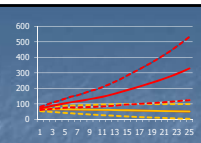
Effects of Black Bear Relocation on Elk Calf Recruitment at Great Smoky Mountains National Park



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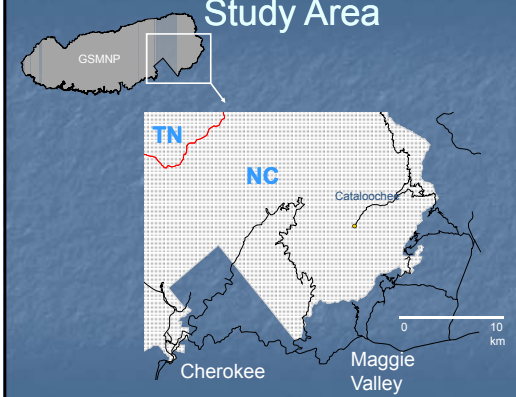
Background

- Elk native to Smokies
- RMEF interest
- Manitoban subspecies
- 25 Elk/yr for 3 years
- 5 years research

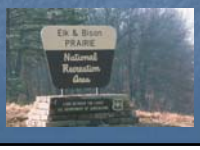
Assess the feasibility, methodology, and probability of success of releasing elk to establish a permanent population at GSMNP.

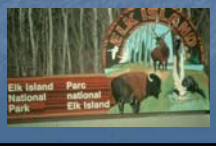
Study Area



Translocations

- 2001 Land Between the Lakes
  - 25 elk: 12 females and 13 males
- 2002 Elk Island National Park
  - 27 elk: 19 females and 8 males
- 2003 Postponed/cancelled



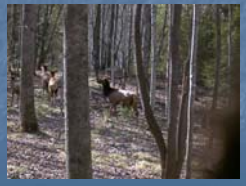


Processing

- DNA sampling
- Ear tags and tattoo
- Body measurements
- Disease testing
- Parasites
- Radio collars

Acclimation

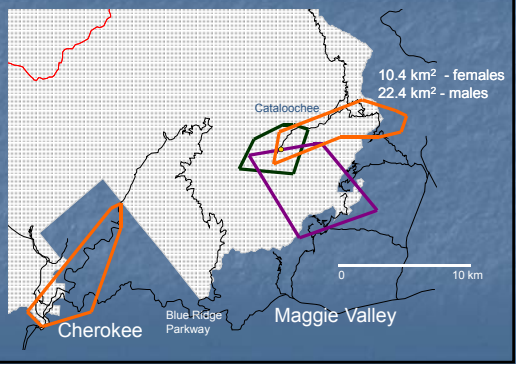
- Holding facility
- 2 – 3 months
- Chute system



Telemetry

- Aerial, ground, GPS
- Movements
- Habitat use
- Mortality: collars
- Reproduction: implants and movements

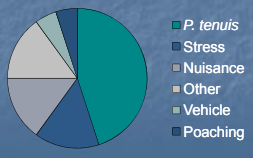
Home Ranges



Annual Survival

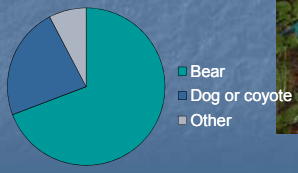
Differed by age and sex

- Adult female – 0.724-0.933
- Adult male – 0.690-0.911
- Subadult female – 0.846
- Subadult male – 0.800



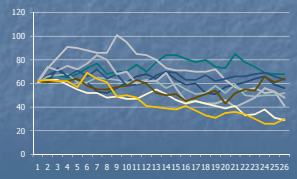
Fecundity

- 37 calves
- Calf production - 0.526
- Calf survival - 0.656
- Recruitment - 0.354
- Black bear predation

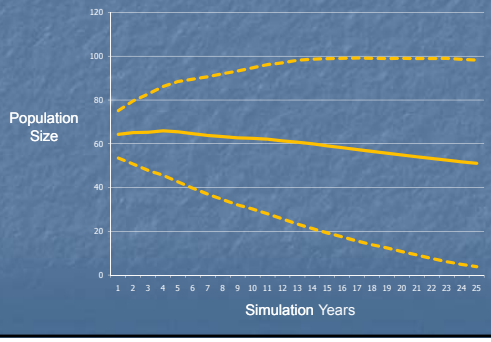


Population Modeling

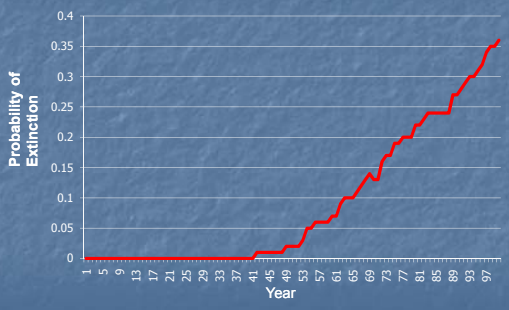
- Population size
- Age structure, sex ratios
- Age-specific survival and fecundity
- Process variance
- Predict population growth (λ) and extinction



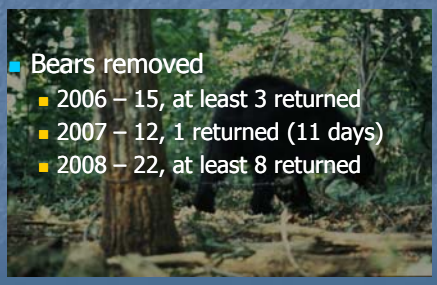
Average annual growth rate = 0.996
Population sustainable in 46% of the simulations



Extinction Rates as a Function of Time



Bear relocation program 2006-2008

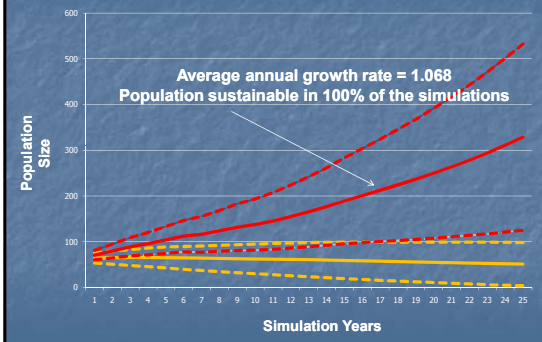


- Bears removed
  - 2006 – 15, at least 3 returned
  - 2007 – 12, 1 returned (11 days)
  - 2008 – 22, at least 8 returned

Did the bear removals increase calf recruitment?

Model	AIC_c	ΔAIC_c	w	# parameters
1. # bears relocated as annual covariate, monthly time trend, by age of mother	189.2	0.00	0.674	4
2. Years before and during bear relocation, monthly time trend, by age of mother	191.5	2.35	0.208	4
3. # bears relocated as annual covariate, monthly time trend	193.4	4.26	0.080	3
4. Years before and during bear relocation, monthly time trend	196.1	6.99	0.020	3
5. Yearly time trend, monthly time trend	197.3	8.16	0.011	3

	2001-2005	2006-2008
Calf survival	0.656	0.714 (9%↑)
Calf production	0.526	0.803 (53%↑)
Calf recruitment	0.354	0.573 (61%↑)
Proportion male calves	0.552	0.595 (7%↑)
Adult male survival	0.690-0.911	0.846-0.947 (11%↑)
Adult female survival	0.724-0.933	0.910-0.970 (13%↑)

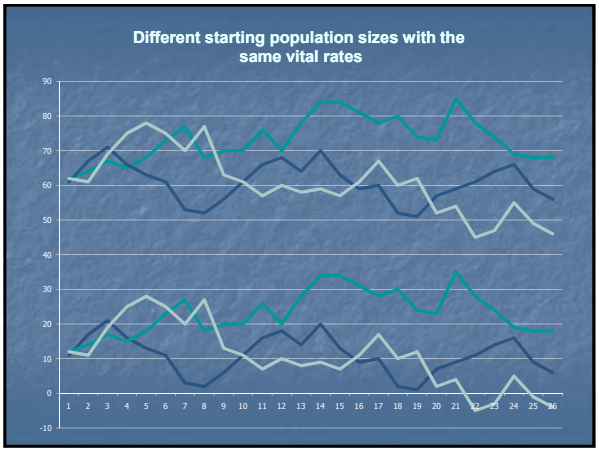


What parameter changes contributed most to increased λ?

Parameter	Parameter change	Contribution to Δλ	Proportional contribution to Δλ
Proportion male calves	0.043	-0.011	-0.090
Calf recruitment age 2 yr	0.147	0.007	0.059
Calf recruitment age 3–9 yr	0.246	0.055	0.451
Calf recruitment age 10–14 yr	0.240	0.019	0.157
Calf recruitment age 15–20 yr	0.025	0.001	0.004
1-yr-old male survival	0.046	0.001	0.008
2–9-yr-old male survival	0.007	0.001	0.005
10–14-yr-old male survival	0.257	0.003	0.024
1-yr-old female survival	0.064	0.010	0.080
2–9-yr-old female survival	0.020	0.014	0.112
10–14-yr-old female survival	0.212	0.023	0.190

Conclusions

- Elk calf recruitment improved
  - Bear relocation effective
  - Changes in habitat use
  - Learning
- Adult survival increased
  - Finding better habitat
  - Exploiting alternative foods (acorns)
  - Learning what to avoid
  - Meningeal worm will be a persistent but perhaps not insurmountable problem
- Growth trajectory positive but small size makes the population vulnerable to stochastic changes in vital rates



Recommendations

- Continue to radio monitor adult females (n=~30)
- Continue to track calf survival (n=~20)
- Determine if bear predation on calves increases again after termination of the program (long-term predator management not recommended)