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Impacts of Heavy Hunting Pressure on the Density and Demographics of Brown Bear Populations in Southcentral Alaska

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Frank Rue, Commissioner

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RESEARCH PROGRESS REPORT

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SUMMARY

From 18 May–1 June, 1998, we applied a Capture-Mark-Resight (CMR) technique to brown bears in a 2150 square kilometer portion of Game Management Unit 13A, following guidelines developed by Miller et al. (1997). The study area was chosen to represent habitats ranging from high mountain ridges in the Talkeetna Mountains to lower elevation (800 m) spruce bog in the Lake Louise Flats. It was also chosen to encompass important concentrations of calving moose and caribou in the drainages of Tyone Creek and the Oshetna, Little Oshetna, and Black Rivers. The average densities of independent bears, bears >2 years old, and all bears during the 5 survey days were 21.3 (95% CI = 18.3-25.9), 21.6 (18.47-26.3), and 27.49 (25.2-30.7). All of these categorizations have some tendency to underestimate variability expressed by 95% confidence intervals, especially due to the dependence of certain observations (e.g., sibling groups, sows with 2-year-old cubs, and sows with younger cubs). The density of brown bears in the Nelchina Study Area is very similar to that in southeastern Unit 13E and is among the higher estimates for brown bears in Interior and northern Alaska.

Key Words: Alaska Brown bear, cub survivorship, grizzly bear, hunting impacts, intensive management, mortality rate, population composition, survivorship rates, *Ursus arctos*.

CONTENTS

BACKGROUND

The Board of Game has set an objective of a 50% reduction of brown bear numbers in Game Management Unit 13A to improve survival of moose calves. An estimate of bear density is necessary to monitor effects of liberalized bear regulations and provide a baseline for the reduction in bear numbers. It also is an important component of our understanding of predator-prey relations in Unit 13. From 18 May–1 June 1998, we applied a Capture-Mark-Resight (CMR) technique to brown bears in a 2150 square kilometer portion of Unit 13A, following guidelines developed by Miller et al. (1997). The estimation of bear density this spring was the culmination of a 3-year effort begun by Sterling Miller with 2 years of premarking in 1996 and 1997.

METHODS

The study area for density estimation was chosen to represent habitats ranging from high mountain ridges in the Talkeetna Mountains to lower elevation (800 m) spruce bogs in the Lake Louise Flats (Fig. 1). It was also chosen to encompass important concentrations of calving moose and caribou in the drainages of Tyone Creek and the Oshetna, Little Oshetna, and Black Rivers. A recent estimate of brown bear density was made in the SE part of Unit 13E (S.D. Miller 1995), and the density of brown bears in this part of Unit 13A was expected to be similar, based on similar rates and patterns of moose calf mortality (Testa 1997).

CMR methods require that animals with radio collars be found within the study area boundary on the day (i) of each survey by an observer using a radio receiver and fixed-wing aircraft. These animals were considered "marks at risk," M_i, and this number was determined each day of the survey by a pilot/observer team that was not involved in subsequent visual searching that day. The remaining planes searched for all bears that they could find visually and determine whether they were collared with functioning radio collars (marked bears seen, or m_i) or "unmarked" (u_i). The key assumptions were that marked and unmarked bears each day were equally sightable; this was partially assured by making the aerial searching and telemetry determination of marks at risk independent of one another. Neither needs to be exhaustive, but precision is increased by increasing M_i and m_i. We premarked female bears in 1996 and 1997, but the density estimate was planned to include ongoing marking of boars and sows during the density estimates (Miller 1997).

RESULTS

We began flying surveys and capturing additional bears on 19 May. Wind in the mountains forced us to stop flying when only 70% and 50% of the survey was completed on 19 and 20 May, respectively. Conditions on both days were poor, with partial snow cover on much of the area, poor lighting, and gusty winds. No survey was possible on 21 May, although we did some capture work. The survey on 22 May was 90% complete when ongoing drizzle turned to snow and ice, forcing planes home. Because the unsurveyed portions were minor (only 2 of the 10 survey areas were incomplete) in relation to normal bear movements and the distribution of collared and uncollared bears, this survey was considered adequate to meet the assumption of equal sightability. On the following day (23 May) there was 6–10" of new snow on the entire area. Tracking conditions in the higher elevations made sighting probabilities excellent, while conditions in the lower hills with higher vegetation and numerous moose and caribou remained difficult for spotters. Following the airplane crash of Webb and Bowen that day, we halted operations for a day and began again on May 24. Spotting conditions were, again, difficult in middle elevations where snow or ground was patchy, but sighting probabilities of bears were good in comparison to other studies (Miller et al. 1997). We completed field operations from Mendeltna on May 25 but elected to mount one more survey without helicopter captures a week later. This was done to address a concern with small numbers of uncollared bears seen in the last 2 surveys, a possible indication of sighting heterogeneity that would bias population estimates (see below). After a weather delay, we completed the final survey on 1 June.

Bears captured and seen each day are shown in Table 1. Results using the Immigration-Emigration Joint Hypergeometric Estimator (IEJHE) described by White (1996) and Miller et al. (1997) are given in Table 2. The average densities of independent bears, bears >2 years old, and all bears during the 5 survey days were 21.3 (95% CI = 18.3-25.9), 21.6 (18.47-26.3), and 27.49 (25.2-30.7). Miller et al. (1997) discussed the merits of each categorization. All have some tendency to underestimate variability expressed by 95% confidence intervals, especially due to the dependence of certain observations (e.g., sibling groups, sows with 2-year-old cubs, and sows with younger cubs). The density of brown bears in the Nelchina Study Area seems very similar to that in southeastern Unit 13E, where Miller (1995) performed a CMR estimation in 1995, and is among the higher estimates for brown bears in Interior and northern Alaska (Miller et al. 1997).

Search intensity and bears seen per hour of search time on each survey day are shown in Table 3. Search parameters from the 4 most recent CMR estimates in Unit 13 are compared in Table 4. Sighting probability of marked bears was somewhat better than that for the Middle Susitna study area, which contains more extensive stands of boreal forest than the Nelchina Study Area, but not as high as the Upper Susitna, which contains more open habitat. Search intensity for this study was less than the others but produced more bears seen per hour of search time.

The number of unmarked bears seen each day was highly variable and strongly influenced the daily Lincoln–Petersen estimates (Fig. 2). This was especially apparent on day 2, when fresh snow made sighting conditions in higher elevations excellent and on days 3 and 4 when conditions returned to "normal" and unmarked bears were difficult to find. The effect of this on days 3 and 4 was partly masked by the inclusion in the "unmarked" category (u_i) of several radiocollared bears not found in the study area during the telemetry search but seen by spotters. This usually involved male bears with eartag transmitters of limited range or bears crossing the boundary of the area during the day. The independence of radiotracking to determine marked bears "at risk" to resighting and the survey for all bears by spotter planes necessitate designating such bears as "unmarked" in the survey when they are seen (u_i).

DISCUSSION

The variation in proportions of unmarked bears in the sighted sample indicates possible differences (heterogeneity) in the sighting probabilities of radiocollared and uncollared bears. The possible behavioral difference between radiocollared bears and those never captured would cause an underestimate in bear density by roughly the proportion of bears that are difficult or impossible to capture using spotters and helicopter darting. That proportion is unknown. However, after a 7-day interval of no flying, the number of unmarked bears seen by spotters increased substantially in the 5th survey, indicating that a rest from aircraft harassment may help alleviate the problem. Immigration of unmarked bears into the area may also have contributed to the increase in u_5, but little change was seen in M_5 or T_5 even though there were several outlying radiocollared bears that could have entered the study area.

Several instances occurred in which bears with functioning radiocollars were not heard on telemetry flights but were later seen by spotters. This usually involved eartag attachments of radiotransmitters that had substandard range. It is recommended that future use of eartag transmitters only occur when range of the transmitter can be tested and found comparable to transmitters on collars. Placing collars on large boars has not been reliable in the past, so some alternative attachment is necessary if large boars are to be included in the marked population.

The occurrence of bears radiotracked to points outside study area boundaries but seen at some other time of the day within the area demonstrates some difficulties with assuring closure of the population during the day. The reverse also undoubtedly occurs, indicating that some errors occur in defining when a bear is truly "at risk" to resighting or in delimiting the target population's actual area. With some cost in precision, this problem may be alleviated either by assigning boundaries for the telemetry search that lie within a buffer area that would assure that marked bears remain inside the area searched by spotter aircraft or by conducting the telemetry searches in smaller areas in immediate association with the spotter aircraft. The latter approach could become logistically difficult, requiring more intensive flying. The presence of radiotracking aircraft also provides clues to radiocollared bears that might affect their detection, creating bias in our estimates.

We now have 2 recent estimates of brown bear density in 2 parts of Unit 13. While these may not be representative of the entire unit, they are from areas of importance for moose and caribou production and can serve as useful indices of bear abundance in surrounding areas. We are at the beginning of a management regime that calls for reducing the number of bears in order to improve production of their ungulate prey in Unit 13. We need to be prepared to monitor reductions in bear numbers and changes in population parameters in both bears and their prey. Rates of bear harvest, even if doubled from the current sustainable rate of 5%, will reduce bear numbers only slowly to the 50% reduction called for by the Board of Game. Careful monitoring of that harvest should continue, and we recommend some thought be given to spatial analysis of both harvest and radiotelemetry data. Although we cannot direct harvest experimentally, there may well be spatial patterns to the harvest that lead to different predictions for spatial patterns in survival of moose and caribou calves and in density-dependent population responses by bears, such as increasing litter size and cub survival. These population responses can only be monitored by maintaining a representative marked population of bears in the area and continued radiotracking in spring and fall at a minimum.

We also believe that radiocollared bears are underutilized with respect to behavioral and ecological questions that might be addressed. Predation by bears on moose and caribou calves is an important phenomenon in this ecosystem, yet rates of predation by various sex–age categories of bears are poorly known and conditions that lead to vulnerable or resistant prey are unknown. Prey-switching by bears as caribou leave the calving areas around the Oshetna River may also be an important element in nearby moose calf survival.

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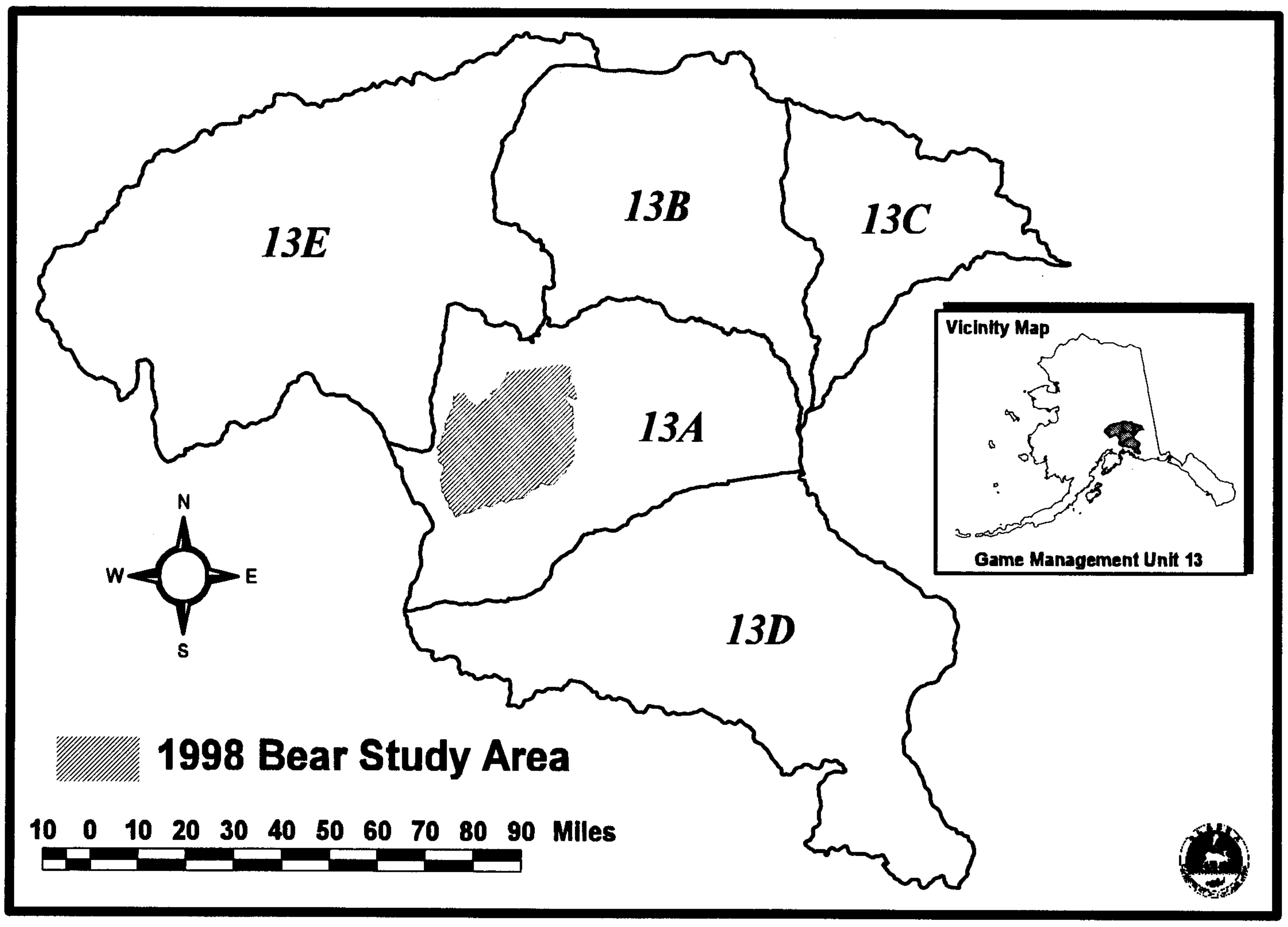


Figure 1. Area of Capture-Mark-Recapture (CMR) estimation of brown density within Game Management Unit 13, southcentral Alaska.

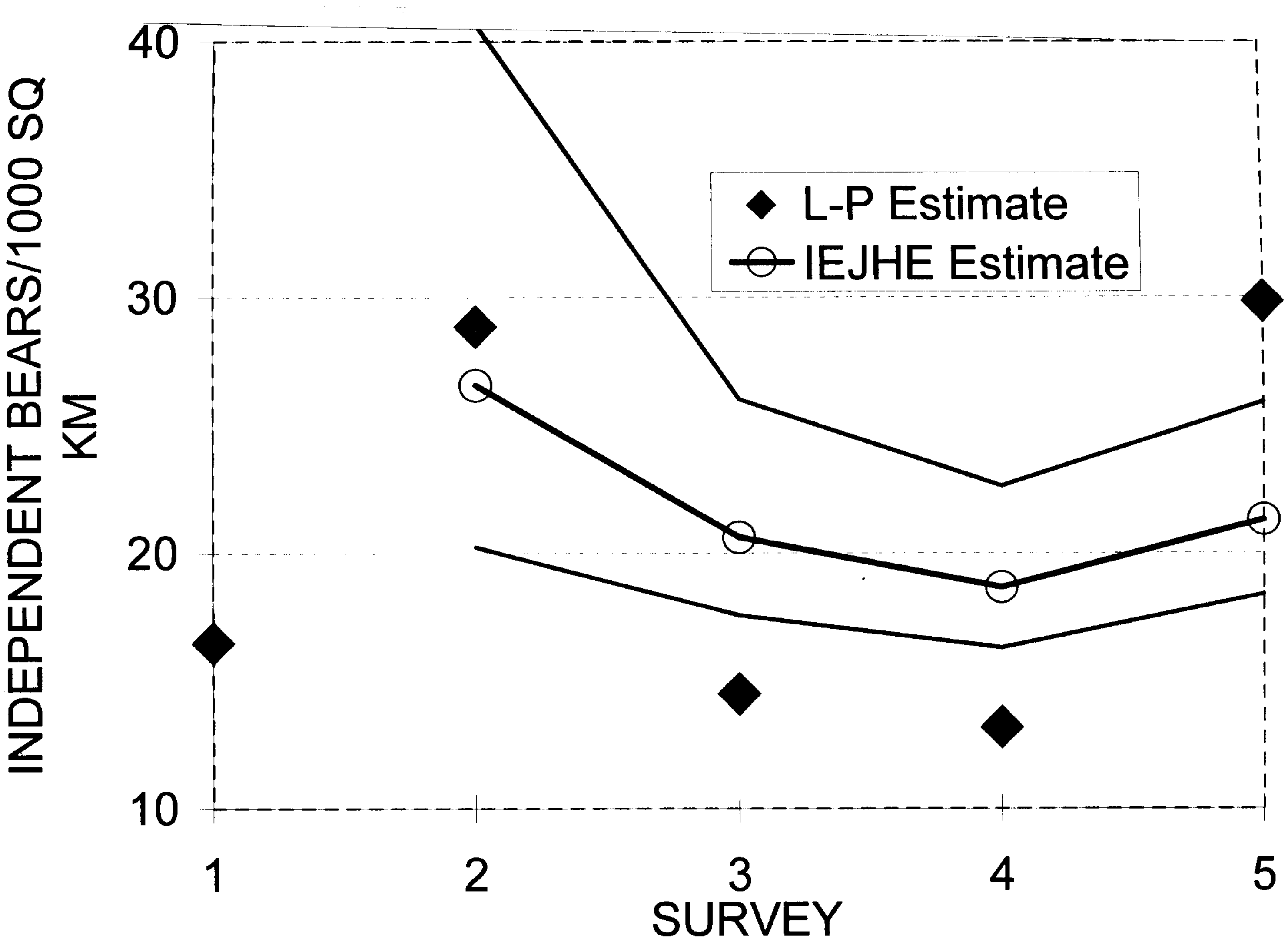


Figure 2. Daily estimates of brown bear density in the Nelchina Study Area, southcentral Alaska by Lincoln-Petersen (L-P) and Immigration-Emigration Joint Hypergeometric (IEJHE) estimators (Miller et al. 1997). The 95% confidence interval is shown for the IEJHE.

Table 1 Capture and sighting histories of brown bears during Capture-Mark-Resighting study in Unit 13A during spring 1998. Sighting codes are 2 = radio in area and bear seen by spotters, 1 = radio in area but bear not seen, 0 = radio heard outside area, blank = radio not heard and bear not seen, -1 = radio not heard but bear seen by spotters, -2 = radio heard outside area but bear seen in area, * = new capture after bear seen by spotters.

		Cubs			Month/Day							
Bear	Sex	new	1-yr	2-yr	5/19	5/20	5/21	5/22	5/23	5/25	5/26	6/1
334	F		1							0	0	0
526	F							1	1	2	1	1
528	F		1					1	-2	2	1	-1
530	F		2		1	1		2	1	2		1
532	F				1	1		1	1	1	1	1
533	F					1		0	0	-2	0	1
536	F	3							1	0	0	0
537	F								1	2	2	1
540	F		1					2	2	1	1	1
541	F		2		1					0	0	1
542	M							*	2	2	0	0
546	F		2		1	1		2	2	2	1	1
549	F											
550	F								0			
554	M					*				1	1	1
555	F											
556	F	2							0	0		
560	F							0		1	0	
563	F	2			1			2	1	2	2	2
564	F			3*				2	1	2	2	2
565	F	3						1	1	0	0	0
567	F				1			0	1	0	0	0
569	F								0			
570	F									0		
571	M				*			-1	2	1	-2	-1
572	F							0	1	0	0	0
573	M							1	1		1	1
574	F							1	0			0
577	F	2			1	1		2	1	2	2	2
578	M									2	2	2
580	M								1			
581	F				*	1			0	0	0	0
582	F		2		*			1	1	2	2	1
583	M					*		1	2	1	1	1
584	F					*		1	1	1	1	2
585	M					*		1	1	2	2	1
586	M							*	*	1	1	2
587	M							*	2	0	0	1

Table 1 Continued

		Cubs			Month/Day							
Bear	Sex	new	1-yr	2-yr	5/19	5/20	5/21	5/22	5/23	5/25	5/26	6/1
588	F	2					*		2	1	1	1
589	M							*		1	2	1
590	M							*		2	1	0
591	F			2				*				
592	M							*		1		
593	F							*		-2		
594	M								*		1	1
544*	M					*		-1	-1	-1		-1
							T(i)*	16	26	34	35	37
							M(i)	16	23	24	21	23
							m(i)	6	7	13	8	6
							u(i)	8	13	4	3	12

* *T(i)*, *M(i)*, *m(i)* and *u(i)* represent cumulative marked bears observed in the study area, number of marked bears at risk, number of marked bears seen by spotters, and number of unmarked bears, respectively, seen on day *i*. Bear 564 was not seen with cubs after her initial sighting.

Table 2. Estimates of brown bear density (bears/1000 km^2) and 95% confidence intervals using Capture-Mark-Resight methods in Game Management Unit 13, southcentral Alaska (from Miller 1995, Miller et al. 1997 and present study).

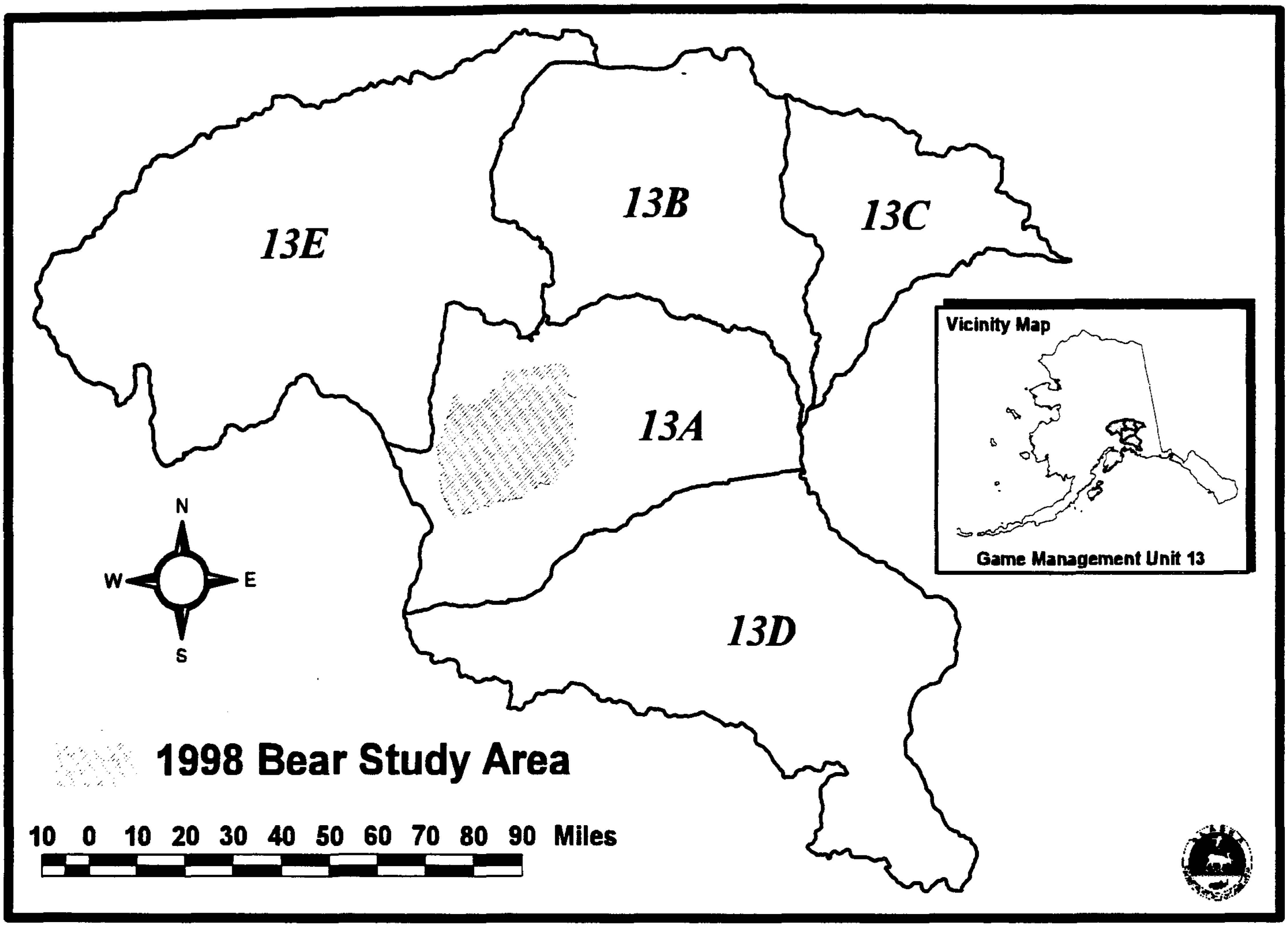
Location	Year	Independent bears	Bears ≥ 2 years old	All Bears
Upper Susitna River	1987	6.4 (5.4-8.4)	6.4 (5.4-8.4)	10.7 (9.0-14.1)
Middle Susitna River	1985	18.8 (15.9-23.8)	18.8 (15.9-23.8)	27.1 (25.1-30.5)
Middle Susitna River	1995	23.5 (19.6-30.4)	30.8 (25.8-38.9)	40.8 (36.0-47.9)
Nelchina Study Area	1998	21.3 (18.4-25.9)	21.5 (18.7-25.8)	28.8 (26.3-32.2)

Table 3. Survey times and bear sighting rates in 2,150 km^2 of Game Management Unit 13A, southcentral Alaska in spring 1998.

Date	Search Intensity (min/km^2)	Bears per Hour		
		Independent Bears	Bears ≥ 2 years old	All bears
5/22	0.72	0.54	0.66	1.08
5/23	0.73	0.77	0.77	1.03
5/25	0.85	0.56	0.56	0.92
5/26	0.76	0.40	0.40	0.70
6/1	0.88	0.57	0.57	0.70
Means	0.79	0.57	0.59	0.88

Table 4. Comparison of independent bears seen per hour of search time and probabilities of sighting marked bears in Game Management Unit 13, southcentral Alaska.

Location	Year	Search intensity (min/km)	Bears/hour	P (sighting)
Upper Susitna River	1987	1.02	0.19	0.47
Middle Susitna River	1985	0.97	0.33	0.24
Middle Susitna River	1995	1.15	0.42	0.32
Nelchina Study Area	1998	0.79	0.57	0.37


13E
13B
13C
13A
13D
Vicinity Map
Game Management Unit 13
N
W
E
S
1998 Bear Study Area
10 0 10 20 30 40 50 60 70 80 90 Miles

The Federal Aid in Wildlife Restoration Program consists of funds from a 10% to 11% manufacturer's excise tax collected from the sales of handguns, sporting rifles, shotguns, ammunition, and archery equipment. The Federal Aid program allots funds back to states through a formula based on each state's geographic area and number of paid hunting license holders. Alaska receives a maximum 5% of revenues collected each year. The Alaska Department of Fish and Game uses federal aid funds to help restore, conserve, and manage wild birds and mammals to benefit the public. These funds are also used to educate hunters to develop the skills, knowledge, and attitudes for responsible hunting. Seventy-five percent of the funds for this report are from Federal Aid.

Margaret Edens