

# Management of wild reindeer in Norway

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*Abstract:* Wild reindeer in Norway are found in 26 separate management areas. Predators are virtually absent from all areas and hunting is the most important factor determining population development through alterations of herd size and structure. Average population density (animals/km<sup>2</sup>) after hunt was 1.96 in Hardangervidda, 1.18 in North Rondane and between 0.78 and 0.87 in Rondane South, Snøhetta, North Ottadalen and Forelhogna. Body size and female pregnancy rates followed a reverse trend. Average net increase of the herds varied from 42.2±10.0% in Forelhogna to 18.8±8.0% in Rondane North. In areas with animals in prime physical condition a high versus a low average harvest rate of calves resulted in a similar number of animals harvested, but a lower total yield of meat and revenue from hunting licences. At a winter population density of 0.8 - 2.0 animals/km<sup>2</sup> annual harvest (per km<sup>2</sup>) of wild reindeer amounts to 0.23 - 0.51 animals, 9 - 18 kg meat and 286 - 850 NKr from sale of hunting licences. There was a significant relationship between body size expressed as carcass weights or mandible length and harvest success.

**Key words:** density, reproduction, body weight, harvest, population increase.

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## Introduction

Wild reindeer in Norway are confined to alpine areas in the southern part of the country. Present population counts indicate some 40 000 wintering animals in 26 hunting areas (Krafft, 1981) which are more or less separated by topographical barriers or by man-made obstacles like railroads, highways and settlement. The areas are generally small and range in size from under 100 km<sup>2</sup> to 8122 km<sup>2</sup>. Due to their limited size and fairly dense mountain road system, all areas are easily accessible.

The reindeer hunt takes place between August 20 and September 25 in all areas. Until the 1960's there was no restriction as to sex or age of the animals hunted.

The current management practice is to issue licences for males, females 2+ years, calves and 1+ years of both sexes. The hunting of adult and young males is regulated through body weight

limits or number of antler points on some areas. Body weights, pregnancy rates and calf mortality vary among the various reindeer herds (Skogland, 1984, 1985b, 1985c; Reimers, 1983) as do harvest strategies. This paper attempts to evaluate the relationship between animal density, body weight and the harvest of animals and meat as well as revenues on licences from six of the wild reindeer areas in southern Norway.

## Material and methods

Aerial total counts of the reindeer herds are usually carried out annually in mid winter, but in Hardangervidda after calving. In this area counts are done every 3 years.

The accuracy of the aerial count technique has never been tested in any of the areas.

Up to 1965 harvest statistics included number of licences issued and total number of 1+ year

males and females killed. From 1965 calves were hunted and harvest statistics was specified on calves and older animals and total number of males and females. Since 1971 the hunt statistics included yearlings and from 1977 it also specified calves, yearlings and 2 years and older animals of both sexes.

Carcass weight (=dressed weight) is the total body weight minus skin, viscera, head and lower legs. The weights and mandibles from killed animals were obtained from hunters or game wardens during the hunting season. The age of harvested animals was determined from tooth development or annuli in the cementum of the first incisor (Reimes and Nordby, 1968).

Pregnancy rates were measured in animals killed during winter, January through May. Net population increase was defined as the difference between two subsequent population counts plus harvest at percentage of the winter population the first year. When there were 2 (or 3) years between population surveys the calculated net increase value was divided by 2 (or 3). Harvest percentage (harvest as percentage of the winter herd size) estimates net population increase during periods when the populations remain reasonable stable. The highest and lowest values were excluded when calculating average net population increase, harvest percentage and harvest success (animals killed as percentage of licences issued).

As carcass weight variations were small from year to year within each area, weights from the various years were pooled within areas. Table 1 shows the carcass weights used to calculate meat harvest. Calf carcass weights are given as the pooled means of males and females. Carcass weights of 1+ year males or females are calculated from the number of animals harvested

in each age class. Prices of hunting licences vary somewhat from area to area. Most areas sat the 1985 prices for non-residents (Norwegian citizens living outside the area) around the following values (Nkr. 100 = US\$ 12.20); calf 340, female 800, small/medium size male 1000, large male (unspecified licence) 1500. The 1+ year male cohort is separated into small/medium and large males which have different prices. I assume that the two male cohorts are equally represented among the 1-year or older males in the hunting statistics. This allows me to use a common licence price tag of Nkr 1250 pr. 1+year male. Resident prices are one half those of non-residents. The number of non-residents who are allowed to hunt reindeer varies between the different areas. The income from sold licences is calculated from non-resident prices and gives area differences in maximum income.

## Results and discussion

The average population densities varied from 1.96 in Hardangervidda and 1.8 in Rondane North to below 0.9 in the other areas (Table 2). The variation is the result of management decisions and all the populations would increase if the harvest was reduced. Female body weights and pregnancy rates were inversely correlated with density. Net population increase is influenced by population sex ratio and recruitment rates. Migration between areas is not important and the population sex ratio has remained fairly constant at 60 - 70% females 1+ years during recent years (Skogland, 1985 c).

Net population increase was highest in Forelhogna (42.4%) followed by North Ottadalen, Snøhetta and Rondane South, with values between 31.8 and 33.4% (Table 3). A high net population increase implies a high pregnancy rate

Table 1. Wild reindeer carcass mean weights (kg)

Area	Calves	1+ years	
		Males	Females
Forelhogna <sup>†</sup>	27.0	64.3	42.3
North Ottadalen	26.1	77.5	39.2
Rondane South	24.4	71.2	40.3
Rondane North	19.1	46.1	35.7
Hardangervidda	15.2	44.6	28.8
Snøhetta	18.4	46.0	33.8

<sup>†</sup> Forelhogna weights from Meli (1985).

Table 2. Average population size and density (winter), female carcass weights and pregnancy rates.

Area	Period	Area size (km <sup>2</sup> ) <sup>1</sup>	Average size of winter population ±SD <sup>2</sup>	Corresp. density (anim./km <sup>2</sup> )	Winter population 1983-1984	Female carcass weight (kg) <sup>3</sup>		Pregnancy rates <sup>4</sup>	
						Year-lings	2+ years	1-2 years	2-3 years
Forelhogna	1974-1984	1638	1425 ± 239	0.87	1770	39.2	43.7	100( 4) <sup>5</sup>	100( 18)
North Ottadalen	1974-1984	3245	2625 ± 431	0.81	2157	37.6	39.6	50( 2)	100( 8)
Rondane South	1981-1984	1500	1174 ± 126	0.78	1000	-	41.1	-	-
Rondane North	1972-1984	1441	1701 ± 254	1.18	1404	32.7	36.1	63( 8)	94( 16)
Hardangervidda	1973-1984	8122	15921 ± 2956 <sup>6</sup>	1.96	14969	25.6	29.3	60(15)	85(160)
Snøhetta	1977-1984	3295	2591 ± 441	0.79	2200	30.3	34.3	-	-

<sup>1</sup> Total hunting area (Krafft 1981).

<sup>2</sup> From Holthe (1977), Krafft (1981), Skogland (1985a) and annual reports from the various Reindeer councils.

<sup>3</sup> Forelhogna carcass weights from Meli (1985).

<sup>4</sup> Pregnancy rates: Forelhogna 1984 (Skogland, 1984), North Ottadalen and Rondane 1966-72 (Reimers, 1983) and Hardangervidda 1948-83 (Reimers, 1983; Skogland, 1984).

<sup>5</sup> Calculated from fig. 1 in Skogland (1985a).

<sup>6</sup> Sample size in paranthesis.

as shown in Table 4, and a low prenatal, neonatal and adult mortality. Skogland (1984, 1985d) found the calf mortality to be low in the Forelhogna and Knutshø herds (Table 4). The relatively low pregnancy rate and the high calf mortality (Table 4) result in a low population net increase in Hardangervidda.

The pregnancy and calf mortality rates in Rondane North fall between those of Forelhogna-Knutshø and of Hardangervidda. In spite of this Rondane North population showed the lowest (18.8%) net increase.

Skogland (1985d) found that the high mortality among Hardangervidda calves was caused by winter food-limitations. Food restric-

tion in late winter reduces fetus growth and calves are born smaller. Smaller new-born calves generally suffer higher neonatal mortality than heavier calves (Rognmo *et al.*, 1983). Winter range quality is very good in Rondane North (Reimers *et al.*, 1983) so that the relatively high calf mortality and the low population net increase in this area must have another explanation.

We have no reason to believe that the Rondane North herd or any other of the herds suffer important adult mortality. Large predators are virtually absent from the areas and the management policy aims to stabilize populations with an annual harvest of the population's net

Table 3. Average population net increase ±SD and annual harvest ±SD.

Area	Period	Population net increase as % of winter population	Number of animals	Harvest		Meat (tonnes)
				% of winter population	% calves	
Forelhogna	1970-1984	42.4 ± 10.0(10) <sup>1</sup>	459 ± 182(15) <sup>1</sup>	35.2 ± 9.1(13)	29.4 ± 6.1(15)	21.1 ± 7.7(15)
North Ottadalen	1972-1984	33.4 ± 1.5( 8)	944 ± 255(11)	36.4 ± 6.1(10)	8.6 ± 4.3(11)	52.7 ± 15.0(11)
Rondane South	1969-1984	31.8 ± 7.2(13)	350 ± 123( 4)	29.2 ± 8.4( 4)	17.2 ± 5.2( 4)	17.4 ± 6.4( 4)
Rondane North	1960-1984	18.8 ± 7.7(16)	357 ± 112(25)	19.8 ± 4.4(18)	7.2 ± 6.6(18)	14.5 ± 4.5(25)
Hardangervidda	1960-1984	24.8 ± 6.4(22) <sup>2</sup>	4143 ± 2376(25)	32.1 ± 25.9(23)	13.7 ± 1.1( 5)	141.0 ± 76.4(25)
Snøhetta	1977-1984	32.1 ± 5.1( 4)	831 ± 444( 7)	26.8 ± 12.8( 6)	13.2 ± 6.4( 6)	29.4 ± 14.9( 7)

<sup>1</sup> Number of years in paranthesis.

<sup>2</sup> Calculated on basis of Fig. 1 in Skogland (1985a).

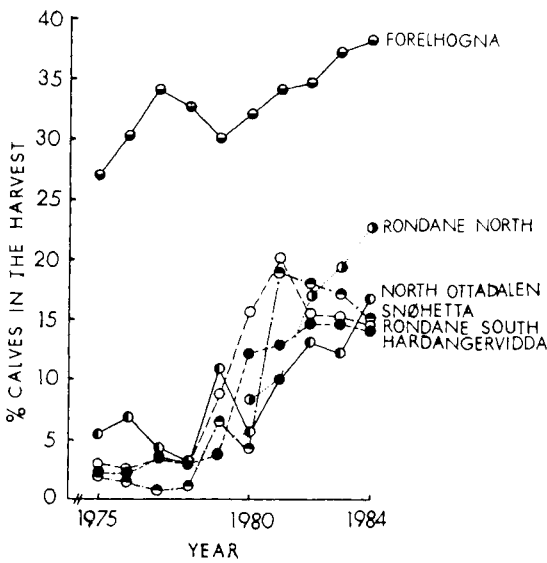


Fig. 1. Harvest of wild reindeer calves from 1975.

increase. Mortality caused by old age is therefore insignificant and large scale mortality caused by starvation of adults has not been observed.

The average net population increase was  $42.4 \pm 10.0\%$  in Forelhogna and  $33.4 \pm 1.5\%$  in North Ottadalen (Table 3). The high variance in Forelhogna may indicate annual variation in reproduction and mortality or, more likely, population count accuracy. Body weights and pregnancy rates are similar (Table 2) and there is no reason to believe that calf survival is different in the two areas. The difference in population growth rate is therefore most likely attributable to harvest strategy differences, in particular calf shooting.

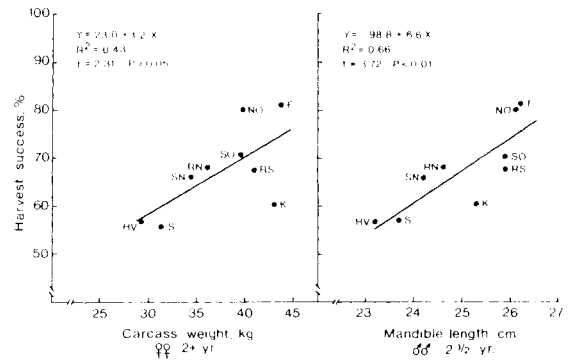


Fig. 2. The relationship between carcass weight (kg) or mandible length (cm) and harvest success. Areas and years: Forelhogna (F) 1964-84, North Ottadalen (NO) 1964-84, South Ottadalen (SO) 1974-84, Rondane North (RN) 1965-84, Rondane South (RS) 1976-84, Setesdal (S) 1964-84, Snøhetta (SN) 1953-84, Hardangervidda (HV) 1960-84, Knutshø (K) 1970-84.

In Forelhogna in order to maximize herd productivity, protect winter ranges and reduce winter mortality of calves, calf shooting has been practiced since 1968 and the average annual kill of calves is nearly 30% of the total harvest (Fig. 1). In North Ottadalen the calf harvest has been kept low and the average percentage during 1974 - 84 was 8.6. The local management of the Forelhogna reindeer herd is very well organized (see Meli, 1985). The management strategy developed in this area, in particular the high calf harvest, has been adopted by the official management authorities and from 1978 there has been a percentage increase in the calf harvest in all areas (Fig. 1).

Table 4. Pregnancy rates among 1-year or older wild reindeer and calf mortality. Sample size in paranthesis.

Area	Pregnancy rates %		Number of calves/ 100 females 2+ years in late summer	Calf mortality (%) from late pregnancy through summer
	Jan.-Apr.	At calving		
Forelhogna and Knutshø	100( 45) <sup>1</sup>	-	95(1085) <sup>1</sup>	5 <sup>1</sup>
Rondane North	83( 24) <sup>2</sup>	85( 589)	57(2014) <sup>3</sup>	33 <sup>3</sup>
Hardangervidda	83(175) <sup>4</sup>	50(1911) <sup>1</sup>	39(3776) <sup>1</sup>	53 <sup>1</sup>

<sup>1</sup> Data from Skogland (1984, 1985d).

<sup>2</sup> Data from Reimers (1983).

<sup>3</sup> Calculated from herd size and composition before calving, pregnancy and herd size and composition in autumn as yearling females and 2+ year were indistinguishable in summer. Data from 1983 - 85.

<sup>4</sup> Data from Reimers (1983) and Skogland (1984).

Table 5. Harvest of animals, meat and sale of licences.

Area	Period	Harvest/100 km <sup>2</sup>		Licences sold <sup>1</sup> / 100 km <sup>2</sup> (1000 NKr)
		Number of animals	Meat (kg)	
Forelhogna	1970-1984	28(33) <sup>2</sup>	1288(1498)	28.6(33.2)
North Ottadalen	1974-1984	29(36)	1624(2005)	35.2(43.5)
Rondane South	1981-1984	23(29)	1160(1487)	31.0(39.7)
Rondane North	1960-1984	25(21)	1004( 850)	37.2(31.5)
Hardangervidda	1960-1984	51(26)	1736( 886)	85.0(43.4)
Snøhetta	1978-1984	40(51)	892(1129)	33.5(42.4)

<sup>1</sup> Non-resident prices. Local residents pay half the resident price.

<sup>2</sup> Values in parenthesis: harvest of animals, meat and sale of licences adjusted to an animal winter density of 1 animal/km<sup>2</sup> in all areas.

The hunter have not shared the management authorities enthusiasm for the calf harvest strategy. Population net increase values from Forelhogna and North Ottadalen support the calf harvest strategy while total harvest as percentage of the winter population does not (Table 3). Of the two, the population net increase estimate probably is the most reliable. However, the increased calf harvest that took place in all areas from 1978 has not resulted in a net population increase. In the two areas, Forelhogna and Hardangervidda, there was a positive but insignificant relationship while in the other four areas there was an insignificant negative relationship.

The harvest of meat and the income from hunter-licences are 26% and 23%, respectively, higher in North Ottadalen than in Forelhogna (Table 5). This development was predicted in an early simulation study (Reimers *et al.*, 1977). Harvest of animals and income from licences were twice as high in Hardangervidda as in the other areas. Meat harvest was however, not much higher.

At a winter population density of 0.8 - 2.0 animals/km<sup>2</sup> annual harvest (per. km<sup>2</sup>) of wild reindeer amounts to 0.23 - 0.51 animals, 9 - 18 kg meat and 286 - 850 NKr from sale of hunting licences.

Table 6. Comparison of domestic and wild reindeer management.

Measurements	Domestic reindeer <sup>1</sup>	Domestic reindeer <sup>2</sup>	Wild reindeer <sup>3</sup>
Range (km <sup>2</sup> )	85 000 <sup>4</sup>	6000 <sup>4</sup>	29 241
Winter population	187 094	11 416	25 437
Animal density (animals/km <sup>2</sup> )	2.2	1.9	1.3
Harvest (%) of winter population (Range in parenthesis)	30(12-52)	45	30(20-36)
Harvest of meat (tonnes)	1484	161	276
Average carcass weight (kg)	26	31	36
Meat harvest (kg/km <sup>2</sup> )	17	27	14
Meat harvest (kg/km <sup>2</sup> ) adjusted to a density of 1 animal/km <sup>2</sup>	8	14	11

<sup>1</sup> Areas where the Saami population has legal exclusive rights to practice domestic reindeer management.

<sup>2</sup> Areas without the exclusive rights for the Saami population. Includes domestic reindeer herds in southern Norway.

<sup>3</sup> Data presented in this paper.

<sup>4</sup> From Langdal and Rundberg (1979). Other domestic reindeer data from Reindrifststyret (1984).

Harvest success varied between areas. There was a significant relationship between harvest success and animal body size expressed as carcass weight and mandible length (Fig. 2), possibly reflecting a relationship between behaviour and body size. Animals with a nervous behaviour as in Hardangervidda are more easily disturbed and therefore more difficult to hunt than the less nervous animals in Forelhogna. A high versus a low disturbance threshold probably have the same effect as a low versus a high level of disturbances and result in a low versus a high body growth rate as found by Reimers (1980).

Average population and harvest data from domestic reindeer areas and from the six wild reindeer areas representing ca. 50% of the total wild reindeer range in Norway is compared in Table 6. Meat harvest (kg/km<sup>2</sup>) is higher among domestic than wild reindeer due to higher animal density in the former.

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