

MONITORING NORWEGIAN MOOSE POPULATIONS FOR MANAGEMENT PURPOSES

Vemund Jaren

Directorate for Nature Management, Tungasletta 2, N-7005 Trondheim, Norway

ABSTRACT: The present status and management policy in Norway is briefly presented. The annual bag has in the late 1980's been quite stable of about 25 000 moose. Management strategies are discussed. Priority is given to identification of regional moose populations, for which it is an important aim to make specific management plans. Hunter observations is the commonly used census method. In the population model CERSIM these observations are used as entry data together with hunting statistics and various population parameters to simulate the population size, age- and sex composition and development retrospectively. Population dynamics in moose can be strongly affected even by small changes in population parameters. It is important to monitor the populations regularly in order to discover changes at an early stage. Contents in a monitoring program is suggested.

ALCES SUPPLEMENT 1 (1992) pp. 105-111

Norway is a country with a great variety in topography, vegetation and climatic conditions. According to this, moose is offered a wide specter of range conditions throughout the country, causing variations in population growth rate. Consequently, different management strategies for the various regional moose populations are required. In turn, this depends on reliable knowledge about the populations' demography and use of land areas.

Present status and management policy

The population and annual bag of moose in Norway has increased rapidly after World War II. An important basis for this has been an increasing amount of available food, mainly due to changes in forestry. In the first period after the war moose hunting was not regulated by licenses, and the increase and expansion of the population occurred more or less accidentally (Haagenrud *et al.* 1987). In 1952 a license system was established, and the harvesting was more controlled in the 1950's and 1960's. The population growth in this period resulted from harvesting at a lower yield than the yearly net production.

After a decline in the annual bag in 1965-70, and based on ideas from new management practises in Sweden, selective harvest was gradually introduced in Norway after 1970. A

proportion of the licenses for adult females were replaced with licenses for calves. Combined with temporarily increased body condition and underharvesting, this led to a fast growing population. The development in the 1970's and early 1980's has been examined more closely by Østgård (1987). In this period the annual bag increased from 6 000 to 25 000 moose (fig.1).

In the late 1980's the total moose harvest in Norway has been quite stable of about 25000 with a slight increase up to 26 100 in 1989. However, this figure conceals the fact that there are great differences between regions concerning the development in harvest numbers. Some regions have had a drop in the annual bag, while other regions show a continuous increase. We believe this also reflects a similar trend in the population numbers.

The Directorate for Nature Management has outlined the following general aim for the management of Norwegian moose populations: "To keep moose populations with an optimal productivity and annual yield, taking into account the quality and carrying capacity of the habitats and the damage caused to agriculture and forestry."

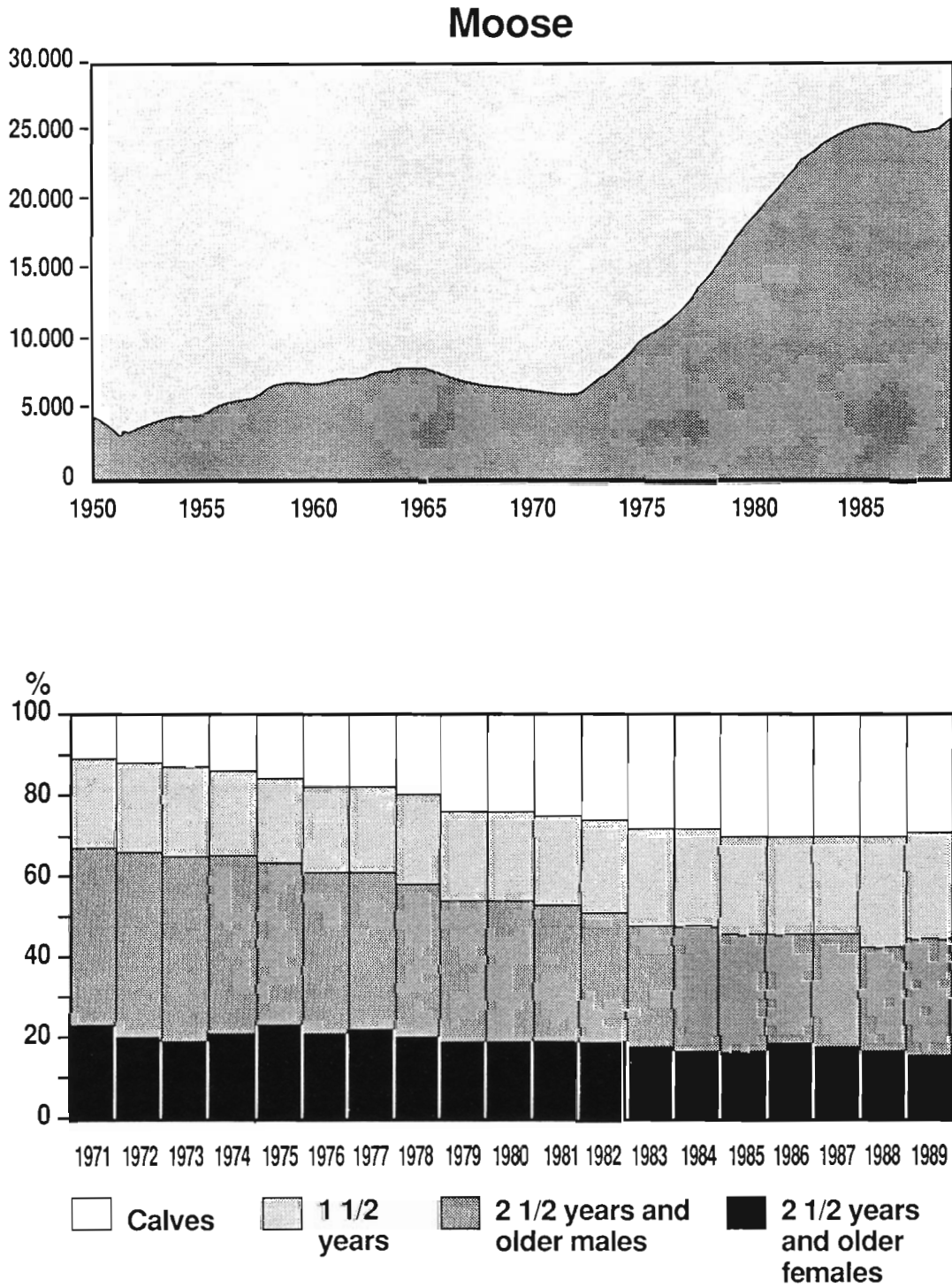


Fig. 1. Number of moose annually felled in Norway 1950-1989 (upper), and composition of the annual bag by different age- and sex classes 1971-1989 (lower).

MANAGEMENT STRATEGIES

In Norway the hunting rights belong to the landowners. The number of moose the landowners are permitted to shoot in their hunting areas each year, are restricted by a "minimum area" for each license issued. This area restriction is set for each municipality by the County Governor, who has a wildlife biologist in his staff. Changes in population size and/or variation in damage to crops and forestry, lead to corresponding changes in the minimum area.

In each municipality there is a Wildlife Board with elected members. The Wildlife Board issues the licenses to the landowners in accordance with the minimum area and the legal opportunity they have to adjust it in relation to local conditions for each hunting area. In the hunting licenses for each hunting area they also specify how many adult males, adult females and calves the landowners are allowed to fell.

Moose harvest is well regulated in Norway due to this management system. However, we have a time-lag problem; the local and regional authorities have a tendency to change the size and composition of quotas a bit late in relation to the real changes in the population development. This problem is connected with the difficulties in predicting changes in growth rate of the various populations in time.

Identification of Regional Populations

In many parts of Norway the great variations in topography and snow cover create a system of moose herds migrating between summer and winter habitats. As a result of this, moose herds are often shared between several municipalities, in some cases also between counties. It is of importance to identify such regional populations and the boundaries between them, as there is often a demand to manage them in different ways. Additionally, it will often be necessary to spread the hunting

pressure in a certain manner within a moose region to avoid too high population densities in restricted winter areas. To obtain this, it might be necessary to increase the harvest in the summer and fall areas, which can be located far from the winter areas.

The methods of identifying different moose herds and migration routes have traditionally been local experience in the Municipal Wildlife Boards combined with different kinds of track registration. In recent years there has been an increasing use of radio telemetry for this purpose. Several such projects have demonstrated surprising migrating directions and distribution of moose compared to what was expected.

Management Plans

Based upon the identification of different moose herds, it is a general aim to make management plans for each regional population. The plan should point out goals and guidelines for the management of that specific population for a period of 3-5 years. This includes the population size and age- and sex composition, the proportion of different age- and sex groups in the quota permits, population data which are to be collected in the plan period and tasks concerning habitat management.

It is also an objective for the wildlife authorities to encourage the landowners to show more interest in the management of the moose populations. As the income from both moose harvest, forestry and agriculture usually belong to the same landowners, it is urgent to create an understanding for optimizing the total yield from these sectors combined. Traditionally the moose harvest has been considered as just an extra profit, and the tolerance level of moose damage to forestry and agriculture has been quite low. It is now a growing understanding for the economic value of the wildlife resources, and through the work with management plans it should be possible to change these attitudes further in a

positive direction. The plans can also include economic means like repartition of profits and costs from moose harvest between the landowners in a region, as a common situation is that only a few landowners have severe damage to crops and forestry.

MANAGEMENT TOOLS

The situation in Norway with the hunting rights belonging to a high number of landowners and the local moose management handled by Municipal Wildlife Boards, makes it obvious that information and recommendations are central elements in the management strategy for the wildlife authorities at both county and national level. Therefore, it is important to have good routines for collecting information on the status and development of the various populations.

Census Problems

Aerial census is only used to a small extent in some local areas in Norway. The main reason for this is that topography and vegetation cover in the winter habitats usually makes it difficult to obtain precise estimates by the use of this method, and sufficient experiments that could evaluate the sightability in different area types have not been carried out. Another problem is that even if the moose herds show strong philopatry to their winter grounds (Andersen 1991, Sweanor and Sandegren 1989), variations in snow cover between years can cause variations in habitat use within a specific winter area. This can cause sampling problems when the objective is to estimate population size and population growth over a period of some years. Finally, the costs of this census method are fairly high.

Snow-track census is used in some areas to count moose migrating between summer and winter habitats. Except for this, the method is mostly used by some landowners for counting moose in their own hunting area. The method is not commonly used for man-

agement purposes by the wildlife authorities.

Hunter Observations

The method of hunter observations was introduced in some research areas in Norway in the late 1960's (Haagenrud *et al.* 1975). The moose hunters are provided with a questionnaire where they are requested to mark down daily the observed numbers of adult males, adult females without calves, females with one and two calves respectively and moose of unknown age and sex. From these figures the sex ratio and calf production within a municipality or a region have been calculated. In a period of some years, the calculated development in the number of moose observed per hunter day can show the growth trend in the population. An important prerequisite for the use of the method is probably that there is a quite stable system of hunting areas where mostly the same hunting teams are hunting in the same way from year to year. The method is now in common use in all moose districts in Norway.

The Population Model "CERSIM"

Until recent years, the hunter observations have been used only for direct calculation of some parameters as already mentioned. In the period 1985-1988 a committee formed by the Directorate for Nature Management developed a computer based population model called CERSIM (Lanestedt *et al.* 1988).

The model uses hunter observations as entry data together with the hunting statistics and various statistical and biological population parameters, e.g. age-specific reproduction among females. The basic principle is that after some years with such relevant data, it is possible to estimate and simulate the definite population size, age- and sex composition and growth rate through the same period. Consequently, CERSIM is not mainly a prognosis tool, but more correctly a descriptive analysis model.

The model can be run on data from dif-

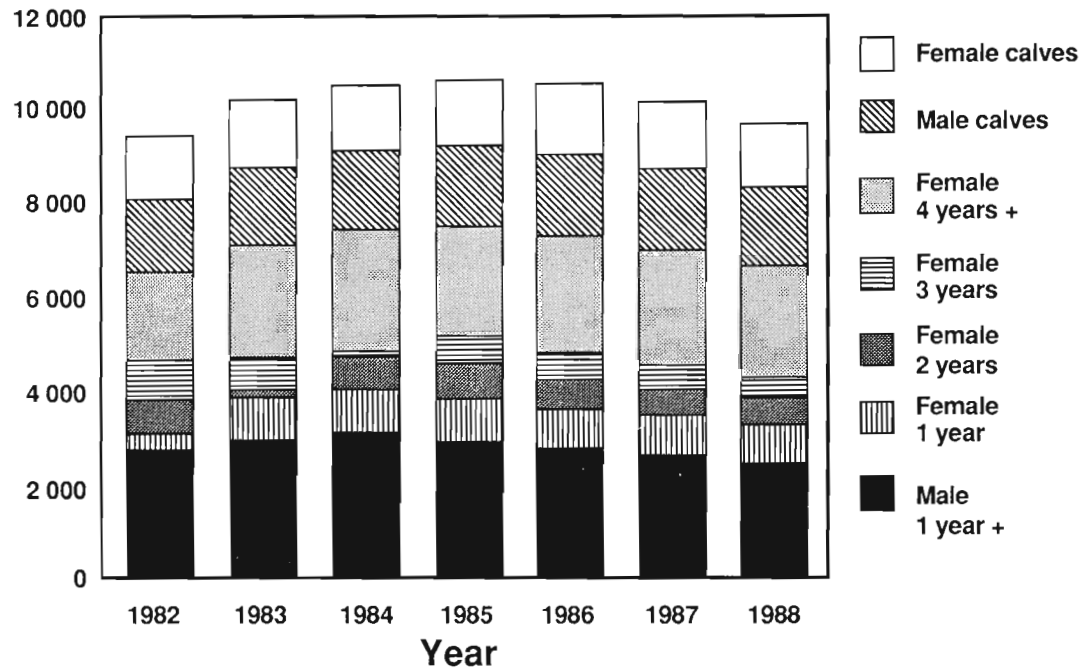


Fig. 2. Moose population numbers and age- and sex composition in Nord-Trøndelag county, Norway, 1982- 1988 as modelled by the population model CERSIM.

ferent geographical levels, e.g. municipality, moose region, county. The CERSIM committee has tested the model on data from several districts, and it seems to give reasonable results if the input data are of good quality for a continuous period of minimum 4-5 years (fig.2).

CERSIM is primarily meant to be a management tool for the county wildlife authorities. The model will enable them to give recommendations of the future management strategies for moose in their respective counties. From 1990 several counties have started to use the model for a test period of some years. We also have plans to test the model results against results from other census methods, e.g. aerial census.

DEMANDS FOR MONITORING MOOSE POPULATIONS

Population dynamics in moose can be strongly affected even by small changes in population parameters, e.g. winter mortality, fecundity. Habitat changes, for instance caused

by modern forestry, can lead to changes in population growth rate within an area, as the moose can show a strong range philopatry (Andersen 1991, Sweanor and Sandegren 1989). Our ability to predict such changes in population parameters depends on detailed monitoring of some representative "model" populations.

In a situation like what we had in Norway in the 1970's, with growing moose populations and underharvesting, we have fairly good margins in the management. Erroneous hunting pressure is to a certain extent compensated as the annual number of moose born into the population is larger than the numbers which are killed by hunting or die from natural causes. When it is desirable to stop the population growth and stabilize the annual bag at a sustainable yield, or when the population is declining, both the numbers and composition of hunting licenses ought to be fixed in a more precise manner to avoid uncontrolled population declines (Sylvèn *et al.* 1987).

We believe the population model CERSIM will be a useful help to identify the point where the population growth curve culminates, which requires shift in the management strategy. However, an important condition for this is the presence of adequate and high quality input data. To achieve this, there is an obvious need of regularly monitoring a number of geographically representative moose populations. Such data should also be of great importance as basis data for management plans. Additionally, data from monitor populations are assumed to function as early warnings for population density in relation to available food resources.

The predicted warmer climate caused by the greenhouse effect is assumed to change the life conditions for wildlife in Norway. It is predicted that some time in the future vegetation regions representing potential moose habitat will cover a much larger part of the country than today (Holten 1990). However, effects on the population dynamics caused by higher temperatures, less snow depth and shorter season of snow covered ground can be expected at a far earlier stage. In Norwegian moose it is well documented that there is a correlation between climatic factors and carcass weight / body condition (Sæther 1985, Sæther and Gravem 1988), and between carcass weight and fecundity rates (Sæther and Haagenrud 1983). There is an obvious demand for the monitoring of populations to get early warning signals of changes in demographic parameters, as this will require adjustments of the annual quota permits.

PROPOSED CONTENTS IN A MONITORING PROGRAM

Collection of basis data concerning population dynamics has been provided in a number of Norwegian moose populations since the late 1960's (Sæther and Haagenrud 1983). The material has included mandibles, reproductive tracts and carcass weights from moose

shot during the hunting season. By analysing the material, age structures and fecundity rates related to age and body condition have been established. Unfortunately, in most of the areas the collection of data has not been carried out regularly to provide continuous time series.

The research program "Moose - Forest - Society" have collected similar data from 3 areas continuously since 1984. In these areas a large number of radiocollared moose have also been traced in the same period, and various interactions between moose and habitat have been studied.

In a permanent monitoring program for moose populations, it will be natural to follow up these 3 areas further. Additionally, it would be desirable to establish 3 or 4 other monitoring areas in order to obtain a monitoring program which is fairly representative for the

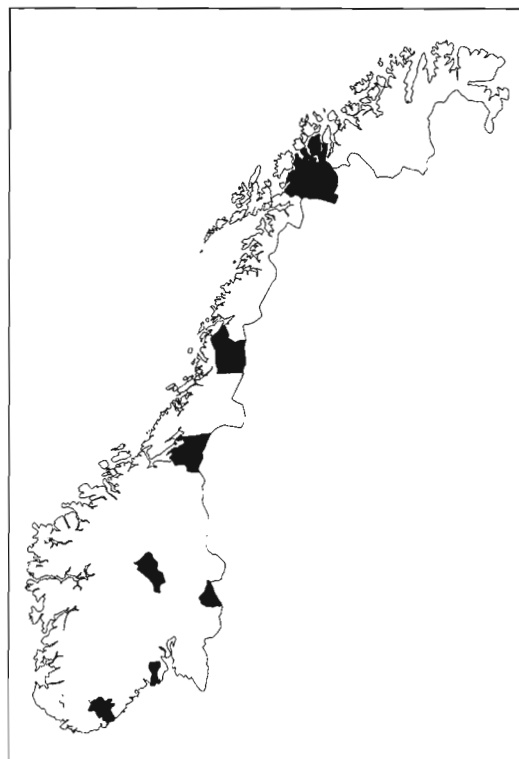


Fig. 3. Location of suggested study areas in a permanent monitoring program for moose populations in Norway.

variations in range conditions experienced by the moose populations in Norway (Fig.3).

The program ought to include annual collection of mandibles, reproductive tracts and carcass weights from a sufficient number of shot moose. Additionally, it is desirable to study a limited number of radiocollared cows of known age and their offspring. Supplementary collection of data from other regions can be carried out more irregularly.

It is natural to organize the program as a cooperation between the county wildlife authorities, who organize the collection of data, and the Norwegian Institute for Nature Research, where data are analysed and reported. If the necessary funds can be raised, we intend to start the monitoring program in 1991.

ACKNOWLEDGEMENTS

I want to express my thanks to Reidar Andersen and Bernt-Erik Sæther for critical comments on the manuscript, and to Gunn Paulsen who helped me improving the language.

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