efficiency of fladry to protect livestock from wolf predation in natural environments is still underway, the use of similar barriers by Portuguese shepherds increases our confidence in this technique. The success of livestock protection measures necessarily requires the implementation of new and traditional methods that best complement and adapt to each situation.

**Importance of long-term support actions**

After the initial scepticism showed by shepherds, this long-term action resulted in an increasingly positive acceptance of LGDs. Participating shepherds can now recognize a good working LGD and are aware of the conditions necessary for raising one. They frequently ask for supplementary dogs to substitute their other dogs and improve flock protection. There is also a good receptivity from other shepherds that learn about the dog's efficiency and increasingly ask for LGDs descending from those dogs. This flow of information between shepherds from the same and neighbouring villages seems to be very effective at a local scale and contributes to enhance their confidence in LGDs and their willingness to use them. Once livestock producers are satisfied with the use of LGDs the mere presence of a good working dog in the flock can contribute to reduce conflicts with the wolf and put damages in a real perspective.

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# Influence of Large Carnivores on the Distribution of Excreta by Sheep on a Summer Pasture, in the NW-Italian Alps

by
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**Introduction**

The presence of large carnivores in the Alps has caused great changes in sheep pastoral systems: the traditional grazing management (exploitation of summer pastures by free ranging flocks) has been replaced by a non-traditional one, with constant shepherd supervisoin and the use of night-time enclosures. As a consequence of the changes in flock distribution and movements, the distribution of animal excreta has been affected, with possible effects on vegetation and pastoral quality.

To evaluate the consequences of the non-traditional grazing management, the distribution of excreta was surveyed in an Alpine summer pasture and related to vegetation types, flock movements, stocking density, and efficiency of grazing. The results concerning dung distribution are presented in this paper.

**Interactions between domestic animals and predators, and consequences for grazing management**

In Valle Stura of Demonte (NW Italian Alps, province of Cuneo), sheep breeding is a traditional activity (still important for the economy of the valley), based mainly on the exploitation of summer pastures. At the same time, it is an important area for the conservation of the alpine environment. Until a few years ago, because of the absence of large carnivores and the lack of labour, shepherds used to drive their flocks to mountain pastures and leave them alone for the whole summer: free ranging flocks used to exploit even the remote areas of summer pastures, spending the night outdoors without protection.

Recently, in relation to the increasing presence of *Canis lupus, Vulpes vulpes* and stray dogs, the risk of losses due to depredation has affected alpine grazing management; discouraging the exploitation of more remote and inaccessible pastures, and forcing shepherds to guard flocks during the day and fence them in protected enclosures during the night. Even the

**Tab. 1:** Solid excreta and nitrogen distributed on the rangeland during the grazing season.

| | Vegetation type (ecofacies) and sub-facies | Surface (ha) | Faeces N faeces (kg ha$^{-1}$) | (kg tot) | N urine (kg ha$^{-1}$) | N total (kg ha$^{-1}$) | (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| A | Nardus stricta | 86.3 | 78.1 ± 12.1 | 6741 | 1.68 | 1.72 | 3.39 |
| B | Festuca paniculata | 17.6 | 4.4 ± 2.3 | 77 | 0.09 | 1.63 | 1.72 |
| | + *Festuca* gr. *ovina* | 46.1 | 47.5 ± 11.1 | 2'188 | 1.02 | 0.92 | 1.94 |
| | + *Anthoxantum alpinum* | 13.4 | 25.3 | 340 | 0.54 | 1.05 | 1.59 |
| | + *Vaccinium myrtillus* | 7.1 | 19.6 ± 9.9 | 140 | 0.42 | 0.59 | 1.01 |
| | + *Potentilla aurea* | 7.2 | 64.7 | 464 | 1.39 | 0.63 | 2.02 |
| C | Festuca gr. ovina | 45.0 | 58.6 ± 33.9 | 2'634 | 1.26 | 2.03 | 3.29 |
| D | Poa alpina | 4.8 | 74.9 ± 21.7 | 363 | 1.61 | 1.52 | 3.13 |
| E | Dactylis glomerata | 3.7 | 37.6 | 138 | 0.81 | 3.28 | 4.09 |
| Total | | 243.0 | 55.4 ± 6.6 | 13'085 | 1.19 | 1.42 | 2.61 |

distribution of excreta on rangelands has been affected by changes in grazing management, with transfer of nutrients from the rangeland to paddocks, which was evaluated in an alpine pasture and related to vegetation types, stocking-rates and grazing efficiency.

## The situation on the "Alpe Ischiator"

Studies have been carried out during 2001, at the Ischiator summer pasture (1800-2830 m a.s.l.), grazed by a flock of 500 Sambucana sheep. Vegetation, morphological characteristics of the grazing areas and sheep solid excreta distribution were surveyed. The vegetation composition was determined with the Daget-Poissonet method (1969), along 32 transects.

To estimate the quantity and distribution of faeces, so to detect possible gradients from shelters outwards, 52 sample areas (20 x 0.80 m) were located over the rangeland (243 ha of herbaceous surface out of 824 ha of total surface), inside which faeces were counted after the sheep had been grazing there. The length of exploitation inside each sector of the pasture, as well as the intensity of grazing were also surveyed. To assess the transfer of organic matter and nutrients from the rangeland due to the actual grazing management, faeces samples were collected, oven-dried (40°C) to determine dry weight, and analysed for N, P, K, Na, and Ca content.

The quantity of nutrients supplied by urine was assessed on the base of literature (Barrow, 1987; Barrow and Lambourne, 1962; Lancon, 1978a, 1978b).

## Fertility management

The rangeland was characterized mainly by *Festuca paniculata* (45 % of the surface) and *Nardus stricta* (34 %) dominated swards. The pastoral value (Daget & Poissonet, 1972) was on average low (12-15 compared to 30 for a good quality pasture in those conditions), but higher forage values (up to 38) were computed for less extended types

As an effect of actual grazing management (sheep grazing for no more than 12 h d$^{-1}$ and night sheltering in 2 areas of approx. 1 ha each, near the shepherds buildings), the flock brought to the rangeland about 13.1 t y$^{-1}$ (55 kg ha$^{-1}$y$^{-1}$) of faeces (table 1), which is less then 50% of the supply with traditional management (26.8 t y$^{-1}$ over a 243 ha surface).

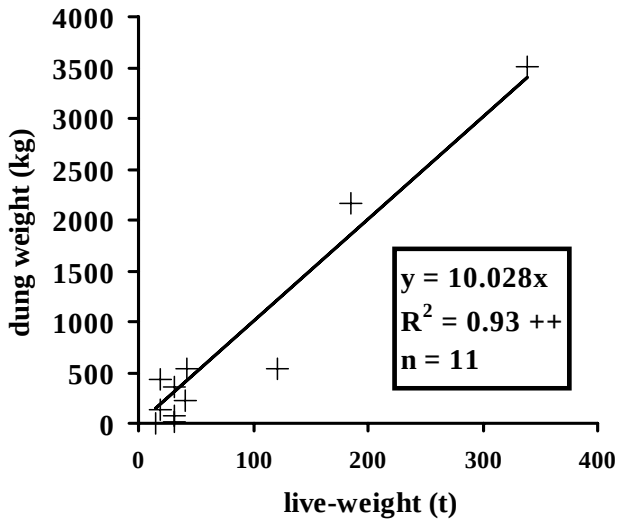


**Fig 1:** Relationship between stocking-rate and quantity of dung.

Because of the wide variability of faeces distribution within the same vegetation type (even if the sheep were herded an uniform grazing pressure was not maintained), a significant effect of vegetation composition on excreta distribution could not be identified in the analysis of variance (P = 0.26 ns). Furthermore, as the shepherd used to guide the flock during the day all over the grazing area, no correlation was found between the quantity of dung and the distance from the night shelters (r = -0.01 ns, n = 44).

Instead, the quantity of dung distributed on the rangeland was linearly related to the stocking-rate, expressed as live-weight (Fig. 1), and well correlated to the intensity of defoliation by sheep (r = 0.62 ++, n = 44).

Among morphological factors, the dung distribution was mainly determined by the slope, to which it was inversely correlated (r = -0.45 ++, n = 44), in agreement to what was found by Lombardi (1997), with cattle.

With regard to nitrogen, 2.6 kg $ha^{-1}y^{-1}$ returned to the rangeland (35% of the amount with traditional mangement), of which 1.2 kg $ha^{-1}$ $y^{-1}$ with faeces, with a wide variability among vegetation types (from 1 to 4 kg $ha^{-1}y^{-1}$) confirmed also in literature (Whitehead, 1995; Lancon, 1978a).

The quantity of dung concentrated inside night shelters, assessed on the basis of stocking-rate and daily distribution of defecations, was 13.7 t $y^{-1}$ of dry faeces and 1200 kg $y^{-1}$ of N (faeces + urine). As a consequence, since 1996, 275 kg $ha^{-1}$ of faeces and 25 kg $ha^{-1}$ of N have been transferred from the rangeland and concentrated into the two small corrals (1 ha each) used during the night. In spite of the little amount per hectare and per year, N and organic matter removal from the grazing area might affect the nutrient budget of this fragile alpine ecosystem, and facilitate the spreading of non-pastoral species, even in a short time period, as reported by Cugno (2001) in a similar environment of the same valley.

## Conclusion

According to Vidrih (2002) the corrals, surrounded by permanent electric fences, seem to be an interesting solution (in terms of cost and feasibility) to prevent livestock depredation. Nevertheless, with the actual grazing management, excreta are excessively concentrated in the areas where flocks are sheltered. In fact, in the summer pasture where the experiment was carried out, about 50% of seasonal faeces production was released in the shelters, with unfavourable effects on the nutrient budget. An important nutrient and organic matter transfer may create conditions for the deterioration of the pastoral quality of vegetation, especially in the more remote areas. As a perspective, this may make it impossibile to carry on sheep grazing, and may be detrimental for the production of high quality lamb meat, on which the local breeding system is based (Sambucano heavy lamb meat is well appreciated not only at a regional scale). Consequently, the presence of large carnivores might be indirectly detrimental not only to the ecosystem, but also to the economic system, if management changes to integrate them will not be put into practice. The long term effects of an integration of predators, which are an important element in food chain and might be a tourist attraction (especially wolves), have to be further investigated.

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