The Effects of Ski Areas on the Population Dynamics of the Pacific Marten in the Lake Tahoe Region

Preliminary

Results

Keith Slauson and William Zielinski

U.S. Forest Service, Pacific Southwest Research Station

Marten Life History Characteristics

Total Length: 500-680 mm

Weight: 500-1400 g

Sexually dimorphic: adult males 40% larger than females

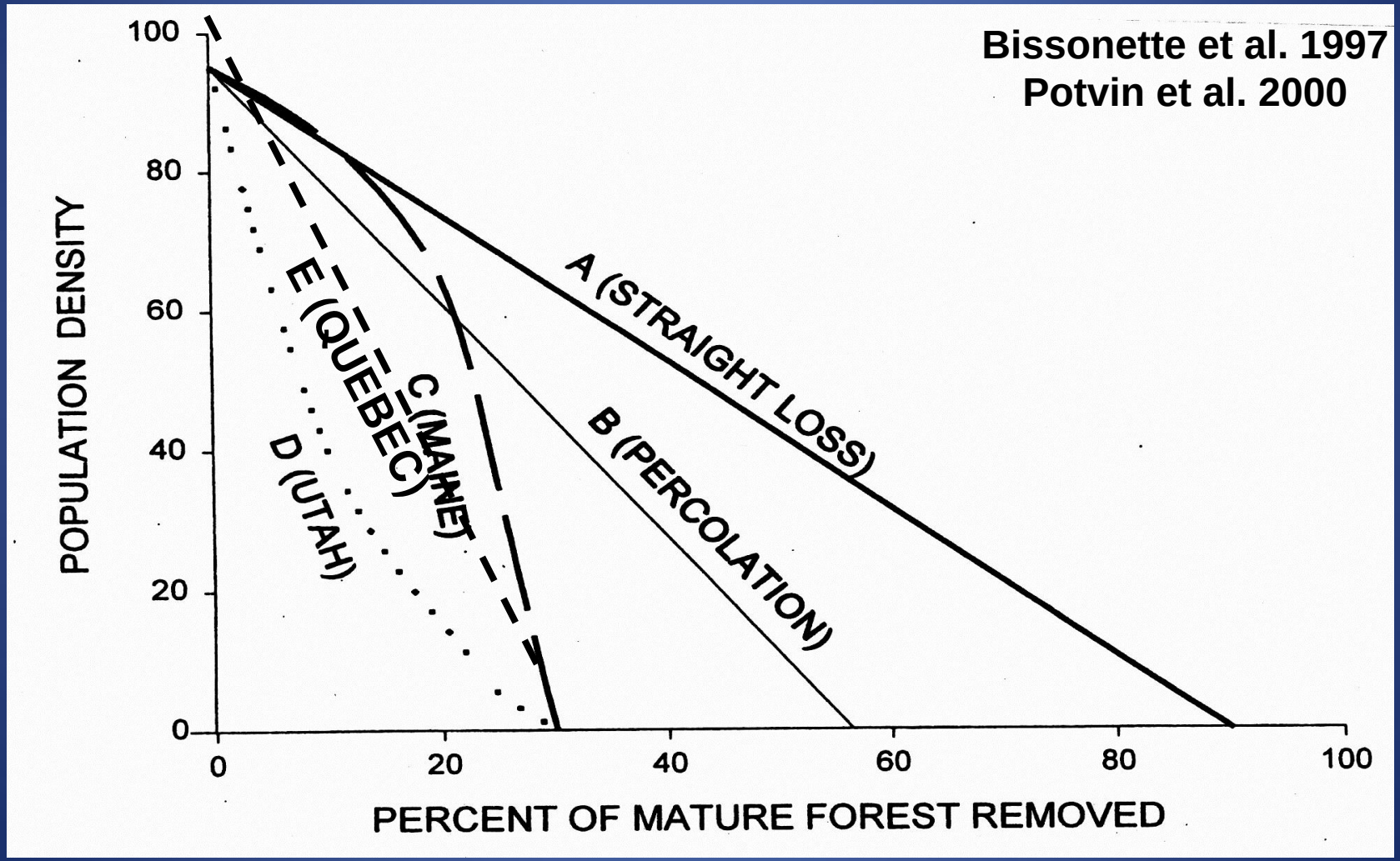
Mating System: Polygamous, females solely responsible for raising young

Reproduction: ≥2 year-old females
1-3 kits / litter

Longevity: Most individuals 5 years

Diet: Varies seasonally, dominated by Squirrels, Voles & Birds

Marten Population Responses to Habitat Fragmentation



Potential Effects of Ski Areas to Martens

Negative: Habitat Fragmentation

of prey

Research Questions

1. **Are population sizes reduced on ski areas?**

   Response variable: marten abundance

2. **Is marten survival lower on ski areas?**

   Response variable: survival estimates (MARK)

3. **Are reproductive females affected by ski area fragmentation?**

   Response variable: distribution of females relative to remnant forest fragments

4. ~~**What is the net effect of ski resort development on marten population persistence?**~~

Study Design: Treatment vs Control

Treatment: Ski Areas

Potential Marten Habitat

- Heavenly Ski Area
- Sierra At Tahoe Ski Area
- Homewood Ski Area

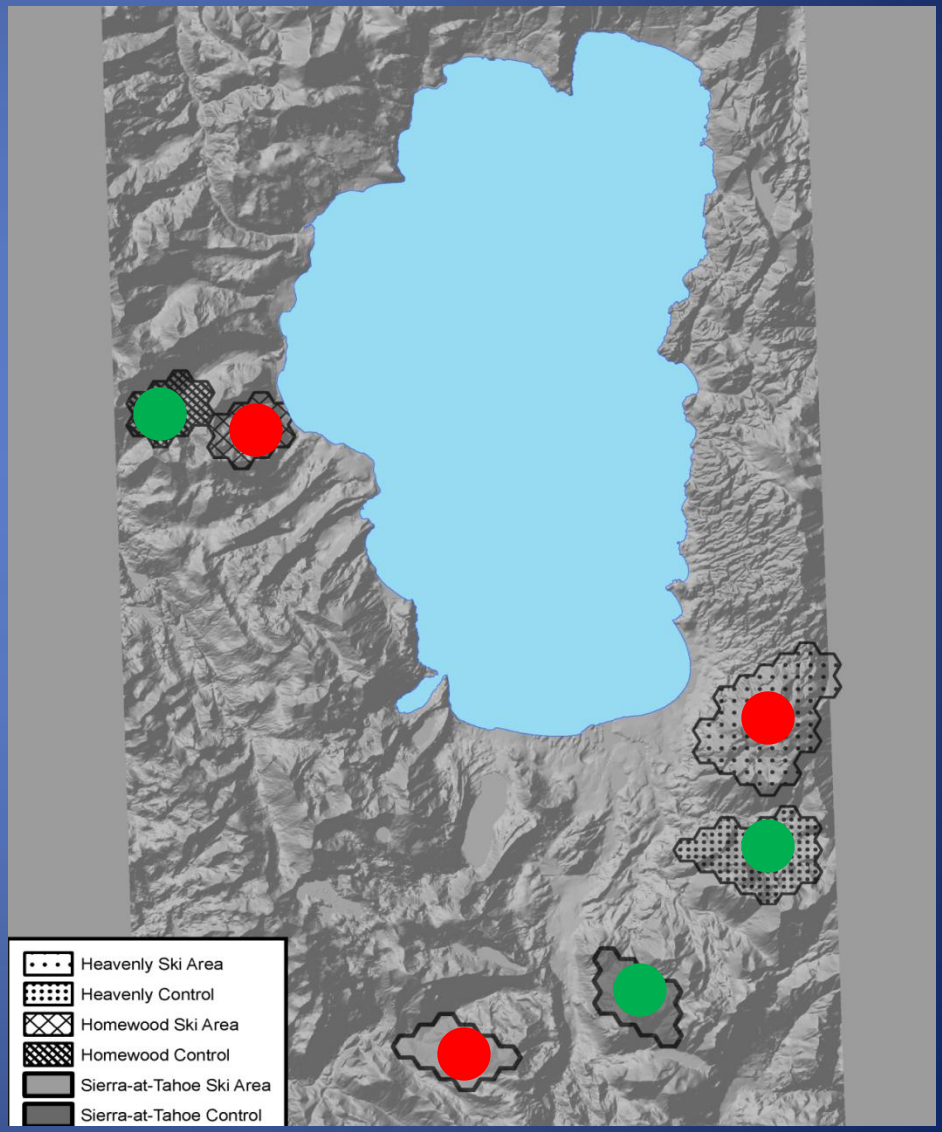
Controls

Pre-development Marten Habitat

Topography

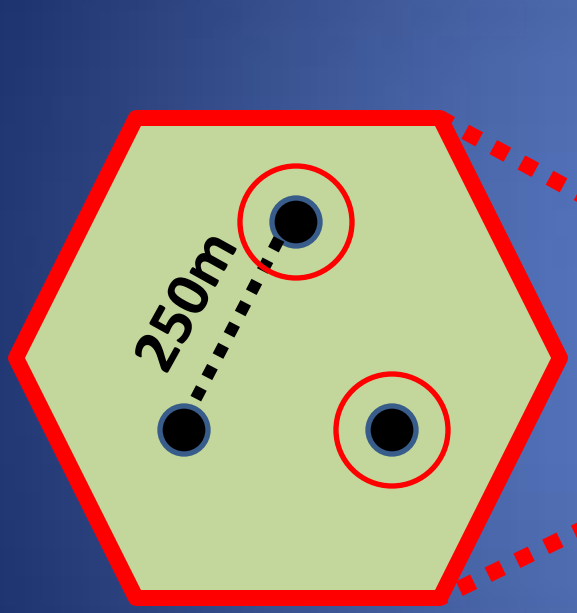
- Elevation Range
- Macro Aspect

Proximity

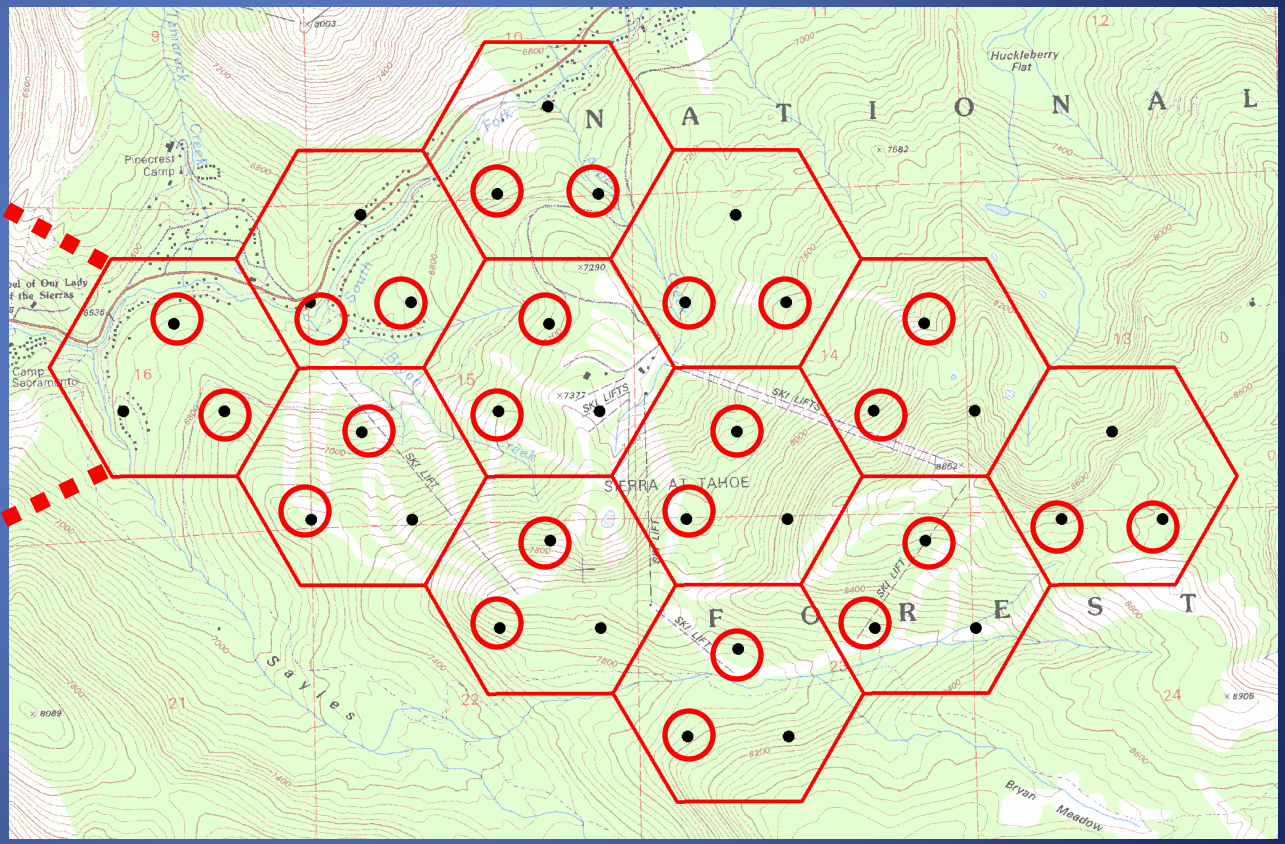


Study Area Sampling Design

Example: Sierra At Tahoe Ski Area



100 ha



Every selected point was sampled for 15 consecutive days during winter of 2009 & each spring 2009-2011

Capture Methods

Winter 2009	Protocol	Spring 2009-2011
January-March		May-July

15-day Station Durations

Winter 5-day Visits

Spring daily Visits

Bait: Chicken
Lure: Gusto

Individual ID

Winter: DNA

Spring: PIT tag

Age
1st premolar

Marten Abundance Does Not Differ Between Ski Areas & Controls

Marten Captures: Winter 2009

	Males	Females
Ski Areas	9	8
Controls	11	11

P > 0.05

Marten Captures: Spring 2009-2011

	Males	Females
Ski Areas	30	14
Controls	31	13

P > 0.05

Survival Modeling in Program Mark

Pradel Model: Survival and Seniority
Robust Design
Closed Population

Model Parameters

Survival (S)

'Seniority' (G) probability that if alive and in the population at time i (this year), that you were also alive and in the population at time i-1 (last year)

Capture Probability (P)

Recapture Probability (C)

Population Size (N)

Marten Survival and Seniority Estimates

Parameter	Estimate (95% CI)	Covariate Effect	
Survival (Winter-Spring)	0.60 (0.44-0.75)		
Survival (Spring-Spring)	0.38 (0.28-0.49)	Control	0.79 (0.11-1.69)
Seniority (Winter-Spring)	0.56 (0.40-0.71)		
Seniority (Spring-Spring)	0.49 (0.35-0.64)	Control	1.67 (0.51-2.82)

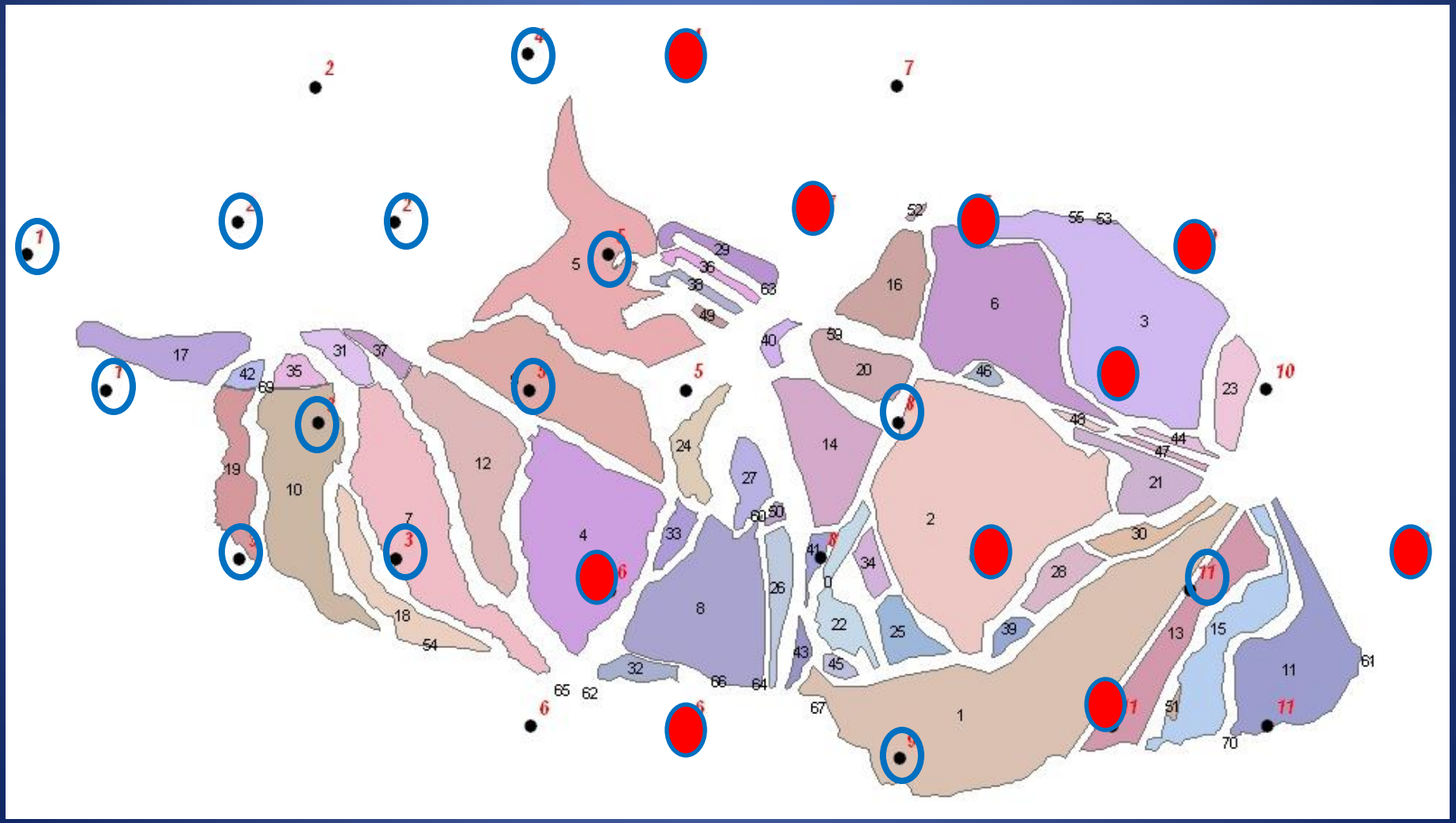
Marten Survival is Significantly *REDUCED* on Ski Areas

Turnover Rates are Significantly *HIGHER* on Ski Areas

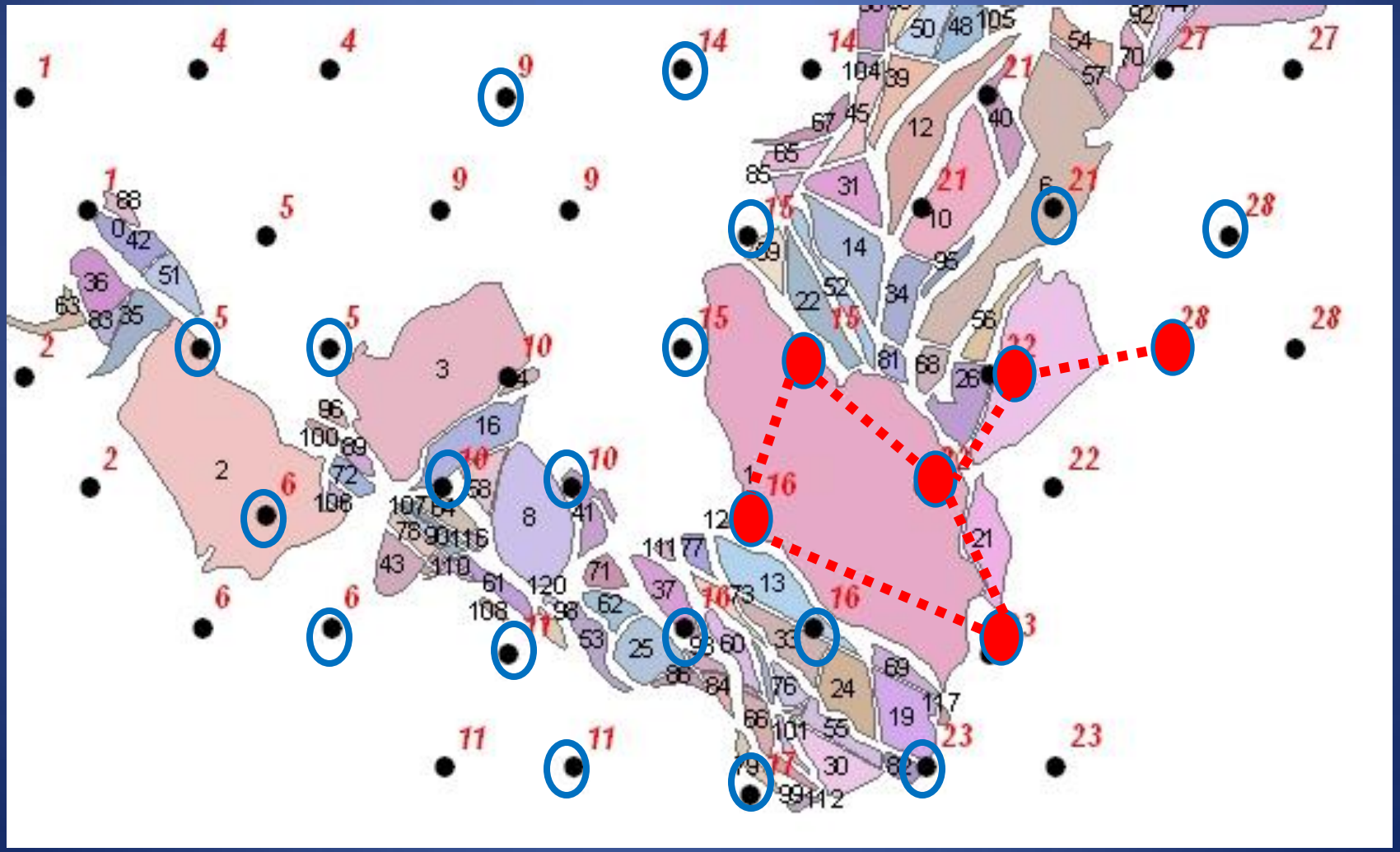
Reproductive Females Captured More Often on Edges of Ski Areas than Controls

	Total	Captured on Edge	Captured in Core	Proportions Test
Ski Areas	14	10	4	*Z-value* *P = 0.06*
Controls	12	5	7	

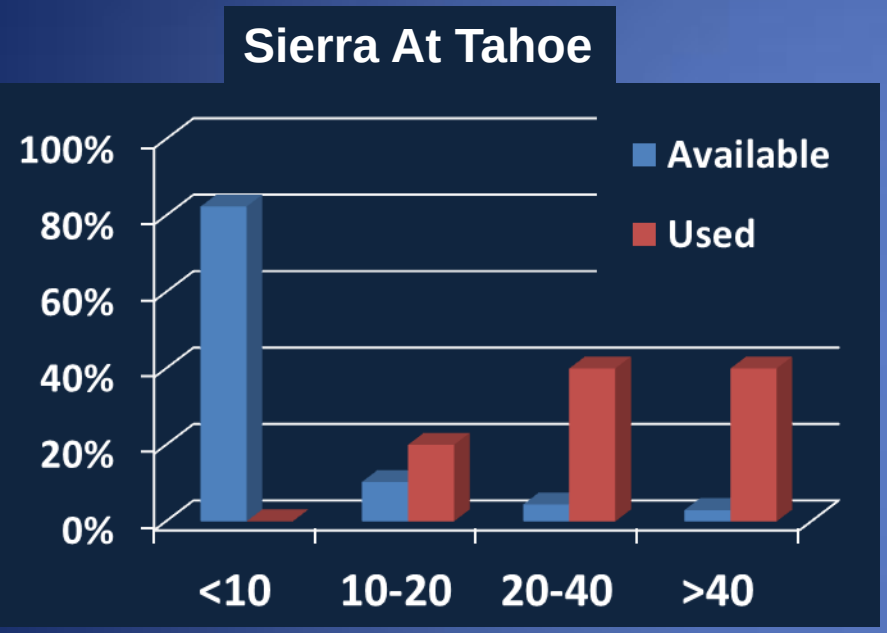
Reproductive Female Capture Locations Sierra At Tahoe 2009-2011

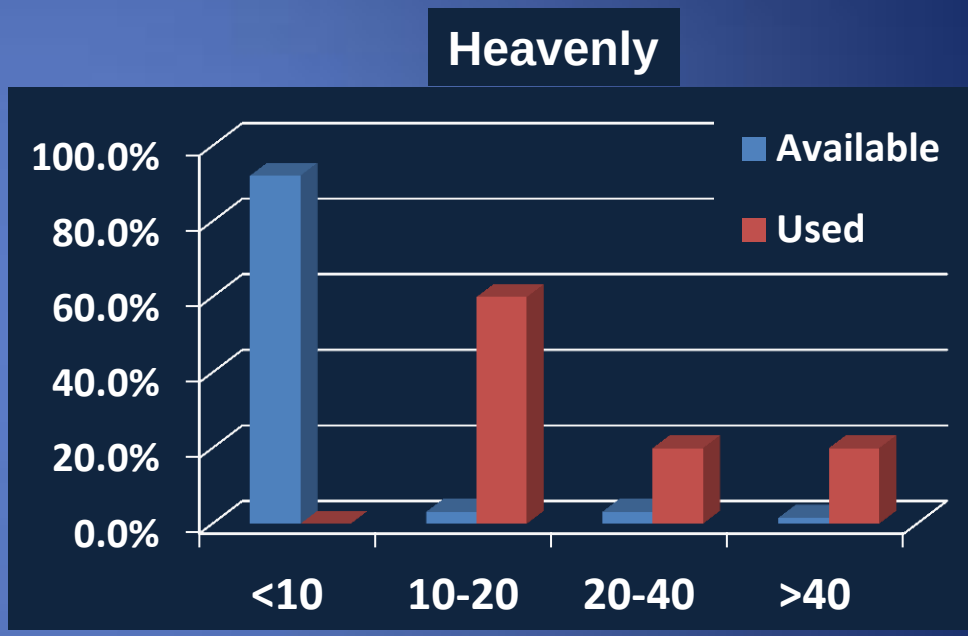


Female-13 Capture Locations on Heavenly Ski Area 2009-2011



Reproductive Females On Ski Areas Use the Largest Remnant Forest Patches





Homewood: 1 residual patch >20 hectares
No reproductive females within operations area

Preliminary Conclusions

- Marten abundance is not affected by ski resorts
- Marten survival is reduced by ski resorts
- Fragmentation from resorts negatively affects the distribution of reproductive females
- Reduced Survival and Reproduction have created population 'sink' conditions on all (Homewood) or portions of resorts (Heavenly & Sierra At Tahoe)

Next Steps

- Parentage analysis to determine recruitment
- Apply female reproductive habitat model to pre-resort development conditions
- Population modeling to quantify magnitude of affects

Acknowledgements

Lake Tahoe Environmental Improvement Program
Sierra Nevada Land Management Act
Tahoe Science Consortium

Lake Tahoe Basin Management Unit
El Dorado National Forest
Tahoe Region Planning Agency

Heavenly Resort
Sierra At Tahoe Resort
Homewood Mountain Resort

Pacific Southwest Research Station

Field Crews: Mark Linnell, Matt Delheimer, Pete Lundberg, Nathan Shea, Katlin Mansfield, Katie Greller, Dustin Marsh, Devin Crenshaw, Natalie Craven, Michelle Rann, Tim Sichmeller, Wes Watts, Conor MacNamara, Natalie Mesce, Kathleen Sholty, Kirsty Lawson