Intensive Management for Moose in GMU 16B, south-central Alaska

Did liberalized management of brown and black bears increase survival of calf moose in GMU 16B???

Highlights of Intensive Management in GMU 16B

- Spring 2004: 92.125 Plan adopted

- Wolf
  - 2004: Wolf control initiated
    - Estimated 50-80% reduction by 2007

- Black bear
  - 2007: Control program established
    - Unlimited harvest, baiting, SDA, etc., for Control Permittees
  - 2009: Snaring permitted

- Brown bear
  - 2001: Bag limit increased to 1 bear/y with tag fee
  - 2003: Tag fee eliminated
  - 2005: Bag limit increased to 2 bears/y
  - 2011: No closed season
  - 2011: Brown Bear Control Area (16B South) established
    - Allowed baiting, snaring, no bag limit, any bear legal

Effects of bear management on calf survival

Evaluated calf survival at 4 spatial scales

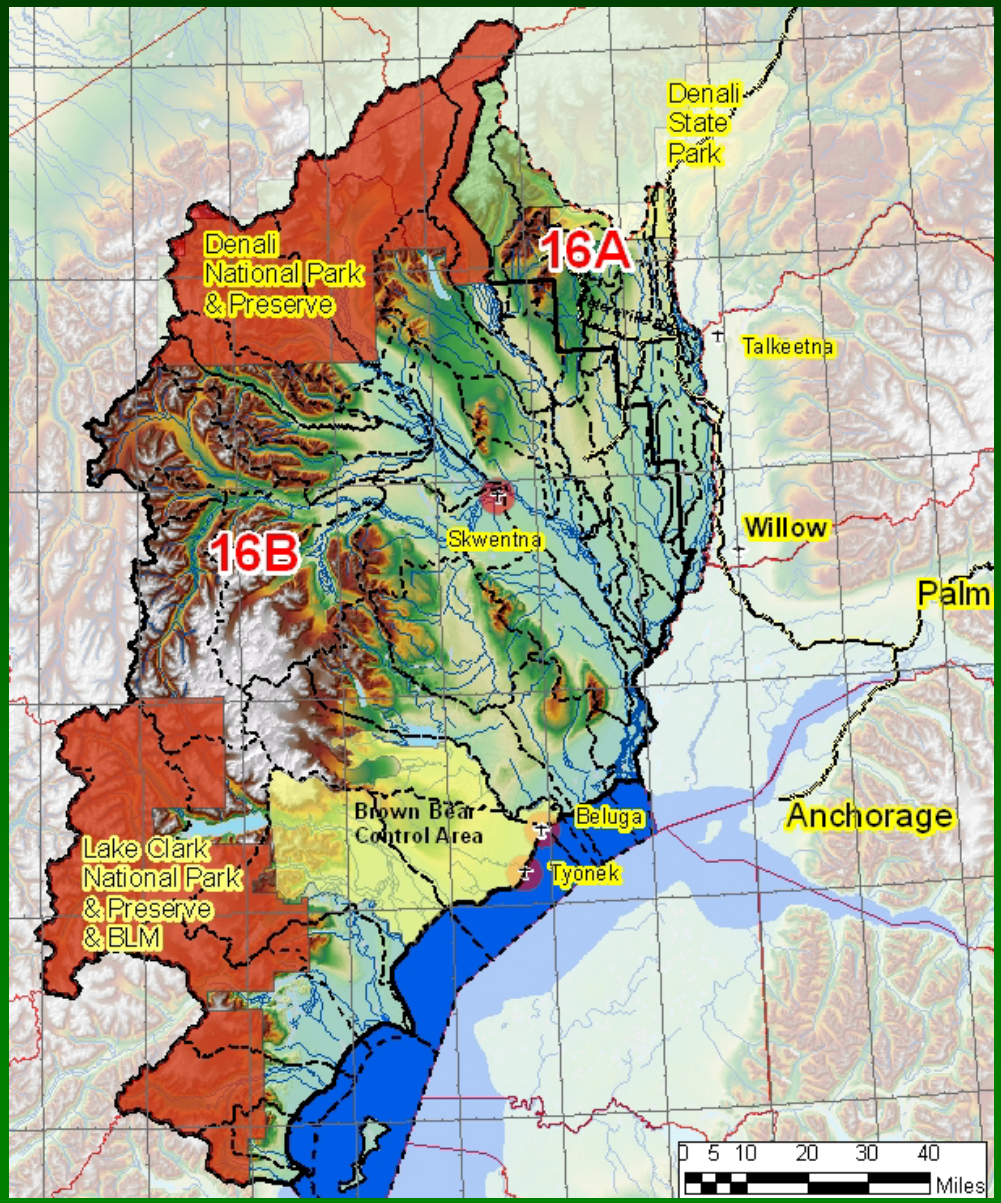
I. Sub-GMU (mostly 16B Mid, some 16B South)
- Survival of calves-at-heel: 2005 – 2012

II. Brown Bear Control Area (BBCA) of 16B South
- Fate of radio-tagged calves (2010, 2012)

III. Uniform Coding Unit (UCU-level = sub-watershed)
- Survival of calves v. estimated bear harvest proportions

IV. Location of cows within UCUs (sub-UCU level)
- Spatial distribution of surviving v. dying calves (cows)

GMU 16B



I. Sub-GMU

II. BBCA

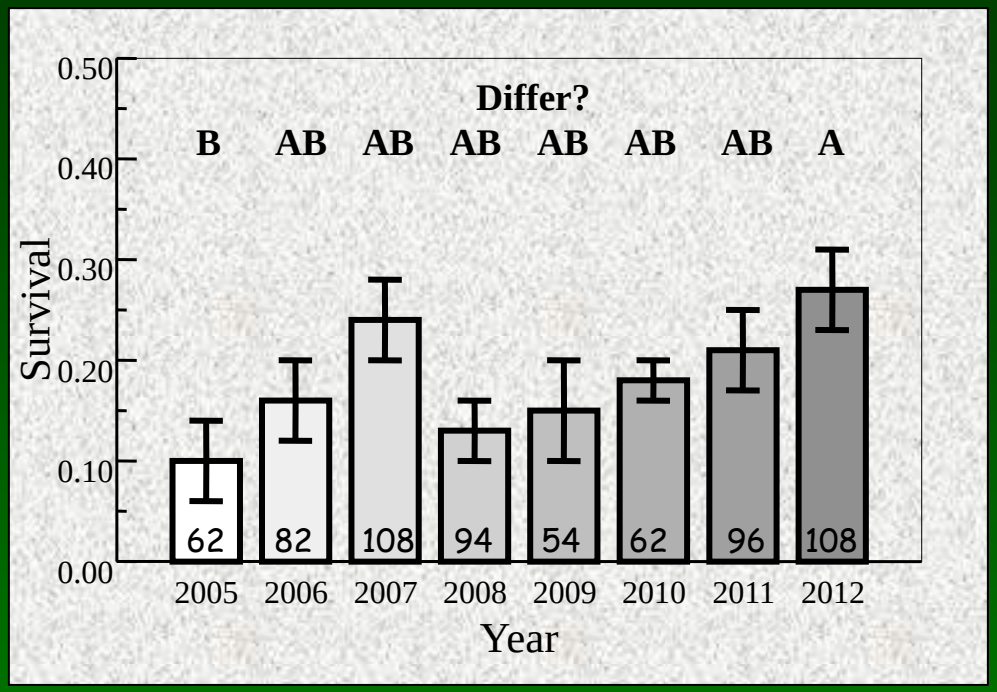
III. UCU-level

IV. Sub-UCU level

I. Did IM affect calf survival at the sub-GMU level?

- Monitored 79 – 96 radio-tagged cows annually, 2005 - 2012
  - Monitored production and survival of calves
- Determined Kaplan-Meier survival rates, 2005 – 2012
  - Compared annual rates at an experimentwise $\alpha = 0.10$
  - Assessed longitudinal trend using Spearman rank correlation
- Includes 2-year PRE and 5-year POST treatment data

Survival of calves-at-heel -- 16B Mid & South



Trend????
r_s = 0.64; P = 0.089

No consistent increasing trend in survival since 2005

No strong effect of maternal condition, climate, etc.

	2005	2006	2007	2008	2009	2010	2011	2012
Mean	0.10	0.16	0.24	0.13	0.15	0.18	0.21	0.27
SE	0.04	0.04	0.04	0.03	0.05	0.02	0.04	0.04

II. Did IM affect calf survival in the BBCA?

- Captured and radio-tagged > 50 calves, 2010 and 2012
  - Monitored survival of calves
  - Determined causes of mortality of calves
  - Estimated Kaplan-Meier survival rates
  - Estimated Heisey-Fuller cause-specific mortality rates

- Determined Kaplan-Meier survival rates, 2005 – 2012
  - Compared annual rates using randomization tests

- Includes PRE (2010) and 2-year POST (2012) treatment data
  - For most liberal brown bear treatments

Radio-tagged calf survival -- 16B South

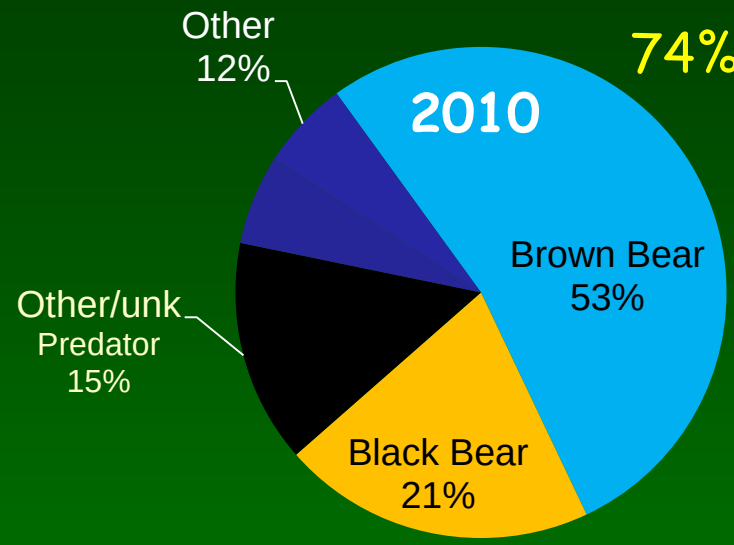
South	2010	2012
Mean	**0.24**	**0.19**
SE	0.07	0.06
N	54	53
DIFFER?	**No** (*P* = 0.294)	

No increase in calf survival after 2-y "treatment"

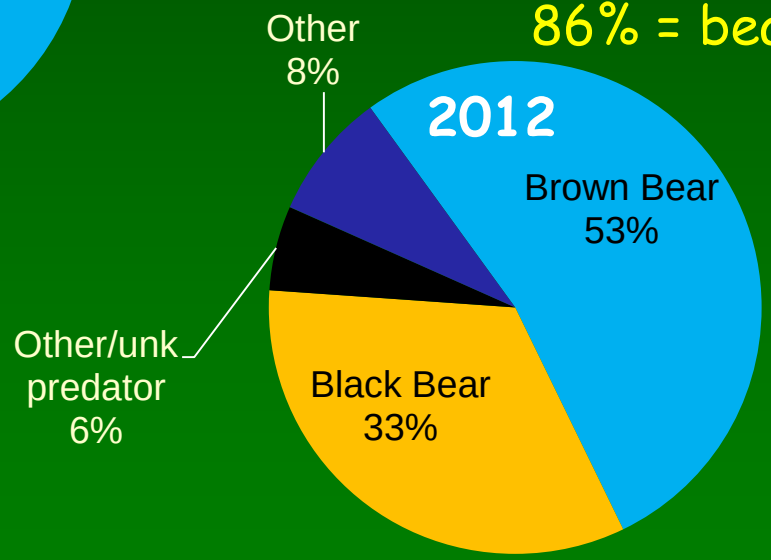
Tagged v. calves-at-heel					
	2010	**2010 (T)**		**2012**	**2012 (T)**
Mean	**0.18**	**0.24**		**0.27**	**0.19**
SE	0.02	0.07		0.04	0.06
N	62	54		108	53
DIFFER?	**No** (*P* = 0.384)			**No** (*P* = 0.144)	

Survival similar to 16B as a whole

Causes-of-death of radio-tagged calves – 16B South



74% = bear predation



86% = bear predation

Bear predation leading proximate cause-of-death of calves

Cause-specific mortality rates: radio-tagged calves

2010	Monthly	
COD	**Rate**	**SE**
Black bear	**0.15**	
Brown bear	**0.37**	
Other/unk predator	0.06	
Non-predation	0.04	
Unknown	0.14	
SURVIVAL	**0.24**	**0.07**

Before:
snaring, baiting, etc = **56%**

2012	Monthly	
COD	**Rate**	**SE**
Black bear	**0.20**	
Brown bear	**0.42**	
Other/Unk predator	0.04	
Non-predation	0.02	
Unknown	0.10	
SURVIVAL	**0.19**	**0.06**

After 2 years:
snaring, baiting, etc. = **62%**

Combined bear predation removed ~56–62% of calf cohort annually

Temporal patterns in calf mortality

Mostly BLACK bear

Mostly BROWN bear

Weekly mortality rates		
	2010	**2012**
May 3	**0.17**	**0.09**
May 4	**0.25**	**0.32**
Jun 1	**0.15**	**0.18**
Jun 2	0.04	0.08
Jun 3	0.08	0.05
Jun 4	0.00	0.02
LATER	0.11	0.07

Lose ~60% of all calves born in 1st 3 weeks

Of calves that DIED:

71 – 82% of deaths within 1st 3 weeks

86 – 89% of deaths occur within 1st 5 weeks

Patterns similar between 2010 & 2012

III. Did IM affect calf survival at UCU level?

- Monitored 79 – 96 radio-tagged cows annually, 2005 - 2012
  - Monitored production and survival of calves
  - Determined UCU in which each cow was located in May & June

- Estimated bear population size and proportion of bear population harvested
  - Used 40.6 brown and 187.3 black bears/1000 km^2, respectively

Population = Area of UCU × Density

% Harvested = Harvest / Population

- Modeled survival of individual calves using logistic regression

Fate (Live/Die) = Proportion of bear population harvested in UCU

Geographic distribution & survival of calves: 16B UCUs

Brown bear					Black bear				
Year	**χ^2**	**P**	**Odds**	**90% CI**	**Year**	**χ^2**	**P**	**Odds**	**90% CI**
2005	0.6	0.444	---	---	2005	0.1	0.782	---	---
2006	1.4	0.238	---	---	2006	0.1	0.775	---	---
2007	0.4	0.510	---	---	2007	0.6	0.442	---	---
2008	0.9	0.342	---	---	**2008**	**3.0**	**0.082**	**437**	**0.5 – >999**
2009	< 0.1	0.830	---	---	2009	1.7	0.186	---	---
2010	0.3	0.599	---	---	2010	< 0.1	0.901	---	---
2011	1.2	0.265	---	---	2011	0.1	0.720	---	---

Calf survival independent of bear harvest at UCU level

Proportion of calves that survived in UCUs with:
≥ 8% v. < 8% brown bear harvest
≥ 17% v. < 17% black bear harvest

= same results (no difference)

Proportion of bears harvested
(all UCUs with calving)

	Brown bear					Black bear				
Year	**Mean**	**SE**	**Range**	**Mid**	**South**	**Mean**	**SE**	**Range**	**Mid**	**South**
2004	0.013	0.004	0.00–0.03	---	---	0.020	0.009	0.00–0.06	---	---
2005	**0.122**	0.026	0.00–0.29	---	---	0.043	0.012	0.00–0.14	---	---
2006	**0.110**	0.024	0.00–0.27	---	---	0.090	0.018	0.00–0.21	---	---
2007	**0.111**	0.027	0.00–0.28	---	---	0.106	0.025	0.00–0.31	---	---
2008	**0.127**	0.024	0.00–0.28	---	---	0.118	0.027	0.00–0.30	---	---
2009	0.093	0.017	0.00–0.22	---	---	0.109	0.029	0.00–0.33	---	---
2010	**0.167**	0.031	0.00–0.34	**0.14^{A}**	**0.26^{B}**	0.160	0.029	0.00–0.28	0.16	0.15
2011	**0.141**	0.032	0.00–0.55	**0.16^{A}**	**0.08^{B}**	0.112	0.023	0.00–0.28	0.12	0.11

BBCA = inconsistent effect v. 16B Mid

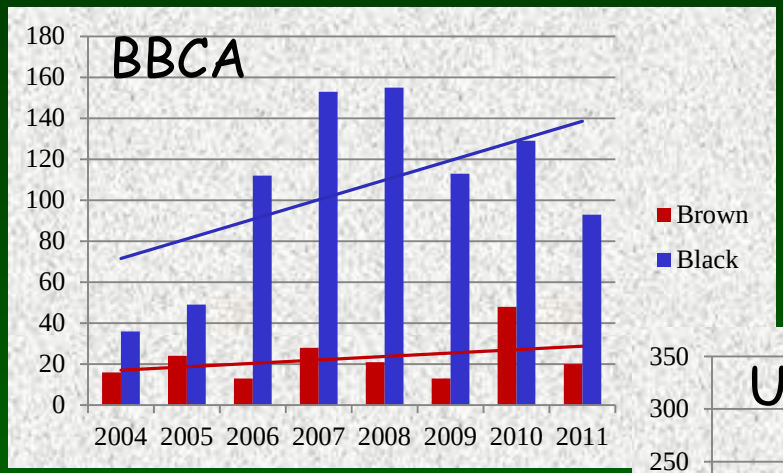
Harvest greater than "sustainable yield" (~8–9%) in 6 of 8 years

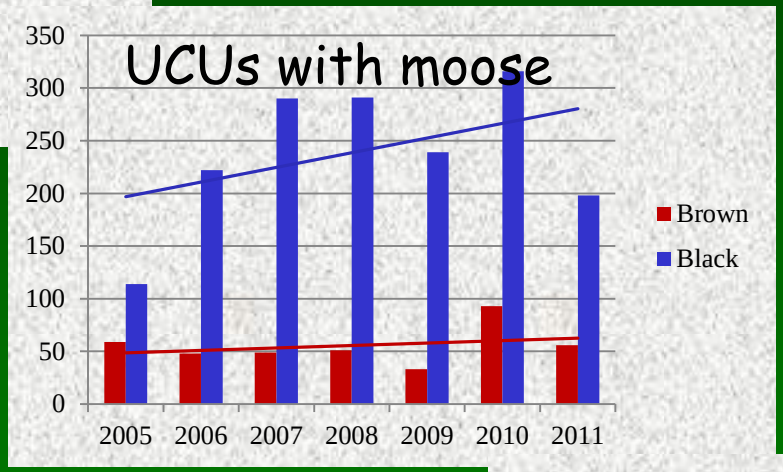
As high as 55% in some UCUs for brown bears

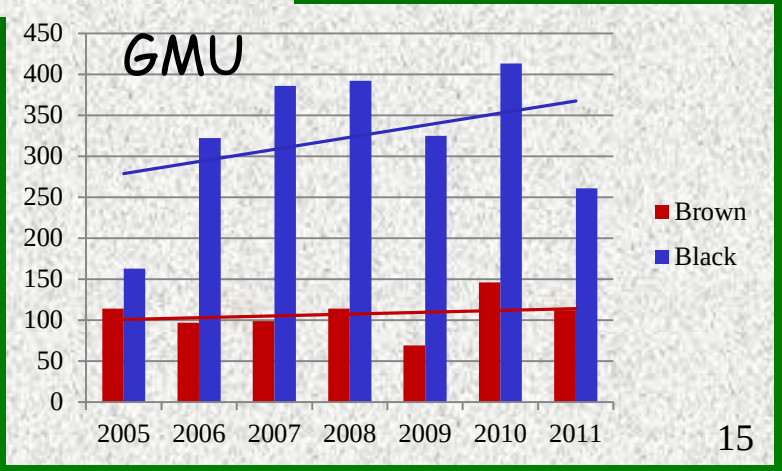
16 – 37% of UCUs annually > 8% BRN harvest (0 – 36% > 17%)

16 – 47% of UCUs annually > 17% BLK harvest

Bear harvest in 16B





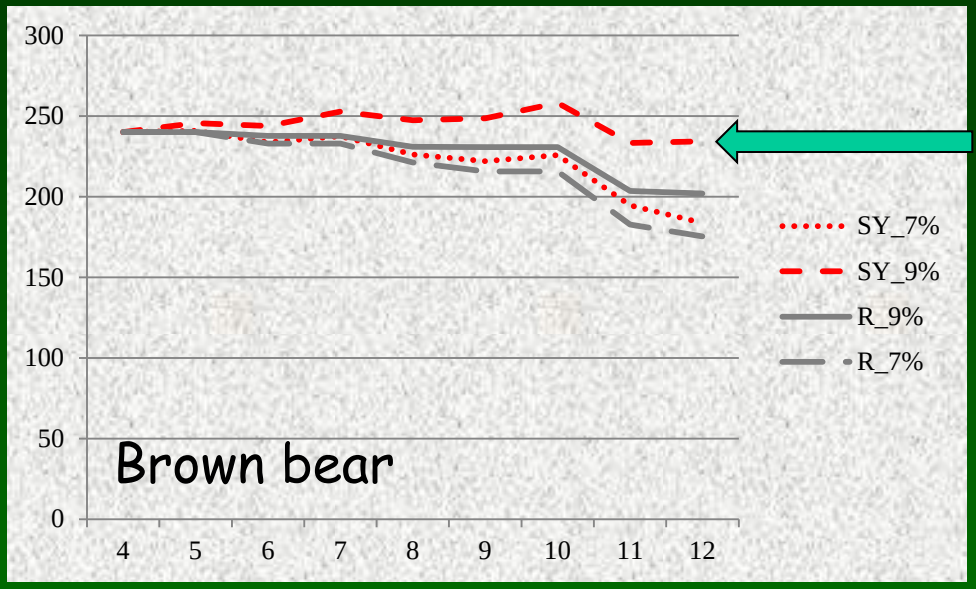


Despite harvests "above" sustainable yields, harvest stable or increasing with:

1. Little or no apparent effect on bear populations
2. No demonstrable effect on calf survival

Trends? Brown & Black: $P \geq 0.100$

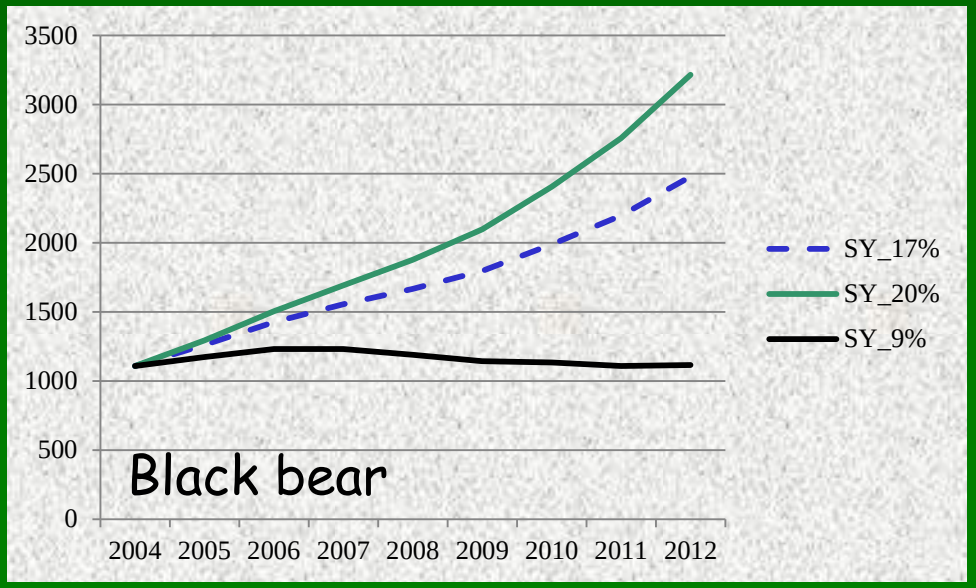
Treatment? Simulated bear population trends -- BBCA



Little effect on brown bear numbers

Effect contingent on assumptions:

1. No immigration
2. No compensatory productivity
3. No compensatory survival
4. Etc.



No effect on black bear numbers

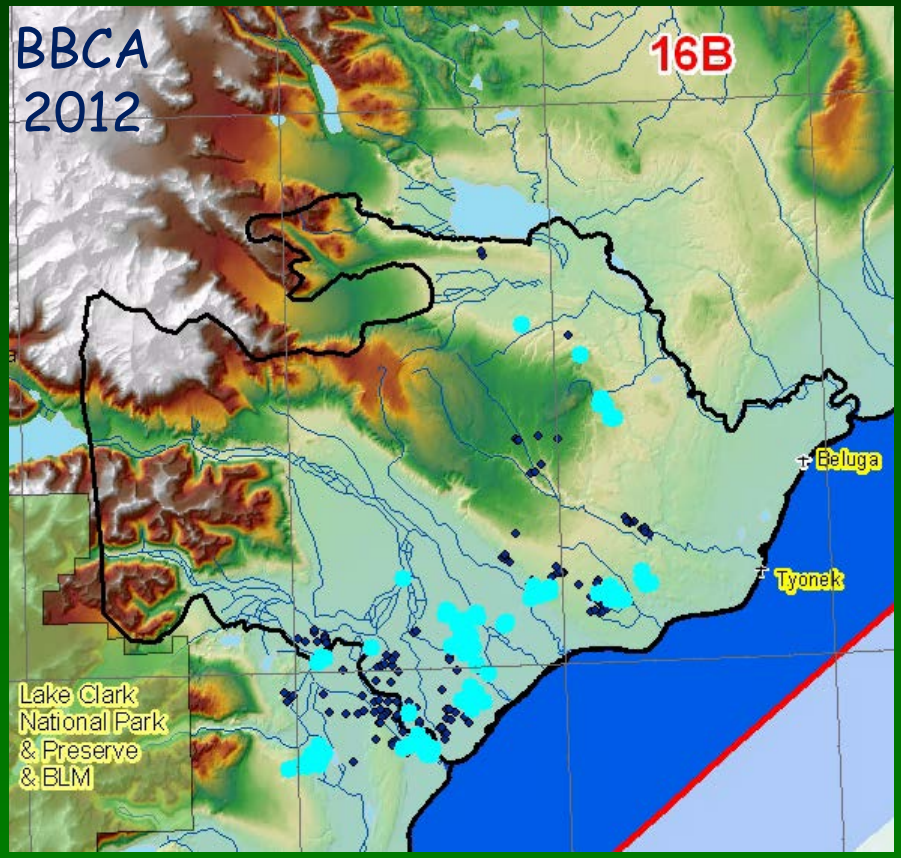
IV. Did IM affect calf survival at sub-UCU level?

- Monitored 79 – 96 radio-tagged cows annually, 2005 - 2012
  - Monitored production and survival of calves
  - Determined geographic locations of cows in May & June

- Compared spatial distribution of cows with surviving calves v. mortalities
  - Used multi-response permutation procedures (MRPP)
    - "Cluster-type" analysis

P (Euclidean distance within groups = Euclidean distance between groups)

Geographic distribution & calf survival: MRPP analysis



MRPP exact probabilities			
Year	**16B**	**Mid**	**South**
2005	0.478		
2006	0.469		
2007	0.777		
2008	**0.029**		
2009	0.252		
2010	0.264		
2011	---	**0.059**	0.340
2012	---	< **0.001**	**0.015**

Calf survival generally independent of cow distribution at sub-UCU level

Few differences = variable Euclidean distances between groups = no "pockets" of survivors

Summary

Did IM of bears increase calf survival?

- No increase in calf survival in response to bear management
  - At any scale: GMU, BBCA, UCU, sub-UCU
  - Harvest levels likely too low to drive desired 60% reduction
    - Even BBCA-level treatments ineffective

- No indications of strong predisposition in calves
  - Inferences limited by small samples of surviving calves

- Cow condition moderate
  - Above levels needed for growth

- High cow survival = increasing population in 16B Mid

Summary

Why no increase calf survival?

- McGrath - calf survival increased with removals of 50 – 90+% of bears
  - Agency-driven removals
  - Unlikely to see anything near this level with public programs