Estimating the Kenai brown bear population on Kenai National Wildlife Refuge and Chugach National Forest in 2010

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Principal investigators

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Why we were (and are) concerned about the Kenai brown bear population….

✓Kenai brown bears designated a *Population of Special Concern* by State of Alaska in 1998

✓DNA analysis confirmed Kenai brown bear population is genetically less diverse than mainland Alaskan brown bears and not panmictic with Anchorage brown bear population (Talbot & Farley 2009)

✓Only estimate of 250-300 brown bears based on multiplying the area of suitable habitat (13,848 km^2) by mean bear density (20 bears per 1000 km^2) from other AK studies

✓Based on 1995-1999 data (IBBST 2001), not clear if population was stable, declining or increasing (λ = 0.9364 – 1.0588)

✓Low estimates of yearling survivorship and small proportion of subadult (2–6 year olds) females in age distribution suggested low recruitment (IBBST 2001)

DNA-based mark-recapture estimate of Kenai brown bear population

Objective: to estimate the brown bear population on the Kenai Peninsula ± 25% of the true population (N)

Simple Lincoln-Petersen Estimator

$R/M = C/N$

N = Estimate of total population size
M = Total number of animals captured and marked on the first visit
C = Total number of animals captured on the second visit
R = Number of animals captured on the first visit that were then recaptured on the second visit

Simple Lincoln-Petersen Estimator

$$N = MC/R$$

N = Estimate of total population size
M = Total number of animals captured and marked on the first visit
C = Total number of animals captured on the second visit
R = Number of animals captured on the first visit that were then recaptured on the second visit

…the key is that the estimate is not based on the number of individuals marked (i.e., genotypes) but on their recapture rates

Assumptions of Mark-Recapture Model

✓ No individuals die, are born, move into the study area (immigrate) or move out of the study area (emigrate) between visits

✓ No marks fall off animals between visits, and that the researcher correctly records all marks

✓ Equal capture probability of individuals
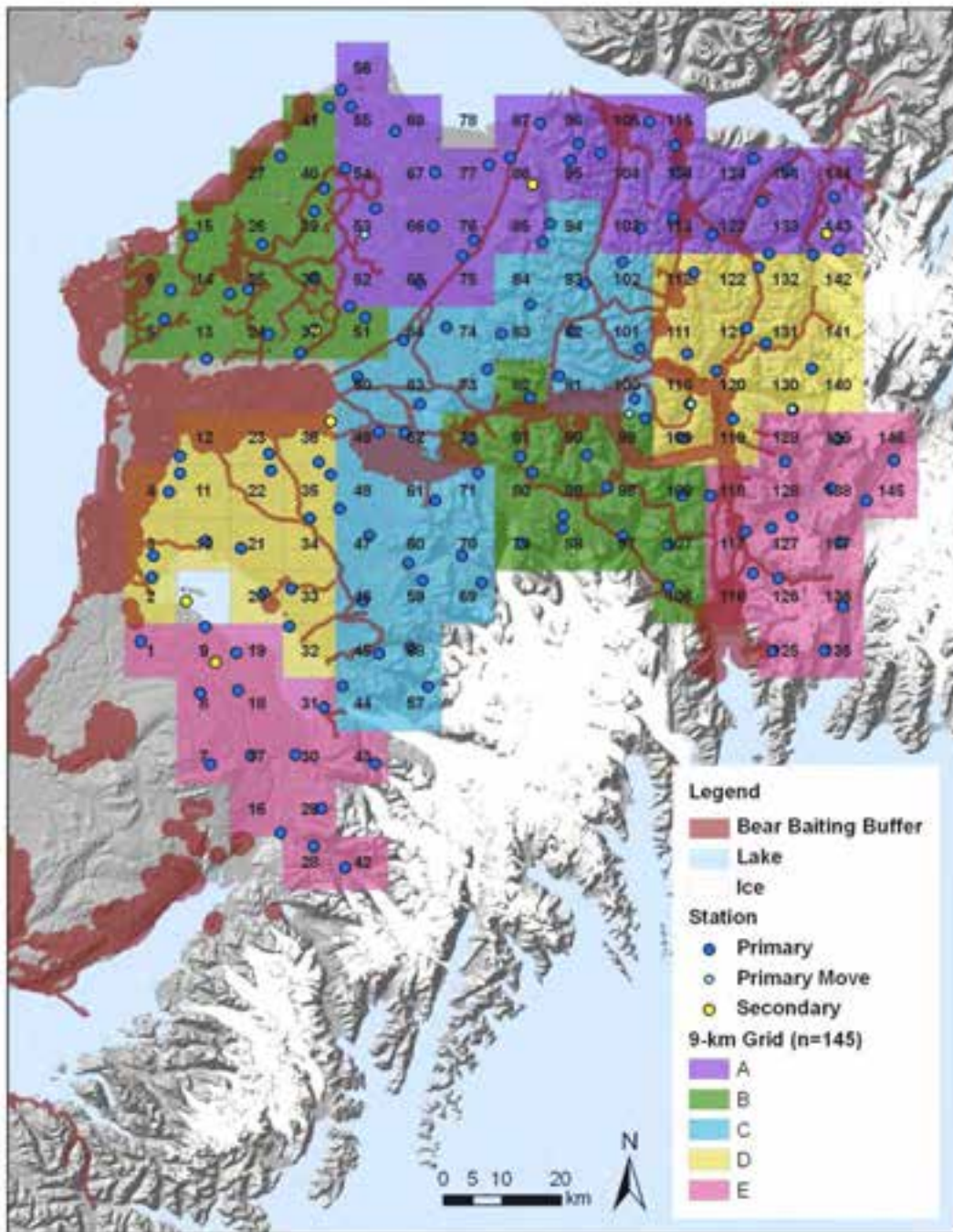
145 primary hair stations subjectively placed within 81-km^2 cells systematically distributed over 11,500 km^2 study area

29 stations sampled daily over five 5-day trap sessions using rotating panel design

Legend
- Bear Baiting Buffer
- Lake
- Ice

Station
- Primary
- Primary Move
- Secondary

9-km Grid (n=145)
- A
- B
- C
- D
- E

0 5 10 20 km

N

Selection criteria for hair stations

- ✓ adequate space for helicopter access
- ✓ >200m from trails, cabins, roads
- ✓ riparian/wetland corridors
- ✓ other travel corridors (ridges, shoulders, chutes)
- ✓ OTBE, ensure good spatial separation among sites within a cell

ADF&G black bear baiting restrictions

no baiting within 1 mile of any residence, including seasonally occupied dwellings, developed recreational facilities or campgrounds;

no baiting within 1/4 mile of any publicly-maintained road, trail, or the Alaska Railroad;

no baiting within 1/4 mile from the shoreline of the Kenai, Kasilof and Swanson Rivers (including Kenai and Skilak Lakes).
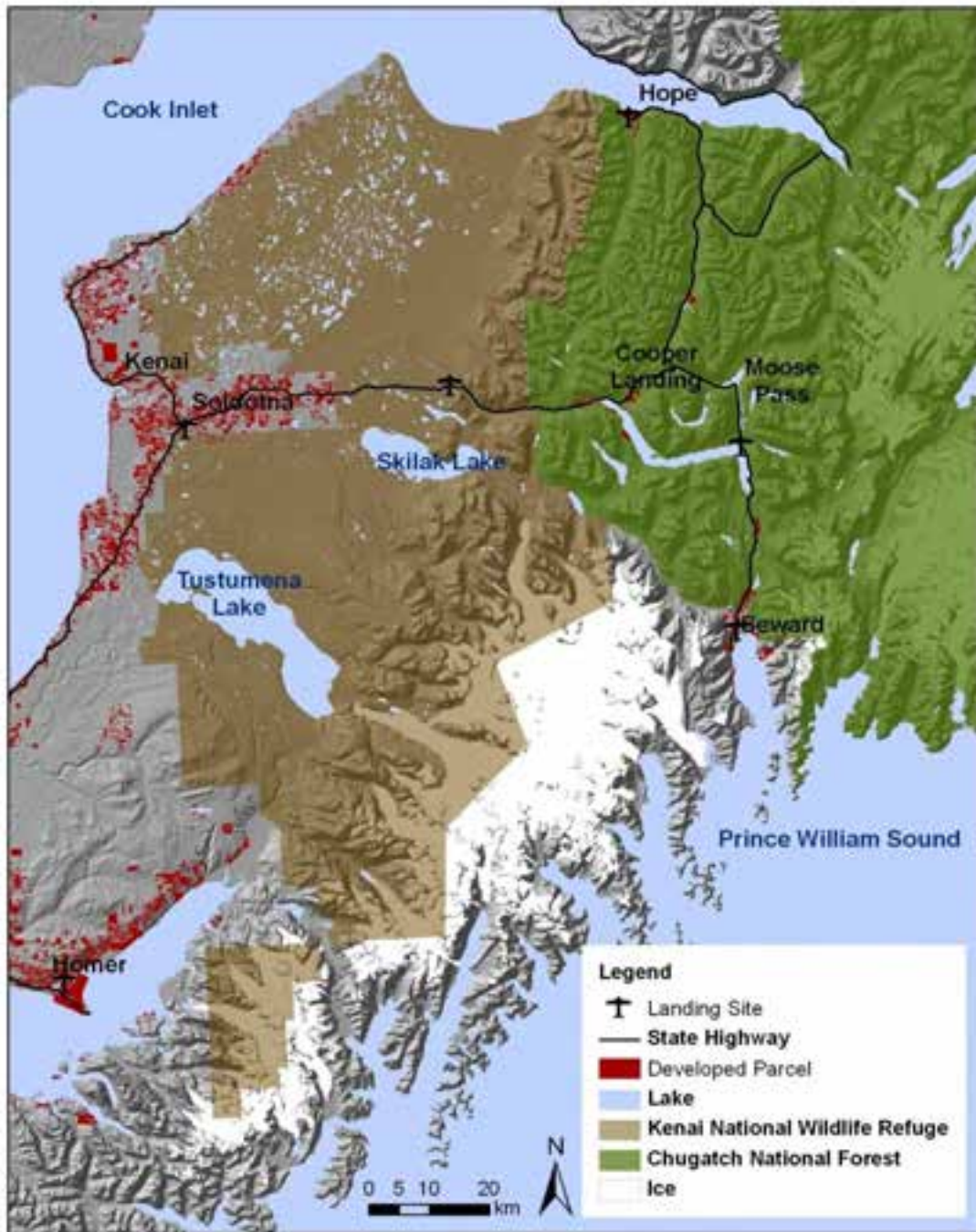
Four sets of 2-person field crews operated out of Moose Pass and Soldotna for 31 consecutive days

Training

General seasonal refuge staff orientation (1 day)
Bear safety training [range, classroom] (1 day)
First Aid/CPR training (1 day)
B3 Aviation Safety training (1 day)
Bear project training (2.5 days)

1MINUTE   07   JUN.19,10 08:00 AM

1MINUTE   07   JUN.19,10 08:10 AM

11,175 hair samples (grid) **+** 91 hair samples (rub tree)
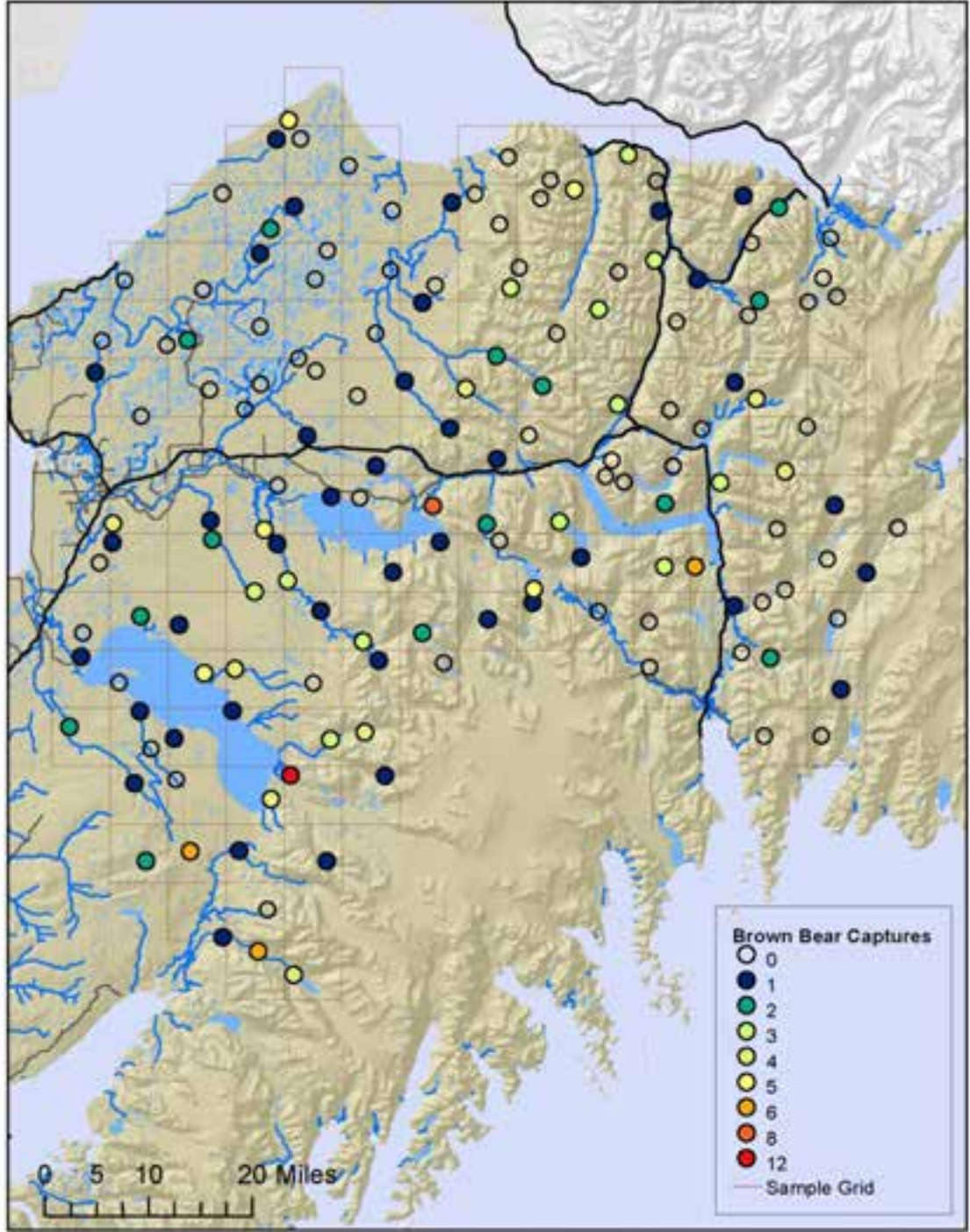
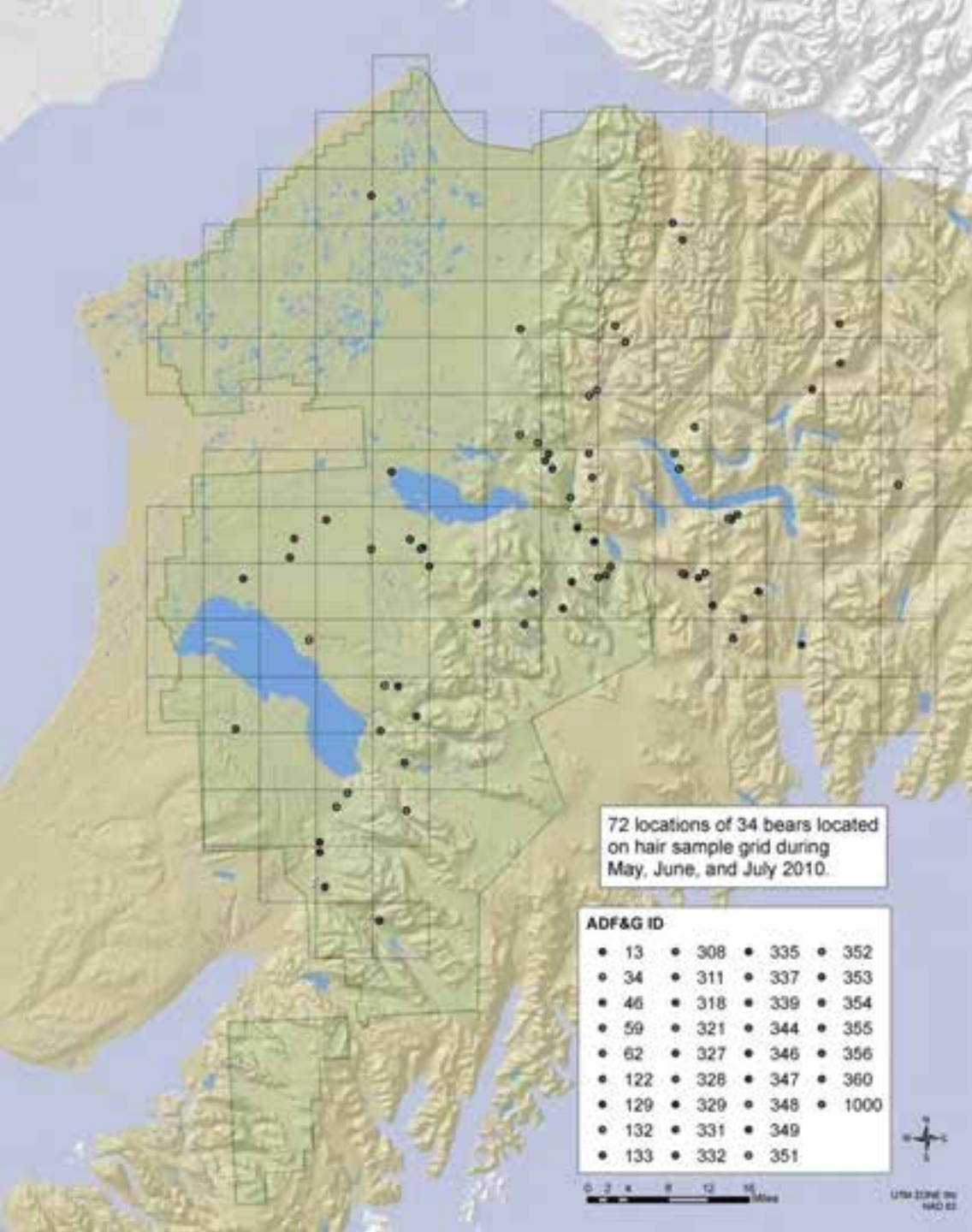11,266 hair samples

2,671 DNA samples

1,034 brown bear samples

211 unique genotypes

104 males **+** 99 females (n = 203)

Distribution of 211 brown bear captures at 145 primary + 7 secondary hair stations

Brown Bear Captures
- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 8
- 12
- Sample Grid

0 5 10   20 Miles

72 locations of 34 bears located on hair sample grid during May, June, and July 2010.

ADF&G ID

• 13	• 308	• 335	• 352
• 34	• 311	• 337	• 353
• 46	• 318	• 339	• 354
• 59	• 321	• 344	• 355
• 62	• 327	• 346	• 356
• 122	• 328	• 347	• 360
• 129	• 329	• 348	• 1000
• 132	• 331	• 349	
• 133	• 332	• 351	

UTM ZONE 9N
NAD 83

**Of 39 females collared by ADF&G,
34 were on study area**

Capture rates were relatively low

Sex	Occasion	Estimate	SE	95% Lognormal CI	
				LCI	UCI
	1	**0.0376**	0.0106	0.0215	0.0650
	2	**0.0902**	0.0198	0.0581	0.1372
Female	3	**0.0783**	0.0179	0.0497	0.1213
	4	**0.1061**	0.0224	0.0696	0.1585
	5	**0.1101**	0.0230	0.0724	0.1639
	1	**0.0595**	0.0156	0.0353	0.0986
	2	**0.1381**	0.0272	0.0928	0.2005
Male	3	**0.1208**	0.0249	0.0799	0.1785
	4	**0.1610**	0.0302	0.1101	0.2294
	5	**0.1667**	0.0310	0.1144	0.2365

Brown bear population estimate (all ages) on 11,700 km² sample frame

GRID ONLY

Sex	Estimate	SE	$M(t+1)$	95% Lognormal CI	
				LCI	UCI
Females	114.2	17.1	65	90.4	160.4
Males	194.1	26.4	101	155.0	261.5
Combined	308.3	31.8	166	258.3	385.4

How did we improve our estimate when capture rates were low?

✓ **We adjusted capture probability using elevation, distance to edge, and sex as covariates**

✓ **We added a 6th trap occasion with bears known to be alive and on the study area (telemetered bears, rub trees)**

✓ **We used model-averaged estimates to ensure robustness**

Brown bear population estimate (all ages) on 11,700 km² sample frame

GRID + telemetry data + rub trees

Sex	Estimate	SE	$M(t+1)$	95% Lognormal CI	
				LCI	UCI
Females	214.6	33.7	99	165.0	301.3
Males	213.1	30.9	104	167.2	292.2
Combined	427.6	46.7	203	353.2	539.1

428 (353-539) brown bears population estimate (all ages) on 11,700 km^2 sample frame
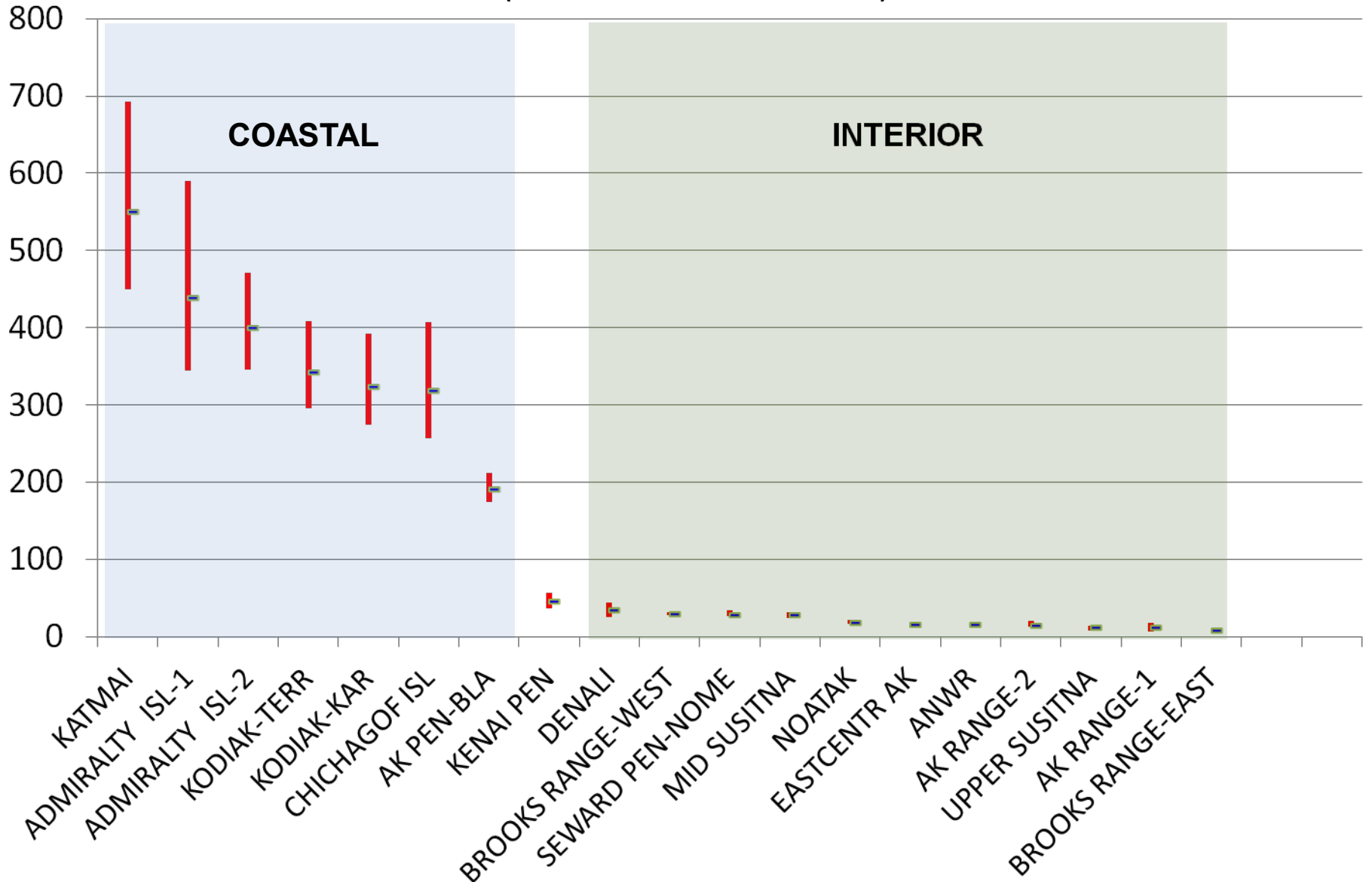
or 9,500 km^2 available habitat

≈ 45.1 bears per 1,000 km^2

≈ 624 bears on the KP (504-772)

≈ 200 reproductive age females

ALASKA BROWN BEAR DENSITIES (PER 1000 KM^2)
(after Miller et al. 1997)

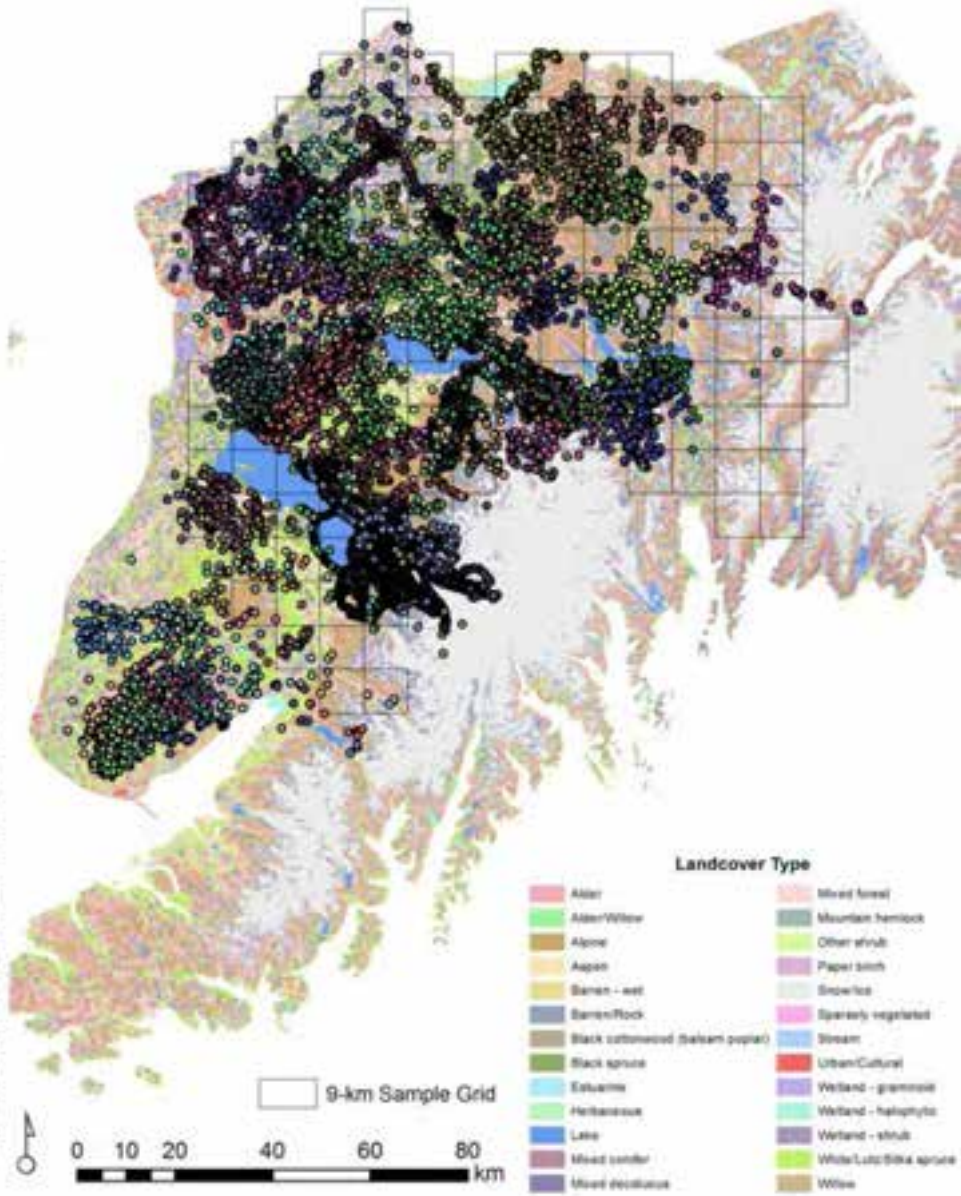# How representative of the Kenai Peninsula is this density estimate?

Landcover types	Study area 1,174,500 ha	Kenai Peninsula 2,433,777 ha
Alpine	16.7%	11.9%
Mixed forest	13.8%	9.6%
Black spruce	11.2%	6.2%
Alder	10.3%	9.8%
White/Lutz/Sitka spruce	8.9%	9.7%
Snow/Ice	6.5%	20.1%
Barren/Rock	6.3%	5.2%
Lake	5.9%	4.0%
Wetland – graminoid	3.6%	3.6%
Mountain hemlock	3.3%	2.5%
Mixed conifer	2.4%	3.8%
Paper birch	2.3%	1.7%
Sparsely vegetated	1.6%	1.8%
Willow	1.2%	1.7%
Barren – wet	1.0%	2.1%
Herbaceous	0.8%	0.9%
Stream	0.8%	0.7%
Wetland - shrub	0.7%	1.0%
Other shrub	0.6%	0.7%
Mixed deciduous	0.5%	0.4%
Alder/Willow	0.4%	0.5%
Black cottonwood (balsam poplar)	0.4%	0.3%
Urban/Cultural	0.3%	0.6%
Aspen	0.2%	0.2%
Wetland - halophytic	0.2%	0.9%
Estuarine	0.0%	0.1%

Kenai Peninsula Land Cover

Legend:
- Black spruce
- White spruce
- Black/White spruce
- Sitka spruce
- White/Lutz/Sitka spruce
- Mountain hemlock
- Mixed conifer
- Aspen
- Paper birch
- Black cottonwood (balsam poplar)
- Mixed deciduous
- Mixed forest
- Alder
- Willow
- Alder/Willow
- Other shrub
- Herbaceous
- Alpine - lichen
- Alpine - herbaceous
- Alpine - scrub
- Moss
- Peatland - herbaceous
- Peatland - shrub
- Halophytic wetland
- Stream
- Lake
- Estuarine
- Snow/ice
- Sparsely vegetated
- Barren
- Barren - wet
- Rock
- Urban/Cultural
- Disturbed

Distribution of 144,024 telemetry locations from 125 female brown bears with GPS and VHF collars (1987-2005)

►87% were on study area
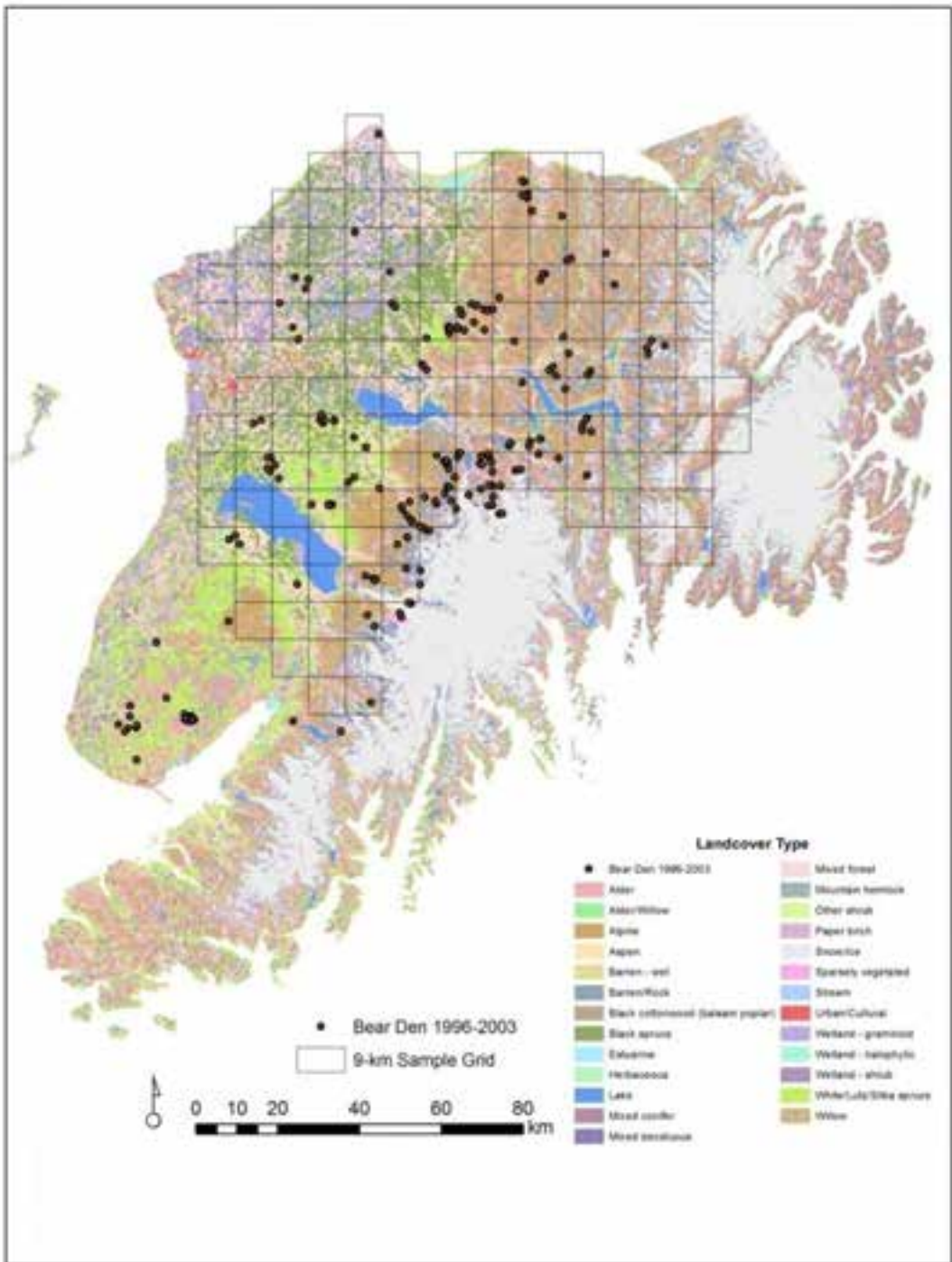
Distribution of dens from 74 brown bear sows during (1996-2003)

►**84% denned on study area**

What are the management implications for Kenai brown bears?

✓ **Represents baseline estimate of the Kenai brown bear population**

✓ **Puts human-caused mortality (legal harvest, illegal take, vehicle collisions and DLPs) into better context**

✓ **Helps determine sustainable harvest of reproductive-age females**

Was it Peer Reviewed?

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Questions????