

**THE USE OF HUNTING METHODS FOR BROWN BEAR HUNTING IN  
SWEDEN  
AND THE EFFECT OF THE BAN ON BAITING**

**A report to the Swedish Environmental Protection Agency  
From the Scandinavian Brown Bear Research Project**

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## INTRODUCTION

This report is based on a thesis written by Rikako Fujita in 2000. She analyzed the methods of hunting used by hunters that had killed bears during 1981-1998, based on the questionnaire that is filled out by all successful bear hunters. We are in the process of analyzing the data from 1981-2004, in order to evaluate the effects of the ban on baiting during bear hunting that was enforced starting with the 2001 hunting season. This report is the preliminary results section of a manuscript that is in preparation, including tables and a figure. We have been asked to make these data available to the Swedish Environmental Protection Agency before a decision is made on hunting regulations for the 2005 bear hunting season. We have summarized our important conclusions in the “executive summary”. We do not expect the readers to study the preliminary results section, but it is included for those who want to read about the results in more depth. We have not yet written a discussion section.

It is important to note that these results are based on what the hunters themselves have reported about the type of hunting they used. If in some areas hunting with bait was not fully acceptable, hunters may have been tempted to report other forms of hunting. Also, even after bait hunting was made illegal in 2001, it still was legal to shoot a bear that was at food, but not at bait, per se, such as entrails from a hunter-killed moose.

## EXECUTIVE SUMMARY OF MAJOR FINDINGS:

1. During 1981-2000, when baiting was allowed, bears were killed by all hunters significantly more often using dogs and less using stalking (smygjakt) than expected. During 2001-04, after baiting was banned, the same pattern was found.
2. Considering only bear-oriented hunters (i.e. not those primarily hunting moose), bears were killed using bait more than expected and stalking and still hunting (passjakt) less than expected during 1981-2000. During 2001-04, bears were killed with dogs more than expected and stalking less than expected.

3. The use of bait to kill bears was more common in the south (Dalarna, Gävleborg, Härjedalen) and north (Norrbotten) than in central Sweden (rest of Jämtland, Västerbotten, Västernorrland) during 1981-2000.
4. There was no difference in the proportion of males and females killed related to harvest method, either before or after baiting was banned.
5. Age of bears killed did vary by hunting method, however. Females killed by still hunting were younger than those killed using dogs and baiting and males killed by still hunting were younger than those killed using dogs, baiting, and stalking.
6. There is some evidence to suggest that females with cubs might be somewhat more vulnerable to be killed when hunted using dogs than by other methods, but it is too early to determine the magnitude of this effect, if in fact it does exist.
7. Bear hunters seem to have responded to the ban of hunting bears with bait by increasing the use of dogs. This probably will not have a major impact on the sex and age of killed bears, because these factors did not differ for bears killed by hunting using bait and dogs.
8. We recommend that research be conducted on the use of baits by females with cubs. It would be important to know if females with cubs often go often to baits, and whether they take their cubs with them. Also, we should document the ability of hunters to see cubs when they are present while hunting with dogs.

## RESULTS

During 1981-2004, hunters in Sweden killed 1015 bears. We used 901 bears with enough available information for our analysis. Bears were killed by using dogs (37%), stalking (15%), still hunting (29%), and bait (18%), over the entire study period (Table 1).

The proportion of bears killed by hunting with dogs increased significantly over the entire study period (linear regression,  $F_{1,22} = 4.728$ ,  $\beta = 0.667$ ,  $P = 0.041$ ) as did the proportion of bears killed by still hunting (linear regression,  $F_{1,22} = 11.337$ ,  $\beta = 0.990$ ,  $P = 0.003$ ). The proportion of bears killed by stalking and baiting decreased

significantly over the entire study period (linear regression,  $F_{1,22} = 14.276$ ,  $\beta = -0.791$ ,  $P = 0.001$ , and  $F_{1,22} = 6.645$ ,  $\beta = -0.906$ ,  $P = 0.019$ , respectively). Since hunting over bait was outlawed in 2001, we also investigated the trend of proportion of bears killed by baiting from 1981-2000. No significant trend in baiting was visible over this time period (linear regression,  $F_{1,18} = 0.093$ ,  $\beta = -0.133$ ,  $P = 0.763$ ).

There was a statistically significant geographical difference in harvest method during the time period 1981-2000 ( $\chi^2 = 39.107$ ,  $df = 6$ ,  $P < 0.001$ , Table 3). After baiting was banned in 2001 the significant geographical difference in harvest methods persisted for the time period 2001-2004 ( $\chi^2 = 13.915$ ,  $df = 4$ ,  $P = 0.008$ , Table 3). Testing with a Bonferroni  $z$  statistic (Neu et al. 1974) showed that in the time period 1981-2000 stalking was used less than expected, hunting with bait and still hunting was used as expected, while hunting with dogs was used more than expected (Table 4). In the time period 2001-2004, stalking was used less than expected, still hunting as expected, and hunting with dogs more than expected (Table 4).

The age of females killed varied by harvest method (Kruskal Wallis test,  $\chi^2 = 10.607$ ,  $df = 3$ ,  $P = 0.014$ , Table 5, data for both time periods pooled). Pairwise tests revealed that females killed by hunting with dogs (Mann Whitney test,  $U = 20305.5$ ,  $P = 0.005$ ) and baiting (Mann Whitney test,  $U = 9535.5$ ,  $P = 0.017$ ) were older than those killed during still hunting (Table 5). Also the age of males killed varied by harvest method (Kruskal Wallis test,  $\chi^2 = 35.182$ ,  $df = 3$ ,  $P = 0.000$ , Table 6, data for both time periods pooled). Pairwise testing revealed that males killed by hunting with dogs (Mann Whitney test,  $U = 18947.5$ ,  $P < 0.001$ ), by baiting (Mann Whitney test,  $U = 10663.5$ ,  $P < 0.001$ ), or stalking (Mann Whitney test,  $U = 6409.5$ ,  $P = 0.003$ ) were significantly older than males killed by still hunting (Table 5).

We investigated if females with cubs of the year and if cubs of the year were more vulnerable to certain hunting methods in the time period 1981-2004. Due to the low sample size we were not able to carry out statistical tests, however 5 out of 6 females with dependent offspring (83%) were killed by the use of dogs. In addition, of the 9 cubs of the year killed during hunting, 6 (67%) were killed by using dogs, 2 (22%) by still hunting and 1 (11%) over bait.

There was no difference in the proportion of male and female bears killed by different harvest methods ( $\chi^2 = 2.246$ ,  $df = 3$ ,  $P = 0.523$ , Table 3) or by bait and nonbait harvest ( $\chi^2 = 0.283$ ,  $df = 1$ ,  $P = 0.595$ , Table 3) in the period 1981-2000.

After baiting was banned, again no difference was found in the proportion of male and female bears killed by different harvest methods ( $\chi^2 = 3.354$ ,  $df = 2$ ,  $P = 0.142$ , Table 3) in the period 2001-2004. Also, when bears aged >5 years and both time periods were pooled and compared, no significant difference was found ( $\chi^2 = 2.157$ ,  $df = 1$ ,  $P = 0.142$ , Table 3).

We found significant differences in the harvest methods used by moose-oriented and bear-oriented hunters in the periods 1981-2000 ( $\chi^2 = 64.903$ ,  $df = 3$ ,  $P < 0.001$ , Table 3) and 2001-2004 ( $\chi^2 = 18.080$ ,  $df = 2$ ,  $P < 0.001$ , Table 3). Testing with a Bonferroni  $z$  statistic showed that moose-oriented hunters used stalking and baiting less than expected, and still hunting and hunting with dogs more than expected in the time period 1981-2000 (Table 6). Bear-oriented hunters in the same time period used stalking and still hunting less than expected, hunting with dogs as expected, and hunting over bait more than expected (Table 6). In the time period 2001-2004, moose-oriented hunters used stalking less than expected, hunting with dogs as expected, and still hunting more than expected. Bear-oriented hunters in this time period used stalking less than expected, still hunting as expected, and hunting with dogs more than expected (Table 6).

There were significant regional differences in harvest with and without bait by bear-oriented hunters in the period 1981-2000 ( $\chi^2 = 23.755$ ,  $df = 2$ ,  $P < 0.001$ , Table 7). Harvest over bait was more common in the southern than in the central area ( $\chi^2 = 11.625$ ,  $df = 1$ ,  $P = 0.001$ , Table 7) and suggestively more common in the northern than in the central area ( $\chi^2 = 2.704$ ,  $df = 1$ ,  $P = 0.100$ , Table 7). There was no difference in the use of baiting between the northern and the southern area ( $\chi^2 = 2.115$ ,  $df = 1$ ,  $P = 0.146$ , Table 7). We found suggestive regional differences in harvest methods by bear-oriented hunters in the period 2001-2004 ( $\chi^2 = 7.838$ ,  $df = 4$ ,  $P = 0.098$ , Table 7). In the northern area stalking, hunting with dogs and still hunting were used as expected (Table 8). In the central area stalking was used as expected, while dog hunting was on the borderline of being used more than expected and still hunting on the borderline of being used less than expected (Table 8). In the southern study area stalking was used as expected, while hunting with dogs was used more than expected and still hunting less than expected (Table 8).

Still hunting among bear-oriented hunters showed a significant increase (linear regression,  $F_{1,22} = 16.970$ ,  $\beta = 1.096$ ,  $P = < 0.001$ ) and hunting with dogs showed a

suggestive positive trend (linear regression,  $F_{1,22} = 3.969$ ,  $\beta = 1.064$ ,  $P = 0.059$ ) over the entire study period 1981-2004. Baiting of bear-oriented hunters showed a significant decrease (linear regression,  $F_{1,22} = 4.614$ ,  $\beta = -1.330$ ,  $P = 0.043$ ) over the entire study period. Stalking showed no trend (linear regression,  $F_{1,22} = 1.733$ ,  $\beta = -0.804$ ,  $P = 0.202$ ). Over the time period 1981-2000, still hunting showed a significant increase among bear-oriented hunters (linear regression,  $F_{1,18} = 6.045$ ,  $\beta = 0.770$ ,  $P = 0.024$ ), while the other hunting methods showed no trend (linear regression, hunting with dogs:  $F_{1,18} = 3.565e-05$ ,  $\beta = 3.759e-03$ ,  $P = 0.995$ , stalking:  $F_{1,18} = 0.731$ ,  $\beta = -0.753$ ,  $P = 0.404$ , bait:  $F_{1,18} = 0.003$ ,  $\beta = 0.038$ ,  $P = 0.961$ ).

We investigated if there was an age and sex difference in bears shot at different times of the day by still hunting (considered to be the most random hunting method, where hunters do not actively search for bears). Male bears killed between 9:00-16:00 hours were significantly younger (mean = 2.9, SD = 3.474) than male bears killed between 16:01-8:59 hours (mean = 4.0, SD = 3.065, Mann Whitney test,  $U = 504.5$ ,  $P = 0.023$ ). However there was no such statistical difference in females (Mann Whitney test,  $U = 694.0$ ,  $P = 0.802$ ).

We tested if there was a difference in age of bears shot at different times of the day by baiting, however we found no significant difference between bears killed from 9:00-16:00 hours (mean = 3.3, SD = 2.270) and bears killed between 16:01-8:59 hours (mean = 5.6, SD = 5.515, Mann Whitney test,  $U = 257.00$ ,  $P = 0.171$ ).

Table 1. Temporal trend in the proportion (in %) of bears killed by various harvest methods in Sweden during 1981-2004. N = sample size.

Year	Percent killed using				N
	Stalk	Dog	Still	Bait	
1981	38	19	25	19	16
1982	16	37	5	42	19
1983	21	24	18	38	34
1984	28	20	24	28	25
1985	23	31	23	23	26
1986	22	47	19	13	32
1987	21	31	26	23	39
1988	11	48	16	25	44
1989	31	22	18	29	45
1990	22	39	36	3	36
1991	15	39	27	20	41
1992	12	46	31	12	26
1993	14	34	21	31	29
1994	8	29	42	21	24
1995	22	26	43	9	23
1996	4	26	22	48	27
1997	7	44	20	29	41
1998	5	37	39	18	38
1999	0	22	47	31	45
2000	19	38	19	23	52
2001	12	63	22	2	49
2002	11	38	51	0	55
2003	13	37	51	0	63
2004	15	54	31	0	72
Total	15	37	29	18	901

Table 2. Temporal trend in the proportion (in %) of bears killed by harvest methods by bear-oriented hunters in Sweden during 1981-2004. N = sample size.

Year	Percent killed using				N
	Stalk	Dog	Still	Bait	
1981	33	33	11	22	9
1982	0	25	0	75	8
1983	33	11	11	44	9
1984	36	27	0	36	11
1985	17	33	0	50	6
1986	7	64	7	21	14
1987	23	23	8	46	13
1988	19	56	0	25	16
1989	33	17	8	42	12
1990	100	0	0	0	1
1991	20	40	0	40	5
1992	0	33	0	67	3
1993	36	36	0	27	11
1994	13	38	13	38	8
1995	38	13	25	25	8
1996	0	18	12	71	17
1997	15	15	8	62	13
1998	7	50	7	36	14
1999	0	24	33	42	33
2000	19	39	17	25	36
2001	4	78	13	4	23
2002	8	54	38	0	26
2003	16	48	36	0	25
2004	17	64	19	0	36
Total	15	41	16	27	357

Table 3. Proportion (in %) of bears killed by different harvest methods in relation to area and type of hunter in Sweden during 1981-2000 and 2001-2004. N = sample size.

Time period			Harvest method				
1981-2000			Stalk	Dog	Still	Bait	N
1981-2000	Area	North	22	37	15	26	190
		Central	17	31	36	17	259
		South	10	34	24	31	213
	Sex	female	17	32	28	23	310
		male	15	36	24	25	352
	Hunter type	moose	15.5	32	37	15.5	310
bear		17	32	12	39	247	
2001-2004	Area	North	27	43	30	0	44
		Central	6	45	49	0	82
		South	12	51	35	1	113
	Sex	female	14	53	33	0	120
		male	12	43	45	1	119
	Hunter type	moose	12	35	53	0	115
bear		12	61	26	1	110	

Table 4: Expected and observed values of the proportion of the use of different hunting methods in the time periods 1981-2000 and 2001-2004. The 95% confidence intervals are calculated with a Bonferroni  $z$  statistic. N = sample size.

Time period	Harvest method	Expected use	Observed use	Confidence interval (95%)	N
1981-2000	Stalk	0.25	0.16	0.13 – 0.20	107
	Dog	0.25	0.34	0.29 – 0.38	223
	Still	0.25	0.26	0.22 – 0.30	172
	Bait	0.25	0.24	0.20 – 0.28	160
2001-2004	Stalk	0.33	0.13	0.08 – 0.18	31
	Dog	0.33	0.48	0.40 – 0.56	114
	Still	0.33	0.39	0.32 – 0.47	93

Table 5. Mean and median ages of brown bears killed in Sweden, by sex and harvest method, during 1981-2004. SD = Standard deviation, N = sample size.

Harvest method	Females				Males			
	Mean age	SD	Median age	N	Mean age	SD	Median age	N
Stalk	4.8	4.6	3.0	40	5.3	5.2	3.0	38
Dog	5.6	5.3	4.0	108	5.5	4.4	4.0	112
Still	4.2	4.0	2.0	91	3.6	3.2	3.0	100
Bait	6.0	6.5	4.0	48	6.0	5.5	5.0	61

Table 6: Expected and observed values of the proportion of the use of different hunting methods by moose-oriented hunters and bear-oriented hunters in the time periods 1981-2000 and 2001-2004. The 95% confidence intervals are calculated with a Bonferroni  $z$  statistic. N = sample size.

Moose-oriented hunters					
Time period	Harvest method	Expected use	Observed use	Confidence interval (95%)	N
1981-2000	Stalk	0.25	0.16	0.19 – 0.19	48
	Dog	0.25	0.32	0.27 – 0.37	98
	Still	0.25	0.37	0.32 – 0.42	116
	Bait	0.25	0.16	0.12 – 0.19	48
2001-2004	Stalk	0.33	0.12	0.05 – 0.19	14
	Dog	0.33	0.35	0.24 – 0.45	40
	Still	0.33	0.53	0.42 – 0.64	61
Bear-oriented hunters					
Time period	Harvest method	Expected use	Observed use	Confidence interval (95%)	N
1981-2000	Stalk	0.25	0.17	0.11 – 0.23	42
	Dog	0.25	0.32	0.25 – 0.39	79
	Still	0.25	0.12	0.07 – 0.17	29
	Bait	0.25	0.39	0.32 – 0.47	97
2001-2004	Stalk	0.33	0.12	0.04 – 0.19	13
	Dog	0.33	0.61	0.50 – 0.73	67
	Still	0.33	0.27	0.16 – 0.27	29

Table 7. Proportion (in %) of brown bears killed by harvest method during bear-oriented hunting by area in Sweden, during the periods 1981-2000 and 2001-2004. N = sample size.

Time period		Harvest method					
	Area	Stalk	Dog	Still	Bait	N	
1981-2000	North	20	30	12	38	60	
	Central	23	37	15	25	79	
	South	11	30	9	50	108	
2001-2004	North	30	70	0	0	10	
	Central	5	63	33	0	40	
	South	13	58	27	2	60	

Table 8: Expected and observed values of the proportion of the use of different hunting methods by bear-oriented hunters in the time period 2001-2004. The 95% confidence intervals are calculated with a Conferring  $z$  statistic. N = sample size.

Area	Harvest method	Expected use	Observed use	Confidence interval (95%)	N
North	Stalk	0.33	0.324	0.140 – 0.509	12
	Dog	0.33	0.486	0.290 – 0.683	18
	Still	0.33	0.189	0.035 – 0.343	7
Central	Stalk	0.33	0.305	0.162 – 0.449	18
	Dog	0.33	0.492	0.336 – 0.647	29
	Still	0.33	0.203	0.078 – 0.647	12
South	Stalk	0.33	0.222	0.087 – 0.358	12
	Dog	0.33	0.593	0.432 – 0.753	32
	Still	0.33	0.185	0.059 – 0.312	10

Figure 1. Number of bears killed in each age class by sex. Open bars are females, solid bars are males. N = 901.

