

THE ECONOMIC VALUE OF MOOSE IN NORWAY – A REVIEW

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ABSTRACT: In Norway, the landowners' income from forestry and farming has decreased, mainly due to changes in international trade and trade conventions, and they are looking for new sources of income. In Norway, as opposed to Canada and USA, the landowner holds the right to hunt on their own land, and the meat from the hunt is sold on the free market. Still, a large, but unknown portion of the hunting permits are used in a closed market of landowners, their friends and local people wherein the only economic value of hunting is free or cheap meat to hunter and landowner. With increasing moose populations and increasing potential income for the landowner, more hunting permits are sold on the open market, where the hunters pay for the meat and/or the hunting experience. The main economic costs are moose browsing on pine plantations and moose-vehicle collisions. Crop damage is an additional small cost. The socioeconomic estimates of benefits and costs vary considerably depending on the methods used. The two main estimation problems are the closed hunting market and damage to plantations, which first show economical losses after about 100 years. The estimates of total annual revenue range from US \$70 to 90 M and the costs from US \$23 to 80 M. When setting the economic carrying capacity for moose, the increased costs of forest damage and traffic accidents, and mitigating countermeasures, should be compared to the increase in income associated with one more moose added to the population. In Norway, the regional management units set regional goals, whereas the duty of national wildlife authorities is to ensure that national and international goals are met. To succeed in managing the moose population to an optimal economic carrying capacity, a broad cooperation between interest groups and detailed spatial economic and ecological knowledge will be needed. We predict that increased economic revenue will become an important objective for many moose regions.

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The value of a species may be measured on different scales in different units. Kellert (1996) categorized the value of wildlife into the utilitarian, naturalistic, ecological-scientific, aesthetic, symbolic, dominionistic, humanistic, moralistic, and negativistic scales. Because of the different scales of measurement it may be difficult to give one unified value for moose (*Alces alces*). In conservation biology, ecological values may get high scores, whereas in local and regional planning those values are often ignored in favor of socio-economic considerations. Here we review

studies of the economic benefits and costs of moose for different groups of interest, with special emphasis on Norwegian conditions. For many participants in the process of moose management, however, values on other scales play a more important role. For instance, in Norway, moose have a strong cultural position (see Brottveit and Aagedal 1999) as demonstrated when the Norwegians nominated the moose as their national animal. We do not appraise these more abstract values of the moose, e.g., cultural, emotional, and recreational.

CONFLICT OF INTERESTS

The main income derived from the moose population in Norway results from harvest. The right to hunt moose is held by the landowners, who harvest moose on their own properties according to plans approved by locally elected boards and supervised by regional wildlife officers. The board decides how much area underlies each hunting license and which categories of age and sex should be shot. The number, age, and sex structures of harvested moose are chosen to steer the moose population towards the goals set by the management plans. The hunting season is usually 4 weeks in fall, when moose still occupy their summer ranges, which in most regions are mainly highland habitats. When snow accumulates, moose migrate toward common wintering grounds usually in the lowland (Cederlund et al. 1987, Gundersen et al. 1998). It is primarily on the winter ranges where moose become an expense due to heavy browsing of young pine (*Pinus sylvestris*) plantations (Lavsund 1987) and moose-vehicle accidents (Andersen et al. 1991, Gundersen et al. 1998).

During moose migration between summer and winter ranges, landowners are affected differently, causing conflicts connected to moose management. While some landowners benefit from hunting grounds during fall, others experience the disadvantages of damaged pine plantations during winter (Sæther et al. 1992). Furthermore, the values and traditions associated with the moose populations differ among regions (Rysstad and Gåsdal 1999). In some regions the moose is traditionally looked upon as a common good for both the landowners and the hunters (Brottveit 1999), while in other regions (e.g. Sweden and Finland), the landowning companies often see the moose as a recreational benefit for the local community and not as an economical resource (Anonymous 1999, 2000). Obvi-

ously, there are conflicting interests between hunting landowners, non-hunting landowners, and hunters resulting in contrasting goals for the management of the moose population.

Due to the conflicting interests and varying economic effects of different moose management strategies, private investments have been scarce in Fennoscandian moose management. There are, however, several studies attempting to study the utilization of forested landscapes and its' economic value (Myrberget 1987, Vistad 1988, Sæther et al. 1992, Gåsdal and Rysstad 1999), and several more are initiated, but not published. Briefly summarized, these studies encompass different management and harvesting strategies for game animals, especially moose, both at the landowner and community level. Moreover, private and socioeconomic principles of multipurpose usage and co-production of moose and wood also are discussed. Other studies focus on the impacts of moose browsing (Haveraaen and Hjeljord 1981, Myrberget 1987, Solbraa 1991, Doenier et al. 1997), enhancement of moose browse (Solbraa 1991, Moen 1998, Hesjadalen and Storaas 1999), the economic value of moose hunting (Jakt och viltvårdsberetningen 1981; Berganutvalget 1982; Sødal 1985, 1989; Mattsson and Kriström 1987; Vistad 1988; Mattsson 1989; Solbraa 1991; Bjerke 1993; Direktoratet for Naturforvaltning 1995; Eggan and Inderberg 1997; Køller 1997), optimal management and harvesting strategies for the moose population (Sylvén 1995, Eggan and Inderberg 1997, Sylvén et al. 1997), economic analysis of traffic accidents (Sødal 1985; Jaren et al. 1991; Lavsund and Sandegren 1991; Ulleberg and Jaren 1991; Stokkereit 1992; Lindgaard 1994; Messelt 1994; Kastdalen 1996a, b; Mysen 1996; Stikbakke and Gaasemyr 1997; Wahlstrøm 1998), and the significance of ecotourism in game management (Wolfe 1987, Boyce

1989, Taylor and Dunstone 1996, Eggen and Inderberg 1997). Absent from these studies, however, are the economic flows connected to the moose resource, and the incomes and expenditures for a landowner who invests in the commercial moose industry.

THE ECONOMIC FLOW OF MOOSE

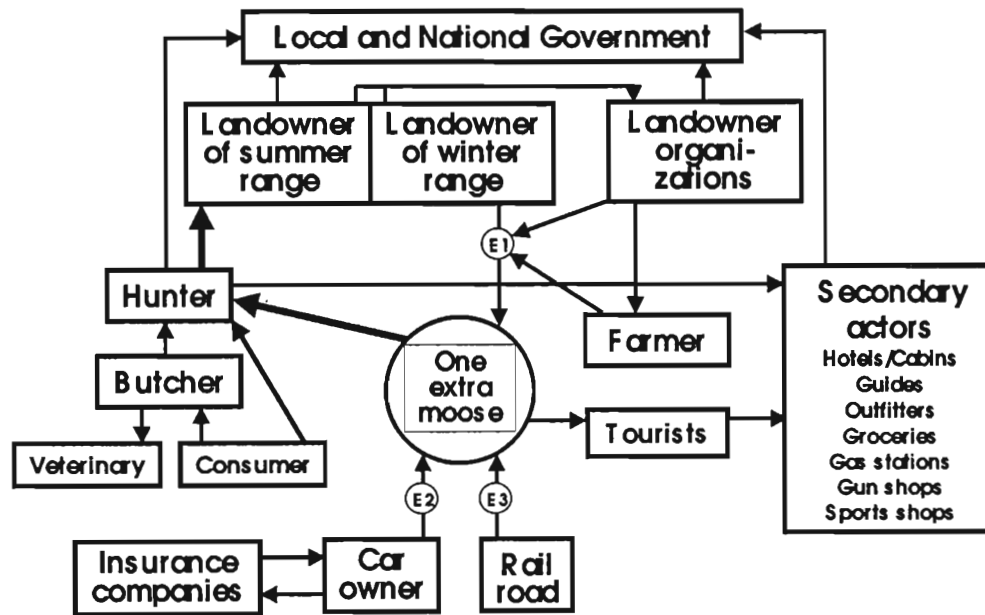
Below we discuss the economic flows connected to the moose resource, including the economic benefits and costs for various actors in the moose economic arena. Values are given in US\$, converted to contemporary (2000) market prices (Statistics Norway 2001). Finally, we discuss the knowledge needed to establish the potential

income for landowners interested in investing in a moose industry.

The main actor in the economic flow is the landowner (Fig. 1). As the landowner holds the hunting licenses connected to his property, he can either be a hunter himself or rent his land to hunting tourism. Hence, moose constitute at least 3 different potential sources of income for the landowner: he may (1) sell hunting adventures; (2) obtain moose meat; and (3) profit from non-consumptive tourism such as "moose safari".

The landowner is not the only person that profits from moose hunting. There also will be some secondary income for the general local society similar to landowners who sell fishing licenses (Navrud 1987).

Fig. 1. The economical flow when one extra moose is harvested. The value of the dead moose goes to the hunter. The market price he has to pay to the landowner varies. The hunter may pay secondary actors such as guides, and rent cabins and hotel rooms. The hunter may earn money by selling the meat directly to consumers or through a butcher. A high-density moose population may attract tourists that provide income to secondary actors. Most actors pay some form of tax to the government. Harvesting an extra moose requires a higher-density moose population. The landowners may pay to a landowner organization that undertakes efforts to prevent further damage to young pine forest (E1), cars (E2), and railroads (E3). The landowners will benefit from increasing the moose population if the income from the extra moose produced is higher than the increased payment to the landowner organization. The increased income may be divided between the owners of summer and winter ranges according to the year-round use of these areas by moose.



Assuming the landowner sells the hunting adventure and moose meat to hunting tourism, the hunter may sell the meat to a local butcher. The butcher in turn will profit from selling prepared moose meat to the consumers. Other components of the local society that profit from hunting tourism include: veterinary services obligated to check the moose meat, local tourist companies offering overnight accommodations, and local groceries.

Even though the landowner acquires most of the profit associated with hunting tourism, he will have to pay tax and fees to the local and national government. The taxation of the landowner's hunting license depends on whether he uses the right himself or if he rents it to another party. If he makes use of the hunting right himself, the tax will be very low, whereas if he rents it to another party the tax will be similar to an ordinary enterprise (Storaas and Punsvik 1996). In addition, the landowner may have to pay some fees to the landowner organizations, which are used to manage the moose population. In some areas this includes steering moose away from highways or buying ensilage from farmers to reduce damage on young pine plantations (Gundersen, unpublished data).

The landowner also may offer wildlife viewing. According to Norwegian law, however, the public has trespassing rights on federal areas and private lands, as long as it is outside cultivated fields. People that do not possess property may thus run organized wildlife viewing and outfitting companies. In Norway, there are but a few moose viewing enterprises. They are small and unstable, however, and their income has been low (Mysterud and Mysterud 1995). Nonetheless, the moose population provides potential for the landowner or other local companies to profit from wildlife viewing. This non-consumptive moose tourism will provide some of the same benefits to the

local society as hunting tourism.

Obviously, moose also incur some economic costs, which may be divided into 3 main categories: (1) moose-vehicle accidents; (2) browse damage on commercial timber plantations; and (3) browse damage on agricultural crops. A central question regarding moose management is who shall pay the bills of the economic loss due to traffic accidents and browse damage. In all Fennoscandia, the individual motorists and their insurance companies must bear the costs of vehicle damage when moose are involved in traffic accidents, while society pays the hospital bills. The governments pay for compensation of damage done by moose on cultivated crops, whereas in Finland the government also pays the costs of pine browsing (Lavsund 1987, Poteri 1996).

ESTIMATES OF BENEFITS AND COSTS

In the appendices we present some values of the benefits and costs of a high-density population according to various Norwegian studies. The main revenue comes from hunt and meat profits, but it is difficult to distinguish between the two values. The meat value depends, among other factors, on quantity available and the quality of the meat (Sødal 1985) and has been reported to differ between \$4 and \$9 per kg (Sødal 1985, Mattsson and Kriström 1987, Vistad 1988, Solbraa 1991, Bjerke 1993, Eggan and Inderberg 1997). Sæther et al. (1992) argued from general economic theory and surveys, that the economic value of an individual moose would decrease as the moose population increased. Due to a changed harvest policy, the total weight of the Norwegian moose harvest has increased from 340 metric tons in 1981 (Berganutvalget 1982) to 4,815 metric tons in 1998 (I. Stensaas, personal communication, 1999). In spite of this, the economic value per moose has increased. This is probably

because the moose market has become more open, and because the demand for moose hunting has been much higher than the allocated supply. Today, the meat has a potential value in Norway well above \$42 million (M). In addition, the hide could potentially be utilized as an industry product, although it is not currently used in Norway, mainly because the hunters find the price too low. The price of one hide lies between \$17 and \$32 (Sødal 1985), and with up to 40,000 moose shot annually in Norway, the hides could have a potential value of \$680,000 to \$1.3 M.

The economic costs of moose are more difficult to estimate, as there are several factors involved. Some costs may even provide a secondary income for the local society, such as vehicle accidents which offer income for local service stations (but see Appendix 2 for some estimated costs). For the landowner the main cost is browsing damage, which Solbraa (1998) estimated to be between \$2.6 – 5.3 M in Norway. However, the main problem with such estimates is that the damage of a young pine will have long-term economic consequences of up to 100 years, which is the rotation age for pine stands. Hence, after 80 years, Solbraa (1998) estimated the loss due to browsing in Norway to be between \$20 - 40 M. In spite of the browse damage, Hänninen (1994) suggested that the moose population actually may have a positive influence on forestry, and that one animal was able to provide forest cultivation worth \$400 a year in Finland. However, the degree of cultivation is probably highly dependent on moose density. Haagenrud (1995) also estimated the costs of the work and equipment moose hunters put into their hunt at \$140 M a year. It is, however, difficult to consider this as a cost, since this is a highly valued leisure activity which may actually result in secondary income for society. From the estimates given in the appendices we have

estimated that the total annual revenue of moose may range from \$70 to 90 M and the costs from \$23 to 80 M.

DISCUSSION

Most estimates show that the economic benefits from moose are considerably larger than the economic costs. Those benefits and costs, however, come to different groups of people. It is difficult to maintain high moose populations when motorists and owners of moose winter ranges have high and increasing losses. Further increases in moose populations will require mitigating efforts, and formula that divides the costs among the different landowners. Today we do not know which management approaches will work best nor the cost of implementing them. We also have little spatial economic knowledge of how these costs should be divided.

Whether or not high density moose populations are an additional source of income in rural areas today will depend on landowners choice to invest in moose. Today most landowners bear none of the costs associated with moose, while society and the owners of pine plantations in the wintering areas have considerable costs. If moose populations increase further, wildlife authorities will probably demand that numbers be reduced (Direktoratet for Naturforvaltning 1995). Conversely, if regional authorities invest in mitigating efforts that reduce traffic accidents and damage on pine plantations, and ensure viable moose populations and maintenance of biotic diversity, the regions likely would be allowed to increase moose populations. The costs to the individual landowner will be the payment to a landowner-based wildlife management unit, that plans and implements mitigation efforts. When setting the economic carrying capacity for moose, however, increased costs of forest damage, traffic accidents, and mitigating efforts

should be compared to the increase in income that results when one more moose is added to the population. In Norway, the regional management units set the regional goals, whereas the duty of national wildlife authorities is to see that violation of national and international goals does not occur. To succeed in managing the moose population to an optimal economical carrying capacity, broad cooperation between interest groups and detailed spatial-economical and ecological knowledge will be needed. We predict that increased economic revenue will become an important objective for many moose regions.

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Appendix 1. Income from hunting, tourism, and moose browsing in Norway, all based on US\$ (2000).

Category	Sub-category	Income (\$)	Source
Hunt	Potential sales values for meat and hide	42 million	Berganutvalget 1982
	The value of hunt in Norway	172-257 million	Muus Falck & Mysterud 1988
	Meat value	4-9 per kg	Sødal 1985, Vistad 1988, Solbraa 1991, Bjerke 1993, Eggan & Inderberg 1997
	Hunting fee	30-52 per animal	Ingebrigt Stensaas pers.comm. 1999
	Hunting ground rental	2-15 per ha	Norges skogeierforbund pers. comm.
	Meat value - game and fish	83 million	Norges skogeierforbund pers. comm.
	Meat and rental value – game and fish	100 million	Norges skogeierforbund pers. comm.
	Hunting value (bulls)	27-2,250 per bull	Eggan & Inderberg 1997
	Hunting value (cows)	27-135 per cow	Eggan & Inderberg 1997
	Gross value	690 per harvested moose	Sæther et al. 1992
Moose browsing	Reduced forest cultivation	1.15 per ha	Solbraa et al. 1986, Statistics Norway 1989
	Performed forest cultivation	400 per moose in Finland	Hänninen 1994

Appendix 2. Cost from browse damage, cultivated fields, and traffic accidents and their mitigating countermeasures in Norway, all based on US\$ (2000).

Category	Sub-category	Income (\$)	Source
Forest damage	Loss per harvested moose	66-132 per harvested moose	Solbraa 1998
	Loss in present value in Norway	2.6-5.3 million per year	Solbraa 1998
	Loss after 80 years	20-40 million per year	Solbraa 1998
	Loss in reduction in waiting value	27 per ha	Hamar 1997
	Loss in waiting value	2 million during 15 years	Hamar 1997
Damage on cultivated fields	Yearly compensation	64,500-165,000	Statistics Norway 1999
	Costs per farm (1985)	700	Myrberget 1987
Countermeasures	Moose feeding	54-135 per moose	Lund 1997
		0.3 per kg moose food	Lavsund 1987

Appendix 2 continued...

Category	Sub-category	Income (\$)	Source
		137 per moose per winter	Lavsund 1987
Traffic accidents			
	Railways	3,140 per accident	Jaren et al. 1991
	Roads	8,390 average socioeconomic cost	Messelt 1994
		22,420-29,060 per accident	Kastdalen 1996a
		11,460-18,200 per accident	Stikbakke and Gaasemyr 1997
		29,130 per accident	Messelt 1994
		25,880 per accident, socioeconomic cost	Kastdalen 1996b
		14,510 per accident	Wahlstrøm 1998
	Roads, yearly average	15-23 million, whole society 660-1100 per ha	Stikbakke and Gaasemyr 1997, Stokkerei 1992, Statistics Norway 1989
		28-42 million, whole society	Kastdalen 1996a
		5,640 per km	Mysen 1996
	Compensations, whole country	5.3 million	Tore Vaaje, Gjensidige Insurance Company, pers.comm. 1999
		3.3 million	Bjørn A. Edvartsen, Storebrand Insurance Company, pers.comm. 1999
		40 million, total	UNI-Storebrand pers. comm.
	Compensations, Hedmark mun.	0.8 million	Tore Vaaje, Gjensidige Insurance Company, pers.comm. 1999, Statistics Norway 1989
		180 per ha	Bjørn A. Edvartsen, Storebrand Insurance Company, pers.comm. 1999, Statistics Norway 1989
	Total costs on damage to cars in Nord-Trøndelag mun.	182,750-243,650 per year	Lorentsen et al. 1991
Countermeasures			
	Yearly socioeconomic costs against all types of accidents	1.2 million	Elvik 1993
	Forest clearing	6,230 per km	Wiseth and Pedersen 1989
	Game fence	32,780-136,590 per km	Amundsen 1996, Stikbakke and Gaasemyr 1997, Mysen 1996
	Illuminated openings	6,740-13,480	Stikbakke and Gaasemyr 1997
	Illuminated road	62,270 per km	Amundsen 1996

Appendix 2 continued...

Category	Sub-category	Income (\$)	Source
	Fauna passage	136,600-819,500	Stikbakke and Gaasemyr 1997, Mysen 1996, Kastdalen 1996b
	Visibility clearing	2,700-8,610 per km	Amundsen 1996, Stikbakke and Gaasemyr 1997, Messelt 1994
	Scent signals	410-1,080 per km	Stikbakke and Gaasemyr 1997
	Illuminated signposts	13,480 per km	Stikbakke and Gaasemyr 1997
	Signposts	1,640-5,460 per km	Amundsen 1996, Stikbakke and Gaasemyr 1997
	Variable signposts	1,380	Amundsen 1996
	Gamereflector	540-1,080	Stikbakke and Gaasemyr 1997