Proceedings of the
6th Workshop on
Reindeer Research,
Tromsø, Norway,
8–10 October, 1990

Tidsskrift om rein og reinnæring

RANGIFER

Scientific Journal of Reindeer and Reindeer Husbandry

Special Issue No. 5, 1990

Rangifer
Published by: Nordisk Organ for Reinforskning (NOR) Nordic Council for Reindeer Research.

Editor: Sven Skjenneberg
Address: Postboks 378,
N-9401 Harstad,
Norway
Telephone: (0)82-64 172
Telefax: (0)82-66 280

Bank account: 4760 56 92776
Postal account: 2 11 63 58

Subscription prices:
Ordinary subscription, prices/year:

Nordic countries	NOK 60,–
Europe, surface mail	NOK 70,–
Europe, air mail	NOK 110,–
Oversea, surface mail	NOK 70,–
Oversea, air mail	NOK 140,–

Back issues: . NOK 15,– per number + postage expenditures

ISSN 0801-6399

A/S Harstad Tidendes trykkeri

RANGIFER

Vol. 10 | 1990 | Special Issue No. 5

Proceedings of the Sixth Nordic Workshop on Reindeer Research, Tromsø, 8-10 October 1990

Contents **Page**

Programme

Monday, 8 October

17.00–20.00 Poster Installation

20.00–23.00 Get-together meeting. **Svein D. Mathiesen:** Among reindeer and penguins on South Georgia

Tuesday, 9 October

09.00–09.15 Opening by Erlend Rian, Chairman of the Council of Tromsø.

09.15–10.15 **Erling Norvik:** Research as the basis for desicion-making in reindeer husbandry. Discussion.

Main subject I. Reindeer husbandry. Basis for resources and the man.

10.15–11.30 Presentation of scientific posters. Session leader: **Sven Skjenneberg.**

11.30–12.15 **Odd Halvorsen:** Resources, reindeer and man. How can research contribute to sustainable development?
Discussion.

12.30–13.30 Lunch.

13.30–17.00 Guided tour on the University of Tromsø: Department of Arctic Biology and Department of Ecology.

18.00–19.00 Reception in «Arctic Gallery». Host: Norwegian Saami Reindeerowners Association. Art exhibition by Sven Skjenneberg.

20.00– Banquette. Restaurant «Arctandria».

Wednesday, 10 October

Main subject II: Meat quality.

09.00–10.00 **Anthony J. Pearse:** What has made deer farming in New Zealand so successful?

10.00–11.00 Presentation of scientific posters. Session leader: **Sven Skjenneberg.**

11.00–12.45 Panel discussion: Meat quality.

13.00–13.15 Evaluation and closing seremony.

13.15–14.15 Lunch.

14.15 Workshops. Discussion groups.

Research as the basis for decision-making in reindeer husbandry

Erling Norvik,
N-1500 Moss, Norway

As you know, I am no specialist in reindeer husbandry. Nor do I have sufficient *academic* background to give any expert opinion on the significance of scientific research for the reindeer industry. But for many years as a politician and, now, as chairman of both the Steering Committee for Reindeer Husbandry and the Reindeer Industry Development Fund, I have been involved in making decisions which directly and indirectly have wide reaching consequences for this fine industry. It is from this standpoint that I make my remarks on the significance of research (and technical advice).

First, a deep sigh: if only we had established a qualitatively and quantitatively much stronger program of reindeer research much earlier! Had we done this, several important decisions which have had to have been made could have been based on solid scientific fact. This has not been the case. The amount of guesswork involved in *today's* decision-making could have been substituted with knowledge - knowledge about good alternative strategies for reindeer husbandry. I am speaking here, for example, of land disposition, of exploitation of pasture, of winter fodders besides lichen, of the environmental consequences of different types of management and of meat quality.

Of course, we do know something of these things - both from experience of the reindeer owners themselves and from research. But we know nothing like enough.

We know, for example, that today there are 3000 healthy Norwegian reindeer on South Georgia. This population has grown from 22 animals, which were taken there during the years between the wars (*sic*), despite the fact that there are no lichens on South Georgia. It is very important that we find out what winter fodders besides lichens may exist here at home, too. I am happy to learn that this is currently being investigated.

Knowledge about diet preferences and the nutritional requirements of reindeer in winter will be of fundamental importance for making decisions with regard to reindeer numbers, land disposition, channelling economic resources and so on.

The principal challenge for Norwegian reindeer husbandry in Finnmark today - seen from the viewpoint of both the central political authorities and the industry itself - is disequilibrium between the number of reindeer and their forage resources. Productivity is low, the economy is worse and a large number of reindeer owners have an unsatisfactory number of animals and an unsatisfactory income. The animals are becoming smaller and smaller. Social and economic problems are increasing. There is an obvious danger of long term damage to the pasture areas. *How* long term, nobody knows. There are no clear research results to guide us but, I am glad to say, research is under way and satellite imagery represents a good, new tool.

When researchers can supply answers to the questions I have mentioned above, it will be easier, not least for the Steering Committee for Reindeer Husbandry, to define both total and regional permitted maximum numbers for reindeer. It will also be easier for reindeer owners to accept the need to reduce the number of animals. But, of course, we all hope that research in reindeers' nutritional requirements, in diet selection and in pasture will reveale new options by which we can avoid having to reduce the number of animals.

Today, however, we have no alternative but to insist that numbers be reduced. It is no simple matter to achieve this. Many reindeer owners are strongly opposed to it.

Many people wonder whether the reindeer Saami might not themselves know best. Surely, they well understand that it is not the number of animals but the number of kilos of meat produced, its quality and its price that matters?

Yes, they understand this. But they are worried that «if I reduce the size of my herd, my neighbour will increase the size of his». And so they remain sceptical that any local reduction in numbers will result in any rapid and satisfactory increase in productivity. There are some experimental results, as well as examples from husbandry in other parts of the country, which suggest that productivity can be increased in this way. But the Saami in Finnmark remain unconvinced that it will work for them.

But, of course, productivity is affected not merely by the number of animals present. Herd structure (age, sex composition etc.) also has an important influence. This has been demonstrated in Professor Dag Lenvik' s dissertation. In addition, animal health (treatment against parasites) is important. Research has come a long way in this field. And all these factors interact.

But, above all else, there is *one* challenge that must be mastered besides research: technical advice and supervision!

Advances in research contribute little unless the results are used. I am very pleased, therefore, that the Reindeer Husbandry Research Committee and Reindeer Husbandry Advisory Council are to be combined. Research and technical advice will go hand in hand in the future. The reindeer industry suffers from barriers of both language and culture. We are plagued, besides, by a deep mistrust of bureaucracy including, in this instance, research and advisory services.

According to the Statutes of Reindeer Husbandry in Norway, the industry shall give: «Secure economic and social conditions for those who practice reindeer husbandry and shall protect reindeer husbandry which is an important component of the culture of the Saami people».

But a lame reindeer industry which generates insecurity instead of security, which in some areas produces a social slum instead of welfare, is anything other than a positive factor in Saami culture.

Of course, it is the industry itself which, together with the political and administrative apparatus, must find solutions to its problems. The role of research is to provide us with an alternative strategy which can turn reindeer husbandry into a secure way of life for as many as possible. You must give us knowledge and advice – we must be cleverer at using them.

Of course, research must have a free hand – but it cannot be fully independent. Researchers must try to direct their activities towards providing both the industry and the politicians with a solid basis on which to base their decisions. It is therefore my hope that «productive» research receives as high priority as possible. With limited funding available for research and the relatively small size of the indus-try, it is important that *its* requirements and *its* own demands for help from researchers be attended to. This, besides anything else, results in building up confidence in research and, consequently, in acceptance and application of research results.

Which is precisely our aim!

Resources, reindeer and man. How can research contribute to sustainable development?

Odd Halvorsen

University of Oslo, Zoological Museum, Sarsgt. 1, 0562 Oslo 5, Norway

Abstract: The sami reindeer industry is a socioeconomic system based on biological productivity. In the biological production chain, plants are converted to reindeer. The basic conditions for this production are laid down by the fraction of primary plant production available to the reindeer, the physiology of the deer, and the size and age and sex composition of the deer herd. The amount of plant production available is influenced by 1: climate, topography, and geology, 2: preferences of the reindeer, and 3: the amount consumed by other exploiters i.e. sheep, made inaccessible by others (roads and cottages), destroyed by vehicles or spoilt by pollution. Losses to the production is caused by herding operations, disturbances from other human activities, predators parasites and diseases. The industry is attempting to maximize the yield through herding activities and the implementation of various remedies, i.e. fences, scooters, cars, helicopters, and sometimes by the use of commercially manufactured fodder. These efforts may be classified as oilbased. The biological production is converted to money in the market. The politically defined aim of the industry is to supply its participants with economic security. This is influenced by the number of participants and the form of ownership and distribution of herd sizes among them. Policies relating to Sami affairs and the general agricultural policy of the country will also strongly influence this side of the industry.

Scientific research has been carried out on relatively few of these elements, and there is, for example, little scientific data available relating to the claimed overexploatation of the vegetation of most of Finnmark county. The Scientific committee of the reindeer industry is trying to identify where research is most needed within this complexity of biological and socioeconomic elements. The committee further regards it as equally important to initiate research that aims at understanding and quantifying the interaction among the elements and the various total results different configurations may produce.

What has made deer farming in New Zealand so successful?

The importance of venison quality, understanding the industry, the market and the biology of the animals

A. J. Pearse

Deer International, MAF Technology, Invermay, New Zealand

In recent years a worldwide interest has developed in controlled production of the red meat venison from indigenous or exotic species of deer in many countries. In most cases this means more than the random selection of suitable animals, often young males, from a population contained within a large area of natural terrain. Harvest is a means of balancing numbers and natural food supplies, at some economic profit. Rather, deer farming is the controlled feeding, breeding and selection of the most appropriate animals for slaughter, at a time when their growth rates, ultimate size, or time of the year fits a marked demand and specification and a productive opportunity for the farmer.

New Zealand has developed deer farming systems based on the modern practices of traditional livestock grazing management that have allowed «exotic deer species» like the European red deer, and the fallow deer, to be farmed in numbers now approaching a million animals on 5,000 varied farms from an embryonic beginning in the early 1970s.

An important number of historical features have been precursors to this rapid development. The industry has an investment of $1 billion (NZ) in animals, fencing and handling systems, and in slaughter, processing and exporting facilities, with industry returns in the June 1990 year of $84 million, a greater than 10 fold increase in only 20 years.

History

Red deer were systematically introduced into New Zealand's natural range since early English-Scottish settlement from 1861 until the 1920s for sport hunting and recreation. In a country with no native herbivores, no predators and abundant natural vegetation, deer numbers grew rapidly aided by favourable climate, protective legislation and hunting control. New Zealand deer were an internationally renowned trophy antler herd in the 1930s but their growth was unchecked and numbers reached pest proportions in the 1950s.

Combined with the now questionable practices of overgrazing and fire to promote new growth, in the natural high country vegetation for sheep and the secondary forest growth was extensively damaged by deer. The deforestation allowed extensive erosion from rapid run-off of rain and snow melt. This created such concern with agencies involved in land protection and in agriculture and forestry that deer were declared a noxious animal in 1951 and an eradication programme began. The Government employed many professional hunters as well as a «bounty system» where private hunters were paid for the deer which they shot. The only value was venison for domestic consumption from sport hunting. New Zealand, dominated as it is by the export of primary products, benefitted from the wisdom and innovative skills of a few individuals. They, aware of the large consumption

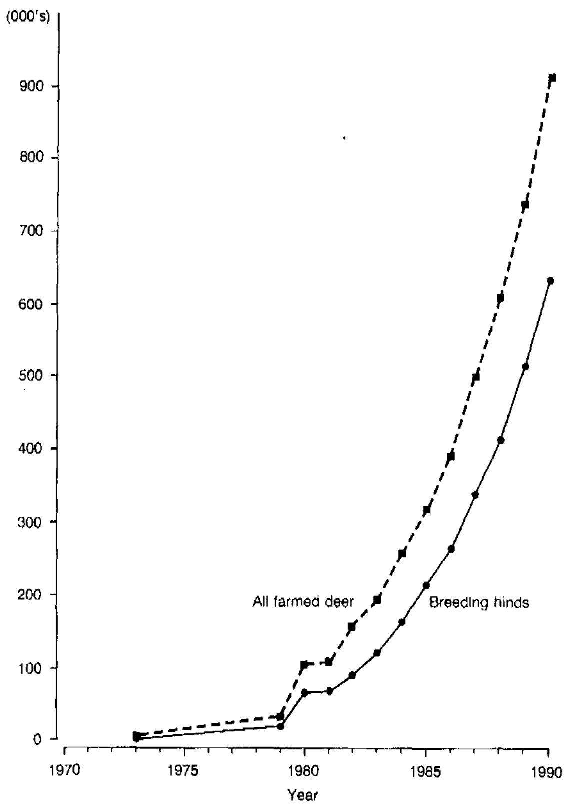


Fig. 1. Growth in farmed deer numbers.

of game meat in Europe, principally West Germany (which today remains the single largest market in volume and return) began a concerted recovery and processing business, exporting shot venison in frozen form in the four primal cuts: saddle or loin, hind legs, shoulders and neck and rib trim. Export peaked at 4500 tonnes in the early 1970s with returns which were comparable to traditional meats. The venison recovery business expanded in sophistication and volume through the use of aircraft and recovery helicopters in an innovative and now classic story of wild game recovery.

The obvious extension of the feral recovery industry and the attendant game packing houses and export markets was to relocate this fast dwindling resource onto the farms nearest the feral range and continue to supply a game ranched product.

Throughout the feral venison recovery industry a small and highly profitable market for the other more exotic deer products existed, principally that of velvet antler in varying stages of growth, the tail, eye, teeth, sinews and pizzle sought by the Korean pharmaceutical business. Early deer farming focused on meat production but by 1976, when the price for velvet antler had begun to rise, the emphasis shifted away from meat and investment money began to flow into the industry. The wild deer were captured by a great variety of means, (bulldogging, dart tranquillizing, netted from helicopters, trapped on the ground) and relocated to typical sheep farms and intensively stocked, at up to 6–8 animals per hectare, confined by a high wire fence, and managed under the most modern of pasture based farming techniques. The deer successfully mated, produced live, healthy calves and suffered no apparant diseases or stress during that operation.

The entrepreneurs of the industry, convinced of the future of deer farming, were then confronted with an administrative battle to change the legal status of deer from a noxious pest into an animal found typically on any farmland within New Zealand. In 1971 the first licence was granted and by 1975 two further significant events had occurred.

The first was the establishment in 1973 of the Ministry of Agriculture's research programme for deer production under the guidance of nutritionist, Dr. Ken Drew, at Invermay. An enthusiastic and very skilled team of scientists and support staff began working with deer in the most basic sense. Significant early research work included the detailed study of the seasonality of deer production and growth, their nutritional requirements and how the feeding and management systems common to most New Zealand farmers could be adapted to these requirements. Equally as important were studies of the veterinary and health aspects, and complications that intensification might bring to deer, for example, on the lowland irrigated pastures, or fertile dairy pastures throughout the entire range of NZ agricultural geography.

The high nutrient values and health aspects of venison were confirmed and, significantly, the criticism or fears that farmed venison would taste differently or, at the worst, like grass fed beef were dispelled in early clinical analysis and taste testing panels.

The foundation for the current success of a large farmed venison industry was laid during this period and the industry-wide awareness of

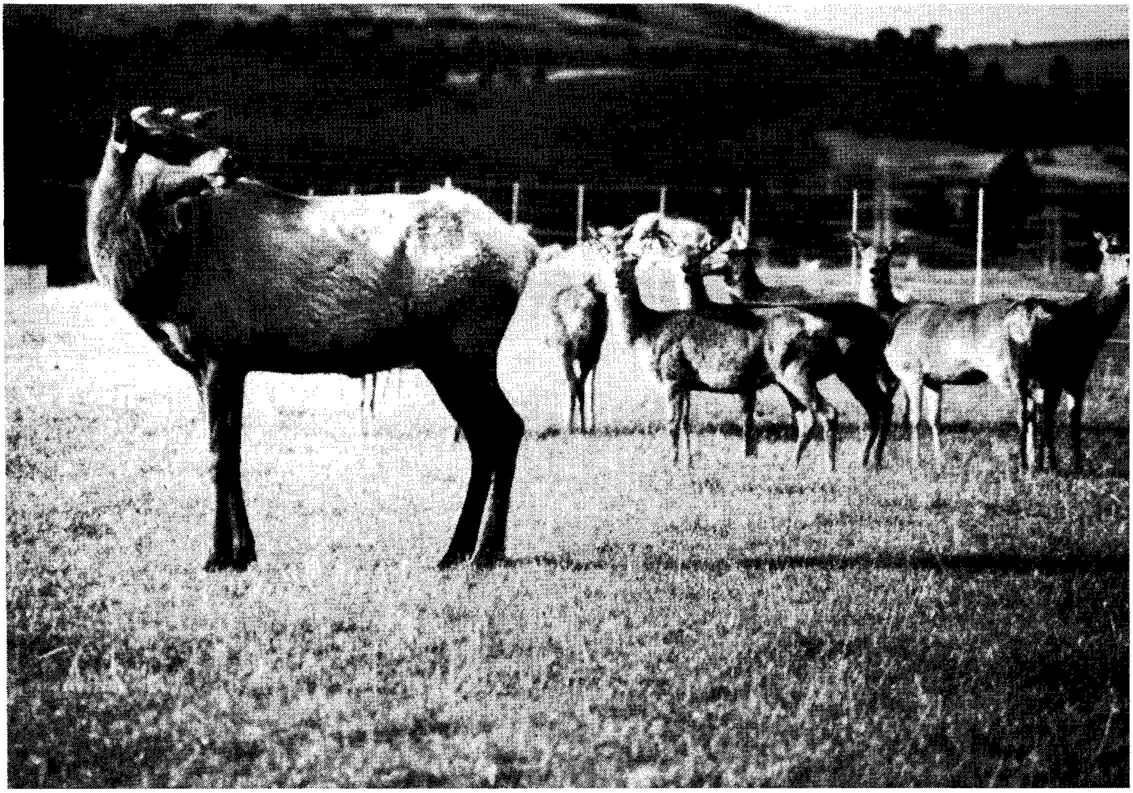


Fig. 2. Red deer hinds and a Wapiti stag in an enclosure at a New Zealand deer farm.

the term *quality* became a focal point for the developing sophistication of the industry both on farm and in in the market place.

Final consumer acceptance of farm raised venison at the top end of the market - the hospitality trade - competing with salmon, pheasant, oysters, relies on two basic qualities; tenderness, and consistency of presentation in age, size of cuts, fat content and meat hygiene. Venison is traditionally acknowledged as a fat free meat, and it was critically important for the developing industry to relate seasonal productivity, growth rates, and carcass parameters to those which the expanding hospitality trade markets demanded.

Before discussing in broad terms the aspects of venison quality that now form the base for the successful marketing of venison, the reason behind the rapid development of deer farming throughout New Zealand as a major livestock pastoral alternative is worth amplifying.

Interest in farming deer from 1976 and onwards was widespread owing, in part, to enormous returns for velvet from the Hong Kong and Korean markets (up to $200–250 per kg for frozen product). No farm raised venison was produced, indeed the modern systems of slaughter, veterinary inspection and processing had not yet been devised. Helicopter recovery of shot game turned rapidly to a live capture and recovery operation. Farmed and captured deer escalated in value and demand. New Zealand's taxation laws permitted these animals, once valued at $200–$250 per carcass, but now as high as $2,500 per live animal, to be capitalised for accounting purposes at a book value of $200. The difference in purchase price and taxation value could be declared as a tax write off in other business, be it agricultural or commercial; a new breed of deer farmer evolved. These new entrants, the city based investor, the private individual or corporate businessmen, provided capital for stock and shared the progeny with the farmer who had invested in the expensive land, facilities and management systems. Deer farming came within the reach of the or-

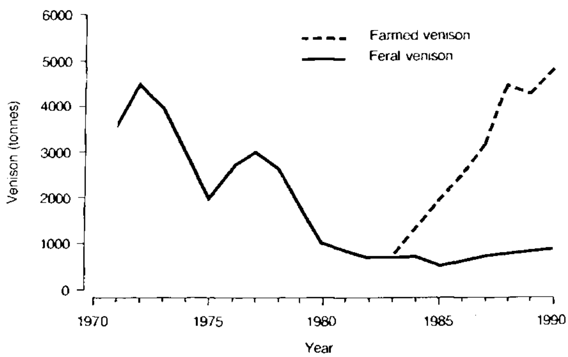


Fig. 3. Venison production in New Zealand.

dinary farmer, and a rare combination of skills provided the incentive for further expansion and development.

With such an additional source of finance, business and political experience with, innovation, leadership and risk taking outside that normally evident in agriculture (NZ farming has been until recently been mainly a family unit operation) the emergence of an industry, vertically integrated from capture, to export of products, was assured.

In 1975 the New Zealand Deer Farmers Association was formed by 29 of the first deer farmers (including the leading scientist from the government research programme). This marked the second significant milestone which assured the success of deer farming. *By their own volition and vision members of the industry at all levels took charge of their own development and directions in the market place, in the face of quite hostile political environment.*

In light of comments already addressed in this conference analysing the role of research and the need of an industry, it is interesting to note that we have been fortunate by design to have a very close relationship between farmers, researchers and exporters and the market place, expressed primarily through the NZ Deer Farmers Association activities. The NZ Game Industry Board (GIB), a statutory marketing organisation funded by levies on the products of velvet antler and venison was established in 1985 to co-ordinate the marketing and market development of venison and other deer products. This Board, up until recently, combined equally the interests of producers, processors and exporters with government participation in shaping the direction and market position of the industry. Recently, the Board's structure was changed to accommodate more readily the producers unanimous desire to control their own destiny, but the complete vertical integration from farm production to market place that unifies our industry still remains. An example of this common purpose, as it relates to the science and research supporting the industry, illustrates the industries responsiveness to market signals.

Deer research programmes have been tabled informally with the NZDFA council and the needs of both groups have been balanced in deciding long term research priorities. The value of basic investigative science is not compromised because the Ministry of Agriculture commits a proportion of funding from the national science programme. Council control does, however, allow quick application of research to immediate and long term challenges in applied areas, as indicated from market requirements. The industry is now required to support research financially .

A recent meeting including all research groups, deer farmers, the NZ GIB, veterinarians and the NZDFA, determined that the immediate industry need was to produce 55 kg carcasses for the chilled and fresh trade in Europe and North America during the months September to November rather than the more favourable February–April period when the natural growth rates and farm management practices are well established and best suit the seasonality of deer production. That objective, truly based

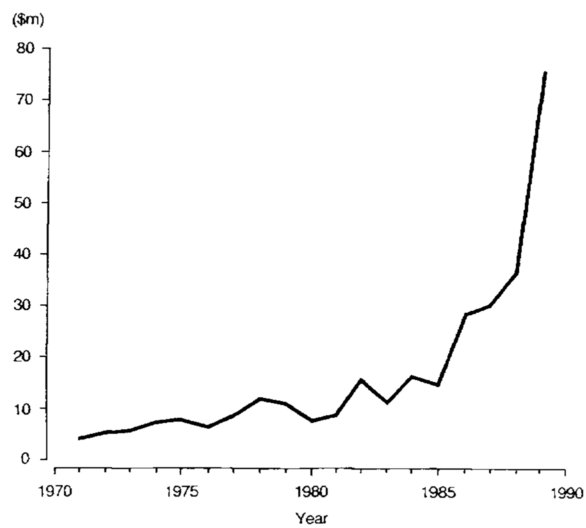


Fig. 4. Export income from deer products in New Zealand.

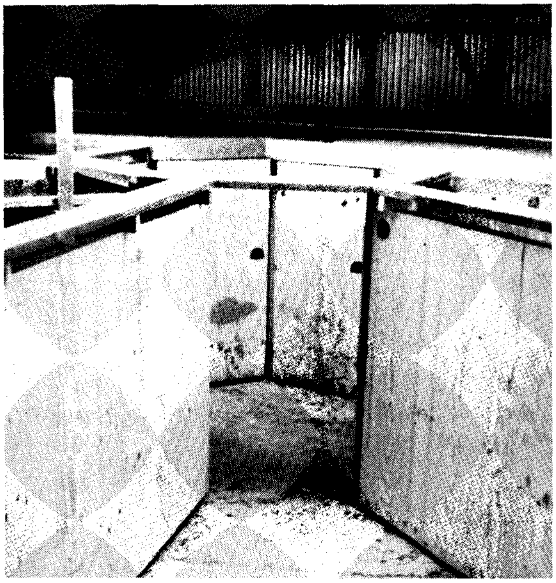


Fig. 5. An indoor facility for sorting animals. Note the plywood sheet walls and the complete abscence of door-handles or bolts or anything else on which the animals could snag themselves.

on industry market information, has led to cooperative programmes in in the following areas:

1. Agronomists and soil scientists are investigating the species and growth patterns of grasses most preferred by deer, rather than pasture developed for sheep and cattle to increase growth rates and better fit lactational demands of breeding stock.

2. An intensive reproductive and management programme to utilize hybridization between the large North American wapiti and the European red deer and thereby to exploit the efficiency of venison production as fully as possible.

3. Research into the technology of semen collection and storage, artificial insemination and reproductive manipulation.

4. Extensive venison research into the qualities of tenderness, hygiene and long term storage of chilled product (-1°C to 1°C), including basic investigation into slaughter and processing systems and the quality assurance requirements of a consistent production.

5. Research into the requirements of venison for transportation by sea freight - hygiene and packaging.

6. Veterinary programmes in preventative animal disease, trace mineral research and animal welfare considerations.

Basic research continues in the areas of advancing calving by manipulation with melatonin and reproductive hormones, twinning potential and in disease identification and control. The list is extensive, multi-disciplinary and involves fallow, red and elk breeds and has already had a major impact on farm production.

The results, news of evolving technologies and of practical farm management solutions are exchanged at producer forums and in an industry magazine as frequently as in the scientific literature.

The industry's success therefore has been boosted by the enthusiastic sharing of information, from basic management skills in feeding, breeding and handling - the «what works and what doesn't» approach, with a common theme in communication; i.e., feedback from the market place about the quality of the product and the timing of its supply to accommodate the market demand.

Researchers not only had to achieve good science, but the techniques employed, particularly in breeding and feeding, had to withstand application on commercial farms, often with a large financial commitment and, therefore, with a need to implement efficient production systems quickly.

The rapid interchange of ideas has meant that farmer innovation was rapidly incorporated as an industry «golden rule» and research did not struggle for credibility.

Quality venison production

Highest returns are achieved for venison that is exported in a fresh or chilled state and prepared for the hospitality trade, rather than in retail competition with traditional red meats in supermarkets and commodity trading. In terms of venison quality the following seven major factors are crucial critical:

a) Carcass grading system and carcass fatness

Premium venison quality from farmed red and fallow deer comes from animals less than 2 years of age. There is evidence that venison increases in toughness in older animals and for efficiency slaughter is most acceptable at the end of summer at ages 12–15, or 22–27 months. Some two year old red and fallow deer are even then in danger of being unacceptably fat. A carcass grading system, based on weight and a total tissue depth measurement (the GR or TD measurement in mm) over the 12th rib at a point 16 cm from the spinal midline, is the parameter used to determine overfatness. The producer can be penalised up to 40 % from deer classified as overfat.

Much of the fat (particularly in older stags) is subcutaneous and intermuscular in location, rather than intramuscular. In the prime cuts of saddle and hind quarter, 55–65 % of the fat is distributed subcutaneously and can readily be trimmed but in the forequarters, neck and ribs trimmable fat amounts to 16–30 % of total fat and removed with difficulty.

The marketing solution has been to remove those animals from the slaughter plant by penalty, and presenting them, instead, in mid winter following the post rut weight loss. However, exporters offer a financial incentive for young carcasses.

b) Further processing

Venison, presented as a gourmet meat is now often marketed in a «no further preparation form», except to cut into steak, cutlet or medallions. With 54 % of the carcass being represented as saddle and hind leg, further fabrication is undertaken to increase return. A leading NZ exporter, Game Meats, pioneered the Denver leg in which the hindquarters are boned out and the individual muscles of the beef type cuts, topside, rump, silverside and shank, are boned out into 8 muscle blocks, desinewed, vacuum packed and chilled. Saddles are boned out into strip and tenderloins and shoulders too are boned out to produce a shepherd's steak.

Table 1. Wapiti hybrid and red deer stag carcass composition.[1]

	2 yr red deer	11 month wapiti/red hybrid
n	53	8
Liveweight (kg)	110	116
Hot carcassweight (kg)	63	68
Dressing	57	59
Carcass composition (% cold carcass weight)		
Saddle	15	18
Hindquarters	39	40
Forequarters	19	20
Neck	16	14
Ribs	11	8
Fatness (GR in mm)	10	4.7

[1] From Drew and Hogg, 1990.

Table 2. Nutrients in 100 g of trimmed feral and farmed red deer leg meat.[1]

	Feral	Farmed	
Age (months)	27	12	27
Carcass weight (kg)	43.1	40.8	75.7
Lean meat (g)	95.6	95.6	88.0
Fat (g)	3.3	3.3	10.9
Minerals (g)	1.1	1.1	1.1
Polyunsaturated fatty acids (g)	0.5	0.3	0.3
Polyunsaturated: saturated fatty acids (P/S)	0.18	0.10	0.03

[1] From drew and Gogg, 1990.

Saddles sold «bone-in» are precisely measured according to the number of ribs, according to the customer's request, trimmed at an exact distance from the midline and protected with a boneguard and vacuum packed.

c) Packaging

Keeping the product cold, clean and covered has allowed the evolution of vacuum shrink wrap (Kryo-vac) packaging systems for the chilled trade, increasing the shelf life of meat to 12–16 weeks when stored at -1°C. Absolute hygiene during slaughter and processing is paramount. Systems of inverted dressing have added to the hygiene control. Little or no washing of the carcass and good sanitation of machinery used in the fabrication of bone-in or boneless venison is important as these areas, if done poorly may inoculate the venison with bacteria prior to chilling and packaging.

d) Electrical stimulation, conditioning and aging

Meat tenderness is by far the most important consideration in eating quality, followed by juiciness and texture. The product must not only be hygienic but the consumer must like it. Research work has shown that electrical stimulation (ES) straight after slaughter to accelerate rigor mortis can prevent tough venison due to cold shock in a chiller.

(1) Electrical stimulation is very effective in improving tenderness, especially in the loin and hind legs. Most systems incorporate a low voltage 80V peak sine wave stimulation for 90 secs 30–60 secs after «sticking» approximately 30 secs after stunning.

(2) Further enhancement of tenderness is achieved through post slaughter conditioning and aging of the whole carcass. The ideal treatment regime, for product that is to be sold frozen, is holding at 10°C for 24 hours, then a further 24–48 hours aging at 2–4°C before freezing at -18°C.

These effects are more noticeable with stimulated carcasses, suggesting that careful post slaughter aging has an improved effect with animals that are older than 15 or 27 months.

Once delivered to point of sale or consumption, tenderness can also be enhanced significantly by a careful thawing regime. By thawing slowly from -18°C at +4°C, venison quality improves significantly, with the effect most noticeable in young deer, non-stimulated, or in carcasses exposed to low temperatures very soon after slaughter.

e) Other aspects of venison quality (pH, stress and the Dark, Firm and Dry phenomenon)

Meat of high pH (6.0 or more) typically has greatly reduced shelf life and is not suitable for extended chilled storage in vacuum packages. Routine pH measurement of slaughtered stock allows the sub-classification of carcasses for frozen or chilled markets, although values are generally 5.6–5.7 from red deer and 6.0–6.2 for fallow, and are remarkably constant even after exposure to high levels of stress. However in the retail trade, consumer preferences in most markets are based on redness in colour.

	Grade	Carcass wiight (kg)	Tissue depth limit for overfatness (mm TD)
Prime Quality	AP1	>70	14
(lean with	AP2	50.5–70	12
good muscle)	AP3	<50	10

AF - Undamaged overfat
AD - Overfat with 1 primal cut damaged
AM - Manufacturing (damaged, emaciated, aged, discoloured)

Fig. 6. Venison grading system.

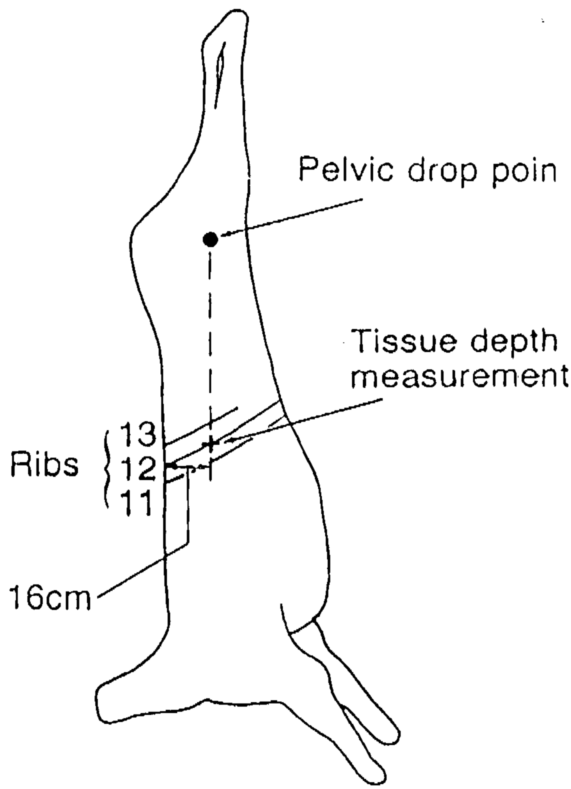


Fig. 7. Site for tissue depth measurement (TD).

f) Quality assurance programme – marketing

The NZ producers, embracing the concept that the industry should be market led rather than production driven, are responsive to the NZ GIB analysis of consumer, demands for the product and expansion of supply. While the GIB supports some specific production-based research their main thrust is to represent the marketing of deer products in an orderly and customer responsive fashion, although in the producers' interests. Funding is currently at a level approximately 4% of producer receipts.

Current marketing priorities are in West Germany, North America, Japan, the local NZ consumer and marketing is aimed at the chefs and distributers of venison. While individual exporters' brands are preserved, i.e., there is no generic promotion of «New Zealand Farm Raised Venison» to the exclusion of the individual, they have put in place a quality assurance programme to be represented by the «Deermark» – an internationally recognised quality standard, auditable and able to be awarded, or withdrawn based on performance.

Farmed venison is classified as slaughtered game, and animals are killed and processed in any one of 13 Deer Slaughter Plants. These plants are now involved in a PIC programme (problem investigation and control) developed by the GIB and, once accreditted, can use the Deermark symbol as an ultimate guarantee of customer satisfaction. The problem identification and solution system is about to be extended from the slaughterhouse and pre-slaughter transport systems onto farms where damage to carcass and pelts may be occurring needlessly.

In summarising these aspects of success within the NZ deer industry we can note:

(1) NZ traditional farming skills of pasture based production have been readily adapted to deer farming.

(2) The industry has grown with strength through the diversity of its participants, leading farmers, innovative researchers, business investors and leaders and the NZDFA and its membership. All are united in their determination that market signals, rather than farm production demands should shape the development of venison supply and presentation.

(3) The frank and rapid exchange of research results, farmer innovation, market information and exchange of experience and ideas within the industry.

(4) The overwhelming commitment to quality production.

Biologically, deer has their own contributing attributes:

(a) they are intelligent and easy to farm;

(b) they are efficient converters of pasture and supplements to venison or to progeny;

(c) they thrive throughout NZ varied agricultural terrain on native grasses or improved pasture, and have a healthy and long productive life;

(d) they have enormous climatic and environmental tolerance, a defined breeding season and predictable calving pattern;

(e) they are immensely seasonal, and now, when feeding and breeding requirements are well understood in terms of that seasonality, productive growth targets are readily set and achieved to accommodate the market signal;

(f) they are simple to manage with a minimum of labour and physical inputs.

Finally, the product, game venison is the red meat of the 1990s and beyond – nutritionally lean, fat free, low in calories and colesterol, high in iron – farm produced at a defined age at a defined weight in modern DSP with rigorous ante- and post-mortem inspection, now supported by the Quality Assurance programme and the Deermark Seal. Our producers are insistent that farm raised venison is marketed as a gourmet food and enjoy returns to match that. The science behind defining quality and in production and management systems has been excellent, both investigative and applied, and in combination with innovative farming has produced a profitable high profile and efficient livestock alternative to traditional agriculture.

The success of the industry therefore is the result of an excellence in application from all areas, in a common goal, the production of high quality farm raised venison, consistent in presentation and supply, enjoying the returns that that objective commands.

References:

Drew, K. R., Crosbie, S. F., Forss, D. A., Manley, T. R, Pearse, A. J. 1988. Electrical Stimulation and Ageing of Carcasses From Red, Fallow and New Zealand Wapiti-type Male Deer. – *J. Sci. Food Agric.* 43:245–259.

Seman, D. L., Drew, K. R., Littlejohn, R. P. 1989. Packaging venison for extended chilled storage: comparison of vacuum and modified atmosphere packaging containing 100 % carbon dioxide. – *J. Food Protection* 52: 886–893.

Guild, J. 1989. The Role of the Deer Farmer's Association and the Game Industry Board in the New Zealand deer industry. – *Deer Branch of the New Zealand Veterinary Association Proc. Deer Course for Veterinarians Deer Branch Course No. 6,* Queenstown, July 1989 pp 1–7.

Drew, K. R. 1990. Deer Farming in New Zealand. – *Edmonton Wildlife Ranching Conference* (in press).

Maintaining reindeer on roughage diet during winter

Ulla Heiskari and **Mauri Nieminen**

Finnish Game and Fisheries Research Institute, Reindeer Research, Rovaniemi, Finland

Abstract: The supplementary rations of reindeer usually contain dry hay, grains, molasses and commercial feeds. Dried water horsetail (*Equisetum fluviatile*) has been traditionally used as feed for domestic animals and reindeer in certain areas in northern Finland. With diets containing a high proportion of roughage, voluntary intake is limited by the capacity of the reticulo-rumen and by the rate of disappearance of digesta from this organ. The purpose of this study was to investigate how much roughage (dried water horsetail) reindeer can digest and whether it is possible to maintain reindeer on pure roughage diet during winter.

The feeding experiment was arranged in Kaamanen Reindeer Research Station in northern Finland from 26th of January to 4th of May in 1989. Sixteen adult female reindeer were divided into two groups with equal mean body weight. The reindeer were weighed weekly during the experiment. Eight reindeer were fed roughage *ad libitum* and the intake of feed was measured daily. The control group was fed with concentrates restricted to 1.1 feed units/animal/day. Blood samples were taken from jugular vein once/month during the experiment. Chemical composition of serum was measured by standard methods.

The daily intake of reindeer varied 1.5–4.1 kg roughage, 1.0–2.7 kg dry matter and 0.8–1.4 fattening feed units during the experiment. The body weight of roughage fed reindeer increased 6.7 kg (9.1 %) on average during the first three weeks of the experiment. At the same time the concentrate fed reindeer gained 1.1 kg (1.5 %) on average. The concentrate fed reindeer continued to increase their body weights towards the end of the experiment, while the roughage fed reindeer maintained their body weights at the level of February. Serum protein, cholesterol and calcium concentrations were higher and serum creatinine and phosphorus concentrations lower in the concentrate fed reindeer than in the roughage fed reindeer during the experiment. Serum triglyceride concentration remained constant but serum urea concentration varied in both groups during the experiment. The high cellulose content of dried water horsetail (28.3 % of dry matter) retarded digestion in the rumen and led to maximum filling of the forestomachs and a rapid increase in the body weights of the roughage fed reindeer during the first weeks of the experiment. The protein intake of the roughage fed reindeer were higher than that of the concentrate fed reindeer. However, the serum protein concentration of roughage fed reindeer was lower than that of the concentrate fed reindeer. Larger part of the roughage protein was metabolized to energy despite of the same calculated net energy intake (1.1 f.f.u.) in both groups of reindeer. However, serum urea and creatinine concentrations had no indication of gave no indication of catabolism of muscle protein in the roughage fed reindeer. The high calcium and low phosphorus concentration of the roughage was reflected in serum of the reindeer.

The effect of ivermectin on reindeer offspring's weight gain and survival: preliminary findings

Andrew John Karter, Ivar Folstad, Arne Skorping and **David W. Hird***

Institute for Biology and Geology, University of Tromsø, 9000 Tromsø, Norway

* Department of Epidemiology & Preventive Medicine, School of Veterinary Medicine, University of California, Davis, Davis, California 95616 U.S.A.

Abstract: Fawn survival is a central issue for Scandinavia's reindeer industry. Nonetheless, there has been minimal research conducted on parasitism's effect on reproductive success of female reindeer and their ability to foster viable offspring to weaning. Investigation of the ecological relationship between parasitism and host fitness, as well as the economic and veterinary medical importance of anthelmintic treatment, is faciliated by conducting field trials in which animals treated with anthelmintic are compared to nontreated controls. We are presently conducting a randomized field trial to explore the effects of ivermectin treatment on pre-reproductive and mature female reindeer. Our primary response variables include age at first reproduction, and offspring survival and weight. Findings will provide fundamental information required for the development of an optimal parasite treatment strategy which aims at minimizing parasite transmission and maximizing meat production. The possible long-term negative side effects of ivermectin are also being explored. On a theoretical level, project result could elucidate the effects of the general parasite community on herd population dynamics and provide data for the study of various quantitative genetic relationships in reindeer.

Nieminen (1989) found that offspring of ivermectin-treated females at Kaamanen Reindeer Research Station, Finland, had a significant 0.5 kg increase ($p \leqq 0.05$) in average live birth weight and a non-significant 2.1 kg increase ($p > 0.05$) in average autumn live weight.[1] However, our preliminary findings indicate that ivermectin treatment of females induces no significant or consistent increase in mid to late-summer fawn live weight in coastal Northern Norway. This discrepancy from the Finnish results may be explained by several factors, among which sample size or differences in parasite abundance are likely candidates. The response variable that showed the strongest treatment effect in our preliminary results was fawning percent.[2] Ivermectin treated females had a 9 % higher fawning rate (64 % vs. 55 %) than control females, although the difference was not statistically significant (Fisher's Exact Test, $p = 0.15$; $n = 180$).

[1] We calculated the statistical significance from the means and S.E. published in *Poromies-Lehti.* 3/1989.

[2] Fawning percent is defined as the proportion of research females that was accompanied by a fawn during the time of summer sampling.

Influence of handling systems on meat quality of beef and some remarks concerning slaughter handling of reindeer

Gunnar Malmfors

Department of Food Science, Swedish University of Agricultural Sciences, S-750 07 Uppsala, Sweden

Abstract: The combined effects of corral design and corral time on the incidence of DFD (dark, firm, dry meat) in young bulls and calves (C.W. 100–110 kg) has been studied in two projects comprising about 1800 young bulls and 600 calves. Three different types of corral design were tested – individual pens, large free-range pens (6–10 animals per pen), and tethering. For each corral type, various holding periods were studied. The use of a so-called delivery-pen at the producer's was also evaluated. The delivery-pen is used for the holding of animals destined for slaughter which are gathered the day before delivery in order to assist the transporter and to make loading a one-man job. In the calf project a low ceiling in the corral to prevent mounting was tested.

The ultimate pH (pH_u) was measured in several muscles. Muscles with $5.80 \leqq pH_u < 6.20$ were classified as moderate DFD and muscles with a $pH_u \geq 6.20$ as DFD.

The main result can be summarized:

- In Sweden DFD is the most common meat quality deficiency in beef and veal. The shelf life and the frying characteristics will be reduced.
- The use of individual pens vis-à-vis large free-range pens resulted in a considerably reduced incidence of DFD meat.
- Long holding periods (i.e. overnight) versus short periods in individual pens caused a minor increase in DFD incidence. A corresponding comparison for large pens resulted in a very substantial increase.
- When young bulls that had been tethered at the producer's were kept tethered overnight in the corral prior to slaughter, hardly any DFD meat was found.
- The use of a delivery-pen caused a dramatic increase in DFD incidence.
- No more than 4–5 calves should be housed in a pen, especially if they have to be fenced overnight.
- The ultimate pH was clearly reduced by lowering the ceiling in the calf-corral to prevent mounting.

The results have been used in the Swedish slaughter industry since 1985. The DFD incidence has been reduced to a minimum. Based on our results and results from Finnish studies on reindeer it is possible to give some theoretical and concluding remarks concerning slaughter handling of reindeer.

It would be recommendable to:

- shorten the slaughter handling procedure as much as possible. Especially the handling moments of individual animals.
- move the abattoir to the reindeer instead of moving the animals to the slaughter house.
- slaughter the reindeer during the autumn season. The DFD incidence increases dramatically during the winter season when the animals often will be in a negative energy balance.
- introduce electrical stimulation of the carcasses to avoid the problem of cold shortening.

Finally, to present detailed recommendations how to handle reindeer at slaughter ensuring (i) optimal meat quality and (ii) proper animal welfare it is necessary to study the various moments in the slaughter chain and during different slaughter seasons.

Benefits from calf harvest

Ilpo Kojola[1] and **Timo Helle**[2]

[1] Finnish Game and Fisheries Institute, Meltaus Game Research Station SF-97340 Meltaus, Finland.
[2] The Finnish Forest Research Institute, Eteläranta 55, SF-96300 Rovaniemi, Finland.

Abstract: In spite of the growing numbers of reindeer in the husbandry area of Finland, calf/female ratio has increased and natural mortality rate decreased since the middle of the 1970s. This has occurred independant of supplementary feeding. Data presented here are based on official statistics from all 56 herding associations for the period of 1960–1987. The natural rate of mortality of reindeer was inversely related to the rate of harvest of calves throughout the period 1974–1987.

Harvesting calves appears to result in improved reproductive success in females. Calves commonly share feeding sites (snow craters) with their mothers in winter. Calves spend less time digging in snow when feeding at shared craters than when feeding alone, but the digging of mother is not influenced by sharing a crater (Kojola 1989). It is therefore plausible that calves exploit their mothers' digging and therefore represent and energetic cost to mother. We suggest that calf harvest improves body condition of maternal females resulting in higher subsequent calf/females ratios. Such effect should be most pronounced in northern Lapland where reindeer dig for food beneath the snow throughout the whole winter.

Correlation between calf harvest and calf/female ratio of the years was, in turn, correlated with the proportion of winter digging ($r=0.621$, $n=56$, $p < 0.001$, data on the length of digging from Helle and Saastamoinen 1979).

Supplementary feeding was initiated in the late 1960s. The results from partial correlation analysis indicated that the harvest rate of calves influenced mortality rate more than supplementary feeding (calf harvest, controlled for feeding: $r=-0.486$, n 56, $p < 0.001$; feeding, controlled for calf harvest: $r=0.263$, $n=56$, $p > 0.05$). This applied also to productivity ($r=0.466$, $p < 0.001$; $r=-0.092$, $p > 0.05$, respectively), though not to the calf/female ratio ($r=0.191$, $p > 0.05$; $r=0.121$, $p > 0.05$, respectively). Supplementary feeding itself resulted in increased production of meat, owing to an increase in the number of reindeer.

References:

Helle, T. and **Saastamoinen, O.** 1979. The winter use of food resources of semi-domestic reindeer in Northern Finland. – *Communicationes Instituti Forestialis Fenniae*, 96(6):1–26.

Kojola, I. 1989. Mothers' dominance status and differential investment in reindeer calves. – *Animal Behaviour*, **38:177–185.**

Dominance relationships in female groups of semi-domesticated reindeer: changes after antler removal.

Kumpula, J., Kumpula, K. and **Nieminen, M.**

Finnish Game and Fisheries Research Institute, Reindeer Research, Rovaniemi, Finland.

Abstract: The study of dominance relationships and effects caused by antler removal was made for reindeer hinds in Kaamanen Reindeer Research Station in winter 1989–90. A total of 24 pregnant hinds were divided into equal three groups and placed into corrals. Several body and antler measurements were taken from hinds. The division of the groups was: Group 1, control, antlered during the whole study; Group 2: antlers were removed at the same time; Group 3: antlers were removed separately according to the rank order. During the study the hinds were weighed weekly and daily feed consumption was measured. The social rank order of the groups was evaluated during intense observation before and after antler removal.

The rank order differed from ideal straight-line organization in the groups and there emerged more complicated links in dominance. The dominance of hinds was explained best by the age, body weight and size of antlers (weight and height). When the hinds gained weight in abundant feeding the relation between dominance and body weight disappeared. Body structure was a determining factor in fights between hinds of same weight and antler size. Hinds of heavier body build were higher in rank order. No dominance changes were noticed in the antlered groups. The dominant hinds lost part of their status, while some hinds earlier lower achieved higher rank order. Age of hinds explained dominance in the deantlered groups, but body weight had no effect. Body structure was again a determining factor in fights between deantlered hinds.

Pathological changes in dictyocaulosis of reindeer

Sven Nikander, Seppo Saari and **Timo Rahko**

Department of Pathology and Laboratory of Parasitology, College of Veterinary Medicine, Helsinki, Finland

Abstract: The lungworms produce pathological alterations in the lungs and may cause severe illness in many wild and domsticated animals. The infection was documented more than half a century ago in reindeer by Hellesnes (1935). The lungworm of reindeer was originally described as *Dictyocaulus viviparus* (Bloch 1782) but was identified as. *D. eckerti* by Boev in 1934 after morphological studies. The pathological changes in the lungs are illustrated on the basis of present studies.

The material consists of 15 lungworm-positive lungs of slaughtered reindeer from Eastern Lappland. The parasitological and tissue samples were studied by routine methods.

The following histopathological lesions are considered typical for *Dictyocaulus*-infected lungs in reindeer:

The acute changes consisted of presence of vascular fluids rich in inflammatory cells and mucus in bronchial lumina which also were regionally narrowed. Respiratory tissues were locally condensed by the inflammatory reaction. In chronically inflammated areas the indurations also contained giant cells and calcified debris. Lymphatic reactions were prominent. In future studies the morphology of the developmental stages of *D. eckerti* and the pathology in the different phases of dictyocaulosis will be investigated.

References:

Hellesnes, P. 1935: Rensnyltere. (Parasites in reindeer). – *Norsk Veterinærtidskrift* 47,(3):117–137.

The establishment of parasites in reindeer calves

A. Oksanen[1], **M. Nieminen**[2], **T. Soveri**[1], **K. Kumpula**[2], **U. Heiskari**[2] and **V. Kuloharju**[1]

[1] National Veterinary Institute, Regional laboratory Oulu, PO 517, SF-90101 Oulu, Finland.

[2] Finnish Game and Fisheries Research Institute, Reindeer Research, Koskikatu 33A, SF-96100 Rovaniemi, Finland.

Abstract: During the reindeer calf gatherings in June and July 1990, rectal faecal samples were collected from 494 reindeer calves at 6 locations in Finnish Lapland. The samples were analyzed according to a modified McMaster method with a detection level of 40 epg (eggs per gram) and, when the sample size was sufficient, also for nematode larvae using the Baermann method. The parasite eggs and larvae were identified according to their morphological characteristics. Samples with coccidial oocysts were incubated in a 2% potassium dichromate solution to sporulate the oocysts for identification.

Typical trichostrongylid eggs ($<100 \mu m$ in length) were found in 36%, *Nematodirus*-type eggs (probably mostly *Nematodirella longispiculata*) in 25% and coccidial oocysts in 35% of the samples. The prevalences of the respective parasites at the different reindeer calf gatherings are presented in figures.

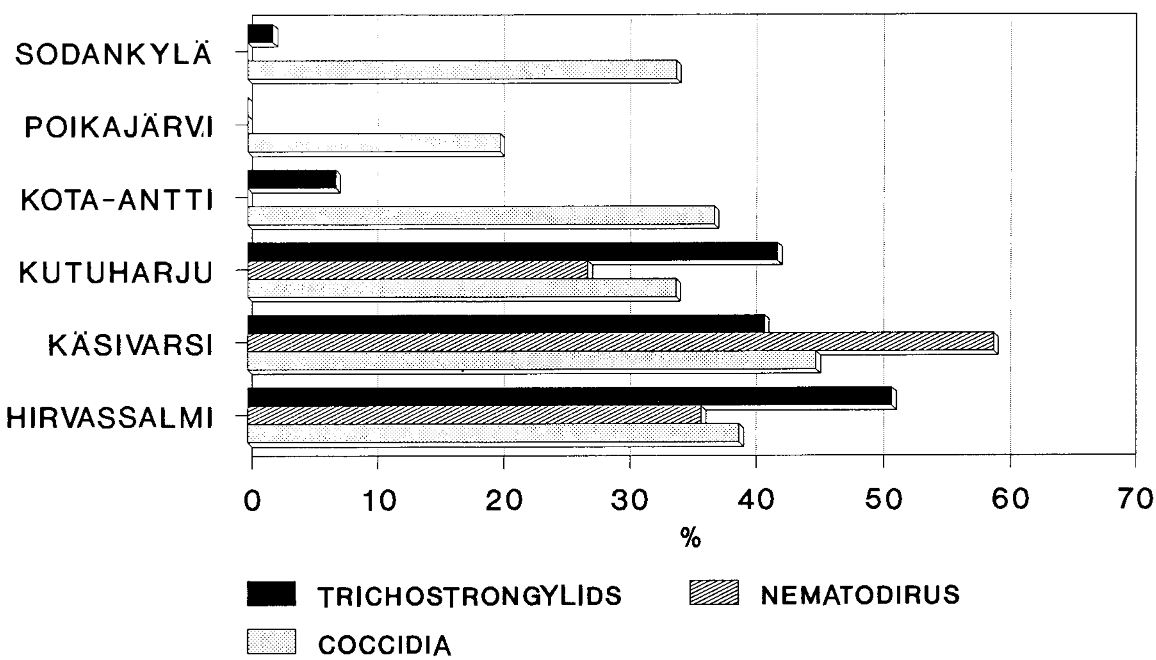


Fig. 1. Reindeer calf parasites. Prevalence during summer gatherings 1990.

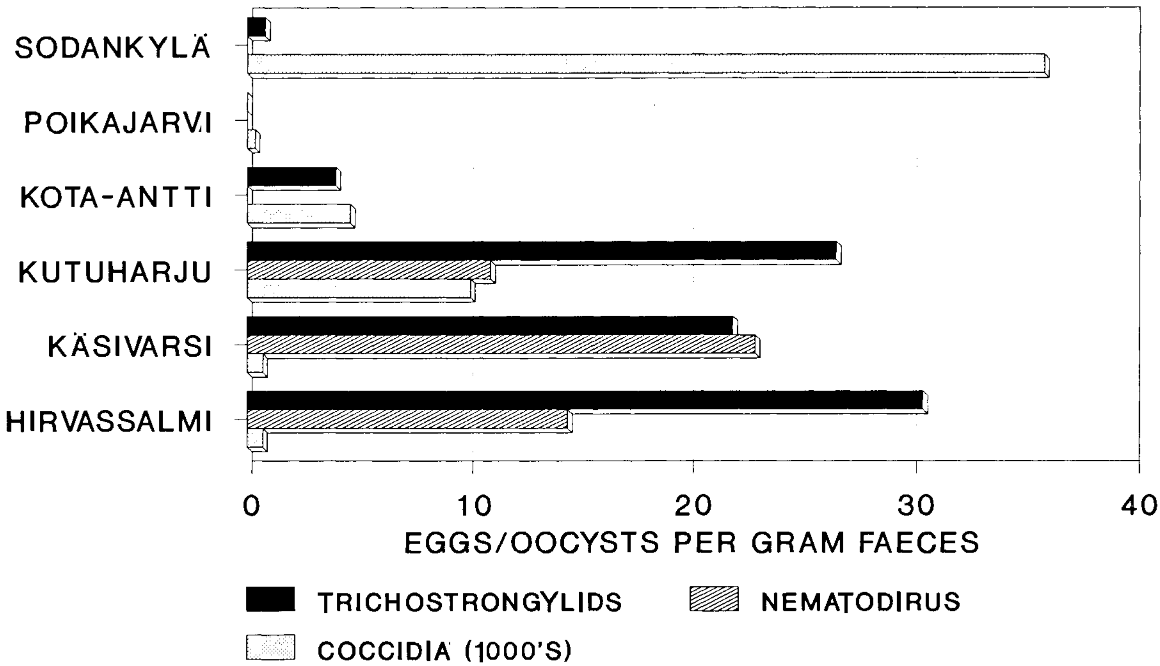


Fig. 2. Parasite infection intensity in average.

In many of the baermannized samples, nematode $l_1$larvae were seen that closely resembled those of *Dictyocaulus viviparus.*

The calves are born in May throughout the reindeer husbandry area, and it is understandable that the infection level of parasites acquired from the pasture increases when the summer proceeds, as has earlier been observed in Sweden. This explains a lot of the differences between the different areas in the present study. Very few helminth eggs were found at the locations where the sampling was first carried out. Obviously, many of the «negative» calves were undergoing the prepatent period of their parasites.

Assuming the prepatent period of coccidia is two to three weeks and that of trichostrongylids (including *Nematodirus*) around three weeks, it is evident that the majority of the reindeer calves are infected with pasture-borne parasites during their first month of living.

Some parasite genera (e.g. *Nematodirus*) are known as poor egg producers and, therefore, the detection level of 40 epg may contribute to faulty negatives. So, the real prevalence of these parasites was probably even considerably higher than observed in this study.

Moniezia cestode eggs were never observed. The prepatent period of this genus is around six to seven weeks. Neither were *Elaphostrongylus rangiferi* larvae seen, which is natural, as the prepatent period of *Elaphostrongylus* probably is around three months.

The prevalence of coccidia was high at all locations. This is a common feature with ruminant calves. More surprising was that often the infection intensity also was high. In farmed cervids, coccidiosis is not considered a problem, although the infection with direct life cycle parasites is favoured by crowding in enclosures. Because each coccidian oocyst destroys at least one epithelial cell when emerging to the intestine lumen, the peak values (up to 800000 opg (oocysts per gram) in this material) cannot be considered apathogenic. In domesticated ruminants, even values of thousands or tens of thousandss opg's may be met in clinical cases of coccidiosis. Two coccidian species were detected, which will be named later. At least the smaller oocysts belong to a species not earlier described.

Data systems for improvement of reindeer production

C. J. Petersson[1], D. Lenvik[2] and Ö. Nissen[3]

[1] Dept. of Animal Breeding and Genetics, The Swedish University of Agricultural Sciences, Uppsala, Sweden
[2] Dept. of Reindeer Management in Sør-Trøndelag and Hedmark, Røros, Norway
[3] Agriculture University of Norway, Ås-NLH, Norway

Expended abstract: The use of the additional marking system in reindeer husbandry as described by Lenvik (1987) and the collar system for the identification of the dams of the calves (Petersson 1990) are essential for recording production data on the individual level. The combination of the individual and owner code is used as an unique identification for each animal in recording systems.

This paper presents a calf selection program, a recording and a database system developed as a part of a joint Swedish – Norwegian development project where one of the main objectives is to improve identification, handling and production recording systems. The systems are used in a reindeer flock in the south parts of the reindeer area in Sweden. The additional marking system has been used in this flock since 1981 and procedures for identification of the mothers of the calves has been used since 1986.

During the reindeer production year the following parameters are recorded:

July:
- the owner of the particular calf
- the date for observation
- the day no. of the year
- the day no. within each round up session
- the code for weighing equipment
- the identity of the calf
- the weight of the calf
- the sex of the calf
- the birth year of the dam of the calf
- the identity of the dam of the calf

The parameters are recorded in a relation database management system, dbase III (Ashton-Tate, 1984). The field information for the database file, KALVRAPP.DBF, in which the calf registrations are stored is shown in Fig. 1. The output to the reindeer owner from this activity is daily lists, as shown by example in Table 2. In the list, data on the calf, average weight for male and female calf group are given and the caif's mothers summer results from the last three years. The software behind those lists are dbase III programs.

September:
- the same parameters as above for calves not marked during the summer.

September/December/January:
- the weight of the calf
- the weight of the dam

Occasionally, selection of calves for slaughter occurs in September although the main selection activities take place in December and January. For fall and winter selection, a computer selection program for calf slaughter strategies is used where the heaviest calves are kept for breeding. The program has been developed by prof. Ö. Nissen at the Agriculture University in Norway and is incorporated in the MSTAT-package (Nissen, 1984).

The main elements in the selection process are:
Before a handling/selection session starts, each

Structure for database: KALVRAPP.dbf
Number of data records: 6317

Field	Field name	Type	Width	Dec
1	AGARE	Character	4	
2	DAT	Character	6	
3	DAG	Character	3	
4	KDAG	Character	2	
5	KVAG	Character	1	
6	KNR	Character	4	
7	VIKT	Character	2	
8	VIKT1	Character	1	
9	MORAR	Character	2	
10	MORNR	Character	4	

Structure for database: KALVVIKT.dbf
Number of data records: 5572

Field	Field name	Type	Width	Dec
1	AR	Character	2	
2	AGARE	Character	4	
3	KNR	Character	4	
4	VIKT	Numeric	2	
5	SEX	Character	1	
6	SL	Character	1	
7	DAT	Character	6	
8	DNR	Character	1	

Structure for database: VAJVIKT.dbf
Number of data records: 2535

Field	Field name	Type	Width	Dec
1	AGARE	Character	4	
2	PRODAR	Character	2	
3	DAT	Numeric	6	
4	DAG	Numeric	3	
5	KVAG	Numeric	1	
6	VIKT	Numeric	2	
7	MORAR	Character	2	
8	MORNR	Character	4	

Structure for database: MORTOT.dbf
Number of data records: 4280

Field	Field name	Type	Width	Dec
1	AGARE	Character	4	
2	MORNR	Character	4	
3	MORAR	Numeric	2	

Fig. 1. Field information for det database files.

reindeer owner gives the figures, as percentage, for the slaughter outtake he is aiming at. The slaughter percentages (sl%), one for each sex group, are transformed in the program to x-points (=location on the standard normal distribution) corresponding to one of twenty slaughter percentage classes and stored as a vector. Table 1 shows the sl%, the x-points and the probability enclosed by the standard normal curve above each point representing the probability for selection.

The owner and the identity of the calf are entered into the computer and as soon as the live weight of the calf has been recorded the program recommends «hfe» or «slaughter» for each particular calf. This recommendation is based on the assumption that the calves weights are normaly distributed and that each calf is compared to a threshold weight. The threshold weight is calculated from the mean, which is continously adjusted, plus the product of standard deviation and corresponding x-point.

Table 1. Transformation of slaughter percentage (sl%) to x-points giving the probability (p%) for selection.

sl%	x	p%
97.5-	5.00	0
92.5–97.4	1.64	0.05
87.5–92.4	1.28	0.10
82.5–87.4	1.04	0.15
77.5–82.4	0.84	0.20
72.5–77.4	0.67	0.25
67.5–72.4	0.52	0.30
62.5–67.4	0.39	0.35
57.5–62.4	0.25	0.40
52.5–57.4	0.13	0.45
47.5–52.4	0	0.50
42.5–47.4	-0.13	0.55
37.5–42.4	-0.25	0.60
32.5–37.4	-0.39	0.65
27.5–32.4	-0.52	0.70
22.5–27.4	-0.67	0.75
17.5–22.4	-0.84	0.80
12.5–17.4	-1.04	0.85
7.5–12.4	-1.28	0.90
2.5– 7.4	-1.64	0.95
0 - 2.4	-5.00	1.00

Table 2. Example on daily output during summer handling.

OWNER	FEMALE ID	FEMALE WEIGHT	DATE 1990	ID 1990	WEIGHT 1990	DATE 1989	ID 1989	WEIGHT 1989	DATE 1988	ID 1988	WEIGHT 1988	DATE 1987	ID 1987	WEIGHT 1987
SL18	C 148	76	900714	L115	28	0	K 0	0	0	J 0	0	870720	H207	28
SL18	H230	62	900714	L117	23	890715	K325	21	0	J 0	0	0	H 0	0
SL18	H186	60	900714	L119	20	890708	K 70	16	0	J 0	0	0	H 0	0
SL18	C 112	77	900714	L121	28	0	K 0	0	880718	J374	25	870716	H101	30
SL18	D 092	0	900714	L122	24	0	K 0	0	0	J 0	0	870724	H321	0
SL18	C 024	70	900714	L123	27	890706	K 53	25	880717	J357	25	870724	H325	0
SL18	H062	60	900714	L124	26	890720	K495	17	0	J 0	0	0	H 0	0
SL18	J 060	66	900714	L125	21	890720	K444	21	0	J 0	0	0	H 0	0
SL18	D 114	78	900714	L126	25	890720	K450	27	880715	J268	23	0	H 0	0
SL18		0	900714	L127	30	0	K 0	0	0	J 0	0	0	H 0	0
SL18	X 504	72	900714	L128	25	890708	K 74	22	0	J 0	0	0	H 0	0
SL18	H138	69	900714	L129	26	0	K 0	0	0	J 0	0	0	H 0	0
SL18	H400	67	900714	L130	22	890718	K371	25	0	J 0	0	870716	H114	23
SL18	C 048	84	900714	L131	30	890714	K281	25	880704	J 25	25	870710	H 55	21
SL18	X 030	68	900714	L132	22	890711	K212	19	880709	J129	20	870709	H 27	20
SL18	G 384	0	900714	L133	25	0	K 0	0	880916	J407	36	0	H 0	0
SL18	X 540	61	900714	L134	19	890720	K428	19	880705	J 49	14	870709	H 36	14
SL18	H358	64	900714	L135	21	0	K 0	0	0	J 0	0	0	H 0	0
SL18	J 266	61	900714	L136	19	0	K 0	0	0	J 0	0	0	H 0	0
SL18	D 194	77	900714	L137	32	890708	K 66	26	0	J 0	0	0	H 0	0
SL18	C 152	0	900714	L138	24	890711	K186	21	880716	J321	22	870719	H180	23
SL18	B 166	71	900714	L139	24	890714	K268	24	880714	J230	20	870719	H165	26
SL18	E 190	68	900714	L140	26	890719	K419	30	880709	J104	21	870723	H260	24
SL18	H286	61	900714	L141	25	890706	K 26	22	0	J 0	0	0	H 0	0
SL18	G 286	69	900714	L142	26	890712	K248	21	0	J 0	0	0	H 0	0
SL18	H304	67	900714	L143	27	890706	K 24	20	0	J 0	0	0	H 0	0
SL18	G 200	0	900714	L144	24	0	K 0	0	0	J 0	0	0	H 0	0
SL18	X 070	64	900714	L145	25	890708	K 62	21	880716	J327	26	0	H 0	0
SL18	J 260	60	900714	L146	24	0	K 0	0	0	J 0	0	0	H 0	0
SL18	F 198	0	900714	L147	24	890706	K 32	23	880715	J301	21	0	H 0	0
SL18	X 018	68	900714	L148	25	890708	K 67	26	880711	J142	21	870711	H 85	23
SL18	H176	60	900714	L150	21	890720	K453	22	0	J 0	0	0	H 0	0
SL18	H294	62	900714	L152	21	890720	K459	16	0	J 0	0	0	H 0	0
SL18	X 210	67	900714	L154	26	890708	K 87	27	880704	J 39	22	870724	H273	0
SL18	G 286	69	900714	L156	22	890712	K248	21	0	J 0	0	0	H 0	0
SL18	B 080	79	900714	L158	20	890710	K154	19	880704	J 15	15	0	H 0	0
SL18	X 138	70	900714	L160	27	890708	K 79	25	880714	J271	23	870724	H323	0
SL18	D 240	0	900714	L162	26	890715	K294	21	880714	J251	19	870723	H258	18

AVERAGE WEIGHTS AND S. D.

MALE		FEMALE	
WEIGHT	NUMBER	WEIGHT	NUMBER
25.6 (3.4)	17	23.5 (2.5)	21

An example;
A female calf's weight is recorded as 42 kg and the sl% for females calves as defined by the calf owner, is 60. The x-point is the 0.25 (Table 1) and the probability for selection is 0.4. During the handling session the average weight for female calves is calculated to 40 kg and the standard deviation is 4 kg. The threshold weight is the computed as 40+4*0.25=41.00. In this case then recommendation will be to keep this calf for breeding purposes.

Petersson & Danell (1990b) calculated standard deviations, as shown in Table 3, from around 10.000 observations of adjusted calves weights on data collected 1986–1989. As shown the deviation increases with the age of the calves.

Fig. 2 shows a diagram constructed for 5 different standard deviations; 3-, 4-, 5-, 6- and 7 kg.

An example;
Sl%=35, mean=41 and s.d.=3. From the curve for 3 s.d. and sl%=35 the threshold weight is derived as 41–2=39 kg. That is, all animals weighing more 39 kg are selected. As can be seen from the figure, the size of the standard deviation becomes more important when the fraction slaughtered is either big or small.

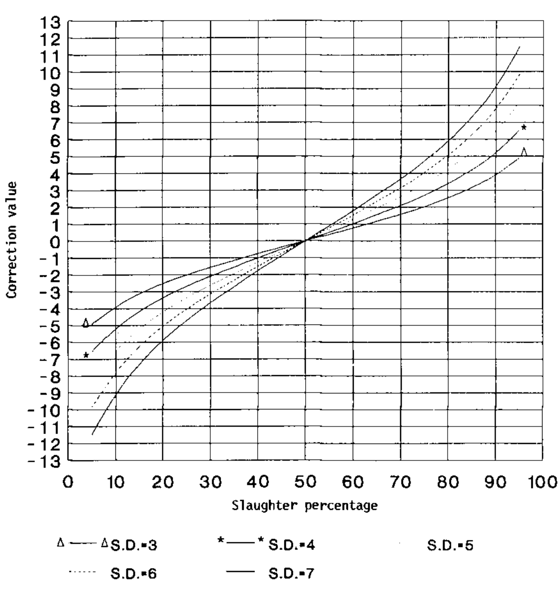


Fig. 2. Threshold weight for 5 different values of standard deviation. Threshold weight = average weight + correction value.

Table 3. Estimated weights and standard deviations for four dates on data collected 1986–1989 (Petersson, 1990).

Date	Male calves X	Male calves S.D	Female calves X	Female calves S.D
20/7	24.38	3.12	23.00	2.80
20/9	42.60	4.53	38.95	4.28
20/12	45.41	4.73	41.90	4.13
20/1	44.05	7.59	40.80	7.47

The weighing/selection program generates a file of production data as shown in Table 4a. Example of the daily output to the individual herder is shown in Table 4b.

After the weighing season the data files from the selection system are transformed to a dbase III file, KALVVIKT.DBF (Fig. 1) and each owner is given a complete list of all his yearlings. Missed calves are specialy indexed. This list is used in other districts outside the owners district and retreived «lost» calved are noted.

During December and January each female's weight is recorded and stored into the computer as a database file, VAJVIKT.DBF, as shown in Fig. 1.

A herd database:
All recordings during the reindeer production year are stored in four different database files which are merged into a database system. The main use of the system has so far been to produce life time production records for the individual female reindeer to be used by the owner as an information in the selection work.

Fig. 3 shows an example of a female life time record that is displayed to the owner during handling of the animals.

Future use of production data:
The information in the database system enables several new areas to be investigated in the field of reindeer researching. For example:

1) Studies of causes of variation in production traits important for choice of selection strategies.
2) Analysis of females life time production ability.
3) Analysis of losses.

Table 4a. Example of output from the calf selection program.

```
 0  2  DISTRICT
 1  3  OWNER CODE
 2  4  INDIVID NR.
 3  3  DAY NO.
 4  3  WEIGHT (hg)
 5  1  SEX  1=MALE  2=FEMALE
 6  1  CHOICE  1=KEEP  2=SLAUGHTER
 7  2  BIRTH YEAR FOR FEMALE
 8  4  ID OF FEMALE
 9  3  G/DAG
10  3  WEIGHT GAIN
```

SETT NR	0 0	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 0
1		18	1	350	540	1	1	84	E164	176	290
2		18	2	350	430	2	1	80	X214	134	220
3		18	3	350	450	1	2	84	E300	140	230
4		18	4	350	370	2	2	87	H314	121	200
5		18	5	350	500	1	1	84	E170	152	250
6		18	6	350	440	2	1	80	X500	128	210
7		18	7								
8		18	8	350	550	2	1	85	F225	189	310
9		18	9								
10		18	10	350	420	2	2	87	H158	140	230
11		18	11	350	480	1	2	80	X244	164	270
12		18	12								
13		18	13								
14		18	14	350	380	2	2	85	F278	134	220
15		18	15	350	360	1	1	87	H228	121	200
16		18	16	350	420	2	1	86	G016	140	230
17		18	17								
18		18	18								
19		18	19	350	410	1	2	87	H142	152	250

Table 4b. Example of production statistic from the calf selection program. The statistic is daily given to the reindeer owner.

	Numbers			Percentages		Average weight		
Sex	Total	Selected	Slaughtered	Selected	Slaughtered	Total	Selected	Slaughtered
Female	90	39	51	43	57	40.72	43.97	38.24
Male	76	15	61	20	80	44.22	50.87	42.59

FILE SEARCH FOR OWNER = SL18

Input ID of female (4 pos) > B072

Owner	ID Female	Birth Year	Weight as yearl.	Dam
SL18	B072	1981	Not rec.	Not rec.

Female weight

Date	Owner	ID	Weight
871215	SL18	B072	66.0
881212	SL18	B072	68.0
891217	SL18	B072	66.0

Female life-time production

Prod.year	Dam ID	Calf ID	Sex	Activity	Weight	Date
1987	B072	H168	Female	Marking	26	870719
1987	B072	H168	Female	Life	46	871208
*						
1988	B072	J218	Female	Marking	21	880714
1988	B072	J218	Female	Slaughter	41	881212
*						
1989	B072	K418	Female	Marking	27	890720
1989	B072	K418	Female	Marking	44	891217
*						
1990	B072	L068	Female	Marking	23	900709
*						

Owner	ID Female	Birth year	Weight as yearl.	Dam
SL18	H168	1987	26 46	B072

Female weight

Date	Owner	ID	Weight
881212	SL18	H168	63.0
891211	SL18	H168	62.0

Female life-time production

Prod.year	Dam ID	Calf ID	Sex	Activity	Weight	Date
1989	H168	K438	Female	Marking	21	890720
1989	H168	K438	Female	Slaughter	35	891211
*						
1990	H168	L075	Male	Marking	22	900709
*						

Fig. 3. Example of a life-time production record for a female reindeer.

Conclusions:

The data systems described has mainly been developed for the recording of research data. Work has to be done before the systems could be used in routine operations run by the reindeer owners themselves.

References:

Ashton-Tate. 1984 dBASE III. Culver city. CA90230. USA

Lenvik, D., Fjellheim, A., 1987. Utvalgsstrategi i Reinflokken. 1 Standard tilleggskode for rein. (Selection strategy in domestic reindeer. 1 Standard tag system for reindeer). – *Norsk Landbr. forskn.*, 1:251–261.

Nissen, Ö. 1984. Brukerveiledning for MSTAT statistikkprogram for mikromaskiner. Landbruksbokhandelen, ÅS-NLH. 66 pp.

Petersson, C. J., Danell, Ö., Lenvik, D., 1990. Improvement of production of domestic reindeer flocks, Proceedings of the Fifth International Reindeer/Caribou Symposium, Arvidsjaur, Sweden, – *Rangifer Special Issue No.* 3:445–447.

Petersson, C. J. & **Danell, Ö.** 1990b. Reindeer production parameters: 1. Live body weight and weight changes of calves between two and eight months of age (unpublished manuscript).

The presence of uncoupling protein in «brown» adipose tissue of reindeer

Päivi Soppela[1], Mauri Nieminen[1], Seppo Saarela[2], Jacqueline S. Keith[3], James N. Morrison[3] and **Paul Trayhurn[3]**

[1] Finnish Game and Fisheries Research Institute, Reindeer Research, Rovaniemi, Finland
[2] Department of Zoology, University of Oulu, Oulu, Finland
[3] Rowett Research Institute, Division of Biochemical Sciences, Aberdeen, Scotland, U.K.

Abstract: Brown adipose tissue (BAT) is a specific organ for thermoregulatory heat production by nonshivering thermogenesis (NST) in the newborn and young of many mammalian species. The importance of NST in the defence against cold has been demonstrated previously in reindeer calves (Hissa *et al.* 1981, Markussen *et al.* 1985, Soppela *et al.* 1986). Histological evidence has suggested that BAT is present in newborn reindeer (Hissa *et al.* 1981), and the distribution, cell-morphological development and respiratory characteristics of the tissue have been examined (Soppela *et al.* 1990). However, definitive differentation of BAT from white adipose tissue necessitates the use of powerful and specific biochemical techniques.

The thermogenic capacity of BAT depends on the presence and amount of a 32.000-molecular weight protein; this mitochondrial uncoupling protein (UCP) is a rate-limiting factor for thermogenesis. In the present study we have examined various locations of adipose tissue in foetal, newborn and young semi-domesticated reindeer (*Rangifer tarandus tarandus* L.) for the presence of UCP. The reindeer ranged in age from 7 months gestation to 3 months *post partum.* Using the presence of the tissue-specific UCP as a definitive criterion, we have aimed to identify the presence and critical development of BAT in reindeer.

Material was collected from the experimental reindeer herd of the Finnish Reindeer Herders' Association near Inari, Northern Finland (69° 10′ N). The tissues were frozen and sent to Aberdeen in solid carbon dioxide. Mitochondria were prepared and mitochondrial proteins separated according to molecular weight by SDS-polyacrylamide gel electrophoresis, and then blotted onto nitrocellulose membranes (Trayhurn *et al.* 1989, Milner *et al.* 1989). The membranes were probed with an anti-(ground squirrel uncoupling protein) serum (Milner *et al.* 1989) and antigen-antibody complexes were detected with goat anti-rabbit IgG horse radish-peroxidase conjugate (Scottish Antibody Production Unit).

Immunoreactivity at the molecular weight characteristic of UCP was present in perirenal, abdominal, interscapular, peristernal, intralumbar, vertebral, peritracheal, inguinal and omental adipose tissues of newborn reindeer (0-2 days of age), indicating that these tissues are functionally «brown». Interestingly, no immunoreactivity was found in coronary adipose tissue, implying that this particular adipose tissue is functionally «white». UCP was evident at high levels in perirenal and interscapular adipose tissues in foetal reindeer, aged 7 and 7.5 months. Although it was present during the first few days *post partum*, little immunoreactivity was found at 1 month of age, and none was apparent by 2 months of age.

It is concluded, on the basis of biochemical criteria, that BAT is present in foetal and newborn reindeer, and that during the immediate

postnatal period most adipose tissues in this species are functionally «brown». When comparing the presence of BAT, as defined by UCP, with the previous description of the distribution of the tissue by histological and respiratory characteristics (Soppela *et al.* 1990) a high correspondence is obtained. However, it appears that by the second month of postnatal life BAT has been «converted» to white adipose tissue. This transition parallels the fall in the capacity for noradrenaline-stimulated thermogenesis in young reindeer (Soppela *et al.* 1986). The mechanisms underlying the transition of BAT to white adipose tissue have not been identified.

The reindeer is the most northerly mammal, and the only *Cervidae* species, in which the presence and development of BAT have been definitively documented through the identification of uncoupling protein.

References:

Hissa, R., Saarela S. & Nieminen, M. 1981. Development of temperature regulation in new-born reindeer. – *Rangifer* 1:29-38.

Markussen, K. A., Rognmo, A. & Blix, A. S. 1985. Some aspects of thermoregulation in newborn reindeer calves (*Rangifer tarandus tarandus*). – *Acta Physiol. Scand.* 123:215–220.

Milner, R. E., Wang, L. C. H. & Trayhurn, P. 1989. Brown fat thermogenesis during hibernation and arousal in Richardson's ground squirrel. – *Am. J. Physiol.* 256:R42–R48.

Soppela, P., Nieminen, M., Saarela, S. & Hissa, R. 1986. The influence of ambient temperature on metabolism and body temperature of newborn and growing reindeer calves (*Rangifer tarandus tarandus* L.). – *Comp. Biochem. Physiol.* 83A:371–386.

Soppela, P., Sormunen, R., Saarela, S. & Nieminen, M. 1990. The distribution, cellular morphology and respiratory characteristics of «brown» adipose tissue in reideer. – *Manuscript.* 20 pp., 3 Tables, 3 Figures.

Trayhurn, P., Temple, N. J. & Van Aerde, J. 1989. – Evidence from immunoblotting studies on uncoupling protein that brown adipose tissue is not present in the domestic pig. – *Can. J. Physiol. Pharamacol.* 67:1480–1485.

Ovarian function and pregnancy rates in reindeer calves (*Rangifer tarandus*) in southern Norway

E. Ropstad[1], D. Lenvik[2], E. Bø[2], M. M. Fjellheim[2] & K. B. Romsås[1]

[1] Department of Reproduction and Forensic Medicine, Norwegian College of Veterinary Medicine, P.O.Box 8146 Dep., N-0033 Oslo 1, Norway

[2] Department of Reindeer Management in Sør-Trøndelag and Hedmark, N-7460 Røros, Norway

Abstract: Reindeer calves (n=632) were slaughtered in November/December (n=476) or in January (n=156). Dressed weights and amount of perirenal fat were recorded and the reproductive organs were collected. A separate group of 130 reindeer calves were weighed at 7 months of age and followed with repeated weighings and pregnancy examinations up to 21 months.

The pregnancy rate and the onset of puberty were significantly influenced by body weight and amount of perirenal fat. About 60 g perirenal fat and about 22 kg dressed weight were found to be the lower limits for pregnancy. A total of 222 (35 %) animals had reached puberty and 126 (20 %) were pregnant when examined after slaughter. Animals which conceived during their first autumn showed only a moderate weight gain the following year and the calf mortality rate in these animals was 47.4 %. It was concluded that calf pregnancies were common in Southern Norway and that measures should be taken to avoid such pregnancies.

The use of cloprostenol and prostaglandin $F_{2\alpha}$ to induce luteolysis in reindeer calves

E. Ropstad[1] and **D. Lenvik**[2]

[1] Department of Reproduction and Forensic Medicine, Norwegian College of Veterinary Medicine, P.O.Box 8146 Dep., N-0033 Oslo 1, Norway

[2] Department of Reindeer Management in Sør-Trøndelag and Hedmark, N-7460 Røros, Norway

Expanded abstract:

Introduction

The pregnancy rate in reindeer is strongly related to body weight (1) and, in southern Norway, has been observed to increase from virtually zero to about 90 % when body weight increased from 40 to 50 kg (2). Reindeer calves can reach body weights of over 50 kg during their first autumn if they have access to high quality pastures. In order to increase the production capacity of a reindeer flock, growing calves and heifers with a body weight less than 60 kg should not be subjected to the risk of pregnancy (3) and the subsequent dilemma of the death of the newborn calf or the stress of lactation (4).

In other ruminants, prostaglandins can be used to cause luteolysis and induce abortion. The aim of the present study was to evaluate the effect of prostaglandins given to young reindeer calves at the end of the breeding season.

Materials and methods

A total of 126 young reindeer of about 7 months of age, were isolated from a flock during the last week of November 1987. Animals weighing more than 46 kg body weight were randomly allocated into two groups to be treated either with prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$), 12.5 mg (Dinolytic®, n=41) or 0.25 mg cloprostenol (Estrumat®, n=50). Thirty-five animals were left untreated and no restriction on live weight was used in this group.

Two blood samples were collected from all animals, the first immediately prior to treatment and the second 2 1/2 days later for the analysis of progesterone.

The response to treatment was evaluated according to the change in plasma progesterone concentration following treatment. Animals with a progesterone concentration > 2 ng/ml prior to treatment and < 1 ng/ml after treatment were regarded as «responders». Animals with a progesterone concentration < 2 ng/ml prior to treatment were excluded. Other combinations of progesterone concentrations indicated a negative response («non-responders»).

Results

The mean concentration of plasma progesterone in both treatment groups before receiving prostaglandin was 3.2 ± 0.4 (± SEM) ng/ml. The untreated group had significantly lower means for both plasma progesterone concentration and live weight than either treatment group had prior to receiving prostaglandin.

Treatment with prostaglandin resulted in a significant decrease in progesterone concentrations in both treatment groups. Although not significant (p=0.08), the mean concentration of progesterone in females treated with cloprostenol was significantly lower (0.8 ± (0.2 ± SEM)

ng/ml) after treatment than in females treated with $PGF_{2\alpha}$ (1.5 ± 0.3 (± SEM) ng/ml). No side effects were seen as a result of treatment.

Grouping the animals into responders and non-responders according to their progesterone concentrations prior to and after treatment (see Materials and methods) revealed a higher frequency of responders (81.5 %) in cloprostenol-treated animals than in $PGF_{2\alpha}$-treated animals (31.8 %).

Discussion

The significant fall in progesterone concentrations observed in treated animals indicated that prostaglandins could be used to induce luteolysis in reindeer.

The average progesterone concentration was lower after treatment, and the number of responders higher in the group treated with cloprostenol than in the group treated with $PGF_{2\alpha}$. The doses given (12.5 mg $PGF_{2\alpha}$ and 0.25 mg cloprostenol) were chosen on basis of the doses recommended for cattle (25 mg $PGF_{2\alpha}$ and 0.5 mg cloprostenol), and on the assumption that the given dose should be sufficient to cause lyteolysis in reindeer weighing about 50 kg live weight. The lower response-rate obtained with $PGF_{2\alpha}$ could be due to a lower effect of this compound in reindeer than in cattle. A similar phenomenon has been reported in sheep where the appropriate luteolytic dose of $PGF_{2\alpha}$ is 20 mg (5).

Treatment with prostaglandins was performed in the last week of November. At this time of the year the normal breeding season is finished. However, little information is available on the normal reproductive physiology of reindeer, and evidence exists that, in the absence of pregnancy, ovulation can continue into December - January (6). Pregnancy may therefore be better prevented by treatment at a later stage.

The limited availability in this study of reindeer calves with a high body weight required that restrictions on body weight could not be placed on animals in the untreated group. Therefore this group cannot be regarded to be a part of the same population as the treated animals.

In conclusion, prostaglandins would appear to be effective in causing luteolysis in reindeer and such compounds may be useful in preventing pregnancy in young animals. The further evaluation of the effect of prostaglandins in this species should address the treatment of animals at predetermined stages of the reproductive cycle and pregnancy.

References:

1. **Lenvik, D., Granefjell, O.** and **Tamnes, J.** 1988. Utvalgsstrategi i reinflokken. 5. Drektighet hos tamrein i Trøndelag. (Selection strategy in domestic reindeer. 5. Pregnancy in domestic reindeer in Trøndelag county, Norway). - *Norsk landbruksforskning* 2(3):151-161.
2. **Lenvik, D.** 1988. Utvalgsstrategi i reinflokken. 6. Brunsttopp og brunstsynkronisme hos tamrein i Trøndelag. (Selection strategy in domestic reindeer. 6. Oestrus peak and oestrus synchronization in domestic reindeer in Trøndelag county, Norway). - *Norsk landbruksforskning* 2(3):163-174.
3. **Lenvik, D., Bø, E.** and **Fjellheim, A.** 1988. Relationship between the weight of reindeer calves in autumn and their mother's age and weight in the previous spring. - *Rangifer* 8(1):20-24.
4. **Lenvik, D.** and **Fjellheim, A.** 1987. Utvalgsstrategi i reinflokken. 2. Ungsimlenes vekt ved 18 måneder relatert til vekten ved 2 og 6 måneder. (Selection strategy in domestic reindeer. 2. Relationship between body weight at 2 and 6 months' old to body weight at 18 months' old domestic female reindeer). - *Norsk landbruksforskning* 1(4):263-274.
5. **Hackett, A. J.** and **Robertson, H. A.** 1980. Effect of dose and time of injection of prostaglandin $_{2\alpha}$ in cycling ewes. - *Theriogenology* 13:347-351.
6. **Mossing, T.** and **Rydberg. A** 1982. Reproduction data in Swedish domestic forest reindeer. - *Rangifer* 2(2):22-27.

Levels of ^{137}Cs in reindeer bulls in July/August and September and the effect of early slaughter

Birgitta Åhman[1] and **Gustaf Åhman**[2]

[1] Dept. of Clinical Nutrition, Swedish University of Agricultural Sciences, Box 7023, S-750 07 Uppsala, Sweden.

[2] Dept. of Animal Nutrition and Management, Swedish University of Agricultural Sciences, Box 5097, S-900 05 Umeå, Sweden.

Introduction

Since the first autumn after the Chernobyl nuclear accident, 1986, early slaughter of bulls has been used as a method to prevent reindeer meat from being rejected because of too high levels of radiocesium (Åhman 1986).

The diet of reindeer varies throughout the year. This result in great variations of radiocesium intake and thus great variations of radiocesium levels in reindeer. The *sameby** Vilhelmina norra is located in one of the most contaminated areas of Sweden. In summer most reindeer from Vilhelmina norra have levels of ^{137}Cs below 1500 Bq/kg, which is the current limit for reindeer meat that is offered for sale in Sweden. In winter, reindeer from this area have levels between 5000 and 30000 Bq/kg.

Normally there is no slaughter of reindeer in summer. The bull slaughter starts at the beginning of September and goes on until around September 20. In September the bulls reach their maximum weight and are in good condition before the rut. At this time, however, the levels of radiocesium have started to increase after summer and in more contaminated areas most of the reindeer already have levels above the limit of 1500 Bq/kg.

* The Swedish word sameby represents a union of reindeer herders and the territory where these herders have rights to graze their reindeer (Beach 1990).

In 1987 the Swedish Board of Agriculture decided to stimulate early slaughter by economic compensation for lower carcass weights and for extra work connected with the gathering of reindeer for slaughter. Since 1987 early slaughter has been put into practice in every *sameby* in the county of Västerbotten. At present the Swedish government pays about 1200 SEK for a rejected reindeer bull with a slaughter weight around 45 kg. The economic compensation to the reindeer owner when the bull is slaughtered in August is about 500 SEK.

In this investigation we studied the effects of early bull slaughter on the number of accepted (< 1500 Bq ^{137}Cs/kg) carcasses in the whole *sameby* Vilhelmina norra and at selected locations in Vilhelmina norra, Svaipa/Gran and Hotagen during the years 1987 to 1990.

Material and methods

Analyses of ^{137}Cs are performed as a routine at all reindeer slaughters in contaminated areas of Sweden. The results are presented in data lists published by «Gammadata mätteknik AB» in Uppsala, a company which carries out many of the analyses.

In Vilhelmina norra samples have been taken from every reindeer slaugthered from July to September each year since the Chernobyl accident. This material has been used to calculate the results shown in Figure 1.

In Table 1 results are shown from reindeer slaughtered at three field slaughter houses in Svaipa/Gran, Vilhelmina norra and Hotagen, respectively. The reason for picking these locations is that reindeer have been slaughtered at these places in both August and September during most years since Chernobyl and that the fallout differs between the locations. Reindeer from three main areas with levels of different contamination are taken to the slaughter house in Giels (Vilhelmina norra). Reindeer from the Marsfjället area were chosen for Table 1.

Results and discussion

The effect of early slaughter varies between different locations and also between years at the same location. The effect depends on the radiocesium deposition in the area and on the time of year when the reindeer starts to graze plants with high radiocesium levels (lichens and mushrooms). The results are shown in Figure 1 and Table 1.

Figure 1 shows the number of reindeer slaughtered in Vilhelmina norra in July/August and in September 1986–1990 and the distribution of carcasses with levels of ^{137}Cs above and below the limit 1500 Bq/kg.

In 1986 all reindeer bulls were slaughtered at normal time in September. Only 7 % had levels of ^{137}Cs below 1500 Bq/kg. These animals were, however, not accepted for human consumption, since the upper limit for all meat at that time was 300 Bq/kg.

Early bull slaughter was effected in Vilhelmina norra for the first time in July 1987. A slightly larger part of the animals were accepted for human consumption (activity concentrations of ^{137}Cs below 1500 Bq/kg) in July/ August than in September.

In 1988 radiocesium levels in reindeer started to increase as early as August, owing to the exceptional quantity of mushrooms that year (Hove et al. 1990). Most carcasses (71 %) were accepted at slaughter in July/August but only 14 % were accepted in September.

In 1989 and 1990 most reindeer were slaughtered in August and a large part of these animals (84 and 78 %, respectively) had activity concentrations of ^{137}Cs below 1500 Bq/kg. Less than 200 bulls were slaughtered in September each of these two years. In September 1989 all animals, except two, were slaughtered on September 3, and 90 % of the carcasses had levels of ^{137}Cs below 1500 Bq/kg. (In 1989 radiocesium levels in reindeer started to increase late in the autumn, since there were virtually no mushrooms and green pasture was available until the end of October.) At slaughters in September 1990, 48 % of the carcasses had activity concentrations of ^{137}Cs below 1500 Bq/kg, and were accepted for human consumption.

Table 1 shows mean values of ^{137}Cs and the percentage of accepted carcasses (activity con-

Table 1. ^{137}Cs in reindeer, mean ± S.D., from slaughter in three different places in August and September 1987–90.

Sameby/ location	date	n	^{137}Cs kBq/kg mean ± S.D.	< 1500 Bq/kg
SVAIPA/				
GRAN	1987-08-24	251	0.36 ± 0.17	100%
Biergenäs	-09 16	116	0.78 ± 0.39	93%
	1988-08-23	514	0.90 ± 0.33	96%
	-09-16	261	1.63 ± 1.05	47%
	1989-08-22	319	0.29 ± 0.09	100%
	-09-13	103	0.47 ± 0.24	99%
	1990-08-23	477	0.33 ± 0.09	100%
	-09-14	376	0.63 ± 0.32	97%
VILHELMINA				
NORRA	1987-09-04	333	1.02 ± 0.36	87%
Gielas	-09-15	218	3.94 ± 1.04	0%
(Marsfjäll)				
	1988-08-26	219	1.54 ± 0.84	63%
	-09-16	184	5.71 ± 2.62	0%
	1989-08-23	350	0.93 ± 0.25	97%
	-09-03	168	1.03 ± 0.37	90%
	1990-08-13	302	0.72 ± 0.16	100%
	-09-15	109	1.82 ± 1.06	53%
HOTAGEN				
Vinklumpen	1987-08-23	112	0.75 ± 0.19	100%
	-09-08	184	1.36 ± 0.50	71%
	1988-08-25	209	1.58 ± 0.39	49%
	-09-07	199	1.89 ± 0.51	22%
	1989-08-23	204	0.43 ± 0.11	100%
	-09-09	257	0.63 ± 0.28	100%
	1990-08-22	260	0.57 ± 0.14	100%
	-09-05	239	0.87 ± 0.29	97%

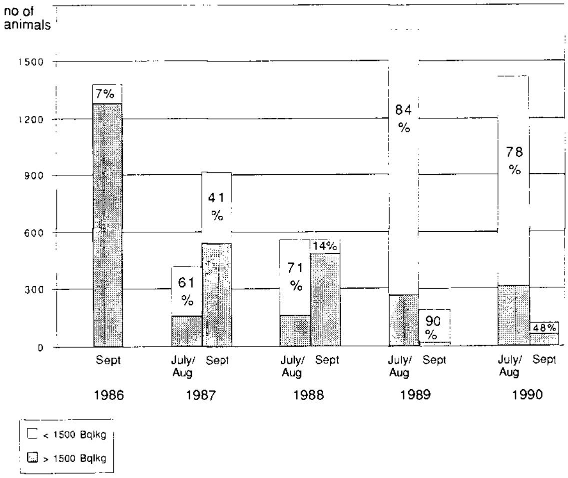


Figure 1. The number of accepted and rejected carcasses (% < 1500 Bq/kg) at reindeer slaughters in Vilhelmina norra in July/August and September 1986–1990.

centrations < 1500 Bq/kg) at early and normal bull slaughter in Biergenäs (Svapia/Gran), Gielas-Marsfjäll (Vilhelmina norra) and Vinklumpen (Hotagen) from 1987 to 1990.

Reindeer slaughtered in Biergenäs and Vinklumpen had been grazing in areas where the radiocesium fallout was 2–5 kBq $^{137}Cs/m^2$ and 5–10 kBq $^{137}Cs/m^2$, respectively. At slaughters in August, except from August 1988, all reindeer have had acitivity concentrations of ^{137}Cs below the limit 1500 Bq/kg. In September the levels had started to increase, but were still sufficiently low and only few carcasses were rejected because of too high levels of radiocesium. In 1988 radiocesium levels started to increase earlier (as discussed above). In Biergenäs most carcasses were accepted in August, but only 47 % were accepted in September. In Vinklumpen 49 % were accepted in August and as few as 22 % were accepted in September.

In the Marsfjället area (the south eastern part of the summer grazing land in Vilhelmina norra) the radiocesium fallout was 20–40 kBq $^{137}Cs/m^2$. Bulls from this area have been slaughtered at three different periods, August 13-26, September 3–4 and September 15–16, however not at all these times each year. At the beginning of September 1987 and 1989 most reindeer from Marsfjället had activity concentrations below 1500 Bq $^{137}Cs/kg$ and were accepted for human consumption. In 1987 and 1988 no carcasses were accepted at slaughters in mid September. In 1988 a large part of the carcasses (37 %) were rejected already at the slaughters in August. In 1990 all carcasses were accepted at slaughter in August and 53 % were accepted in mid September.

Conclusions

In areas with radiocesium fallout below 10 kBq $^{137}Cs/m^2$ bull slaughter could be made at ordinary time of year, except from years like 1988 when the access to mushrooms was exceptionally high. In areas like Vilhelmina norra, were the fallout is over 20 kBq $^{137}Cs/m^2$, few reindeer have activity concentrations below 1500 Bq $^{137}Cs/kg$ in September, the normal time for bull slaughter. In these areas bull slaughter should routinely be made in August (or possibly very early in September) to save as many reindeer carcasses as possible from being rejected due to high levels of radiocesium.

References:

Beach, H. 1990. Coping with the Chernobyl disaster: a comparison of social effects in two reindeer-herding areas. – *Rangifer*, Special Issue No. 3:25–34.

Hove, K., Pedersen, Ø., Garmo, T. H., Hansen, H. S. & Staaland, H. 1990. Fungi: A major source of radiocesium contamination of grazing ruminants in Norway. – *Health Physics* 59(2):189–192.

Åhman, G. 1986. Studier av radioaktivt cesium i svenska renar. Översikt över pågående undersökningar 1986. – *Rangifer*, 1986, No 1, Appendix: 53-64.

Panel discussion

Meat quality.

Chairman: Professor **Arnoldus** Schytte **Blix**, Department of Arctic Biology, University of Tromsø.

Panel:

Johan Mathis Turi, Vice-chairman of the Saami Reideer Herders Association of Norway, Kautokeino, Norway.

Gunnar Malmfors, Research group leader, Department of Meat Quality, Sweden's Agricultural University, Uppsala, Sweden.

Mauri Nieminen, Research scientist, RKTL/Porotutkimus, Rovaniemi, Finland.

Knut Framstad, Section leader, Norsk Kjøtt A.s, Oslo, Norway.

Steinar **Holme**, Product developer, Stabburet A.s, Fredrikstad, Norway.

Bror Saitton, Consultant, Swedish Saami Association, Umeå, Sweden.

Veikko Huttu-Hiltunen, Director, Paliskuntain Yhdistys, Rovanemi, Finland.

Summary of the debate.

Despite certain differences in the administration and organisation of the reindeer meat industry in the three countries represented, several problems are held in common. These are summarised as follows:

1. Quality.

It was emphasised that it is essential to be clear about exactly what «quality» means. One must distinguish between (a) Carcass quality and (b) Meat quality.

(a) Carcass quality
- carcass composition (meat, fat, bone)
- proportion of high priced cuts.

This represents the basis of good raw material. Even though carcasses may be acceptable in terms of hygiene and shelf-life, there is nevertheless a considerable difference in value between a thin and a well filled carcass. Those parts of a carcass which, in a well filled specimen, are suitable as sale as «luxury product» may, in a thin specimen, be suitable only for processing less valuable secondary products. This has an important effect on what the industry is willing to pay.

(b) Meat quality

This refers to the quality of particular muscles with regard to colour, texture, eating quality, shelf-life, nutritional value and so on.

These two categories of «quality» are related. The meat off a thin carcass is often dry and tough.

Shelf-life is best determined by measuring pH.

There are two main problems with regard to meat quality.

a. The Dark, Firm and Dry (DFD) phenomenon in meat with too high pH at slaughter. This results in reduced shelf-life, especially in vacuum packed meat. The frequency of DFD increases from autumn to winter. The risk of DFD can be reduced by maintaining a high energy content (glycogen concentration) in the muscles. This is achieved by ensuring careful handling of the animals to minimise stress prior to slaughter.

b. «Cold shortening», which occurs if the temperature of the meat falls below 10°C within 10 hours of slaughter. Cold shortening can be avoided in cattle by electrostimulation which exhausts muscle stores of ATP. There is clearly a risk of cold shortening in reindeer and the problem should be properly addressed.

The need to agree on objective standard measurements of meat quality was emphasised.

2. Objectives and possibilities.

Objectives for marketing reindeer meat are:

a. to sell all that is produced

b. to sell at the highest possible price.

There was general agreement that there is no difficulty, or ought to be no difficulty, either practically or politically, to sell all reindeer meat that is produced on the home market. The reason for this is that reindeer meat represents so small a proportion of meat sales in each of the three lands: approximately 1% in both Norway and Finland and 0,5% in Sweden. The problems are, rather, how best to exploit the potentital future «luxury» market and with which products to compete with «traditional» meats. Once good products have first been developed, the problem could easily become simply one of satisfying the demand.

3. Requirements for achieving these objectives.

a. Consistent quality.
Variation in sorting and classifying meat remains a major problem today. The industry demands tighter control to ensure the consistent quality which is necessary in type products.

b. Quality control.
Clear standards of quality covering slaughter procedures, raw material and products must be developed, agreed and applied. Currently, no such quality control exists. Instruction and motivation are essential to achieve introduction of new standards which will guarantee product quality.

c. «Luxury market».
Reindeer is regarded by many as a speciality and should, therefore, be able to command a high price. One problem, however, is that many old fashioned, everyday receipes for raw material like reindeer meat are being forgotten. Meals that come ready-prepared or which require only a minimum of preparation are increasingly popular. Consequently, more and more reindeer meat is being sold in fully or partly processed form.

Fresh reindeer meat is only available at certain times of year and, consequently, a large proportion of the products must be sold frozen. Presentation, including cut and packaging, is extremely important.

4. Demands of the industry.

The food industry demands three things before it will be willing to invest in reindeer meat:

a. Consistent quality.
b. Guarantee of quality.
c. Improved carcass quality. In particular, more well-filled carcasses. This represents a clear message to the producers to husband their resources better in terms of grazing pressure.

5. Demands made to the producers.

a. Improved carcass quality.
The higher the proportion of well-filled carcasses the greater the possibility for obtaining highest posible prices. The better the carcass quality, the better raw material which can be delivered to the private customer and the industry. The relation between the quality of the products and its price is obvious. The conclusion is that optimal exploitation of pasture is essential. The consequence of overstocking is low carcass quality and low prices. The price must, in future, reflect product quality and market demand rather than the extent of government subsidisation.

b. Those involved in reindeer husbandry must take greater responsibility for marketing. Reindeer meat currently represents such a small fraction of the total meat market in Scandinavia that relatively small investment is likely to yield a large return, in terms of increased sales. For the reindeer industry itself, of course, meat is everything. Clearly, therefore, the reindeer industry must be made primarily responsible for marketing it's products. This responsibility extends from the pasture to the slaughterhouse and then through every stage of processing and packaging all the way to the meat counter.

Acknowledgement

Dear friends

I thank you all, members of the NOR 5th Nordic Meeting of Reindeer Research in Oulu in 1989, for your kind token of appreciation and for the excellent book-gift (thank you, Eigil!) at your gathering in Oulu. I am also very grateful, touched, and happy about the dedication of Special Issue No. 4 from the meeting.

At the same time as the part of my ego that is liable to self-criticism (with which, though somewhat shrunk, i believe myself to be equipped) bravely fights to keeps some sort of distance to the introductory chant, I cannot stop the other part of myself shamelessly to indulge in lapping up the kind exaggerations. That is my way.

I consider myself lucky to have witnessed and taken part in the development of the Nordic Reindeer Research work with its flagship «the Rangifer», so skilfully and with so much dedication steered clear of shoals and rocks of shallow waters by Sven.

Lastly I wish you all further progress in your research work in a spirit of practical nordism and internationalism.

Fare well!

Sincerely yours
Magnus Nordkvist

Kära venner

Tack alla ni som deltog i NOR's 5th Nordiska Renforskarmöte i Oulu, 1989 för er vänliga uppvaktning och för den förnämliga bokgåvan (Tack Eigil!) när vi var samlade i Oulu. Jag är också mycket tacksam, rörd och glad för dedikationen av Special Issue No 4 från mötet.

Medan mitt självkritiska jag (jag tror att jag är utrustat med ett sådant, ehuru något förkrymt) tappert ansträngar sig att hålla någon sorts distans till den inledande drapan, kan jag inte hindra den andra delen av mig att med skamlöst välbehag lapa i sig de vänliga överdrifterna. Sådan är jag.

Jag skattar mig lycklig över att ha fått uppleva och deltaga i uppbyggnaden av det Nordiska renforskningssamarbetet med flaggskeppet «Rangifer», som Sven så skickligt och hängivet har lotsat ut i rum sjö.

Till sist önskar jag alla fortsat framgång i ert forskningsarbete i den praktiska nordismens och internationalismens tecken.

Lev väl.

Er tillgivne
Magnus Nordkvist

Participants

Invited speaker

Anthony Pearse
Deer International
MAF Technology
Invermay
New Zealand

Finland

Pekka Aikio
Box 2282
SF-96201 Rovaniemi

Ulla Heiskari
RKTL
Porotutkimus
Koskikatu 33A
SF-96100 Rovaniemi

Timo Helle
Norra Finlands Forskningsinstitut
Koskikatu 18A
SF-96200 Rovaniemi .

Veikko Huttu-Hiltunen
Paliskuntain Yhdistys
Koskikatu 33A
SF-96100 Rovaniemi

Ilpo Kojola
Meltaus Wildlife Research Station
SF-97340 Meltaus

Jouku Kumpula
University of Oulu
Department of Zoology
Linnamaa
SF-90570 Oulu

Mauri Nieminen
RKTL
Porotutkimus
Koskikatu 33A
SF-96100 Rovaniemi

Sven Nikander
College of Veterinary Medicine
Department of Pathology
Box 6
SF-00581 Helsingfors

Mikko Niskanen
Norra Finlands Forskningsinstitut
Koskikatu 18A
SF-96200 Rovaniemi

Antti Oksanen
National Veterinary Institute
Regional Laboratory Oulu
Box 517
SF-90101 Oulu

Kristina Rissanen
Finnish Centre for Radiation
and Nuclear Safety
Louhikkotie 28
SF-96100 Rovaniemi

Aino Risto
RKTL
Porotutkimus
Koskikatu 33A
SF-96100 Rovaniemi

Päivi Soppela
RKTL
Porotutkimus
Koskikatu 33A
SF-96100 Rovaniemi

Bengt Westerling
State Veterinary Institute
Box 368
SF-00100 Helsingfors

Greenland

Henning Thing
Greenland Home Rule Authoroty
Box 309
DK-3900 Nuuk

Norge

Tove Aagnes
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Arne G. Arnesen
Agricultural Department
Office of Reindeer Husbandry
Box 8007 Dep
N-0030 Oslo 1

Arnoldus Schytte Blix
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Karstein Bye
Directorate of Reindeer Husbandry
N-9500 Alta

Inger Margrethe Hætta Eikelmann
Institute of Biology and Nature
Management
Agricultural University of Norway
N-1432-Ås-NLH

Nils Isak Eira
Fossbakken
N-0465 Tennevoll

Ivar Folstad
Institute of Biology and Geology
University of Tromsø
Breivika
N-9000 Tromsø

Knut Framstad
Norsk Kjøtt A/S
Boks 60 Refstad
N-0513 Oslo 5

Geir Gotaas
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Odd Halvorsen
Zoological Museum
University of Oslo
Sarsgt. 1
N-0562 Oslo 5

Helge Hansen
Department of Reindeer Husbandry
in Sør-Trøndelag & Hedmark
N-7460 Røros

Rolf Egil Haugerud
Fylkesmannen i Tromsø
Kaigt. 4
N-9000 Tromsø

Steinar Holme
Stabburet A/S
Box 66
N-1601 Fredrikstad

Johan Kleppe
Troms County Veterinary Office
Box 652
N-9401 Harstad

Dag Lenvik
Norwegian University of Agriculture
N-1432 Ås-NLH

Tore Marthinsen
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Svein Disch Mathiesen
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Jens Halvdan Mosli
Bajos A/L
N-9056 Mortenhals

Arne Nilssen
Tromsø Museum
N-9000 Tromsø

Hans Søren Norberg
State Veterinary Laboratory
for Northern Norway
Box 652
N-9401 Harstad

Erling Norvik
Fylkesmannen i Østfold
N-1500 Moss

Øyvind Pedersen
Institute of Farm Animals
Norwegian University of Agriculture
Box 25
N-1432 Ås-NLH

Arne Rognmo
Directorate of Reindeer Husbandry
N-9500 Alta

Knut Breden Romsås
Norwegian College of Veterinary Medicine
Box 8146 Dep
N-0033 Oslo 1

Erik Ropstad
Institute of Reproduction
and Forensic Medicine
Norwegian College of Veterinary Medicine
Box 8146 Dep
N-0033 Oslo 1

Sveinung Rundberg
Department of Reindeer Husbandry
in Troms
N-9220 Moen

Harald Rundhaug
Department of Reindeer Husbandry
in Nordland
N-8250 Rognan

Anne Cathrine Rørholt
Norwegian Saami Reindeerowners
Association
Box 508
N-9001 Tromsø

Sven Skjenneberg
Nordic Council for Reindeer Research
Box 378
N-9401 Harstad

Harald Sletten
Department of Reindeer Husbandry
in Nord-Trøndelag
N-7760 Snåsa

Odd Erling Smuk
Norwegian Saami Reindeerowners
Association
N-9820 Varangerbotn

Hans Staaland
Institute of Zoology
Norwegian University of Agriculture
N-1432 Ås-NLH

Wenche Sørmo
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Johan Mathis Turi
Norwegian Association of Saami
Reindeerowners
N-9520 Kautokeino

Nicholas J. C. Tyler
Department of Arctic Biology
University of Tromsø
Breivika
N-9000 Tromsø

Sweden

Riitta Airakorpi
Blodstensvägen 17 310
S-752 44 Uppsala

Lasse Andersson
Committee of Agriculture
Department of Reindeer Husbandry
Box 453
S-901 09 Umeå

Tord Constenius
Agricultural Board
S-551 83 Jönköping

Öje Danell
Institute of Forestry Improvement
Swedish University of Agricultural Sciences
Box 7007
S-750 07 Uppsala

Olof Eriksson
Department of Reindeer Research
Swedish University of Agricultural Sciences
Box 559
S-751 22 Uppsala

Christer Hoel
Swedish Council for Agriculture
and Forestry
Odengatan 61
S-113 22 Stockholm

Gunnar Malmfors
Department of Food Science
Swedish University of Agriculture
Box 7051
S-750 07 Uppsala

Olle J. Omma
Fack 24
S-920 66 Hemavan

Tage Persson
AB Västerbottens Fodercentral
Box 76
S-913 00 Holmsund

Carl Johan Petersson
Institute of Domestic Animals Breeding
Swedish University of Agricultural Sciences
Box 7023
S-750 07 Uppsala

Leif Pløen
Anatomy and Histology
Faculty of Veterinary Medicine
Swedish University of Agricultural Sciences
Box 7011
S-750 07 Uppsala

Axel Rydberg
Department of Reindeer Research
Swedish University of Agricultural Sciences
Box 5097
S-900 05 Umeå

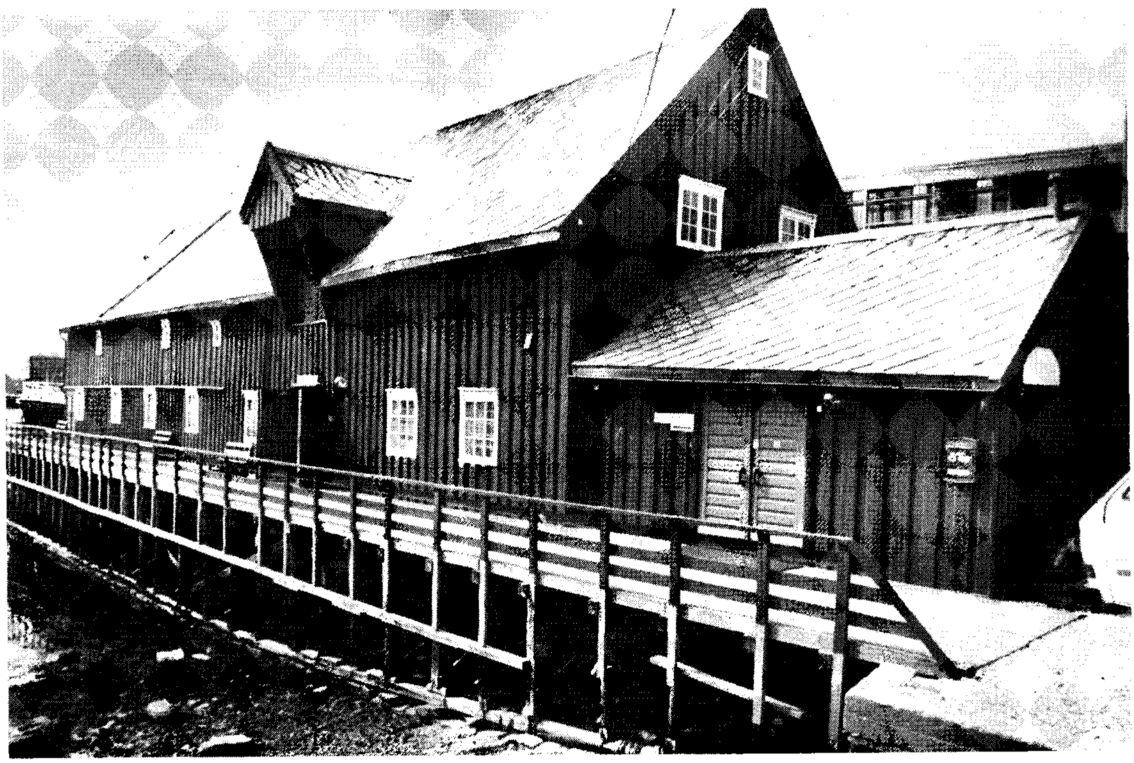
Bror Saitton
Swedish Saami Association
Brogatan 5
S-902 48 Umeå

Åke Strömberg
Fori HB
Box 112
S-913 00 Holmsund

Per Mikael Utsi
Borgargatan 2
S-960 40 Jokkmokk

Birgitta Åhman
College of Veterinary Medicine
Department of Clinical Nutrition
Swedish University of Agricultural Sciences
Box 7023
S-750 07 Uppsala

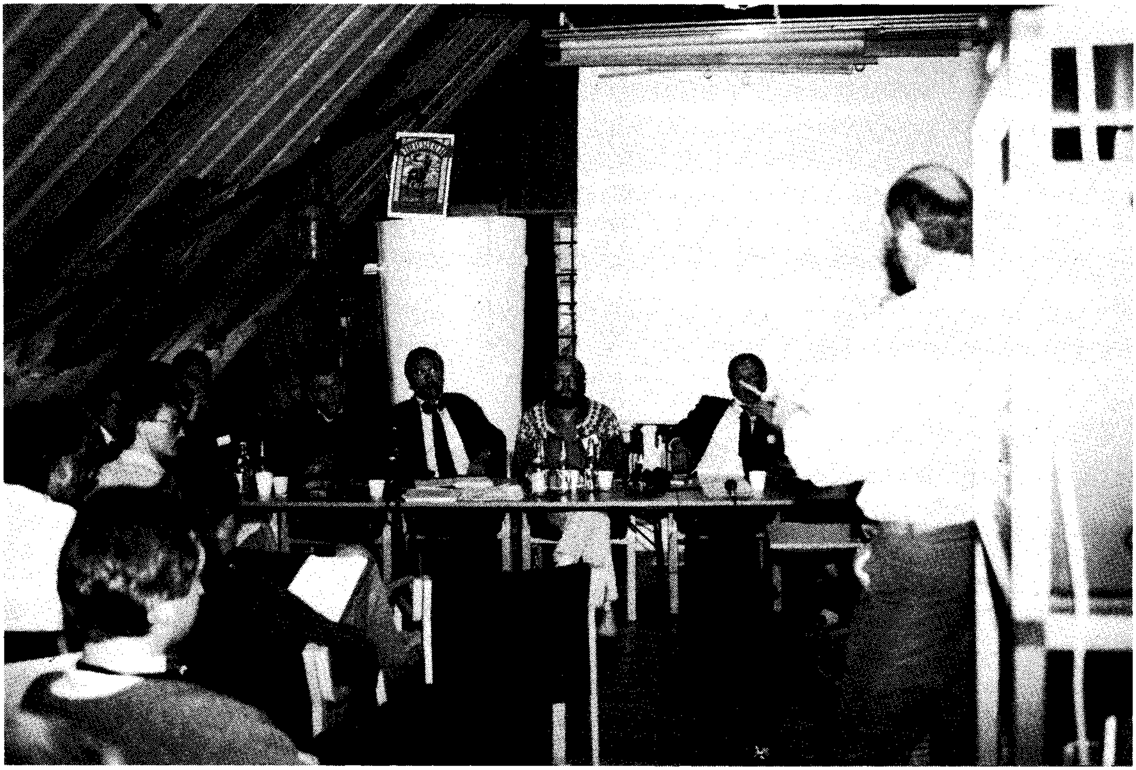
Gustaf Åhman
Department of Reindeer Research
Swedish University of Agricultural Sciences
S-750 07 Uppsala



The Polar Museum, Tromsø, Norway. (Photo: Nordlys Foto)

The hotel-ship «Isprinsen», Tromsø. (Photo: Birgitta Åhman)


Coffee-break. From right: Henning Thing, A.S. Blix, Karstein Bye and Arne Nilssen. (Photo: Birgitta Åhman)



Panel discussion. From left: Veikko Huttu-Hiltunen (partly covered), Bror Saitton, Steinar Holme, Knut Framstad, Mauri Nieminen and Gunnar Malmfors. (Photo: Päivi Soppela)

Assembly in inspiring surroundings. (Photo: Päivi Soppela)

Poster presentation. Kristina Rissanen. (Photo: Päivi Soppela)

Visit in Department of Arctic Biology. Svein D. Mathiesen. (Foto: Päivi Soppela.)

THE TEN COMMANDMENTS
OF
REINDEER HERDING

Shepherd thy herd closely when calving for thy calves are more precious than rubies.

Kill not thy healthy reindeer except they be in abundance or be castrated and castrate not thy young reindeer for they will grow slowly and not fatten as quickly as thy bulls.

Husband thy pastures carefully that they not be overgrazed or destroyed by fires or trampling and never allow surplus reindeer to graze on winter lichen ranges.

Love thy reindeer as thy sons and daughters, protecting them from wolves and bears, and assuring them abundant food and water all the days of their lives.

Thou shalt not cause thy reindeer great stress or make them to run swiftly for they will lose weight or overheat and die as surely as though smitten by thy sword.

Healthy reindeer grow fat and have many calves, whereas sickly and diseased reindeer bring only shame and an empty purse.

Seek solace for thy reindeer in cool breezes when hordes of mosquitos and warble flies haunt the summer ranges.

Suffer not thy old, thy sickly nor thy castrated reindeer to endure another snowfall for these reindeer are unproductive and will not fatten further.

Attend to thy tablets carefully for the keeping of tally sheets and daily journals is the hallmark of a successful reindeer herder.

Honor thy pasturelands, its waters and all its creatures, large and small, for they are a family that has endured for centuries.

INFORMATION FOR CONTRIBUTORS TO **RANGIFER:**

LANGUAGE

Manuscripts can be written in English or a Scandinavian language. There shall be a comprehensive summary in English. Translations of summaries to Finnish or Swedish/Norwegian, if necessary, are taken care of by the editorship.

TABLES AND ILLUSTRATIONS

These shall be numbered with Arabic numbers (1, 2, 3 etc) and provided with short, but adequate text, such that they as much as possible can be understood independently of the article text. Their place shall be clearly stated in the manuscript.

Tables are typed on separate sheets. Start each table on separate page and continue onto more pages if necessary, even if long tables should be avoided.

Illustrations shall be ready to be printed. Text for illustrations shall be typed on separate page, each text clearly marked with the number of illustration. Legend of illustrations shall be written in same language as the paper and in English or Norwegian/Swedish. NOTE: The text on illustrations must be to scale, such that charts/graphs if necessary can be reduced to 1 column (67 mm). Mark back of each illustration with name of senior author, figure number and «TOP». Colour illustrations are exeptionally accepted and shall be delivered as slides.

KEYWORDS

Keywords to be placed after the summary and should state topics, animal species, plant species, methodology etc.

COPY

Use double space with 3 cm margins. Do no hyphernate at the right margin. On the top of page 1, type the name and complete address of the person who is to receive editorial correspondance. On succeeding pages, type the senior author's laste name in the top left corner. Manuscripts with single spacing are returned for retyping!

Submit 2 good copies, keep 1. Do not fold copies.

MEASUREMENTS AND UNITS

Use metric units and whenever possible, follow the accepted nomenclature of the International Symbol of Units (SI).

Numbers shall be given as: 739 847.34.

REFERENCES

Sources given in the text shall be written: Smith (1974) or (Smith, 1974).

The list of references shall be placed at the end of the paper, written on a separate sheet and listed alphabetically according to the author: **Holleman, D. F., Luick, J. R. & White, R. G.** 1979. Lichen estimates for reindeer and caribou during winter. – *J. Wildl. Manage.* 43 (1): 192 - 201. (43 indicates volume number, (1) number in volume series and: 192 - 201 page numbers).

ITALICS

Italics to be indicated by single underlining. Latin genus and species names shall always be written in italics.

PROOFS

First correction to be read by the author. Authors are fully responsible for checking all numerical material for accuracy.

OFFPRINTS

Offprints must be ordered when an article is sent in. 50 offprints are free of charge. Additonal offprints available at cost.

RANGIFER:

WORLD'S ONLY

Rangifer is the world's only scientific journal dealing with topics about reindeer/caribou and reindeer husbandry exclusively.

INTERNATIONAL

Rangifer is registered in international databases for references of scientific papers.

REFEREEING

Rangifer's manuscripts are evaluated by scientists relevant to the topic in question.

POLICY

Rangifer is dealing with topics about reindeer husbandry, reindeer biology and -pastures.

Articles can be of 4 types: original scientific articles, preliminary reports, summary articles or short notices.