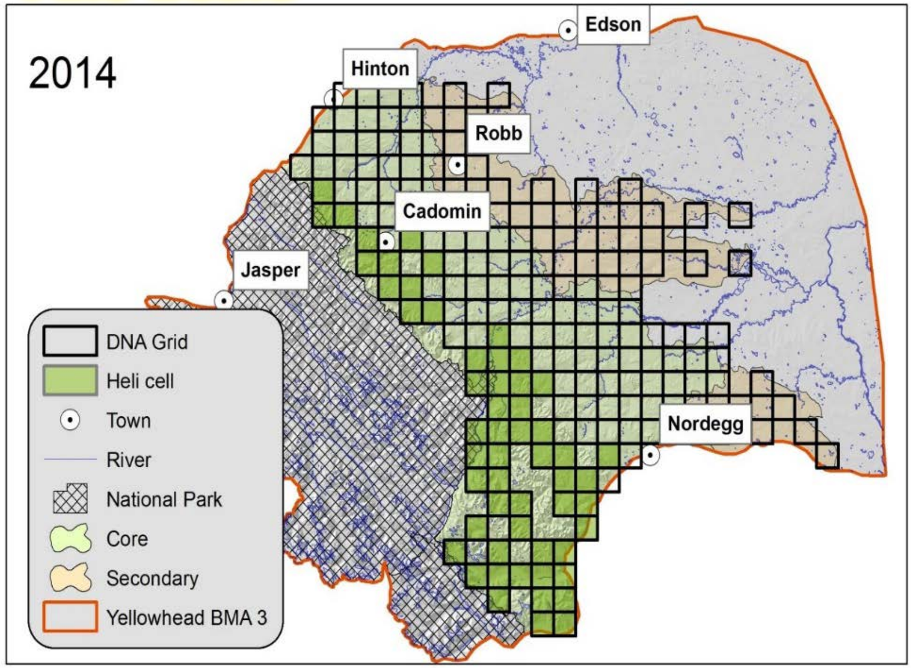
Denny et al. (in prep)

Next steps: 2004 to 2014 changes in population

- Developing nutritional landscape models for the <u>two time periods</u>
- Relate <u>landscape change</u> to differential patterns in <u>population increase</u>

36.0 bears (CI: 28.6-45.3) → **71.3 bears** (CI: 53.9-94.2)





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Acknowledgements & questions

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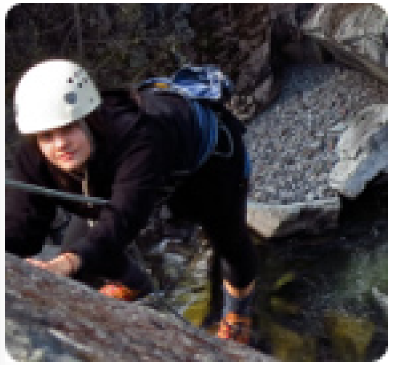

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