

# Abundance of brown bears and wolves in central south Norway after 1733 as revealed by bounty records

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Disbursements for bounties were made locally in Norway from 1733 to 1845 for the killing of brown bears (*Ursus arctos*) and wolves (*Canis lupus*). More than 3000 bounty records of these two species from 19 parishes in central south Norway were analysed. The greatest number of bounties paid per unit of area was found in forested areas in the lowland. The number of bounties paid was positively correlated with the size of forested areas and negatively with the density of people and their wealth, represented by the number of cows per inhabitant. The gradient of the regression lines for bounties paid in relation to time in the period 1738-1815 was negative, even after correcting for inflation, suggesting that the bounty system caused a slow decrease in the populations of both brown bears and wolves during the 18th century. The introduction of better firearms after about 1850 led to an abrupt decline in the wolf population, which was nearly exterminated around 1870. The brown bear survived a few decades longer, but was also gradually reduced to very small numbers in the beginning of the 20th century.

*Key words:* brown bear, wolf, historical records, bounty system, Norway.

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## INTRODUCTION

Central registration of bounties paid by the government for killing of large carnivores was initiated in Norway in 1846 (Jaktstatistikk 1846-1977 see Appendix I). Payment of bounties for the killing of brown bears and wolves had, however, been administered locally since 1733. Records of the legal proceedings are preserved in public archives and are here used to analyse variation in numbers of brown bears and wolves bountied during the period 1733-1845.

The aim of this study is to give a historical background for the Vassfaret brown bear population, which has been studied previously (for review of references see Elgmork 1994). After about 1930 this was the only remaining brown bear population in southern Norway. The study focuses on the effect upon carnivore populations of a long term use of a bounty system also for the wolf.

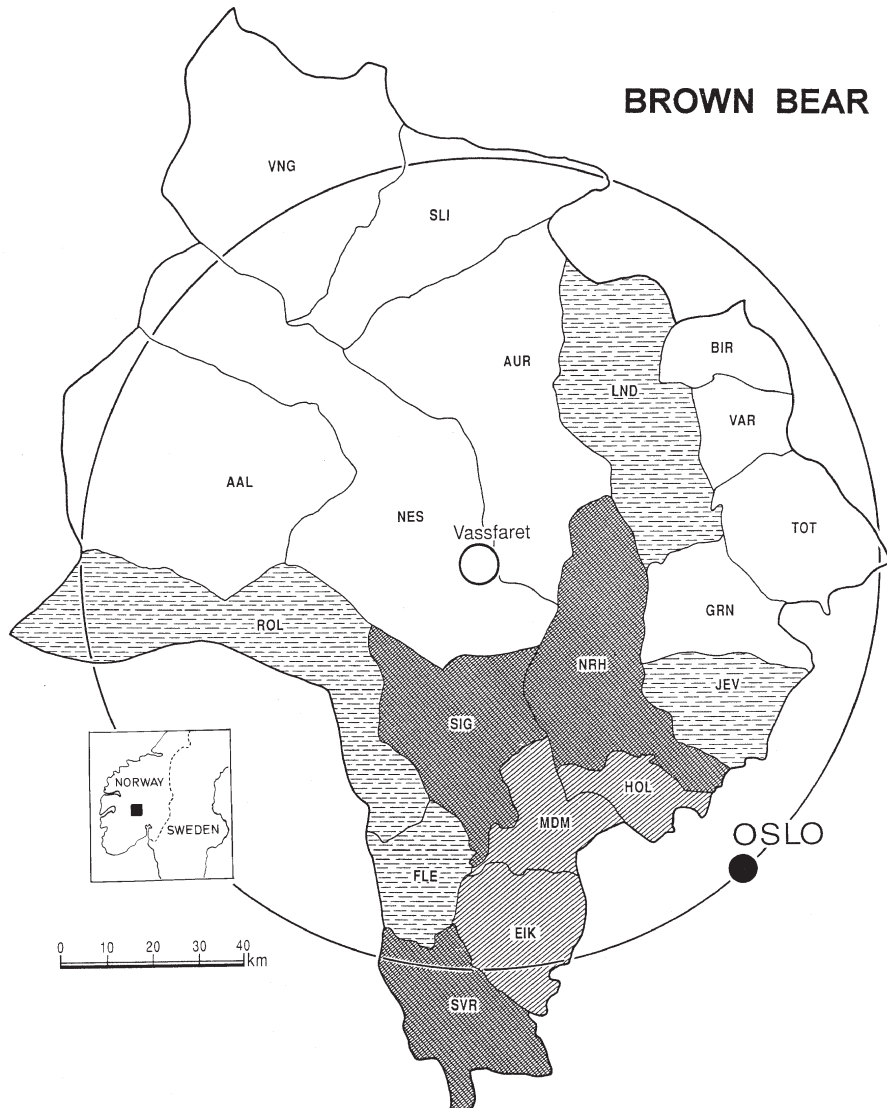
## MATERIAL AND METHODS

The payment for bounties for the brown bear and wolf was instituted by the King in a decree of 8 May 1733 for the whole of Norway. For an adult brown bear and wolf the bounty was

2 rigsdaler (courant), for a young animal of the two species, 1 rigsdaler, and half that value for animals between 13 to 26 weeks old. About 85% of the bounties were paid for adults of both species.

Records came from 19 parishes covering about 22,500 km<sup>2</sup>, centering around the Vassfaret area, in Buskerud and Oppland counties (Figure 1). The parishes selected and their abbreviations are shown in Table 1. During the period 1733-1845, the payment of 3124 bounties was recorded; 1617 for brown bears, and 1507 for wolves. The hunter had to show the hide at the local court and two witnesses had to verify that he had killed the animal. As perjury was a serious crime, this rule supports the reliability of the material. Bounties were paid as a delayed grant after the local courts were held. This procedure is of importance to note, as it would have ensured that the incentive for hunting carnivores was independent of money being available in advance.

The court records were translated from Gothic handwriting by Mr. Olav K. Opsahl (1887-1973). State archives for the counties of Buskerud and Oppland confirm that Opsahl translated all books covering the period 1733-1845 from the 19 parishes selected for study.



**Figure 1**  
Bounties paid for brown bears in the various parishes, expressed as number paid per km<sup>2</sup> of total area during 1733-1845. Abbreviations of parishes are explained in Table 1. Dark: > 20, lines > 15, stippled: > 5.

Variable conditions and distances to the courts may have influenced the hunting statistics; for example bounties may not have been collected because of great distances to the court house. There are also examples of a few rich hunters who never collected the bounties. The bounty paid for an adult brown bear and wolf (2 rigsdaler) was high, equivalent to 57% of the value of a cow in 1720 and to 31% of a cow in 1790 (Rudie 1966). Errors such as those mentioned above are therefore considered to be non-essential.

Background data came from official statistics (see Appendix I). A more comprehensive account with statistical details from the parishes has been published in Norwegian (Elgmark 1996). Statistical correlations were calculated with the non-parametric Spearman test.

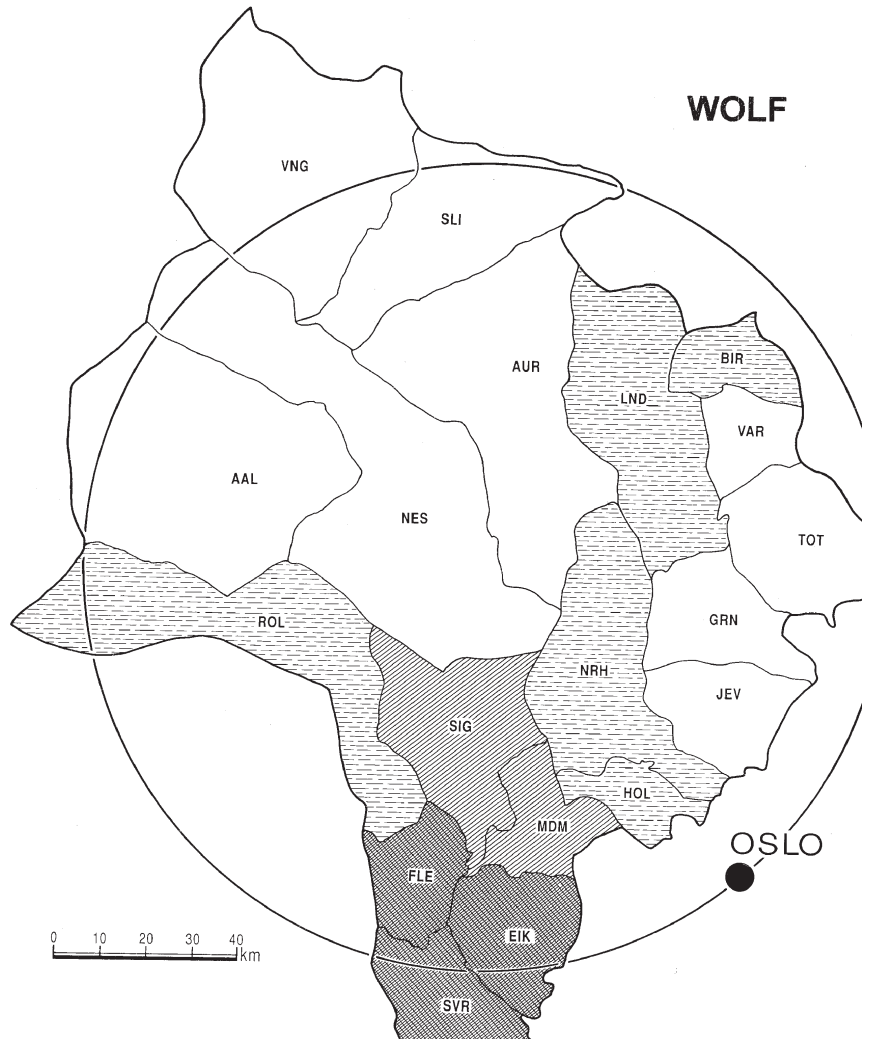
**Tabell 1.** Abbreviations of the names of parishes used in the study.

Buskerud county Abbreviations    Oplands county Abbreviations

Ål	AAL	Vang	VNG
Nes	NES	Slidre	SLD
Rollag	ROL	Aurdal	AUR
Sigdal	SIG	Land	LND
Flesberg	FLE	Biri	BIR
Sandsvær	SVR	Vardal	VAR
Eiker	EIK	Toten	TOT
Modum	MDM	Gran	GRN
Hole	HOL	Jevnaker	JEV
Norderhov	NRH		

Figure 2

Bounties paid for wolves in the various parishes, expressed as number paid per km<sup>2</sup> of total area during 1733-1845. Abbreviations of parishes are explained in Table 1. Symbols as in Fig. 1.



## RESULTS

### Geographical distribution 1733-1845

The greatest number of bounties paid for both species was recorded from the lowland in the southernmost part of the study area (Figures 1 and 2). Bounties paid per unit of total area were lower in north-western mountainous areas and in eastern parishes with the highest percentage of cultivated area, however never exceeding 17% in a single parish. The number of bounties paid by parish was related to total area, forested area, density of people, and cows/inhabitant (Statistical publications) in Figs. 3 and 4. Correlations with total area were not statistically significant (brown bear:  $r^2=0.14$ ,  $P=0.11$ ; wolf:  $r^2=0.19$ ,  $P=0.07$ ). Correlations with forested areas were significant for both species ( $r^2=0.52$ ,  $P<0.001$ ). Quite unexpectedly, the number of bounties was negatively correlated with the density of people in both species ( $r^2=0.35$ , and  $0.32$ ,  $P=0.01$ ).

A factor that could have influenced the number of bounties paid, was that wealthy parishes could have afforded to pay more in

bounties than poorer ones even if bounties were national. This hypothesis was tested by correlating the number of bounties with the number of cows per inhabitant as an index of richness (Figures 3 and 4). There was a significant negative correlation in both species (brown bear,  $r^2=0.28$ ,  $P<0.05$ ; wolf,  $r^2=0.25$ ,  $P<0.05$ ).

These results are supported by the fact that the parish with the highest percentage of cultivated land (Toten) showed a very low number of bounties. Even when excluding this parish, no significant correlation between number of bounties paid and cultivated area was found in the remaining 18 parishes (brown bear:  $r^2=0.15$ ,  $P=0.11$ ; wolf  $r^2=0.18$ ,  $P=0.07$ ).

The results of the correlation analyses indicate that both the brown bear and the wolf were bountied primarily in poor and sparsely populated forested areas. This coincides with habitats preferred by these species today. The relations also indicate that the geographical distribution as recorded by the payment of bounties for both species, was little influenced by the parishes' economical capacity.

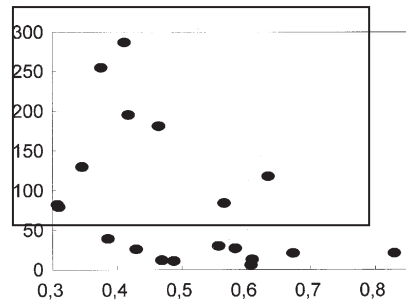
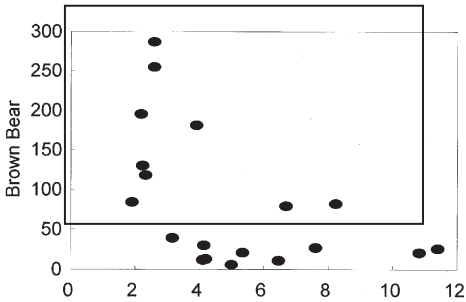
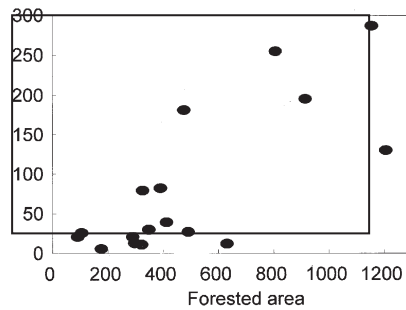
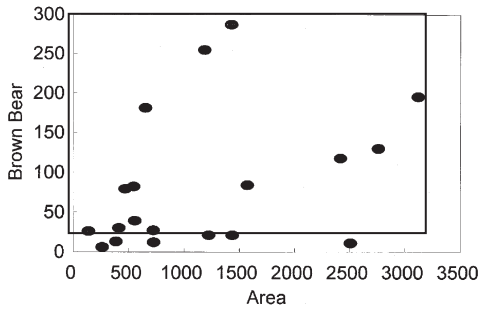


Figure 3 Relationships between bounties paid for brown bears and total areas (1927), forested areas (1927), densities of people (1835) and cows per inhabitant (1835) in the various parishes.

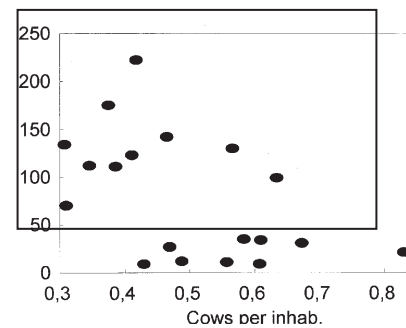
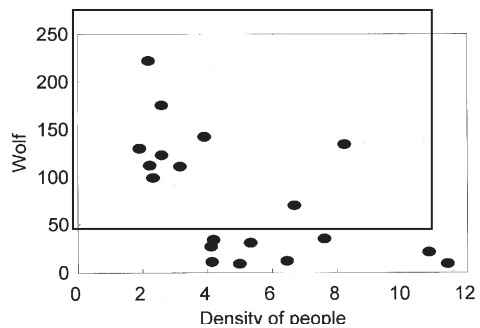
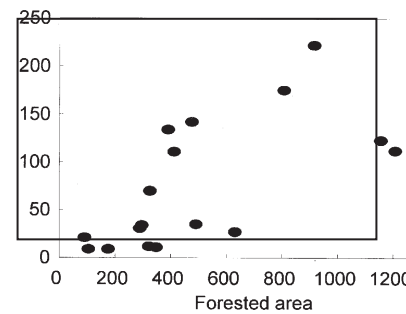
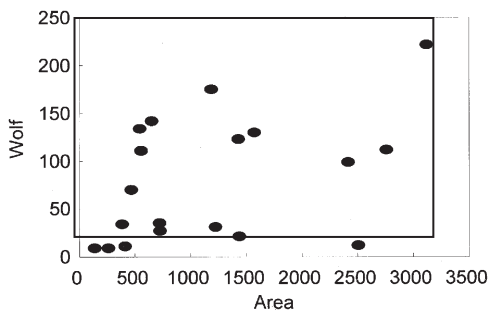


Figure 4 Relationships between bounties paid for wolves and total areas (1927), forested areas (1927), densities of people (1835) and cows per inhabitant (1835) in the various parishes.

**Variation in time**

The number of bounties paid per 5-year interval varied greatly during the study period (Figure 5). The period 1733-1845 is based on bounties paid in the local courts of the 19 parishes. Figures for the period 1846-1921 are the number of bounties paid centrally by the state in the larger counties of Buskerud and Oppland (Jaktstatistikk 1846-1977, Appendix I) reduced by a factor of 0.73. This factor is the quotient between forested areas in the 19 parishes and in the 2 counties.

The number of bounties paid for the two species were significantly correlated during the period 1733-1845 ( $r^2=0.40$ ,  $P=0.001$ ). The numbers of both brown bear and wolf bountied, showed a reduction during the period, most conspicuous for the brown bear.

After 1846 the two curves no longer follow each other. The wolf showed the greatest maximum recorded around 1850, followed by an exceptionally steep fall to nearly zero 15 years later. The

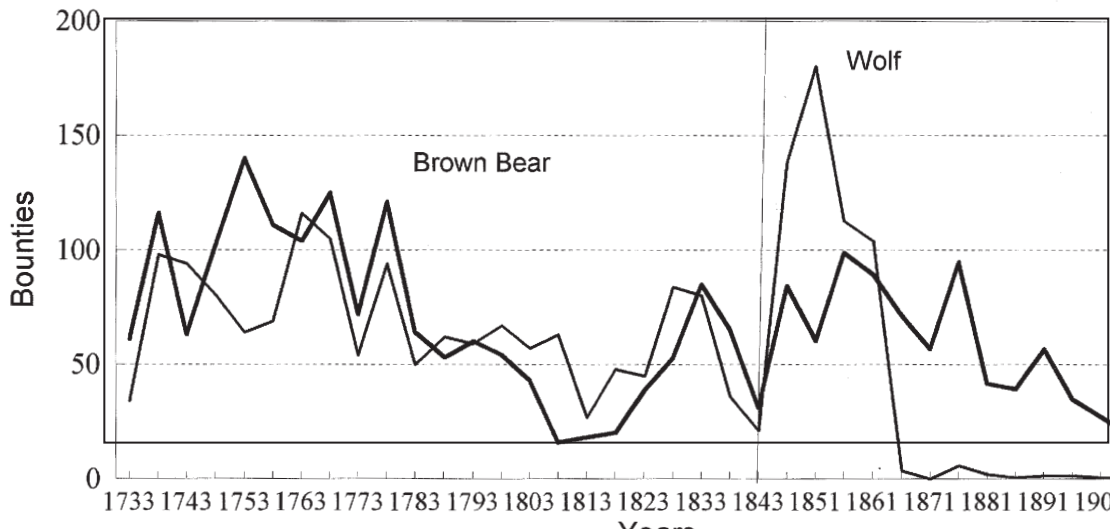


Figure 5

Number of bounties paid for brown bears and wolves per 5-year period based on local court records during 1733-1845 in 19 parishes, and on national hunting statistics for the counties Buskerud and Oppland during 1846-1920. Heavy line indicates brown bears, thin line wolves.

brown bear showed a more gradual reduction to very small values around 1920. Subsequently, only a few brown bears were killed yearly in Norway.

### Killing methods and seasons

Methods of killing was specified for about 80% of the brown bears and 75% of the wolves during 1733-1845 (Table 2). The great majority, however, were generally reported to be shot or hunted, giving little information as to details. Among other reported methods, poison was much used for killing wolves

besides wolf traps, and cocked set guns were used for brown bears more than other methods.

About 50% (N=978) of the brown bears were killed during spring, whereas about 65% (N=871) of wolves were killed during winter, localised by snow tracking.

### Numbers and densities

The number of brown bears in Norway around 1850 has been calculated to have been around 2500 (Elmork 1979) to 3000 (Swenson et al. 1995). The two figures are based on the assumption of a maximum harvest rate of 10% and 7% respectively, which are set as equal to the bounty record in the mid-1800's. About 8.5% of the bounties paid in Norway were disbursed in the counties Buskerud and Oppland for the period 1846-55. The two counties thus had a population of brown bears from 213 to 255 individuals. These were assumed to have occurred principally in forested areas. Forested areas in the 19 parishes studied constituted about 73% of forests in the 2 counties. This results in an estimate of 155-186 brown bears present in the study area, or a density of about 14-17 brown bears per 1000 km<sup>2</sup> forest. This density was considered as high in a national context with variations from 2-5 to 28-48 (Swenson et al. 1995). Densities in the present day Swedish brown bear populations over larger areas are slightly smaller, 10-15 individuals per 1000 km<sup>2</sup> (Sandgren & Swenson 1997).

The number and percentages of juveniles varied considerably with time during the period 1733-1845 in both species. The

Table 2. Killing and trapping methods.

	Brown bear		Wolf	
	N	%	N	%
Shot, hunted	1250	94,9	704	62,8
Killed	25	1,9	127	11,3
Caught	2	0,2	61	5,4
Beaten to death	1	0,1	24	2,1
Shot on bait	6	0,5	14	1,2
Shot in den	5	0,4	4	0,4
Wolf trap	0	0	48	4,3
Wolf pit	0	0	7	0,6
Poisoned	0	0	129	11,5
Cocked set gun	24	1,8	3	0,3
Caught alive	3	0,2	0	0
Sum	1316	100,0	1121	99,9

average proportion of bounties paid for juvenile brown bears was 15% (0-26%). The average was the same for wolves, but the variation was greater (1-53%). The proportions of juveniles in the two species were not correlated through time. For 5-yr periods during 1733-1845,  $r^2=0.01$ ,  $P=0.64$ . On the other hand, the number of cubs and young of the brown bear were strongly correlated with the number of adults killed ( $r^2=0.52$ ,  $P=0.0001$ ). This was not the case with the wolf ( $r^2=0.03$ ,  $P=0.47$ ). This difference can be attributed to the fact that brown bear cubs and young follow the mother closely for a much longer time than the wolf cubs, and were thus more often killed with the mother.

The percentage of young brown bears killed did not differ much by season. For the wolf, however, there was a large seasonal difference, with 77% young individuals and 3% adults killed in the summer, suggesting that young were being dug out from dens. On the other hand, 8% of the young wolves and 72% of the adult wolves were killed in the winter.

## DISCUSSION

The Vassfaret population was the only remnant brown bear population in southern Norway after about 1930 shown by the fact that the bounties paid for brown bears in south Norway were concentrated in the Vassfaret area (Elgmork 1994). This study shows that during the period 1733-1845 the greatest densities of brown bears based on bounty payments, were found in the lowland far to the south of Vassfaret (Figure 1). It was not until the first part of the 20th century that the Vassfaret area became known as the last resort of a brown bear population. The brown bear had been eradicated in other areas by then, and the Vassfaret population was left as a relict population until its extinction in the 1980's (Bækken et al. 1994, Elgmork 1994).

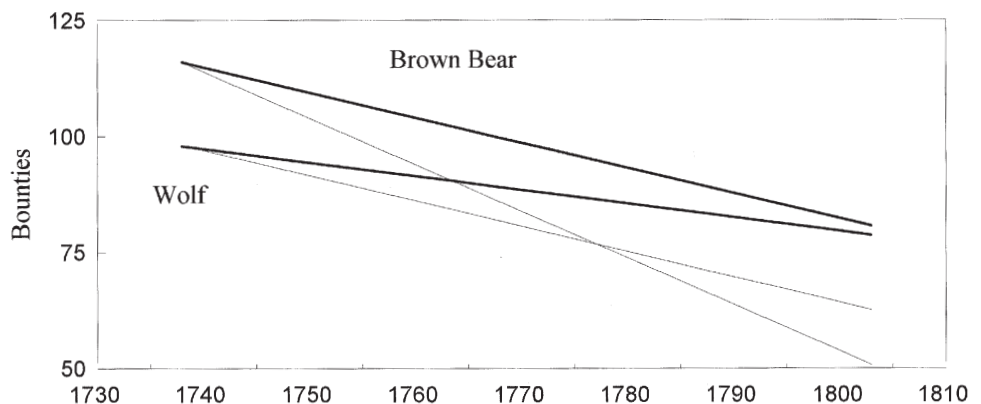
The minimum number of bounties paid for both species around 1813 (Figure 5) is interpreted as a result of the Napoleonic wars, when Norway was blockaded by the British fleet and at war with Sweden. In addition to economical stagnation and crop failure, most young men were at the front, and had their weapons with them. During this period considerably more wolves were killed

than brown bears, perhaps because the wolf was regarded as a more harmful animal than the brown bear. After the war the number of bounties paid rose rapidly to higher values, apparently because the populations of brown bears and wolves had increased while experiencing low hunting pressure during the war. That the rise covered a period of about 20 years, makes it unlikely that hides from already shot animals had been accumulated during the war.

If the minimum number of bounties around 1813 is disregarded as a result of the Napoleonic war, both species showed a decreasing trend during the 80 year period from 1733 to 1813. This gradual reduction is most reasonably interpreted as an effect of the bounty system. Economical factors must, however, be taken into consideration. In spite of different monetary units during the study period, bounty prices were nominally about the same between 1733 and 1845, but there was inflation throughout the period. This inflation is poorly documented, but can be estimated by using the variation in the price for a cow, which about doubled from 1720 to 1790 (Rudie 1966). The question is whether the observed decrease in bounties reflected a reduction in carnivore populations or was caused by the relative lowering of bounty prices due to inflation.

Regression lines for bounties paid during 1738-1803 showed a decreasing trend with  $r^2=0.42$  for the brown bear and  $r^2=0.29$  for the wolf (Figure 6). The gradients of the regression lines are both significantly different from 0 ( $P=0.01$  and  $P<0.05$ , respectively). These regression lines can be corrected for inflation by a gradient reduction of 0.5, based on a doubling of the prices. The gradients of the corrected regression lines were, however, not significantly different from 0 ( $P=0.15$  and  $P=0.26$ , respectively). It is therefore not statistically safe to conclude that the populations were reduced by the bounty system during the period 1733-1815. The motivation for killing, however, was not entirely based on economical considerations. The hunters were themselves interested in reducing the carnivores to safeguard their domestic animals. The meat of brown bears was also used as food and sold and was thus an extra income for the hunter. Such incentives would have reduced the influence of inflation. The steady decline of number of bountied brown bears and wolves is

**Figure 6**  
Regression lines for number of bounties paid for brown bears and wolves in the study area for 5-yr periods during 1738-1807. Heavy lines corrected for inflation. Upper heavy line indicates brown bears, lower wolves.



therefore more likely a reflection of a reduction in the population sizes of these carnivores throughout the 18th century.

Also the number and structure of the human population in the area changed throughout the study period. There was a considerable increase in population numbers and in the proportion of cotters (countrymen living in a cottage on a farm and working for the farmer). About the year 1800 cotters constituted one third of the population (Dyrvik 1978). As the number of bounties was negatively correlated with density of people (Figures 3 and 4), it is doubtful that the increase in the human population had any influence on the hunting pressure. Economical and demographic factors thus do not seem to have influenced the bounty statistics significantly. A further indication is that there was an increase in bounties during 1815-1830 (Figure 5), when the economy was in a state of crisis, and a decrease 1830-1845, when the economy had recovered (Dyrvik 1978).

The exceptionally large maximum of wolves recorded around 1850 was noted over most of south Norway (Johnsen 1947). In the European part of Russia, a large maximum of wolves was also recorded around 1850 (Olav Hjeljord, pers. comm.) As there was a decrease in the wolf population in Sweden at the same time (Helland 1914), the corresponding maxima in Norway and Russia may be incidental.

The reason for the more rapid reduction of both the brown bear and wolf after about 1850 is certainly due to an improvement in the firearms. The first breech-loaded firearms came into use about 1840, and represented a considerable improvement in killing power.

The present study indicates that from 1733 to about 1860 large populations of both brown bears and wolves were present in central south Norway, which is now devoid of both species. The carrying capacity for both species seems to have been sufficient and the hunting methods not efficient enough to dramatically reduce or exterminate the brown bear and the wolf. Nutrition poses no problem for the omnivorous brown bear (Elgmork & Kaasa 1992). It is more difficult to explain the presence of the wolf, which is dependent upon large cervids in the winter. In this area, the moose (*Alces alces*) was the main prey of wolves as roe deer (*Capreolus capreolus*) and the red deer (*Cervus elaphus*) were absent in the study area at that time (Collett 1912). The moose was quite common in the 16th and 17th century, but numbers were greatly reduced during the 18th century due to unwise hunting and the presence of excessive number of wolves (Collett 1912, p. 487). The moose was so scarce in the 18th century that periods of protection were repeatedly enforced, indicating very low numbers. In spite of the recorded scarcity of moose, the present material indicates that, at least in central south Norway, the moose population must have been large enough to support a considerable wolf population as shown by the bounty record.

There was a strong incentive to reduce and exterminate these carnivores during the entire study period. The philosophy of reduction and extermination of carnivores was present among authorities in Norway up to quite recently. Full protection was first introduced for both the brown bear and the wolf in 1973. Since then the policy of giving shooting licenses for attacks on domestic animals by brown bears has been very liberal even after the brown bear was protected. The wolf has been practically non-existent until the last years in the 1990-ies.

Thus, Norway remains, in spite of a natural environment that is favourable to carnivores, a country unproportionally poor in both brown bears and wolves.

## ACKNOWLEDGEMENTS

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## SAMMENDRAG

### Forekomst av bjørn og ulv i sentrale deler av Østlandet etter 1733, basert på fellingspremier

Fellingspremier for bjørn og ulv ble utbetalt lokalt i Norge fra 1733 til 1845. Mer enn 3000 utbetalinger for disse to artene fra 19 prestegjeld i sentrale deler av Østlandet ble analysert. Det var flest utbetalinger i skogområder i lavlandet. Antall premier var positivt korrelert med størrelsen på skogområdene og negativt korrelert med befolkningstettheten og betalingsdyktighet, representert ved antall kyr per innbygger. Antall utbetalte fellingspremier avtok over tid i perioden 1738 - 1815, også om tallene ble korrigert for inflasjon. Dette indikerer at premiesystemet førte til en langsom nedgang i bestandene av både bjørn og ulv i det 18. århundret. Bedre skytevåpen etter ca. 1850 førte til nedgang for begge arter, særlig for ulven som var nesten utryddet omkring 1870. Bjørnebestanden overlevde noen 10-år lengre, men også den ble redusert til svært små antall tidlig i det 20. århundret. Se for øvrig Elgmork (1996) for en mer omfattende presentering på norsk.

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## Appendix I

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