Research Note

Reindeer population size and trend on Edgeøya Svalbard

NILS ARE ØRITSLAND

Øritsland N.A. 1998: Reindeer population size and trend on Edgeøya Svalbard. *Polar Research 17(1)*, 101–105.

Two censuses made of the population of Svalbard reindeer on Edgeøya in 1983 and 1996 resulted in 1586 and 2434 individuals respectively. Together with data from earlier population surveys (1969–77), this indicates, numerically, a population growth during the period 1969–96. Because of the weaknesses in the different census methods used, we cannot conclude that in reality a population growth has taken place even though the numerical data is correct. Therefore an average population size of 1730 (±451 SD) individuals for the period 1969–96 is suggested. Earlier estimates of vegetated area indicate that the present data corresponds to reindeer densities averaging 1.05 and ranging from 0.79 to 1.47 individuals/km^2.

Nils Are Øritsland, Norsk Polarinstitutt, P.O. Box 5072 Majorstua, N-0301 Oslo, Norway.

Introduction

The Svalbard reindeer *Rangifer tarandus platyrhynchus* Vrolik is a subspecies of the genus *Rangifer*. By the beginning of the century, the Svalbard reindeer was considered as being close to extinction due to over-harvest; it was protected in 1925 (Wollebæk 1926). Growth of the populations on the Svalbard archipelago has not been adequately monitored, but incidental surveys indicate that the total number of reindeer may now be in the range 10,000 to 11,000 individuals (Øritsland unpubl.). The early over-harvest probably did not encompass the reindeer on Edgeøya. A population size ranging from 500 to 800 individuals in 1959 has been suggested (Lønø 1959). Population sizes on Edgeøya island have later been appraised a few times (Norderhaug 1971, Hjeljord 1975; Alendal et al. 1979), and it was assumed that the population is at ecological carrying capacity (Alendal et al. 1979; Reimers 1983).

Presently, the term carrying capacity has little operational value for the practice of wildlife management, but it is useful as an ecological metaphor for some properties of mathematical expressions of our understanding of natural limitations to population growth. Variations rather than stable equilibriums are now considered the norm for both populations and ecological systems (Bascompte & Solé 1995; Sæther 1997). Caughley and Gunn (1993), using kangaroos and caribous as examples, suggested that studies of the dynamics of plant-herbivore systems would make better progress if the work were focused on hot or cold deserts, because such systems are highly labile and the causes of stability can be deduced only when the system is perturbed. The Svalbard archipelago, where reindeer live without herbivore competitors and predation except the possible kill of some very few individuals by arctic fox (*Alopex lagopus*), offers unique possibilities for such studies.

Annual observations of reindeer population size are presently being collected from only two small areas on Svalbard (Øritsland unpubl.). The analysis and verification of models for plant-reindeer dynamics that may emerge from such observations will benefit from comparisons with observations from other areas. Therefore, and in order to follow up on the oldest reliable information about reindeer population status on Svalbard (Norderhaug 1971), I conducted censuses on the reindeer population on Edgeøya in 1983 and 1996. The results are reported here and compared with data from previous work.

Study area and methods

The island Edgeøya is located between 77°15′ to 78°15′N and 21° to 24°E and has a total area of

Table 1. Census of Svalbard reindeer, adults and calves (about 10 months old), for Edgeøya, 1983 and 1996, together with the values for 1977 of Alendal et al. (1979). Areas not covered by the census are marked with –. Areas covered, but found empty are marked with zeros. The names and numbers in brackets after the names corresponds to those given by Alendal et al. op. cit.

Area	(1977)	(1977)	1983	1983	1996	1996
	Adults	Calves	Adults	Calves	Adults	Calves
Meodden coast (1)	0	0	0	0	83	1
Berrflota (2)	193	54	–	–	326	11
Atndalen (3)	5	0	11	0	100	3
Skrukkedalen (4)	46	13	138	7	142	3
Svingeldalen + coast (5)	10	0	4	0	4	0
Snøskardet, Arvedal and Åmotsdalen (6)	30	2	0	0	0	0
Rosenbergdalen (7)	73	4	48	1	44	2
Visdalen (8)	8	0	16	0	1	1
Coast Blankodden (9)	0	0	0	0	0	0
Raddedalen (10)	0	0	5	1	0	0
Pistradalen (11)	81	18	263	21	202	3
Blåbuktdalen (12)	45	15	149	5	195	1
Mangadalen (13)	28	9	81	5	78	1
Smelledalen (14)	6	1	13	1	16	0
Drivdalen (15)	0	0	0	0	0	0
Diskobukta north (16)	20	0	23	0	4	1
Pass Blåbukt- Dyrdalen (17)	14	3	0	0	0	0
Coast Albrectbreen (18)	20	0	0	0	0	0
Guldalen north (19), Guldalen south (20) and Mudalen (21)	160	13	266	110	428	0
Veitdalen (22)	0	0	0	0	0	0
Dyrdalen (23)	41	10	171	6	99	6
Slåen (24)	0	0	–	–	–	–
Plurdalen (25)	49	9	92	7	149	0
Grunnlinjesletta (26)	63	5	87	1	391	11
Tjuvfjordskardet (27)	0	0	10	0	21	0
Tjuvfjordlaguna to Halvmåneøya	–	–	40	4	101	6
Sums	892	156	1417	169	2384	50
Totals		1048		1586		2434
Calf %		15		11		2

about 5100 km^2 (Hisdal 1985). Based on an evaluation of topographical maps, combined with detailed vegetation mapping of a smaller area, the total vegetated area has been estimated at 1651 km^2 (Brattbakk 1986). Standard meteorological records are not available for Edgeøya, but a more continental climate than that observed for the western part of the Svalbard archipelago is assumed. Thus, in the coldest part of the year (February–March), mean air temperatures between −12 and −20°C may be expected, while a mean of 7°C may be expected for July. The amount of precipitation is small, less than 400 mm (water) per year on the western side of Svalbard, but may amount to 1000 mm per year in the southern part and eastwards facing mountain slopes in the eastern areas such as Edgeøya (Hisdal 1985).

The total number of calves (about 10 months old) and older animals were counted between 18 and 29 April 1983 and between 22 March and 8 April 1996 by use of snowmachines and binoculars. Numbers of animals were noted at distances of 10 to about 1000 m, which also made it easy to separate calves from older animals. Each census required about 14 days, driving altogether about 4000 km in order to cover the terrain. Total counts were made, but the glaciers were only visited and not surveyed completely. I assume that there were no reindeer on the glaciers during the census periods because no tracks leading from, to or on top were observed. Svalbard reindeer are

Table 2. Estimates of the population size for Svalbard reindeer on Edgeøya, 1969–96. Per cent change between censuses are given in %, r is the exponential growth and R the corresponding annual growth rate.

Source	Year	Population size	%	r	R
Norderhaug-71	1969	1448			
Hjeljord-75	1972	1568	8.3	0.027	1.027
Alendal et al.-79	1977	1300	−17.1	−0.037	0.963
This study	1983	1900	46.2	0.063	1.065
This study	1996	2434	28.1	0.019	1.019
Average		1730		0.018	1.019
Standard dev.		451		0.042	0.042

relatively sedentary during March and April, and movements which result in reindeer going unnoticed or being double counted do not pose problems for the census. Double counts of areas in other parts of Svalbard indicate that the census results of the areas covered are accurate within 10% (Øritsland, unpubl.). One minor area, Slåen, was not surveyed and another area, Berrflota, was not counted in 1983 due to deep soft snow stopping the snow machines. These areas are noted in the results section (Table 1).

Results

The values from the 1983 and 1996 censuses, and for comparison the 1977 census of Alendal et al. (1979), are given in Table 1. The names given in the table correspond to the map of Alendal et al. (1979). Rainfall during the cold parts of the winter produced considerable ice layers which covered parts of the vegetation both down in the valleys and higher on the mountain plateaus in 1995/96. Due to microtopographic features such as small hummocks, ridges, stones, pebble-sized rubble, slope and soil coarseness that affected water runoff, the thickness of the ice layers ranged from zero to 10 cm, the ice coverage was patchy and the ice cover could therefore not be measured in a manner that would be meaningful in terms of plant availability for the whole reindeer population. Subjectively I assume that, in contrast to 1983, the ice caused the reindeer to stay at low altitudes in March–April 1996. Deep and soft snow precluded census of the Berrflota area in 1983. The number of calves (Table 1) was significantly lower in 1996 (2%) than in 1983 (11%) ($\chi^2 = 181$, $P < 0.001$).

Discussion

Inasmuch as the Berrflota area contained nearly 340 individuals in 1996, and the plant availability as indicated qualitatively by lack of ice cover was better in 1983 than in 1996, it is also reasonable to increase the 1983 estimate from 1586 observed individuals to 1900 individuals. The assumption about poor feed availability due to icing in the winter of 1995/96 is corroborated by the low calf percentage of only 2% (Table 1), the lowest value reported for both this and other areas on Svalbard (Reimers 1977; Tyler 1987). There is no similar reason for assuming a higher than observed population size for 1996. Alendal et al. (1979) suggested a somewhat higher than observed population size for 1977. Thus the estimates for the total population size for Edgeøya for the period 1969–96 are as given in Table 2.

Numerically there is a positive correlation (correlation coefficient 0.90) between year and estimated population size for the period 1969–96. But both the differences in census methods used and the possibilities for natural variations in population size in intermediate years suggest that it is not realistic to conclude that a net population growth took place. The census of 1972 was carried out by use of both a helicopter and a fixed-wing aircraft, which is a poorer observation platform than a helicopter. A helicopter was used in 1969. The real population value for 1972 could therefore be considerably higher than the 1568 given above. The 1977 survey was conducted on foot by four persons who did not visit parts of the Berrflota area. It is therefore reasonable to assume that the estimate of 1300 individuals for that summer may be too low. Errors due to the fact that the Slåen area was not covered in 1983 and 1996 and Halvmåneøya was not covered in 1977

are assumed to be negligible because Slåen is very small and no animals were detected there in 1977 (Alendal et al. 1979) and only rarely a few (< 10) individuals are known to stay for brief periods on the small island Halvmåneøya (Lønø 1959). As quantitative examinations of the accuracy of the different census methods used are not available, reliable corrections of the reported census values can therefore not be made. Thus, it seems reasonable to conclude that the number of Svalbard reindeer on Edgeøya was about 1700 individuals (1730 ± 451 (average ± SD)) during the period 1969–96.

An appraisal of census methods relevant for Svalbard reindeer is evidently needed. A review of remote sensing methods including *Rangifer* is given by Lavigne et al. (1977). There is reason to believe that improved technology for detection of thermal infrared radiation may now be utilised for improving population surveys. Further discussion of such possibilities is outside the scope of this work.

Alendal et al. (1979) suggested that Edgeøya and the neighbouring island Barentsøya is occupied by only one population of Svalbard reindeer. This is not in accordance with the indications from Adventdalen that Svalbard reindeer are relatively stationary (Tyler & Øritsland 1989). In reality, there is no data available relevant to identifying population boundaries on Edgeøya. The observations from Adventdalen could as well be extrapolated to indicate that there are, for example, four reindeer populations on Edgeøya, as speculating that a single population occupies both islands.

By use of topographical maps, the vegetation on Edgeøya has been evaluated as covering 1519 km^2 (Norderhaug 1970), while Brattbakk (1986), with experience from detailed on ground vegetation mapping, suggested 1651 km^2. Here the term "vegetated area" means an area with vegetation coverage ranging as low as 5% and excludes water surfaces, river beds, gravel beds and glaciers. The corresponding reindeer densities range from 0.86 to 1.6 individuals/km^2 for the 1969–96 period. Because the 1651 km^2 vegetated area suggested by Brattbakk (1986) is based on experience with vegetation mapping, this value is considered the best estimate and corresponds to a reindeer density ranging from 0.79 to 1.47 and averaging 1.05 with standard deviation 0.27 individuals/km^2. The present densities are in general agreement with values reported for other *Rangifer* (Bergerud 1996; Leader-Williams 1988), but they are lower than the 4 to 7.4 individuals/km^2 reported for Adventdalen based on vegetation estimates from satellite imagery (Øritsland et al. 1980). This difference is probably due to the poor resolution and sensitivity of earth resource satellites for detecting sparse patchy vegetation. As studies of herbivore – plant interactions at the population level require values for plant biomass and growth, there is good reason to invest in remote sensing of vegetation coverage using aircraft as platforms in lieu of satellites.

It appears that the present data do not have sufficient detail for an analysis of the population variation boundaries and interactions between vegetation and reindeer. A follow up series of yearly counts over, for example, a five-year period would increase the value of the data significantly by providing a basis for such analysis.

Acknowledgements. – Thanks to G. Bangjord, R. Hansson and R. Hovelsrud for help with the field work.

References

Alendal, E., de Bie, S., Sipke, E. & van Wieren, S. E. 1979: Size and composition of the wild reindeer *Rangifer tarandus platyrhynchus* population in the Southeast Svalbard Nature Reserve. *Holarct. Ecol. 2*, 101–107.

Bascompte, J. & Solé, R. V. 1995: Rethinking complexity: modelling spatiotemporal dynamics in ecology. *Trends Evol. Ecol. 10*, 361–366.

Bergerud, A. T. 1996: Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer 9*, 95–116.

Brattbakk, I. 1986: Flora og vegetasjon. Pp. 15–34 in Øritsland, N. A. (ed.): *Svalbardreinen og dens livsgrunnlag*. Universitetsforlaget Oslo.

Caughley, G. & Gunn, A. 1993: Dynamics of large herbivores in deserts: kangaroos and caribou. *Oikos 67*, 45–55.

Hisdal, V. 1985: *Geography of Svalbard*. Norsk Polarinstitutt. 75 pp.

Hjeljord, O. 1975: Studies of the Svalbard reindeer. *Norsk Polarinst. Årbok 1973*, 113–124.

Lavigne, D. M., Øritsland, N. A. and Falconer, A., 1977: Remote sensing and ecosystem management. *Norsk Polarinst. Skr. 166*. 51 pp.

Leader-Williams, N. 1988: *Reindeer on South Georgia*. Cambridge Univ. Press. 257 pp.

Lønø, O. 1959: Reinen på Svalbard. *Norsk Polarinst. Medd. 83*.

Norderhaug, M. 1970: Svalbardreinen i 1960- årene. Beiteareal og bestand. *Norsk Polarinst. Medd. 99*, 253–264.

Norderhaug, M. 1971: Investigation of the Svalbard reindeer (Rangifer tarandus platyrhyncus) in Barentsøya and Edgeøya, summer 1969. *Norsk Polarinst. Årbok 1969*.

Reimers, E. 1983: Mortality in Svalbard reindeer. *Holarct. Ecol. 6*, 141–149.

Reimers, E. 1977: Population dynamics in two subpopulations of reindeer on Svalbard. *Arct. Alp. Res. 4*, 369–381.

Sæther, B. E. 1997: Environmental stochasticity and population dynamics of large herbivores: a search for mechanisms. *Trends Evol. Ecol. 12*, 143–149.

Tyler, N. J. C. 1987: Natural limitation of the abundance of the high Arctic Svalbard reindeer. Ph.D. dissertation. University of Cambridge. 321 pp.

Tyler, N. J. C. & Øritsland, N. A. 1989: Why don't Svalbard reindeer migrate? *Holarct. Ecol. 12*, 369–376.

Øritsland, N. A., Ødegaard, H., Frøyland, E. & Brattbakk, I. 1980: Use of satellite data and the IBM-ERMAN system in mapping of reindeer grazing range on Svalbard. Pp. 174–177 in Reimers, E. Gaare, E. & Skjenneberg, S. (eds.). *Proc. 2nd Int. Reindeer/Caribou Symp., Røros, Norway 1979. Direktoratet for vilt og ferskvannsfisk.*

Wollebæk, A. 1926: The Spitsbergen reindeer (*Rangifer tarandus spetsbergensis*) – *Resultater av de norske statsunderstøttede spitsbergenekspedisjonerr 1*, 1–71.