

Livestock-guarding dogs in Norway Part II: Different working regimes

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Abstract

Livestock-guarding dogs are an effective way of protecting rangeland sheep from predators. However, open mountain/forest range and widely ranging sheep are factors that may make adaptation to Norwegian conditions difficult. This paper focuses on the dogs' working patterns and effectiveness under different working regimes. A 3,500 ha, unfenced forest/mountain range pasture in bear habitat comprised the research area in which 624 sheep from 2 herds grazed. The field trial lasted 3 months, and a total of 10 Great Pyrenees participated for various time intervals. Three different working regimes were evaluated: 1) loose dogs without the command of a dog handler (Method A); 2) loose dogs under the command of a dog handler (Method B); and 3) loose dogs guarding sheep inside a fenced, 1 km² forest pasture (Method C). Nocturnal behavioural activity patterns and data on predation were recorded. Method A proved too uncontrolled for Norwegian conditions, because sheep dispersed too widely and dogs ranged too far, causing conflicts in nearby settlements with wildlife, and with livestock. Pasture dogs (C) were >3 times less active and were engaged in guarding activities < 50% as often as patrol dogs (B). However, they barked >15 times more frequently, and no sheep carcasses were found inside the fence. Therefore, Method C probably had the best preventive effect.

Key Words: Great Pyrenees, behavior, sheep, carnivores, depredation

More than 100,000 sheep disappear each year on Norwegian mountain and forest ranges during 3 months of summer grazing (Miljøverndepartementet 1997). Depredation caused by protected large carnivores [Scandinavian brown bears (*Ursus arctos*), lynx (*Lynx lynx*), wolves (*Lupus lupus*) and wolverines (*Gulo gulo*)] can exceed 70% of the total losses in severely affected areas (Kvam et al. 1995, Mysterud and Mysterud

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Resumen

Los perros guardianes de ganado son un medio efectivo de proteger los ovinos de los predadores. Sin embargo los pastizales de montaña abierta/bosque y el amplio rango de los ovinos son factores que pueden hacer difícil la adaptación a las condiciones noruegas. Este artículo se enfoca en los patrones de trabajo de los perros y su efectividad bajo diferentes regímenes de trabajo. El área de investigación fue un potrero sin cercar de 3,500 ha de pastizal de montaña/bosque en hábitat de osos y en el cual apacentaron 624 borregos divididos en dos rebaños. El ensayo de campo duró 3 meses y un total de 10 perros Great Pyrenees participaron en varios intervalos de tiempo. Se evaluaron 3 diferentes regímenes de trabajo 1) perros libres sin la dirección de un perro líder (método A); 2) perros libres bajo el mando de un perro líder (Método B) y 3) perros libres cuidando ovinos dentro de un potrero cercado de 1 km² en un área de bosque (método C). Se registraron los patrones de comportamiento de actividades nocturnas y datos de predación. El método A resultó muy sin control para las condiciones noruegas porque los ovinos se dispersaron muy ampliamente y los perros se movieron muy lejos causando conflictos en asentamientos humanos cercanos con la fauna silvestre y el ganado. Los perros guardianes del método C fueron más de tres veces menos activos y estuvieron en actividades de guardia menos del 50% de las actividades de guardia realizadas por los perros patrulleros (método B). Sin embargo, los perros del método C ladraron más de 15 veces más frecuente y no se encontraron cadáveres dentro de la cerca. Por lo tanto el método C probablemente tiene el mejor efecto preventivo.

1995). The Norwegian Government wants to increase/recover the populations of large carnivores and to maintain a sustainable sheep farming at the same time (Miljøverndepartementet 1997), which means that we need to find preventive attempts to reduce depredation.

Livestock-guarding dogs might be an effective method for protecting sheep from predators (Lorenz and Coppinger 1986, Coppinger et al. 1988; Green and Woodruff 1990, Andelt 1992). A strong social bonding between dog and sheep based on raising the puppy with sheep from the age of 6–8 weeks is recommended to assure a trustworthy, attentive and protective dog (Coppinger et al. 1983; Lorenz and Coppinger 1986, Green and Woodruff 1990, Sims and Dawydiak 1990). However, widely dispersing sheep (herding is not common)

and open (unfenced), rough ranges make it difficult to use guarding dogs in Norway. Additionally, free public access is guaranteed by law to all rangelands (Lov om friluftslivet 1957), and dogs are not allowed to be loose during the summer in order to protect wildlife (Viltloven 1981), grazing livestock (Bufeloven 1926), and farmed reindeer (Reindriftsloven 1978).

This paper encompasses results on the Great Pyrenees' working patterns and effectiveness under different working regimes. Part I focused on basic behavioral characteristics of the Great Pyrenees (Hansen and Bakken 1999).

Methods

Study Area

The study was conducted in Holandsfjellet, an unfenced grazing area located in the municipality of Lierne in Nord-Trøndelag County, in mid-eastern Norway (Fig. 1). The area chosen for the field trial fulfilled 3 criteria: 1) it was located in occupied bear habitat, with annual predation rates of 10–20% of all sheep released; 2) it represented a traditional Norwegian mountain and forest range, in which the sheep dispersed widely; and 3) it was unfenced and situated close to human settlements, a condition typical of most Norwegian mountain ranges.

Dogs

A total of 10 Great Pyrenees dogs were used. Most of the data are on dogs identified as No. 2 and 3 (2 years old) and No. 6 and 7 (3 years old), which worked continuously the last month of the study. All dogs were reared on sheep farms from the age of 12–16 weeks, but in following strong recommendations from the Norwegian Kennel Club, they were handled by several different people.

Field Trials

The field trials lasted from 7 June until 3 September 1995. A total of 624 sheep (lambs and ewes) from 2 different herds (Herd I and II), were released onto the 3,500 ha. summer pasture. The sheep were not familiar with guarding dogs, and an initial 3-week period was used to familiarize the sheep with the dogs in small paddocks prior to their release onto the open range. The dogs

always worked in teams of 2 or 3. Three ways (i.e., "A", "B", and "C") of using guarding dogs at night were evaluated. Because of insurmountable problems encountered with method A, the original procedures were redesigned to include methods B and C.

Method A: Loose dogs in the grazing area without direct supervision of a dog handler.—Six dogs were released from 3 tent camps in the herding area and were allowed to work independently. Radio telemetry was used when the dogs were out of sight. These dogs are referred to as "loose dogs".

Method B: Loose dogs patrolling the herding area under the command of a dog handler.—Dogs No. 2 and 3 were used. They were strongly bonded to the dog handler and did not cause trouble by wandering off. These dogs are called "patrol dogs". Different parts of the herding area were patrolled each night.

Method C: Loose dogs guarding sheep inside a 1 km², enclosed forest pasture, in which 120 sheep grazed.—Dogs No. 6 and 7 were used. A 3-strand, 60–110 cm high electric fence (Ultra Electronic 1600, 50Hz, 3.5 W) surrounded the pasture. Electricity was turned off during the hours that bear depredation was most likely to occur (2300–0600 hrs). The dogs were leashed inside the pasture during the day. These dogs are called "pasture dogs".

Observations

Emphasis was put on documenting the activity patterns of the dogs at night, since most depredation occur during this time. Individual behavior patterns were estimated by scan sampling at 150 sec intervals during two, 30-minute periods each night, representing a total of

1,219 behavioral observations on dog No. 6, 1,218 observations on dog No. 7, 494 on dog No. 2, and 489 on dog No. 3. Sixteen different behaviors were registered, but were finally categorized into 3 behavioral categories: "inactivity" (laying, sitting, standing); "guarding" (patrolling, ranging around, alertness, barking, and scent marking); and "other activities" (walking, running, sniffing, digging, hunting, playing, social interactions, comfort behavior). Distances between the dog and the sheep and between the dog and the observer were recorded as objective measures for the strength of the social bonding between dog-sheep versus dog-man. Behavioral reactions of the dogs towards sheep and wildlife were also recorded. After the grazing season, data on sheep depredation were collected. These were compared to data on neighbouring herds and to data from the previous 3 years.

Statistics

Due to the low number of dogs, descriptive statistics were applied for most of the data. When valid, SAS pro-

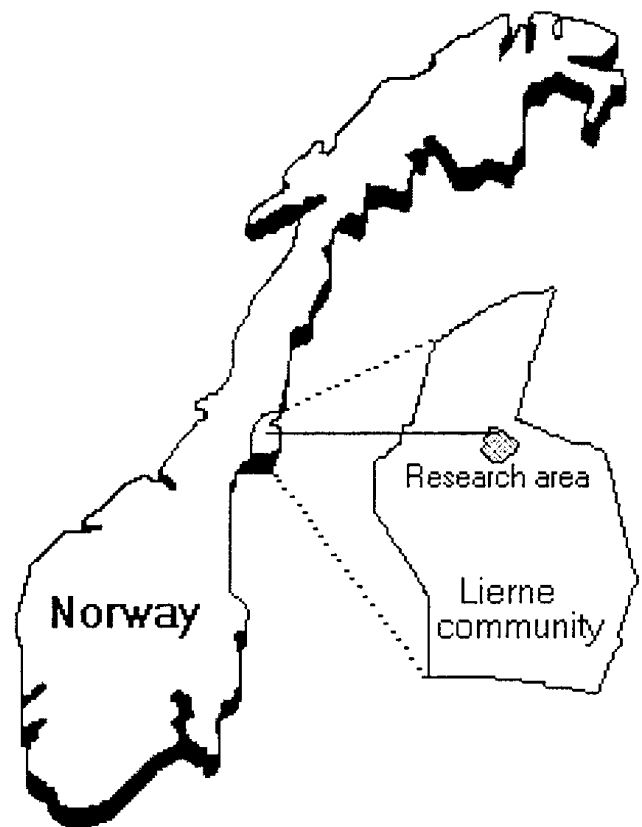


Fig. 1. Map of the research area "Holandsfjellet", located in the municipality of Lierne in Nord-Trøndelag county. A total of 624 sheep were grazing in the 3,500 ha combined mountain and forest range.

Table 1. Mean distances (m.; mean, SD, range) between dog and sheep and between dog and observer.

	Method A			Method B			Method C		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Distance dog-sheep ¹	261	151.1	5-500	366	56.7	100-500	202	129.1	30-500
Distance dog-man	102	151.6	0-500	34	9.5	0-1000	15	34.3	0-500

¹In 48% of the observations the data are missing because sheep were out of sight.

cedures (SAS 1987) were used: Mann-Whitney U-test and Student's t-test for testing the difference between 2 non-parametric and 2 parametric variables, respectively. Differences discussed are statistically significant of the 5% level unless otherwise stated.

Results

Behavioural Comparisons between Methods A, B and C

Using loose dogs without the command of a dog handler (Method A) was too uncontrolled under Norwegian conditions. The dogs ran to the nearby settlements, and they did not cover the area around the widely dispersed sheep sufficiently. They also chased wildlife (see below), and 9 domestic rabbits at a farm were killed. In addition, some dogs chased sheep. The episodes of chasing sheep became more aggravated, causing lambs to be separated from their mothers and possibly resulting in the death of 5 lambs. Because of the problems, it was not possible to collect sufficient amounts of data on Method A-dogs for statistical purposes.

Compared to the patrol dogs (dogs No. 2 and 3, Method B), pasture dogs (dogs No. 6 and 7, Method C) were >3 times as inactive (21% versus 76%, Fig. 2), and they were engaged in guarding activities half as often (19% versus 41%), but they barked 15 times more frequently. In addition to being observed from a fixed observing site, the pasture dogs were also observed for 4 hours (8 observation periods) when patrolling the enclosed area together with people. On these occasions the behavioral frequency distribution with respect to guarding, inactivity and other activities was 40%, 26%, and 35%, respectively. This is different from the activity pattern found when not guided (Mann-Whitney U-test), but nearly identical to the behavior shown by the patrol dogs (Fig. 2).

Within each working regime (B and C), differences in behavior between dogs were observed. Dog No. 3 was more inactive than dog No. 2 (Fig. 2), and dog No. 6 was more engaged in guarding activities compared to dog No. 7, particularly regarding barking, which he did >2 X as often.

Guarding Methods

The distance between dog and sheep was greater than the distance between dog and observer (t-test, Table 1). The dogs were 100 m or closer to the observer in 67% of the observations, but this close to the sheep only 4% of the times. These measures indicate that the dogs were more strongly socially bonded to people than to sheep. On some occasions exclusive to the observation periods the dogs ranged farther from the dog handler than Table 1 indicates. Maximum ranging distances were; method A: 10 km, method B: 2 km, and method C: 1 km (limited by the fence). The dogs wandered away less from the

dog handler after rearranging the field trial (methods B and C versus method A), as intended.

During observation periods, dogs were observed confronting 31 woodland birds, 19 Lapland marmots (*Marmota* spp.), 4 moose (*Alces alces*) and a roe deer (*Capreolus capreolus*). In 85% of the cases the wildlife was chased/ followed. About 50% of the marmots were attacked and killed.

Behavioral observations indicated there were at least 3 confrontations between the dogs and bears during the field study. The possible confrontations correspond well in time with findings of bear tracks and fresh sheep carcasses in the area.

Depredation and Economic Effect of Using Dogs

Little bear damage was recorded within the study area compared to the neighbouring areas until 24 August. Outside the study area depredation on sheep started 14 days earlier. However, some

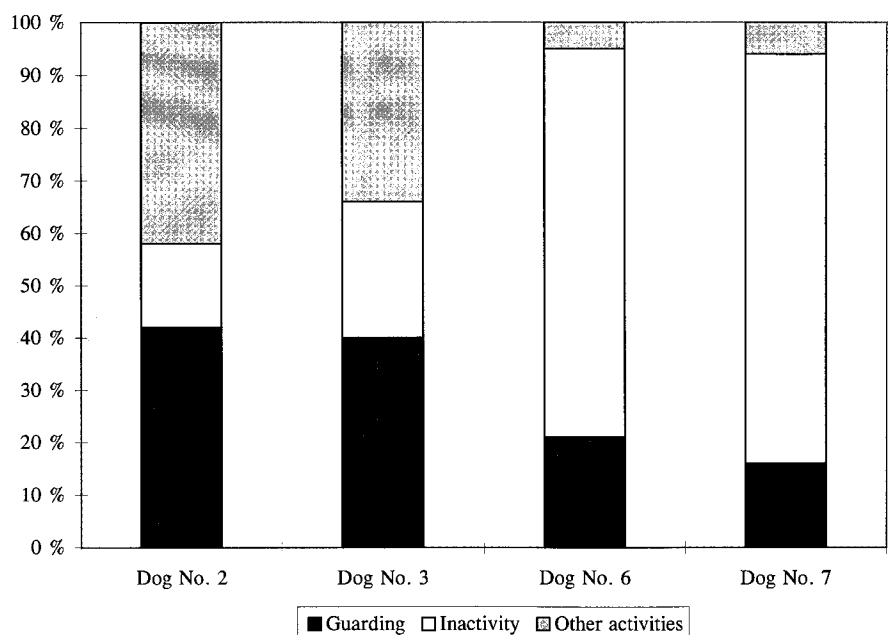


Fig. 2. Frequency distribution of the behavioral categories: guarding; inactivity; and other activities for dogs No. 2, 3 (patrol dogs), 6 and 7 (pasture dogs).

animals in the research herds (30–50%) periodically grazed outside the defined study area, and the majority of depredation in Herd I occurred outside the study area, where dogs were not used regularly (Table 2).

The pasture dogs expressed high frequencies of guarding activities (barking, patrolling), specifically on nights when sheep outside the fence were victims of depredation. Carcasses were not found inside the electric fence, whereas a ewe was killed and a lamb was injured only 200 m outside the fence.

The total loss on summer range (predators, disease and accidents) throughout the whole grazing season (7 June 7–15 October 1995) was 12.3% in Herd I and 10.8% in Herd II. Regarding the 2 research herds, the mean loss was reduced by 7% in 1995 compared to the 1994 grazing season, whereas the mean loss in the neighbouring herds (N=7) was reduced by 3.7%. Compared to the mean loss on summer range during the last 3 years, the loss was 1.0% lower in the research herds this year, while it was 0.6% higher in the neighbouring herds.

If a guarding dog in Norway is capable of working until the age of 7 (few accidental losses in Norway), it will have 6 effective guarding seasons. During these 7 years a Pyrenees will cost the owner about NOK 46,000 (U.S. \$7,100) based on the mean costs for the puppy, food, veterinarian, dog yard, etc. (N=5). According to the 1995 compensation rates for sheep killed by large predators: NOK 1,760 (\$270), lambs: NOK 920 (\$140), a dog has to "save" at least 9 lambs or 5 ewes each working season before it will be an economical asset. Time spent for training and taking care of the dogs and special field costs as telemetric equipment, transportation, compensation for damages, etc. are not included in the cost calculations.

Discussion

Method A—Loose Dogs

The use of loose dogs without the command of a dog handler was too unrestricted with respect to the strict Norwegian regulations for dog-keeping. Conflicts with neighbours are often caused by dogs when the herding area is close to settlements. The wandering problems were most likely a result of the imprinting procedure. If the dogs

Table 2. Number of sheep and percent of total herd documented killed by bears in the two research herds during the research period 7 June –3 September 1995.

	Herd I				Herd II			
	Ewes		Lambs		Ewes		Lambs	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Bear kills within the research area	5	(3.4)	2	(0.9)	5	(5.4)	5	(3.2)
Total bear kills in the herd	17	(11.5)	2	(0.9)	5	(5.4)	5	(3.2)

were more strongly bonded to sheep, they would be more attentive to them rather than ranging away (Coppinger et al. 1983, Lorenz and Coppinger 1986, Green and Woodruff 1990, Sims and Dawydiak 1990). The use of guarding dogs in the U.S. is a helpful management technique even on huge forest and mountain ranges, when the dogs are properly imprinted to sheep and the sheep flock close together (Hansen et al. 1996). Widely dispersing sheep complicate an adaptation of this technique to Norwegian conditions.

The sheep-chasing problems could have been avoided if the sheep had accepted the dogs as part of the flock. More attention should be focused on the significance of a mutual socialization between sheep and dogs. The socialization of sheep to dogs might take from a few days to years, depending on sheep breed, sheep management practices, and whether or not the dog shows the right submissive behavior (Aunsmo; Jacobson; Headly; Lorenz, pers. comm.).

Method B—Patrol Dogs

Patrol dogs showed a higher activity level than did the pasture dogs, because the observer in field moved around and contributed to dog activity. They barked far less than the dogs inside the pasture, and this way of using the dogs probably produced weaker preventive effects than Method C. Bear did kill sheep, despite that humans and dogs had vacated the site only a few hours previously, and their scent was obviously still present. It seemed as though the dogs had to encounter the bear directly and more than once before the bear would avoid the area. This is in accordance with other reports on bear-dog confrontations (Green and Woodruff 1989, Wikan 1996). In an arranged confrontation, autumn 1995, dogs No. 2, 6, and 7 were released on a radio-tracked bear (Hansen and Bakken 1999). The dogs encountered the bear and chased him for 25 minutes, but the bear returned within 1 hour.

The use of guarding dogs under the command of a dog handler is resource-demanding. To make the patrolling more effective, one could give priority to areas where fresh carcasses are found. However, guarding dog experts in the U.S. do not believe in using handlers (Jacobson; Hansmire; Lorenz; Woodruff; Coppinger, pers. comm.), because the full capacity of the dog's livestock-guarding behavior is actually not utilized.

Method C—Pasture Dogs

The pasture dogs guarded a rather small territory around their feeding site. They barked frequently, but ran off to the other side of the pasture (1 km) only a few times. There were no losses due to predation within the pasture. However, the dogs' guarding effect is unclear, since the electric fence might have helped prohibit bear damage, although the electricity was turned off at night.

A close connection to people functioned well for the patrol dogs, but not for pasture dogs. If they were left alone (loose), they jumped the electric fence and sought out people. The use of guarding dogs in pastures without handlers is an effective method only if the dogs are properly imprinted to sheep and stay with them (Coppinger et al. 1983, Lorenz and Coppinger 1986, Green and Woodruff 1990, Sims and Dawydiak 1990).

Effect of Using Guarding Dogs

Most of the depredation in Herd I occurred outside the research area where dogs were not used regularly, and the total number of sheep lost on summer range was relatively greater in neighbouring herds than in research herds. However, the single effect of using guarding dogs in this research remains unclear. In contrast to earlier years, the managers of the 2 most heavily depredated herds had now stopped sheep farming, and there had never before been traffic by dogs and people in the area at night.

From the end of August until the end of the research period, it seemed impossible to guard the herding area sufficiently. This was probably due to more bears entering the area, too few dogs to cover the whole range, and darker nights (the research area does not have the midnight sun) which made it impossible to patrol at night.

To fully realize guarding dog capabilities (Lorenz and Coppinger 1986, Coppinger et al. 1988, Green and Woodruff 1990, Andelt 1992), conditions must be adapted to the dog rather than attempting to change the dog. Before guarding dogs can be effective in Norway, we need either a sheep breed that flocks well or we need to reintroduce shepherding, or we need enclosed grazing areas. Under the U.S. conditions, one shepherd can manage 1,000 sheep, and only 2 to 5 dogs are needed to guard the flock (Hansen et al. 1996). High compensation rates for livestock losses and high costs for dog-keeping in Norway require the efficiency of guarding dogs in Norway to be even greater than that observed in the U.S. (Green et al. 1984, Andelt 1992) before this method can be economically feasible.

Socialization Program and Guarding Techniques

The socialization program followed (introducing the dogs to sheep at 12–16 weeks of age, with frequent association with people) is not the one recommended by guarding dog researchers (Coppinger et al. 1983, Lorenz and Coppinger 1986, Viner, pers. comm.). The error is obvious; too late and too weak social imprinting to sheep resulted in dogs bonded socially closer to people than to sheep. Consequently, these dogs were not attentive to sheep, and they did not guard sheep without the presence of people.

There is a conflict between the Norwegian Kennel Club and behaviourists about how to rear the pup to get the best guarding behavior adapted to the strict and specific Norwegian conditions. We argue that the degree of social imprinting of the puppy on sheep versus people is dependent on the future guarding method planned. Is the dog going to work under the command of a dog handler or independently among sheep? Is it going to work within its own flock of sheep or in a common herding area? The less command by people, the stronger the social bonding to sheep that is required.

Conclusions and Management Implications

It is difficult to use guarding dogs the traditional way in Norway because of the open mountain/forest range and widely dispersing sheep. Based on our results, we suggest 3 alternative management procedures:

1. Guarding dogs working among sheep inside a fenced area. This will be an effective way of guarding sheep only if the dogs are socially bonded to sheep and the sheep accept the dogs as part of their flock.

2. Guarding dogs patrolling the herding area under the command of a dog handler. The dogs must be socialized to people as well as to sheep. Preferably, the dogs are used only during the night.

3. Guarding dogs on unfenced forest/mountain range, using a herder and/or a sheep breed with closer flock characteristics, dogs closely bonded to sheep, and sheep who accept the dogs. In the most severely affected areas we recommend this method, even though it requires changing the Norway sheep grazing management used on open range.

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