Effects of Sport Hunting on Cougar Population, Community and Landscape Ecology

Presenter:

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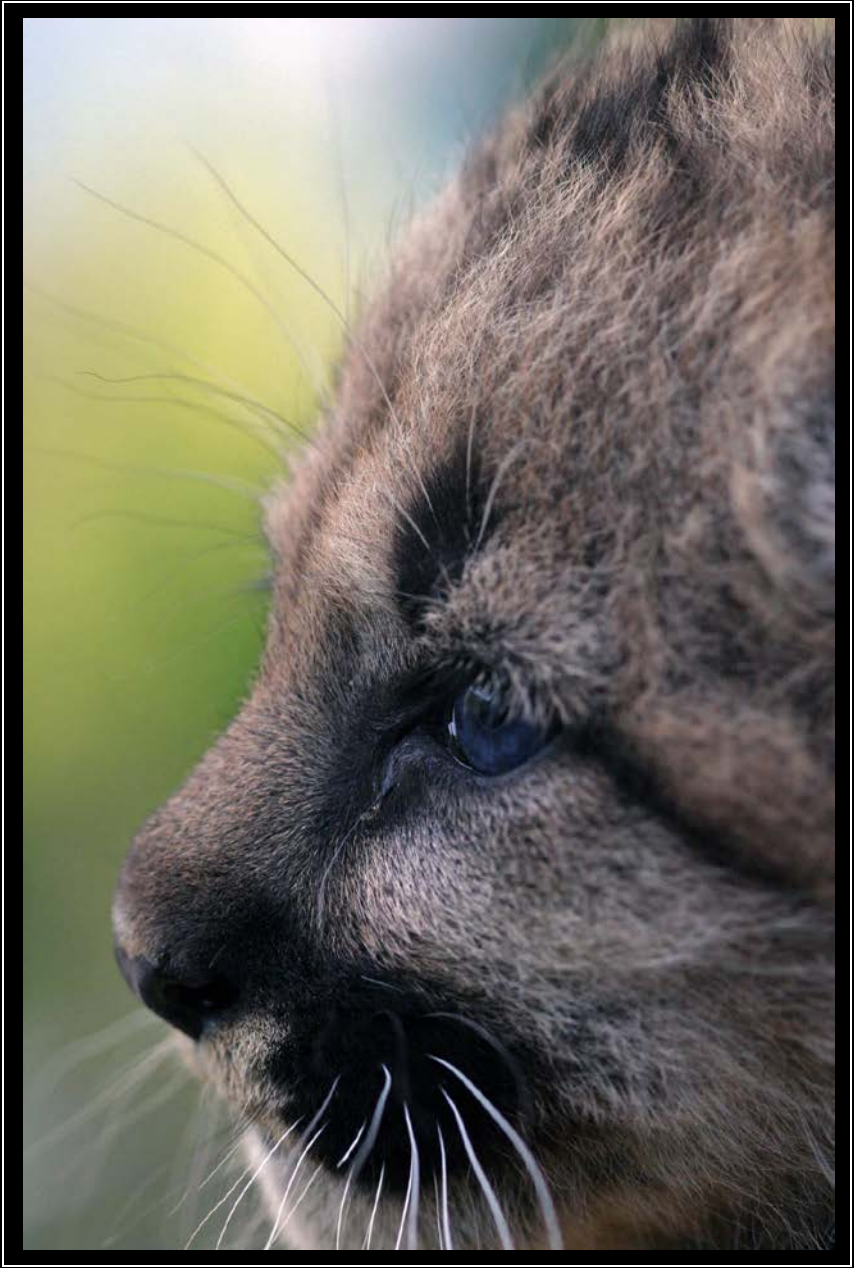
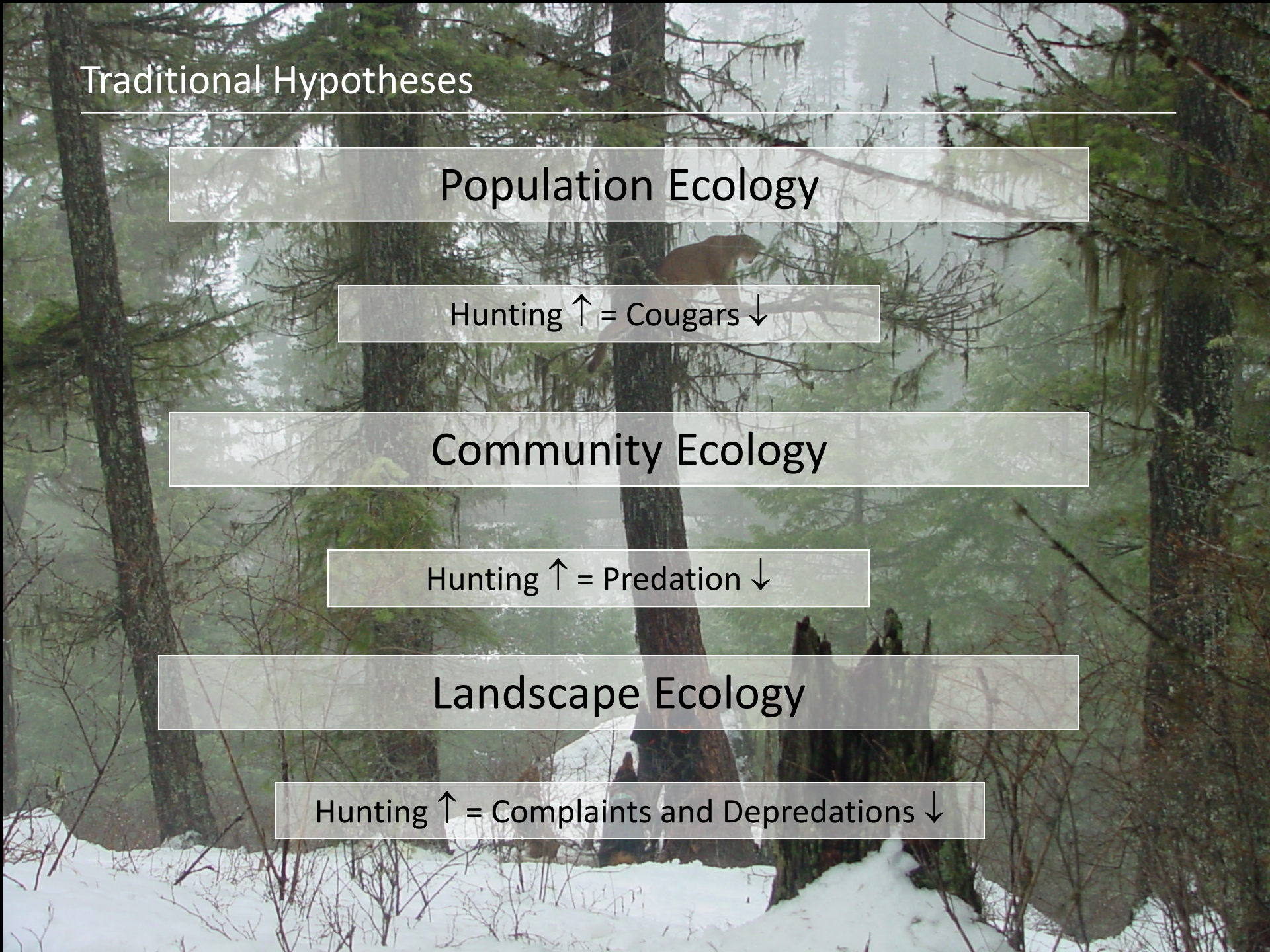
Washington State University

National Science Foundation





Traditional Hypotheses

Population Ecology

Hunting ↑ = Cougars ↓

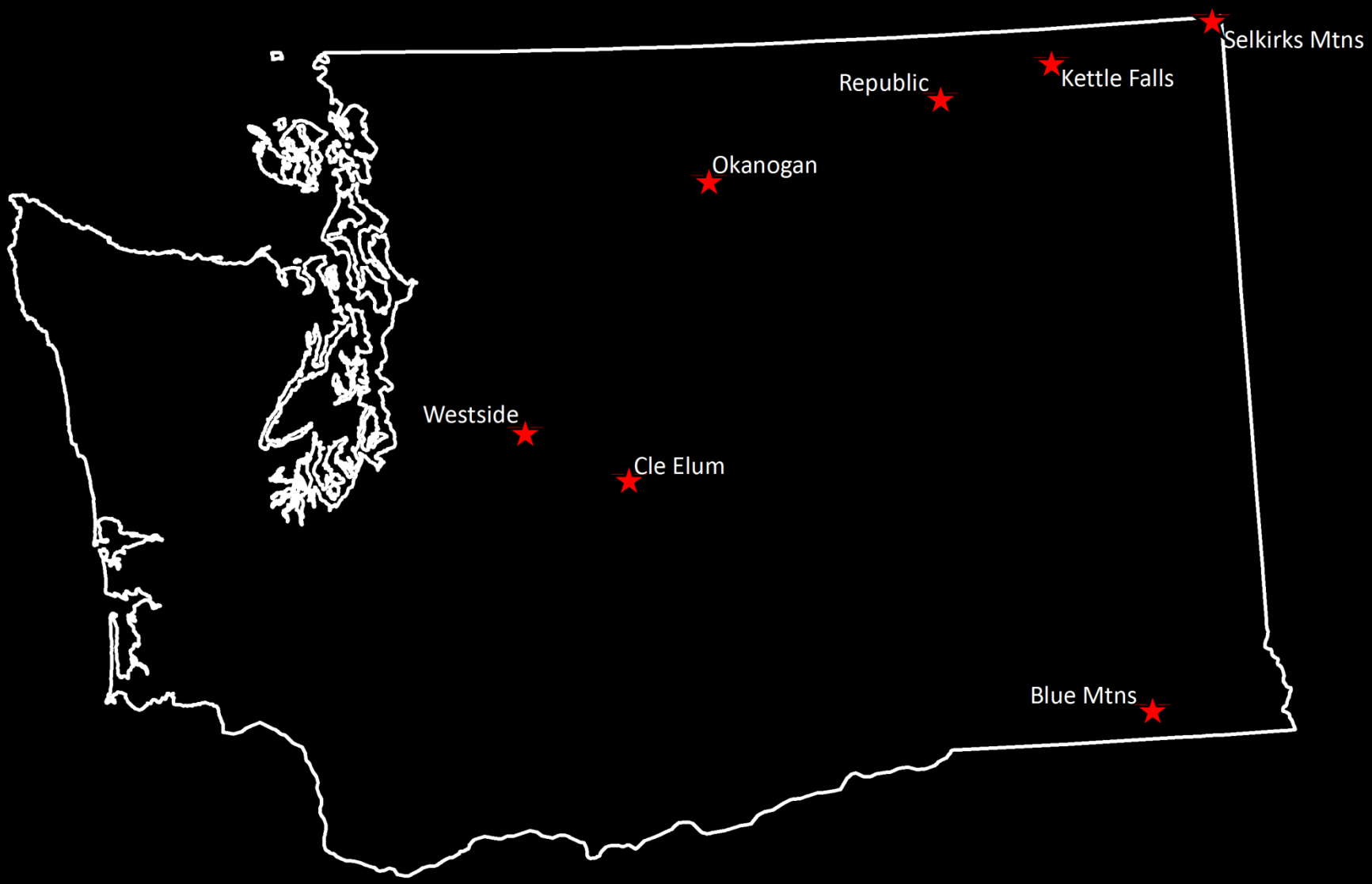
Community Ecology

Hunting ↑ = Predation ↓

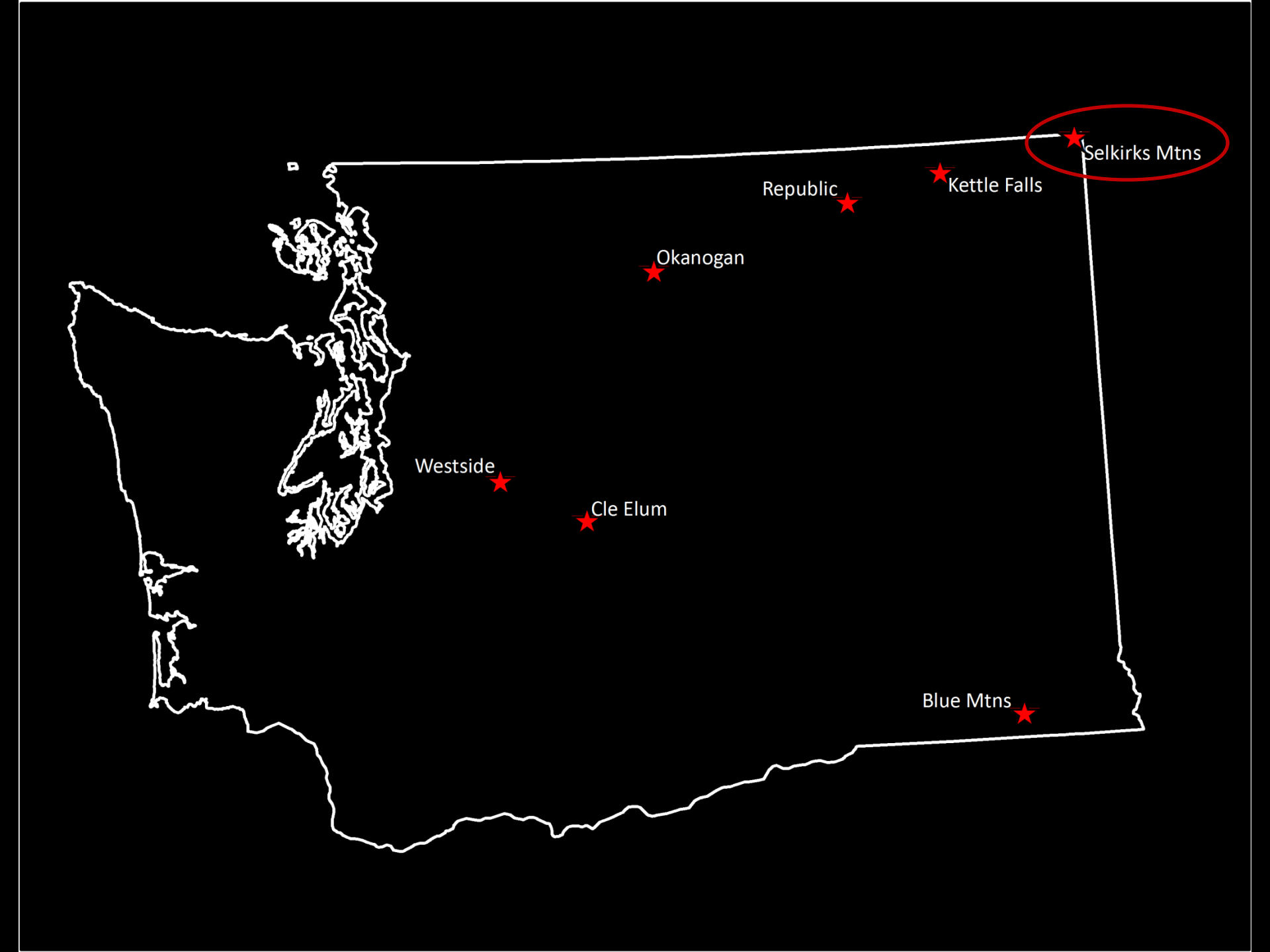
Landscape Ecology

Hunting ↑ = Complaints and Depredations ↓

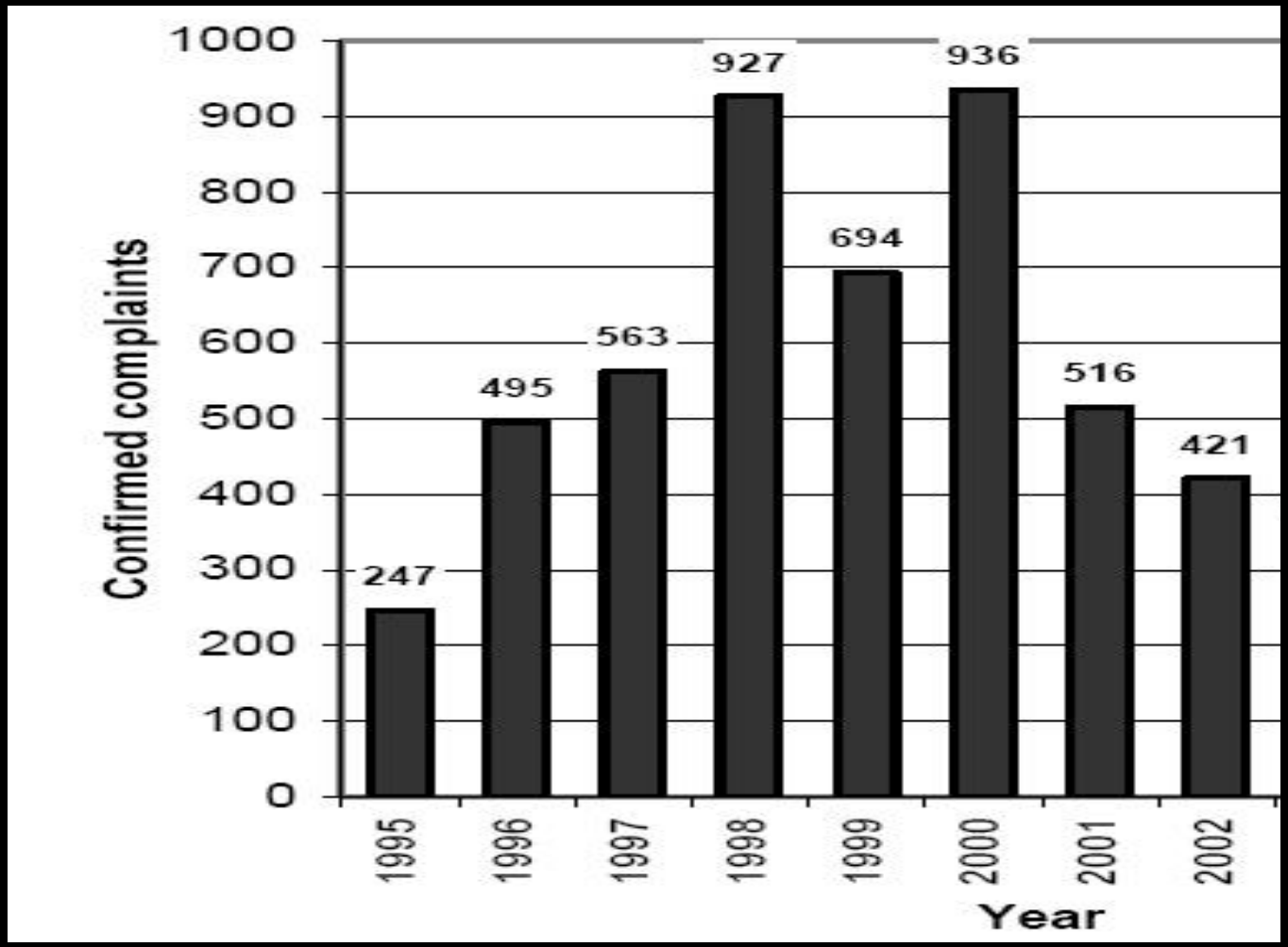
Seven Study Areas
(1998 – 2011)



Population Ecology


Selkirks Mtns
Republic
Kettle Falls
Okanogan
Westside
Cle Elum
Blue Mtns

Complaints ↑ = Cougars ↑ ?



Washington Department of Fish & Wildlife Pilot Cougar Control Program 2008 Legislative Report

Survival & Fecundity Population growth rate: 0.80 +- 0.04

Hunting Mortality Rate = 0.37

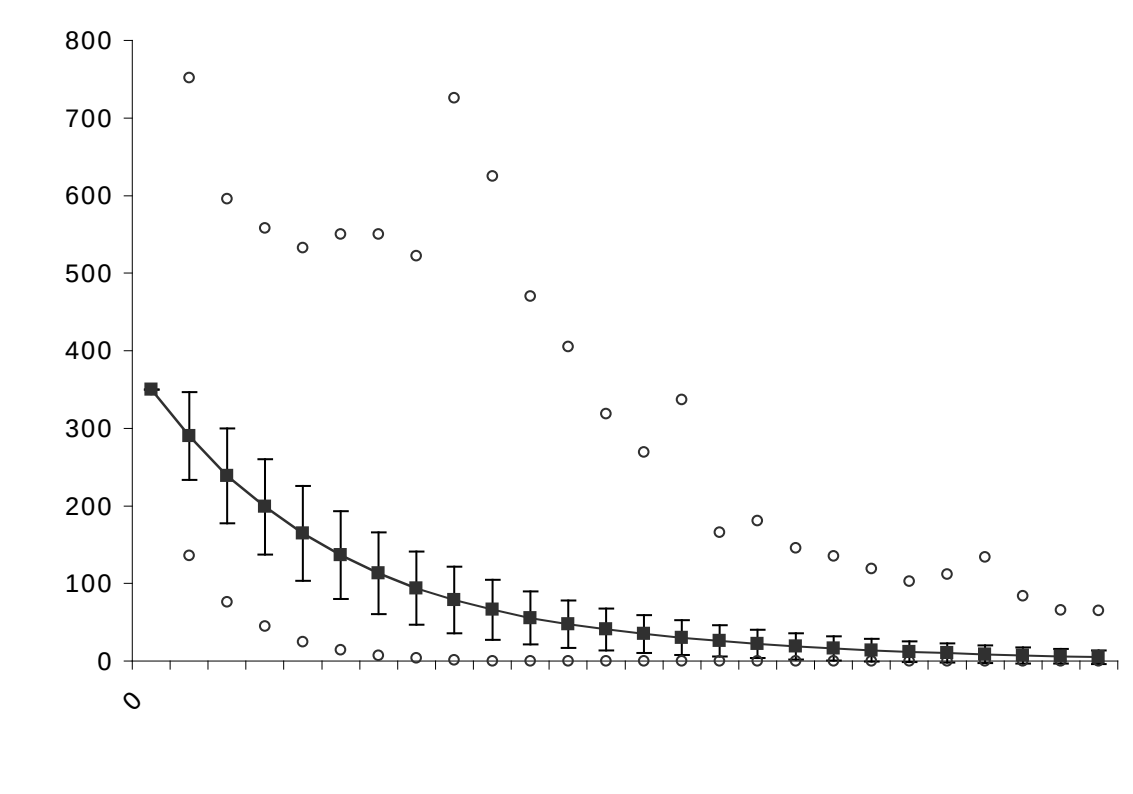


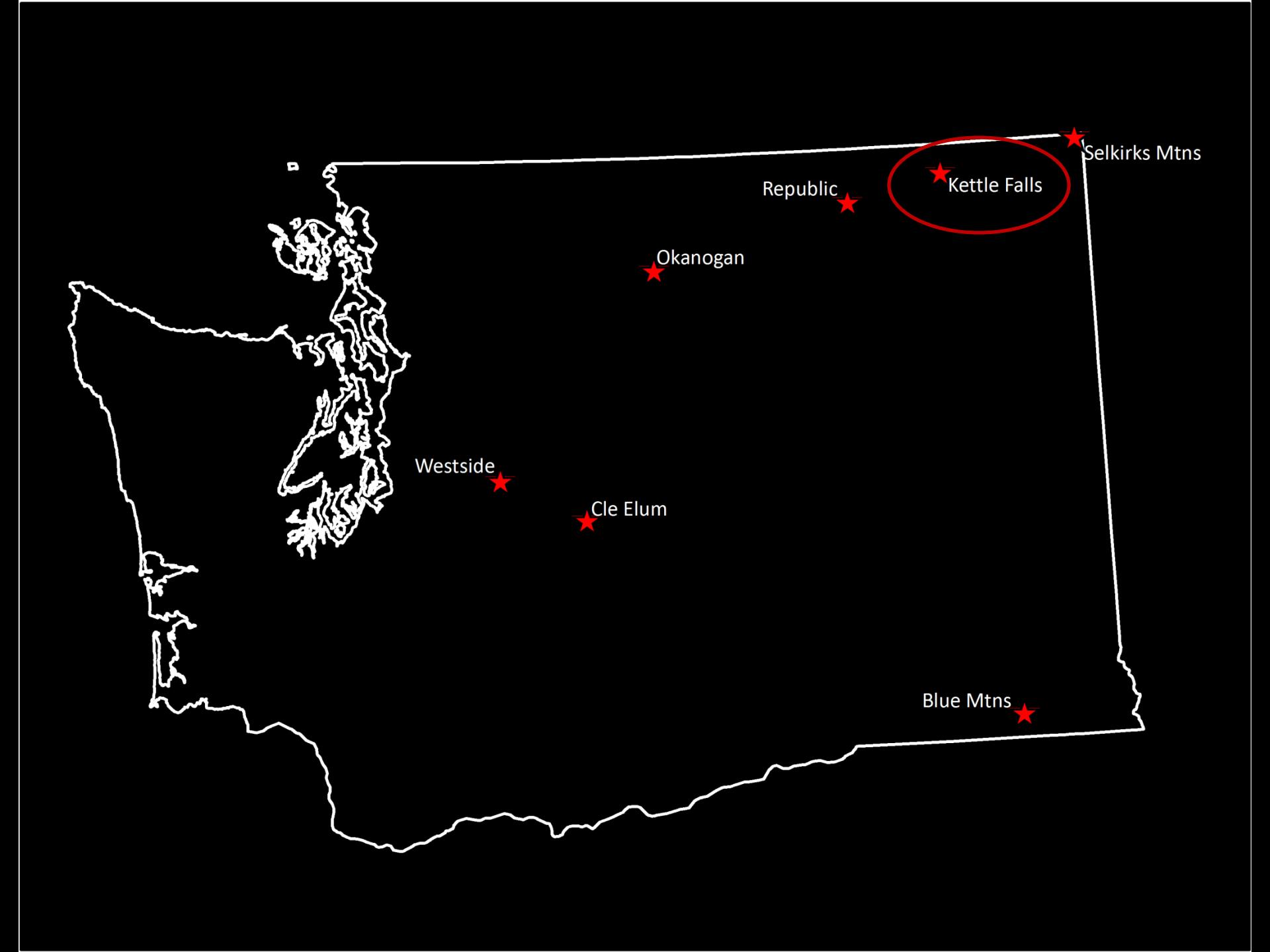
Figure 6. Simulated trajectory of the studied cougar population, based on demographic rates from 1998 to 2003. The squares represent the average abundance, the vertical lines are the standard deviations, and the empty circles are maximum and minimum values obtained in 5,000 simulations.

Complaints ↑ ≠ Cougars ↑

WHY?

Observed young age structure (immigrant males?)

Lambert, C. M., R. B. Wielgus, H. S. Robinson, H. S. Cruickshank, R. Clarke, and J. Almack. 2006. Cougar population dynamics and viability in the Pacific Northwest. Journal of Wildlife Management 70:246-254.


Selkirks Mtns
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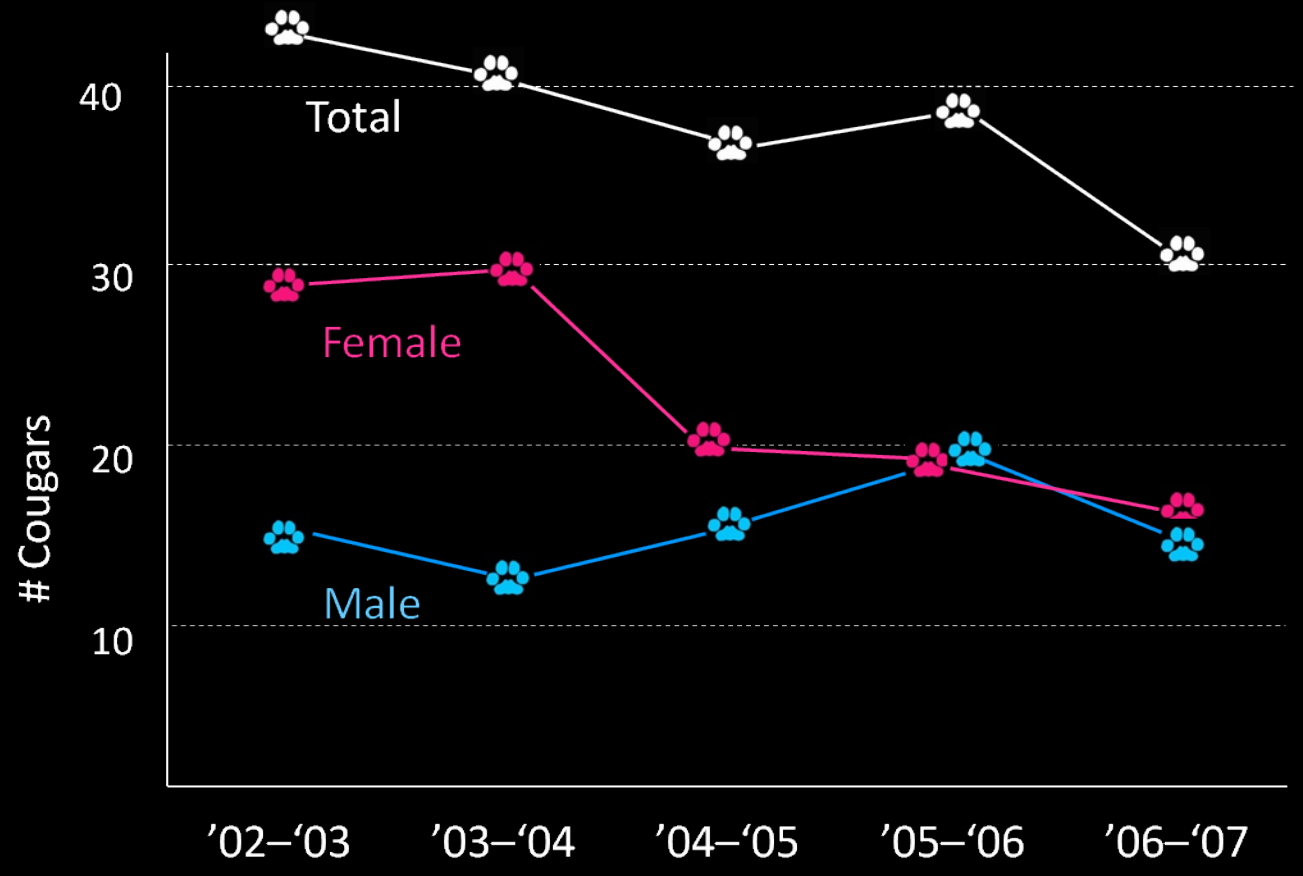
Survival & Fecundity Population Growth = 0.84

Observed Population Growth Rate = 1.0

Immigration rate = 0.16

Hunting Mortality rate = 0.24

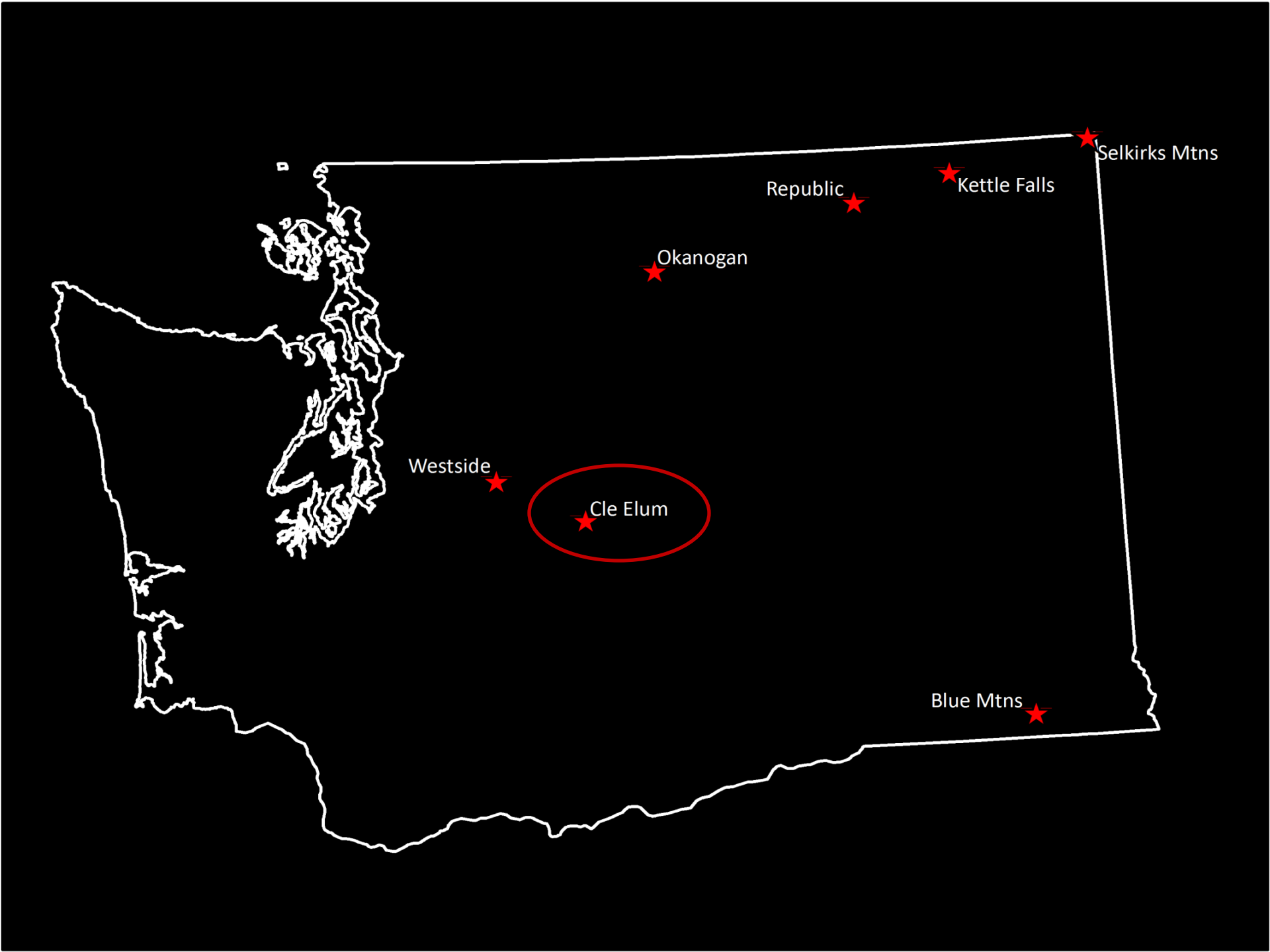


Hunting ↑ ≠ Cougars ↓

WHY?

Increased immigration (male)

Robinson, H.S., R.B. Wielgus, H.S. Cooley, and S.W. Cooley. 2008. Sink populations in large carnivore management:; cougar demography in a hunted population. Ecological Applications. 18(4): 1028-1037.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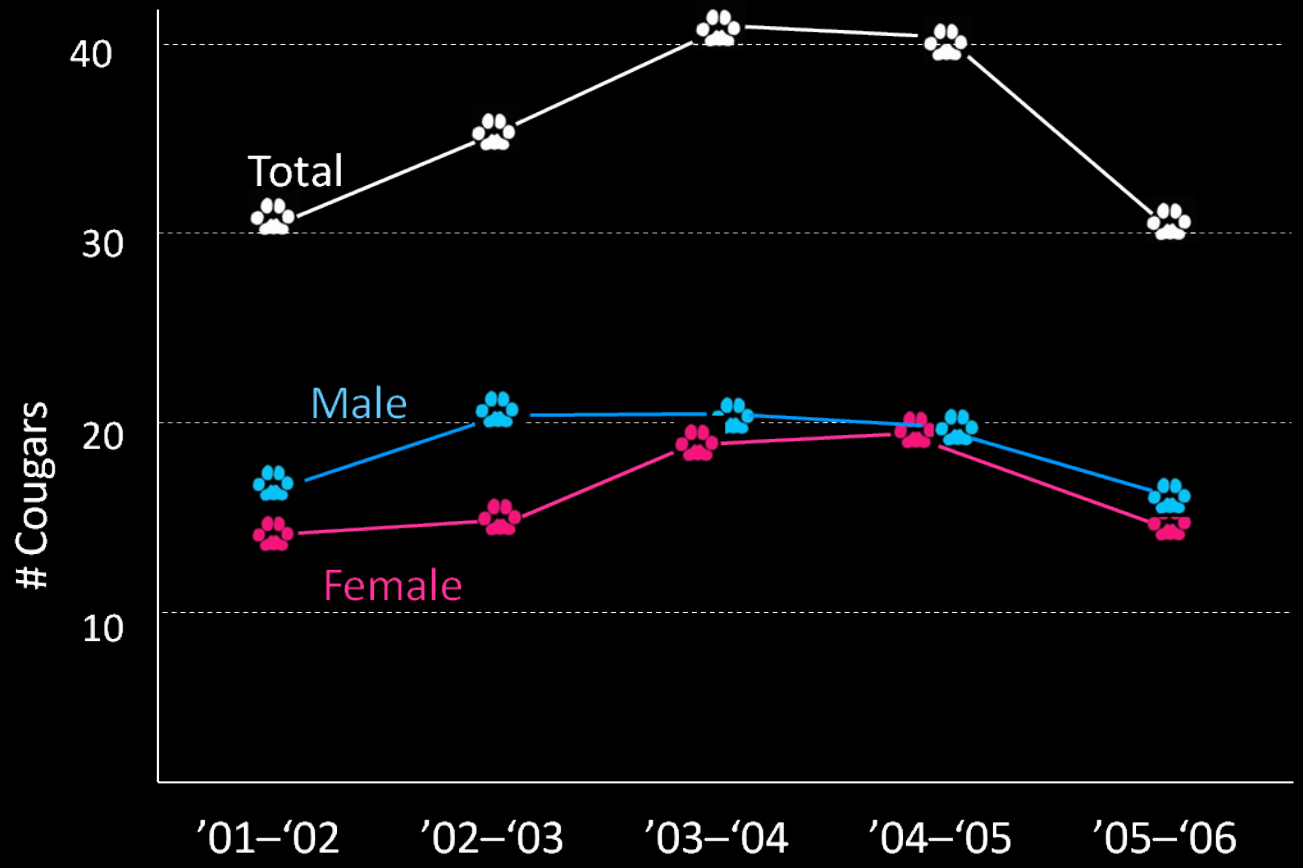
Survival & Fecundity Population Growth = 1.10

Observed Population Growth Rate = 0.98

Emigration rate = 0.12

Hunting Mortality rate = 0.11

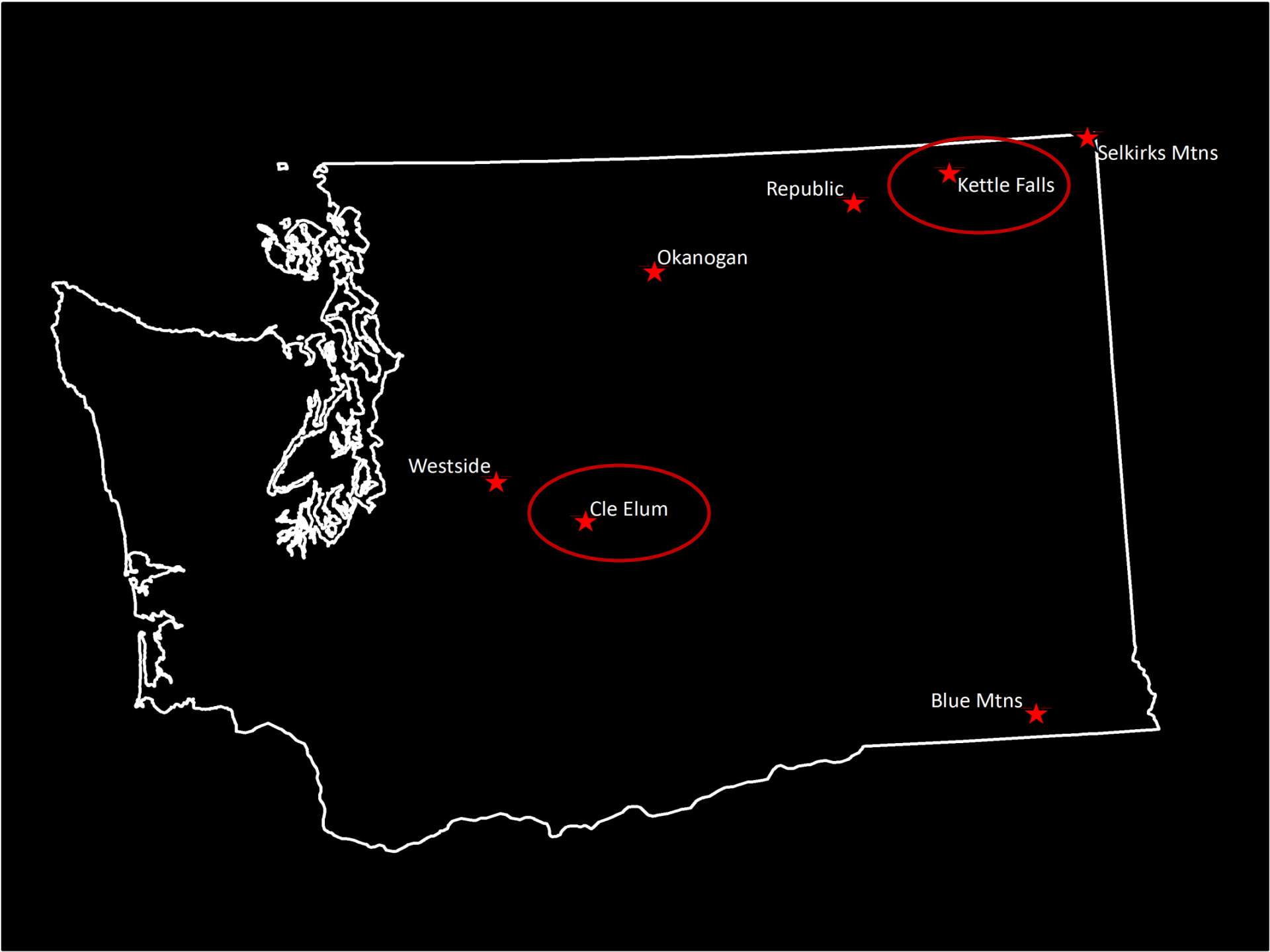


Hunting ↓ ≠ Cougars ↑

WHY?

Increased emigration (male)

Cooley, H.S., R.B., Wielgus, G. Koehler, and B. Maletzke. 2009. Source populations in carnivore management: cougar demography and emigration in a lightly hunted population. Animal Conservation 12: 321-328.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Calculating Population Change

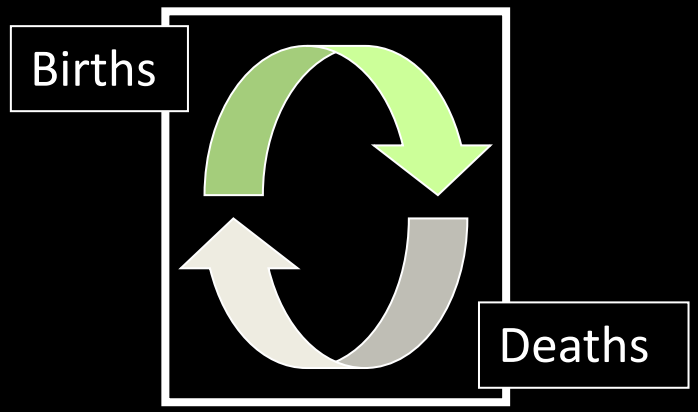
$$\Delta N = (B - D) + (I - E)$$

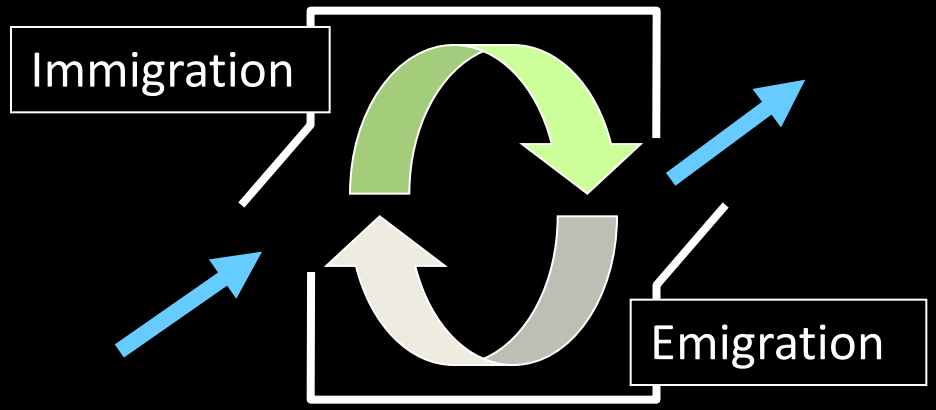
Cle Elum	0.98	1.10	- 0.12
Kettle Falls	0.91	0.73	+ 0.18

Calculating Population Change

Kettle Falls:
Immigration Rate
18%

Cle Elum:
Emigration Rate
12%





CLOSED POPULATION

OPEN POPULATION

Hunting ↓ ≠ Cougars ↑

Hunting ↑ ≠ Cougars ↓

WHY?

Immigration & Emigration

Cooley, H.S., R.B. Wielgus, H.S. Robinson, G. Koehler, and B. Maletzke. 2009. Does hunting regulate cougar populations: a test of the compensatory mortality hypothesis. Ecology 90: 2913–2921.

Hunting Mortality is not Compensatory

Hunting ↑ ≠ Reproduction ↑

Hunting ↑ ≠ Natural Mortality ↓

Cooley, H.S., R.B. Wielgus, H.S. Robinson, G. Koehler, and B. Maletzke. 2009. Does hunting regulate cougar populations: a test of the compensatory mortality hypothesis. Ecology 90: 2913–2921.

Survival Rates

	Cle Elum (LH)	Kettle Falls (HH)
Kitten	**0.58**	**0.59**
Juvenile	**0.87**	**0.93**
Adult	**0.91**	**0.88**

After removing the effects of hunting (incidental female deaths and infanticides), survival rates were remarkably similar for the 2 populations

Stochastic Growth Rates

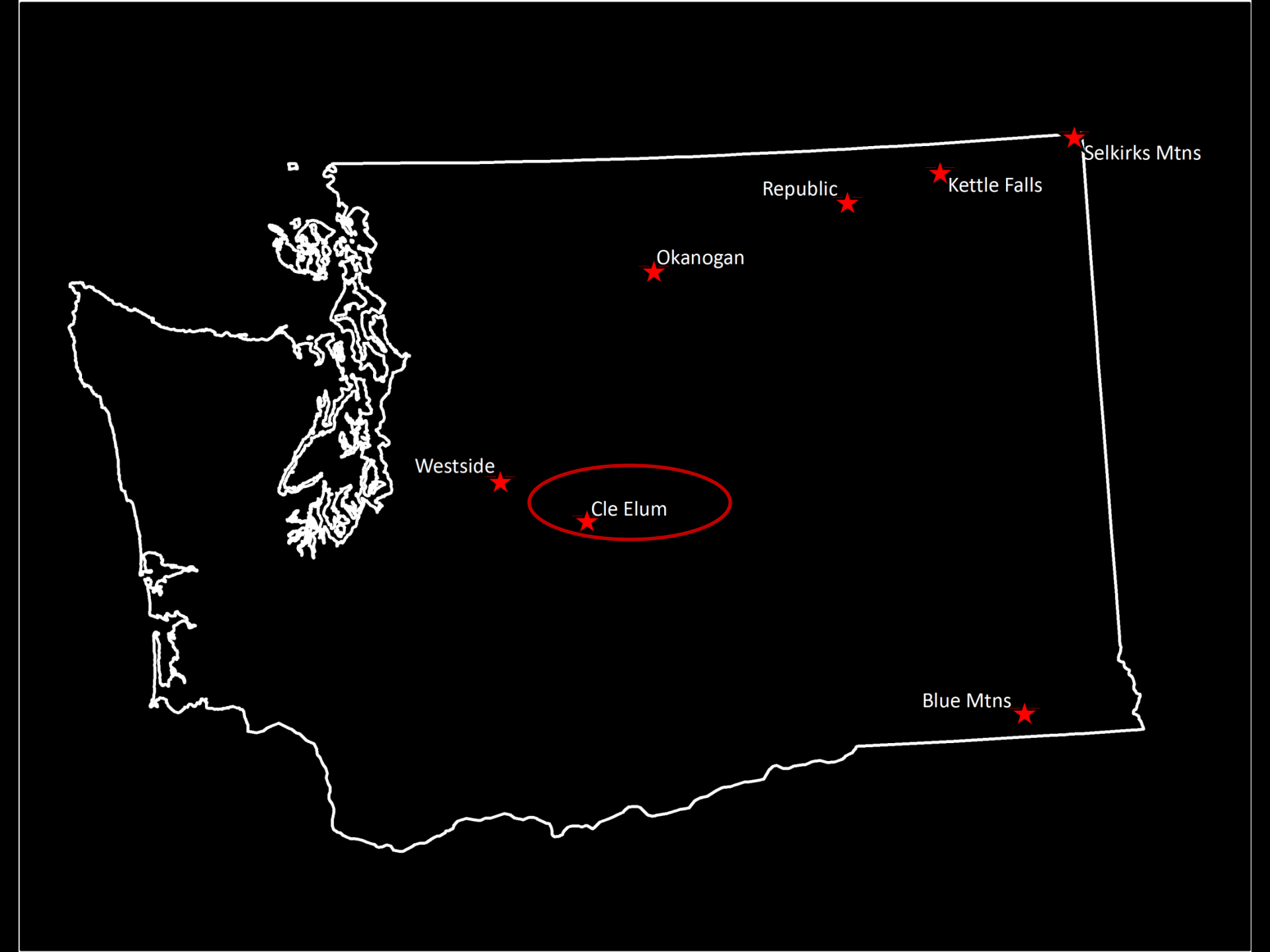
	Cle Elum (LH)	**Kettle Falls (HH)**	**Selkirk (HH)**
Hunting and infanticide included	1.05 ± 0.01	0.78 ± 0.78	0.80 ± 0.11
Just hunting removed	1.14 ± 0.03	0.91 ± 0.04	1.17 ± 0.11
Hunting and infanticide removed	- - - - - -	1.14 ± 0.01	- - - - - -
Just infanticide removed	- - - - - -	0.99 ± 0.17	- - - - - -

Intrinsic Growth Rate = 1.14

Sustainable Hunting Rate = 0.14

R.B. Wielgus, Morrison, D.E., H.S. Cooley, B.T. Maletzke, and G.M. Koehler. 2013 Effects of male trophy hunting on female carnivore population growth and persistence. Biological Conservation 167: 69-75

Community Ecology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Okanogan
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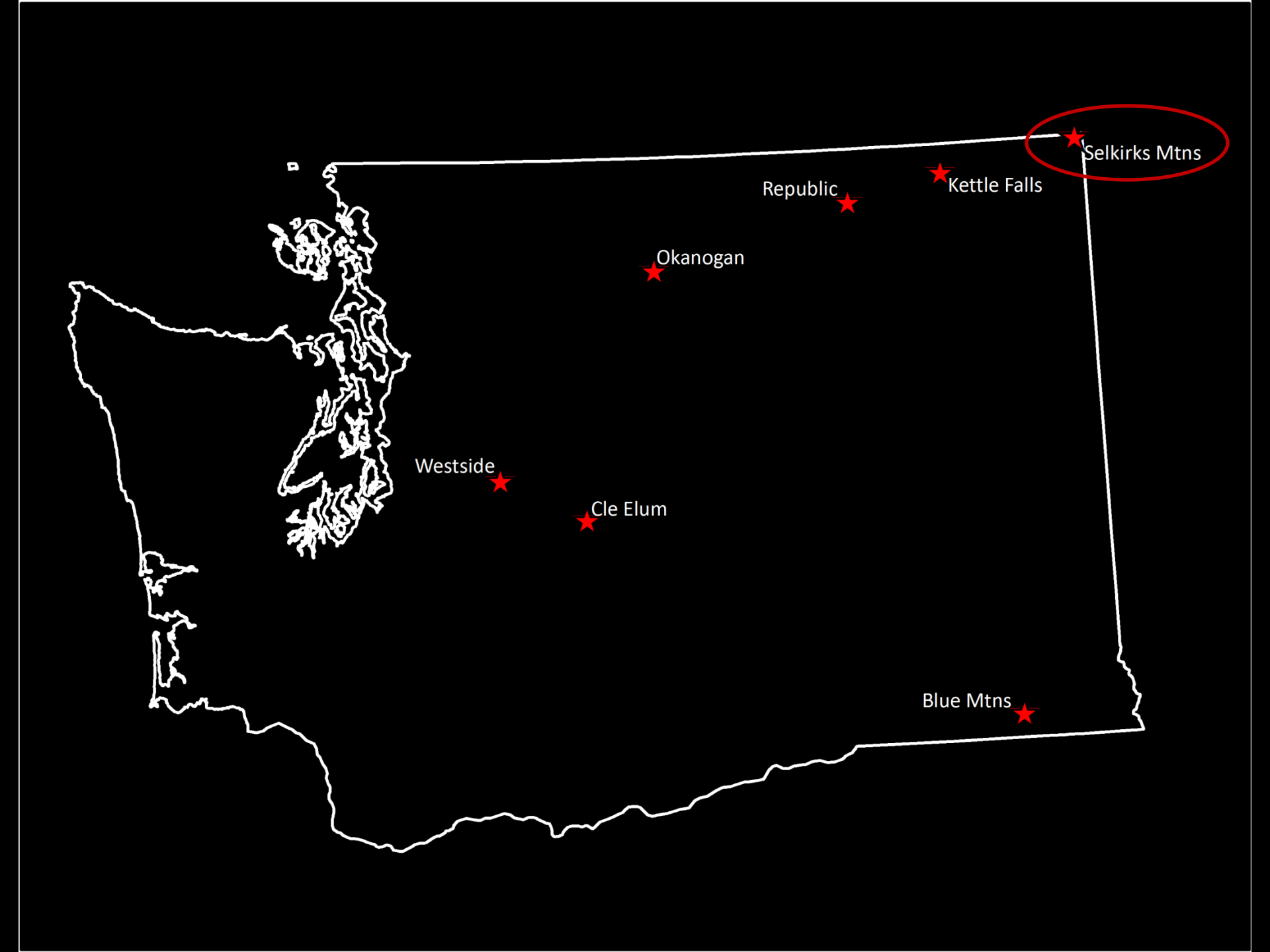
Cougar Prey Use by Sex

Observed Frequencies

Age	Species	Cougar Sex	
		Female	Male
Juvenile	Mule Deer	73	19
	Elk	65	37
Adult	Mule Deer	51	14
	Elk	13	22

- More mule deer were killed than elk.
- Females had higher proportional use of mule deer.
- Males had higher proportional use of elk.
- Males proportionately killed more adult prey than females .
- Males proportionately killed 4 times as many adult elk as females.

White, K.S., G.M. Koehler, B.T. Maletzke, and R.B. Wielgus. 2011. Differential prey use by male and female cougars in Washington. Journal of Wildlife Management. 75(5):1115-1120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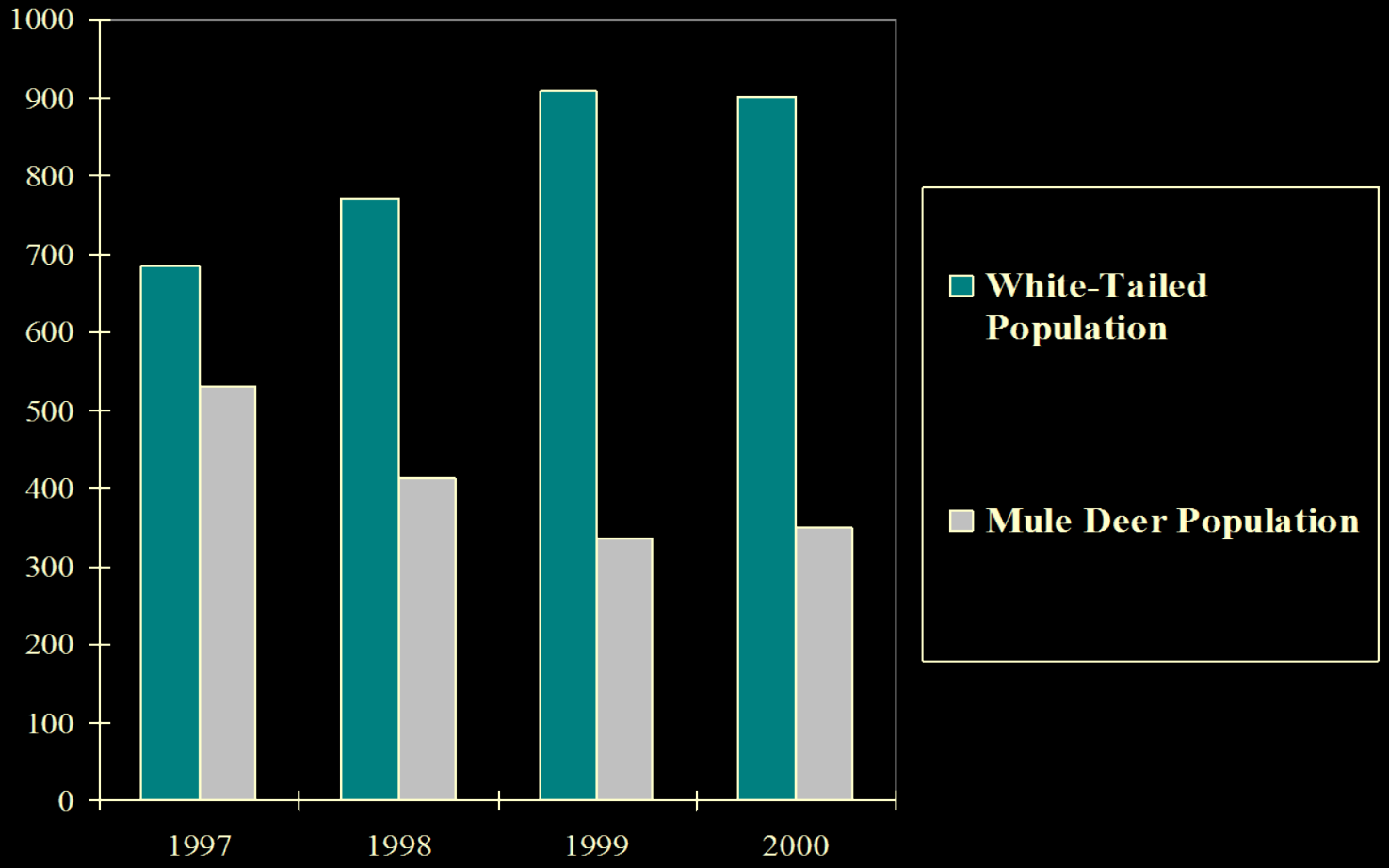
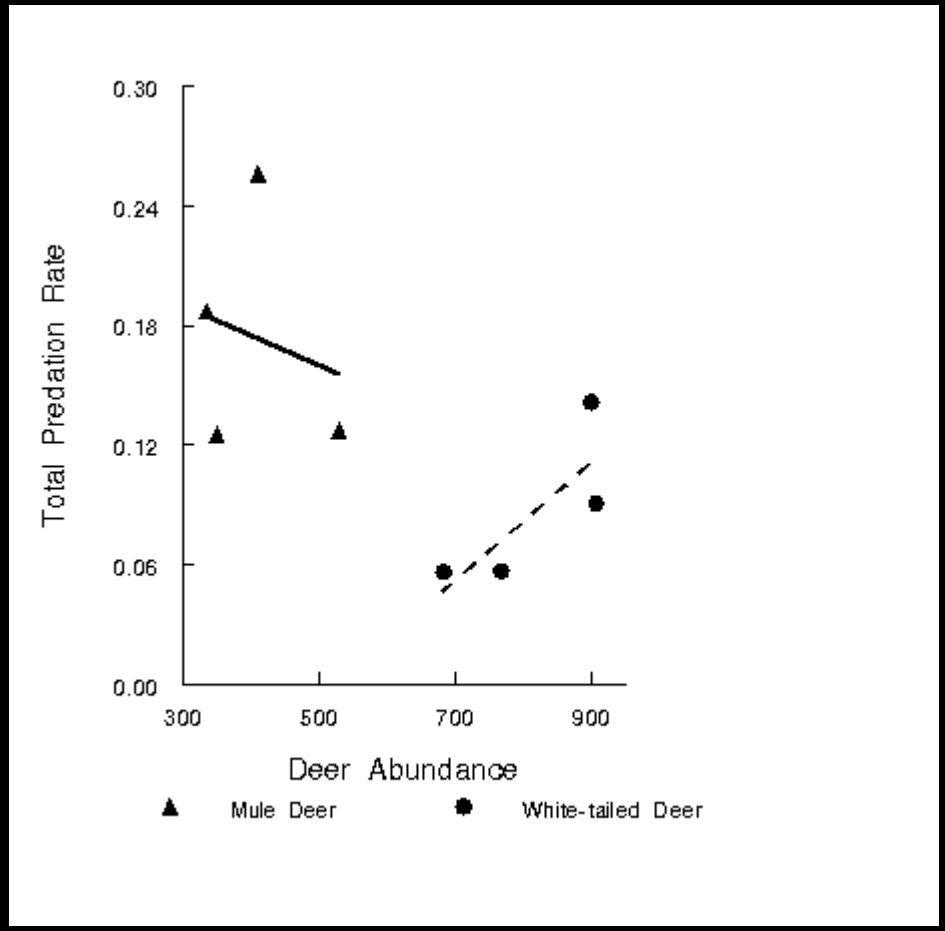
Mule Deer/Whitetail Deer Numbers



Due to cougar predation rate
Mule Deer = 17%
Whitetail Deer = 9%

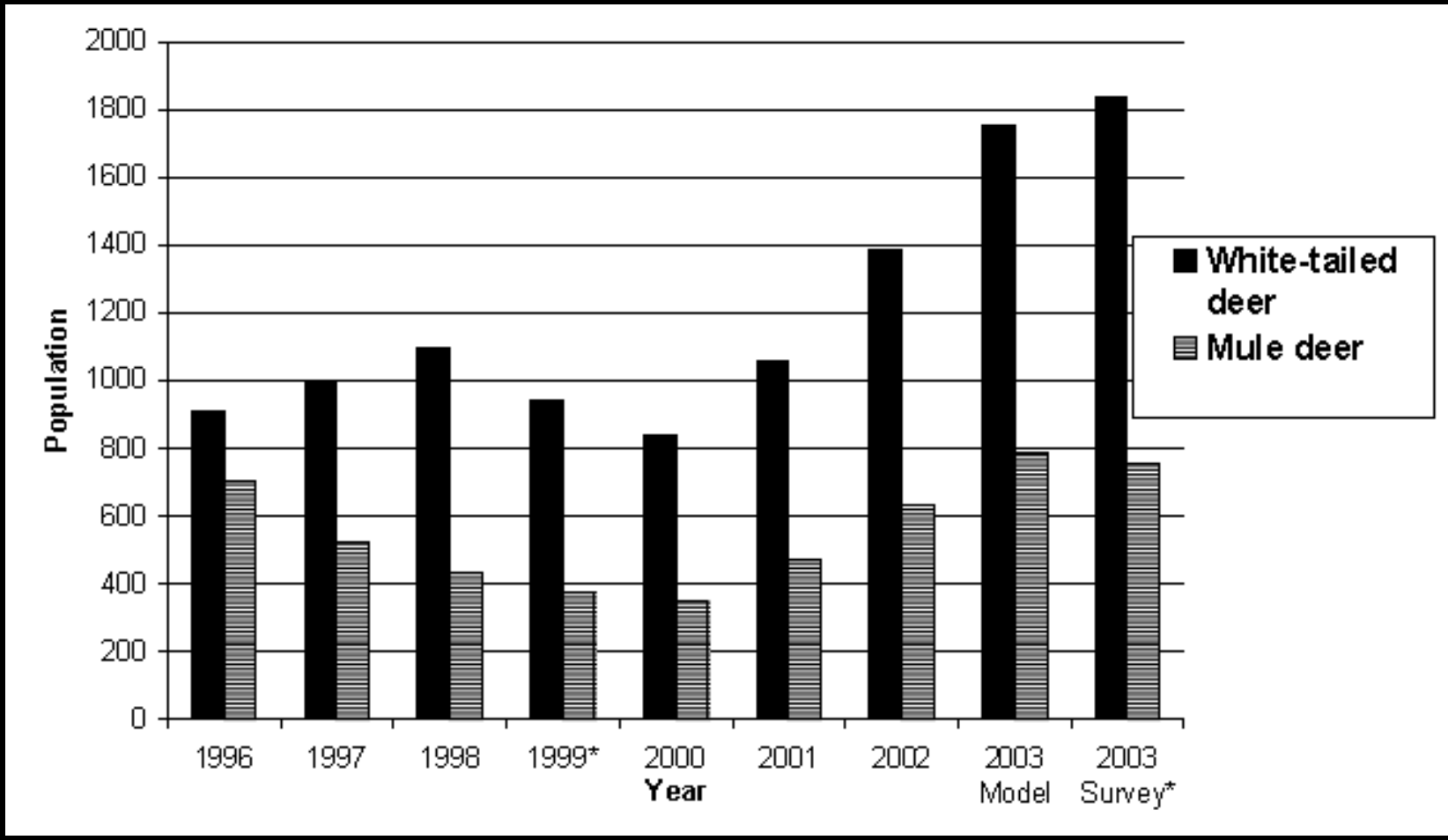
Predation appears to be density independent on mule deer and density dependent on white-tailed deer



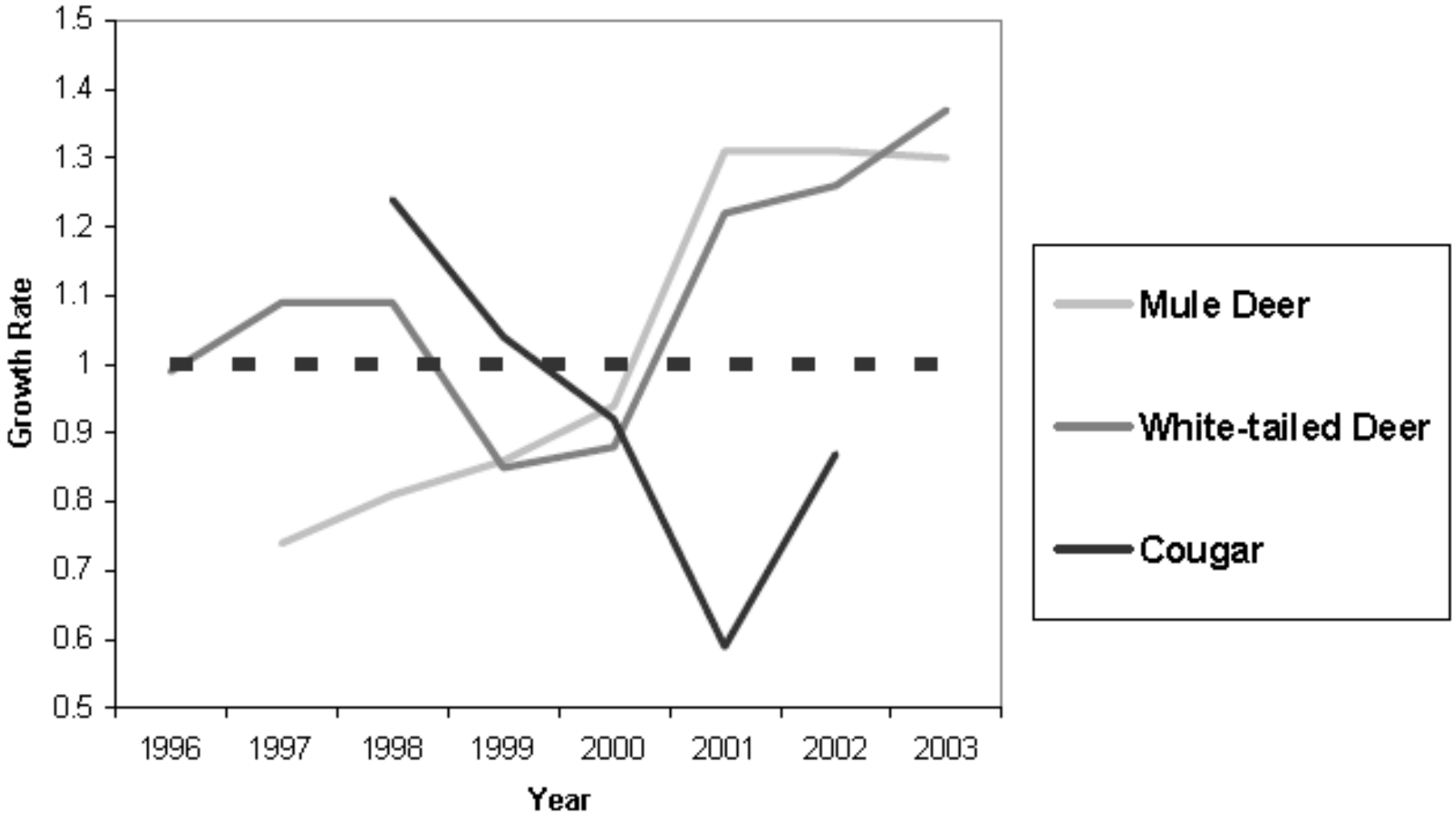
Why?

Robinson, H.S., R.B. Wielgus, and J.C. Gwilliam. 2002. Cougar predation and population growth of sympatric mule deer and white-tailed deer. Canadian Journal of Zoology. 80(3): 556-568.

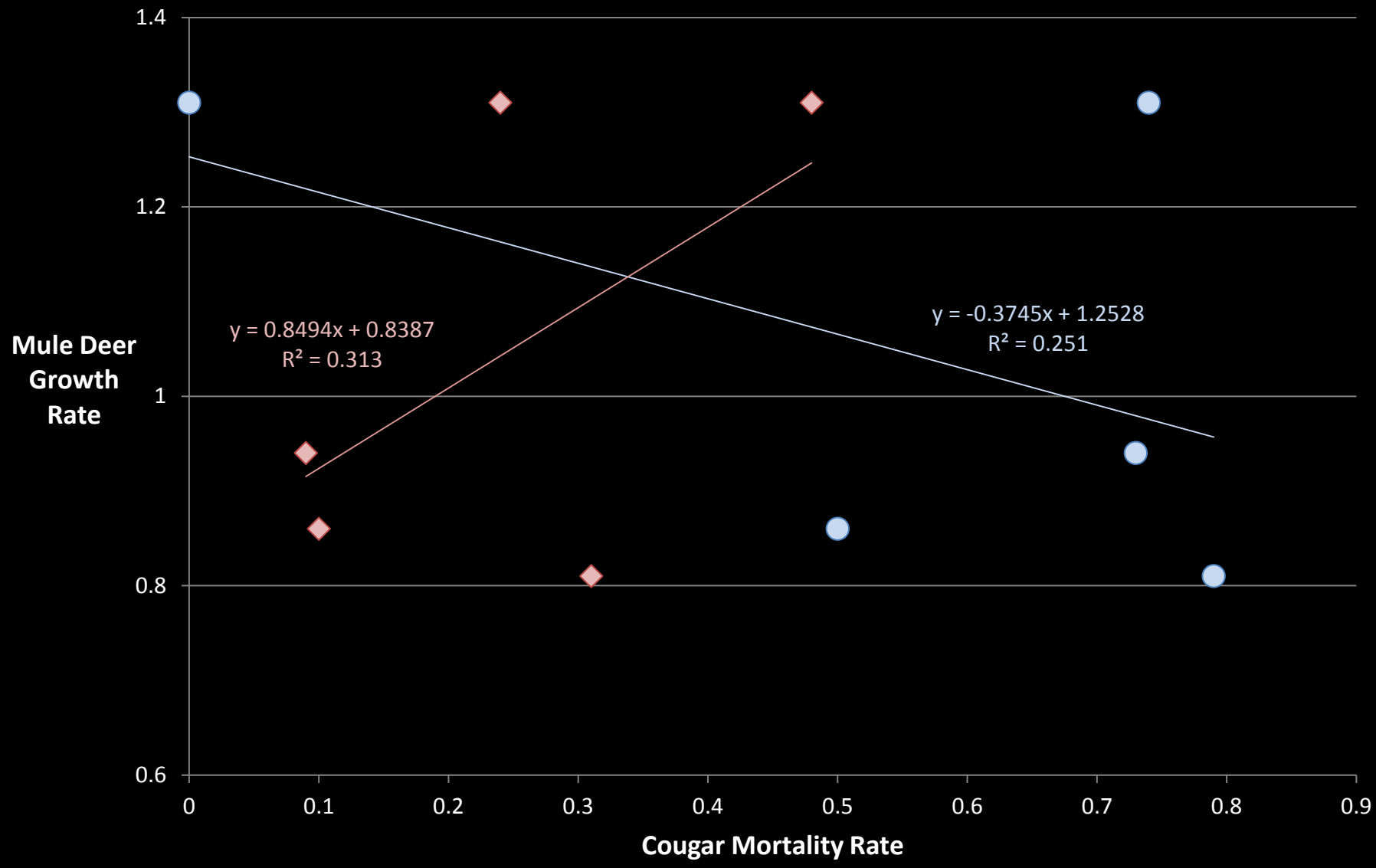
Longer Time Series

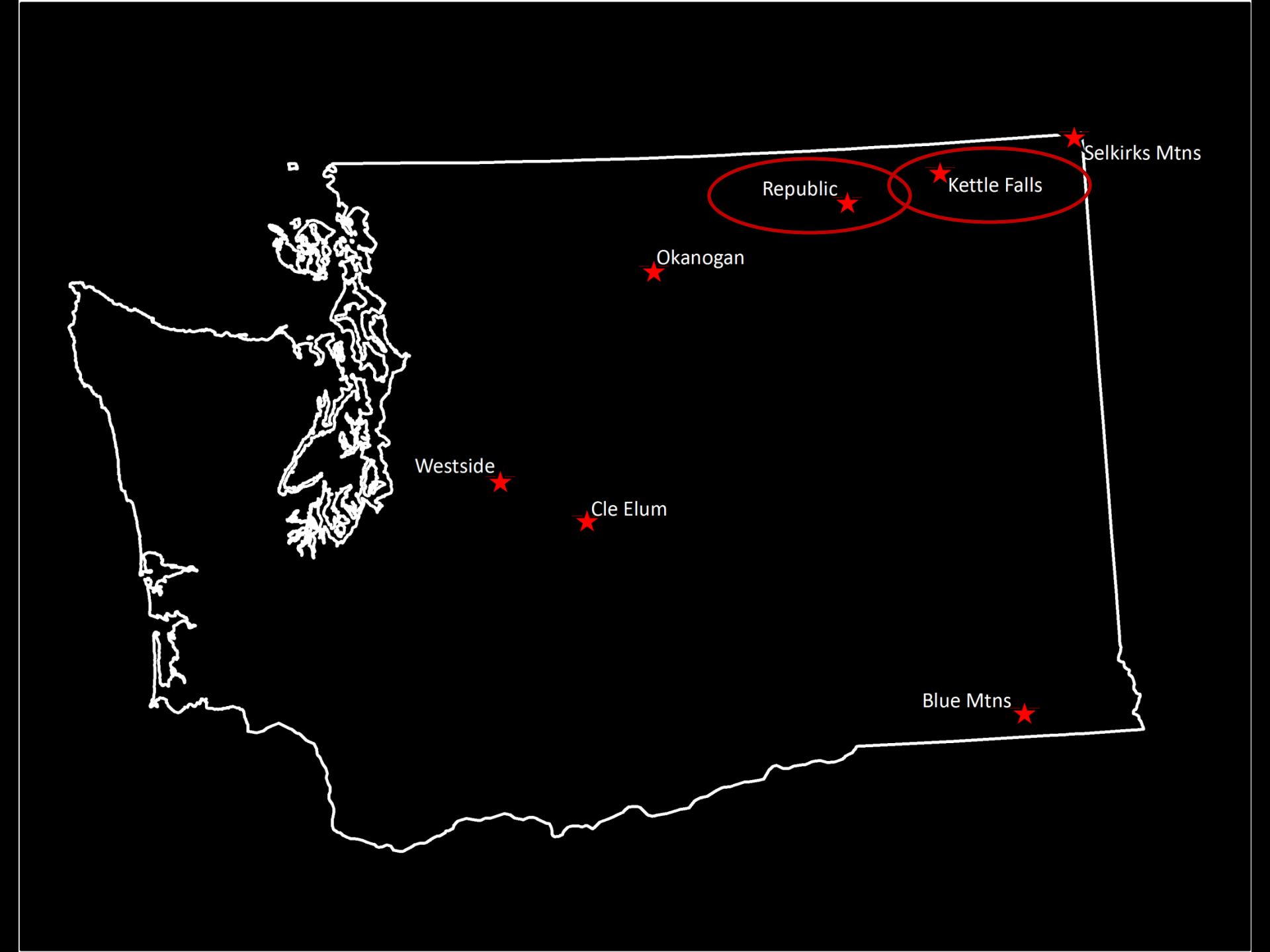


Mule Deer Recovery in 2000-01 = Female cougar mortality ↑ From 10% to 48%



Mule Deer Growth Rate and Cougar Mortality Rate

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Cougar Prey Selection

			Selection Ratios	
	χ^2	p	WT	MD
ANNUAL				
Wedge	2.82	0.09	0.84	1.74
Republic	1.99	0.26	0.79	1.26
Study Area	4.42	0.04	0.82	1.53
SEASONAL				
Summer	4.28	0.04	0.83	1.44
Winter	0.04	0.84	1.04	1.03

Cougars select for 20% Mule Deer but not 80% Whitetail Deer

(Only in Summer)

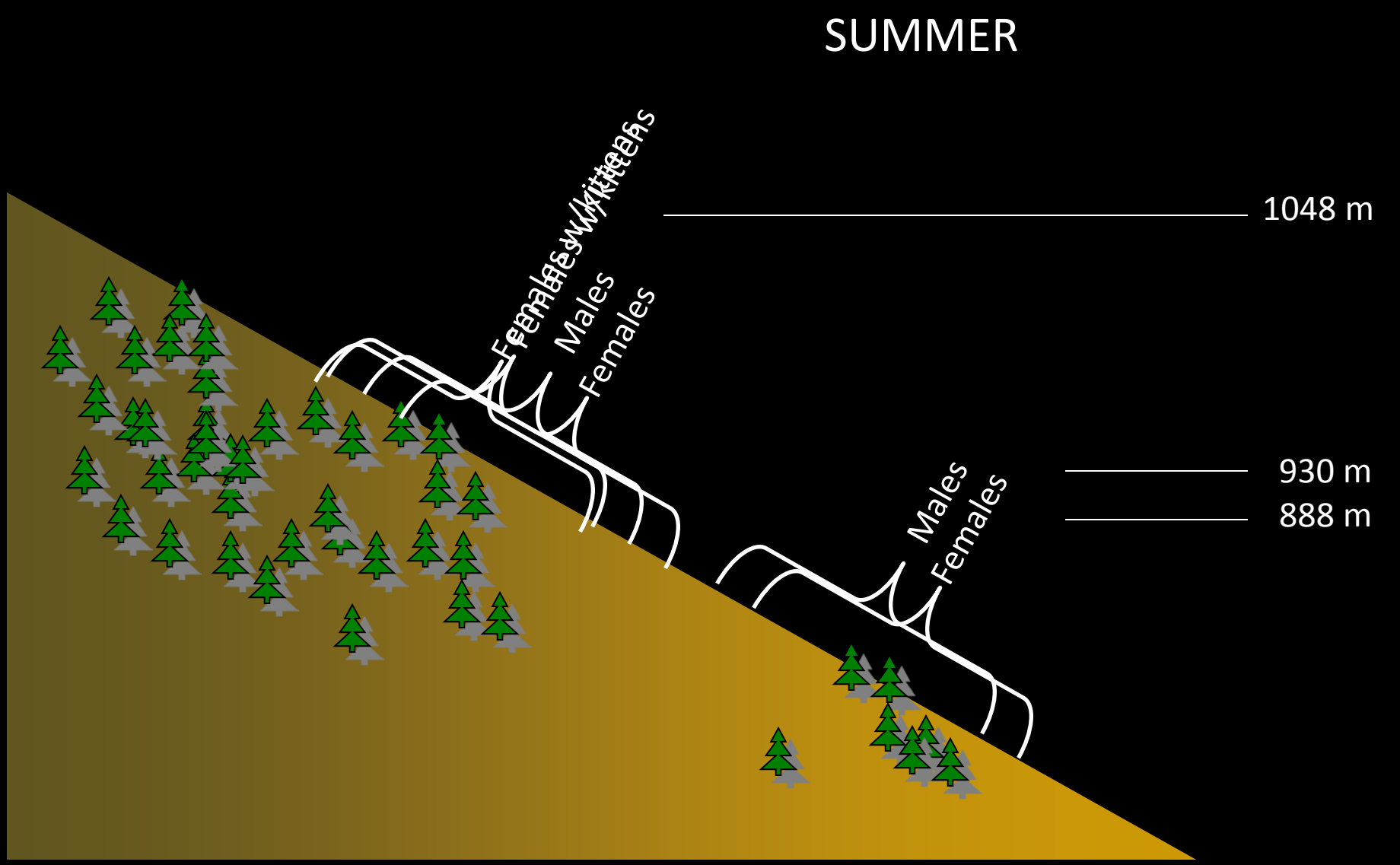
Why?

Cooley, H.S., H.S. Robinson, R.B. Wielgus, and C.S. Lambert. 2008. Cougar prey selection in a white-tailed deer and mule deer community. Journal of Wildlife Management. 72(1): 99-106.

Cougar Prey Selection

	Prey	Obs.	Exp.	X^2	*P value*
Annual (ALL)	WT	144	184	40.05	<0.01
	MD	82	42		
Summer (FK)	WT	12	25	27.81	<0.01
	MD	19	6		
Summer (F)	WT	22	25	2.06	0.15
	MD	9	5		
Summer (M)	WT	24	27	1.55	0.21
	MD	9	6		

Sexual segregation



Female cougars with kittens select for low density Mule Deer during summer and others don't.

Why?

Keehner, J.N., R.B. Wielgus, and Keehner A.M. 2015. Effects of male targeted hunting regimes on prey switching by female mountain lions: implications for apparent competition on declining secondary prey. Biological Conservation. 192: 101-108.

Only Females/w Kittens avoided males
~ Only in Kettle Falls
~ Only in Summer

Only Females /w Kittens selected MD at higher elevations
~ Only in Kettle Falls
~ Only in Summer

Because of Sexually selected infanticide by immigrant males

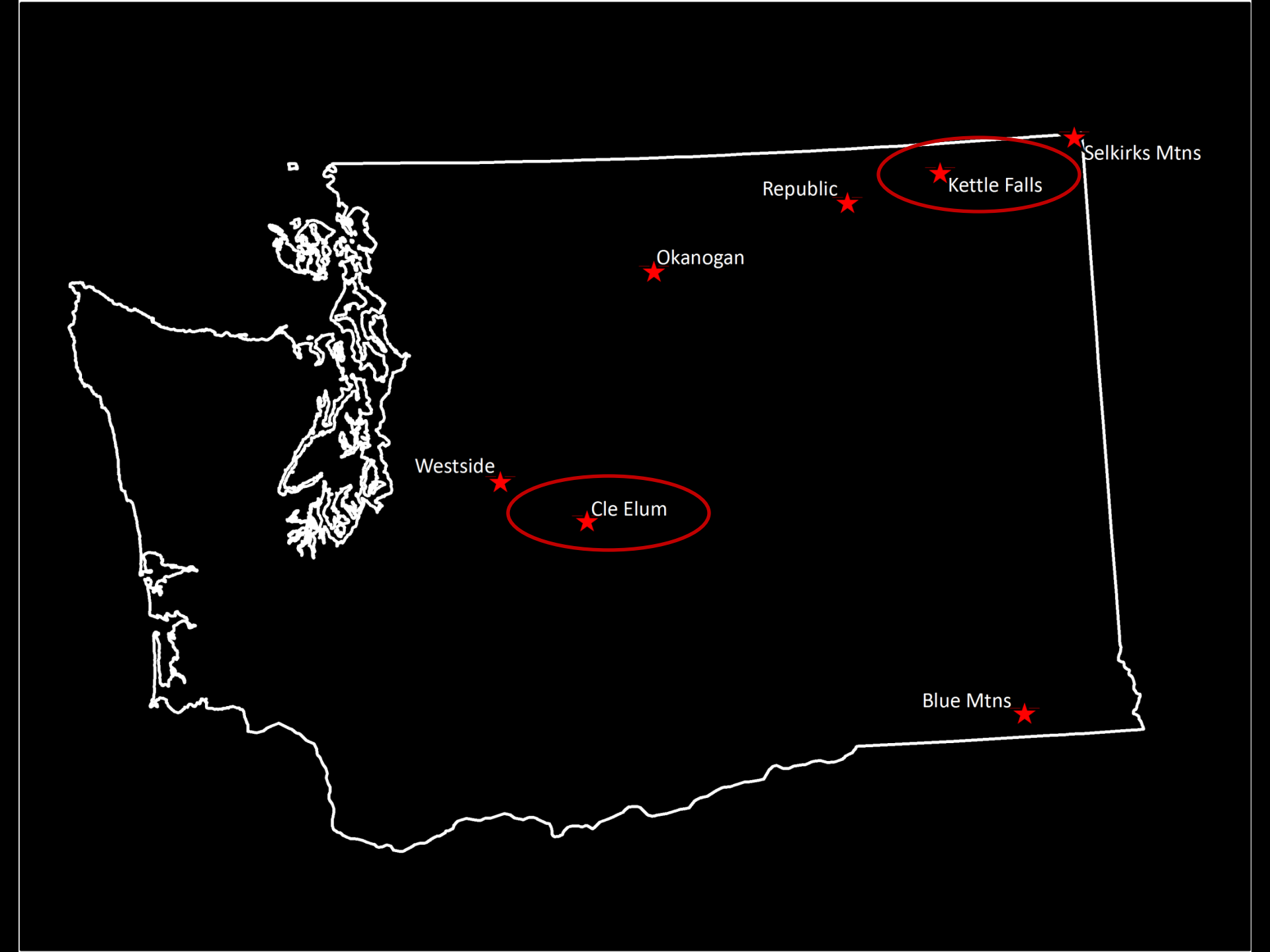
Keehner, J.N., R.B. Wielgus, B.T. Maletzke, and M.E. Swanson. 2015. Effects of male targeted hunting regime on sexual segregation in mountain lion. Biological Conservation. 192: 42-47.

Hunting ↑ ≠ Predation ↓

WHY?

Increased immigration by males (Elk?)
Sexually segregated prey use (Mule Deer)

Landscape Ecology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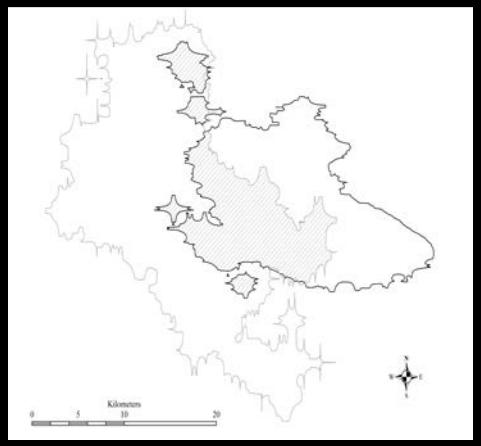
Home Range Size Comparison

Home range size of Wedge males was significantly higher .

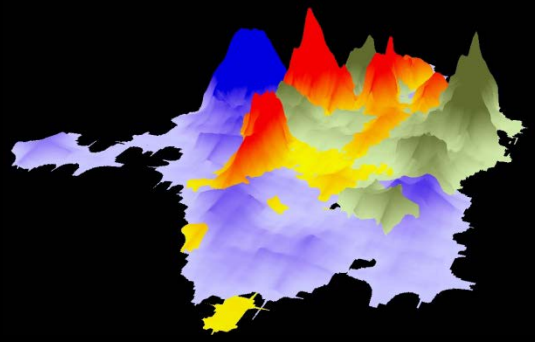
	Wedge (Mean $km^2 \pm$ SD)	**Cle Elum** (Mean $km^2 \pm$ SD)	***P*-value**
Males	753 ± 338	347 ± 134	< 0.01
Females	240 ± 104	199 ± 240	0.53



2-D Overlap Comparison

Sex	Wedge (Mean $km^2 \pm$ SD)	Cle Elum (Mean $km^2 \pm$ SD)	*P*-value	*Holm_Bonf* α/k
♂	0.41 ± 0.23	0.17 ± 0.11	< 0.01	0.01
♀	0.31 ± 0.18	0.20 ± 0.15	0.03	0.02
♂ - ♀	0.16 ± 0.06	0.26± 0.18	0.22	0.03
♀ - ♂	0.57 ± 0.19	0.51± 0.26	0.55	0.05

Holm-Bonferroni adjusted alpha value where $\alpha = 0.05$ and k is the number of pairwise comparisons

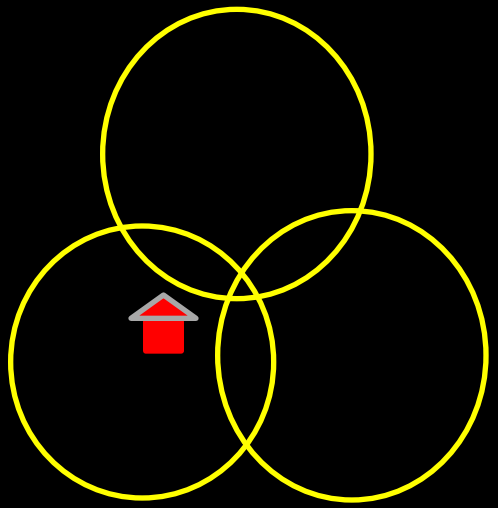


3-D Overlap Comparison

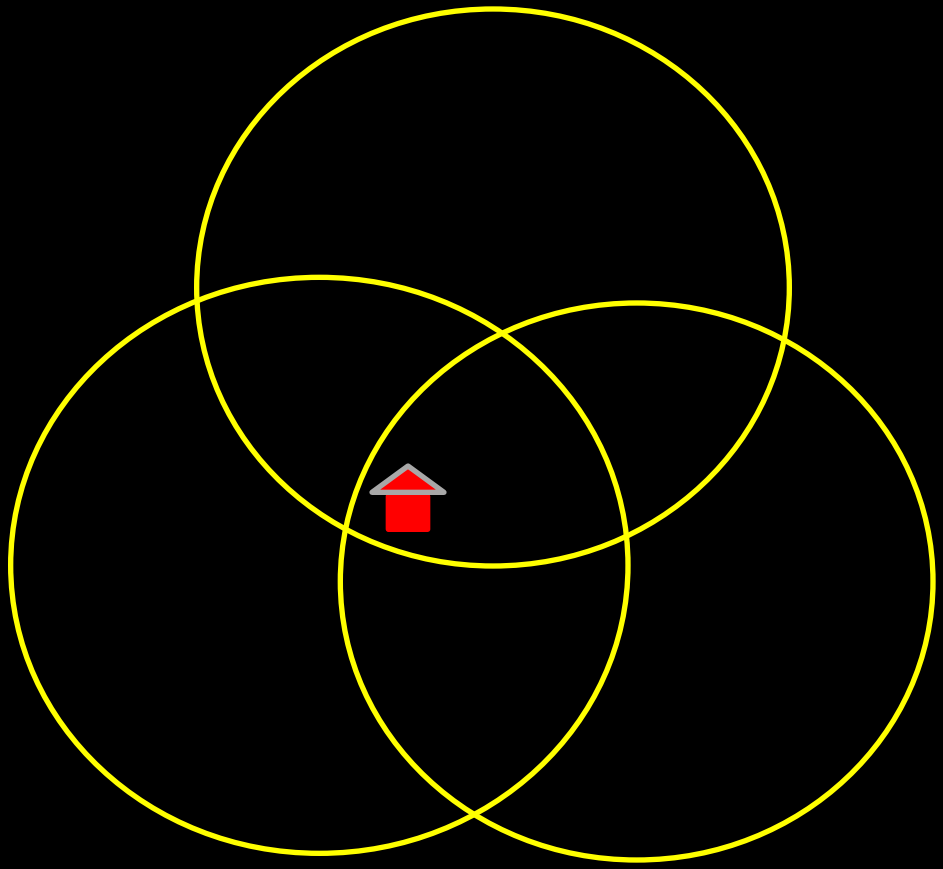
Sex	Wedge (Mean km^2 ± SD)	Cle Elum (Mean km^2 ± SD)	*P*-value	*Holm_Bonf α/k*
♂	0.38 ± 0.27	0.16 ± 0.15	0.01	0.01
♀	0.27 ± 0.29	0.12 ± 0.14	0.04	0.02
♂ - ♀	0.19 ± 0.08	0.30± 0.25	0.36	0.03
♀ - ♂	0.19 ± 0.11	0.32± 0.30	0.30	0.05

Holm-Bonferroni adjusted alpha value where α = 0.05 and k is the number of pairwise comparisons

Cougar - Human Encounters



Cougar Encounter = 1



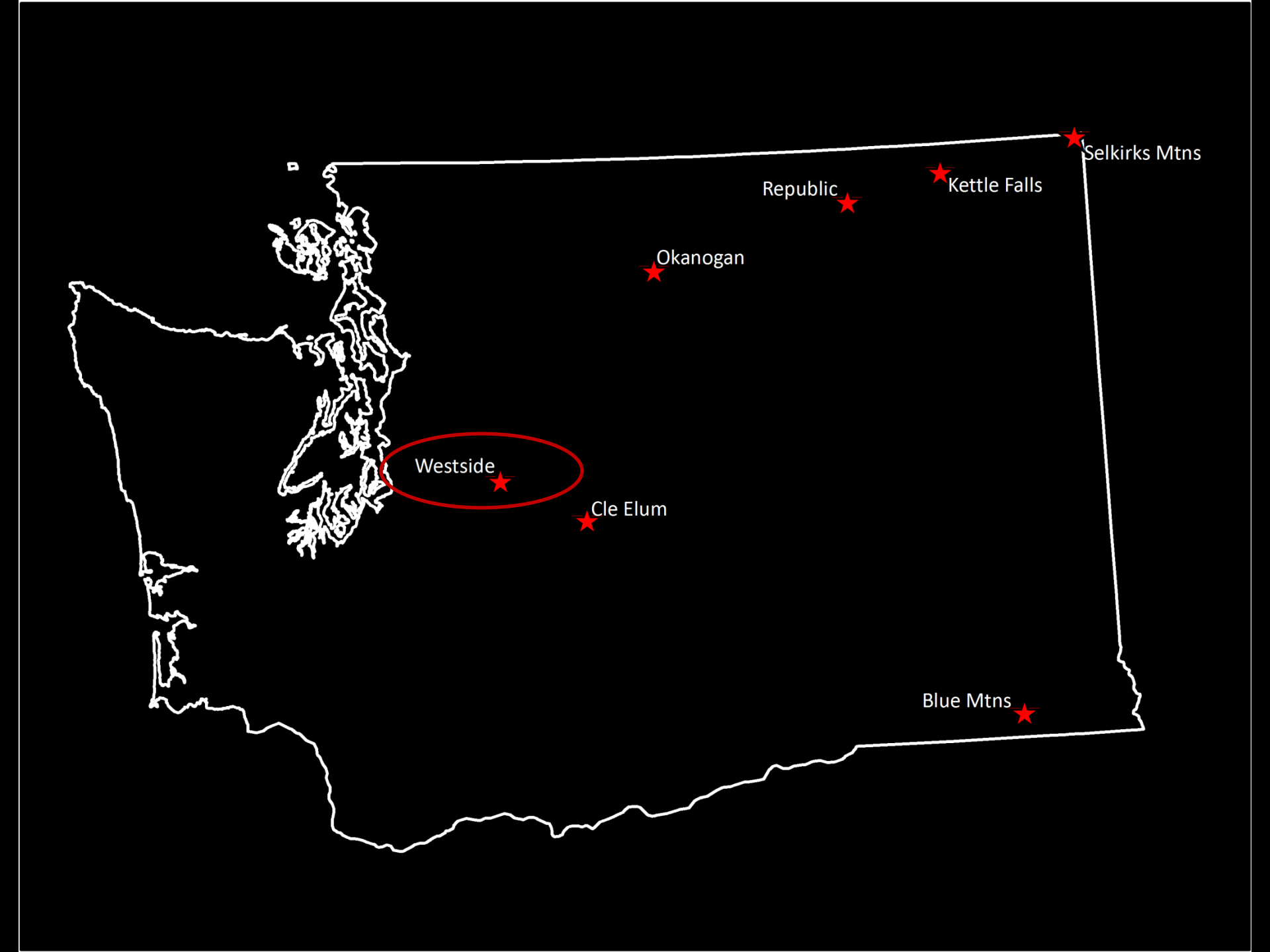
Cougar Encounter = 3

Hunting ↑ = Home Range Size ↑

Hunting ↑ = Home Range Overlap ↑

Hunting ↑ = Cougar Human Encounter↑?

Maletzke, B.T., R.B. Wielgus, G.M. Koehler, M.E. Swanson, H.S. Cooley, and J.R. Alldredge. 2014. Effects of hunting on cougar spatial organization. Ecology and Evolution. Doi: 10.1002/ECE3.1089.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Comparison of Sex & Age on UD & 99% fixed KHR overlap with residential development.

	Sex				Age			
	Male (n = 17)		Female (n = 16)		Adult (n = 24)		Subadult (n = 9)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
UD Volume	16.33	16.13	17.42	18.50	12.69	16.05	27.99	15.19
Home Range Area	20.09	17.43	16.51	16.36	13.90	14.04	30.23	18.38

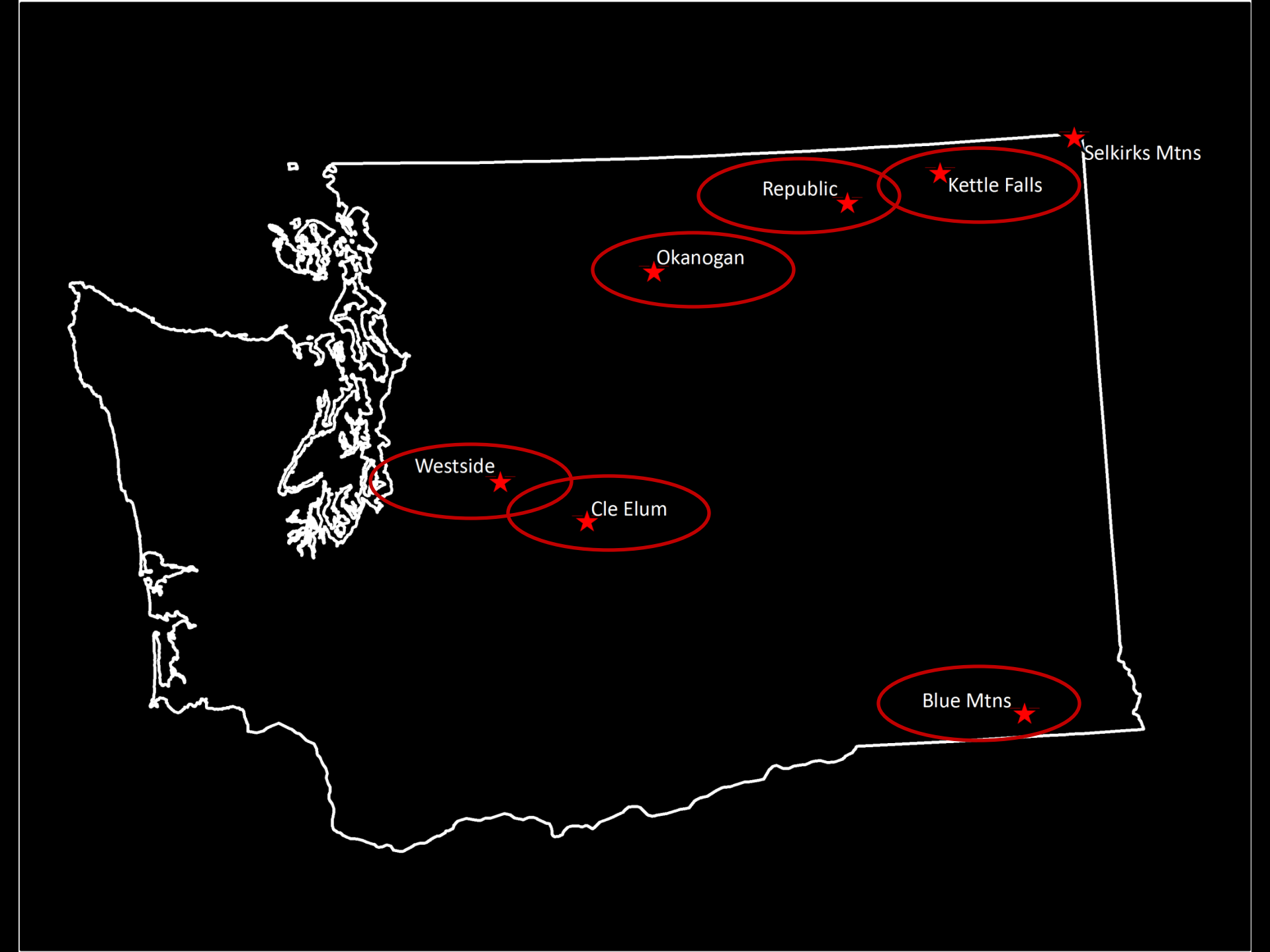
Young Animals = More Overlap

Comparison of Resident & Transient cougars on Average UD & 99% fixed KHR overlap with residential development.

	Subadult Male Transient (n = 5)		Subadult Female Transient (n = 4)		Adult Male Resident (n = 9)		Adult Male Transient (n = 3)		Adult Female Resident (n = 12)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
UD Volume	26.89	20.43	29.35	7.38	11.30	11.70	13.79	17.20	13.45	19.57
Home Range Area	30.48	24.36	29.92	10.46	14.90	10.56	18.36	20.03	12.04	15.74

Transient Animals = More Overlap

Kertsen, B.N. Spencer, R.D., Grue, C.E. 2013. Demographic influences on cougar residential use and interactions with people in Washington. Journal of Mammalogy. 94(2): 269-281.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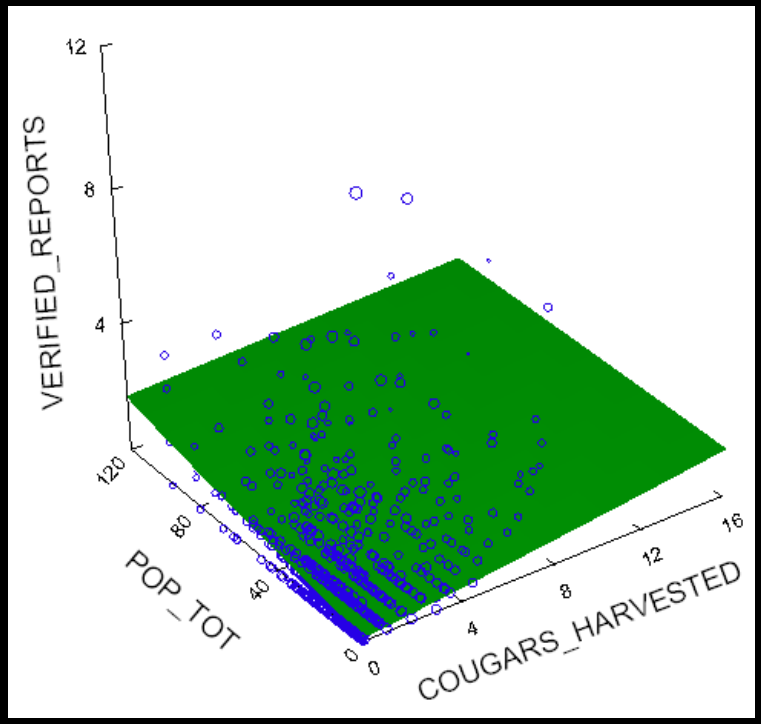
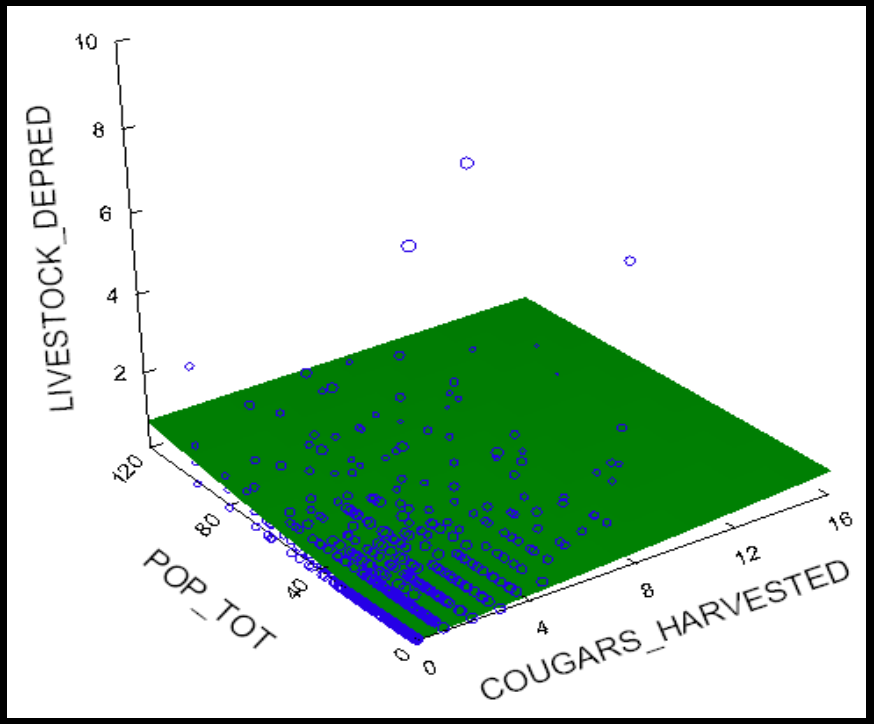
Verified Complaints vs Cougar Population and Cougar Harvest for 136 GMUs in WA from 2005-2010



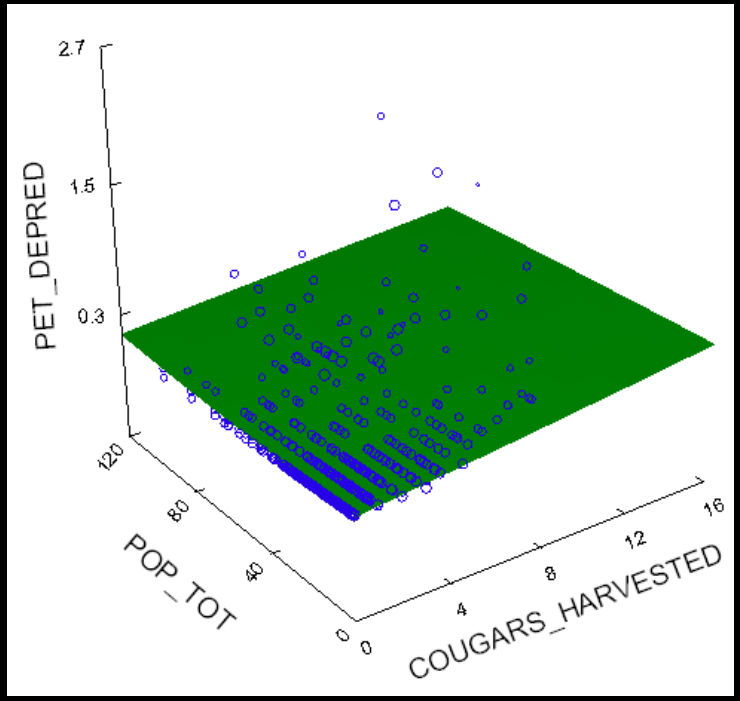
Effect	Coefficient	Standard Error	Std. Coefficient	t	p-value
Constant	0.095	0.063	0.000	1.509	0.132
Cougar Population	0.014	0.002	0.215	5.808	0.000
Cougar Harvest	0.086	0.020	0.158	4.276	0.000

Livestock depredations vs Cougar Population and Cougar Harvest for 136 GMUs in WA from 2005-2010



Effect	Coefficient	Standard Error	Std. Coefficient	t	p-value
Constant	0.019	0.038	0.000	0.488	0.626
Cougar Population	0.006	0.001	0.155	4.090	0.000
Cougar Harvest	0.037	0.012	0.116	3.059	0.002

Pet depredations vs Cougar Population and Cougar Harvest for 136 GMUs in WA from 2005-2010



Effect	Coefficient	Standard Error	Std. Coefficient	t	p-value
Constant	-0.005	0.013	0.000	-0.386	0.699
Cougar Population	0.001	0.000	0.079	2.105	0.036
Cougar Harvest	0.025	0.004	0.232	6.189	0.000

Hunting ↑ = Verified Incident Reports ↑

Hunting ↑ = Livestock Depredations ↑

Hunting ↑ = Pet Depredations ↑

Peebles, K.A., Wielgus, R.B., Maletzke, B.T., and Swanson, M.E. 2013. Effects of remedial sport hunting on cougar complaints and livestock depredations. PLoS ONE 8(13) e79713

Summary

Hunting ↑ ≠ Cougars ↓

Hunting ↑ ≠ Predation ↓

Hunting ↑ ≠ Depredations ↓

Hunting ↑ ≠ Complaints ↓

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Questions?