SHIELING TRANSHUMANCE AND CHANGES IN LAND-USE IN THE SCOTTISH HIGHLANDS

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SUMMARY

The mountain regions of Europe were once fully used by pastoral based communities; these marginal areas are now depopulated and scarcely used. It may be more profitable to produce food on intensively managed lowland or indoors, but often these systems are not self supporting; as they become dependent on supplies from outside, they become divorced from the potential level of production of the immediate environment. It seems probable that the time will come when Europe will have to call on the production of these neglected marginal areas and they will again be managed intensively. The recognition of the value of marginal land will probably come, not only in Europe, but throughout the world.

In the Scottish Highlands there evolved, over many hundreds of years, an indigenous pastoral system based on seasonal migration or shieling transhumance. Migration is common to many forms of subsistence pastoralism; Scottish shieling transhumance is therefore viewed alongside different systems of migration found in marginal areas of the world. Systems of nomadism and transhumance are discussed with reference to patterns of migration of wild animals: Chapter 1. These systems of animal management and range utilisation have to be flexible, the animals adapted to the environment and a balance maintained between the size of the herd, the available resources and the human population.

The subsistence pastoral economy of the Scottish Highlands continued, with increasing outlets for trade, until the eighteenth century. The rising human population, the growing dependence on

cropping agriculture and the introduction of commercial sheep farming brought about the complete breakdown of the traditional pastoral economy of the Highlands.

The Norwegian mountains offer an unique opportunity for studying a system of altitudinal transhumance similar to that found in the Scottish Highlands before 1800. The similarities and differences between the vegetation of the Norwegian and Scottish mountains are discussed and transhumance is considered in relation to the utilisation of the plant resource: Chapter 2.

The relic system of seter transhumance found in an area of South Norway is described, the recent changes in land use, the management and production of the animals, the use made of the mountain pastures and the present situation are considered: Chapter 3.

Some of the contemporary descriptions of shieling transhumance in Scotland are viewed in the light of Norwegian experience: the location of shielings, seasonal movement of animals, winter feeding and the type of animal are considered. The domestic animals appear to have been well adapted to the Highland environment and although the milk yield was low, the butter fat content was high; butter and cheese production are discussed. The regulation of the herd size and its composition is considered and the relationship between herd size and rent: Chapter 4.

Shieling transhumance, sheep farming and deer forest management are compared in a study of the changes in land-use that have occurred over the last two hundred years in an area in south Ross and north Invernes in Scotland. A detailed study of Glen Strathfarrar shows some of the effects that these changes have had on the vegetation: Chapter 5.

It is intended that this whole study should give an insight into the factors involved in managing marginal land; these are discussed with reference to the Scottish Highlands.

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SHIELING TRANSHUMANCE AND CHANGES IN LAND-USE IN THE SCOTTISH HIGHLANDS

The mountainous regions of Europe were once fully used by pastoral based communities; since the last war the move to urban centres has accelerated and now these marginal areas are depopulated and scarcely used. Man may be able to produce food more profitably on intensively managed low land, or indoors, but these systems are not self supporting and as they become more dependent on supplies from outside they become divorced from the potential level of production of the immediate environment.

It seems probable that the time will come when Europe will have to call on the production of these neglected marginal areas and they will again be used intensively. The recognition of the value of marginal areas will probably come not only in Europe but throughout the world. Each environment imposes its own constraints on production, these may be more serious in areas that are marginal for management than elsewhere, but in all environments effective management requires a full understanding of the ecological relationships and constraints. This sort of understanding is inherent in subsistence forms of pastoralism operating without buffering from outside. It is important and rewarding to study these systems in order to get a full understanding of the factors essential to the successful use of marginal land.

The greater part of the Scottish Highlands are marginal for cultivation. They form an oceanic extension of the mountain lands of north west Europe; there are large areas of peat in the west, and the tree line is lower than in other European mountain areas

such as the Swiss Alps or the Scandinavian mountains. Admittedly there are small pockets of fertility, in base rich areas and in those sheltered from the wind, which are of an importance out of all proportion to their extent.

In these mountains there evolved an indigenous pastoral system which operated for hundreds of years. Mixed herds of cattle, goats, sheep and horses were managed under a system of seasonal migration or shieling transhumance, utilizing both low and high ground in a pattern very similar to that shown by red deer. Little is known about the stability of the system prior to the seventeenth century as little was written and little is known about the size of the human population[1]. There must have have been fluctuations in the local populations; seasons of bad weather resulting in poor harvests and high mortality of stock, out-breaks of disease and raiding and fighting would have evened out the peaks in these fluctuations. Probably the overall rate of change of population was slow.

A great deal is known about the conditions in the Highlands from the later part of the eighteenth century[2] onwards but earlier than 1700 information is lacking, particularly on the conditions of people in the Highlands. Although there was some trade in cattle

1. Smout (1969, p.111) suggested that at the end of the seventeenth century the population of Scotland was about a million, probably a quarter of which lived in the Highlands. Youngson (1973, p.43-44) discussed Walker (1812, v.1, p.18-47) estimates of population of the Highlands which appear to have been an updating of Webster's survey of 1755, and concluded that the population of the Highlands in 1750 was around 300,000 or a quarter of that of Scotland.
2. The forfeited estate papers of 1715 and after 1746 give a great deal of insight into the agricultural conditions of the late eighteenth century and of the changes occurring; the general surveys of agriculture in the Scottish counties produced for the Board of Agriculture; The Statistical Accounts of the parishes and Sir John Sinclair's Analysis of 1826 and then the government surveys into the condition of roads, fisheries, causes for emigration, conditions of the people and the use of land are all extremely valueable. Gray (1957) lists and discusses these government surveys and reports.

and dairy produce and in furs and skins between the Highlands and England, the economy was primarily a subsistence one based mainly on dairy animals, except in coastal regions where fishing would have been important. This subsistence economy continued with increasing outlets for trade until the eighteenth century when the natural mechanisms of regulating the size of local populations, such as high infant mortality and short life expectancy, were by the eighteenth century being broken down by the introduction of better food supplies, more peaceful conditions and improved medicine[1]. The rapid increase of population that followed, brought with it a comparable increase in the numbers of domestic animals. But as there was also an increased dependence on cropping agriculture and on potatoes which were introduced to the Highlands in about 1750[2], the number of domestic animals probably did not increase as rapidly as did the human population.

The increasing population and the growing dependence on potatoes must have meant that the agricultural system became less resilient, and the inherent flexibility of the old pattern of land-use was lost. The sheep farming system that replaced the shieling system in the late eighteenth and early nineteenth century accelerated the movement of people from these areas, as it was a system that required only a low input of labour and a high capital expenditure. The shieling system on the other hand, which in one way was extremely intensive, required high labour inputs and low capital

1. See Youngson (1973, p.161-190) chapter on 'More people less land'; Smout (1969, p.240-260) discusses the changes in population in Scotland during the eighteenth and nineteenth centuries and the medical improvements that brought about a decline in the death rate.
2. See Salaman's (1949) history of the potato and also the Old Statistical Accounts of the 1790's and Sinclair's analysis of them of 1826.

expenditure. The sheep farming lasted for little more than eighty years in the higher mountain areas of the Highlands. The shortness of this period was partly attributable to environmental factors resulting from the use of a single animal species, but probably mainly due to economic factors. Nowadays, much of the land that once supported herds of domestic animals is deer forest. The intensity of management and the capital inputs are, at present, both very low.

Prior to the agricultural improvements of the late eighteenth century, the people living in some areas of the Highlands must have been almost entirely dependent on their herds; in other areas, this dependence may have been much less as cultivation must have been more successful. These differences became more marked as improved low ground agricultural techniques, such as rotation, fertilisation and high yielding cereal crops were introduced from the south[1]. This study is mainly concerned with the subsistence pastoral system found in the Highlands before these eighteenth and nineteenth century innovations, and with the consequent changes in the use of high ground. The political and economic changes that occurred in the Highlands during the eighteenth and nineteenth century are only considered in so far as they affect the use made of high ground[2]. An attempt has been made to show how the use of high ground has declined and the management of marginal land has become inappropriate or non-existant.

1. See some of the studies of Highland agriculture in the eighteenth century listed on page 49, and also the reports to the Board of Agriculture on conditions in the Scottish counties: Mackenzie's (1810) survey of Ross and Cromarty, and Robertson's (1808) survey of Inverness are the two surveys related to the Scottish study area in South Ross-North Inverness.
2. These factors have been studied in depth by Gray (1957), and Youngson (1973).

It is not possible to judge the conditions of subsistence pastoral Highlanders by the standards of modern, urban industrial life, nor to consider the efficiency of the shieling system in terms of present economic standards or in comparison with modern intensive animal husbandry. The shieling system has therefore been viewed alongside different migration systems evolved by wild animals and also by man and his domestic animals in other marginal areas of the world. (Chapter 1).

The study of changes in land-use in south Ross and north Inverness showed how the high ground was used intensively under a system of shieling transhumance until the beginning of the nineteenth century: (Chapter 5). According to the literature, this decline was general over mainland Scotland. Although the contemporary descriptions were considered, none was sufficiently detailed or comprehensive to allow a full understanding of the shieling system. The Norwegian mountains are very similar to those of Highland Scotland: (Chapter 2), and a system of transhumance is still operated in some parts. This therefore offers an unique opportunity to study a system of land-use very similar to that which operated in the Highlands. The experience gained in Norway helped in the interpretation of the limited information available on the Scottish shieling system. In the study of Norwegian seter transhumance, an attempt was made to understand the system of animal management and the use that the domestic animals make of mountain areas. The changes that have occurred in Norway are very interesting, but as the land tenure system and the external factors involved have been different from those in Scotland, it is unwise to draw many close parallels.

Before interpreting the effects of changes in land-use, it is essential to know precisely what these changes have been. Therefore a detailed study of the land-use and the changes that have occurred in one region of the Highlands, in south Ross and north Inverness, are considered with respect to changes in vegetation: (Chapter 5). It is intended that this should give an understanding of the factors that have to be considered when managing marginal land, where the ecological constraints are severe and there is little room for error. This is of relevance at present as these areas are again being recognised as being valuable. The pressure to use them for recreation, for red deer production and for timber production on the lower ground is increasing, and a case for their use for some form of domestic animal production is more than a possibility.

CHAPTER 1.

MIGRATION, NOMADISM AND TRANSHUMANCE

In areas of the World that are unsuitable for cultivation, man has had to develop alternative means of subsistence. An economy based on hunting can develop in an area where there is sufficient game. However, under a hunting economy human population density can never be very great as man is totally dependent on the availability of the prey species. The hunter has usually little knowledge of factors such as recruitment and natural mortality, and he can do little in the way of manipulating the herd structure and thus influencing the level of production. By domesticating animals man has increased not only his control over them but also the extent of their mutual interdependence. In the wild situation, animals can adapt to changes in their environment either by making physiological adaptations, such as hibernation or by moving to a new, more suitable environment. In the domestic situation, man has not only to compensate for changes that directly affect himself, but also those that affect his dependent herd.

Areas that are marginal for cultivation, through aridity or an insufficient growing season, can usually support a grazing animal population for only part of the year, because the factors that limit cereal production will also limit the production of pasture plants. When man is harvesting at the secondary production level[1], he is not limited to the immediate area as he would be if he was growing crops. He is able to move to areas where there are food rescurces for his domestic herds and he can, therefore, adapt to fluctuations in the

1. Plants are regarded as primary producers, grazing animals as secondary producers and carnivors as tertiary producers.

availability of these resources.

There are some fundamental principles common to all forms of consumer/producer relationships, which are generally applicable to all animal production systems, from subsistence pastoralism to intensive livestock husbandry. The consumer has a basic demand for animal products; in subsistence pastoralism this is to meet his daily calorific requirement; in the more intensive system, it is to meet market demands also. If these demands cannot be met on a sustained basis throughout the year, the consumer has to develop techniques of storing products or resources in times of plenty in order to compensate for fluctuations in supply. The animal herds upon which the pastoralist or intensive stock farmer are dependent also have to have a sustained supply of food, and the management system therefore has to be able to compensate for periodic deficiencies in order to meet the fixed demands of the animals.

In situations where the environmental constraints are very severe, such as in the arid semi-desert of north Africa or the tundra of northern Canada, the land-use systems have to have a high degree of flexibility so that advantage can be taken of the resources when and where they become available. The approach must be opportunist in order to maintain a state of dynamic equilibrium with the environment. The pastoralist must retain freedom of movement and flexibility in order to survive, sometimes on very little. If the approach becomes more exploitive, and the demands made by the consumer increase above a certain level, this high degree of flexibility is lost and the system cannot be sustained without external inputs. The demands of the subsistence pastoralist cannot exceed the resources that are available; the size of his

herd cannot exceed, for more than a brief period, the carrying capacity of the range at the most limiting time of the year. Therefore, for a subsistence economy to be successful, the operator has to have a great understanding of the potential and limitations of the environment in which he operates. This understanding may not easily be expressed in words, or be recognised by an outsider, but it is an inherent and essential part of a subsistence economy. If, however, the environmental constraints become too severe, or the fluctuations too extreme for the pastoralist to adapt to, he will not be able to survive.

In an efficient animal production system, the only way to increase production is to overcome the ecological constraints that control the level of production by putting in capital and technology. The system itself, however, is changed. As it becomes dependent on the provision of external buffering agents it becomes more rigid and ceases to be totally related to specific environmental potential.

The more harsh the environment, the more flexible and sensitive the land use system has to be in order to maintain a balance and to sustain production. As the dependence on external factors increases and the dependence on the immediate environment diminishes, the understanding of the true potentials and limitations of the environment usually also diminishes resulting in less effective use being made of it.

Because subsistence pastoralists often have to operate within extreme environmental constraint, with only weak external buffering agents, their land-use system has to be in delicate balance with the available resource supply. The pastoralist has to be sensitive to changes and make short term adaptations to counter-balance them.

In the wild, animals adapt to fluctuations in their environment by altering their physical demands or by moving to a new, more suitable environment. Pastoral herders have the same choices open to them, either to change the demands that they make or to change their environment and develop a system of migration.

DEFINITIONS OF MIGRATION, NOMADISM AND TRANSHUMANCE

Migration

Migration is a periodic, directional movement in response to an environmental change or a physiological change within the animal. It involves an alternate displacement between two or more regions and is not an uni-directional movement or dispersal. Dispersal follows a particular change in the environment, such as a natural disaster or an increase in population that alters the balance between population and resources. Migration is an adaption that enables use to be made of marginal areas at the specific time when they can support an animal population over and above the resident population that may be supported throughout the whole year. Migration should not be used loosely as a term meaning 'immigration' or 'emigration'; it implies a periodic alternating movement to and from an area.

Migration involves the periodic utilisation of different parts of the animals' range. The migratory cycle takes place within the year as it is a response to seasonally changing environmental conditions or seasonal changes in the demands made on the environment by the animals. Animals, by migrating, can adjust to fluctuation in habitat suitability brought about by seasonal factors, such as rainfall and snow cover, that affect food supply. Large mammalian

herbivors, under natural conditions, have often to be highly migratory, moving seasonally in response to changes in food availability, predator pressure and changes in weather condition. Migratory behaviour can also help to minimise over-grazing, and with a diversity of species involved, can result in a more complex use of the available plant species in an area, at all stages of vegetative development than would occur if there was only a constant low number of animals present of a single species (Bell 1969).

In the wild, animals adapt to fluctuations in their environment by altering their physical demands or by moving to a new, more suitable environment. When environmental changes are seasonal or periodic and, therefore, predictable, animals can develop patterns of seasonal or periodic migration. Nomadism and transhumance can be thought of as being the formalisation of animal movement in response to environmental fluctuations. Many of the patterns of migration shown by pastoralists with domesticated herds are similar to those shown by wild herds. This is to be expected because systems of pastoralism often operated in the same environment as wild grazing herds. Both nomadism and transhumance are systems of animal management that enable use to be made of the marginal areas of the world, that can support a grazing animal population for only part of the year.

Herbivores are never random in their dispersal over an area or in their utilisation of their range, as an even distribution of food, shelter and water is very rare. In areas where the seasonal changes are not marked, the movement pattern of the animals has to be sufficiently flexible to enable them to utilise food and water when and where they are available. The movement pattern then approaches

nomadism. Nomadic wild animals and pastoralists do not have fixed migration routes from one area of suitable environment to another, but, instead, show a general annual pattern of range use which has a specific form suited to the circumstances of the moment. In areas of distinct seasonality, transhumance patterns can develop with fixed migration routes between specific summer and winter areas.

It is not productive to draw a sharp distinction between nomadism and transhumance on ecological grounds as the differences lie in the social and cultural context. Nomadism and transhumance are both forms of pastoralism that involve the movement of livestock from one area to another, in response to changes in food supply, water availability and weather conditions. However, there is a gradation between true nomadism where the herders have no fixed settlement or migration routes, through semi-nomadism, where herders are without fixed settlements but have fixed migration routes, to transhumance where herders spend part of the year in temporary settlements and part in permanent villages. However, because each of these systems has developed in response to special sets of environmental conditions, each should be looked at against its own environmental background and not simply as part of the gradation from pure nomadism to the transhumance practised by settled agriculturalists.

Nomadism

Nomadic pastoralism as a form of resource utilisation, is an adaptation made by man to living in regions of very low plant production where settled cultivation or permanent settlement is not possible over a period of time. The classic locus of pastoral

tribes is in the trans-continental arid belt of Asia and Africa; Manchuria, Mongolia, Tibet and Turkestan, Iran, Arabia, the Sahara and environs (Sahlins 1968). For example, there are several million pastoralists in Inner Asia; one fifth of the population of Arabia is pastoralist showing some degree of nomadism, and in Africa the area of land used by pastoral tribes is greater than that used by cultivators.

Truly nomadic herdsmen have no fixed settlement, but move with their herds over a tribal area following changes in pasture availability. Nomadic pastoralists are highly specialised herders, almost entirely dependent on their animals for food, clothing, fuel and tradeable products. It cannot be stated emphatically that nomads are totally independent of settled agriculturalists. In many instances dairy products or live animals are exchanged for grain with which to supplement an animal-based diet. It cannot be said that nomadism is solely connected to subsistence pastoralism; trade and communication play an important part in the life of many nomadic tribes. For example, the caravan Bedouins of north Africa and Arabia are trading nomads.

Nomadism is no longer thought of as being a more primitive form of land-use than cultivation (Allan 1965), but rather as a highly sophisticated adaptation to extreme environments. Graham (1969), in her interesting study of Man-Water relations in the Sudan, describes 'Nomadism' as the most extreme adaptation that man can make in response to limited water supplies. The spatial and temporal mobility of nomadic tribes enables them to utilise fluctuating or seasonally available resources. The 'a priori' argument of cultural evolution from hunting and gathering, through

a pastoral, to an agricultural stage, is no longer accepted by anthropologists. Sahlins (1968) quotes the example of the highly mobile mounted tribes of Inner Asia, which developed around 1500 - 1000 B.C. as an offshoot of mixed farming. Allan (1965, p.287) quotes Professor Toynbee, who sees cultivation and herding as having evolved in response to the challenge of desiccation; first hunting tribes had to change to rudimentary forms of agriculture with increase in population and then only, after 'Nature gave her screw of desiccation a second turn' and cultivation became impossible, did the tribes have to turn to herding.

In regions with particularly severe environmental constraints, whether due to lack of water or periods of extreme heat or cold, people will depend heavily on a single animal species that is especially well adapted to the environment; for example, the camel of the desert of north Africa and the reindeer of northern Eurasia. In the less extreme areas, use can be made of a variety of species, each utilising a different aspect of the available plant food resource. Krader (1955) discusses in great detail the relationship of herd composition to habitat type, with reference to the mixed herds of sheep, cattle, goats, horses and camels of the nomadic tribes of the central Asian Steppes. The ratio of the different species changes with the suitability of different animals for particular environments. In the more arid areas, the percentage of camels is higher, and in the areas where grass is an important component of the vegetation, cattle play a greater role.

Despite having highly developed herding techniques and intricate knowledge of the environment in which they operate, pastoralists are very much at the mercy of events. Nomadic

pastoralists have not developed techniques of storing food and water for their herds, and therefore have to move these to areas where supplies are available.

Transhumance

The term 'transhumance' comes from Latin, trans meaning across and humus land. It has been widely used by French authors to describe systems of animal husbandry found in Europe and North Africa (Evans 1940). Transhumance is an ancient practice, but although there are some early references to the use of mountain pastures in north west Europe from as early as Roman times, transhumance has, to a large extent, passed unnoticed (Sayce 1956). It has received very little attention from British writers, with the exception of Carrier (1932) in her extensive study of transhumance in southern Europe. She gives a useful bibliography for the early European work. Most of the studies in this field have been made by German and French workers, and Földes (1969) gives references to the more recent studies on transhumance in Europe and north Africa.

Authors differ in their definitions of transhumance and in their idea of the factors that distinguish it from nomadism. The management of domestic herds and flocks under a system of transhumance entails 'periodic and alternating displacement of flocks and herds between two regions of different climates' (Newbiggin 1911 quoted in Evans 1940, p.172). Evans (1940) himself felt that this definition did not make the distinction between nomadism and transhumance clear enough, for, although nomadism and transhumance merge into each other, they occur in very different social and cultural situations. Evans therefore elaborated as follows,

'The movements of flocks and herds under transhumance are seasonal and altitudinal: they take place to and from an established settlement which is regarded as a permanent home' (Evans 1940, p.172). Part of the population becomes migratory and pastoral and part remains sedentary and agricultural. Walton (1919) also used the idea of a fixed settlement to distinguish nomadism and transhumance, but recognised further that,

> 'In Nomadism, the whole population accompanies these needful movements, and between this extreme and settled agriculture all gradations and stages exist, including semi-Nomadism, where part of the population takes part in the seasonal migration and part remains fixed in the villages and habitations'.
> (Walton 1919, p.103).

It is probably more valuable to recognise that the differences that exist between patterns of extensive animal husbandry are results of different sets of environmental constraints and economic needs of the human population. It is then unnecessary to distinguish between nomadic pastoral systems that have definite migration routes and seasonal pastures, and the long distance movements of a portion of a settled population.

Transhumance is dependent on the juxtaposition of two regions that compliment each other in respect of food supply, water supply and environment. It is therefore useful to distinguish between two essential schemes of transhumance on the basis of the relationship between summer and winter pasture. In mountainous areas, the complementary areas are separated altitudinally. In regions

with mediterranean climate with extreme changes between the mild wet winters and the hot dry summers the winter and summer grazing districts may be separated by latitudinal distances of several hundred miles.

Horizontal, or Mediterranean, transhumance, according to Davies (1941), occurs in areas with high summer temperatures and low summer rainfall. The wintering areas are subject to drought in summer and there is, therefore, very little pasture for domestic animals. The flocks and herds have to be taken to the cooler, moister regions for summer. Horizontal transhumance practised for example in Algeria is not usually related to cultivation, as there is not the same need for the storage of winter food that there is with altitudinal or alpine transhumance.

Altitudinal, or alpine, transhumance is the form of seasonal migration of domestic animals used in the alpine regions of Europe, from the Pyrenees through the Swiss and Austrian Alps to the Tatras of Czechoslovakia. It was practised in various forms in Ireland, England, Wales and Scotland, and existed until quite recently in the Island of Lewis. It is still found in Norway and Sweden, but is rapidly dying out. (Edward 1942, Hayward 1948, Reinton 1955,1969).

Transhumance is practised in alpine regions, not because of the lack of grazings in the lowlands during the summer, but, rather, because the lowland regions have to be used to supply fodder for the winter months and therefore to be free from grazing in the summer. During the winter, either because of snow or other severe weather conditions, the animals have to be housed and fed, or at least kept on low pastures and given some additional fodder. As the low ground has to be used for the cultivation of winter feed,

the animals are moved to higher ground following the melting of the snow and improvement of weather conditions in the spring. The animals will remain in the hills until late summer and early autumn when they are moved back to the low ground for the winter. The movement involved is usually a change in altitude, and not a long distance change in latitude, as in the mediterranean form of horizontal transhumance found in other parts of Europe.

The pastoralist has to identify the limiting aspect of the system. In the case of altitudinal transhumance, this is winter keep, and he has to move the animals in such a way as to husband this, his scarcest resource.

The terms 'migration', 'nomadism' and 'transhumance' have been discussed with reference to the definitions in the literature, and now distinct types of pastoralism are looked at in the context of the patterns of migration of wild grazing animals. The systems of pastoralism discussed are the land-use patterns of the reindeer Lapps of northern Europe and Asia, which are examples based on semi-wild animals operating in extreme environments. The mixed pastoral and cultivation economies of cattle herders in Africa show varying degrees of dependence on animals and cereals and these economies perhaps have many similarities to the subsistence economy of the Scottish Highlands before 1800.

Horizontal and altitudinal transhumance systems as found in Europe, north Africa and Asia are then discussed. The Scottish shieling system has often been described as being a transhumance system of an altitudinal or alpine form, but, although there were

similarities between the shieling system and the patterns of transhumance practised in the Alps, the Scottish system was unique in terms of the period in which it operated and the environment in which it was practised.

It should be borne in mind, when reading the following descriptions of types of subsistence pastoralism, that external pressures of industrial society and large increases in human population are rapidly bringing about the breakdown of all forms of subsistence economy. Therefore, many of the systems cited are in a state of recession or have already been abandoned.

In the discussion of transhumance in England, Wales and Ireland, details of the particular animal management practised have been omitted because the changes in land use that have occurred are considered to be more important. The shielding transhumance system of animal management found in England, Wales and Ireland was very similar to the system used in Scotland.

MIGRATION OF WILD GRAZING ANIMALS

The patterns of migratory behaviour developed by man and his domestic herds in pastoral systems are remarkably similar to those developed by wild animals in the same environments.

An example of a nomadic pattern of migratory behaviour can be found in the steppes of Europe and Asia; a continental semi-desert environment where the precipitation is extremely variable and gives rise to a very complex vegetation. The saiga, Saiga tatarica, a small sheep-like herd animal, with long slender legs and a distended muzzle overhanging its mouth like a soft, mobile proboscis,

(Bannikov et al. 1961), is the most common ungulate found in these regions. It plays an important role as a meat-producing animal in the local economy of some of the northern steppes of the Soviet Union.

As the environmental changes in that region do not occur at regular intervals, the saiga has not developed fixed patterns of seasonal movement and is therefore permanently nomadic. There are, however, great differences in the general character of distribution and in the size of the saiga herds between summer and winter, although there is little consistency in the timing and direction of the movements that brings about the dispersion. The range of the saiga has to be sufficiently large to allow the animals to move in response to the fluctuating conditions of this very difficult environment.

The pattern of movement shown by the saiga, and this method of extensive range utilisation, can be compared to the system of land-use developed by the cattle herding tribes of Africa. These tribes utilise very arid habitats by grazing herds of cattle, sheep, goats and camels in a system of semi- or complete nomadism.

The barren-ground caribou, Rangifer rangifer, of northern Canada, on the other hand, can be thought of as being a more definitively migratory species than the saiga. They show a pattern of bi-annual movement, which is directional and purposeful, taking place between distinct summer and winter ranges. The migratory period, that is the time the animals spend actually on the move, occupies three to four months of the year. During this time the herds may contain several thousand animals. For the remainder of the year, the animals move around in smaller groups of a few

hundred, in a nomadic fashion, in response to small-scale variations in food availability or in response to such things as fly harrassment (Kelsall 1968). The winter is spent on the taiga, the northern boreal coniferous forests. These coniferous forests are dense in the south but open out in the north as a transition zone, or forest/tundra ecotone, before the true northern tundra begins. During the short summer season, when most of the snow has melted in the tundra region, there is a wide variety of vegetation types available to the caribou; although the tundra is 60% water, there are areas where organic debris has been able to build up, allowing sedges, grasses, dwarf shrubs, such as willows, and a variety of herbaceous plants to grow, offering a highly nutritious diet for the caribou. The range of the barren-ground caribou consists, therefore, of a wintering area in the northern parts of the boreal coniferous forest and a summer grazing ground in the tundra.

In the spring there is a very rapid migration up to the calving grounds on the tundra. Many theories have been put forward to explain this migratory movement and the factors that initiate it. Among the most important factors are the need to shift to the new food resources that are becoming available further north on the tundra as the snow melts, and also the need to escape from the summer heat and fly harrassment of the wooded taiga zone (Kelsall 1968). But little is known about the factors that actually initiate the spring migration. The position of the sun on the horizon, the suitability of the snow for travelling and the condition of the gonads have been suggested. It is probably a combination of both physiological and environmental factors.

After the calves are born in June, the caribou are gregarious

for a period, grazing in the most northernly part of their range. By late July and early August they have started to move back to the taiga, utilising the southern part of the summer range. The autumn migration is less rapid than the spring migration and is in response to deteriorating weather conditions and the decline in the quality of the vegetation[1].

The pattern of movement of the caribou is a form of horizontal transhumance with seasonal nomadism superimposed, and forms a pattern possible in regions with distinct seasonal changes. The seasonal migration of the caribou is sufficiently regular to allow tribes of Eskimo hunters to be dependent on these animals. Eskimos follow the herds and slaughter animals for food, clothing and tools[2].

It is interesting to look at a species that is migratory in one type of environment but is sedentary where the environment is more productive and stable. One such species is the wildebeest Connochaetes taurines of the Western Masailand in East Africa. Talbot and Talbot (1963) found that the annual pattern of movement of the wildebeest was primarily determined by the availability of food and water; the herds of wildebeest spend the wet season on open grasslands and the dry season in bush country, where shrub vegetation is available. The movement of these animals is determined by the rainfall and fires, both of which affect the distribution of grass and surface water. The distance that the wildebeest have to move is determined solely by necessity. In areas where food and water are available throughout the year, movement is minimal. In the

1. See discussion of nutritional quality of mountain vegetation in Chapter 2, page 87
2. The ecology of the reindeer Lapps of Northern Europe and Asia is comparable; page 24

Ngorongoro Crater of East Africa, where there are fertile soils and adequate water supplies throughout the year, the wildebeest is non-migratory. This shows, in effect, that migration only occurs in areas where it is necessary and that, if the animal finds itself in an optimal habitat, it ceases to migrate.

Altitudinal transhumance patterns are shown for example by the elk Cervus canadensis nelsoni, of North America, the big-horned sheep Ovis canadenis of the american Rocky Mountains and the red deer Cervus elaphus of Scotland. Craighead et al. (1972) studied the elk herds that summer in Yellowstone National Park in the United States. The summer range of the elk lies between 2,100 - 3,000 metres, that is, in the low and middle alpine zones[1], above the coniferous woodlands. During June and July the elk graze on the alpine meadows, and in August they descend to the timber zone. They winter in the low ground along the valleys of the Yellowstone and Lamer rivers. The movement up to the summer pastures occurs in April and May, following the snow melt, and it has been shown, by marking individual animals, that they return to the same summer and winter areas year after year. Bighorn sheep in the Rocky Mountains have the same seasonal pattern of movement (Buechner 1960).

Red deer in Scotland also show altitudinal movement patterns by moving up to higher pastures in summer, but, when weather conditions deteriorate, they move down again temporarily to the lower ground until the weather improves. These variations in distribution continue throughout the year, superimposed on the seasonal altitudinal movements.

1. The zonation of mountain vegetation is discussed with reference to Norway in Chapter 2, page 59

High-quality pastures are essential for all these species in the summer, to enable them to make up for the severe nutritional deficiencies of winter when their diet is barely sufficient for maintenance.

The types of movement shown by these species are similar to those shown by domestic animals managed under a system of altitudinal transhumance in northern Europe, where winter is a period of severe food shortage.

REINDEER NOMADISM

Reindeer nomadism is a form of pastoralism based on semi-wild animals which occurs throughout the arctic and sub-arctic regions of northern Europe and Asia. The reindeer Rangifer rangifer which are native to the region, are adapted to the very severe conditions found at northerly latitudes.

The degree of domestication of these animals is low, and the herders have evolved a migratory pastoralism without greatly affecting their grazing and reproductive ecology. The semi-domestic reindeer herds of the Chukchi of Siberia intermingle and breed with the wild populations in this area (Leeds 1965), which illustrates the low degree of domestication. The level of management varies throughout Eurasia, but can in effect be divided into two forms, extensive and intensive herding (Pehrson 1957). The extensive form found, for example, in the northern Lapp regions of Scandinavia, involves large numbers of comparatively wild reindeer, which are herded in the winter but not in the summer. The economy of these extensive herding communities is based on meat

and hide production and is geared to an external market. The cows are milked only in late summer and in early autumn, and the milk is used only for limited domestic purposes. Apart from the few animals that are trained to pull sledges, direct contact between man and animal is minimal.

The systems of intensive reindeer management, which were until recently, common in the south-central regions of Lappland, have a higher degree of internal self-sufficiency, as they are subsistence economies. The herds are small and the animals comparatively tame as they come into greater contact with man than those in extensively managed herds. The Lapps, under this system, are dependent solely on the reindeer for food, clothing and tools. Milk is the major item of diet and the cows are milked through lactation. Because of external pressures, the Lapp herders are having to change to a market-orientated economy and this subsistence form of pastoralism is dying out.

These two systems in northern Scandinavia are similar in many respects as they have to operate within the same ecological constraints imposed by arctic and sub-arctic. The winter is very long and snow lies for approximately 200 days. The growing season is further limited by low temperatures and light intensities to around 110 days (Steen 1968). The actual length of the growing season varies with the specific site characteristics and with latitude, but, throughout the reindeer herding area of northern Europe and Asia, it is very short. The semi-domesticated reindeer has a vast grazing area at its disposal, (in Scandinavia 2.4 reindeer per kilometre square (Steen 1968)) because of the great seasonal variation in the availability of pasture there has to be a definitive seasonal

pattern of utilisation.

The reindeer has adapted to the very short growing season and long winter by developing a cyclic pattern of metabolism. During the summer and early autumn the animals are able to meet their nutritional requirements by selecting a diet that provides the energy, protein and nutrients needed for growth. Their diet in winter consists mainly of lichens (Steen 1968) which are very low in protein and minerals but high in carbohydrates and of high digestibility. During a good winter when lichens are readily available, the reindeer may put on fat but will lose considerable muscle tissue as they are in a negative nitrogen balance (Steen 1968). Weight loss may be more than 10 kg. per animal. In a very bad winter with snow falls of more than a metre or when the snow forms layers of ice after periods of alternating thawing and freezing, the reindeer are unable to dig craters to reach the lichen. The end of the winter can be extremely critical, and there can be high mortality. The reindeer need adequate lichen supplies in winter to prevent excessive weight loss and must be able to move to areas where they can meet their requirements for growth and reproduction.

Lappland can be divided into three distinct ecological zones of reindeer habitat:-

1. The Norwegian Mountain Zone from 1300-2080 metres, with montane grasslands.
2. The Swedish/Norwegian Low Mountain Zone from 500-825 metres, with mixed lichen and grass pastures within the birch woodlands.

3. The Swedish Low Hill Zone with pine woodland and lichen pastures (Pehrson 1957).

The seasonal migration routes of the Swedish Mountain Lapps cut across these three zones at right angles on a south east/north west axis. The Lapps spend the winter in permanent settlements in the south east woodland region of Zone 3. In late spring the herds migrate to the calving grounds in Zone 2 and soon after calving move up to the high mountain pastures in Zone 1, where they remain for the summer. The Lapps live in temporary camps during the summer at the end of which, as conditions deteriorate, the herds move south eastwards towards the wintering grounds in the coniferous woodlands of Zone 3.

The whole of the yearly life pattern of the Lapps revolves round the annual cycle of the reindeer. Conditions are inconstant and show much seasonal variation. The Lapps therefore have to be 'ready to shift techniques and approaches in response to the changing problems of a variable and difficult environment' (Pehrson 1957).

In winter, the animals are relatively inactive; a high degree of herding is then possible and the Lapps can move the herds from one area to another in search of lichen. The availability of lichen in winter varies within an area with the snow conditions. This, in some respects, acts as an insurance against overgrazing as it ensures rotational use. Lichen are very slow growing and may take years to recover from over-grazing and damage by trampling. Towards the end of the winter at the end of April the hard crusted snow makes lichen resources unavailable for long periods which means the time just before the spring migration to the calving grounds may be extremely critical. The start of the spring migration is partly determined

by the condition of the snow crust. Migration can only take place while the snow can support the weight of the herds, it cannot be delayed too long as the cows will be near to calving and food will be short. The Lapps have little control over the animals at the time when they move off fast to the calving grounds.

During the summer there is abundant grazing in the mountains. The mountain vegetation is resistant to over-grazing as it has a short growth cycle and can recover quickly; herding intensity is not high except while the calves are being marked. The herd is disturbed as little as possible in summer. The Lapps spend the time during the summer protecting the herds from predators, such as wolves, that attack the young and the weak animals.

The herds undertake the long spring migration of 200 km., not only because of the abundance of summer grazings, but also to escape insects, such as mosquitoes and gadflies that cause them serious disturbance. Although harassment is not as great in cool mountain regions as it would be in the wintering areas, it can still greatly reduce the total grazing time of the reindeer (Steen 1968). Steen states that insects may, perhaps, be the most important factor in reducing the time spent grazing by the reindeer. Insects are most active in July and early August, especially in warm summers, and may have a significant effect on the build up of fat reserves by the reindeer during the summer. Lapps say that the reindeer are in better condition after the cold summer than after a warm one.

Human contact is kept to a minimum during the summer, partly because it is unnecessary and partly, perhaps, because the Lapps realise that the animals have to spend time grazing in order to built up food reserves. The greatest contact with humans comes at

the end of the summer when the Lapps round up the big communal herds in order to separate them into the smaller individually owned herds. The autumn slaughter takes place near winter villages to facilitate meat processing and marketing. The animals will be in good condition at the end of the summer and the hides will still be undamaged by unhatched warbles.

The domestic reindeer herds remain very similar to the wild herds, although slaughter may alter the age structure of the herd, and the gelding of some young males will alter the sex ratio. By herding, man increased the concentration of animals in an area and this may lead to localised over-grazing problems, but unless external pressures force a large increase in human population and necessitate a subsequent increase in herd size, the flexible systems of management practised by the Lapps can minimize the risks of over-grazing.

The question of the minimum number of reindeer needed to support a reindeer herding family is discussed by Leeds (1965) with reference to the Chukchi reindeer herders of Siberia. The reindeer herd has to be made up of breeding females, stud males, gelded animals for pack and sledge work, animals reared for slaughter, and young animals for replacement. Leeds (1965) sets the minimum number of reindeer needed by a Chukchi family at between 70 - 100 animals. This herd would have to include 50 breeding females, 7 breeding males, 8 geldings to pull sledges and 35 fawns. In Siberia there are still herds of wild reindeer, unlike Lappland where all the reindeer are semi-domestic. The Chukchi utilize these wild reindeer to supplement their food supplies and to act as herd replacements. Despite this intermixing, herding has to be intensive because of the danger from

predators and the danger of loosing tame reindeer to the wild herds. The presence of wild herds means that the minimum number of animals needed by the Chukchi in their domestic herds is lower than that needed by the intensive reindeer herding communities of Lappland.

The Chukchi have found that it is difficult to manage herds of over 3,000 - 5,000 animals because herds of this size are less mobile and exert too heavy grazing pressure. The Chukchi have also found that with very large herds disease is more common among the reindeer and that insects become a greater problem. Therefore, when a herd gets too large, one or two of the family groups will split off and start a new herd.

> 'A herd of optimal size and composition is one whose reproductive capacity remains virtually unaffected by the slaughter of animals within it for food, but at the same time does not, under various kinds of circumstances, exert undue pressure on the herd's food supply'.
>
> (Leeds 1965, p.102-103).

The optimal herd size fluctuates within certain parameters, with seasonal, annual and environmental variations as well as social and economic factors. However, the ultimate control of herd size is the carrying capacity of the environment at the most difficult time of the year. The environmental constraints within which this system work are so rigid that the reindeer herders can have very little control in maintaining a balance between the available food and the animal numbers. They have modified the life pattern of the reindeer to some extent, but, if the flexibility inherent in the herders system of animal management is lost, through the desire for larger commercial herds, the system will break down, unless ways can be developed to override the environmental constraints.

Pastoralism, dependence on flocks and herds, survives in East Africa, in regions where crop cultivation cannot be relied on and also in the sparsely populated savannah regions of West Africa (Allan 1965). In these semi-arid savannah zones of East and West Africa there are still a large number of cattle herding tribes, for example the Fulani group of Nigeria (Stenning 1959), the Masai and the Karamajong group (Dyson-Hudson 1969) which includes the Dodos (Deshler 1965), the Jie and Turkana (Gulliver 1955), and the Karimojong of East Africa. These pastoral tribes vary in their degree of dependence on herds of cattle and on flocks of sheep, goats and camels. In regions such as the tribal lands of the Jie, Dodos and Karimojong in north-east Uganda, there is sufficient rainfall in parts to allow the tribes to grow crops. But further east, in north-west Kenya, the Turkana, also of the Karamajong group, have to be completely dependent on flocks and herds as the rainfall is very low in their tribal area.

Gulliver (1955) made a very interesting comparative study of the tribes in the Karamajong group showing that the Jie, the Dodos and the Karimojong have mixed economies of cultivation and pastoralism, while the Turkana are purely nomadic herders. In the Scottish Highlands prior to 1800 there must have been similar regional variations in the degree of dependence on animals.

The tribal lands of the Jie, Dodos and Karimojong in north-east Uganda lie in a region of undulating plains of an average altitude of 1200 metres dipping towards the Kioga-Nile basin in the west and south-west. Rainfall is unpredictable and varies in annual

amount, but there is usually a wet season from March to September with a peak of rainfall in May. Although there is an average of a little over 60 cms of rain a year, the average annual rainfall figure is not a very useful guide as the actual amount is so irregular. During the dry season, which lasts from September to March, there is insufficient moisture for plant growth.

The rainfall distribution is uneven and is generally higher in the west. There is permanent water in the central area where some cereals can be grown under a system of shifting cultivation. The Dodos, for example, clear two areas near their central semi-permanent settlements which they cultivate on a two to three year rotation. The crop yield in bad years may provide food for only four to seven months and even then may supply only part of the tribe. The tribes supplement their diets by gathering foods that range from termites to wild onions.

The tribes have to have large herds of animals to supply them with milk, blood and meat to make up the rest of their diet. They have developed a system of migration to enable them to utilise the seasonally available pastures across the tribal lands. In the dry season, the herds are kept near to the permanent water holes in the centre of their area and when the rains come in March the herders move out to where grasses have started to grow, which rapidly reaches two to three metres in height. However, by mid-June the grasses have begun to dry out and become less palatable. The animals are then moved eastwards to where surface water and young pasture are available. At the end of the wet season, the temporary water supplies dry up in the eastern region, and the animals are moved back to the west to graze on the tall dry grasses. When

water again becomes scarce in the west, the herds are moved back to the central area.

Formerly, there used to be a large scale movement of the whole population but it is now government policy to settle the population. As a result of this, women, children and old men remain in the central villages and grow crops, while the young men take part in the seasonal migration. When they are away from the permanent villages, the men have to survive on milk, blood and occasional meat. The women, children and old men live mainly on a cereal diet which they supplement when possible with animal products.

The Turkana, on the other hand, have to be completely dependent on animals. Their tribal area is in the very arid region of north-west Kenya within the eastern branch of the Rift Valley. This area is a plateau of 375 metres to 900 metres altitude, with mountains of 2,100 metres rising from it. The temperature is high throughout the year at between 20 and 35°C, with little diurnal variation. Rainfall is unpredictable, as low as 15 cms in the east central desert region and rising to 64 cms in the mountain areas at over 1,200 metres. The rainfall differences are reflected in the vegetation distribution in the area. The ground cover is only intermittent on the plains even in the better areas. Acacia bush scrub predominates in the west and in the centre, while in the east there are districtsof rock and sand desert. In the wetter areas along river valleys and in the mountains there are trees and at times dense grass cover and above 2,100 metres in the humid montane zone, there are permanent grasslands.

Cultivation is impossible in these tribal lands of the Turkana so the tribe has to be dependent on mixed herds of cattle, sheep,

goats and camels. These are managed according to the dietary requirements and capabilities of each species. The cattle, being grazing animals, spend the wet seasons in the low foot-hills and along the water courses, grazing on temporary pastures, and the dry seasons on the permanent grassland of the high mountain zone. The camels and goats, being browsing animals, and the sheep being both grazers and browsers, are not managed in the same altitudinal transhumatic way. Instead, they range widely all over the poorer area in a nomadic fashion during the wet season, and then are herded on the best region of the foot-hills in the dry season.

The Turkana have no fixed settlements although many of them may remain for several months in one place in the mountains herding the cattle. Family groups are split up, as part take care of the cattle and part the sheep, goats and camels. It is impossible to express simply the annual pattern of animal movement of the Turkana.

> 'The irregular distribution and effectiveness of the rainfall, the complex distribution of plains and mountains and the dietary needs of the different types of stock cannot be reduced to a simple formula'.
> (Gulliver 1955, p.31).

Because of these factors the Turkana have to have a flexible system of animal management. The different types of animals enable them to utilise both browse and pasture.

The annual movement of the cattle is of an altitudinal transhumance form, whereas the sheep, goat and camel movements are seasonally nomadic. However, nomadic movement is by no means random even within a season, for although each herder has the right

to graze his animals where he wishes within the tribal area, his individual knowledge of the region and his interpretation of the situation govern his decisions as to direction and distance. Each man develops special knowledge of one area and has an approximate annual movement pattern which he modifies to suit the particular seasonal conditions. To be successful the herder must have skill and experience in judging when and where to move his animals. Sometimes, if conditions become too severe, he cannot avoid disaster, and a drought can be very serious if it lasts for long.

Although the Turkana are the only truly nomadic tribe among the four discussed, many of the problems faced by these tribes are similar. Man has a basic calorific requirement that has to be met each day, the actual figure depending on the environment, the work load of the individual and sex, age and condition. Brown (1971) in a paper on the biology of pastoral man, calculated that an average family of 6.5 adult equivalents in central Africa had a daily calorific requirement of 14,950 cals., (i.e. about 2,300 cals. per person).

The Karamajong tribes lack technical knowledge of meat storage, except of how to dry it, and therefore they use the products of the live animals, that is milk and blood, for food. Milk is either drunk immediately or turned into ghee, a form of clarified butter. Animals are bled regularly throughout the wet season. One or two pints of blood are taken from the jugular vein of cattle and a small incision is made above the eye in the small stock, the sheep and goats. Cattle are only slaughtered for ceremonial occasions when a large amount of meat will be eaten. Sheep and goats are killed when only a small amount of meat is required. Dying animals are

often slaughtered and even carrion is sometimes eaten.

Brown (1971) continuing in his calculation of the basic minimum herd size, estimates that a daily diet of 16 litres of milk and 2.41 Kg. of meat is required by a family of 6.5 adult equivalents. In order to get 16 litres of milk daily throughout the year, the family needs a herd of 14 milking cows. Deshler (1965) in his study of the Dodos, described the lactation cycles of the Dodos' East African zuba cattle as being 330 days long, with milk production of two pints (1.14 litres) a day in the wet season, falling to a $\frac{1}{2}$ pint (0.281 litres) in the dry season. With such low milk production a herd of 14 cows would only be able to supply 16 litres per day for a family during the wet season. However, Brown goes on to develop his ideas on the calculation of a basic herd in the following way: to maintain a herd of 14 milk cows there have to be a number of heifers for replacement and also a couple of bulls for breeding. The animals are under severe nutritional stress in the dry season and a mature beast of 650 lbs. may lose up to a 100 lbs. in weight. This severe stress delays maturity; Deshler (1965) quotes maturity being reached at 5 or 6 years and Dyson-Hudson (1969) at 3-4$\frac{1}{2}$ years. This delay in maturity will increase the number of age classes needed for replacement. Brown (1971) concludes that a family must maintain a herd of 30-40 head of cattle for survival.

HORIZONTAL TRANSHUMANCE IN EUROPE AND SOUTH ASIA

The migrations of the semi-nomadic pastoralists of the steppe lands of north Africa and south east Asia resemble the horizontal form of transhumance found in Spain, Italy, the Balkans and parts of France. The regions in which horizontal transhumance is found are

characterised by very hot dry summers and cold winters. Often the domestic animals have to be moved several hundred kilometres from the lowland winter pastures to the high summer pastures. The flocks and herds consist mainly of sheep and goats as it is not easy to take lactating dairy cows on long treks. The problem of handling large qualities of milk while the herds are moving could be very great. In Mediterranean regions oil is usually obtained from olives and not in the form of butter as it is in alpine areas.

In the case of many of the Asiatic and north African pastoral tribes the whole population is on the move throughout the year, whereas with European transhumance it is more usual for only a small part of the population to move with the herds. There are exceptions, the Vlachs of the Pindus Mountains have fixed settlements in the mountains, which they consider to be their true homes, but the whole population moves to their winter quarters in the Plains of Thessalica and Macedonia in the autumn (Wace and Thompson 1914).

Cultivation is not an essential part of horizontal transhumance, as it is not necessary to provide the animals with winter food which is usually available in the lowland areas. Therefore, although part of the population may be involved in growing crops and thus affect the total economy of the community, cultivation is not a part of horizontal transhumance.

The semi-nomadic pastoral tribes of South Persia have developed a transhumance system as they have no fixed settlements or cultivation areas, but have a permanent annual cycle in movement with fixed routes.

There are several million of these semi-nomadic pastoralists in Persia today; the exact figure is difficult to estimate because of

the problems of censusing a moving population (Cressey 1960). These semi-nomadic tribes have some fourteen million head of sheep, seven million goats and lesser numbers of cattle, oxen, camels, horses and donkeys. Random counts made during the migration period suggest that there are in the order of fifty animals per person (Cressey 1960). The sheep and goats are kept for milk, meat and skins, and the camels, donkeys and horses for transport.

The Basseri tribe of the Klamseh confederacy of south Persia (Barth 1961) is an example of one of the tent dwelling tribes of South Persia. They keep large herds of goats and sheep with a few donkeys and camels for transport. They use an area 480 kilometres long and 32-48 kilometres wide running north/south from the mountains of Kul-i-Bul to the coastal hills to the west of Lars. This is a continuous strip called an "il-rah", each part of which is used at regular seasonal intervals. The tribe lays claim to an il-rah and has the right to water, to pass along roads and over uncultivated land. The tribal il-rah may be used by other tribes at different times of the year.

The summer pastures of the Basseri tribe are at 3,963 metres. The annual precipitation is low, 25.4 cms, but, as it falls as snow, the run-off is reduced and there are permanent grasslands and some trees in the mountains. In the south, in the wintering areas, precipitation is at the same low level, but, because it falls as rain, and because run-off is very high, the vegetation is desert shrub with some grass in spring. During the five months when the high pastures are snow covered, the herds are down in the coastal regions, where there are only mild frosts. As spring comes, they start to move northwards to get to new pastures and to escape the

increasing heat.

'Ahead of it are pastures of certain kinds slowly coming into maturity, behind them the pastures are being burned by sun and drought or frozen by advancing winter'.
(Barth 1959, p. 7).

'The pattern of succession in any one locality is adapted to the seasonal changes in the carrying capacity of that locality, so as to maintain balance between the utilization and the rate of production between load and capacity'.
(Barth 1959, p. 5-6).

The Basseri milk their sheep and goats every day. Because of the problems of storing fresh milk, they have developed techniques for processing the milk, so that it can be stored and transported. Cheese is made by mixing the milk of the sheep and goats just after milking, heating the mixture to just above body temperature and adding a spoonful of sour milk or stomach extract of a lamb to curdle it. The best quality cheeses are made while the herds are in the mountains. The women, who move with the sheep and goats in order to clip and save the wool, do the milking and make cheese and ghee (Lamb 1946).

The ewes and lambs are kept in separate herds to prevent the lambs from taking milk. When it is not possible to separate them a small stick is placed through the lamb's mouth which presses down the lamb's tongue and prevents it from suckling. Lambing is arranged to correspond with the beginning of spring. Therefore tribes wintering further north, at middle altitudes, separate the

ewes and rams in August and September to prevent early lambing before conditions are suitable. This is also the practice with hill and low ground flocks in Scotland.

Meat is eaten fresh and the wool and hides are sold to enable the tribes to get products, such as flour and sugar, which they cannot produce themselves.

During the winter, when pasture is scarce, the tribe is widely distributed over the wintering area, in groups of two to five family tents, three to four kilometres apart. In summer, they camp in bigger groups of ten to forty tents. A family needs sixty animals for subsistance but a hundred provide for a margin of safety (Barth 1961). There are sixteen thousand members of the Basseri tribe in about three thousand tenting or family units. That means that they need in the order of three hundred thousand animals, which gives a concentration of about one animal per 4.8 hectares over the whole area. The animals are in fact at much higher densities for most of the year and can be assumed therefore to exert a considerable pressure on the pasture.

In Europe the traditional pattern of horizontal transhumance is found in the sheep rearing system practised in the Appennines of Italy. Large sheep flocks, kept mainly for meat and wool, are taken to the mountain grasslands of the Abruzzi in the Appennines in summer. In winter they graze on the low land marshes of the Campagna around Rome. Much of these low land marshes have been drained for agriculture, and the increase in cultivation has intensified the conflict that has existed for a long time between the pastoralists and the cultivators. Although the cultivators benefit from the animal manure, the damage from trampling and

grazing may be very great.

Only a portion of the male population makes these seasonal migrations; the women and children live in permanent villages in the foot hills of the Appennines, in the region between the mountain pastures and the low ground agricultural land. This form of transhumance is rapidly dying out in Italy (Evans 1940).

The Vlachs of the Pindus Mountains in the Balkan Peninsula have their permanent villages in the mountains and consider their villages on the Plains of Thessalica, which they use in the winter, as temporary. They move back to the mountains at the first opportunity in the spring. The shepherds are the first to arrive in the permanent villages in the spring and the last to leave in the autumn, the rest spend a shorter time in the mountains. This system is fairly similar to that of the Basseri of South Persia, but the time spent actually moving from the Plains of Thessalica and the Pindus Mountains is minimised by the non-pastoral part of the population (Wace and Thompson 1914).

The environmental conditions and the history of the Spanish Peninsula favoured extensive pastoralism and discouraged the development of cultivation. By the fourteenth century the shepherds had formed a powerful association, the Mesta, which fought to protect their rights. Early on fixed routes across Spain were developed for the migrating herds. These lay between cultivated ground, but at times went across fallow ground benefiting the cultivators (Klein 1920).

It is estimated that nearly three million head of livestock were involved in these seasonal migrations during the fifteenth century, but now only a proportion of that figure is involved.

The flocks of goats and sheep wintered in Andûlusia or the mediterranean coastal lowgrounds and spent the summer in the mountain areas of north Spain such Leon and Soria. The flocks left the winter pastures in the middle of April and arrived on the summer pastures in the northern uplands by May and early June. The sheep owners employed shepherds to take care of their sheep, a few shepherds being in charge of very large flocks. The lambs were born in the spring and sold after the summer; in the autumn, in the towns on route to the wintering grounds; wool was also sold at these towns during the spring migrations.

The unenclosed strips linking the summer and winter pastures were traditional sheep walks that were reserved for pasture for the flocks passing over the area in spring and autumn. This central plateau of Spain gets rain at these times and there is adequate grass for the few weeks the animals move through. There was great hostility between the herders and cultivators, but this has lessened during this century as rail transport has cut down the need to move the animals on foot. The flocks travelled fairly quickly through cultivated ground, covering between 25-29 kilometres a day, but over open or fallow ground the pace would be slower, 6-10 kilometres, to enable the animals to benefit from the temporary pastures.

The same sort of long distance horizontal transhumance is found in Mediterranean France. The sheep of the deltic lowlands of Crau and Camarque, summer at above 1,500 metres in the Alps of Dauphiny and Savoy. As in Spain there is an elaborate system of migration routes linking the lowlands of Provence with the mountain pastures, utilising the ridges between cultivated valleys.

The main products of systems of horizontal transhumance as

found in Europe are meat and wool. This is because cheese and butter production involves considerable work of a type that is traditionally done by women. This is not wholely the case as men are involved in dairy activities in the Balkans; however, when there are only a few shepherds to look after the sheep and goats and the distances travelled are great, the animals are not usually milked.

The life of transhumant societies in the Mediterranean countries does not have the same solidarity as the alpine transhumant societies or the semi-nomadic tribes of Asia and Africa, because herding is often carried out under a commercial agreement between the sheep and goat owners and the shepherds. Also the summer and winter pastures are only rented by the sheep owners.

ALTITUDINAL TRANSHUMANCE IN THE SWISS ALPS

Altitudinal transhumance systems were widespread throughout the mountain districts of Europe and many aspects of the economy of these pastoral communities were similar. In most examples of altitudinal transhumance the movement of the domestic animals is a simple upward movement in spring followed by a downward movement in autumn. The human movement may be considerably more complex as altitudinal transhumance is usually practised by settled agriculturalists who depend partly on their herds and partly on cultivation. Crop cultivation has to be fitted into the annual cycle of animal management. Altitudinal transhumance involves an understanding of the interdependence of low and high ground; there has to be sufficient high ground to provide summer pastures for the size of herd that can be supported on the low ground in winter. Often the

division of farms in mountain areas was designed to include both low and mountain pastures, the high ground often being owned in common. This was the system used in Ireland (Graham 1954) as well as in Scotland, Norway and in the Swiss valleys. Systems for regulating animal numbers were also common and were related to the amount of pasture available. In Scotland, the quota of animals allowed was termed the souming, which involved a system of standard stock units, or soums[1], similar systems operated throughout the British Isles.

Altitudinal transhumance, involving a large-scale movement of people as well as animals, is rapidly dying out. The labour inputs in altitudinal transhumance systems have to be high as a great deal of work is needed for butter and cheese production; the level of management of the animals has also to be high to ensure that maximum use is made of the food resources. Also it is hard to operate a modern commercial dairy concern in mountain districts because of transport costs. Therefore, unless roads or rails can be built into the area, dairy-based pastoralism will die out. This in many ways is regrettable as the quality of mountain pastures in summer is often high and of more value in some instances than the low ground pasture[2].

In many of the Swiss valleys altitudinal transhumance was the most appropriate system of pastoralism, for example in Val d'Annivers. Val d'Annivers is a steep wooded valley running south from the Rhone. There is very little flat land that is suitable for cultivation, and

1. A discussion of soums and souming with reference to Highland Scotland is given in Chapter 4, page 182 .
2. A discussion of the nutritional value of mountain vegetation is given in Chapter 2, page 87 .

the steep gorges at Lower Nacisance at the foot of the valley, have hindered the development of a system of horizontal transhumance using the Rhone valley as wintering ground.

Fertile pockets along streams, often at high altitudes, are used for hay production. Winter fodder for the animals is considered more important than crop production. These hay meadows have to be managed intensively to get maximum yield. The meadows are fertilised and irrigated using techniques developed in the area in the twelfth century (Dumont 1957). Once the hay has been cut and dried, it is stored in small barns on the meadow; these also serve as byres for the animals in winter. There is a high concentration of small barn byres near the villages. The animals spend two to three weeks in each byre in winter when the valley is snow covered. The system of moving the animals through the snow from one grazing area or hay meadow to the next was also found in Gudbrandsdalen in Norway.

At the end of June, the cows and goats will be sent up to the alpine pastures above the tree line, in the care of employed herders. The farmers have an association, similar to one they have to organise their irrigation system, to control the summer herding of the cows and goats. Before the animals go up to the alpine pasture in July, the farmers will go up to repair the chalets for the herders; they will also repair the paths and remove stones from the grazing around the chalets. Each group of farmers has a series of chalets at different altitudes, ranging from 1,800-2,000 metres.

At the very high chalets, far above the tree line, there is little fuel available for cheese making. Therefore, at the

beginning of summer, several loads of timber are taken up by mule; throughout the summer one of the herders will return to the middle or low chalet each day with the newly made cheeses, and return with a load of fuel. Because of the scarcity of fuel at the high chalets, the type of cheese made is one that does not require long periods of heating.

The milk yield gradually falls off through the summer. During the time the cows are in the alpine zone the yield falls from around 4.5 litres per cow per day to 2.25 litres per cow per day (Dumont 1957). The quality of the milk produced in the mountains is very high; 1 kilo of cheese is made from about 8.5 litres of milk[1]. Careful account is kept of the milk yield of each cow throughout the summer, so that the herders can calculate how much cheese belongs to each farmer. The heifers are also taken to the alpine pastures in summer, where they graze on remote ridges. The weight gained is about 30 kilos.

As the weather conditions deteriorate and the mountain vegetation matures and dries out, the animals are gradually moved down to the spring-autumn chalets or mayens, where they are allowed to graze on the hay meadows and in the areas around the villages. Once the snow comes, at the end of November, the animals are taken inside for the winter.

1. This compares well with the Norwegian and Scottish yields discussed in Chapter 3, page 111 and in Chapter 4, page 176.

In the mountain and hill country of the British Isles transhumance and the use of shieling pastures (by herds and flocks accompanied by herders) in the summer was widespread until late in the seventeenth century. Gradually, with the rise in the human population and the need to intensify agriculture, many of the summer shieling areas were brought under cultivation and were converted to permanent farms. All that now remains to remind us that shieling transhumance was once widespread throughout upland Britain are the place names.

Pounds (1942) examined place names in Cornwall, these included 'Hendra', 'Gwavas', 'Hewas' and 'Kenhewas'; these names mean:- 'Hendra' - old settlement, 'Gwavas' - winter settlement, 'Hewas' - upland summer dwelling and 'Kenhewas' - autumn house. The name 'Laity' is also found, meaning milking place. These Cornish names are similar to the Welsh names 'Hendre', 'Pentre' and 'Hafod' (Richards 1959). Pounds concluded, from his examination of the distribution of these names in Cornwall and from a limited historical documentation, that the transhumance system practised in Cornwall, using the upland area of central Cornwall as summer pasture, was similar to that generally associated with the alpine regions of Europe.

In a recent report of the Royal Commission on Historical Monuments, Ramon (1970) described in detail the shiels and bastles (small fortified farm houses) in a part of Cumberland and north Westmorland. He cites evidence (rentals and lists of cattle raiders' booty) for the change over from solely summer use to per-

manent use as farms of many of the shiels during the seventeenth century. Ramon (1970) mentions the problems the commission had in distinguishing permanent settlements from earlier shieling ruins. The criterion used was the presence or absence of folds or arable enclosures. This may be a valid criteria to use in this instance, but it would not hold true in the Scottish situation. Animals were folded at night at the Scottish shielings as protection against predators and in order to separate the mothers and their young, and at some shielings crops were grown, which required protection from grazing animals.

Transhumance appears to have continued in Wales until a later date than in England where many of the shiel areas had been permanently settled by the late seventeenth century. In Wales, pastoral agriculture had been practised for many centuries, and, up until the great enclosure movement of the eighteenth century, a system of transhumance, based on cattle, sheep and goats, was widely used (Roberts 1959). Although there were a number of wealthy monasteries in the mountains of North and Central Wales in the middle ages owning large flocks of sheep, comparable to the situation in the Scottish Border counties (Franklin 1952), sheep did not begin to take over prime importance from cattle and goats in the pastoral economy of Wales until the late eighteenth century. Elfyn-Hughes (1973) has made a study of the status of sheep in the Welsh mountains of Caernarvonshire, and has looked at the changing ratio of sheep to cattle and goat numbers. The approximate ratio of sheep to cattle number at the middle of the sixteenth century was 2:1, but from then on, there was a sharp rise in the number of sheep and a decline in cattle numbers. By 1969 the ratio for all Wales was 64:1, but in

mountainous areas such as Snowdonia the ratio was 52:1 in 1969. Goats were important early on for tallow production as well as milk (Roberts 1959). When Pennant (Roberts 1959) toured through Wales in the 1770's he wrote that he saw large flocks of goats in Snowdonia. However, by 1800, there were few remaining herds of any size (Elfyn-Hughes 1973). Sayce (1956) has written a valuable comparative study of the use of summer pastures and describes transhumance in Wales as well as in other parts of Europe. He, too, points out the change from dairy based pastoralism to extensive sheep husbandry that took place in Wales at the end of the seventeenth century. Many of the shieling customs and techniques found in Wales appear to have been very similar to those found in Scotland.

Transhumance in Ireland has been studied in detail by Graham (1954) and, to a lesser extent, by Delargy (1939), Mogey (1947) and Aalen (1963, 1964).

The Irish word 'Buaile', meaning a cattlefold or milking place, has been anglicised to 'Booley', and the term 'booleying' has come to be the equivalent of the words 'shieling' or 'summering'. The word 'Booley' is present in many Irish place names, particularly in the more mountainous districts (Graham 1954). However, booleying, or transhumance, involving the movement of stock and people, died out in all but the mountainous regions early on. This occurred especially in areas suitable for crop cultivation or reclaimation. An important factor in this change must have been the increase in population, and the resultant pressure for more intensive use of the land. Delargy (1939) quotes a late example of the conversation of a shieling to a permanent home at the beginning of the twentieth century in Donegal. Transhumance survived in a modified form in

some parts of Ireland until the twentieth century, but

> 'changing conditions of farming and the total destruction of self sufficiency in rural communities has succeeded in making transhumance an historical aspect of Irish geography.' (Graham 1954, p. 79).

In Britain, one feature of the old system of transhumance remains and this is the practice of 'away wintering' stock. This modern relic of transhumance does not involve the movement of people to any extent; it just involves the movement of animals. It is normal practice for pregnant ewes and young sheep from highground farms to spend the winter on low grounds, for example sheep summered in the Cumberland mountains are wintered on the Solway marshes (Bainbridge 1940). Carlyle (1970) has made a detailed study of the inter-farm movement of livestock in Scotland and shows how widespread the practice of away wintering is. The animals used to be moved on foot but they are now transported by road or rail.

'Away wintering' not only has the advantage of enabling seasonally available pastures to be used, but it also helps to reduce the danger of diseases due to mineral deficiency or toxicity and the build up of parasites. Examples of 'away wintering' for these reasons are numerous. Adult sheep can be kept all the year round on the Romney Marshes of Kent, but the lambs are more susceptible to parasites, and therefore have to be 'away wintered' in the Kentish Highlands (Walton 1919). 'Away wintering' is also practised in the Welsh mountains. Sheep which graze the whole year round in the mountains of mid-Wales are prone to Braxy, a disease due to manganese deficiency; they are, therefore, wintered

on the coastal plain of Cardiganshire. There are many other examples of the seasonal use of pastures in Britain. However, with intensification of sheep feeding and management there is less incentive to face the problems of using remote hill pastures.

Many of the changes that have occurred in the use made of the mountain district of England, Wales and Ireland parallel those that have occurred in Scotland. As the population increased in Britain, there were increasing incentives to use some of the less productive areas for cultivation, and many former shieling areas came under cultivation from about the seventeenth or eighteenth centuries (Chambers and Mingay 1970). The development of the use of winter fodder crops, such as turnips, reduced the need to summer the animals away from the low ground farms. Furthermore, the change from a subsistence economy to one geared to a market, which came about with the development of urban centres, meant also that the structure of the dairy industry had to change. Milk had to be produced near to the centres of population and in much larger quantities than formerly, when the herd had merely to supply the needs of the farmer's family and workers.

When sheep production systems took over from the dairy systems that had been based on mixed herds of sheep, cattle and goats, less labour input was required. (One girl can manage not more than 20 cows. One man can run a group of 600 sheep). These changes occurred in England and Wales at an earlier time than in Scotland, and, therefore, field evidence and detailed descriptions of the shieling system are less numerous in England and Wales than in Scotland (Miller 1967).

In all forms of subsistence pastoralism, the herding family is almost totally dependent on domestic animals to provide food and materials to make clothing and tools; in some instances, fuel and tradable products are also produced. There may be the opportunity to supplement the diet by gathering wild plants, or by hunting and fishing. The herders may also practise limited trade in animal products, such as hides, which will enable them to get grain and other plant food products, but the products of domestic animals form the bulk of the diet. Most subsistence pastoral communities are dairy based; the storage of meat is difficult and, without an organisation for trading live animals, the economy has to be based on the live animal products, milk and blood. In the Highlands of Scotland there has probably always been some degree of trade between the Highlands and Lowlands, exchanging butter, cheese, skins, fur and tallow from the north for grain and meal from the south.

If the herding family has no way of obtaining additional food supplies by trade, the family must maintain a sufficiently large herd of animals in order to get a year round supply of food. If on the other hand their diet is supplemented from outside, the herd has to be large enough to supply a tradeable surplus. In areas such as the tribal lands of the Karamajong, where the level of plant production is very low, the milk yield of the cows averages only about one to two litres a day throughout the lactation period. The family therefore needs a large herd of dairy animals to provide the milk, blood and meat it requires. The herd has not only to be made up of lactating females, but also of yield females, bulls and young

stock for replacement. The actual number of animals needed will depend on the production of the herd. This will vary according to the milk and meat yield and also with the reproductive and mortality rates. The reproductive rate is dependent on the age at which the females reach sexual maturity, the frequency with which they produce young and the number of young born each year. The number of animals will also vary according to the needs of the pastoral family. These requirements will be influenced by the environment, i.e. in the sub-arctic conditions of northern Europe the calorific requirements of the pastoralist are higher than of those living in the warmer parts of Asia or Africa. The cultural and social conditions of the group will also affect the number of animals kept.

A cattle herding family in central Africa needs thirty to fourty cattle, including fourteen milk cows, to provide them with sufficient food throughout the year. The Basseri tribe of south Persia needs sixty sheep and goats as a minimum; the reindeer herding Chukchi of Siberia need between seventy and one hundred animals and in the more productive regions, such as the Swiss Alps, Norway and probably Highland Scotland fewer animals were needed under a subsistence economy. The milk yield of cows in Switzerland, Norway[1] and Highland Scotland[2], at the peak of lactation, was four or five times that of the African cattle, and therefore fewer cattle were needed. One Swiss farmer, although admittedly not wholely dependent on his animals, had only three dairy cows, three heifers and two goats (Dumont 1957). In the Norwegian study it is

1. See the discussion of the milk yield of Norwegian cattle, Chapter 3, page111 .
2. See the discussion of the milk yield of the old type of Highland cow, Chapter 4, page176 .

shown that in the eighteenth century in the area concerned there was one cow equivalent per person[1]. In Scotland probably a slightly higher number was needed and using Brown's (1971) technique with the milk yields discussed in Chapter 4 it can be calculated that a family could subsist on a minimum of nine milk cows and their followers.

The importance of cattle as the main food producer must not be over estimated; Allan (1965) pointed this out with reference to the cattle herders of central and east Africa. Sheep and goats may well provide a more adequate and regular food supply, in relation to their numbers, than cattle which only yield little milk, and which may only be slaughtered when a large amount of meat can be consumed. The Fulani of northern Nigeria who live entirely on milk and its products, keep very few sheep and goats and have to maintain herds of up to twenty cattle for each person (Allan 1965). In some of the poorer regions, however, the Fulani have no cattle and have to be entirely dependent on goats and sheep. Often the important economic role of sheep and goats in pastoral economics is overshadowed by the social and cultural prestige attached to cattle. In Scotland, with the development of trade in livestock in the English markets, the price of cattle rose during the eighteenth and early nineteenth centuries (Gray 1957, Smout 1969, Chambers and Mingay 1970) and the importance of cattle obviously increased. Earlier on, however, the smaller animals must have been very important considering the large number that were kept.

1. See Table 2 , Chapter 3, page 106 .

The total herd size limited not only by the capacity of the area to support the animals, but also by the amount of labour needed to look after the herd. Together, these factors control the stocking density of the animals at any one place, and also the distribution and size of the herding unit. At the times of the year when pasture is plentiful and water is freely available, the herd can be large. In the Swiss Alps, for example, the dairy cattle graze in large groups at the height of summer when they are herded in common in the high alpine pastures. For the rest of the year they are kept in small groups belonging to each family. In the Highlands, where it was not essential to house animals in winter and where it was therefore easier to let them forage for themselves in the lowground woodlands and on the old arable, the animals grazed in large communal groups.

In the more extreme environments, the pastoralist is restricted to herding species that are native to the area. Reindeer is virtually the only species that the Lapps could use because no other herd animal is available which is adapted to living through the severe winters of Scandinavia and northern Europe. Reindeer herding has developed out of a hunting economy. The Lapps used to follow the migrations of the wild reindeer and slaughter them when they had driven them into a suitable place. The economy was similar to that of the caribou hunting Eskimos of northern Canada. In these severe environments, the management system must not destroy the special adaptations of the animals. Selective breeding, for qualities such as increased milk yield or an increase in meat production, may make the animals less suited to the environment and therefore less productive unless it is given extra food and shelter

in winter.

Political frontiers often cut across seasonal migration routes, so unless agreement can be reached to allow for the movement of migratory tribes across these frontiers, as it has in Lappland, some areas are denied to the tribes and go out of use. It is the definite policy of some governments in countries with a large number of migratory tribes to settle them to avoid boundary disputes or to facilitate government, for instance in Iran and in the Soviet Union.

There are many instances where alien species have been introduced which have been very successful in the short term, but which have been unsatisfactory with longer experience. Often animals with some specially attractive features have been introduced with insufficient consideration of the effect they might have on the existing plant and animal complex. In most modern pastoral systems, based on an introduced species, man has attempted to control the factors that limit herd size and production, without first determining how many animals that area could support on a sustained basis. Central Australia is an example of an area that has been changed and degraded by the introduction of domestic cattle and the accidental invasion of rabbits. In Africa cattle herding has to be restricted to areas that are free from tsetse fly because of the disease risk to man and animals. Once the tsetse fly is eradicated in an area, cattle can be introduced.

The number of animals that can be supported initially in such an area may be very high, but usually it falls off rapidly. Persistent cropping with a single animal species at high densities can bring about large changes in the vegetation and it is essential, if serious damage is to be avoided, that close consideration be

given to the effects an introduced species can have on the area and its vegetation, as well as to understanding the effects an introduced species can have on an area and its vegetation. Such understanding should precede the commercial or field introduction of alien species or breeds to an area.

Herds of mixed species, such as those of the Turkana of East Africa can often increase the utilisation of an area, as the various animal species will use the area in different ways and may select a different range. Again, in order to make the best use of the possibilities, different requirements of the species and the limiting factors of each species must be recognised so that the composition and size of the herd will relate to the resources and to the constraints.

Nomadism and transhumance are adaptations or techniques for escaping from environmental constraints, such as severe conditions in winter, summer drought or fly harrassment. When a subsistence economy changes to a money-based economy a sequence of changes is initiated and gradually the production becomes geared both spatially and temporally to the market's requirements. There are very strong pressures to intensify the methods of productions and it is usually necessary to centralise production to reduce transport and storage costs. As a result the animals may be concentrated into a small part of their former range and serious problems of over grazing can result.

The subsistence pastoralist has only limited ways of modifying the environment. He may change the structure of the herd by manipulating the sex ratio, the age structure and the time of calving so that it corresponds to the time when the weather and vegetation

are at their best. The annual slaughter, or sale of animals will generally take place at the end of the season of highest plant production, when the animals are in relatively good condition. Animals are usually killed or sold just prior to the season of lowest production, when the number of animals that can be supported in the locality is at its lowest. The technique of reducing the herd size to fit the resources is an alternative to supplying additional winter fodder. The herd that remains must be sufficiently large to support the family through the winter and also to reproduce to maintain the herd size the following spring. In many cases only a small percentage of the herd can be killed in the autumn because annual production is only slightly higher than the herd's maintenance requirements.

One way by which the subsistence pastoralist can modify the environment directly is use fire. It has been a wide-spread practice all over the world for thousands of years to burn off old and dead vegetation in order to encourage the growth of succulent young plants and to encourage grass dominated communities. In some parts of the world, such as the savannahs of Africa, it is difficult to decide whether fire climax vegetation is a natural or artificial condition. Fire can be useful in maintaining a stage in the vegetation succession that is suitable for grazing animals, but if the intensity of fire gets too great, serious changes can occur in the vegetation complex which can lead to degradation. For example, open savannah woodland can be changed to shrub dominated vegetation with a ground cover of perennial grasses, which in time can be changed by further burning to a state of bare ground with only a sparse cover of annual grasses.

CHAPTER 2.

THE MOUNTAIN ENVIRONMENTS OF NORWAY AND SCOTLAND

It is necessary to understand the mountain environments of Norway and Scotland before being able to discuss the pastoral systems found in these two countries or being able to make a comparison. The following account of the mountain environments of Norway and of Scotland is based on a system developed by the International Biological Programme of Norway for the classification of vegetation for mapping purposes. This system of vegetation classification was used in the study of grazing animals in the Norwegian study areas of Veigdalen: (Chapter 3). It provides a useful basis for discussing Norwegian and Scottish mountain vegetation. A description of the classification of Scottish mountain vegetation is also given.

This chapter concludes with a discussion of the nutritional value of mountain vegetation.

NORWEGIAN MOUNTAIN VEGETATION

In the Norwegian mountains, the vegetation in the region above the tree-line has been divided into three altitudinal zones: the low-alpine zone, the middle-alpine zone and the high-alpine zone. There is usually a belt of birch scrub Betula pubescens above the upper limit of the pine or mixed deciduous woodlands; this birch scrub zone is called the sub-alpine zone. The boundary between the sub-alpine zone and the low-alpine zone is marked by the tree line. This is a difficult concept to be objective about. Nordhagen (1943) makes a descriptive, but imprecise definition of a forest.

'By a forest is understood an assemblage of birch trees higher than man, which are not more remotely spaced than physiognomically to give impression of a patch of forest, and where the trees ecologically affect the ground vegetation by shadow and litter'.

(Nordhagen 1943, translated from Norwegian by Dahl 1956, p.247).

Ording (1944) gives a more precise definition of the tree line.

'The timber limit is the limit where the distance between individual trees exceeds 25 metres. The tree limit is marked in locality by the uppermost occurrence of trees. A tree must not be less than 2.5m high'.

(Ording 1944, quoted by Dahl 1956, p.247).

The important point is that the trees within the sub-alpine zone affect the ground cover by shading and litter and by affecting the water table.

The low-alpine zone, which lies immediately above the sub-alpine birch scrub zone, is dominated by dwarf shrubs. In continental regions of Norway, the most common dwarf shrubs are the dwarf juniper Juniperus communis nana, the dwarf birch Betula nana, and arctic willows such as Salix glauca, S. lanata, S. lapponum, S. myrsinites and S. phylicifolia. In more oceanic areas, heather Calluna vulgaris is more prominant.

As the altitude increases and the snow cover becomes more important, the dwarf shrubs of the low-alpine zone give way to the heath communities of the middle-alpine zone; these grassland communities are dominated by Nardus stricta, Festuca ovina or the

three leaved rush Juncus trifidus. The boundary between the low-alpine and the middle-alpine zone is marked by the disappearance of Vaccinium myrtillus (Du Rietz 1925, 1950; Dahl 1956). Vaccinium myrtillus is a characteristic species of the low-alpine zone as it requires snow cover in winter, but cannot endure prolonged snow cover in spring and early summer. Its disappearance is, therefore, a useful indicator of the change over from the dwarf shrub communities of the low-alpine zone to the grass and rush dominated communities of the middle-alpine zone.

The boundary between the middle and the high-alpine zones is drawn where the last stable communities on deep soil disappear. In the high-alpine zone there are only scattered plant communities with large areas of bare rock and scree inbetween them.

The altitude at which these changes occur varies considerably with differences in aspect and exposure to wind and with the degree of oceanicity of the climate. Poore and McVean (1957) described how these altitudinal changes occur at a lower level in Scotland than in Norway, and how the low-alpine zone becomes increasingly more important as the degree of oceanicity increases. In Scotland there are few mountain ranges which have large areas of middle-alpine vegetation and it is doubtful whether there are any true examples of high-alpine vegetation (Poore and McVean 1957).

The importance of snow in the distribution of mountain vegetation was recognised very early on in the study of Scandinavian mountain vegetation.

> 'Snow is a most decisive factor for the distribution of the different plant communities in the mountains'.
> (Vestergren 1902, quoted by Gjaerevoll and Bringer 1965, p.257).

Although the amount of snow may vary from year to year, the distribution is remarkably constant. Wind blows the snow around, causing it to drift in certain places and leave other areas free from snow. The actual pattern of the snow lie is dependent on the topography of the area. Snow forms an insulating layer which protects the underlying plants from wind abrasion and frost damage. The temperature fluctuations of the soil under a snow cover are much less than when the soil lies unprotected. The temperature of the soil surface under a snow cover of more than $\frac{1}{2}$ a metre does not fall below freezing point and the soil water does not freeze (Baadsvik 1971). The fixed pattern of snow distribution gives rise to a characteristic pattern of plant communities. This pattern reflects the variation in snow cover and often there are distinct boundaries between communities. There is a delicate balance between the benefits to be gained from the protection afforded by the snow cover in winter and the disadvantages of the subsequent reduction in the length of the growing season, due to a prolonged snow lie. A continental climate is characterised by hard, cold winters and warm, dry summers; snow melts less rapidly in a warm, dry, sunny period than it does in a cool, wet one. Therefore snow lies for much longer in the continental regions of Norway than it does in the oceanic mountains of Scotland. In Scotland there are often mild, wet periods in spring when the snow melts rapidly leaving the vegetation unprotected from the severe frosts that are liable to follow. Scotland, therefore, has a smaller proportion of frost sensitive species than Norway.

The plant communities of the mountain regions can be divided into two types with respect to snow. In areas that are free from snow early on in the year, chionophobous communities develop

consisting of plant species such as lichen and dwarf shrubs that are resistant to low temperature, wind erosion and drought. In areas with a longer snow cover, chionophilous communities of frost sensitive species develop. Grass dominated communities develop in areas with moderate length of snow lie, but, when snow lies until the end of July, grasses are superseded by species like the dwarf willow Salix herbacea. If the snow does not melt until very late in the summer or, in some years, does not melt at all, the communities are dominated by mosses.

In areas where the plants are irrigated by oxygen-rich snow melt water, meadow communities can develop even on base poor sites. These meadow communities are rich in herbs.

The main differences between the low and middle-alpine zones lie in the differences between the chionophobous plant communities and not between the snow bed or chionophilous communities.

In base rich areas, the plant communities are more diverse and the number of species is higher than in poorer areas. This is because the conditions for plant growth are better and species that are not adapted to living in base deficient areas can compete. There is a gradation between base poor and base rich sites depending on the type of bed rock, but, in order to simplify classification, communities have been divided into those found on calcium-poor sites and those found on calcium-rich sites. The amount of calcium in the soil is one of the most important factors in the distribution of plant species in the Norwegian mountains.

In the low-alpine region of Norway there are extensive mires, which are absent from the middle-alpine zone where drainage is better. The plant species composition of these mire communities depends on

the nutrient supply, the pH of the water and whether or not the water is stagnant or running.

THE CLASSIFICATION OF NORWEGIAN MOUNTAIN VEGETATION

The classification of the mountain vegetation of Norway,[1] devised by IBP for use in mapping vegetation, is based on the work of Gjaerevoll (1956), Gjaerevoll and Bringer (1965), Du Rietz (1942a,b), Nordhagen (1943), Dahl (1956) and Knaben (1950). It is a classification based on altitudinal zonation, differences in snow cover, the base status of the soil and the soil water regime, all of which are reflected in the dominant life form of the community, e.g. dwarf shrub communities of the low-alpine zone.

SUB ALPINE BIRCH WOODS

Lactucion Alpinae

There is a transition zone between the birch woods of the sub-alpine zone and the true dwarf shrub heaths of the sub-alpine zone. This transition zone is made up of shrubs such as the dwarf birch Betula nana, juniper Juniperus communis, and the arctic willows. This alliance is called Lactucion alpinae and contains many of the herb species found in the sub-alpine birch woods, such as the yellow globe flower Trollius europaeus. Some of the plant species found in the Lactucion alpinae alliance are also found in the alliance Phyllodoco-Vaccinion myrtilli as the conditions needed are similar. There is some protection in winter from freezing but the snow melts fairly early and there is a long growing season.

CHIONOPHOBOUS (EARLY SNOW FREE) COMMUNITIES OF THE LOW-ALPINE ZONE

1. Arctostaphyleto-Cetrarion nivalis.
2. Phyllodoco-Vaccinion myrtilli.
3. Kobresieto-Dryadion.

Gjaerevoll and Bringer (1965) divided the vegetation types

1. See Key 1, page 71 .

found in the areas of the low-alpine zone that are free from snow early in the summer (chionophobous) into three alliances. Two of these alliances are found on soils of a low pH and the other one on neutral or slightly basic sites. Gjaerevoll and Bringer (1965) named these three alliances after the most prominent plant species; the two alliances on acid sites he called Empetrion and Myrtillion after Empetrum hermaphroditum and Vaccinium myrtillus and the third, found on calcium rich soils, Dryadion named after Dryas octopetala. The classification used by IBP for chionophobous heath vegetation is similar.

1. Artostaphyleto-Cetrarion nivalis

The Empetrion alliance corresponds to the alliance Arctostaphyleto-Cetrarion nivalis and is found on ridges which have little or no protective snow covering in winter. On these wind blown ridges, conditions in winter can be extremely severe. The plants have, therefore, to be resistant to frost and great fluctuations in temperature. There are only a small number of species in the alliance Arctostaphyleto-Cetrarion nivalis. The most important species are the dwarf shrubs Empetrum hermaphroditum, Loiseleuria procumbens, and the two species of Arctostaphylos Arctostaphylos uva-uris and A. alpina. These are low growing and form dense stands. In areas where competition is less, individual clumps of grasses, such as Festuca ovina and/or the viviparous fescue Festuca vivipara, the rush species Juncus trifidus and Luzula arcuata and the sedge Carex bigelowii colonise. Lichens also play an important part in this alliance.

2. Phyllodoco-Vaccinion myrtilli

The alliance Phyllodoco-Vaccinion myrtilli (Myrtillion of

Gjaerevoll and Bringer 1965) develops on more sheltered areas on the sides of ridges. The species in this alliance requires the protection of snow in winter but need to be clear of snow by the end of June. The plant species found in this alliance are frost sensitive shrubs, such as Phyllodoce coerulea and Vaccinium myrtillus, and grass species, such as Anthoxanthum odoratum and Deschampsia flexuosa, which can withstand snow cover until the end of June. These species are, to some extent, sensitive to water-logging. Their sites have to be well drained and they are therefore usually found on slopes.

3. Kobresieto-Dryadion

The Dryas heaths of this alliance, found on base rich sites, contain a great variety of species. Some of the species in this alliance, Kobresieto-Dryadion, are also found in the poorer heath alliances, Arctostaphyleto-Cetrarion nivalis and Phyllodoco-Vaccinion myrtilli; for example, Empetrum hermaphroditum and Betula nana. Others, like Vaccinium myrtillus are absent.

Potentilleto-Polygonion Vivipari

In calcium rich areas the heath communities of Kobresieto-Dryadion change, with increasing length of snow lie and increasing soil moisture, to low growing herb communities of the alliance Potentilleto-Polygonion vivipari, with species such as moss campion Silene acaulis, alpine bistort Polygonum viviparum and the grass Poa alpina.

CHIONOPHOBOUS (EARLY SNOW FREE) COMMUNITIES OF THE MIDDLE-ALPINE ZONE

Juncion Trifidus

In the middle-alpine zone the Chionophobous shrub heaths are not of much importance. In parts of Northern Norway Cassiopo

tetragona is the most prominent of the dwarf shrubs. Dryas octopetala is found on more acid areas in the middle-alpine zone than it is in the low-alpine zone, because of reduced competition. In the middle-alpine zone, grass and rush heaths are much more important and these are classified into the Juncion trifidus alliance.

CHIONOPHILOUS (SNOW BED) COMMUNITIES OF THE LOW-ALPINE AND MIDDLE-ALPINE ZONE

Nardeto-Caricion Bigelowii

This grass/sedge community is found below the Phyllodoco-Vaccinion myrtilli alliance of the low-alpine zone and the Juncion trifidis heath of the middle-alpine zone. It is characterised by the mat grass Nardus stricta, sweet vernal grass Anthoxanthum odorata, and the sedge Carex bigelowii.

Cassiopeto-Salixion Herbaceae

This is found in sheltered hollows, gullies and north facing slopes where the snow lies for longer than it does in areas where Nardeto-Caricion bigelowii is found, and where the snow does not melt until mid-July. The vitality of the grasses is diminished with the shortened growing season and the dwarf willow Salix herbacea forms a dense moss-like mat.

Allosoreto-Atryion Alpestris (Fern Rich)

In areas along stream beds and in ravines, fern-rich snow bed communities develop of the alliance Allosoreto-Atryion alpestris. This alliance and the alliance Cassiopeto-Salicion herbaceae are found in areas which are very wet during the time that the snow is

melting but which dry up rapidly.

LATE SNOW BED COMMUNITIES

Polytrichion Norvegici (Moss Dominated)

Where the snow persists for a long time, maybe all through the summer, vascular plants are unable to survive and the species found are liverworts and mosses; this alliance was called Distichion capillacei by Gjaerevoll and Bringer (1965) and Polytrichion norwegici by IBP.

MEADOW COMMUNITIES (CHIONOPHILOUS COMMUNITES IRRIGATED BY FLUSH OR MELT WATERS)

Ranunculeto-Oxyrion Digynae

Gjaerevoll and Bringer (1965) divided these meadow communities into four alliances, two on rich sites and two on poorer sites. The IBP classification has only one alliance for meadow communities, but sub-divides this alliance into three to take into account species differences due to base status: one type is found on stable soils in calcium rich areas, one on unstable soils and one on mesotrophic sites.

MIRE COMMUNITIES

There are four mire alliances as seen in the Key, and one oligotrophic birch mire community, Oxycocco-Empetrion hermaphroditi. This alliance has shrub species Betula nana and Empetrum hermaphroditum as dominants, and cotton grass Eriophorum vaginatum and Carex pauciflora as characteristic with various Sphagnum mosses and cloudberry Rubus chamaemorus.

ANTHROPOGENIC GRASSLANDS

In addition to these natural alliances, IBP include two alliances for the anthropogenic grassland communities that develop as a result of grazing, dunging and treading by animals.

Nardeto-Agrostion Tenuis

This is found around seters but not in the immediate area of the huts which are the most nitrogen rich areas. The characteristic species are yarrow Achillae millefolium, bent grass Agrostis tenuis, the rush Luzula multiflora, clover Trifolium repens and self heal Prunella vulgaris. The red fescue Festuca rubra and mat grass Nardus stricta are both dominant.

Polygonion Avicularis

This anthropogenic grassland type is found in very nitrogen rich areas immediately around the seter houses. The characteristic species are shepherd's purse Capsella bursa-pastoris, common knot-grass Polygonium aviculare, the creeping butter cup Ranunculus repens, and chickweed Stellaria media. The two common grass species found are Poa annua and P. trivialis.

These two types were found around the seters in Veigdalen, south Norway. The dark green Poa species were particularly noticeable immediately around the seter huts for about three meters.

This classification was used in the study of the grazing behaviour of sheep in Veigdalen, Norway. It was easy to use in the field as the vegetation types could be recognised from a distance using 10x40 binoculars. Problems would have arisen if it had proved necessary to distinguish between the mire communities but as the sheep were not seen on these communities; they did

KEY 1.

CLASSIFICATION OF NORWEGIAN MOUNTAIN VEGETATION

ALTITUDINAL ZONE	LOCATION, SNOW & WATER REGIME	VEGETATION COMMUNITY TYPE BASE STATUS CALCIUM POOR ——— CALCIUM RICH	
SUB-ALPINE	Sub-alpine birch woods	LACTUCION ALPINAE	
	Antropogenic grasslands	NARDETO-AGROSTION TENUIS	POLYGONION AVICULARIS
LOW-ALPINE	MIRES Stagnant water	LEUCO-SCHEUHZERION	STYGIO-CARICION LIMOSAE
	Running water	CARICION CANESCEN-TIS-NIGRAE	SALICION MYRSINITIS
	Oligotrophic birch mire	OXYCOCCO-EMPETRION HERMAPHRODITI	
	MEADOWS Late snow bed communities irrigated by melt water	RANUNCULETO-OXYRION DIGYNAE	
		ALLOSORETO-ATRYION ALPESTRIS	
	SNOW BED Very low snow line	POLYTRICHION NORWEGICI	
	Snow melting in late June	CASSIOPETO-SALICION HERBACEAE NARDETO-CARICION BIGELOWII	
	Snow melting in early July	PHYLLODOCO-VACCINION MYRTILLI POTENTILETO-POLYGONION VIVIPARI	
	RIDGE No water logging or prolonged snow cover	ARCTOSTAPHYLETO-CETRARION NIVALIS KOBRESIETO-DRYADION	
MIDDLE-ALPINE		JUNCION TRIFIDUS	

however use the oligotrophic mire communities Oxycocco-Empetrlion hermaphroditi which was easily recognised.

The complete lists of dominant and characteristic species for each of these vegetation types are given in the IBP publication 'Nordisk vegetationsklassificering för kartläggning' (1971).

CLASSIFICATION OF SCOTTISH MOUNTAIN VEGETATION

It is considerably harder to devise a systematic classification for the vegetation of the Scottish mountains, than it is for Norwegian mountain vegetation. This is because the Scottish mountain vegetation reflects not only environmental factors but also past land-use.

In Scotland until the work of Poore and McVean (1957) no attempt had been made to fit all the vegetation types found in the Scottish mountains into a broad classification. Most of the previous studies had either been detailed or regional botatical survey such as Crampton (1911), Pearsall (1950), Tansley (1949) and Watt and Jones (1948), or classification devised for forest management purposes such as Fraser (1933).

Poore and McVean (1957) after looking at the ways that vegetation had been classified in Scandinavia, put forward the idea that Scottish mountain plant communities could be classified in the same way. McVean and Ratcliffe (1962) went on to describe, in semi-quantitative terms, the different types of terrestrial vegetation found in Scotland. They found that the Scottish vegetation fitted remarkably well into the Scandinavian system despite difference.

The following classification is based on the work of McVean and

Ratcliffe (1962), Burnett (1964), Fraser (1933) and McVean and Lockie (1969).[1]

WOODLANDS OF THE SUB-ALPINE ZONE

Vaccinio-pineion (pine and birch forest vegetation)

1a. Moderately dense pine woodlands with a ground cover of blaeberry Vaccinium myrtillus, cowberry Vaccinium vitis-idaea and feather mosses such as Hylocomium splendens. It is found in the central and northern Highlands from sea level to 475 metres. Soils - well drained sands and gravels with raw humus and a well developed podzol profile.

1b. Open pine woodland with a ground cover of tall heather Calluna vulgaris, blaeberry Vaccinium myrtillus and deep tussocks of Sphagnum moss over the dead tree trunks. This type of pine woodland is found in the west from sea level to 305 metres and in the east from around 300 metres to 600 metres. Soils - podzolic with an accumulation of raw humus. Type 1b is found at higher altitudes than type 1a and it is more extensive in the west and on moist north facing slopes in the east.

2a. Birch woodland, herb rich with a ground cover of short blaeberry Vaccinium myrtillus and abundant mosses. It is often found in similar sites to type 1a, where birch has colonised after clearance by grazing and felling. Soils - brown earths with a mull humus.

2b. Birch and oak woodland with a ground cover of grasses, mosses and herbs and some blaeberry Vaccinium myrtillus. Oak can replace birch as the dominant tree to about 275 metres in the southern and east central Highlands and to 550 metres in the west. Soils - slightly podzolised soils and acid brown earths.

1. See Key 2, page 80.

ANTHROPOGENIC DWARF SHRUB HEATHS OF THE WOODLAND OR SUB-ALPINE ZONE

3a. Pure heather moor dominated by Calluna vulgaris with a sparse ground cover of mosses and lichen, maintained by burning. Easterly distribution.

3b. Arctostaphylos rich heather moor develops from pure heather moor of type 3a after excessive burning and also takes over from type 3a at higher altitudes. On fertile, base rich sites this type 3b resembles the herb rich birch woodlands of type 2a.

3c. Damp heather moor with Vaccinium myrtillus, crowberry Empetrum nigrum and deep mosses. Replaces pure heather moorland of type 3a in the west, but develop in the east if pure heather moorland of type 3a is not burnt for a long time. Type 3c has great similarities to the open pine woodland of type 1b to which it would probably revert in the absence of grazing and burning.

ANTHROPOGENIC GRASSLANDS OF THE SUB AND LOW-ALPINE ZONE

4a. Nardus sub-alpine grassland occurs on peats and on a wide range of mineral soils, therefore there are two varieties species rich and species poor. Type 4a is similar to Festuca/Agrostis type 4e but Nardus stricta is the dominant grass, constant species are Agrostis tenuis, Anthoxanthum odoratum, Festuca ovina, Carex pilulifera, Galium hercynicum, Potentilla erecta, and the mosses Hylocomium splendens and Rhytidia delphus squarrous. Type 4a is distinguishable from type 10a the natural Nardus stricta grassland of the low-alpine zone, by the scarcity of Carex bigelowii, Trichophorum caespitosum, Rhacomitrium lanuginosum, Cetraria islandica and Cladonia uncialis.

4b. Juncus squarrous grassland can be divided into species poor and

species rich varieties. The species rich variety is very similar to type 4a; Juncus squarrous is the sole dominant in the species poor variety. Type 4b usually occurs with type 4a but does not extend far east.

4c. Molinia grasslands with/without Myrica gale, this is the principal grassland type of the western Highlands, locally on base rich soils there are herb rich types. Molinia caerulea is a valuable pasture plant in the early summer.

4d. Festuca Deschampsia grasslands with either Nardus stricta or Molinia caerulea. A mixed grassland type found on peaty podzols and acid gley soils mainly in the Southern Uplands.

4e and 4f. Festuca/Agrostis and Agrostis/Festuca grasslands. The species poor variety with Festuca ovina dominant, develops on mineral soils or slightly peaty ones with poor drainage; the ~~rich~~ rich Agrostis/Festuca with Agrostis tenuis dominant variety develops on more fertile sites or following more intensive use by grazing animals. These are important grassland types and provide some of the best unimproved grazings in the Highlands.

4g. Poa rich grasslands develop in localised areas, for example where animals lie up at night. Poa pratensis and P. trivialis, Agrostis tenuis, Festuca rubra, Holcus lanatus and Trifolium repens are common.

ANTHROPOGENIC GRASSLANDS-RELATIONSHIP BETWEEN TYPES

NARDETO-AGROSTION TENUIS ..... POLYGONION AVICULARIS

(Taken from King and Nicholson 1964)

Humus Mor ..... Mull		
Base Status	Very leached, low phosphate	Base rich, High phosphate
	(Species poor)	(Species rich)
Nardus 4a.....	Festuca/Agrostis 4e..	Agrostis/Festuca 4f..Poa rich 4g
Juncus squarrous 4b..	Festuca/Deschampsia 4d	
Molinia 4c		
Uncontrolled grazing Low summer intensity Moderate to high winter grazing intensity	Uncontrolled grazing High overall grazing intensity	Controlled grazing

SUB-ALPINE SCRUB

Lactucion alpinae

5a. Juniper scrub, fern rich. There are very few examples of this type in Scotland, a similar type is also found in the woodland zone. Juniperus communis is sensitive to burning, but resistant to grazing, Soil - not strongly podzolised, humus mild and friable. It is found in damp hollows and on north facing slopes of high level heather moors of type 3a in the eastern and central Highlands.

5b. Montane willow scrub. Probably once extensive on damp, base rich soils, but now it only occurs on inaccessible ledges. It is widely distributed in the north and central Highlands but has a marked easterly distribution.

FLUSHES AND MIRES

6a. Rush flushes. Found on humose mineral soil.

6b. Iron flushes. Very local with abundant sedges.

MEADOWS OF THE LOW-ALPINE ZONE

Ranunculeto-Oxyrion digynae

8a. Herb and fern meadows for climate and biotic reasons these are rare in Scotland and exist only on inaccessible rock ledges.

HEATHS AND BOGS ON PEAT IN THE SUB AND LOW-ALPINE ZONE

7a. Calluna/Trichophorum heaths are a mixture of heather Calluna vulgaris and deer hair sedge Trichophorum caespitosum, rich in either mosses or lichen. Type 7a forms a transition type between pure heather of type 3a and the Eriophorum-Trichophrum bog type 7d. It has an easterly distribution.

7b. Calluna/molinia. This is the western equivalent to type 7a. It develops from heather rich communities of type 3a following periodic burning in high rainfall areas. Type 7b is found on slopes where there is some movement of water through the peat. If the peat dries out Calluna/Trichophorum of type 7a or species poor heather moor of type 3a develops. If the water is stagnant, for example, in flat areas, type 7c develops with Calluna vulgaris and Eriophorum sp. dominating.

7c. Calluna/Eriophorum bog is the typical bog community of eastern Scotland, but occurs in the low-alpine zone in the west. The low-alpine type of 7c has a higher proportion of alpine species such as cloud berry Rubus chamaemorus and dwarf birch Betula nana than does the sub-alpine variety of type 7c.

7d. Eriophorum/Tricophorum bog. Western blanket bog dominated by bog cotton grass Eriophorum vaginatum, E. augustifolium, Calluna vulgaris, Erica tetralix, deer hair sedge Trichophorum caesptosum, Narthecium ossifragum and mosses such as Sphagnum sp. are common.

SNOW BED COMMUNITIES OF LOW AND MIDDLE-ALPINE ZONE

Cassiopeto-Salicion herbaceae

9a. Late snow bed communities with dwarf willow Salix herbacea, found in hollows where snow lies for a long time; grasses cannot survive.

NATURAL GRASSLANDS OF THE LOW AND MIDDLE-ALPINE ZONE

Nardeto-Caricion bigelowii

10a. Nardus stricta grasslands develops where there is fairly consistant snow cover in winter, from December until April. Mosses and lichen are common. The alpine Nardus grasslands of type 10a are of less value as grazings for animal than type 4a.

10b. Alpine Deschampsia caespitosa the species rich variety is found on calcareous rocks and the species poor type on siliceous rocks. The species poor type of 10b is common and extensive in the west occuring from 488 to 914 metres, the species rich type is restricted to the limited calcium rich sites. Moderate snow cover and high humidity in summer appear to affect this type.

10c. Carex bigelowii heaths are grass and moss heaths, found between 793 metres and 1,159 metres on level or gently sloping terrain. They have a close affinity to the Rhacomitrium heaths of type 12a.

10d. Juncus trifidus heaths lichen rich, markedly chionophobous, occupying some of the most exposed ground in the Highlands. It provides some grazing during June, July and August.

DWARF SHRUB HEATHS OF THE LOW AND MIDDLE-ALPINE ZONES

Phyllodoco-Vaccinion myrtilli

11a. Empetrum heaths with Rhacomitrium characteristic of the high

ground in the west and is closely associated to the Rhacomitrium moss heaths of the high tops Type 12a.

11b. Vaccinium heaths with/without Empetrum and mosses found at higher level than Calluna dominated dwarf heaths of types 3. It is found from 610 metres in the northern Highlands and from 914 metres in the central Highlands, but small in extent.

11c. Vaccinium heaths with grasses, sedges and lichen. This type is distinguishable from type 11b by the presence of the lichen Cladonia. Stands of this type are seldom large. In exposed areas this type passes to Rhacomitrium heaths of type 12a.

11d. Vaccinium heaths with Festuca ovina and Alchemilla, confined to calcium rich sites. Stands found below 950 metres often derived from other types by burning and grazing. (Kobresieto-Dryadion calcarious dwarf shrub heaths are very rare in Scotland).

MOSS HEATHS OF LOW AND MIDDLE-ALPINE ZONE

Arctostaphyleto-Cetrarion nivalis

12a. Rhacomitrium heaths (species rich and species poor)

Characteristic of the high tops. Species rich type found on base rich rocks. There is no comparable vegetation type in Norway.

12b. Rhytidiadelphus heaths with Deschampsia caespitosa, found in more sheltered sites than type 12a. In large corries these moss heaths pass gradually to Deschampsia grasslands of 10b and are often valuable grazing in summer.

KEY 2.

CLASSIFICATION OF SCOTTISH MOUNTAIN VEGETATION

WOODLANDS OF SUB-ALPINE ZONE VACCINIO-PINEION	Moderately dense pine wood	1a
	Open pine wood	1b
	Birch wood, herb rich	2a
	Birch and oak wood	2b
ANTHROPOGENIC DWARF SHRUB HEATHS OF THE WOODLAND OR SUB-ALPINE ZONE	Pure heather moor	3a
	Arctostaphylos rich heather moor	3b
	Damp heather moor with Vaccinium	3c
ANTHROPOGENIC GRASSLANDS OF THE SUB AND LOW-ALPINE ZONE NARDETO-AGROSTION TENUIS POLYGONION AVICULARIS	Nardus grassland (sub-alpine)	4a
	Juncus grassland	4b
	Molinia with/without Myrica	4c
	Festuca/Deschampsia	4d
	Festuca/Agrostis	4e
	Agrostis/Festuca	4f
	Poa rich	4g
SUB-ALPINE SCRUB LACTUCION ALPINAE	Juniper scrub, fern rich	5a
	Montane willow scrub	5b
FLUSHES	Rush flushes	6a
	Iron flushes	6b
HEATHS AND BOGS ON PEAT OF SUB AND LOW-ALPINE ZONE OXYCOCCO-EMPETRION HERMAPHRODITI	Calluna/Trichophorum heaths	7a
	Calluna/Molinia moors	7b
	Calluna/Eriphorum moors	7c
	Eriophorum/Trichophorum bogs	7d
MEADOWS OF LOW-ALPINE ZONE RANUNCULETO-OXYRION DIGYNAE	Herb and fern meadows	8
SNOW BED OR LOW AND MIDDLE-ALPINE ZONE CASSIOPETO-SALICION HERBACEAE	Late snow bed communities with Dwarf willow	9
NATURAL GRASSLANDS OF THE LOW AND MIDDLE-ALPINE ZONE NARDETO-CARICION BIGELOWII	Nardus stricta grasslands	10a
	Alpine Deschampsia caespitosa	10b
	Carex bigelowii heaths	10c
	Juncus trifidus heaths, lichen	10d
DWARF SHRUB HEATHS OF LOW AND MIDDLE-ALPINE ZONE PHYLLODOCO-VACCINION MYRTILLI	Empetrum heaths with Rhacomitrium	11a
	Vacciniun heaths with/without Empetrium and mosses	11b
	Vaccinium heaths with grasses, sedges and lichen	11c
	Vacciniun with Festuca ovina and Alchemilla	11d
MOSS HEATHS OF LOW AND MIDDLE-ALPINE ZONE ARCTOSTAPHYLETO-CETRARION NIVALIS	Rhacomitrium heaths (Species rich and poor)	12a
	Rhytidiadelphus heaths with Deschampsia	12b

COMPARISON BETWEEN SCOTTISH AND NORWEGIAN MOUNTAIN ENVIRONMENTS

One of the most succinct descriptions of Scottish mountain vegetation is given by McVean and Lockie (1969).

> 'Grassland, dwarf shrub heaths, and various types of wet moorland and bog constitute the greater part of the upland vegetation of Scotland. Forest, both natural and planted, moss heaths on the highest ground, and the rare, herb-dominated patches of late snow fields and inaccessible mountain ledges make up the remainder. Surviving native woodland and scrub is generally thin so that the trees and bushes have little effect on the subordinate species which thus show much the same groupings as in the vegetation outside the woodland limit'.
> (McVean and Lockie 1969, p.17).

In its unmodified state the vegetation found in the Highlands would represent the oceanic extension of the type of plant communities found in the mountain regions of north west Europe. However, the vegetation of Scotland has been greatly modified by man and his grazing animals over many hundred years and this has accentuated the differences between the Norwegian and Scottish mountain flora.

The differences between the Scottish and Norwegian mountain vegetation are due to four things; the effects of the ice age, the differences in climate, differences in geology and differences in land-use. As Britain is an island the re-invasion by plant species eliminated by the ice age was not easy and therefore there are fewer plant species in Scotland than there are in Norway.

The Scottish climate is more oceanic and more subject to cyclonic influences than is the Norwegian climate, much of which is continental. Wind is a very important factor in Scotland and affects the pattern of mountain vegetation in several ways. It restricts the growth of woody plants not only because of mechanical damage but also by increasing the evapo-transpiration and thus encouraging drought. The upper limit for tree growth is therefore lower in Scotland than it is in Norway where severe gales are not common. The average summer temperature is higher in Norway partly because of the lack of cloud cover; this in effect increases the length of the growing season. One other factor of considerable importance is the length of snow lie in the mountains in the spring. In the continental regions of Norway winter temperatures are very low and there is a deep and persistent cover of snow from November until nearly mid June. In Scotland the weather in late winter and spring is oceanic and cyclonic and therefore very changeable. Cold frosty days are interspersed with mild wet periods. Mild wet conditions cause the snow to melt, leaving the plants in danger of damage from frost.

The combined effects of high winds and of changeable snow conditions with frequent freezing and thawing make the climate of the Scottish mountains much more severe for plants than that of Norway. In the Norwegian mountains there are, as a result, a higher proportion of frost sensitive snow bed communities than there are in Scotland.

Although the metamorphic rocks of the Highlands belong to the same petrological complex as those of the Norwegian mountains, the higher rainfall and the higher atmospheric humidity caused by the

greater cloud cover has led to a much greater extent of peaty and leached acid soils in Scotland (Poore and McVean 1957). There are therefore a greater number of oligotrophic vegetation types in Scotland.

In Scotland three broad altitudinal soil zones can be recognised; the soils of the mountains at above 760 metres, the soils of between 300 metres and 760 metres and those below 300 metres. The soils at above 760 metres are formed by the action of wind and frost which results in the formation of scree slopes, boulder fields and bare rock pavements on which alpine humus soils develop. Peats and peaty podsols are found on the intermediate zone on plateaus of gentle slopes where drainage is impared. Where drainage is better iron podsols occur. In the woodland zone where drainage is good, brown forest soils and iron podzols develop which are moderately fertile soils. On poorly drained sites gleys are found (Glentworth 1961).

To summarise, the main soil types in the Highlands may be grouped as acidic peats, podsols, brown earths and gleys. In the Norwegian study area, at the higher altitudes alpine humus soils had developed and lower down either peaty or well drained alluvial soils have developed.

In Scotland much ground which was once covered with woodland has been gradually changed by burning, felling and grazing in anthropogenic dwarf shrub heathlands and grasslands. In Norway the effect of man and his grazing animals is much less marked. In the immediate areas of the seters, or summer grazing, species rich grasslands have developed and the birch woods of the sub-alpine zone

have been affected to some extent by felling for fuel.

In Scotland it is much harder to recognise a simple altitudinal or climatic zonation of forest types than it is in Norway and it is hard to find a natural occurrence of birch above pine. In Scotland birch colonised areas that were once under pine and therefore it is often difficult to interpret the pattern of tree species in an area in terms of the environmental factors as we see them now.

The sub-alpine birch scrub zone has probably been replaced by dwarf shrub heaths or antropogenic grasslands and now in Scotland this birch-willow-juniper zone is almost non-existent. Poore and McVean (1957) cite relicts of this community type. Fern rich juniper scrub is found above the upper limit of the pine woods in Creag Fhiaclach in the Cairngorms at 610 metres (Watt and Jones 1948, Poore and McVean 1957) and this is the best example of the sub-alpine scrub left in Britain (McVean and Ratcliffe 1962). There are patches of montane willow scrub on ungrazed ledges in the northern and central Highlands on damp base rich soils at levels higher than the potential tree line: the hypothesis that this birch-willow-juniper zone once existed in Scotland is supported by evidence of the processes of degradation of the Norwegian birch scrub communities following clearing and grazing.

The dwarf birch Betulà nana is an important constituent of the birch scrub zone and of the low-alpine zone in Norway. Betula nana has an easterly distribution in Scotland although it cannot be thought of as a continental species. Ratcliffe (1964) suggests that

'Burning of hill blanket bogs has probably greatly increased

the rarity of some dwarf shrubs such as Betula nana ...'. (Ratcliffe 1964, p.458).

Grassland develops directly from woodland or via dwarf shrub heath depending on the intensity of grazing and/or the frequency of burning. The type of grassland that develops depends on the grazing intensity and various edaphic factors. Anthropogenic grasslands range from poor Nardus stricta or Molina caerulea dominated communities to species rich Agrostis-Fescue communities. The relationship between woodlands, dwarf shrub heaths and grassland is in a constant state of flux; it is complex and dynamic. The pressure of the grazing animals, the history and present burning regime, the inherent base status of the soil and the drainage pattern all affect the type of community that develops and is retained. King and Nicholson (1964) discussed in great detail the effects of grazing animals on vegetation and the interrelationship between community types and their successional relationships. They show how both soil and grazing pressure affect the type of grass community found. With an uncontrolled grazing of overall low intensity on leached podzolic soils, oligotrophic Nardus and Molinia communities develop; on mull soils high in phosphates with high grazing intensity, species-rich Agrostis-Festuca grasslands develop, and in areas of controlled grazing on mull site Poa rich grassland develop.

Scotland has a relatively greater area of anthropogenic grassland in both the sub-alpine and the low-alpine zones than Norway, and there is also a greater extent of anthropogenic dwarf shrub heath. Vegetation is not burnt in Norway in order to provide a

diversity of ages of heather Calluna vulgaris and to provide increased grasses for food for sheep or grouse, except in some of the heathland in the south of Norway, which are used for sheep. Domestic animals have to be housed in large barns during the winter in Norway because of the snow and severe cold. In Scotland this is not so as animals can often be wintered outside on low ground or in woodland, and therefore the year round grazing intensity can be much higher in Scotland than it can be in Norway. Both burning and a high number of both domestic and wild animals has helped to extend grassland and dwarf shrub communities into the woodland zone.

To summarise, the actual number of plant species found in Scotland is much less than in Norway; there are fewer true alpine species and a greater proportion of southern species. This is due partly to the effects of the Ice Age. The high rainfall, cloud cover and atmospheric humidity in Scotland associated with the oceanic climate has led to peat formation, and there is, therefore, a much greater proportion of oligotrophic bog communities in Scotland than there is in Norway. A severe oceanic climate has the effect of lowering the tree line and extending the importance of the low-alpine dwarf shrub zone. The past land-use in Scotland has helped to accentuate these differences; the reduction of the tree cover has affected the water balance of the soil and thus increased the formation of peat. Burning and grazing have reduced the extent of woodlands and increased the extent of dwarf shrubs and grasslands in Scotland. Therefore, it is in the sub-alpine and low-alpine zones that the sharpest contrast between Scotland and Norway exists. However, despite these differences the vegetation

found in the Scottish mountains is fundamentally an oceanic extension of the type found in the Norwegian mountains.

THE ADVANTAGES OF MOUNTAIN VEGETATION AS SUMMER GRAZINGS

Under a system of altitudinal transhumance domestic animals are taken up to the mountains in summer for several reasons, some of which have already been discussed. One of the most important is the need to produce food for winter. The pastoralist can do this in one of three ways: he can preserve areas of low ground grazing for use in autumn and early winter, under a haining system; he can make hay or silage from natural planted grasses, or he can grow special fodder crops, such as turnips and oats. All of these practices require that the animals are herded, enclosed or removed to other areas to prevent damage from trampling and grazing. In unfenced areas, such as the Highland glen prior to enclosure, it is easiest to remove the animals to other feeding grounds.

Summering the animals away from the low ground winter areas means that a large number of animals can be kept through the winter without the input of additional feeding stuffs. It also reduces the risk of diseases such as braxy that are due to mineral deficiencies or toxicity. The grazing animals are often able to compensate for deficiencies caused in one area if supplies are adequate in the alternative grazing area. The build up of parasites, both internal and external, can be a problem in regions that hold a year-round population of grazing animals. The removal of the animals from that ground for part of the year lessens the chances of parasites completing their life cycle, and thus prevents the build up of

parasite populations.

None of the points so far mentioned relates to the advantages of using mountain grasslands during the summer as opposed to any other pasture; they relate only to the advantages of summering animals away from their wintering grounds. The advantages of using mountain pastures in summer are related to the availability and the quality of the vegetation, except perhaps in relation to freedom from flies such as nasal bot flies and warble which is given more in mountain areas than in alternative lowland pastures.

In mountain regions which are relatively unmodified by man, such as in Veigdalen, grasslands are found in the zone above the low alpine dwarf shrub heath that lies above the tree line. Grasslands develop at lower altitudes, following the removal of woodlands by felling, burning and grazing. Nowadays, in countries such as Scotland, which have a long history of use by man, anthropogenic grasslands form a considerable part of the vegetation mosaic. However, in unmodified conditions, grasslands are characteristically found in alpine areas which are affected by snow in winter and spring. This means that, in virgin mountain areas, the only appreciable extent of grasslands is to be found at high altitudes which will be available only in summer.

Extensive montane grasslands are not the only reason for using mountains during the summer. Alpine and arctic plant species have special adaptations to enable them to survive. The summer and the effective growing season are short as a result of latitude or altitude. Therefore alpine and tundra plants have to grow rapidly to enable them to complete their life cycle within the short season available (Klein 1970, Bliss 1962).

In higher latitudes, at the height of summer, the hours of daylight are very long and this, combined with the cool nights, reduces the amount of catabolic night-time metabolism that occurs in the plants (Bliss 1962). At lower latitudes, and in more temperate regions where the hours of darkness are longer and the nights warmer, there may be a substantial reduction in the concentration of carbohydrates in the growing leaves. Grazing animals have periods, throughout the day and night, of high and low grazing intensity, which are related not only to their need to ruminate and rest, but also to weather conditions. These cyclic patterns of high and low grazing activity have been found in sheep (Arnold 1962), reindeer (Gaare et al. 1970), and probably occur in most grazing animals. The peaks of grazing activity usually occur in the early morning and early evening. The sheep in Veigdalen followed this sort of pattern. The reduction in catabolic metabolism may have an effect on the nutritional quality of the mountain vegetation in the early morning and, therefore, may be a slight added advantage to herds grazing on mountain plants. The importance of this in Scotland has not been investigated.

Mountain regions offer a great variation in the micro-environments available for plant growth. This diversity comes from differences in aspect, topography, exposure to the prevailing wind, the extent of snow lie and the base status and moisture regime of the soil. All these factors are interrelated and combine to give, not only a wide range of plant communities, but also great variation in the stages of growth reached by the plants at any one time. Plant communities on south-facing slopes, for example, will start growing at an earlier date than those on north-facing slopes. In

mountain areas there is, therefore, a great range of plant communities and nutritional quality available for the grazing animal to select.

The factors that influence the nutritional value of herbage are complicated; they are, furthermore, interrelated in such a way as to make a study of their separate effects very difficult. The six major factors as defined by Oelberg (1956) are:- 1) the stage of maturity, 2) edaphic influences, 3) plant species, 4) climate, 5) animal class, 6) condition of the range.

The type of animal (5) is important as the ability to select and utilise plant species varies between species. Non-ruminants, or mono-gastric animals, unless they have a well-developed caecum, as has the horse, are unable to utilize large quantities of roughage. Pigs fall into this category. Ruminants, such as cattle, sheep and goats, are adapted to the digestion of complex cellulose. Although the animal class is an important factor in determining the extent of utilisation of certain plant species, it is not a factor in determining the nutritional quality of the plants other than indirectly through the influence of defoliation, trampling and manuring.

The stage of maturity of the plant (1) is one of the most important factors affecting the chemical composition and thus the digestibility of the plant. At the early stages of growth, pasture plants are more succulent and have a high crude protein content in relation to crude fibre. As the crude fibre content increases with maturity, digestibility decreases because crude fibre is resistant to breakdown within the rumen.

The absolute phosphorus content of the plant declines with increasing maturity and generally parallels the decline in crude

protein content. The absolute calcium content increases as the plant matures as it is a constituent part of crude fibre.

There are striking differences in the changes in nutritional quality (3) that occur in browse or shrub plants in grasses and in herb species. Browse plants are less affected by summer drought conditions as they have deeper rooting systems than have grasses and herbs. The chemical composition of browse species remains fairly constant through the winter as they are resistant to leaching and weathering by wind and rain. There is however, some translocation of nutrients from the leaves to the roots and a limited loss of nutrients and vitamins through leaching at the beginning of winter. The vitamin content of browse or woody plants decreases at a lower rate than in grass or herbs because vitamins, being particularly unstable, quickly disintegrate when the leaves and stems of grasses and herbs desiccate at the end of the summer.

Seasonal change alters the nutritional quality of herbs and grasses much more quickly than of browse or shrub plants. The nutritional value is highest in the early stage of growth and then declines very rapidly in grasses and herbs, whereas shrubs retain their nutritional value although they never reach such a high level.

Climate (4) affects not only the amount of incoming solar radiation but also rainfall. Allen, Carlisle, White and Evans (1968) found that the amount of nutrients coming down in the rainfall was related to the amount of rain and therefore varied seasonally. Although the macro-climate may be uniform over a large area, the topography, slope and aspect modify the effects of wind and the amounts of incoming radiation, precipitation and evaporation. Climate, therefore, affects not only the stage of growth in an area

but also the input and leaching of nutrients. Crude fibre is resistant to the action of rain and wind and does not leach; therefore the percentage of crude fibre in the plants increases and the digestibility decreases following leaching by rain.

There have been few studies to compare the digestibility and chemical composition of plant species grown in mountains and in lowland areas. Johnston, Beseau and Smoliak (1968) in a comparative study of alpine tundra vegetation in the south eastern Canadian Cordillera Mountains and in lowground grass fescue associations, found that the alpine tundra vegetation had a higher percentage of crude protein and phosphorus, a lower calcium to phosphorus ratio and a higher digestibility than the low ground vegetation at all stages of growth and was therefore of better nutritional value. Work done in Britain has been mainly concerned with the effects of altitude on the growth of cultivated grasses. Hunter and Grant (1971) used perennial rye grass Lolium perenne grown at altitudes of 125-570metres. The increase in altitude reduced the spring and autumn yields but had little significant effect during the summer. It would be interesting to study the differences in nutritional quality of plant communities at different altitudes using plant species indigenous to those altitudes and adapted to those environmental conditions, rather than using an introduced lowground species as Hunter and Grant did in their work.

In addition to the lack of comparative studies of the nutritional quality of mountain and lowground vegetation, there are few studies of the digestibility and chemical composition of mountain plants. Oresteinsson and Ólaffson (1965) made a study of the digestibility and chemical composition of Icelandic range plants to

see how they varied through out the year. They found that heather Calluna vulgaris, had a fairly constant crude protein content of about 7% throughout the year and its level of digestibility varied little, from 29% in April to a peak of 45% in June. The water soluble carbohydrate content was also constant ranging from 12% in May to 8% in the mid winter month January. The grass species Festuca rubra, Deschampsia caespitosa, Agrostis tenuis and Poa pratensis, all common in the Scottish mountains were much more variable. The crude protein content rose to a peak in early summer of about 22% falling to 8% by mid August and then to a low level of 3-4% in winter. The sedge Carex rostrata and bog cotton grass Eriophorum angustifolium did not have such a high peak of crude protein content in early summer, only 12%, but fell only to 5% in winter.

Cecilia Littlewood (1971) studied the comparative feeding habits of the red grouse Lagopus lagopus scoticus and the mountain hare Lepus timidus in relation to the nutritional quality of the vegetation in an area of the Pentland Hills and found seasonal differences.

Gardarsson and Moss (1969) looked at food selection by Icelandic ptarmigan Lagopus mutus in relation to the availability and nutritional value of the food. In Iceland the vegetation starts to grow by May and Gardarsson and Moss found that there was an improvement in the nutritive value of the plants from their over-wintering state and this was reflected in the change in the plant species selected by the ptarmigan.

It has been found that the wild reindeer Rangifer rangifer of Hardangervidda in the south of Norway select plants that are either at an early stage of growth or are the most nutritious available.

In late spring they graze on mire communities selecting the still green stems of Eriophorum sp. As the snow melts on the ridge communities they switch to stripping leaves from the dwarf birch Betula nana which is one of the first species to start to grow in spring. As the summer progresses they change and graze on grass dominated communities on south facing slopes and then on the north facing slopes; by late summer they are grazing on the snow bed communities dominated by the dwarf willow Salix herbacea (Gaare et al. 1970).

Mountains offer a wide range of plant species and a diversity in the stages of growth of the plants through the summer. Grass and sedge dominated communities are naturally found in the middle alpine zone and are of higher nutritional value than scrub plants for a short time at the beginning of the growing season. The system of transhumance used in mountain districts such as the Alps, the Scandinavian mountains, the Highlands of Scotland and on many other mountain regions of the World, such as those of Chile and Tibet, utilise the high quality vegetation that is available in these areas for a short time in the summer. The animals are moved up to the mountains to be there when the vegetation associations there are at the peak of quality. As the grasses mature, flower and decline in quality rapidly, the period spent in the mountains is relatively short. When grassland types mature other species such as shrubs and trees become more attractive to the animals and are of better food value. This, in addition to deteriorating weather conditions means that the animals move to the lower altitudes and start to graze on different plant communities. This pattern could be very clearly seen in Veigdalen, Norway; by mid August the grasses

had started to turn brown after flowering, and the sheep and cattle had begun to browse on the leaves of birch Betula pubescens and to strip off the leaves of the arctic willows Salix sp. By the end of August the animals had started to move down to the lower woodland pastures.

CHAPTER 3.

PHOTOGRAPHS IN CHAPTER 3

1 Øvre Eidfjord, low ground farm looking south through Hjölmodalen, September

2 Viveli farm in Veigdalen, 950 metres, September.

3 Hedlo Seter in Veigdalen, 1000metres, September.

4 Sandvad, in Veigdalen, used as a farm at the end of the ninetee-nth century, then as a seter, 1000 metres, August.

5 Øvre Bøvre, old wooden barn for housing the domestic animals in winter.

6 Hay meadow cleared out of the woodland, at Øvre Bøvre.

7 Browsed juniper bushes Juniperus communis near Tveiti Seter, Øvre Bøvre.

8 Low ground farm in West Norway, hay drying on racks, July

9 Fargeli Seter, summer grazing area for Øvre Bøvre 1100 metres July

10 Fargeli, a seter hut made of boulders and roofed with slates.

11 Hadlaskard, a seter hut made of worked stones and roofed with turf.

12 Fljodal, a seter hut made of wood, boulders and roofed with turf and birch bark.

13 Oyni Seter, spring autmn seter for Hedlo, now a holiday house, structure to the left is a pig sty.

14 Storlie Seter surrounded by former hay meadows, looking north to Oyni sete

15 Cheese store at Bao Ster.

16,17 & 18 Tveiti Seter, spring autumn seter for Øvre Bøvre.

19 Rjoto Seter showing the willow shrubs Salix sps. that have grown up since goats were grazed in the area in the 1930's, September.

20 Rjoto Seter new seter hut built in 1920's surrounded by seter meadow, August.

21 Rjoto Seter, close up of seter green, tall clumps of Deschampsia caespitosa and shorter sward of Poa alpina, salt lick.

22 Steinstolen, traditional method of milking goats.

23 Steinstolen, Cheese store and fuel collected for cheese making.

24 Ridge vegetation of type Arctostaphyleto-Cetrarion nivalis.

25 Willow shrub vegetation of type Lactucion-alpina with snow bed communities of types Ranunculeto-Oxyrion digynae and Nardeto-Caricion bigelowii.

26 Oligotrophic birch mire vegetation of type Oxycocco-Empetrion hermaphroditi.

27 Cow browsing birch Betula pubescens, mid August.

28 Localised erosion in an area used by sheep.

29 Birch Betula pubescens and willow scrub on an island in the River Veig, free from grazing in summer, September.

30 Langdalen Seter, coarse grasses such as Deschampsia caespitosa have come in since the seter was used by cattle, July.

31 Birch woods used by sheep in June and September, looking north to Eidfjord, September.

32 Spring - autumn seter for Øvre Eidfjord in the birch woodland to the north of Viveli, 950 metres, September.

VEIGDALEN, NORWAY - A STUDY OF SETER TRANSHUMANCE

This study is mainly concerned with the details of animal management, the types of animal used and their production and the location and ownership of seters. There is a lack of information in the contemporary Scottish literature on these aspects of shieling transhumance[1]. A field study was made to see how the grazing animals used the mountain vegetation during the summer.

The mountains of Norway and Scotland are fairly similar and the problems of operating a subsistence pastoral system are almost the same. It is probable, however, that the Norwegian mountains are more productive. Also in Norway the animals had to be housed in winter, which was not always so in Scotland.

In Norway there is very little ground suitable for cultivation except in the Trondheim and Oslo districts. Until recently altitudinal transhumance has had to play an important role in the agricultural economy, especially in the west and central parts of the country where the valleys are narrow and steep sided. As the valleys are the only areas in which people can live all the year round they have been, everywhere, cultivated and settled. Despite the lack of arable ground, there are abundant pastures in the mountains of Norway, available for grazing from the end of June until September. Transhumance, using mixed herds of cattle, sheep and goats, continued until well into this century. The domestic animals were housed until the snows melted at the end of May and then they were taken to the woodland pastures above the farms for a month or six weeks as was the custom in the Swiss Alps. These spring-autumn

1. See Chapter 4.

seters were usually within easy walking distance of the farm. At the end of June when the snow has partly melted in the mountains the animals were taken to the high pastures for the summer. There was much regional variation in the patterns of transhumance practiced in Norway and these have been studied in great depth by Lars Reinton (1955,1969).

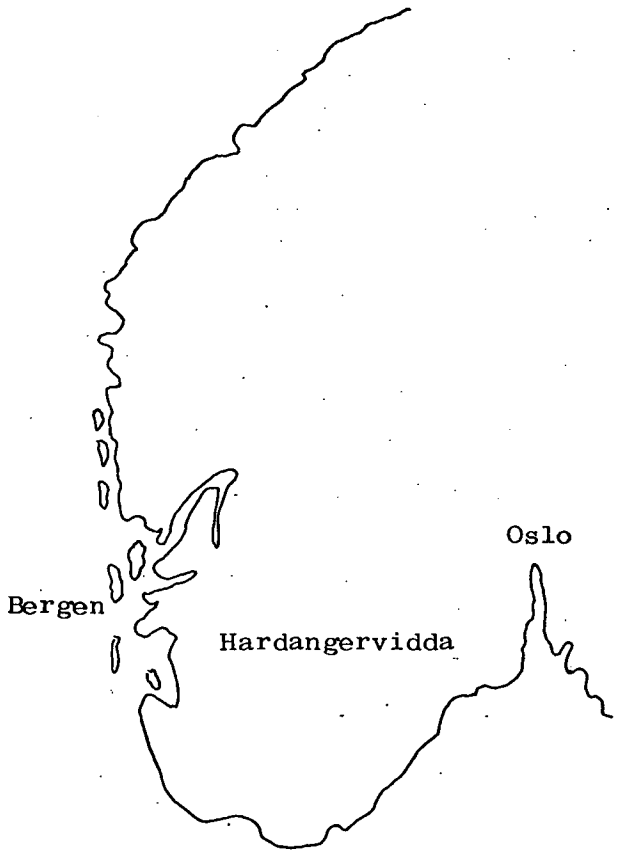
There were still examples of near subsistence farming in the more remote valleys in Norway until the last war. But in the more accessible valleys and valleys with roads through them, trading had become important earlier on with the development of urban centres such as Oslo, Trondheim and Bergen.

Many of the valleys in the west of Norway have never been totally self-sufficient especially in years of bad harvest, as they were unable to produce all the corn that the people required. Life in the Norwegian valleys was very similar to that in the Highlands, which is not surprising as the environmental problems that had to be contended with were comparable. The farmers were dependent on their domestic animals, their crops, fish and game. Grain often ran out before the end of the year and they had to buy it in exchange for skins, live animals and dairy produce.

Since the turn of the century, many farmers have given up transhumance and instead of taking their dairy cows to the mountain seters they allow them to graze through the summer on the low ground pastures. Improved winter feeding and centralised state dairies have meant that the cows are calved during the winter giving the peak of lactation earlier in the year than formerly, when the cows were calved in late spring. Many farmers have now changed over to flocks of sheep instead of cows. These flocks are still sent to the seters in summer. When predators, such as wolverine Gulo gulo were common

the farmers would employ shepherds to look after the sheep during the summer, but now there is much less shepherding. Goats are still sent to the mountains, but nowadays they usually go to collective summer seters. This system is used primarily to remove goats from the low ground, in order to lessen the conflict with forestry interests.

MAP I.





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3

DESCRIPTION OF VEIGDALEN - THE SUMMER GRAZING AREA FOR THE FARMS OF ØVRE EIDFJORD AND EAST SORFJORD

The area of summer seters that was chosen for this study was the upper part of the valley of the River Veig. Veigdalen lies on the north west of Hardangervidda, a large plateau region in the south of Norway, mid way between Oslo and Bergen. The valley of the River Veig, Veigdalen, is approximately 12 km long; the river rises under the mountain Hårteigen and runs due north descending into the low valley at the water fall Valurfossen, going out through the deep valley of Hjölmodalen into Eidfjord.

Veigdalen runs north-south, falling from 1,100 metres at Hadlaskard to 900 metres at Viveli. The underlying rock is granite with an over-lying layer of basalts. The distribution of base rich basalts affects the vegetation very greatly; there are areas of calciphile vegetation on the peaks of the mountains Haraldshaugane, Trongaskardnutane, Rjupehauge and Store Grananutane, and also in the areas lower down that are fed by streams coming off these richer areas, e.g. Hedlo and Hadlaskard Seters. At the 1,200 - 1,300 metre level the decomposing rocks release nutrients and develop a soil that is rich in bases. In areas that do not have a steady input of nutrients the vegetation is adapted to nutrient deficiency and is less diverse.

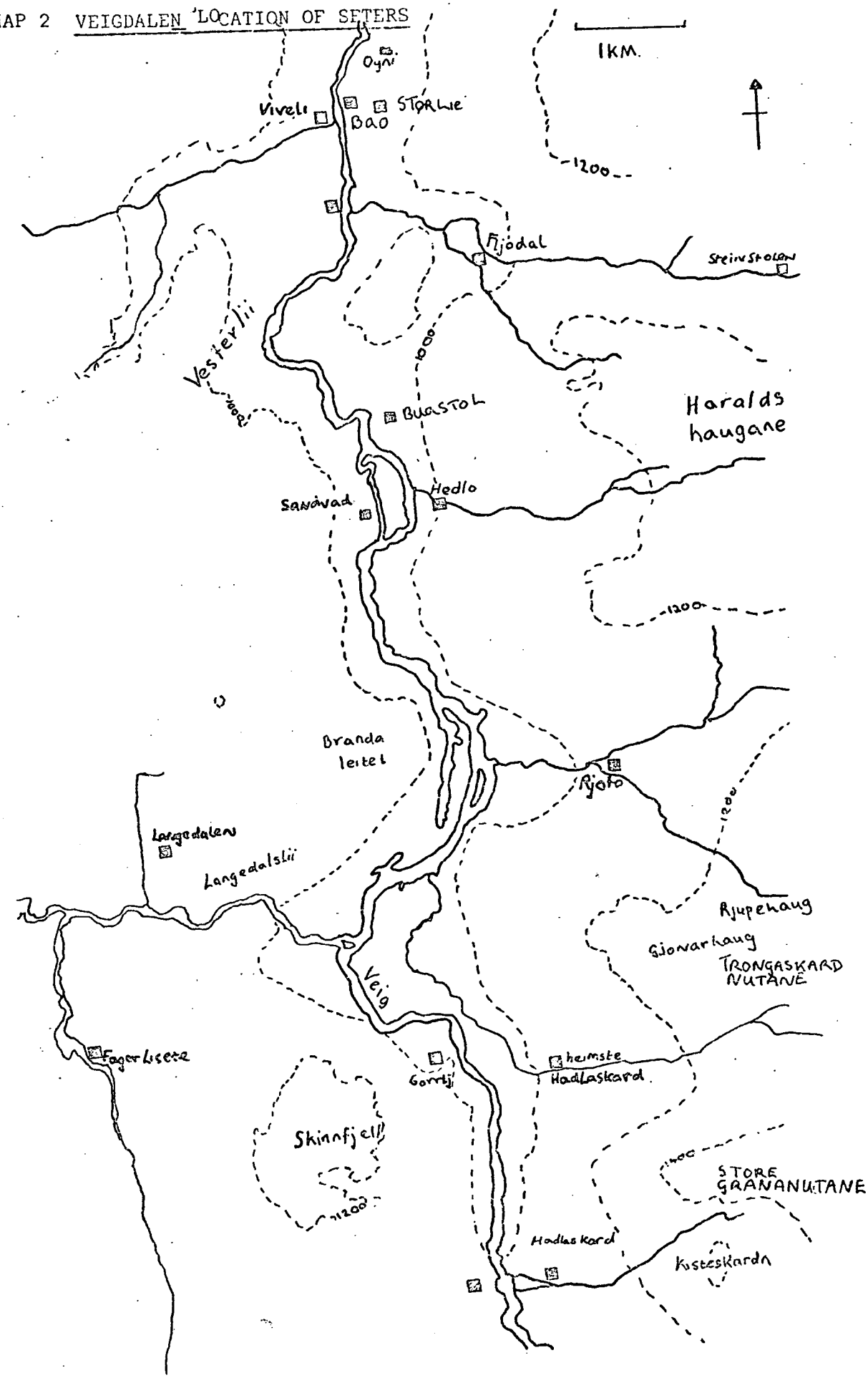
There are high mountains to the west of Veigdalen rising to 1,450 metres and there are also a large number of small lakes. To

the east of Veigdalen the mountains have been eroded and are not so high; the terrain changes to the flat open Hardangervidda. Veigdalen can be thought to lie on the transition zone between the oceanic west of Norway and the continental east represented by the true Hardangervidda. This is reflected in the vegetation: in the east there are extensive lichen heaths and large areas of vegetation dominated by dwarf birch Betula nana; to the west there are extensive grasslands and some wet heath communities.

In Veigdalen birch trees grow up to 1,050 metres in favourable south-facing sites that are away from seters, e.g. Langedalslii. But in areas such as the region to the north of Hedlo Seter, the tree line has been depressed by a long history of felling and grazing. There are still some large mature birch trees, but most have been felled. Regeneration has been accelerating since the reduction in the number of domestic animals grazed in the area and also since wood is no longer needed for fuel. On Hardangervidda the traditional technique for making cheese involves simmering the milk for many hours over a low fire, the fire had, therefore, to be constantly fed. If mature trees were not available willow, young birch, dwarf birch and any other woody species had to be used. Cheese is still made at Steinstolen in this way and the immediate area has been largely cleared of woody vegetation. Goats add to this destruction. At Rjoto Seter for example dense willow thickets have grown up to two metres high since goats stopped being brought there in the 1940's.

The largest herd of wild reindeer in Scandinavia is on Hardangervidda and consists of about 10,000 animals. The herd size fluctuates considerably in response to food supply and hunting

MAP 2 VEIGDALEN LOCATION OF SETERS



pressure. The reindeer in the north of Norway are semi-domesticated and are herded by the Lapps[1]. The Hardangervidda reindeer are also migratory in so far as they winter in the east of Hardangervidda sometimes grazing in the birch woods. This is because in the continental regions, lichen which is the main winter food of the reindeer, grows well. In early spring the reindeer cows move to the western region, as the snow melts there first. Calving takes place in May around the mountain Hårteigen, and afterwards, in early June, the cows and calves come down into Veigdalen to feed on the newly leaved dwarf birch Betula nana. In early summer the reindeer cows and calves move about in small units of 100 animals while the bulls are in separate herds. As the snow melts in the central plateau and the temperature rises the behaviour of the animals changes; the herds build up to several thousand and move about more rapidly. During mid summer they are to the east of Veigdalen moving considerable distances in response to changes in weather conditions and fly harassment (Gaare, Skogland and Thomson 1970).

There are said to be several moose Alces alces in Veigdalen in the winter but no sign of them was seen. There were large numbers of grouse Lagopus lagopus and ptarmigan Lagopus mutus and also some mountain hares Lepus timidus. The presence of small grazing animals in the area was indicated by the damage to small birch Betula pubescens, less than a metre in height, that occured in winter.

Veigdalen had been used as a summer grazing area for herds of dairy cattle, sheep and goats for many hundreds of years. The area to the west of the river belonged to the farms on the east of Sorfjord and the area to the east of the river to the Eidfjord farms.

1. See the discussion of Reindeer Lapps in Chapter 1, page 24 .

The agricultural pattern of both the Sorfjord farms and the farms of Øvre Eidfjord as studied, in particular the farm of Øvre Bøvre on Sorfjord, because information on the present management of the sheep was most easily obtained from these farmers.

DESCRIPTION OF THE FARMS AND THE PAST AGRICULTURAL SYSTEMS

SÖRFJORD FARMS WITH SPECIAL REFERENCE TO ØVRE BØVRE

On either side of Sörfjord the hills rise steeply to 1,000 metres. The farms have had to be developed on the small amount of flat ground along the fjord side or on ledges at around 200 metres. Sörfjord is a salt water lake, that runs north-south and this orientation, with the steepness of the surrounding hills, reduces the hours of sunlight considerably in summer. The district is still densly wooded except where trees have been cleared for agriculture. Lower down the woods are very mixed with rowan, introduced norway spruce, ash and birch as well as other tree species.

Until the last war, all the farm houses at Øvre Bøvre were built in a group and when a man married he would build a new house within the same complex as his father. The eldest son of the family would eventually inherit the family house, but the farm itself would be split to some extent to accommodate the younger sons. The farmers in one farm group were usually related, but not necessarily. They still often use as a surname the name of the farm, the farmers of Børve, for example, are called Bøvre. Since the war this system of communal farms has gone; now each farmer has a separate holding with a farm house and barn on his own piece of land.

Sörfjord has long been one of the best soft fruit growing areas

in Norway. Fruit is collected at depots along the road side and sent off to the Bergen and Oslo markets. Strawberries, raspberries and currants are the most important fruits, but cherries, apples and plums are also grown.

Until the end of the last war each family had a herd of dairy cows, some sheep and a few horses. Goats have never been kept in this area in any numbers because of the damage they would do to the fruit trees. The farmers have small flocks of about fifty ewes. The lambs are sold in autumn of their first year and the wool and the meat are equally important.

ØVRE EIDFJORD FARMS

The situation is rather different on the farms of Øvre Eidfjord at the lower reaches of the River Veig. The granite mountains rise almost vertically from the river and there is very little low ground. Until recently potatoes, barley and rye were the most important crops grown, and cattle were the most important animals. The farmers had sheep and goats but mainly for their own domestic use. The valley had never been able to supply all the corn that it needs and in the past the farmers had to sell cattle in order to get extra corn.

Until the beginning of this century the farmers of Øvre Eidfjord brought cattle from the coastal districts in spring and grazed them in Veigdalen for the summer, and then, in autumn, drove them across Hardangervidda to the markets in the east. The Myklatun family from Øvre Eidfjord, the owners of Hedlo and Rjoto Seters, began droving in 1830. They would take 70-80 cows from Veigdalen each September across the vidda to the market at Kongsburg. The journey took fourteen days and they had to spend each night at

pre-arranged places, which they rented each year. The profit to be made from droving varied a great deal; in bad years, when there had been a poor harvest in the eastern part of Norway, there would be little money available to buy cattle and also little surplus corn to sell to the farmers from the west. Cattle drovers were not the only people to cross the vidda; traders from Eidfjord went over Hardangervidda in winter on sledges carrying salt and manufactured products to exchange for cloth and grain. The opening of the Bergen-Oslo railway, early in this century, put an end to this sort of trading as the farmers from the east prefered to come over and to choose the animals themselves.

It is not clear when dairy products, such as fresh milk, butter and cheese began to be sold commercially from the farms of Øvre Eidfjord, but certainly by the end of the nineteenth century buyers were coming from Bergen and Haugesund on the coast to buy meat and dairy produce. In spring and early summer before the animals went up to the mountains, fresh milk could be sold; once the animals were in the mountains, the milk had to be processed into cheese or butter so that it could be carried back to the lowground farms each week.

There is a valuable local history of the farms on the east side of Sorfjord in the districts of Odda, Ullensvang and Kinsarvik by Olav Kolltveit (1971). Unfortunately the Eidfjord farms have not yet been covered by one of this series of local histories. There is, however, a survey carried out by the History Museum of the University of Bergen (1971), as part of a major study programme on Hardangervidda, that proved very useful in giving historical background.

Kolltveit (1971) gives population figures for each of the farm

groups from the seventeenth century to the present time and also gives figures for the number of domestic animals on each farm, which proved useful for showing the changes that have occurred.

Four farm groups are chosen to illustrate the changes that have occurred. Two of the group, Opedal and Helleland, are on the low ground by the fjord and are on the main road; they have now developed into service centres serving the growing tourist trade and the needs of the locality. The other two farm groups, Nedre and Øvre Bøvre and Eidnes, are still farming communities and lie higher up further from the road. The system of standard stock units, which is used later in comparing the changes that have occurred in the Scottish study area in Ross-shire, is used here to show changes in the ratio of domestic animals to people (appendix 1).

Table 1 shows the changes in the human population and Table 2 shows the changes in the number of stock units per person. There has been a gradual increase in the human population, at least from the mid seventeenth century. At Bøvre a peak of 164 people was reached in 1865 and the population has now fallen to the level that it was at the beginning of the nineteenth century. It is not easy to say when the maximum agriculturally supported population was reached but in Table 2 there appears to have been a drop in the stock units per person in the last half of the nineteenth century. At Bøvre for example (combined Nedre and Øvre Bøvre) the ratio of stock units per person was 0.92 in 1875 which was the lowest figure reached. At this time the human population was nearly at its highest and the total number of animals or stock units held on the farm was also at its highest. One cannot judge whether or not the total number of animals that could be supported at Øvre and Nedre

TABLE 1 POPULATION 1650 - 1950

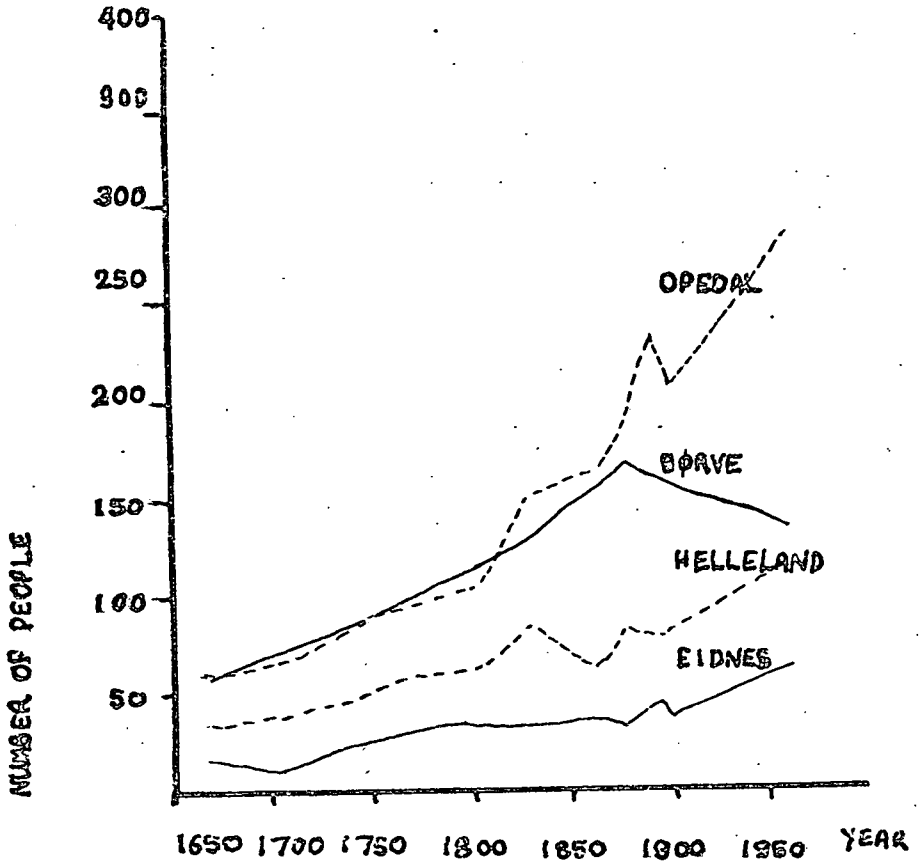
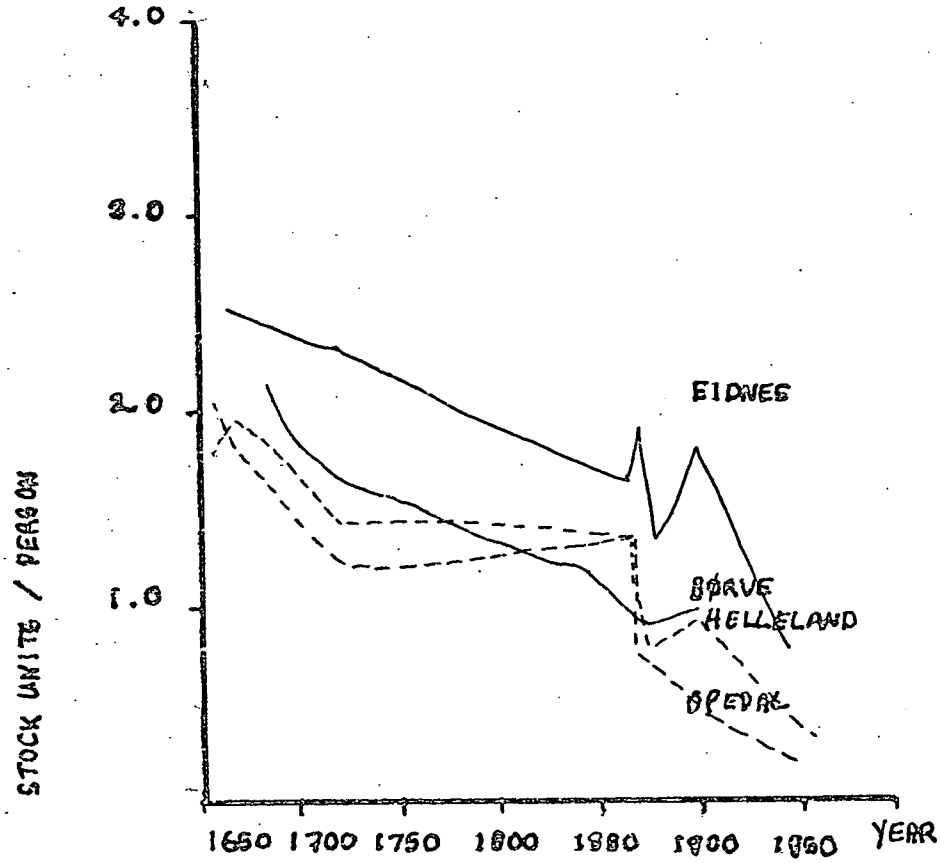


TABLE 2 STOCK UNITS / PERSON 1650 - 1950



FARMS OF EIDNES, BØVRE, HELLELAND AND OPEDAL (Taken from Kolltveit 1971)

TABLE 1 Number of people

	1664	1701	1748	1801	1825	1865	1875	1891	1900	1960
Helleland	33	36	50	65	84	62	81	73	80	119
Opedal	60	65	90	109	150	162	184	231	209	284
Eidnes	17	12	22	29	33	35	34	42	37	63
Bøvre	56	70	88	114			168		155	134

TABLE 2 Stock units / person

	1657	1667	1725	1865	1866	1875	1900	1955
Helleland	2.06	1.81	1.20	1.37	1.17	0.70	0.93	0.34
Opedal	1.8	2.0	1.46	1.38	0.79	0.71	0.54	0.27

	1651	1667	1723	1865	1866	1875	1900	1955
Eidnes	3.7	2.5	2.36	1.67	1.92	1.36	1.8	.86

	1675	1700	1750	1800	1850	1875	1900
Bøvre	2.17	1.84	1.53	1.34	1.19	.92	.99

Bøvre was in the order of 160 stock units, the highest figure reached. However, 0.92 stock units per person seems to be a very low figure; but by this time potatoes were being grown in the area and would have supplemented the diet of the farming communities. Furthermore if this area followed the pattern of changes that occurred in Øvre Eidfjord in the late nineteenth century, trading with the growing towns nearby would have reduced the dependence on cattle.

During the last half of the nineteenth century some of the more productive seter areas came under permanent cultivation and settlement. There was a farmer who settled at Sandvad Seter for a short time during the last part of the nineteenth century, but the living was too hard, and he and his family emigrated to America. At this time it was very common for the younger sons of farming families to emigrate owing to land scarcity. This was similar to the emigration that occurred in Scotland towards the end of the eighteenth century and during the nineteenth century.

Photo 4. Sandvad Seter - Old Farm House.



TYPES OF DOMESTIC ANIMALS KEPT AND THEIR PRODUCTION

SHEEP

The old Norwegian sheep were very similar to types of primitive sheep found in Scotland[1]. There is a small flock of old Norwegian sheep at the Norwegian Agricultural University at Ås near Oslo. These animals are lightly built, with fine heads and long thin legs; their coats are made up of two types of hair, a dense under coat of short hairs and a fine outer coat of long straight hairs. They have only two horns, unlike the Icelandic sheep which have up to six horns, and they are black and brown in colour. It has been suggested that some of the types of primitive breeds found in Scotland developed from these Norwegian breeds (Walker 1812).

The ewes used to be milked and produced less than two kilograms of butter in a summer. The sheep had to be kept in enclosures at night because of danger of predators, and either the lambs were kept apart from their mothers at night and the ewes were only milked in the morning, or the lambs were kept with the ewes at night and these were only milked in the evening. Sheeps' milk was mixed with the goats' milk to make cheese because it has rather a sharp taste.

The sheep bred in Norway nowadays are much larger than the little unimproved breeds, as sheep from Holland as well as cheviots and other breeds have been introduced. In the past the sheep were only kept for domestic purposes, but now they are sold for both meat and wool.

In 1972 the farmer at Øvre Bøvre had a flock of 41 ewes with 68 lambs. The lambs were born at the end of April and the beginning of May. They were weighed on June 1st with a spring balance, to the

1. See description of old Highland sheep in Chapter 4, page 178.

nearest kilogram and then again when they had returned to the farm from the mountains in mid October, before being sent to market.

Each year twelve lambs are kept for replacement and a similar number of old ewes are sold. In the summer of 1972 five lambs died in all, three before being taken to the mountains and two in the mountains; also one ewe was lost at lambing. The lambing percentage was therefore 158.5% in early summer and 154% at the end of summer.

The average amount of weight gained per day from June 1st to October 15th was 0.517 lbs.

	Mean	Standard Deviation	Standard Error
Age on June 1st	38 days	6.03	0.73
Weight on June 1st	16.7 Kg	2.9	0.36
Weight mid October	49.2 Kg	5.8	0.74
Weight gain	32.3 Kg	5.1	0.64

(The discrepancy between the two mean weights and the mean weight gain is due to the death of five lambs).

It is interesting to compare this with the growth rate of blackfaced lambs kept on hill ground in Scotland. In Scotland the lambs are also born at the end of April, but outside, the mean birth weight is between 8.8 and 9.2 lbs. (Eadie, pers. comm.). The lambs are sold to low ground farmers for fattening for the meat market in mid August, when they weigh in the order of 55 lbs. The mean growth rate is between 0.4 and 0.43 lbs per day. The mean weight at 38 days is therefore 25 lbs (11.5 Kg). The Norwegian lambs are not only larger at 38 days by 45%, but have a growth rate that is

20% higher than the blackfaced lambs. The difference in the actual weights of the lambs would be due to better winter feeding and the fact that Norwegian sheep are kept inside in winter in a controlled environment. However, the weight gained in the summer is due wholely to the quality of the woodland and mountain vegetation and to the Norwegian system of management.

CATTLE

The type of cow used under the old system was much smaller than those kept now. The old breed of cows was adapted to living in the mountains and were very light and were agile over rocky terrain.

The milk production was low, only about 4.5 litres or 1 gallon per day in summer. However, the butter fat content of the milk was very high, especially during the summer, when the cows were grazing on the mountain pastures[1]. In winter cows were deemed to be more important than the sheep or the goats and got preferential treatment. Branches of trees, such as birch Betula pubescens, aspen Popula tremula, rowan Sorbus aucuparia, willow Salix caprea, and bird cherry Prunus padus were cut at the end of summer and fed to the cattle in winter. The dairy cows got the youngest shoots, whilst the sheep got the older parts. Lichen Cladonia rangiferina and C. alpestris were collected at the end of summer and were also fed to the cows in winter. Later on herring meal was mixed with the lichen to increase the protein content of the diet. This was given in addition to the hay that had been made on the low land and also at the spring-autumn seters. This diet had a high fibre

1. See discussion of the milk yield or old type of Highland cow, Chapter 4, page 176 .

content but was very low in protein. The animals lost weight during the winter, and the cows were unable to produce a calf every year. The animals also took much longer to mature than they do nowadays. Conditions were very similar to those in the Highlands before 1800, except that in Norway the animals had to be kept inside in winter because of the snow. This varied in Scotland, but in many parts the animals were only housed at night and were allowed to roam at will through the woods and on the arable land in winter.

In Norway it is interesting to learn that each farmer had rights to certain trees and some trees such as Wych elm Ulmus glabra sp. montana were considered to be particularly valuable (Myklatun, pers. comm.).

GOATS

The goats kept fifty years ago, in Norway, were probably fairly similar to those kept today, except that they have been selectively bred for qualities such as increased milk yield. The goats at Steinstolen in Veigdalen are kept inside for most of the year. While inside they are fed on concentrates, as well as hay and silage. The value of goats' milk lies in its taste. Research is being done at the Norwegian Agricultural University at Ås to find out what the factors are that control the flavour of the milk. The farmers find it profitable to keep goats as dairies pay 45% more for goats' milk than they do cows'. This is because goat whey cheese is very popular in Norway. The average yield per goat per year has risen from 150 kg in 1907 to 350 kg in 1968, as the result of improved feeding and selective breeding (Opstvedt 1967).



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MANAGEMENT OF THE ANIMALS

During the winter, from the end of October until May, the animals are kept inside in large two storey barns. The upper storey is used to store the hay and silage made on the farm in the summer and also agricultural machinery, and the lower storey is used for the animals. The sheep are kept in small pens for seven or eight and there are stalls for the cows and horses. Nowadays it is easy to control the diet of the animals in winter. Concentrates are used on some farms, but on the whole the farmers rely on the hay and silage that they produce in summer. In the old days, late winter was a very critical time of year for the animals as the level of winter nutrition was very low; many died in March and April. The young were born in the late spring and the animals were let out to the spring pastures as soon as possible afterwards. Nowadays, with improved winter feeding encouraged by government subsidies, it is possible for the cows to calve earlier and for the peak of the lactation period to be in winter when the cows are still indoors. This makes the marketing of the milk much easier and reduces transport costs, as the fresh milk can be sent direct to state owned daries. Dairy cows are now only sent to the mountains where there are access roads or where the milk is needed for tourists.

At Øvre Bøvre the pastures around the home farms are free from snow in May and soon after the lambs are born the sheep are sent out to graze in the area of the old spring-autumn seter, Tveiti[1]. The seter area has been divided since 1945 into small paddocks for

1. See description of Tveiti Seter on page 119 .



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each farmer and they take great care to use the available pasture in the best way, by moving the sheep each day from one pasture to the next. Certain areas are reserved for hay and silage. The grass is cut and either stored in large silos or hung to dry on wires. In the old days, hay was made in this way on the low ground, but in the mountains, it was just dried on the ground and stacked in small heaps.

By the end of June some of the grass dominated communities in the mountains are free from snow and have started to grow. The Bøvre farmers nowadays take their sheep to the summer grazing area at Fargeli in a common flock of 500 animals. Each ewe wears a numbered collar and bell and has a distinctive flock ear mark similar to those used for the Ronaldsay sheep in Orkney. It takes the farmers the best part of two days to travel the twenty five kilometres to Fargeli. They spend the night at an intermediate bothy at Monkabu (The monk's cow seter). The area over which they travel is covered with small lakes and streams, and offers no good pasture for the flocks.

Fargeli has been the main grazing area for the farms of Øvre Bøvre for 200 years. It lies at 1053 metres sheltered to the west and south by hills. Two rivers flow through the area and the soil is rich, well drained, alluvial sand. When the area was used for dairy cows, the farmers had grazing for 170 cows and 300 sheep. Now only the 500 sheep are summered at the seter.

Sea planes are used to bring supplies to the remote seters as they can land on the numerous lakes in the area. Although the sheep are not shepherded continuously throughout the summer many of the farmers come up to Fargeli for a few weeks in August for a

holiday to fish for trout in the lakes and streams, and to check up on their sheep. There is some summer mortality, in some cases due to infections of the udder caused by change in diet; however, mortality is now relatively low[1]. Each farmer's flock appears to stick to a definite range although some animals wander. In mid September the farmers go back to Fargeli to collect their sheep. On their return, the lambs are kept for a few more weeks on the home pastures before they are sold for slaughter. By the end of October winter is beginning to set in and the animals are put into the barns again.

Some of the west coast farmers allow their sheep to make their own way to the summer grazing areas, twenty five kilometres away, on the west of Veigdalen, but the sheep are collected at the end of the summer to ensure that none is lost. The system in Øvre Eidfjord is similar to this, because there is little uncultivated ground suitable for grazing in spring and in autumn, close to hand. So the sheep are allowed to make their own way up to the mountains. They spend the late spring in the woodlands and by July most of them have reached the high grazing area in Veigdalen. There were some sheep in the mountains, at Fljodal, Steinstolen and Rjoto seters in Veigdalen, by the middle of June when there were still reindeer in the valley.

Cows are taken to the two seters in Veigdalen that are used as walkers' hostels, Hedlo and Hadlaskar in early July. The journey from the home farm takes at least eight hours as the calves are still young and the way is rough. The Eidfjord farms that had their

1. See page 110 .



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mountain seters at Hedlo, Rjoto, Heimste Hadlaskard and Hadlaskar had seters in the area of Viveli which they used in spring and autumn. These were used only for a very short period but were important for hay production.

Each farmer had the right to graze a certain number of cows at his seter. For example, there were three partners at Fljodal; two were allowed to keep twenty five cows each and the other partner was allowed to keep ten cows. One cow was thought of as being equivalent to six sheep or six goats (Myklatun, pers. comm.).

It has long been the custom to put out salt at the seters. In the old days, the dairy girls would put out salt for the ewes once a week and if the sheep did not come down for it the girls would go out and look for them, thus keeping track of their small flocks. The cows were given salt each day. Nowadays, the farmers put out mineral licks to encourage the animals to stay near the seters. The salt certainly attracts the ewes to the seters as is shown later in the discussion of the sheep grazing observations.

It is difficult to find out about why animals develop an appetite for salt. It did not appear to have been a usual practice in the Scottish Highlands under the shieling system. Very little appears to have been done on analysing the Sodium chloride content of vegetation in either Norway or in Scotland. Salt enters the system through precipitation: in the Norwegian mountains the major part of the annual precipitation falls as snow. The salt is, therefore, locked up in the snow until the early summer when it is released over a very short period of time. In Scotland rain falls through the year and there is, therefore, a continuous input of Sodium chloride into the vegetation. Denton (1965, p.251) writes

that 'The Sodium content of soil and plants may also be low in alpine areas due to leaching by melting snow. This may bear a relation to the well-attested appetite for salt exhibited by cattle that have grazed during the summer on mountain pastures'.

In the study area, there was a series of seters ranging from those within a few kilometres of the home farms to those in the high mountains. The seters close to the farms were used in May and June and then again in September and October, while the high mountain seters were used for eight weeks in July and August. The spring-autumn seters, such as Tveiti, were within the woodland zone or just on the edge of the woods, whereas the summer seters were either at the tree line or in the low-alpine shrub zone.

All the seters in Veigdalen were summer seters except those north of Viveli which were used as spring-autumn seters in conjunction with the summer seters further up the valley, Hedlo, Rjoto and Hadlaskard.

The Veigdalen seters on the east of the river are sited in areas of alluvial soil where streams come down to the river. As it is essential to have clean water for dairy purposes, all the seters are sited by streams. On the west side of the river there are only two sites that have been used recently. Viveli is a farm and is inhabited all the year round. Around each seter an area of grassy sward has developed as the result of grazing, trampling and manuring[1]. There is an area of 12.5 hectares around Fljodal seter which has been cleared of stones and artificially drained.

The seters on the east of the river are from two to four

1. See description of Rjoto Seter on page 124 .

kilometres apart. This distance must have been affected by the amount of grazing needed and also by the availability of suitable sites. Although nowadays, the Hedlo cows graze later on in the summer, at Fljodal Seter, when there were still cows kept at Fljodal, there was marked a dividing line between the areas the cows grazed and these boundaries were recognised by the cows. However, when cattle did graze outside their own areas there were arguments and feuds between the farmers and sometimes court cases over trespassing cows.

At the seters each family had two or three huts, one to live in and make cheese in, and at least one in which to store the dairy utensils and cheeses. Most of the seter huts were made of stone. The later ones were made of squared off stones, while the very old ones, such as the small semi-circular hut at Buastol to the north of Hedlo, were made of rough stones and often built into the side of the hill. Large semi-circular chimney breasts were built to accommodate the big copper pot used for making brown cheese. The huts were roofed with either large stone slates or with turf and bark. By 1972 many of the huts have lost their roofs.

One of the old stone huts is still in use at Steinstolen. It is dank inside and there are no windows, only a hole in the roof for light and air and to allow smoke to escape. The roof is lined with planks or wood and the walls on two sides are white washed. The floor is earth and there is a large box bed in one corner. Until recently dried willow branches were used for a mattress. There is also a dairy hut at Steinstolen, inside which there is a large number of shelves for storing the 'Geit Ost', or goats' milk cheese. The cheeses were kept in wooded presses for several weeks.



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Nowadays the milk at Steinstolen is kept in metal churns in the stream to keep cool, but in the past all the churns and other dairy equipment were made of wood.

Large numbers of churns, storage barrels and separating bowls were needed at the seters, so at most of the seter sites, there were several small huts used to store this equipment. Some of the cheese storage huts were circular. At some of the seters, there were byres for the cows, but this was not universal as often the animals were allowed to be outside at night.

SPRING-AUTUMN SETER FOR ØVRE BØVRE - TVEITI SETER

Tveiti seter lies at 425 metres in a cleared area above the farms of Øvre Bøvre, looking out westwards of Sorfjord. It lies in the mixed woodland of ash, hazel, aspen, plant Norway spruce and birch. Tveiti is one kilometre from Øvre Bøvre, but it is a steep climb. Much of the woodlands below the seter have been cleared of trees and stones, and are used for hay.

Tveiti was used as the spring-autumn seter for the cows of Øvre Bøvre until the late 1940's. Since then the farmers have given up keeping cows and now have flocks of around 50 ewes each. The cleared area around Tveiti has been fenced into separate paddocks for each of the nine farmers. In the old days, although they grazed their cows in common, each farmer had his own byre for housing the cows at night, early and late in the year when there was a danger of frost. The calves were weaned very early and fed out of buckets on diluted milk. They had, however, to be separated from their mothers at night to prevent them from taking milk. Sheep have



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not been milked in the area for several hundred years and the farmers had no memory of hearing about the practice. Sheep, up until the last war, were only kept to supply the family needs for meat and wool and were not sold commercially. They grazed in the area of Tveiti along with the cows in the spring and autumn.

The cows were milked twice a day. The women and girls who did the milking cameup to the seter every day and carried the milk down to the farm using ponies. In areas where it was not possible to have the spring-autumn seter within daily walking distance from the farm the girls stayed at the seter for the weeks that the cows were there. This is similar to the practice of staying at the mayens in Val d'Annivers in the Swiss Alps. The seter Orrasete for Nedre Bovre, the farm group lower down the hill to Øvre Bøvre, lies at 650 metres and as it is a very long steep climb from the home farm; there was living accommodation above the cows in the byres. An elaborate system of pulleys and chains was used to transport the milk in churns, down to the farm, as the path was too steep for ponies.

Description of huts

Number of hut	Width	Length	Other
1	4m	8m	Stone base with wooded upper portion, roofed with large flat stones.
2	5m	8m	Similar to 1. Stalls inside for nine cows.
3	4m	6½m	Ruin, evidence of fire.
4	3½m	3½m	Ruin, stone base remains.
5	4m	4m	Ruin, as above.

Description of huts - continued

Number of hut	Width	Length*	Other
6	3½m	3m	Wood and stone cow byre, roofed with flat stones. Three stalls 0.75m by 0.75m.
7	5½m	7m	Large ruin, stone base.
8	5m	?	Large ruin.
9	5m	8m	Similar to 2, room for ten cows.
10	5m	8m	Large ruin.
11	5m	8m	Similar to 2 and 9, stalls for eight cows.

* external measurements.

The smaller huts, for instance 4, 5 and 6, were probably used for storing the milking equipment. As the photographs show the buildings were well constructed of stone and wood. Other seters visited, for example some in the mountains to the south of Voss, were made solely of wood with wooden roofs covered with turf and birch bark. The seter at Fljodal in Veigdalen had one hut constructed in this way as is shown in the photograph.

VEGETATION AROUND TVEITI SETER

In the immediate area of the old seter building, nettle Urtica sp., chickweed Cerastium alpinum, buttercups Ranunculus acris and the grass species Poa annua and Poa trivialis were abundant. Further away from the building there were tall Juniper bushes Juniperus communis; these had long trunks that had been browsed and were free from branches, and in some cases had been bark stripped. Bracken Pteridium aquilinum was common on rocky patches. Further away from

the buildings there were fewer nettles and increased diversity of grass and herb species. The amount of grass that had been grazed closely also decreased further from the seter buildings. It was difficult to estimate how large an area had been affected by the seter as the woodland is still being cleared to increase the pasture for the sheep. Fire is not used to clear woodlands; the trees are cleared by hand using an axe.

Quadrats of 1 x 0.33 metres were used. The following is only a species list and gives no indication of abundance.

Immediate area of the old seter buildings

Woody plants	-	nil
Grasses	-	Poa annua Poa trivialis
Herbs	-	Ranunculus acris Trifolium repens Cerastium alpinum Achillea millefolium Urtica sp.

50 metres from the seter buildings

Wood plants	-	Juniperus communis
Grasses	-	Agrostis tenuis Deschampsia caespitosa
Herbs	-	Cerastium alpinum Trientalis europaea Potentilla erecta
Mosses	-	Rhytidiadelphus loreus

250 metres from the old seter buildings

This area did not appear to have been so heavily grazed, there were sheep in the area but they appear to have been concentrating their grazing activity to the area nearer to the seter buildings.

Woody plants	-	Juniperus communis Betula sp. seedling Erica cineria Vaccinium myrtillus
Grasses	-	Deschampsia flexuosa Nardus stricta Luzula pilosa Anthoxanthum odoratum
Herbs	-	Potentilla erecta Viola sp. Trientalis europaea Rumex acetosella Polygonium viviparum Pteridium aquilinum
Mosses	-	Polytrichium sp. Rhytidiadelphus loreus



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SUMMER SETER FOR ØVRE EIDFJORD - RJOTO SETER

Rjoto seter lies at the head of the valley Rjotodalen, just above the delta the Rjoto burn, where it enters the River Veig. The seter buildings lie at 1000 metres and are on either side of the stream. The area is sheltered on the south west side by cliffs; to the west are marshes with thick willow thickets that have developed since the seter stopped being used after the last war. There are two groups of huts; this is because there were two seter partners. The newest house was built in the 1920's and is partly constructed of wood, the other houses are of the traditional pattern and are representative of others in Veigdalen.

VEGETATION AROUND RJOTO SETER

Immediately around the wooden seter house there is a grassy sward, dominated by Poa alpina. Salt blocks were put out for the sheep in this area and thus help to concentrate the animals.

Immediate area of the seter hut

Woody plants	-	nil
Grasses	-	Poa alpina Deschampsia caespitosa (in large clumps not grazed) Deschampsia flexuosa Carex sp.
Herbs	-	Cerastium alpinum Polygonium viviparum Leontodon autumnalis

20 metres from the seter hut

Woody plants	-	Vaccinium myrtillus
Grasses	-	Deschampsia caespitosa

Herbs	-	Polygonium viviparum Cerastium alpinum Rumex acetosella Sibbaldia procumbens
Mosses	-	Polytrichium sp. Hylocomium splendens

The surrounding area was of the type Lactucion alpinae.

Number of hut	Width	Length	Height	Description
1	5m	5m	3m at centre 2m at walls	Stone bothy with a roof, walls 1.20 metres thick, door 1.5 metres high and 0.75 metres wide.
2	5m	5m		Two roomed ruin built into the hillside.
3	?	?		Small ruin facing southwest.
4	6m	9m		Animal house.
5	4m	4m		Ruin not built into hillside, door 1 metre wide and 1,5 metres high.
6	6m	6m		Living house.



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THE PRESENT SITUATION IN VEIGDALEN AND FUTURE TRENDS

Most of the seters in Veigdalen have not been used for dairy purposes since the war but three are still used. Hedlo and Hadlaskardare now hostels for walkers, and herds of five and six cows plus calves are kept there during the holiday season to supply milk. At the third seter Steinstolen goats are kept for six weeks at the end of July and the beginning of August. Goats' milk cheese is still made in the traditional way and the family still lives in the old seter huts under very primitive conditions. Sheep use the other deserted seters, in particular those where salt has been put out. Young cattle and yield cows are sometimes still sent to the seters for August but are unattended.

The primary land-use in the area is now recreation, which involves walking through the mountains in summer, skiing at Easter or reindeer and ptarmigan shooting in the autumn. 'Turist' in Norwegian means someone who walks in the mountains, and this form of recreation developed from very small beginnings. The first 'turist' hostel on Hardangervidda was opened after the first world war at Sandhaug, the summer seter of Viveli. Hedlo had been used solely as a cheese making seter until 1923, when the Norwegian hiking association (Norske Turist Forening) approached the Myklatun family and asked if they would cater for hikers over night. They agreed and in the summer of 1923 they looked after two hikers, in 1925 they looked after 70 and in 1972 the number was over 1000.

There is nowadays a network of marked routes across Hardangervidda linking the over-night stopping places. A number of the seters are now used exclusively as hostels. All the milk is used to supply the visitors and so cheese is no longer made. The tourist association

maintains the tracks across the mountains, seeing that they are clearly marked with red T's painted on prominent stones at intervals of 25 metres. The tracks usually follow the old drove routes across the vidda, however, not all the old routes are marked in this way. The tourist association also publish maps of the vidda showing the marked routes and giving some indication of the average number of walking hours between hostels. The maps also show the unmarked tracks through the mountains but the inexperienced hiker is advised to stick to the marked ones, as the others are often hard to follow. Food and fuel have to be flown in during the summer by sea plane or helicopter, or brought up by mechanical sledge in winter. Conditions in the hostels are simple and the food plain. Some of the hostels are un-staffed and the hiker has to collect a key before setting out on his expedition, but all have food and fuel supplied.

Norwegians of all ages like to spend part of each summer walking in the mountains. Most hostels are six to eight hours walk from each other, and the going is often rough. Although temporary bridges are put up each summer over the larger streams, quite often deep streams have to be waded. Each hostel keeps a strict record of where hikers have come from and where they are going, so that if weather conditions deteriorate it is known how many people are out on the hill and where they are likely to be. The hostels now keep in contact by radio telephone which enables rescue operations to be called out quickly. Despite these precautions, accidents occur, especially when people over estimate their strength. As weather conditions are more settled in Norway than they are in Scotland during the summer this form of holiday is

perhaps more feasible in the Norwegian mountains.

Until recently, the tourist hostels were mainly run by the farmer and his family, but with the increased pressure on use, some of the large tourist hostels are now run professionally, by the tourist association. Food and other supplies are flown in, three or four times a week.

The large number of people walking in the mountains brings problems such as erosion of paths and litter. The increase in numbers is likely to continue, as more and more people from Germany, France, Holland and the other western European countries discover the fine recreation areas of Norway.

Hardangervidda is state owned in parts, and other parts belong to the districts or communes. Many of the lakes and streams have very good trout, and fishing is a popular part of holidaying in the mountains. This is controlled by a system of licenses. In autumn, hunting for ptarmigan and reindeer is very popular, not solely for sport but also for food. A limit is set to the number of reindeer shot each year, and if necessary in some years hunting is stopped altogether. It is very difficult to enforce this and in years when hunting has not been allowed, poaching has increased to a very high level; in such periods not only are a large number of animals killed, but a high proportion are wounded and left to die in the winter. Another factor which encourages poaching is that the reindeer are herd animals and highly mobile; therefore, it is sometimes difficult for an owner with the right to shoot a fixed number of reindeer, to guarantee shooting his quota.

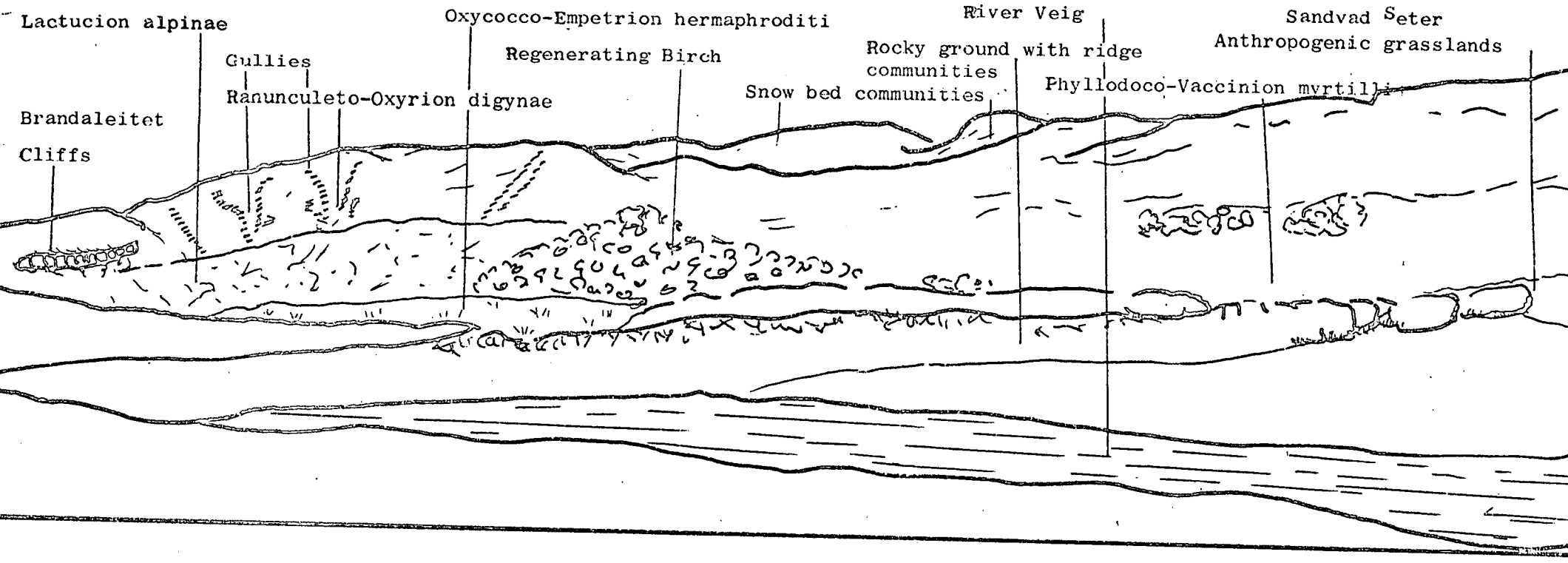
Similar systems of tourism and hunting occur in the other mountain districts of Norway, such as in the Dóvre Mountains.

Seter agriculture has almost died out, except in areas with good access roads. The seters are now either deserted and used by sheep, or used as holiday homes or hostels for hikers. Although Norway has few mineral resources, the large number of lakes and water falls means that water power can be used to generate cheap electricity. Many valleys have now been dammed and many river systems have been modified to supply water for hydro-electric schemes. There is a plan to flood the upper part of Veigdalen, in the area of Rjoto seter, to supply electricity for an aluminium smelting plant at Odda. Although this plan has been in existence since the early part of the century no agreement has yet been reached. A dam would not only destroy the amenity of the valley itself and destroy some valuable grazings, but it would cut off access to the central part of Hardangervidda as one of the few routes up onto Hardangervidda from the west, running through Veigdalen.

The form of tourism that exists now over Hardangervidda is based on the resources available and does not, at present, require the provision of additional facilities such as roads. However, with increased pressure of numbers, changes will come.

The area is still being used by domestic animals in summer but to a lesser degree than before. Soon it will be possible to devise a management plan for the wild reindeer herd to help maximise the use that is made of the plant and animal production in the area. It will be hard to implement such a plan unless poaching can be controlled. However, as neither reindeer nor sheep utilize the seters fully, the fertility that has been built up in the area in

ROUGH SKETCH OF NUHAUGANE AND SANDVAD SETER (Taken from a photograph)



the past will be lost. The changes that have occurred in Veigdalen will be discussed later with respect to the changes that have occurred in the Scottish study area in Ross-shire.

FIELD STUDY OF GRAZING BEHAVIOUR OF SHEEP

The first aim of this field study was to see what use the sheep made of the seters and the second was to get an idea of the type of vegetation the sheep grazed and how this changed through the summer. The study therefore fell into two parts.

1. A small flock of 33 sheep used Nuhaugane on the east of the river; they were observed each day to get information on their daily pattern, the use they made of Sandvad seter and the seasonal changes in the vegetation grazed. Sheep were recorded as grazing, walking, lying or standing and the vegetation type recorded. Notes were made on wind direction and speed and the afternoon temperature was taken. Some days it was possible to follow the sheep for the whole time they were visable, and on other days they were observed for only a few hours.

2. The sheep on the east of the river Veig were studied in order to get a broad picture of the use made of the whole area, from Viveli to Hadlaskard, the places they frequented and how this pattern changed through the summer. The area was walked at various intervals and the distribution and activity of the sheep recorded.

1. Description of Nuhaugane

Nuhaugane rises to 1203 metres, but the ground over 1,100 metres was not visible from the east of the river without climbing to a vantage point on the mountain Haraldshaugane, which is opposite.

There has been considerable regeneration of birch Betula pubescens on the east facing slope of Nuhaugane above the seter at Sandvad. Two of the three seter partners gave up using the seter in the 1930's, the other in 1964. The low ground along the river is covered with sedge dominated mire communities with birch mire communities, Oxycocco-Empetrion hermaphroditi, on the better drained sites. Above are the areas of regenerating birch woods with an under storey of willow Salix sp. of the vegetation type Lactucion alpinae. A number of streams come down the hillside and along their banks are meadow communities of the type Ranunculeto-Oxyrion digynae. Further up these streams or gullies there are snow bed communities; these were not divided into Nardeto-Caricion bigelowii and Cassiopeto-Salicion herbaceae as it was too difficult to distinguish them from a distance. Above the willow dominated Lactucion alpinae and on ridges there were heath communities of Phyllodoco-Vaccinion myrtilli.

It was estimated that 33 of Haldor Eidnes' sheep from Sörfjord used this area. This was done by recording the group size and the ear marks of the sheep which were identified when the sheep came down to the seter at Sandvad. There was also a group of 12 belonging to Sekse from the west coast who used the seter occasionally.

General pattern of movement

The sheep showed a marked diurnal pattern, they would come to the seter to get salt and to rest in the shade of the seter huts, at around 9 a.m. They would sit until afternoon and then move off southwards, grazing and resting and slowly moving up the hillside to disappear over the skyline at dusk. If the ewes did not come to



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the seter they would sit up under the Brandaleitet cliffs until early afternoon and then start to graze, also moving up the hillside, using definite gullies. This pattern was not so apparent on wet, grey days and it seems to have been modified by the weather conditions and also the stage of the season.

Use made of the seter

Salt had been put out for the sheep at the seter but not at the next seter at Langedalen. On most fine mornings there was at least one group of sheep at Sandvad. The sheep moved around in groups of up to 11, probably because they are kept in pens in the winter, in groups. Sheep were only seen at the seter on 3 out of the 18 wet days, but were seen there on 23 of the 31 fine days. The appetite for salt and the use of the seter was, perhaps, controlled by temperature. The two rams in the flock were only seen at the seter twice; they were not lactating and therefore did not have a high demand for salt. The ewe and lamb groups came to the seter on average once a week.

Changes in the vegetation types grazed for the period July 1st to September 2nd, 1972

July 1 - July 10

The sheep grazed on the middle area of Nuhaugane on Lactucion alpinae, on the grasses and herbs below the willows and on the meadow communities of Ranunculeto-Oxyrion digynae. In the late afternoon they would move up the gullies grazing on the snow bed communities and disappearing over the sky line at dusk at 22 hours. Sheep were seen to browse on the Salix bushes but not to any great extent. They were not seen to browse on the dwarf birch Betula nana or to take leaves of birch Betula pubescens.

July 11 - July 24

This was a period of fine hot weather, with the wind in the north. The temperature reached 24°C by late afternoon. The sheep were at Sandvad by 1100 hours and remained there until between 1600 to 1800 hours. They would then move off up the hill in a southerly direction splitting up into groups as before.

July 25 - July 26

Two wet days when no sheep were seen at the seter; there were sheep resting under Brandaleitet cliffs until early afternoon and then they moved up hill as before.

July 27 - August 6

During this period sheep only came to the seter at Sandvad on fine days. On wet days when the wind was in the south the sheep spent the day sheltering in the birch woods on the south of the hill in Langedalslii. During this period there was a decline in the number of observations of sheep grazing on Lactucion alpinae, and there were more observations made of sheep grazing on the heath communities of Phyllodoco-Vaccinion myrtilli. Previously the sheep had been seen to walk through Phyllodoco-Vaccinion myrtilli but had not appeared to graze. This change over may be explained by the increased silica content of the grasses Deschampsia caespitosa in the Lactucion alpinae and the higher digestibility of Deschampsia flexuosa in the Phyllodoco-Vaccinium myrtilli type.

August 7 - August 11

The sheep appeared to be using Phyllodoco-Vaccinion myrtilli more than before. The weather was grey and cloudy and no sheep came to the seter.

August 12 - August 16

The sheep started to use the area low down by the river grazing on the oligotrophic bog communities of the type Oxycocco-Empetrion hermaphroditi. At this time there were large numbers of fungi in these types which may explain why the sheep appeared to favour this type during this period.

August 17 - September 2

The weather was fine and cool, with slight frosts in the morning. When the sheep came to the seter they would only stay until mid morning. They would then move off up the hill using the middle portion of young birch woods. The sheep would concentrate their time browsing on birch Betula pubescens or grazing low down under the willows and dwarf birch Betula nana which made up the shrub layer. The way they took birch leaves was interesting; they would bit off individual leaves off the side of the shoots. Cattle on the other hand ripped off the tops of shoots.

The sheep would disappear over the top at dusk which was around 19.30 hours. On the days the sheep were not at the seter they seemed to be in the area of Brandaleitet cliffs or in the shade low down by the river. On September 2nd the sheep were collected and taken back to Sörfjord.

NUHAUGANE SHEEP STUDY

Study period July 3rd - September 4th	64 days
Number of days when no observations made	7
11/7, 16/7, 18/7, 1/8, 24/8 no observations	
10/7 fog. 29/8 light conditions, haze too bad.	
Number of days observation made	57

Number of days sheep seen on Nuhaugane	49
Number of days when no sheep seen on east face	7
Number of days sheep seen elsewhere	1
	57

Number of days sheep seen at Sandvad seter	26
Number of days sheep not seen at Sandvad	23
Number of wet days sheep seen at Sandvad	3

3/7 and 10/7 wet, 28/7 grey only.

Number of fine mornings sheep not at Sandvad	8

5/7, 13/7, 4/7, 8/8 (disturbed going to seter disregard)

13/8, 16/8, 19/8, 28/8, 1/9

Number of fine days sheep seen at Sandvad	23

Weeks 9. July 3rd - September 4th

Group 9 to seter 10 times

Group 11 to seter 8 times

Group 6 to seter 6 times

Group 3 to seter 9 times

Group 2 to seter 8 times

2 Rams came to seter 2 times

(This is one interpretation of the observations relating the groups seen on the hill, size and composition to the total number seen at the seter. This will explain the low number of visits of group 6.)

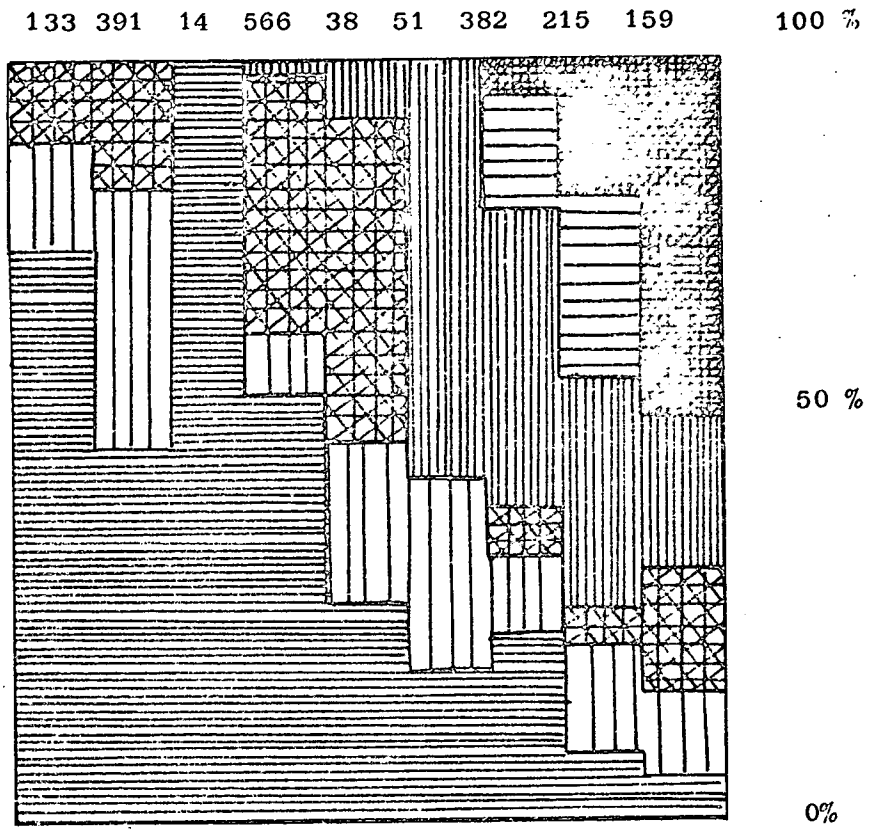
Group 12 was in the area only until August 26th, 7 weeks and 5 days. They came 7 times to the seter (estimated).

The total number of sheep/day observations at Sandvad seter for the 9 week period was 420.

TABLE 3 SHEEP GRAZING OBSERVATIONS

Percentage of total weekly grazing observations per vegetation type

NUMBER OF OBSERVATIONS



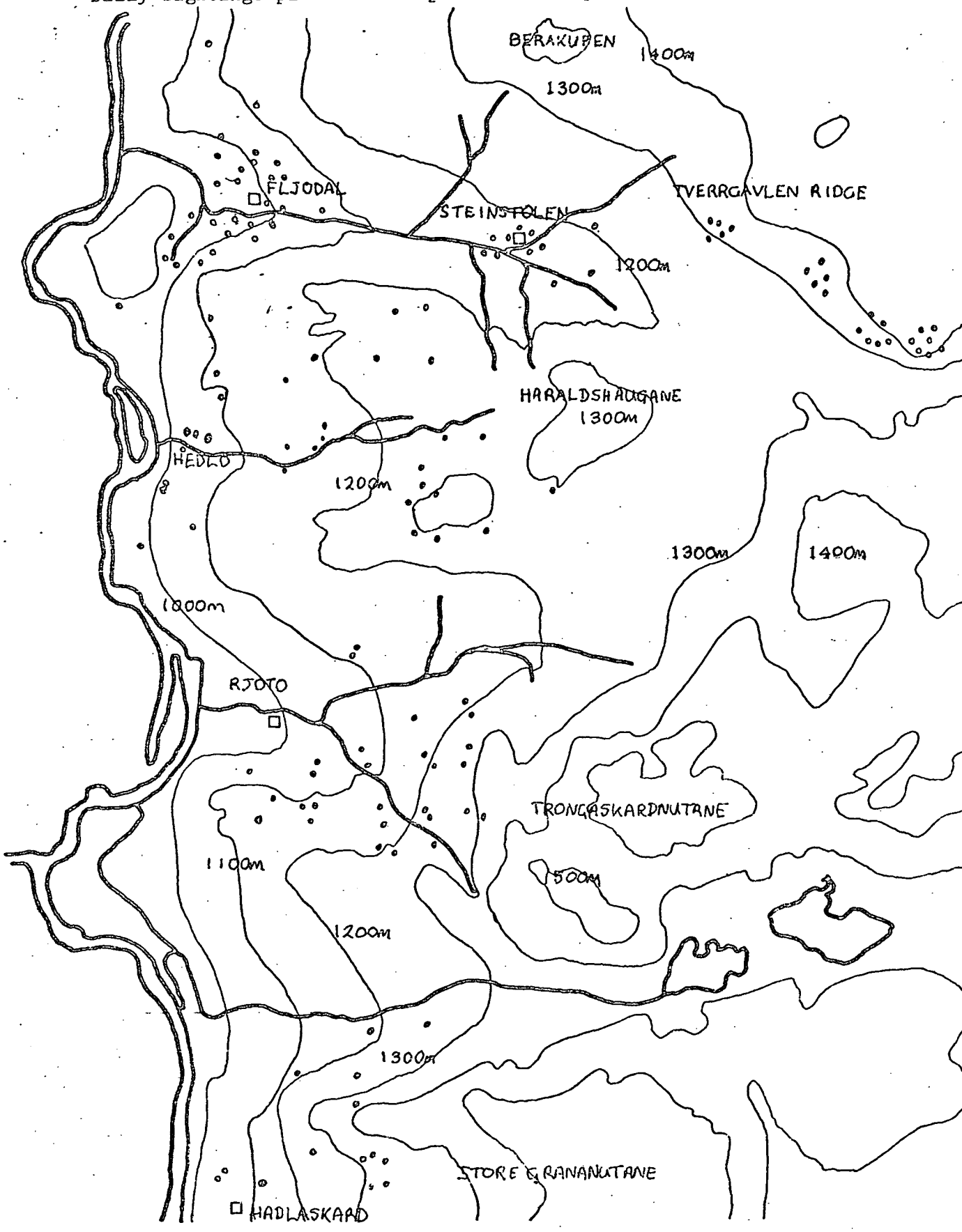
2. Around 250 sheep used the areas from Viveli to Hadlaskard on the east of Veigdalen. This was an estimate from field observation; no precise figures were available from the farmers but a figure for 250-300 was suggested.

The sheep showed the same marked rest period in the middle of the day: for instance the groups of sheep living under the Tverrgavlen Ridge would lie under the cliff at midday. There was also a similar diurnal movement down to the seters for salt in the mornings followed by an up hill movement in the afternoon. This pattern was seen at Hadlaskard seter on three days and also at Fljodal and Steinstolen.

The analysis of the grazing observation on the east side of the river is not as satisfactory as that for Nuhaugane as one could not assume that the sheep all had the same choice of vegetation types: that is that each sheep range from Hadlaskard to Viveli was similar. A large number of sheep had begun to move down into the birch woods towards the end of August showing how they selected over the total area of the east of Veigdalen and were not just restricted to the areas around the seters as they appeared to have been at the beginning of the summer. This movement down into the woodlands of the valley started in the last fortnight of August. From August 19th onwards the number of sheep grazing around Fljodal seter fell, this area had been well used earlier on. On August 18th sheep were seen in the birch woods between Viveli and Øvre Eidfjord and by August 23rd there were sheep in the valley. This gradual movement to the valley, corresponded to the time the Nuhaugane sheep began to concentrate on browsing birch and when the four cows and calves from Hedlo also started to browse birch heavily.

MAP 3 VEIGDALEN, DISTRIBUTION OF GROUPS OF SHEEP

Daily sightings plotted on a ½ kilometre square grid



• Sheep group sighted in ½ kilometre square/day



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GRAZING BEHAVIOUR OF COWS

This study was observational and no attempt was made to quantify the measurements. At the beginning of the summer the cows and calves grazed in the immediate area of Hedlo , in the third week they started to graze further afield. They had very definite pathways and patterns of movement. The cows were housed at night, and were milked twice a day. Each morning after milking the cows and calves staged around the seter; in early afternoon they moved off to graze and would return in the early evening to be milked.

There was no evidence of the cows browsing on the birch saplings in the area until the second week in August when there was a definite change and the cows and calves appeared to concentrate solely on birch for long periods. The cows took birch in a very different way to the sheep; instead of taking individual leaves they took off the upper portion of twigs at the 1.5 metre level, either by making a clean cut or leaving a swallow tail, where they had removed some of the bark. The amount of damage caused by the four cows and five calves was considerable and it seemed to be holding a large percentage of the young birch below 1.5 metres.

The cattle were much less selective than the sheep, taking coarse grasses such as Deschampsia caespitosa and Carex sp., that the sheep only took early in the summer. This was clear, at seters such as Langedalen, where there were no cows. The differences in selection of plant species between cattle and sheep can be explained in terms of their digestive capabilities. Various studies have been made of the differences in grazing selection and the digestive abilities of sheep and cattle with regard to their utilisation of various habitats; for example Van Dyne and Heady (1965) and



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Thetford, Pieper and Nelson (1971).

DISCUSSION

Most of the Veigdalen seter ceased to be used ten to twenty years ago. The sites are still more fertile than the surrounding areas, although the grassy sward around the deserted seters is gradually being invaded by coarse grasses and shrubs. There has been an increase in the birch and willow since cattle and goats no longer use the area and since wood is no longer needed for fuel.

The stocking density of sheep summering in Veigdalen is low (1 sheep:30 acres or 12 hectares) in comparison with the sort of stocking of Highland grazings that occurred in the early nineteenth century[1]. This was useful as it enabled a study to be made of the sheep without the problems of competition. The sheep appeared to concentrate on areas of calcifile vegetation that grow on light friable soils. They have the habit of lying in these areas and scrapping out small crescents in which to sit; this leads to localised erosion sites. If sheep were shepherded, this concentration of animals might be prevented in fragile areas.

The sheep were hefted to certain area until the end of the summer when the pattern broke up. This probably corresponded to the time shrub and tree species became more attractive than the grasses and herbs which by this time had flowered and were beginning to brown. (It would be very valuable to follow the changes in the nutritional quality of the vegetation by chemical analysis.) Under the traditional seter system the animals were concentrated for

1. See Chapter 5.

at least part of the day at the seter. This pattern still exists as the ewes and lambs come down to the seters to get salt.

CHAPTER 4.

The Union with England in 1707, the uprisings of 1745 and the agricultural improvements of the second half of the eighteenth century caused a gradual decline in the traditional system of shieling transhumance in the Highlands. Before the agricultural improvements of the eighteenth century and the development of an organised trade in live cattle and sheep with England that followed the Union of 1707 (O'Dell and Walton 1962, Chambers and Mingay 1970), the economy of the Highlands was based on dairy pastoralism, trade in furs and skins and a limited trade in live animals. Little has been written about the extent of this trade before the Union with England. Some travellers to Scotland describe the trade in skins and furs; Hector Boece (1527) made reference to the Highland trade in skins

> 'Beside Lochnes, quhilk is XXIV milis of lenth, and XII of breid, ar mony wild hors; and, amang thame, ar mony martrikis, bevers, quhitredis, and toddis; the furringis and skinnis of thaim ar coft with gret price amang uncouth marchandis'
>
> (Boece 1527 quoted in Hume Brown 1893, p.74-75).

During the seventeenth century although much of the Scottish trade was with the Baltic countries and with France, a large number of skins were sent to England. For example, Lythe (1960) found from custom books that in 1621-1622 up to 8,000 goats and 16,500 kid skins as well as cattle hides and deer skins were sent to London. In 1698 100,000 goat skins alone were sent to London (Smout 1963, p.219). Trade in dairy produce between the Highlands and Lowlands was also fairly extensive. Fenton and Michie (1963) quoted

Craig (1909) to show the extent of the dairy production in the Highlands; in 1605 the Highlands were able to supply the Lowlands with dairy produce and help to prevent a famine after an exceptionally bad harvest. Lack of facilities for storing meat, other than by salting it, and the lack of opportunities for selling live animals must have meant that the production of dairy products was as important as it was in Norway and the Swiss Alps. The Highlands apart from some of the more fertile straths of Perth and of Easter Ross, which can be considered as Lowland, can have only supported pastoral economies, particularly at a time when the knowledge of cultivation techniques such as rotation of crops and fertilising was small.

Trade must have played some part in the Highland economy prior to eighteen hundred, but most of the communities in the central mountains and on the west had to be self supporting; they were dependent on their herds of cattle, sheep, goats and horses and on hunting and fishing. Although large areas of the Highlands were reserved as deer forest with restricted hunting rights, venison was probably an important item of diet of the Highlands until the seventeenth or eighteenth centuries.

The pastoral system had to be based on transhumance: the low ground pastures were small and precious for winter keep; importation of feeding stuffs was then impossible; the high grasslands above the woodlands were essential but were available only from June until September. This was not only because of severe weather in spring and autumn, but also because the mountain vegetation became of little nutritional value in the autumn. The whole annual cycle of animal management had to be geared to having the cattle, sheep and goats that were milked, and the ponies that were used for ploughing and

transport, up at the shielings at the time when the mountain grasses were growing and abundant nutritious pasture was available. The summer movement of the animals away from the low ground co-incided with the time that the crops were ripening and thus prevented damage by the domestic animals without the expense of fencing.

In the Outer Hebrides, dairy cattle continued to be taken to the shielings until this century, although on mainland Scotland the practice gradually died out during the eighteenth and early nineteenth centuries. Even before the shielings were given up or converted to sheep runs, the use made of them had changed. Winter fodder crops such as turnips and cultivated grasses for hay were introduced to the Highlands as part of the agricultural improvements of the late eighteenth century. These crops and the enclosure of low ground arable land made it less essential to move the animals away in summer and it was therefore possible and more convenient to keep the dairy animals near the home farm all the year round. Also the development of the droving trade in the eighteenth century, and the opening up of markets with the south, brought a change of emphasis; beef cattle production became more important than dairy production, except perhaps in districts near to urban markets, such as Argyll. Dairy animals ceased to be taken to the mountains, and only yeld and young stock spent the whole summer at the shielings in the charge of herders.

It is difficult to find first hand accounts of the pastoral system practised in the Highlands before 1700. Although there are some accounts of conditions in Scotland, many relate only to the Lowlands. Hume Brown's (1891) collection of the writings of the early travellers to Scotland is very valuable. However, the

descriptions of the Highlands are not very comprehensive. After the Union of Scotland and England in 1707 the number of reports on the conditions in the Highlands increased; travellers such as Defoe (1769), Burt (1754) writing before 1745 and Pococke (1760 ed. Kemp 1887). Pennant (1776), Dr. Johnson and James Boswell (1773 ed.Crampton 1970), Dorothy Wordsworth (1803) and many others wrote vivid accounts of their experiences. Some, like Dr. Johnson, came expecting to see 'a people of peculiar appearance, and a system of antiquated life' and were disappointed as there had been considerable changes in the eighteenth century and the traditional pastoral economy of the Highlanders was disappearing.

Most of the writers commented on the shieling system; Burt (1754) for instance wrote in the 1720's that

> 'In summer the people remove to the hills and dwell in much worse huts than those they leave below, these are near spots of grazings and are called shealings, scattered from one another as occasion requires. Every one has his particular space of pasture ...'
> (Burt 1754, V.2, p.123).

Richard Pococke, Bishop of Meath, who braved the wilds of Sutherland during one of his Scottish tours in the middle of the eighteenth century, saw the pastoral life of the people living near the Kyle of Durness as picturesque, simple and healthy,

> 'The people here live very hardy, principally on milk, curds, whey and a little oat meal, especially when they are at the sheals in the mountains, that is the cabins and huts in which

they live when they go to the mountains during the months of June, July and August'.

(Pococke 1760, ed. Kemp 1887, p.127).

The agriculturalists who reported to the boards of agriculture on the conditions in the various Scottish counties at the end of the eighteenth century were for the most part English men (for example William Marshall who reported on the conditions in the Central Highlands in 1794) with a great deal of experience of low ground cultivation agriculture and little insight into the problems of managing high ground pastoral farms. Often they were struck by the primitive conditions of the people and the 'inefficient' form of land use and failed to see how applicable transhumance was to the Highland environment. Marshall (1794) for instance saw

> 'In these detached grazings, the distant shealings, are involved a train of evils: the drift of the stock; the driving across intermediate grazings; the inconveniences and dangers of the consequent hounding and harassing of stock, and, by the over stocking of parts, ...'
>
> (Marshall 1794, p.31).

These comments may have been justified, but whatever outside opinion might have been about the way of life of the Highlanders, a system of altitudinal transhumance, using mountain shielings was widespread and indeed essential. Walker (1812) appears to be one of the few commentators on Highland life to recognise the significance of the transhumance system; this was possibly because he seems to have had knowledge of agricultural systems in other mountainous districts of Europe and to have travelled over a large part of

Scotland.

'In most Highland farms there is a small portion of arable ground, and a large extent of mountain pasture, considerably distant. The homestead is on the arable land, and generally situated on the sea shore, by the side of a lake or river, or low in a valley. Here the farmer, with his cottagers, live in what are called their winter houses. Soon after the middle of June, when the arable land is sown they emigrate from these dwellings, with their cattle, to a mountainous place belonging to the farm. Here they quickly erect, or repair, their summer houses or shielings, which are composed chiefly of sods and the branches of trees. In these dwellings they live during the summer. Their only occupation is tending the cattle on the heights and the manufacture of the butter and cheese. Their chief sustenance is oat and barley meal, with milk in its different forms. In this way they pass the fine season, in a pastoral and cheerful manner of life, of which the people are extremely fond. When the corns begin to ripen, about the middle of August, they leave their pleasant summer residence and return to their winter houses. This method of management is natural to the situation of the country and is not peculiar to the Highlands'.

(Walker 1812, V.1, p.313).

Whitaker (1959) collected all the references to shieling sites that he could find in his fairly extensive reading of the literature in English, and he mapped the distribution of shieling sites for

each century from 1500 to the present. This exercise showed, to some extent, that the use of shielings in mainland Scotland had declined by the nineteenth century. It also showed conclusively that there is a great lack of printed references to shieling sites, particularly prior to 1745.

One productive source of information about shieling life, that has not been studied to any great extent except by Mary Mackeller (1887, 1888), are the gaelic songs written about the shielings. These often name and describe specific shielings and relate actual incidents. These songs are unfortunately lost to the non-gaelic speaker, and reliance has to be put on the descriptions of the eighteenth and nineteenth century travellers, the papers of the forfeited estates and also on the surveys and reports on the state of the agriculture in the Highlands and the government enquiries of the nineteenth century[1] and the old and new statistical accounts of the parishes.

There are also two accounts written in the later part of the nineteenth century. One written in 1896 by Duncan Campbell tells of the author's childhood experiences at the shielings of Glen Lyon. He gives one of the few comprehensive descriptions of shieling life; the distribution of shielings; the construction of shieling bothies; the types of dairy utensils used; the milk processing techniques and also a discussion of the other shieling industries of spinning and

1. Gray (1957, p.263-264) lists the parlimentary and official papers relating to the Highlands published before 1900. Those used in this study were:- Report of the Commissioners of Inquiry into the Conditions of the Crofters and Cottars in the Highlands and Islands of Scotland, 1884, XXXII-XXXVI, referred to as the Napier Report 1884. Report of the Royal Commission on the Highlands and Islands, 1895, XXXVIII-XXXIX, referred to as the Brand Report 1895. The Report of the Departmental Committee Appointed in November 1919 to enquire and report with regard to lands in Scotland used as deer forest, referred to as the Deer Forest Report 1919.

weaving, This is an extremely valuable piece of work. The other late nineteenth century account written by Carmichael (1884) describes the condition of the crofters and cottars in the Outer Bebrides. Carmichael appears to have concentrated his attention more on recording shieling hymns, superstitions and traditions than on the more mundane aspects of shieling life.

Donald Macdonald (1950) spent his childhood on Lewis, and remembers going to his mother's shieling in the 1920's. However, in his writing he concentrates on recreating the special atmosphere that he felt existed at the shielings, rather than documenting the techniques of animal management, pasture utilization and milk processing.

Sayce (1956) referring mainly to transhumance in Wales, has written a comparative study on the use of the old summer pastures, and has brought together much of what has been written about transhumance in Britain. His work is probably the most valuable of the recent studies on written descriptions of shieling transhumance in Britain.

There are also some recent studies on shielings. Miller (1967b) has made a study of the location and structure of shieling bothies of Loch Tay, Assynt, Rhum and Lewis; Gaffney (1959, 1960, 1967) has worked on the ownership and grazing rights of shielings on the Gordon estates of Strathavon as well as on other areas, and Macsween (1959, 1961) has made a study of the shielings of Skye.

The following sections are by no means complete and rely heavily on the reports to the boards of agriculture of the late eighteenth and early nineteenth century and on the descriptions of the use of the shielings given by nineteenth century commentators.

Unfortunately, the shortage of time has allowed little of the seventeenth century material to be consulted, except some of the published material. It has become apparent in this study that, in order to get a true picture of the shieling system and the pastoral economy of the Highlands, the sixteenth and seventeenth material requires to be looked at in detail.

There are a number of studies of the changes that occurred in Highland agriculture in the eighteenth centuries both on the wide scale[1], such as Gray's valuable and comprehensive study of the economic and social changes from 1750 - 1850 and in local detail of particular estates[2] such as Gaskell's study of Morvern (1968) and Hamilton's study of Monimusk in Aberdeen (1945, 1946). The traditional shieling system changed during the eighteenth century and too much emphasis should not be placed on the eighteenth and nineteenth century literature when attempting to create a picture of the traditional pastoral system. This deserves consideration in the following discussion of the location and seasonal use of shielings and the type and level of animal production in the Highland context.

1. Handley (1953); Gray (1957); Youngson (1973); Symon (1959) O'Dell and Walton (1962).
2. Grant (1924).

In Veigdalen, as in other parts of Norway and in Val d'Annivers and other parts of Switzerland, each farm has a number of grazing areas. Some are only a few miles from the home farm, often in woodlands, and are used in the spring and autumn. Hay is made at these spring-autumn seters or mayens while the domestic animals are away in the high mountains. Where these seters are close to the home farm the girls can come each day to milk the animals, but if they are too far away the girls stay at the seters or mayens for several weeks. Each farm also has high mountain seters, which are often held in common with one or two other farmers; each farmer has the right to graze a certain number of cattle, sheep and goats in relation to the amount of winter keep he can provide. The time spent at these mountain pastures is relatively short because of the length of the growing season in the mountains.

There is evidence to show that a similar pattern existed in the Scottish Highlands, and it certainly existed in Wales and in Ireland.

> '... a farmer might not be restricted to one area of pasturage away from his main farm. In addition to the high-level pastures in the mountains, he might have had grazing rights on less elevated land, which would not be so far from the hendref. Here there would be grass earlier in the spring than at the hafodydd, and so the cattle could graze it before being sent further away'.
> (Sayce 1956, p.141).

> 'The people of Sliabh Mor, in the Achill Islands, regularly used four sets of pastures, staying at each one as long as the grass lasted'.
> (Sayce 1956, p.129).

In Scotland the importance of this gradation of shielings, or grazing

areas perhaps has often been over looked or been mis-understood. The shielings near to the townships or low ground farms, do not seem to have been mentioned as separate units in rentals as were the distant shielings[1]. But some of the estate surveys made in the second half of the eighteenth century, as part of the attempt to improve cropping agriculture, show up a pattern of near and distant shielings. Home in his survey of Assynt in 1769 (Adam 1960) described three sorts of shieling, those adjacent to the arable area of the low ground farms, for example the shieling of the farm inver Chirkag 'lies next to the farmstead'; those further away within the surrounding woodlands for instance some of the shielings at Oldernay (p.40), and others high up in sheltered gullies. The shielings attached to the township seem to have been individually owned, whereas the detached grazings were held in common by a group of farmers.

Campbell (1896) refers to shielings in Glen Lyon, which were used in winter as well as spring and autumn, where the women could go for milking daily.

> 'Throughout the Highlands most of the old lairds and tenants had double residences - permanent abodes where there was arable land, and summer sheiling huts to which women and children were sent with the cattle during several months of the year. But not far from permanent dwellings there were sometimes folds or 'crodhan' for cattle, sheep, and goats, without huts, because these places were near enough for women to go to milk the animals in the morning and evening, and for the herds to get there to tend them throughout the day'.
>
> (Campbell 1896, p.64).

Sometimes the summer grazings were also only a few miles away and the people had no need to leave their homes in summer. Mary

1. See Rental for Strath Glass 1775 Appendix 4.

Mackeller (1887) called this piece of pasture and folds near to the farm a 'buaile'. The practice of folding the animal near to the farm in winter, spring and autumn lead to pockets of increased fertility. These were then used under a system of shifting cultivation and later with the pressure of growing population they came under permanent cultivation. Mary Mackeller describes how this system of shifting cultivation operated.

> 'The cows were not every year put to pass the nights in the same place, for the thrifty owners of the cattle frequently went in the spring to the hills to make small rigs and furrows, and sow corn or barley in them where the cows had passed the nights the previous year, as the soil would have been enriched with their droppings, and they had that to take home with them at the end of the season, as well as their stores of dairy produce'.
>
> (Mary Mackeller 1887, p.141).

On Lewis, Donald Macdonald (1950) also remembers two kinds of shielings,

> '1) The Airidh or ordinary sheiling.
> 2) The tigh earraich or spring dwelling...
>
> The 'tigh earraich'...was bigger than the 'airidh' and was similar in design to the house at the village. There was a room as in the airidh and another for the animals on stormy nights. Because of this, crofters who owned these dwellings, could go out to them in April when fodder was getting scarce and while it was still too cold to leave the cattle out at night'.
>
> (Macdonald 1950, p.91-92).

Robertson (1799) in his survey of the agriculture of Perth also described how former shieling areas came under cultivation.

> 'The shealings, that we have been speaking of, were for the most part set down in favoured situations, at the head of a small lake, on the banks of a river or at a confluence of brooks, where the benignity of nature had provided shelter, had made the surface green and the grass rich; but when the inhabitants were obliged to establish shealings on spots that

were naturally covered with heath, they became as green as a meadow, to the extent of several acres around the huts, by the manure of the cattle which lay there at night. I have seen shealings have such a tract of green ground by these means, that they were afterwards converted into regular farms'.

(Robertson 1799, p.348-349).

In many cases, the yeld (barren) and young cattle were sent to the shielings in the mountains several weeks before the dairy cattle. Boys would go with them to act as herders. The men would also go up early in the season to mend the shieling huts and to check that there was enough fuel for the summer.

'There was a small flitting and a big flitting to the sheilings. Whenever spring grass began to sprout freely on the hill grazings the young and yeld animals, and the horses which were not wanted for farm work, were sent to the sheilings, with boys to herd them, under the direction of provisional or permanent "airidhi chean" or caretakers. Men, too, went up to repair and thatch huts, and to see that the store of peats from last year would do until the new peats came into use. The boys pulled heather, which, when packed close standing right end upper-most, within broad frames, or borders of stone on the beaten clay floors, was as good to lie on as a spring mattress, and far more fragrent'.

(Campbell 1896, p.68).

There is a description of a similar pattern of movement in Breadalbane writen probably in the early part of the eighteenth century.

'The manner of grasing generally over all the highlands in the Grounds adjacent to Glen Lyon is as follows: from the 15 of May to 1st June they hain their grass (ie protect it to give hay), and then they graze upon their shielings with their whole Cattle for a month or five weeks, it being inconvenient for them to stay longer in the hills, because of their peats and summer tathing (ie. dunging of the infield by pasturing the cattle on it). And after this haind grass is seat up in this manner there is no more haind grass. Then in harvest, they send their yeld (barren) cattle to the Shealings for a fortnight or so. And continue themselves in winter towns with their

milk cattle of all kinds, to attend to thir labouring and their tathing in the harvest; for the people must be where the milk cattle are, being the most part of their sustenance, and such farms as have shealings sometimes leave stragling mares there till the storms come on. And its the common practice everywhere, that all the zeld cattle are brought back to the Shealing, till the next spring and few keeps them even till harvest, because of keiping a separate hird with them, and when kept in the hills after the middle of harvest they have liberty to range at pleasure, the grass being of little use and the hills commonly covered with snow'.

(Anderson 1967, V.I, p.340.).

In Breadalbane early in the seventeenth century, the dates for moving the stock were fixed by law.

'The court fixed the dates for the moving of stock from the low ground to the hill pastures and later in the season to the shielings. The tenants had to send all their cows, horses 'nolt', and sheep outwith their head dikes from the 1st of May each year, where they remained until the 8th of June, when they were transferred to the shielings. Cattle were grazed at shieling until 15th of July, and it was laid down by law that no beast be brought back until they all returned together, the only exception being in the case of a cow that was sick and one required at home to supply a sick man or woman with milk'.

(Gillies 1938, p.257).

All over the Highlands, the time that the dairy cattle spent at the shielings seems to have been short. In Caithness, Henderson (1812) reporting on the state of agriculture recorded that the shielings were only used by the dairy cows from June 20th for four to six weeks. He also reported that the shieling pastures were preserved or hained from April 15th until June 20th. After this the housewives and maids went to the shielings with from ten to twenty cows. At the shielings there were a bothy to live in, a cabin for the milk vessels and a small fold to keep the calves from the cows during the night. They only stayed at the shielings for

four to six weeks. When the grass was used up the women came home with the milk cows, leaving behind the yeld and young cattle and the horses that had hither to been herded away from the shielings, to have the run of the shieling pasture until winter (Henderson 1812, p.145-146).

In the central Highalnds also, the shielings were only used for a very short time by the milk cows.

> 'Formerly it was a common practice, I believe, to the Central Highlands, to drive cattle and other stock to distant shielings or hill pastures, where they were kept during 6 or 7 weeks in the summer months'.
> (Marshall 1794, p.45).

Campbell (1896) remembered how, in Glen Lyon, the dairy maids

> 'did not stay more than six weeks, when the milch cows were taken down to places which had been kept clear for them near enough to admit of being milked night and morning from the farmsteads. These lower places had no huts, but they had folds, because some cows were so shy or wild that without being folded and caught by the horns they would not stand to be milked..'
> (Campbell 1896. p.89-90).

In the Outer Hebrides, the whole period spent at the shielings appears to have been shifted forward so that the cattle could meet up with the drovers going south for the autumn cattle markets. On North Tolsta originally the first of May was the date for the removal of the sheep and cattle to the moors and the last night at the shieling (airidh) was the last Friday in July (Macdonald 1950, p.90).

Carmichael (1884) also recorded that the people of the Outer Hebrides went to the shielings earlier in the year than on the mainland,

'Having finished their tillage, the people go early in June to the hill-grazings with their flocks'.

(Carmichael 1884, p.469).

This may have been due to spring coming earlier to the western isles, which possibly allowed the farmers to sow the corn earlier.

Differences in the length of time spent in the mountains and the date of going to the shielings was probably due to regional variation in climate and topography; the same can be said for the location of shielings and their distance from the home farm. It is impossible to draw a comprehensive picture for all the different regions of Scotland, because so little material is available, but, if it were possible, distinct patterns would probably emerge.

The movement to the shieling always caused a great deal of excitement and many traditions and customs developed around it. Carmichael (1884) gave a very vivid description of the 'flitting' to the shielings on Lewis,

'This is a busy day in the townland. The people are in commotion like bees about to swarm. The different families bring their herds together and drive them away. The sheep lead, the cattle go next, the younger preceeding and the horses follow. The men carry burdens of sticks, heather ropes, spades and other things needed to repair their summer huts (Sgitheil, Bothain). The women carry bedding, meal, dairy and cooking utensils. Round below their waists is a thick wollen cord or leathern strap (Crois-f heile, kilt band), underneath which their skirts are drawn up to enable them to walk easily over the moors. Bare-footed, bare-headed, comely boys and girls, with gaunt sagacious dogs flit hither and thither, keeping the herds together as best they can, and every now and then having a neck-and-neck race with some preverse animal trying to run away home. There is much noise'.

(Carmichael 1884, p.469-470).

Campbell (1896) also described the summer migration or 'big flitting' and lists the equipment that was needed for the short stay

in the mountains,

> 'Milk vessels, churns, cheese presses, pots, pans, meal bags, salt arks, rennet apparatus, blankets, clothing, shoes and stockings - which were little used - spinning wheels, spindles and distaffs, flax and wool and many other things, had to be packed in the light peat carts...'
>
> (Campbell 1896, p.69).

It is interesting to see that they took salt arks to the shieling. There are very few references to giving salt to the animals while they were in the mountains as they do in Norway. The salt was probably used to salt the butter or to coat the cheeses.

Milking and cheese and butter making were the major activities of the women while they were at the shielings, although, as in Norway, the women collected herbs and lichen to use to dye wool and flax and also for medicinal purposes.

The animals were carefully herded while up at the shielings, the best grass was reserved for the milk cows and the yeld cows, the young cattle, the goats and the sheep and ponies were kept to the distant corries in the care of the herd boys.

In Kintail in 1793 there were about 300 ponies kept for ploughing. They were never allowed to graze with the milk cows in summer, the benty grasses, possibly Molina, were reserved for them (OSA 1793 v.6, p.242).

The cows and the ewes were folded at night to protect them from predators and also to separate them from their young. Although wolves disappeared from the Highlands in the seventeenth century, foxes were a plague until long after (Ritchie 1920). James Hogg, describing the ancient mode of farming found in Selkirkshire, wrote that

'In all the high lying grassy farms, the occupiers had shielings for the summer tending of cattle, of which there are unequivocal marks in every glen. You have the marks of the little bothy or shieling there, the small round fold for the calves, the larger one for the cows, and the little milking bught for the cross camstarry ones'.

(Hogg 1832, quoted by Anderson 1967, v.1, p.339-340).

Shieling huts had to be made of whatever natural material was available in the area. Shielings near woods were constructed of wattle and turf and those above the woods were made of stone and turf. Pennant (1776) described some shieling huts that he visited on Jura during his tour of the Hebrides in 1772.

'... a bank covered with sheelins, the habitations of some peasants, who attended the herds of milch cows, these formed a grotesque group, some were oblong, many conic, and so low that entrance is forbidden without creeping through a little opening, which has no other door than a faggot of birch twigs, placed there occassionally: they are constructed of branches of trees covered with sod; two blankets and a rug; some dairy vessels, and above, certain pendent shelves made of basket work, to hold the cheese, ...'

(Pennant 1776b, V.1, p.246).

Hugh Miller, the geologist from the Black Isle, visited the island of Eigg on his tour around the Hebrides in 1847 and described 'The shieling' as 'a rude low-roofed erection of turf and stone, with a door in the centre some five feet in height or so, but with no window ...' (Miller 1858, p.81). Conditions seem to have been little different in the islands, for when Carmichael (1884) reported to the Napier Commission on the conditions in the Outer Hebrides, he found that in a few wooded districts of the island wattle was used for houses and folds; these wattle structures were plastered with clay and whitewashed. In the mountain districts he found stone and turf shielings. He described the two sorts of

shielings.

> 'The walls of the shealing in which people live are of turf, the roof of the shiels covered with divots. There are usually two shealings together; the larger the dwelling, the smaller the dairy. This style of hut (Sgithiol) is called 'Bothan cheap', turf bothy; to distinguish it from the 'Both Cloiche', or 'Bothan cloiche' stone bothy'.
>
> (Carmichael 1884, p.472).

These 'Both Cloiche' or stone bothies, seem to have been similar in shape to the conical bothies found on Jura by Pennant about a hundred years before.

> 'This is entirely constructed of stone, the roof tapering to a cone more or less pointed. The apex of the cone roof is probably finished off with a flag, through the centre of which there is a hole like that through an upper millstone, the opening of which for the egress of smoke and the ingress of light. There is a low door-way with a removable door, seldom used made of wicker work, wattles, heather or bent ... these beehive stone houses are still the shealings of the Lews people'.
>
> (Carmichael 1884, p.472).

Duncan Campbell (1896) described the shieling huts in Glen Lyon where he stayed as a child.

> 'I feel certain that the two huts with which I was well acquainted were typical of all those which had fallen into ruin before I was born. They were not much to look at on the outside, but they were rather roomy, substantial edifices, which were built of stone, thatched with heather, and well constructed for dairy purposes ... The chimney was a hole or barrel with its end knocked out, placed in the middle of the roof'.
>
> (Campbell 1896, p.71-72).

Professor Miller (1967) has visited many shieling areas and has made detailed surveys of the shielings of Loch Tay, based on MacArthur's survey of 1767 (MacArthur 1936), as well as of the shielings of Assynt and of Rhum. Miller found that shieling huts

varied from 6' by 4' to 3' by 5' internal measurement. He found that the shieling huts were usually in groups of three or four and sometimes in bigger groups. Many of the turf and wooden shieling huts must have disappeared long ago, all that is now left of them are green fertile areas.

The study of the old shieling sites in the south Ross-north Inverness study area throws light on the siting of shielings but little on the structure of the bothies as most of these have disappeared or have changed into shepherds' or gamekeepers' houses. Shieling huts were sited by streams and often with consideration to defence. It was probably very important to have the shieling settlement well hidden, because late summer when the animals would be in good condition was the best time for stealing cattle.

There are few descriptions of cheese making in the Highlands, Sinclair (1795, p.279) mentions that besides using rennet for calves, rennet was taken from animals such as hare and deer, Elizabeth Hamilton (1808) described how the cottagers of Glen Burnie heated milk in order to separate it and then added rennet. If butter was made, presumably some form of whey cheese was also made. In Norway all of the milk was used, the cream was used to make butter and the whey was used to make 'Gamel Ost' or 'Prim'. In Norway a brown cheese was also made from the whole milk; this involved simmering the milk for many hours. There are no descriptions of this technique being used in the Highlands. Hugh Miller, the geologist from the Black Isle, visited the Island of Eigg in 1847 and described a remote isolated shieling that he found. He gave a description of the interior of the hut and the dairy utensils and mentions that

fire

'There was a turf/at one end, at which there sat two little girls, engaged in keeping up the blaze under a large pot.... while the other end was occupied by a bed of dry straw, spread on the floor from wall to wall, and fenced off at the foot by a line of stones. The middle space was occupied by utensils and produce of the dairy, - flat wooden vessels of milk, a butter-churn, and a tub half-filled with curd ; while a few cheeses, soft from the press, lay on a shelf above'.

(Miller 1858, p.82).

In Norway, flat-bottomed round wooden bowls were also used to separate the milk. Campbell (1896) described the dairy utensils used in Glen Lyon in Scotland.

'Their milk vessels of all descriptions were of wood - preferably of hard wood... It was held as a sin to permit any suspicion of sourness about dairy vessels. They were scrubbed and scalded with hot water, baptised into purity with splashing of cold water and laid out to dry on thyme-covered banks before being used again'.

(Campbell 1896, p.72).

In the Highlands the cross-leaved heather Erica tetralix was thought to have special cleansing virtues (Campbell 1896). In Veigdalen, Norway, juniper Juniperus communis was thought to have similar properties and was used to rinse out the wooden dairy vessels.

A competent dairy maid could cope with up to twenty cows (Henderson 1812, Macdonald 1872) which was the number quoted in Veigdalen. She would have to milk the cows and also the goats and sometimes the sheep, twice a day and also do all the dairy work.

'Where there is a large herd of cows, the milk also is churned once, and sometimes even twice a-day; in this way, the butter is always formed from sweet cream, and it is from this only, that butter of the most exquisite flavour and sweetness can be obtained. The richness of the milk is also very remarkable in the quality of the Highland cheese. Wherever it is made of the entire milk, it is richer than any other cheese in the kingdom, that is formed without any addition

of cream'.
(Walker 1812, V.2, p.61).

The term cattle was often used to mean all dairy animals, cows, sheep and goats. Goats were particularly important probably to the poorer farmers as their yield is high in proportion to their size. The yield and size of the old types of domestic animals found in the Highlands is discussed later on in this chapter. Many descriptions of visits to shielings mention goats. For instance when Pennant and his travelling companions came upon a shieling in Glen Tilt in Aberdeen, they were offered goats milk whey to drink.

> 'Ascend a steep hill, and find ourselves on an Arrie or tract of mountain which the families of one or two hamlets retire to with their flocks for pasture in summer. Here we refreshed ourselves with some goats milk whey, at a Sheelin or Bothay, a cottage made of turf, the dairy house, where the Highland shepherds or grasiers, live with their herds and flocks, and during the fine season make butter and cheese. Their whole furniture consists of a few horn spoons, their milking utensils a couch formed of sods to lie on and a rug to cover them'.
> (Pennant 1776, p.122-123).

While at the shielings the diet of the people must have been very simple, based on milk and its products with maybe a little blood and some oat meal. The summer diet of the farmers that Pococke visited in Sutherland in 1760, was mainly curds, whey, and oat meal supplimented by fish if these were available. He found that the hardy peasants of Durness would catch fish only if the weather was fine and that they flourished during the summer on their simple diet.

> 'They are mostly well-bodied men, of great activity, and go the Highland trot with wonderful expedition'.
> (Pococke 1760, edit by Kemp 1887, p.127).

During the summer food was relatively plentiful for both man and his animals; winter was the hard time. In autumn when the cows were in relatively good condition, about $\frac{1}{4}$ of the adult stock could be sold to the drovers going south, but the rest had to be kept through the winter.

> 'So good is the Hebridian breed of cattle, that two or three months of tolerable feeding, or pasturage, restore them from the jaws of death to a state approaching fatness. One cannot easily believe in August, that the sleek beautiful animals which frolic among the meads, and can scarcely be restrained by any fence or inclosure, are the same creatures which he saw in the beginning of May so miserably reduced and weak that they could not rise from the ground without help, or walk to their pastures without staggering like a drunken man'.
>
> (Macdonald 1811, p.435-436).

WINTER FEEDING

Under the shieling system the pattern of animal husbandry was very similar to the pattern of movement shown by red deer. The animals spent the summer on high ground and in the winter roamed at will through the woodlands. In some parts of the country young animals may have been housed at night. However, if the animals were not allowed to fend for themselves the farmers would have had to provide a great deal of winter fodder. Before the middle of the eighteenth century very little seems to have been done to care for the cattle, sheep, goats and ponies in winter and consequently severe mortality in late spring and early winter sometimes could not be avoided. Walker (1812) understood that the winter was the limiting time of year in cattle production in the Highlands.

'They (the cattle) are indeed sufficiently fed in summer... They are never housed, but kept abroad the whole year round. During winter and spring they receive no dry or artificial provender, and have, nothing to support them but the decayed gleanings of the herbage of the former summer. During the summer season, the grasing fields are greatly understocked. The summer pasturage far exceeds the winter provision; yet no more cattle can be kept and preserved, than the winter forage in the fields or in the house can support'.

(Walker 1812, V.1, p.381).

Walker felt that before suggesting the introduction of new fodder crops that would need new techniques and agricultural improvements, methods of collecting and storing natural hay should be looked into. He came to the conclusion that hay had not been made in the Highlands much before 1700. He saw the value in making hay from coarse grasses, such as Nardus stricta, deer hair sedge Trichophorum caespitosum, bog cotton grass Eriophorum vaginatum and E. austifolium as well as rushes and sedges of the Juncus and Carex species. All these species are grazed by cattle, sheep and goats as well as red deer early in summer. The coarse nature of these plants makes them resistant to leaching and they are therefore of more value at the end of winter than finer grasses. Walker (1812) suggested that these plants should be cut for hay in July and August when they were 'fresh and succulent', and then reserved for use till February when the animals would be suffering from lack of food. He quite rightly realised that, although this form of natural hay would be insufficient either to fatten the animals or to keep them in milk, it would supply the bulk that ruminants need.

Although little hay was cut, haining grass or protecting it from grazing animals and preserving it for a later date was practised in many parts of the country, before the introduction of speoial

winter fodder crops. The farmers of Loch Alsh for instance, until the middle of the eighteenth century

> 'trusted for winter provender solely to pasture grass on which no cattle were pastured from 12th August to the 12th of November. Having little straw, and no hay, many cattle die in severe winter for want'.
>
> (OSA 1794, v.11, p.424).

In Kintail at the same time some of the farmers wintered their cattle in the more sheltered glen and made some form of hay.

> 'It is customary to cut down a great quantity of natural grass in the month of August; which after receiving proper seasoning, is made into ropes of two fathoms in length, and then twisted two-fold; being thus compressed, it requires less room in barns, where all their crops are laid up. This process has another advantage; for, in this mode, it is carried with greater facility, into distant glens for the relief of weak cattle in stormy weather'.
>
> (OSA 1793, v.6, p.248).

In Norway and in the Alps domestic animals have to be kept inside in the winter and considerable quantities of food have to be collected in the summer and autumn. Hay is made and in the past, lichens and branches of trees such as birch, oak, alder, wych elm and hazel were collected and dried for use as winter food. This does not seem to have been a usual practice in the Highlands although there are a few references to the use of leaves in times of famine (Anderson 1795, p.18). Walker (1812, V.1, p.388-389) did, however, discuss the possibilities of using leaves for winter fodder; he thought that they would be 'very nourishing and eligible provender' and were 'found to be wholesome and sufficient to preserve cattle from perishing from want'.

In most of the Highlands animals could be wintered outside,

especially in the west where the winters can be relatively mild; therefore little attention appears to have been paid to collecting or storing food until the late eighteenth century when special fodder crops such as turnips were introduced; Johnson (1773, ed. Chapman 1970) for example mentions the introduction of turnips to Coll in 1773. If no other provision was made for the animals than a little hained grass or coarse hay they would have had to fend for themselves in the woods or on the arable ground.

If a red deer cannot get sufficient food in winter to maintain a positive energy balance and thus withstand a certain level of chilling by wind and rain it dies. In regions where deer can get shelter and adequate food they are able to put up with more severe conditions than if they are denied access to areas such as woodlands which provide food and shelter. The same was true for domestic herds in the Highlands. When the number of animals were low, as they probably were in the early middle ages, they could get sufficient food and shelter in the woods and they would have been able to withstand all but extreme conditions. During the seventeenth and eighteenth centuries when the human population in the Highlands rose, the number of domestic animals would have risen. It is likely that the number of goats also rose considerably during this time; the extent of this rise in the number of domestic animals and in particular in the number of goats, requires further research.

With an increasing number of domestic animals wintering in woodlands the amount of damage caused by browsing and trampling would have been considerable. A certain benefit is gained from trampling; it improves the seed bed to some extent, but this was probably a minor benefit in comparison to the damage caused by browsing. The practice

of wintering animals in the woodlands has been put forward to explain the lack of woodlands in the Highlands.

> 'The reason for this general absence of trees in Scotland is to be found neither in climate nor in the direct action of man, but in the ancient system of husbandry. In the absence of enclosure the entire stock of each crofter township roamed everywhere as soon as the crop was off the ground. There being as yet no turnip nor sown grass, but only a very little coarse hay from the boglands, every green thing within reach ran risk of being eaten up. There would be plenty of self sown trees, but few would ever have a chance of surviving'.
>
> (Colville 1897, p.6).

In the late seventeenth century legislation was introduced to ensure that cattle were herded in winter and thus reduce the damage to the woods.

> 'Old Scots Law recognised the enmity between domestic herds and forest growth, for it was ordained in 1686 that cattle should be herded in winter and in summer for the protection of plantations and enclosures. It thus appears that cattle were not then herded and it is only within comparatively recent times that open "out field" and "in field" gave place to the enclosed fields of the present day'.
>
> (Ritchie 1920 quoted by Anderson 1967, v.1, p.341).

This would have made conditions even harder for the animals, as woodlands were their major source of food in winter. Possibly during the eighteenth century when the population of domestic animals was very high and when they were denied access to woodlands the mortality in late winter and early spring was higher than it had been in the previous century. Factors such as the severity of the winters must also be taken into consideration, because when the weather is very bad, for example if there are blizzards, cattle could not survive even if they have access to woodlands. However, it is interesting to note that many of the descriptions of the

miserable state of the animals at the end of the winter were written in the second half of the eighteenth century.

> 'Their cattle are much weakened by want of sufficient food in the preceeding winter, and this with immoderate bleeding reduces them to so low a plight, that in a morning they cannot rise from the ground, and several of the inhabitants join together to help up each others cows'.
>
> (Burt 1754, v.2, p.123).

> 'I well remember to have seen the poor wives during the ripping cold north east winds in May, provincially termed the cow quake, tending their cows, reduced to a skeleton and covered with a blanket, while they picked up any spires of grass, which had begun to rise in the kail yard or bottom of walls and banks. And to such extremities were they reduced at times that I have heard of their taking the half rotten thatch from the roofs of their homes and giving it to the half-dead animal as a means of prolonging its miserable existence'.
>
> (Art 1808, p.436 quoted by Handley 1953).

There must have been considerable conflict, on the one hand if cattle were excluded from woods in the winter and were not given supplementary food, they would have had poor chance of surviving. On the other hand if large numbers of domestic animals were wintering in the woodlands the tree would have had small chance of regenerating. Dr. Johnson made some interesting and perceptive comments on the problems of timber production in the presence of grazing animals; possibly as a result of his visit to Mull in 1773.

> 'Neither is it quite so easy to raise large woods, as may be conceived. Trees intended to produce timber must be sown where they are to grow; and ground sown with trees must be kept useless for a long time, inclosed at an expence from which many will be discouraged by the remoteness of the profit, and watched with that attention, which, in places where it is most needed, will neither be given nor bought. That it cannot be plowed is evident; and if cattle be suffered to graze upon it, they will devour the plants as fast as they rise. Even in coarser countries, where herds and flocks are not fed, not only the deer and the wild goats will browse upon them, but

> the hare and rabbit will nibble them. It is therefore reasonable to believe, what I do not remember any naturalist to have remarked, that there was a time when the world was thinly inhabited by beasts, as well as men, and that the woods had leisure to rise high before animals had bred numbers sufficient to intercept them'.
>
> (Johnson 1773 ed. Chapman 1970, p.127).

The reproductive rate of the domestic herds and the slow growth rate meant that only a small percentage of the herd could have been sold in the autumn to reduce the size of the over wintering herd. Therefore, if large herds were to be reared, artificial and cultivated fodder crops had to be provided for them. By the end of the eighteenth century this had started to be done in some areas and the mortality of the domestic animals was being reduced. Mackenzie (1810) mentions this in his survey of the agricultural conditions of Ross and Cromarty at the end of the eighteenth century.

> 'In former times, the stock on cattle-farms was much higher than it is now; and the consequence was, that vast numbers of animals died of want during severe winters. It is a well known fact, that thirty or forty years ago, as many cattle died on one farm, during one spring, as the whole stock now amounts to. By diminishing the stock, and increasing the quantity of winter food, serious losses are not now felt'.
>
> (Mackenzie 1810, p.253-254).

TYPES OF ANIMAL AND PRODUCTION

CATTLE

Until the end of the eighteenth century, the cattle found in the Highlands were 'unimproved' stock, the product of a fairly natural form of selection. The only artificial selection was that most male

calves were killed at birth (Mackenzie 1810, Loch 1820) and selected animals were sold to the drovers.

Although there was great regional variation in the kinds of cattle found, in comparison to cattle bred on low ground farms, they were all small and unproductive, their low milk yield and small size were as much a result of the severe environment as of breeding. Macdonald (1872) gave detailed descriptions of all the breeds of cattle found in Scotland in the nineteenth century. He described the lowland high milk yielding Galloways, the small Aberdeenshire cows, who were the fore-runners of the black Aberdeen-Angus, the West Highland cows, or Kyloes, and the hardy little Shetland cows amongst others. By the time Macdonald wrote some of the regional differences had been accentuated by selective breeding for qualities such as increased milk yield and larger body size, and some characteristics were being lost by the introduction of breeds from elsewhere. Management had also changed; housing in winter had become more common with the introduction of winter fodder crops and the whole cattle system, especially dairy production, was becoming independent of the hill pastures.

The value of the small 'unimproved' cattle was often underestimated by those studying the agricultural situation in the Highlands at the beginning of the nineteenth century. The old type of Highland cow appeared to be very unproductive, calving only once every two years, with a low milk yield and weighing only about twenty stone, but they had advantages which a few of the writers recognized. James Macdonald, writing about the agriculture in the Hebrides in 1811, summed up the value of the small native cattle of the Islands and very wisely cautioned against ill consider attempts at

improvements:

> 'Strangers, on visiting the Western Isles, cry out against the folly of the people in keeping the cattle of a small breed; when by changing it for the Irish, or the Lowland Scotch, they might greatly enlarge the carcases of their stock. But this is often a rash opinion. The great question in Hebridean grazing and rearing is, what breed will best answer the land and climate, and what size can be most easily and securely raised at the smallest expense? Heavy cattle cannot seek their food in bogs and marshes, leap over ravines, rivers and ditches, or scramble through rocks, and in the faces of cliffs and precipices, like the present breed, which is almost as active and nimble as a Chamois goat; nor can the poor Hebridean tenant afford to breed any stock which is not proof against the inclemency of his rains and storms all the year round. It is infinitely safer for him, therefore, in the present imprefect state of his agriculture, and perhaps even at all times, and in all circumstances of his country, to rear too small, than too large a breed of cattle; and to improve his indigenous, hardy, excellent species, than to import from other districts such breeds as may be indeed profitable for their circumstances and climate, but which would probably perish in the Hebrides, without more attention being paid to them than, in his situation, he can conveniently afford',
>
> (Macdonald 1811, p.426).

It is hard to generalize about the size of the cattle bred in the mountain areas of Scotland. Fussell (1929) collected information on the size of cattle in the eighteenth century and the references he gives, which date from 1785 - 1813, describe the Scottish cattle as weighing from 20 - 50 stone. However, these cattle were those that had been driven down from the north and had been grazed on the English pastures before going to be slaughtered. Haldane (1952) mentions that Highland cattle were often fattened on the meadows of Norfolk before being taken to Smithfield Market to be sold and Pococke in 1760 mentions the Galloway Cattle being fattened in East Anglia (Kemp 1887, p.18).

The Shetland cattle did not reach twenty stone except when they

were put on very good pastures and, even then, most of them only reached fifteen or sixteen stone (Macdonald 1872, p.323). A well bred Ross-shire bullock on the other hand weighed over thirty stone, and the country cattle of Caithness ranged from 27 - 45 stone (Macdonald 1872, p.307). There was obviously much regional variation. John Smith described the cattle of Argyll in 1798.

> 'When in good condition, and from three or five years old when they are commonly sold off, the carcase may weigh from 360-400 lbs. avoir dupois. But such as are brought to better pastures as in England maybe brought to weigh 560 lbs. or more'.
>
> (Smith 1798, p.235 quoted by Haldane 1952).

Some of the cattle going south were much smaller. A survey of Dumbartonshire, made in 1795, referred to very small cattle from the north, only eleven to fourteen stone being sent to the English markets (Ure 1794, p.58 quoted by Haldane 1952). Probably the cattle reared in the more mountainous areas did not weigh much more than twenty stone. This is borne out by Sir George MacKenzie (1810). In his report on the agriculture of Ross and Cromarty to the Board of Agriculture describes the cattle of Kintail and Loch Alsh as being,

> '... a very superior breed of Highland cattle. They are not remarkable for size; but for their shape and hardiness'.
>
> (Mackenzie 1810, p.251).

He goes on to discuss the size of these animals, and the price,

> 'The weight of the stot from three to five years old, when lean, may be stated at 70 to 80 lb, av. per quarter; average price from L.4 to L.7. Weight of the cow, when lean, from six to nine years of age, may be stated at 60 to 70 lb.; average price from L.4 to L.6. (Breeding cows often fetch L.15). Weight of the stot when fattened, from 100 to 110 lb.

per quarter. Weight of the cow when fattened from 95 to 100 lbs.

(Mackenzie 1810, p.255).

The stots, or young males, therefore weighed between 20 - 23 stone (127 - 146 kilograms) lean and 28 - 32 stone (178 - 200 kilograms) when fattened. The cows weighed 17 - 20 stone (108 - 127 kilograms) lean and 27 - 28 stone (171 - 178 kilograms) when fattened.

Franklin (1952) also mentions the great difference between cattle fed on turnips and those not so fed, in his discussion of the size of cattle in the Highlands at the end of the eighteenth century.

The old type Highland cow produced very little milk compared with a modern dairy breed, but one has to remember that the modern dairy cow kept out all the year round on the Scottish mountains would probably not survive for long. The figure often quoted for the average milk yield of the old type of Highland cow is a gallon of milk per day at the peak of lactation and only half a gallon later on in the year (Watson 1932). The lactation period of cows usually lasts nine to ten months. In Norway, the Veigdalen cows calved in November and were still being milked the following September. The old type of Highland cow calved in April or May, so presumably produced milk until at least December when food would be getting short.

Milk is made up of non-fat solids, fat, protein, lactose and water, approximately 13% solid to 87% water (Waite —). The yield and composition of milk are determined by various factors; breed, age, nutrition, the stage of lactation and the season, milking interval and disease. Therefore the actual yield of the old type Highland cow and the composition of the milk, in particular the butter fat content, would probably have been a factor of environment as well as of breed.

It is interesting to note that the yield per lactation rises to a peak at the sixth lactation (Waite —). This would explain why cows in the Highlands were often kept until they were twelve. If they had not started to give milk until their fourth or fifth year the maximum yield would have been reached when they were ten year old. The farmers on Lewis kept their cows until this age.

> 'They frequently keep their cows till they are twelve or fifteen years old'.
> (Macdonald 1877, p.165).

There are few contemporary references to the actual milk yield of the old types of Highland cows, but these point out that though the volume of milk produced was very low, the milk was particularly rich in butter fat; Walker (1812) mentions this in his general description of Highland cattle.

> 'The richest milk is always produced upon the poorest pasture; and wherever it is small in quantity it is usually superior in quality. The best cows in many parts of the Highlands afford only a Scots quart of milk a-day; of this, the calf gets a chopin in the morning; and the same quantity in the evening; but many of them yield not daily above a Scots pint of milk. This milk, however, is like cream, compared to that of large cows fed upon clover, which give from fourteen to eighteen Scots pints of milk a-day.
>
> One of the best, and one of the worst milk cows yield together, during the summer season, about two stone weight of butter, and four stone of cheese, at twenty-four pounds the stone; some times in all, seven stone but seldom eight. The butter they afford is often more than one half of the quantity of the cheese, which shows the peculiar richness of the milk'.
> (Walker 1812, V.1, p.60-61).

Other writers, such as Pennant, quote the amount of butter and cheese produced by cows and not the actual milk yield of the cows. On the Island of Canna for example Pennant found that,

'Each couple of milch cows yielded at an average seven stones of butter and cheese: two thirds of the first and one of the last. The cheese sold at three and six pence a stone; the butter at eight shillings'.

(Pennant 1776b, V.1, p.312).

The stone referred to was one of 24 lbs., a Dutch stone. In Caithness, at the end of the eighteenth century, Henderson (1812) found that, after the family had taken what it needed, there was about 24 - 30 lbs. of butter and 24 - 30 lbs. of cheese for sale from each cow. In 1760's the butter sold at around 5/- per stone and the cheese for 2/- to 2/6d per stone.

There is an extremely interesting description of the management of cattle in the early nineteenth century given by Mackenzie (1810) in his survey of Ross and Cromarty.

'The cows generally produce their first calf at the age of four years. While the price of cattle was low, it was the practice to kill half the number of calves, and to allow one calf to suck two cows. In order to accustom the cow whose calf was killed to that of another, the latter was covered with the skin of the one killed, when sent to the cow; and by degrees she became fond of the stranger. By this means the calves were well reared; the cows were kept in better condition, and the surplus milk compensated the loss of a calf. One cow, besides rearing a claf, generally produces one stone of butter and two stone of cheese.

..... Since cattle have become more valuable, the system of coupling has been given up, except in the case of young cows, which are not allowed to rear their calves singly'.

(Mackenzie 1810, p.251-252).

This practice of 'coupling' would explain why the yield of two cows was given.

Pennant (1776), Walker (1812) and Robertson (1808) all state that two cows gave about seven stone of butter and cheese. Walker (1812) and Robertson (1808) quote two stone of butter to four stone

TABLE 4 MILK, BUTTER AND CHEESE PRODUCTION

Well bred Ayrshire cow Macdonald 1872	5 gallons/day for the first two to three months after calving, 3 gallons for three months then only 1½ gallons for three months, 32 gallons of unskimmed milk gave 1 Dutch stone of cheese & 90 gallons gave 1 Dutch stone butter	800 gallons/year 200 lbs butter/year
Average dairy cow in C19th, Macdonald 1872	430-450 gallons of milk/year 30-40 pints of milk gave 1 lb of butter	440 gallons/year 100 lbs of butter/year
Channal Island cow at the end of C19th. Macdonald 1872	16 pints of unskimmed milk gave 1 lb butter	
Veigdalen, Norway cow Myklatun, pers. comm.	Max. yield if fed on pasture 2 gallons/ day(10 litre) 16 pints of milk gave 1 lb butter (20 litres gave 1 kilo)	300-400 gallons/year (1500-2000 litres)
Hill cow from Ross Macdonald 1872	2-3 gallonsof milk/day in summer or 5-7 Scots pints, yielding 4-6 lbs of butter/weeks	
West Highland Kyloe fed on good pastures on Tiree or North Uist	Yielded 22-24 lbs of butter and 80-90 lbs of cheese	If similar to Veigdalen cows the the summer yield of milk was between 124-138 gallons minimum and 214-228 gallo maximum.
Modern dairy cow fed on grass	Expected yield about 600 gallons/year	
OLD TYPE OF HIGHLAND COW		
Couple	2 stone of butter and 4 stone of cheese	If similar to the Kyloes the annual mil
Pennant 1776, Robertson	7 stone of butter and cheese	yieldwas 100 gallons minimum and if they
Walker 1812		were similar to the Ross cattle theminimum
Henderson 1812	4,5 rarely 6 Scots pints a day, 1 stone of butter and 2 stone of cheese	was 168 gallons
One good and one bad cow, Macdonald 1811	24lbs of butter and 2 stone of cheese up to 2 stone of butter and 4 stone of cheese	

1 Scots pint equalled around two English pints, 1 choppin equalled two Scots pints or about 1 English quart.

of cheese.

It is difficult to get a clear idea of the milk yield of the old types of Highland cows, Macdonald gives some figures that are useful, but they are very incomplete. Table 4 shows some of the information available.

Trow-Smith (1959) in his history of British livestock quotes the figure of 150 gallons per cow. If at the peak of lactation the old type of Highland cow gave only $1\frac{1}{2}$ gallons and at the end of the lactation only gave $\frac{1}{4}$ of a gallon the annual yield would have been in the order of 200 gallons which would fit with some of the estimates given in Table 4 . The total yield of milk is not the most important factor to consider when evaluating the worth of the old type of Highland cow as a dairy animal; the solid content of the milk are probably more important. Wild grazing animals, such as reindeer, give only small amounts of highly concentrated milk which is rich in fat and protein. This is very important, as the calves have to grow rapidly to ensure that they will be big enough to survive the winter.

	CONTENT OF THE MILK	
	FAT %	PROTEIN %
REINDEER (Klein 1970b)	22	10
MODERN DAIRY COW (Waite —)	4.05	3.3

Possibly the yield of the old type of Highland cow and the composition of the milk was comparable to that of the wild animals.

GOATS

Goats figure prominently in the Scottish records as they still do in Norway. Megaw (1963, 1964) in the first two papers of a series on the role of goats in the old Highland economy discusses and quotes many of the contemporary descriptions of goats and their uses in the Highlands. Smout (1965) in the same series of papers questions the role of the goats in the destruction of the Highland woodlands.

Goats are valuable not only as milk producing animals but also for meat and skin. The yield of the goats of Veigdalen was about 1/5th to 1/6th of that of the cows. In late summer the goats gave 1 litre or 1.75 pints of milk per day; the average annual yield of goats in 1907, managed under the traditional seter system, was 150 litres or about 35 gallons. Goats' milk cheese is made in Norway from the whole milk and 1 kilo of cheese is made from 8 litres or 1 lb. is made from 6 pints. In Veigdalen the souming relationship or standard stock equivalents between cows and goats was 1 cow to 6 goats.

Considerable numbers of goats were kept in the Highlands until the late of the eighteenth century; in Glen Strathfarrar for instance in the South Ross-North Inverness study area there were 700 goats in 1770, in Loch Alsh also in the study area there were 1,011 goats in the parish in 1794 (FEP E/769/72/6, OSA 1794, V.11).

SHEEP

The sheep found in the Highlands before the introduction of the blackfaced and cheviot sheep from the Lowlands and border counties were small and probably very similar to some of primitive breeds

such as the Soay sheep found on St. Kilda, the small Shetland sheep and the Ronaldsay sheep from the Orkneys. They were possibly similar also to the old Norwegian sheep already described.

> 'The sheep of the old Highland breed were small delicate creatures that required to be housed in winter. They had very fine wool and their mutton was very sweet. They were less able than goats to defend themselves and their young from foxes and golden eagles so they needed a great deal of care and protection'.
>
> (Campbell 1896, p.66).

Macdonald (1811) and Walker, writing in 1812, both thought that the race of sheep, then in the Highlands, had been planted there by the Norwegians between the eighth and twelfth centuries, when the Western Islands and west coast were under Norwegian domination. Walker went on to add that the native sheep of the Hebrides and of the Shetlands looked exactly like those of Norway.

> 'The Hebridean sheep is the smallest animal of its kind. It is of a thin lank shape, and had short streight horns. The face and legs are white, the tail extremely short, and the wool of various colours; for, besides black and white it is sometimes a blueish grey colour, at other times brown and sometimes of a deep russet, and frequently an individual is blotched with two or three of these different colours. In some of the low islands, where the pasture answers, the wool of this small sheep is of the finest kind, and the same with that of Shetland. In the mountainous islands, the animal is found of the smallest size, with coarser wool, and with this very remarkable character, that it has often four and sometimes six horns.'
>
> (Walker 1812, V.2, p.69).

In Norway ewes used to be milked during the summer both morning and evening. This was also the practice in the Highlands and it still is in Poland, Italy and some other parts of Europe. The ewes would give between 1.5 and 1.75 kilos of butter or between 3 and 4 lbs. of butter (Reinton 1955). Various combinations of goat, cow

and sheep milk were used to make cheese (Campbell 1896). However, as it was thought to harm the lambs to take much milk from the ewes, they were not milked for long after lambing. Later, when the blackfaced and cheviots were introduced to the Highlands at the end of the eighteenth century the practice of smearing was introduced; ewe's milk was used to make a crude butter which mixed with tar made a smearing agent. Smearing or coating the fleece with a sticky substance was not only to protect the sheep from the cold but also to prevent parasites from invading the fleece.

> 'In former times, it was customary in many places to milk the ewes in order to make ewe-milk cheese, which, when well made is very nutritive. Then, when smearing was common, milk was sometimes drawn from the ewes to make a low-class butter to mix with the tar for smearing. The practice of milking ewes, however, has been discontinued in this country. It is injurious to the ewes, it hindered them from storing up fat in the system, so very essential for the ewes that have to face the storms of winter in upland situations'.
> (Macdonald 1891, V.2, p.453).

Robertson (1808) also described how the sheep were milked for a few weeks after lambing and how the milk is used for cheese and butter and the butter used for smearing. Sinclair (1826) in his analysis of the statistical accounts also discussed the use of ewe's milk to make butter for smearing.

It is hard to work out even a rough figure for the yield of milk of the primitive breeds of Highland sheep. The yield of modern black-faced sheep for a sixteen week lactation period is found to be 84.14 litres (23 gallons) (Munro 1955, quoted by A.R.C. 1965) and for cheviots between 51 and 105 litres (14 - 29 gallons), (Thomson and Thomson 1953 quoted by A.R.C. 1965). From these figures it can be presumed that sheep were never very important as dairy animals

on the Highland whereas goats could have been extremely.

> 'sheep were considered as of little value in this country. Farmers kept only as many as were sufficient to clothe their families and to afford a little mutton....'
> (Campbell 1896, p.67).

One can not say whether the types of animals used under the shieling system were the most productive animals that could have been used, but because they had evolved in the mountain environment and were adapted to living under the severe conditions found in winter they were probably a great deal more productive than animals brought in from elsewhere.

HORSES

The Highland ponies were small, only 9 - 12 hands high, but they were strong and sure footed. Walker (1812) noted that the ponies found in the Highlands, like the sheep, were similar to those found in Norway, Iceland and the Faroes. The ponies were not managed at all intensively. In Kintail, for example, large numbers of small ponies were reared on the hills. Each year a number were caught by driving them into bogs and were sold to drovers going south, (O.A.S. 1793, V.6).

Four small ponies were needed to draw a plough and with the development of heavy two horse ploughs, it was necessary to introduce larger animals, the Highland ponies therefore were often replaced by Clydesdales for farm work (Grant 1961). Ponies were also used to carry peats and therefore had to be brought down from the mountains for a short time in the summer. They were not broken in until they were around seven years old, probably because they were

not mature until five or six, and were not strong enough for work until then. Often the numbers of ponies in a glen were not known and were not taken into consideration when the total number of grazing animals belonging to a township was calculated.

SOUMS, SOUMING AND RENTS

Before the breakdown of the land tenure system of the clans during the eighteenth century, the number of animals held by a family was probably very closely related to their needs and to the environment. The rent that each farmer paid was related to the number of animals that he had as well as the extent of the arable ground. The system of souming and soum equivalents developed through experience of the needs of the family and of the number of animals the area could support. A soum was simply a standard stock unit in a recognised scale of equivalents, and as such tells nothing of the stocking rate of a farm or the number of animals needed to support a Highland family. The souming is more interesting as it shows the number of animals supported on a farm all the year round. The two interesting factors are, therefore, the relationship between the souming and the quality of the land, and the number of soums per family.

The system of soum relationships varied through the Highlands; in some places 1 cow = 1 soum; 1 three year old heifer or stirk = 1 soum; or a two year old and a calf = 1 soum. The soums relationships given in Table 5 show some of this variation. Burt (1754, p.155) is the only one that is significantly different as he quoted 20 goats to a soum in the early eighteenth century. These relation-

ships developed from experience of the needs of the different species or types of animals in the particular area.

It is difficult to work out how the souming for a farm was calculated, before the second half of the eighteenth century it was probably done by experience and subjective judgement rather than by quantitative, objective decisions. John MacArthur in his survey of the south of Loch Tay in Perthshire made in 1769, explains in detail, how he calculated quantitatively the souming for each farm (MacArthur 1936). He estimated that there were 416 acres of moor on the farms of Easter and Wester Tullicans. He divided this between the two farms, and then looking at the amount of pasture each farm had within the head dyke, he decided how many acres could support 1 soum or cow equivalent. In the case of Easter and Wester Tullichacans, he decided that $4\frac{1}{2}$ acres (scots) would be needed to support 1 soum. When pasture was less good he allowed 5 acres (scots) per soum. He then calculated the total souming for each farm by dividing the total acreage by the land needed to support 1 soum. He set a figure of between 3/6d - 4/2d. per soum for the rent. The rent to be paid per soum may have been related to the amount of arable attached to each farm (MacArthur 1936).

Another way to enquire the number of animals needed to support a family and the stocking rate of an area is to look into the ancient denominations of agricultural land in the Highlands. This has not been considered in any detail in the present instance, but could prove a valuable line for further research. The denominations of agricultural land in Scotland were extremely complicated, due partly to their different Celtic and Norse origins. McKerral (1944), in a detailed paper, discusses the types of land denominations

and the cultural origins. James Macdonald (1811) described the denominations found on Islay. These are good examples of the types of denominations used. The 'Ceathramh' or 'quarter' was a farm rented at £70 - £80, the 'Ochdamh', or 'eighth part' was half the 'Ceathramh' and was rented for between £35 - £40. The 'Leorthas', or 'sixteenth part', was considered a 'sufficiency', that is a farm large enough for the tenant to supply a plough, and to pay a rent of between £17 - £20. The Leorthas or 'Plough gate' was defined as 104 Scotch acres. This was not necessarily all ploughed at one time (McKerral 1944, p.49). McKerral quotes W.F. Skene as saying 'The smallest possession held by a free farmer appears to have been two bovates or oxgangs of land or the fourth part of a plough gate', (Skene 1880, p.243). The difficulty here is that it is not clear to which period Skene is referring to, but it was presumably prior to 1700.

By the eighteenth century, the penny land was a division in use in the south Ross-north Inverness study area. A well-off farmer held a penny land and a poorly-off cottar or servant held a farthing or quarter of a penny. A penny land was a third of an oxgate or plough gate in Kintail in 1795 (OSA 1793, v.6, p.249). It would be interesting to study the changes in the average minimum size of holding that occurred from the seventeenth century to the early nineteenth. Local variation in the terms used to classify agricultural land would complicate such a study. It appears that the average size of holding and the number of animals held declined considerably during that period.

During the eighteenth century cattle increased in cash value and the number of animals held by a pastoral farmer would no longer

have to be closely related to the level of milk production. Until the late eighteenth century, rents were paid in kind as well as in money and by direct labour to the lord[1]. Gray (1957) discusses the system of paying rent and also the proportion of the annual income that went as rent. Little, however, has been written about the proportion of the annual production of the herds or of the arable ground that went towards rent. Smout and Fenton (1965)in an exploratory paper on Scottish agriculture before the improvers, suggest that roughly one third of the grain production was kept for food, one third was kept for seed and one third was paid as rent.

The following discussion is very crude, but may serve as a guide to the probable proportion of the annual animal production that went as rent; further research is needed before more definite figures can be given.

In a rental for Comar and Strathglass dated 1728 (FEP 1715 Comar) the rent payable in money was £156. 14s. 22/3d. and the value of the rent payable in kind was £11. 3s. 10d.

		Wedders	Kids	Lambs	Hens	Butter	Cheese
Total	£156.14s.$2\frac{2}{3}$d.	22	10	6	122	11st. 8lb.	23st.

11st. 8lbs. of butter and 23st. of cheese, most probably Dutch stones of 24 lbs., were the annual production of around eleven cows. The farmers who had to pay their rent in dairy products were those with farms on higher ground and were presumably more dependent on pastoralism than on cultivation. Mather (1970) discussed this

1. Walker (1812) has an interesting chapter on land tenure, rents, souming and payment in kind.

relationship with reference to Glen Strathfarrar, which is the next glen north of Glen Cannich which is being discussed here.

In 1715, Alexander Chisholm of Muckerach one of the farms in the west of Glen Cannich, mentioned on the rental had to pay a rent of £11.2.2$\frac{2}{3}$d., 2 wedders, 1 kid, 4 stone of butter and 2 stone of cheese: that is the production of around 3$\frac{1}{2}$ cows or 21 goats. Hugh Maclean also of Glen Cannich, had to pay only £2.15.6$\frac{2}{3}$d., half a wedder (presumably one over two years), 1 kid, 1st. 8lbs. of butter and 12 lbs. of cheese, that is the production of 1 cow or 6 goats.[1]

In 1770 the farmers in Glen Strathfarrar were having to pay between 3/- and 4/- per soum (appendix 2). Using the slightly lower figure of 2/- per soum because of the forty year gap, it could be calculated that Alexander Chisholm of Muckerach would have had around 55 soums and Hugh Maclean would have had 14 soums. Hugh Maclean paying a rent of £2.15.6d. and having a probable souming of 14 (ie. perhaps five cows and their followers, 20 goats and 20 sheep) would have had to have paid nearly one tenth of the dairy production as rent. Alexander Chisholm with a souming of 55 would have had, probably 20 cows and had to pay a little more than a tenth of the annual production.

1. FEP 1715 Comar No.6.

Table 5.

SOUM RELATIONSHIPS

SOURCE	DATE	SOUM RELATIONSHIP
Burt 1754	1720's	1 soum = 4 sheep; 2 soums = $1\frac{1}{2}$ cows = 40 goats
Pennant 1776 p.320	1760's Canna	1 soum = 1 cow = 10 sheep; 2 soums = 1 horse
Lovat FEP.E/769/72/6	1770	1 soum = 1 milk cow = 1 three year old heifer or stirk = 2 two year olds = 2 calves = 1 horse = 10 sheep = 10 goats
Robertson	1808 Inverness	2 soums = 1 horse
Carmichael	1884 Hebrides	1 horse = 8 foals = 2 two year old fillies = 1 three year old + 1 one year old filly = 2 cows; 1 cow = 8 calves = 4 stirks = 2 two year old queys = 1 three year old quey + 1 one year old stirk = 12 hoggs = 16 lambs = 16 geese 1 horse = 2 cows = 24 hoggs = 16 calves = 32 lambs = 22 geese

Table 6.

LAND DIVISIONS AND THE NUMBER OF ANIMALS SUPPORTED

SOURCE	DATE	
Pennant 1776; p.314	1760's Canna	1 pennyland supports 7 cows and 2 horses and produces 8 bolls of black oats from 2 bolls, 4 bolls of bear from ½ boll and 7 bolls of potatoes from 1 boll.
p.320	Rum	1 pennyland supports 28 soums, about 14 cattle.
OAS 1793 v.6, p.249	Kintail	1 pennyland supports 8 cows and 3 followers per cow. 3 pennies to an oxengate. A well-off farmer had 20 milch cows and sowed 4 bolls of oats and ½ boll of barley.
Walker v.1, p.3-4	1812	A large farm had 20 - 30 pennies. 1 pennyland supported 4-5 cows and followers, 6-8 horses and some sheep. ½ pennyland supported 8-9 soums, 4 cows, 3 horses and 10 sheep. Rent £5 - £6. ¼ pennyland or a farthing used in remote areas supported 4 cows, 4 horses and sheep rent £1.10s - £2.10s.
Skene	1880	1 Davoch supported 320 cows. 1 merk land supported 12 milk cows, 12 one year olds, 4 horses, 4 fillies, mares and followers, 100 sheep and 80 goats. 1 Davoch = 4 plough gates = 12 merklands = 20 pennies. Therefore 1 penny land supported 16 cows.

CHAPTER 5.

SOUTH ROSS - NORTH INVERNESS STUDY

There were several requirements to be met in the choice of the Scottish study area; it had to be mountainous with little low ground suitable for cultivation; there had to be adequate records available to illustrate the history of land-use; and, preferably, it had to be reasonably typical of land now used as deer forest. The area chosen lies north of the Great Glen in the counties of Inverness and Ross and Cromarty. It stretches from Strathglass in the east to the River Ling and Loch Long in the west. It comprises of four river catchments; in the east it is cut by three glens, Glen Strathfarrar, Glen Cannich and Glen Affric and in the west by Glen Elchaig. This area formed part of the Lovat, Chisholm and Seaforth Estates, in the parishes of Kilmorack, Kintail and Loch Alsh. The Chisholm and Seaforth Estates were broken up, the latter in the early nineteenth century and the former in the twentieth century.

The South Ross-North Inverness study area, is now deer forest; ninety ewes and their lambs are summered on Beinn Dronaig on Attadale forest and there are sheep on the south side of Glen Affric in the summer and on Glen Cannich and Killilan. Seven hundred cattle from the Lovat home farms, around Beaufort, graze from June until the end of August in Glen Strathfarrar.

The aim of this study was to find out how the area was used, under a well developed shieling system prior to the introduction of sheep in the early nineteenth century; and to follow the changes that have occurred since then. Glen Strathfarrar was studied in detail; changes in settlement, in the number of grazing animals using the glen and also the changes in the woodlands that have occurred

during the last two hundred years were considered. The distribution of shielings or summer grazing areas over the whole area is described.

TOPOGRAPHY AND GEOLOGY

When the human population in the area was at its height in the early nineteenth century, land up to 240 metres was cultivated in suitable sites; however most of the central area is over 240 metres and uncultivated. In the east the mountains rise to over 900 metres. In the centre and in the west except along the river valleys the ground is over 300 metres. The mountains are made up of pelitic gneiss and siliceous schists of the Moine Series with areas of acid and hornblende gneiss of Lewisian gneiss. Most of the area, except the higher ground, is covered with morainic deposits and undifferentiated boulder clay. Along the rivers there are alluvial deposits which give rise to well drained soils and fertile pockets. Much of the lower ground, particularly in the west, is covered with peat.

CLIMATE

In the west the weather is generally cloudier, the rainfall higher and the winters milder than in the east. In the central mountains, the winters can be as severe as anywhere in the British Isles. Long term changes in climate have not been considered; there does seem (according to the Old Statistical Accounts of the 1790's) to have been, however, a worsening of weather conditions in the area towards the end of the eighteenth century.

VEGETATION

The vegetation found in the study area is typical of the west central Highlands. There is only a limited range of types found on calcium soils but there are possibly a higher number of snow influenced vegetation types on the higher ground than there are in similar mountain areas such as the Ben Nevis range (McVean and Ratcliffe 1962).

The study area, except for Glen Affric, was surveyed in the summer of 1972 as part of the deer management research programme of the South Ross Deer Unit, Department of Forestry and Natural Resources, University of Edinburgh. Broad divisions for the plant community types were essential as the time available for the survey was short. Although there are obvious limitations to such a general survey, some important differences came to light. In the east of the area, immediately above the relict woodlands the main vegetation types are wet heath communities of type 7 (Key 2, p80) dominated by heather Calluna vulgaris and communities of type 3c dominated by Vaccinium myrtillis, with dwarf shrub heaths of type 11. Above the dwarf shrub heaths in the east at altitudes of over 600 metres there are natural grass sedge communities of type 10, and above these are moss heaths of type 12. In the west grass/sedge communities both natural and anthropogenic are more extensive; these grassland communities of type 4 and type 10 take over from the dwarf shrub communities at 450 metres. The larger extent of grass/sedge communities in the west is probably due to the two factors: higher altitude and the depression of the grassland resulting from the oceanic influences of climate. These grass/sedge communities were defined in the South Ross Deer Unit survey of 1972 as comprising of

Molinia caerulea, Anthoranthum ordoratum, Festuca vivipara, Deschampsia caespitosa, D. flexuosa and various Carex species. In the west this community is apparently dominated by anthropogenic Molinia grasslands of type 4c at the lower altitudes and by the natural grasslands of type 10 Deschapsia (species poor) and Nardus stricta at the higher levels.

The types of natural woodlands are also different in the west and in the east. There are still examples of native Scots pine woodland in Glen Strathfarrar, Cannich and Affric, type 1b, whereas in the west birch and alder are more important. It is not possible to define precisely the complex factors that have brought about the differences in vegetation. There are, for example, no accurate records about the burning of vegetation for sheep although it is still done in the area. Another important factor is that sheep farming lasted longer in the west.

DEVELOPMENTS

The upper parts of Glen Strathfarrar and Glen Cannich and part of Glen Affric have been dammed and flooded by the North of Scotland Hydro-electric Board. Loch Monar, in upper Glen Strathfarrar was formed by extending the existing loch and raising the water level to 260 metres. Loch Mullardoch in upper Glen Cannich was dammed and raised so that it now includes the former Loch Lungard or Glasletyr and the smaller lochans in between, Frith na acha and Loch na Cloiche. The land that was flooded was classified just before hand as poor grazing, able to support only one sheep per two hectares, but these pockets of alluvial soil had been used as summer grazing areas from at least the beginning of the eighteenth century and probably

much longer. They were under cultivation at the beginning of the nineteenth century and would probably have then supported a higher stocking rate than one sheep per two hectares.

TRACKS THROUGH THE AREA

Although there are no very easy routes across the study area, the main east west roads being in Strathbran to the north and through Glen Shiel to the south, but formerly there were several well used routes through the area. Thomson's map of 1826, based on Roy's map of 1747, shows the routes at that time. One way led up Glen Elchaig, through Coire nan Each to Riabhachan, then to Glen Inchlochel and Glen Strathfarrar. Another went east from the present Iron Lodge in Glen Elchaig, south of Carn na Breabaig, along the shores of Loch Longard and Mullardoch to Glen Cannich. The third main route was mentioned by Haldane (1952) as a drove road and was surveyed in 1795 by Brown as a potential roadway; it runs from Strathcroe, through Gleann Gniomaidth to Glen Affric, then through Guisachan to upper Strathglass. Haldane (1952) mentions this as one of the routes taken by the drovers bringing cattle from Skye to the tryst at Muir of Ord. It is now a popular hike with an overnight stopping place at Allt Bethe which is a former shieling area. Since the upper parts of Glen Strathfarrar and Glen Cannich have been flooded communications are much more difficult.

SOURCES

Early maps of the study area, such as Blaeu Extima Scotiae (1654), Roy's map surveyed between 1747 and 1755, Arrowsmith's map (1807) based on Roy's map and Thomson's map of Ross and Cromarty

of 1826, were all useful for locating settlements and showing tracks through the area but they were little help in locating shielings. There is a map of a proposed road from Kintail, through Glen Affric to Strathglass and Beauly, dated 1795, which shows the shielings in Glen Affric as well as the low ground townships of Strathglass (Brown 1795).

The area was first surveyed by the Ordinance Survey in 1864 and the first O.S. map (6 inches - 1 mile) was published in 1873. The name books of these surveyors were consulted. They record all the Gaelic names included on the maps and give English translations supplied by the local people. Houses referred to by name are described; their function, condition and the name of the owner are recorded. These books were useful not only for locating houses but also for giving the Gaelic names of burns, coires, and other natural features. According to the name books the words Ruighe, Innis, Airidh or Ari were used to describe a shieling or pasture. Unless the named site could be substantiated from other sources they were not taken to be definite shielings. The Ordinance Survey maps of 1901, 1954 and 1972 were also consulted.

The Seaforth Estate, which included Kintail and Loch Alsh, and the Chisholm Estates, which included Glen Cannich, Upper Strathglass and Glen Affric were forfeited to the crown in 1715. The estate papers from 1715 until around 1730 when the estates were sold are available. The rentals were consulted and these gave the names of settlements and a few references to shielings. Some of these estate papers have been published by MacPhail (1916).

The Lovat Estates were forfeited in 1745; these estate papers were extremely useful as they contained rentals from 1697 to 1770, a

report on the souming and rouming for the glen in 1770 (appendix 2) and also the papers relating to a survey of the glen made in 1758 by an Aberdeenshire surveyor Peter May. The map made for this survey is now in the Lovat Estate Office at Beauly, Inverness.

More recent information about the Chisholm Estates came from rentals and leases, held by Captain William MacKay of Glassburn, Inverness. The rental for 1775 which gives a great deal of information about the shieling areas for the townships of Glen Cannich and Upper Strathglass is included in Appendix 4.

Evidence given to the various government commissions[1] had its limitations as most of the witnesses were talking from memory, however, in most instances, information about grazing areas, the dates at which the areas were taken over for sheep and when they were cleared for deer forests were usually substantiated by more than one witness.

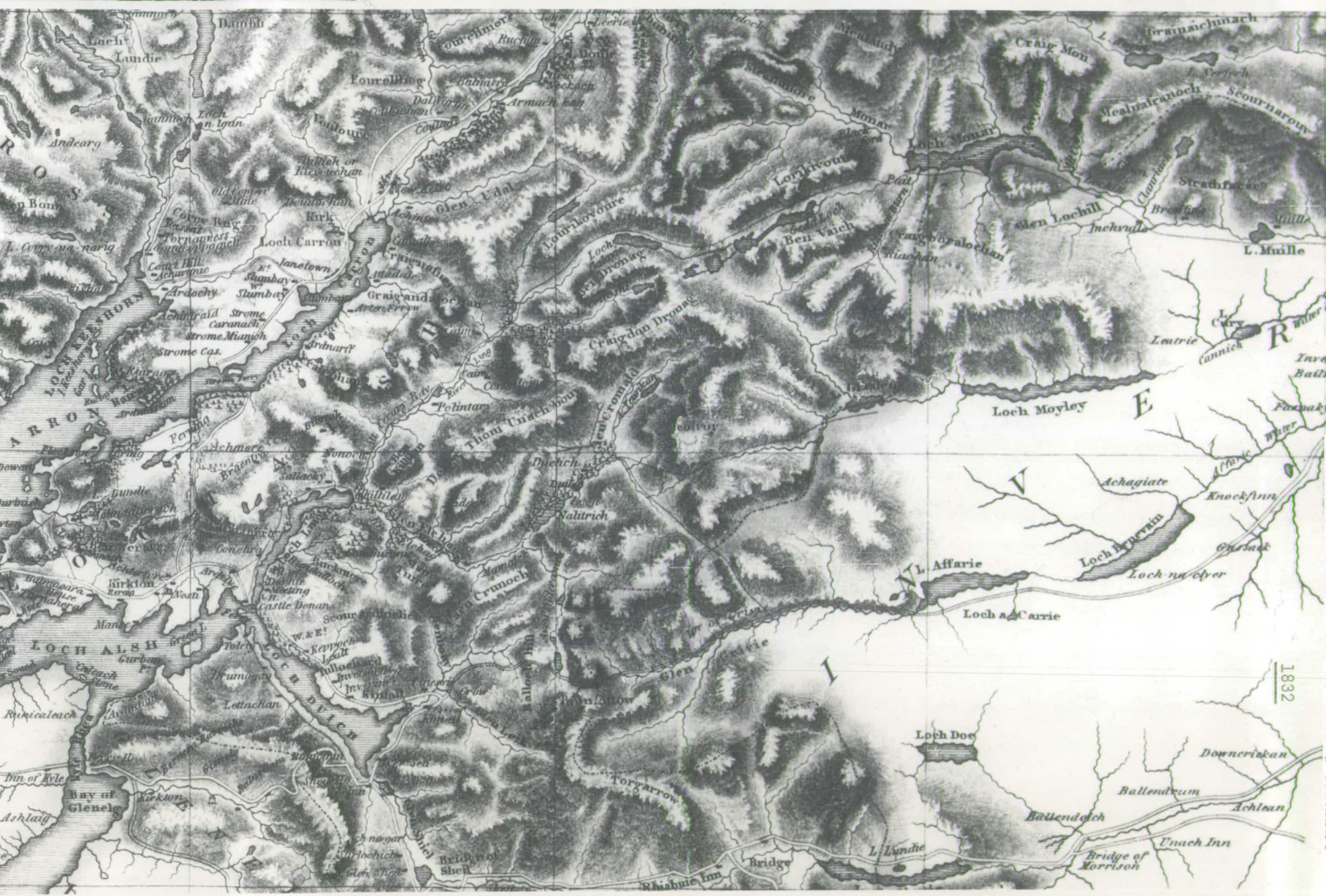
The Old and the New Statistical Accounts of the parishes written in the 1790's and in the 1840's give a general picture of conditions in the parishes including the number of people and, in some instances, the number of domestic animals. They show clearly the changes that occurred at the beginning of the nineteenth century.

The census returns of 1841-1891 were extremely valuable for corroborating information from other sources. These returns include details of the age and sex of members of each household and

1. Report of the Commissioners of Inquiry into the conditions of the Crofters and Cottars in the Highlands and Islands of Scotland, 1884 XXXII-XXXVI; Royal Commission on the Highlands and Islands, 1895 XXXVIII-XXXIX; Report of the Departmental Committee appointed in November 1919 to enquire and report with regards to lands in Scotland used as deer forest.

the occupation of the head of the household. They also show clearly when areas were changed from sheep runs to deer forest.

Other information was collected from printed material; particular reference must be made to Mather's (1970) study of Glen Strathfarrar, and to MacKay's study of the clearances of Clachan in Strathglass (1968), both of which were extremely valuable.



MAP 4

THOMSON. SOUTHERN PART OF ROSS & CROMARTY

1832

THE SETTLEMENT OF THE GLEN AND CHANGES IN THE HUMAN POPULATION

Glen Strathfarrar is the most northerly of the three glens in the study area that run eastwards into Strathglass. It is 18 kilometres long; the western part is at 150 metres and in the east where the River Farrar joins the River Glass at Struy the altitude is 60 metres. The glen is now uninhabited except for two families at Monar in the west, a family at Bencharran and a small community at Culligran.

The eastern and more accessible part of Glen Strathfarrar was settled at the latest by the beginning of the fifteenth century. Culligran and Deanie were probably the first sites to be settled as they are on the largest area of alluvial sands on the south facing side of the glen. The more remote and higher western part of the glen was primarily a deer forest, reserved for hunting until early in the seventeenth century, although some areas may have been used for shieling.

The first mention of settlements in the glen is of Culligran, Deanie and Achteroe (Ochterbrau) in a wadsett agreement dated 1417.[1]

> 'William Heleburton, Barron of Culbriny wodsetted from William Forbes of Kinaldy two Struyes, Culgarany, Deames, Killwoody, two Crochells, Commers, Ochterbrau, for 200 libs. anno 1417, which lands William Forbes redeemed and sould them to Lord Thomas anno 1420'.
>
> (MacKay 1905, p.128).

Struy is at the mouth of the glen; Culbrunie was near Belladrum and Kiltarlity, on low ground around Beauly; the others are in Strathglass.

1. See also Mackenzie (1896, p.627).

The western part of the glen came into the hands of the Lovat family, to whom it still belongs, in the early part of the fifteenth century when it was granted as part of a marriage settlement by William de Fenton to his sister who was about to marry into the Lovat family.

> 'On the 13th of March of that year, (1415), William de Fenton grants his sister, her husband and their heirs the lands of Guisachan, Comar-Kirkton, Mauld and Western Eskadale, all lying in Strathglass within the barony of Aird. Until the lands of Uchterach in the parish of Kilmorack were recovered the two Buntaits of 100 merks of old extent were given in pledge'.
>
> (Macdonald 1934, p.28).

Uchterach probably included much of the western part of the glen that was reserved for hunting. At this time organised deer hunts involved a large scale slaughter of animals and would only take place occassionally. Small numbers of deer must have been killed through the year for food. The big hunts lasted for several days and involved great festivities. Dogs were used to drive the animals out of the woods into corries or narrow passes where they were set upon by the hunters with knives and swords and killed indiscriminately.

> 'Five or sixe hundred men doe rise early in the morning, and they doe disperse themselves divers wayes, and seven, eight or tenne miles compasse, they doe bring or chase in the deere in many heards (two, three or foure hundred in a heard) to such or such a place, as the noblemen shall appoint them; then when day is come, the Lords and gentlemen of their companies doe ride or goe to the said places, some times wading to the middles through bournes and rivers: and then they being come to the place, doe lye downe on the ground, till those foresaid scouts which are called the Tinkehell, doe bring downe the deere: but as the proverbe sayes of a bad cooke, so these tinckehell men doe like (lick) their own fingers; for besides their bowes and arrows which they carry with them, wee can heare now and then a harquebusse or a musket

goe off, which they doe seldome discharge in vain. Then after we have stayed there three houres or thereabouts we might perceive the deere appeare on the hills around us (their heads making a shew like a wood), which being followed close by the tinckehell, are chased downe into the valley where we lay; then all the valley on each side being way-laid with a hundred couple of strong Irish grey-hounds, they are let loose as occassion serves upon the heard of deere, that with dogges, gunnes, arrowes, durkes, and daggars, fourscore fat deere were slaine'.

(Taylor 1618 in Hume Brown 1891, p.122).

There is another vivid description of hunting in the Wardlaw Manuscripts (Mackay 1905, p.416). It describes a week's hunting in the Forest of Monar in upper Glen Strathfarrar in 1655. This land then belonged to Lord Seaforth from the district of Loch Alsh and Kintail. This description has been quoted by Stuart and Stuart (1848), Mackenzie (1896) and Mather (1970). There seem to have been a high deer population as 600 or 700 were seen on the shores of Loch Monar. The hunt lasted for four days and there were great festivities. On the fifth day the hunters went home leaving the deer herd to recover before the next massive slaughter.

It is not clear whether the hunting reserves were reserved exclusively for deer, but probably they were before the seventeenth century, as the pressure on land was low. However, by 1600 domestic animals were being grazed in deer forest areas during the summer. There is an undated description of the shielings in the forest of Monar. The sites that can be identified are on the north side of Loch Monar.

'All and whole the lands and grazings of Luipinvir of Monar; as also the lands and grazings of Mulchullinish, and the lands along the middle division of Luipinvir[1] of Monar, as also the lands and grazings of Luiptiltrails of Monar'.

(Fraser MacIntosh 1897, p.4).

1. Luban-Inbhir 163421 O.S. 1st Edit. 1873.

The change from deer forests to shielings can be shown clearly for the forest of Corrycharrabie to the north of Glen Strathfarrar; there are many references to hunting in this glen from as early as the thirteenth century.

> 'Alexander, a brave youth, being about 17 years of age, hunting in the Forest of Corricharby, after a burst of running, decaying dayly dayed, anno 1269'.
>
> (MacKay 1905, p.64).

By the middle of the seventeenth century Corrycharrabie and Glen Orrin had certainly been used as shielings by the monks of Beauly Priory amongst others (Batte 1877).

> 'Now go home, Rory, and looke to your cowes in Glen Orrin, a fit employ for you, (ca, 1659)'.
>
> (MacKay 1905, p.328).

Strathglass and Glen Strathfarrar began to be settled by Lord Lovat in 1589 (MacKay 1905, p.184). It is not clear quite what this means, but it seems to have been done in order to protect the marches. The settlement process gained momentum, and at the turn of the century Lord Lovat, the owner of Glen Strathfarrar, granted out portions of the glen; for instance he granted Bencharran to James Fraser of Phopachy and his wife in 1607. Phopachy was a low ground farm in Strathglass.

> 'By charter dated Beauly, 2nd May, 1607, Simon, Lord Lovat, grants inter alia the lands of Bencharran, lying within the Barony of Aigas, Forestry of Brewlin and Sheriffdom of Inverness, in wadset to James Fraser, first of Phophacy and Elizabeth Fraser, his spouse, daughter of William Fraser of Struy'.
>
> (Fraser MacIntosh 1897, p.2).

In 1636 Lord Lovat granted the major part of Glen Strathfarrar to the Frasers of Belladrum with whom it remained for the next 150 years (Fraser MacIntosh 1897).

> 'On November 26th, 1636, Lord Lovat grants Hugh Fraser of Belladrum a feu farm charter of the town and lands of Belladrum and Little Culmill, of which a tack was given in 1598, but there were added thereto the two crofts of Easter Downy, the town and lands of Browlin, the town and lands of Muilzie and of Ochteroe, and the town and lands of Bencharran',
> (Macdonald 1934, p.63).

In 1641 when Hugh Fraser of Belladrum paid 20 merks feu duty to the Master of Lovat, the townships and lands in Glen Strathfarrar were described like this:

> '... and of the lands of Benchrane, town and lands of Muilzie, town and lands of Ochtero and easter half of Browline extending to an half davoch and 8th davoch of old extent, lying in the Barony of Aigas, forest of Browline, and the lordship and Sherrifdom foresaid'.
> (Macdonald 1934, p.66).

Ochtero (Auchteroe) is described in both as being a town and lands, Bencharran is described as a town with lands in 1636 but just lands in 1641.

It is difficult to decide quite how these lands were used during the seventeenth century. Auchteroe on the north side of the river was certainly used as a shieling in the early part of the seventeenth century. There is a letter from one John MacIntaggart to the Lord Lovat, written in the early part of the seventeenth century, offering to pay in one of three ways for the right of using the grazings of Ochteroe.

'The conditions offerit be Johne McIntaggirt for the grissing of Ochtero.

First the said John offeris to my lord (illegible) merks moey for ye said girssing my lord obleissing himself to give ye said Johne McIntaggirt fortier head off sufficient milk ky with fortie head of sufficient yeild ky and the said Johne to be obliest to delyver twentie head off sufficient calves at Hallowmas of fyve merks for the piece to my lord.

Secundlie iff this please not my lord let his lo provyde for sufficient bowmen for his lo girssing and quides and his lo to tak off them als mutche duetie as he can both for the girssing and for ye profite of his lo quidis both milkiries and calves.

Thirdlie if any off the former tua offeris please not my lord let his lo give me the said Johne McIntagirt the said girssing of Ochtero in tack without any quidis and I shall obleiss myselff to give yeirlie to his lo four hundred merks moey for the said girssing except thet warres and hearschipe tak it off me throw force. So let thir thrie poynts be considerit of glk of them my lord acceptis let his lord subseryve the same.'

(Macdonald 1934, p.92).

Broulin, further west, was also used as a summer grazing area for domestic animals, possibly under the same sort of agreement. When General Monk, Cromwell's representative in Scotland, travelled from Kintail in the west to the foot of Glen Strathfarrar in July 1654, he described the journey in his log book,

'The 30th the army marched from Glen Teugh to Browling the way for neere 5 miles soe boggie that about 100 baggage horses were left behinde, and many other horses bedd'd or tird'. Never any horse men (much lesse an armie) were observed to march that way. The souldiers mett with 500 cattell, sheepe and goats, which made some part of amends for the hard march'.

(Mackay 1891, p.).

Glen Lochel, through which General Monk and his marauding army must have passed, runs westwards from the head of Glen Strathfarrar. This glen came into the hands of the Mackenzies of Kincraig in 1637; before that it probably was used as summer grazings by the

TABLE 7 RENTS FOR GLEN STRATHFARRAR

FARM	1697	1743	1749	1755	1760's	1770	1803
	SCOTS MERKS*			POUND STERLING			
DEANIE				9.14.11	10,11.0	15.0.0	26.10.0
BENCHARRAN	133.0.8		54.6.8	5.15.0	5.1.2 8/12	6.10.2	
WEST MUILLE		106.13.14		7.0.0+	5.2.2	6.10.0	8.1.8
EAST MUILLE	133.0.8			9.8.10 8/12			9.11.3
MUILLERIACH						9.8.10	8,1.8
ACHTEROE	200.0.0	160.0.0	100.0.0	6.7.9 4/12	9.11.0		10.10.4
ARDCHUILK			33.6.8	6.7.9 4/12	9.11.8	11.18.8	15.10.0
EAST BROULIN	80.0.0	93.6.8	160.0.0	10.4.5 4/12	7.13.4	11.12.0	26.10.0
WEST BROULIN	173.6.8			5.2.2 8/12	7.13.4	10.0.0	
INCHLARY		93.6.8		8.19.3 4/12	8.19 3 4/12	11.4.0	14.5.0
INCHVUILT	93.06.08	93.6.8	93.6.0	8.17.9 4/12	7.15.6	11.13.9	12.12.6 8/12
INCHLOCHELL	120.0.0	120.0.		5.17.9 4/12	5.17 9 4/12	9.19.3	11.2.2 8/12
ISHVALIGAN							
BENEREIRAN							
LUBRIACH							
TOTALS	£52 ca.	£37	£24	£78.15.10 4/12	£77.16.3 4/12	£103.14.10	£142.14.10
	E769/1/2	E769/4	E769/1/4	E769/69	E769/72/2&4	E769/72/2&4	Lovat Estate Office, Beauly

Total rent in 1804 = £600, 1824-1833 = £500 1834-1839 = ca. £350, 1839-1847 = ca. £250 1847-1850 = ca £70.

* 18 merks taken to equal 1 pound, see appendix 4.

Earl of Seaforth's men for the west. In 1656 the glen was taken over by the Belladrum family who had the farms and shielings further east, in Glen Strathfarrar (Frazer MacIntosh 1897).

By the beginning of the eighteenth century, many of the former shieling sites in Glen Strathfarrar were being settled and brought under cultivation. Inchlary and Muilleriach on the south side of the River Farrar were settled by the sons of the lease holder Hugh Fraser at the beginning of the eighteenth century (Fraser MacIntosh 1897).

It is much easier to follow the process of subdivision that occurred in the glen after 1697 as rentals, after that date, are in existence (see appendix 3) for in 1746 the Lovat Estates were forfeited to the Crown for Simon Lord Lovat's part on the rising of 1745.

During the first half of the eighteenth century, the number of tenants in the glen rose from seven to eleven, and the total rents of the glen rose from around £50 to £80 (Tables 7&8). The rentals for the glen for 1697 to 1803 give an index of the changes in population that occurred during the eighteenth century, but it must be remembered that, with the hierarchical system of Laird, tacksman, tenant and cottar found in the Highlands until almost the end of the eighteenth century, the number of tenants mentioned in the rentals is not the actual number of heads of families in the glen. Some of the townships, were obviously sub-divided at the latter part of the eighteenth century; for example in 1803, there were five families at Deanie (Fraser MacIntosh 1897) but the rental for 1804 names only one tenant (appendix 3).

There was an increase of twelve tenants in the glen between

TABLE 8 NUMBER OF TENANTS IN GLEN STRATHFARRAR 1749-1850

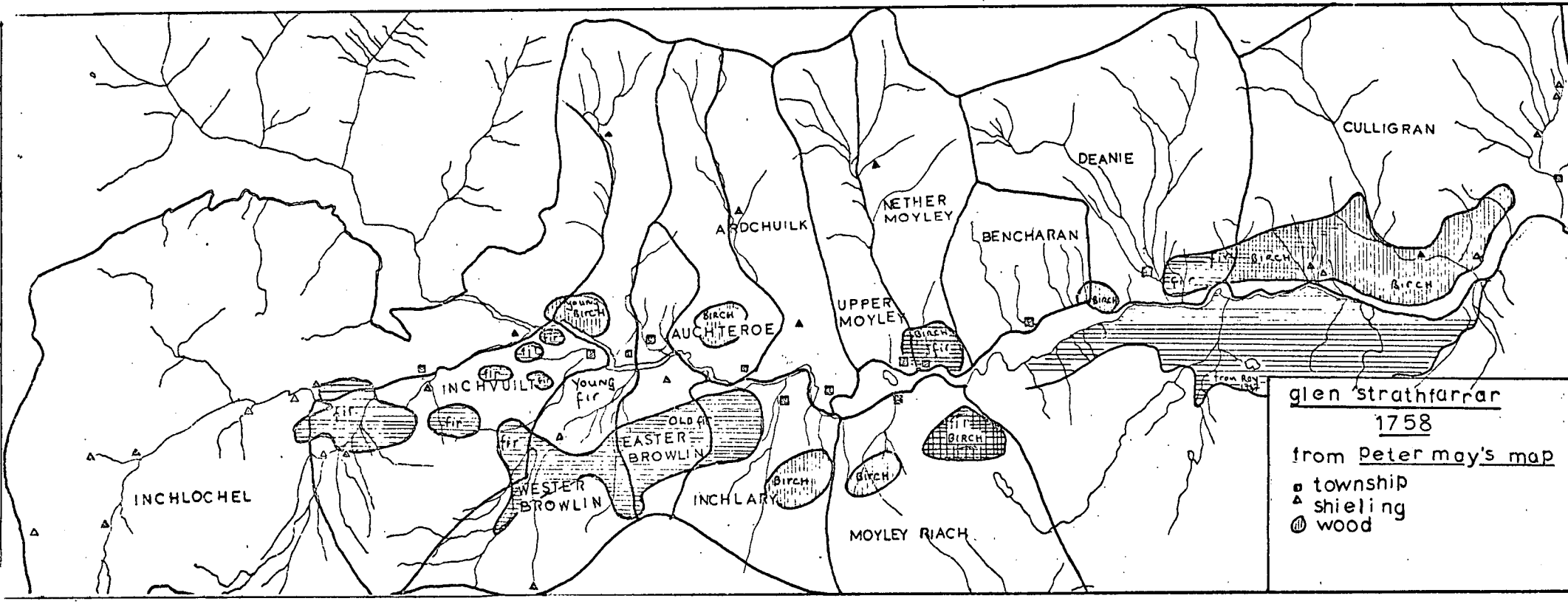
FARM	1749	1755	1767[1]	1770[2]	1802	1803[3]	1804	1824	1834	1847	1850
DEANIE	1	1		1		5			2		
BENCHARRAN	4	4+*****	5**	5		4					
WEST MUILLE		1	1	1	1	5			2	2	
EAST MUILLE					1+				2		
MUILLERIACH		1			1+	3				1	1
ACHTEROE	3	4***	4**	1	1	1					
ARDCHUILK	1	3***	4**	1	1	2					
EAST BROULIN	1	2*	1	1			2	1			
WEST BROULIN	1	2**		2	1	5			2	2	
INCHLARY		1		1							
INCHVUILT	1	4***		4***	1+	1			1	1	1
INCHLOCHELL						4					
ISHVALIGAN		1 grazing		1	1						
BENEREIRAN											
LUBRIACH						2					
TOTALS	12	24	15	18	10+	32	2	1	5	3	1

1 Incomplete,2 Not including East Muille, Muilleriach or Ardteroe, 3 Heads of families only.
1749 FEP E769/1/4,1755 E769/69, 1767 Fraser Macintosh (1897, p.5), 1770 E769/72/2, 1803 rental in Lovat Estate Office, Beauly, Inverness & 1824 - 1850 Napier Report 1884, appendix lxxx.
* new name on the rental.

1749 and 1755. Either some of the previous tenants had been lost during the '45 rising and their places had not been filled before 1749, or the holdings were sub-divided and new people were settled in the glen between those years. The figures for the 1767 rental are incomplete, but there does then appear to have been a drop in the number of holdings. According to tradition, General Simon Lovat went into Glen Strathfarrar in 1753 and got two hundred volunteers to fight the French 'on the height of Abram near Quebec' (Brand Report 1895 q. 9694). Wolfe captured Quebec from the French in 1759, the battle was fought on the Heights of Abraham, so this could explain the apparent drop that occurred between 1755 and 1770, although two hundred able bodied men seems a very high number.

Another factor that could explain the drop in the number of tenants in the glen was the improvement in agriculture that was taking place under the management of the Forfeited Estates Commissioner. For example, there was a decline in the number of tenants at Auchteroe and Ardchuilk between 1755 and 1770. In 1755 both townships had three tenants each, and in 1770 they only had one each. It is not possible to say what happened to these tenants, but there are letters from the new tenant, William Robertson of Auchteroe in 1770, to the Commissioners of the Forfeited Lovat Estate putting forward his plans to enclose and improve the farm of Auchteroe (FEP E/769/91/341). Maybe the former tenants moved voluntarily or stayed on for a while as cottars or servants to William Robertson. Fraser MacIntosh (1897) tells of voluntary emigration that occurred from Glen Strathfarrar in the second part

MAP 5 GLEN STRATHFARRAR IN 1758



of the eighteenth century.

> 'The Commissioners on the Forfeited Estates, or more properly their factors, were the first evictors in the Highlands, and they were guilty of favouritism to such a degree in favour of strangers that many of the tenants emigrated voluntarily'.
>
> (Fraser MacIntosh 1897, p.6).

The process of sub-division of holdings in the glen shows how, as the population rose, areas that had once been summer shielings came under cultivation and were permanently settled. Lubriach, at the west of the glen is an example of this. In 1758 Peter May, the surveyor for the Forfeited Estate Commissioners described Lubriach as an improvable shieling. It must have been settled by 1803 for, when the glen was taken over by two low ground farmers from Aigas and Eskadale in Strathglass for the introduction of sheep, two farmers were removed from Lubriach (Fraser MacIntosh, 1897, p.10).

A large extent of the glen, along the sides of the river was cultivated at the end of the eighteenth century and was limed. Peter May mapped the arable land in the glen in 1758 as well as the shielings (Appendix 2). By the end of the eighteenth century all the suitable sites along the river were inhabited. Potatoes by this time must have been very important, particularly for the farmers who had few animals such as those in Bencharran.

The total rents of Glen Strathfarrar nearly trebled during the eighteenth century from £51. 16s. in 1697 to £142. 14s. $8^{4}/12$d. in 1803. The number of tenants also rose considerably, so the rent paid per individual tenant probably did not rise as much as the

total rent. The money to pay rents in an area such as Glen Strathfarrar would have come from the sale of cattle and of dairy produce. Cattle were not sold until they were three years old or over as they took a long time to mature. A report of the factor of the Lovat Estates to the Commissioners in the 1750's mentions the price of cattle reared in Glen Strathfarrar:

> 'A good many black cattle reared from fourty to fifty shillings value, a good deal of butter and cheese made and brought to Inverness Market for sale'.
> (FEP E/769/105/(1)).

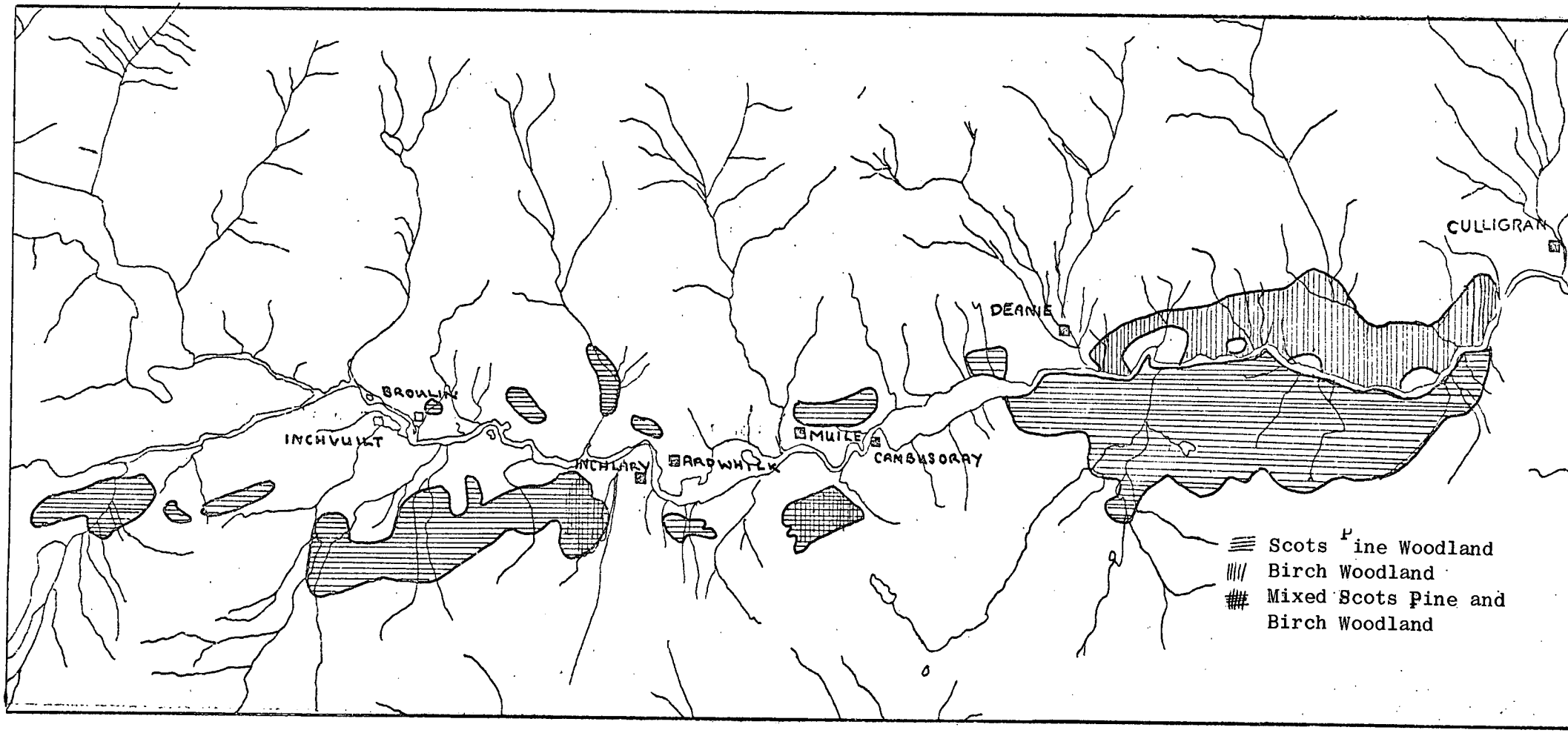
In 1755 the rent for Glen Strathfarrar was &83. 15s. 10^{4}/12d. (FEP E/769/69). This meant that a maximum of 40 cattle would have to be sold each year in order to pay the rent. In 1770 the total rent was at least £113. 7s. 8d. (FEP E/769/72/2&4). Presuming the price of cattle was the same, 50 cattle would have had to be sold (Gray (1957, p.142) gives the figure of £2 to £2. 10s. for the price of cattle in 1770's). In 1802 the total rent was £142. 14s. 8^{4}/12d. (Lovat Estate Office Beauly, appendix 3). The price of cattle was at least £3 at this time; in Loch Alsh in 1794 it averaged three guineas, in Kintail between £4 and £5, in Glen Shiel between £3 and £5 and in Loch Carron £5 to £7 (OSA 1793-98 Vols. 6,7,11,13, 20). Therefore, less than fifty cows would have had to be sold from Glen Strathfarrar to have paid the rent.

The souming and rouming[1] report of 1770 (appendix 2, FEP E/769/72/6) gave the total number of three year old heifers and stirks in the glen as 80 and the total number of adult cows as 160. If 50

1. Rouming refers to the extent of wintering ground and the animals it can support.

MAP 6 GLEN STRATHFARRAR AT THE MIDDLE OF THE NINETEENTH CENTURY

(Taken from the Census Returns of 1861 and the Ordinance Survey of 1873)



of the three year old heifers and stirks were sold each year, there would have been 30 in the four year old class the following year. If adult mortality was fairly low there would have been about 30 old cows to sell each year. Therefore, it appears that as long as cattle prices were over £2 and mortality was not unusually high the rents could be paid and they seem to have been in relation to the amount of cattle that the glen could produce.

In 1803 the lease of the whole of Glen Strathfarrar was taken by two men, Hugh Fraser of Achnacloich, who had married into the Frasers of Eskadale, and Robert Fraser of Aigais. The new rent for the whole glen was £600. By 1806 the glen had been cleared of farmers, and sheep were introduced; 500-600 blackfaced hoggs were put on to Inchlochel in 1803, and others followed (Fraser Mackintosh 1897). The glen must have been in a suitable condition for the introduction of sheep as there probably was a large extent of anthropogenic grasslands formed as the result of the heavy grazing pressure that the mixed herds of cattle, goats, sheep and ponies had exerted on the glen over the previous hundred years. Hugh and Robert Fraser gave up sheep farming in Glen Strathfarrar in 1824; Grieve,[1] a farmer from the Borders, took over the lease and held it until 1834 when he gave up. There was a small increase in the population of the glen in 1833, when several families, who had been evicted from Glen Cannich on Chisholm ground to the south, were settled in the north of the glen and were provided with sheep by Lovat. However, by 1850 all the shepherds had gone from the glen, and the only people who lived there were gamekeepers employed by Lord Lovat, and a crofter who lived at Muille (Census Returns 1841-1891). It is impossible to come to any conclusion why sheep

1. See Napier Report 1884, Appendix A LXXX.

farming lasted in the glen for such a short period, perhaps because it is basically heathery ground and after twenty to thirty years of sheep the fertile greens in the glen that had once been cultivated had reverted to heath.

Since 1900, there has been a further decrease in the number of people. Now there is only a stalker and gillie and their families living at Monar, a family living in a house built by the North of Scotland Electricity Board at Bencharran, and several families at Culligran at the extreme mouth of the glen. The other houses, if they are not in ruins, are only used seasonally. The glen is once again primarily a deer forest.

CHANGES IN THE NUMBER OF GRAZING ANIMALS IN GLEN STRATHFARRAR

The only accurate figures that there are for the number of domestic animals in the glen, during the eighteenth century, is a report on the soumings and roumings for the glen made in 1770 of the townships that were not under lease (FEP E/769/72, Appendix 3). East Muille, Muilleriach and Ardteroe were under lease in 1770 and were therefore not included. This report was made for the Commissioners of the Forfeited Estates to enable them to reassess the rents. The actual rents that were fixed appear to have been based not only on this report but also on Peter May's (1758) assessment of the arable land attached to each farm (appendix 3, FEP E/769/72). It is not possible to tell how the soumings or the rent to be paid per soum were assessed. Possibly, a similar system to that discussed in Chapter 4 was used. The souming, however, may just have been a reflection of the number of domestic animals in the glen already.

It seems likely that the soumings laid down by this report of 1770 were followed. West Broulin, for example, was given a souming of 18 milk cows, 9 three year olds, 9 two year old and 9 calves, 6 horses, 80 sheep and 80 goats; this added up to 67 soums, (see appendix 2). In 1789, when John Macdonald of Brewlin died, his stock of 18 cows (made up of milk cows, heifers and stirks), 1 bull, 3 horses, 35 sheep and 34 goats was sold (Fraser MacIntosh 1897, p.6). The rental for 1770 shows that Thomas Macdonald had a souming of about 18 of his holding in West Broulin, John Macdonald also had about 18-20 soums and he was presumably the heir of Thomas Macdonald.

The souming for Glen Strathfarrar in 1770 was 542, as this did not include the whole glen, the total can be assumed to have been around 600-650 because three farms were not included.

The deer population had been fairly high prior to permanent settlement of the glen in the seventeenth century, if the descriptions of the hunts in the Forest of Broulin are at all accurate. However, by the end of the eighteenth century, the deer population must have been low as the number of domestic animals wintering in the glen was high, and because the large number of people in the glen at that time would probably have made good use of wild game to supplement their diet when it was possible. At the beginning of the nineteenth century, a number of advertisements appeared in the Inverness and Edinburgh newspapers calling for the protection of game species before they became extinct. This is an example referring to the Lovat Estates; similar advertisements appeared for other estates.

'Preservation of Game

The Hon. Col. A. Fraser of Lovat finds that, to prevent the entire extinction of the game on his Estates, a Jubilee for the present is absolutely necessary on his estates and manors in the close vicinity of Inverness and in Stratherrick, Coryarick, Abertarf, Strathglass, Glen Strathfarrar, Corycharby, Urchany, his part of Glen Gourie and the Baronies of Beaufort, Beauly, Lovat and North Morar. His tenants, therefore, are by their holdings, as well as his ground-officers and game-keepers to stop and inform against all trespassers as well as poachers; and all former permissions are recalled, a precaution his friends will readily execute'.

(The Inverness Journal and Norther Advertiser 16.8.1811).

It is thought that the deer population was low throughout the Highlands at the end of the eighteenth century. According to the Deer forests Report of 1919, deer numbers were at their lowest in 1780-1790. Evidence given to the commissioner of the Brand Report (1895) as to the number of deer in the study area, stated that numbers had risen considerably since the sheep were taken off the hill and the land had once again become deer forest (Brand Report 1895 q.11,512).

When the glen was stocked with sheep in 1804, the rent was £600. The average rent paid for pasturing a ewe in the parish in 1845 was between 2s. 6d. and 3s. (NAS 1845, v.14, p.368). The sheep population must, therefore, have been around 4,000-4,800 animals. The Napier Report (1884) assessed the sheep carrying capacity of the glen to be 4,000. The glen was under sheep from 1804-1850 (Napier Report 1884, Appendix LXX$^{X)}$ but not wholely as some areas such as Glen Lochel was cleared in 1833. The deer population would have started to rise before sheep were cleared off completely.

The deer population of Braulin forest, which is the area surveyed by Peter May (1758), minus Culligran at the foot of the glen, was censused in February 1973 by the Red Deer Commission and

was found to be 485 stags, 1314 hinds and 539 calves. 700 cattle are now summered in the glen.

Using a system of standard stock units (appendix 1) the changes in the number of grazing animals can be compared

	Cows	Y. Cattle	Horses	Sheep	Goats	Deer	Total Head	Standard stock units
1770	160	240	82	700	700	?	1,882	547 (600)
Incomplete								
1810				4000	?	?	4,000	1,000

	Stags	Hinds	Calves	Cows	Total Head	Standard stock units
1973	485	1,314	539	700	2,338 (+700)	1,284

To summarize, until the early nineteenth century there were mixed herds of cattle, horses, sheep and goats as well as some deer in the glen. Then, at the beginning of the nineteenth century, the number of cattle and horses declined and the overall number of sheep increased and the sheep were of larger breeds, cheviots and black faced. Goats were still found in the western parts of the glen (NAS 1845, v.14), but were by then feral. As the number of sheep in the glen decreased during the middle of the nineteenth century, the number of deer would have increased. Probably the number of grazing animals in the glen was at a low level from 1850 to 1890 before deer number had built up. Deer may have been able to move in from other districts, but as Glen Strathfarrar was one of the first glens in the area to be converted to deer forest

presumably there were no large reserves of deer in the immediate area which could invade.

The present deer population wintering in the glen is higher than the population of domestic animals in the glen at the end of the eighteenth century and the summer population, which includes the 700 Lovat cattle, is also higher than the previous number summered in the glen. The deer do, however, move on to higher ground in summer.

Although the stocking rate appears to have increased during the last 150 years, the number of people living in the glen has declined gradually from 1804, and probably therefore the pressure on the woods from factors other than grazing animals has been greatly reduced.

CHANGES IN THE WOODLANDS OF GLEN STRATHFARRAR

Before the detailed survey of the woodlands and agricultural conditions which was made by Peter May, the Aberdeen land surveyor, in 1758, no known large scale maps of the glen had been made. There is a map of Inverness and Ross-shire in Blaeu's Atlas of Scotland published in 1654 (scale 5 miles 1 inch). This map was drawn from information collected in the early part of the seventeenth century (Steven and Carlisle 1959) and, because of this, shows only some of the settlements present by the middle of the seventeenth century. The map marks settlements at Culligran, Deanie, Bencharran, Browlin and Braulin Beg (in the area of Inchvuilt). In the discussions that appear in the Scottish Volume of Blaeu's Atlas (1654), there is this description of conditions in Ross-shire in the early part of the seventeenth century. Although

no one area in particular is mentioned, it could well apply to Glen Strathfarrar.

> 'The entire land rises into rugged mountains, and is infertile in crops, but there are numerous woods, and it is very well suited for pasturage. The scarcity of crops is relieved by the abundance of oxen and venison, for every year many herds of oxen raised here are driven far and wide for sale'. (Macfarlane 1905, V.2, p.444-445).

Sites on the south facing side of the glen were settled first. Of these, Deanie, Bencharran and Culligran were settled before the others probably as they are on the largest areas of alluvial outwash.

The early settlement of these areas would explain the lack of pine in the woods on the north side of the river. As the number of people living in the glen for the whole year round increased during the early part of the seventeenth century, and as the transient summer population of domestic stock changed to a permanent wintering population, the pressure on the woodlands would have increased considerably. The areas round the settlements would have had to be cleared for cultivation, whereas, before, when the settlements were used only as summer shielings, the situation would have been similar to that of the spring autumn seters of Norway, with each shieling being surrounded by an area of grassy sward. Timber would have been cut for fuel and building construction before the sites were settled permanently, when people were only there for the summer, but, as fuel would not have been needed in any great quantity for the making of cheese, the cleared area might not have been much more than two hectares. With an increasing permanent population, however, the pressure on the woods would have been much greater; animals wintering in the glen would have browsed the birch, rowan and willow

at the time when little else would have been available for them; pines would have been used for building and for fuel. These factors would not have directly diminished the area of woodland in the glen, but would have changed its species composition from a pine dominated one, to one of mixed pine birch. Birch invades areas that have been cleared of pine. Even before this, the effect of man and his animals must have been very noticeable, for by the end of the sixteenth century conservation measures were being taken. In 1583, Lord Lovat, who owned the glen, sent an order to various of his Fraser tenants to protect his woods and game.

> 'desist and cease from the feu lands and living pertaining to Simon, Lord Fraser of Lovat, woods, fishing and deer, and from cutting of the woods of Strathglass, molesting and troubling the waters of Forne (Farrar), Kiltarlity and Kilmorack, and from slaying of any black and red fish with spears, nets or any other instruments.... from hunting or slaying of the deer of Strath Glass.'
>
> (MacKenzie 1896, quoted Mather 1970, p.163).

Another order relating in particular to the exploitation of the woods of Glen Strathfarrar for fuel and tanning purposes, was passed in 1637. Even though there was still considerable woodland in the glen, the effects of the increased human and animal population must have been felt.

> 'In 1637 plantations of trees were pretty general throughout the Lovat Estates, though these were probably of native growth, such as birch, oak, elm, hazel, ash. At a Barony court of July 1637, for the town and lands of Bunchrew, Muilzie, Octero, and the Easter half of Browlin.... an act or by-law was passed forbidding the peeling or transporting any of these trees or saplings on tha pain of a fine variously assessed according to the extent of the offence'.
>
> (Macdonald 1934, p.91).

It is clear that the value of woods had been recognised by the

middle of the seventeenth century, and wood was being sold for commercial purposes. For example, most of the Scots pine in the woods on Struy ground, to the south side of the glen, was sold for 30,000 merks in 1652, and was used in the construction of the Cromwellian fort at Inverness (MacKenzie 1896, p.639-640).

> 'In 1670 when Captain Phineas Pot came down from London by sea to trye all the fir woods in the north for masts. He had visited the woods of Straboickle and found few there; went then to Struy and Glen Strathfarrar, and that old wood pleased him'.
>
> (MacKay, 1905, p.485).

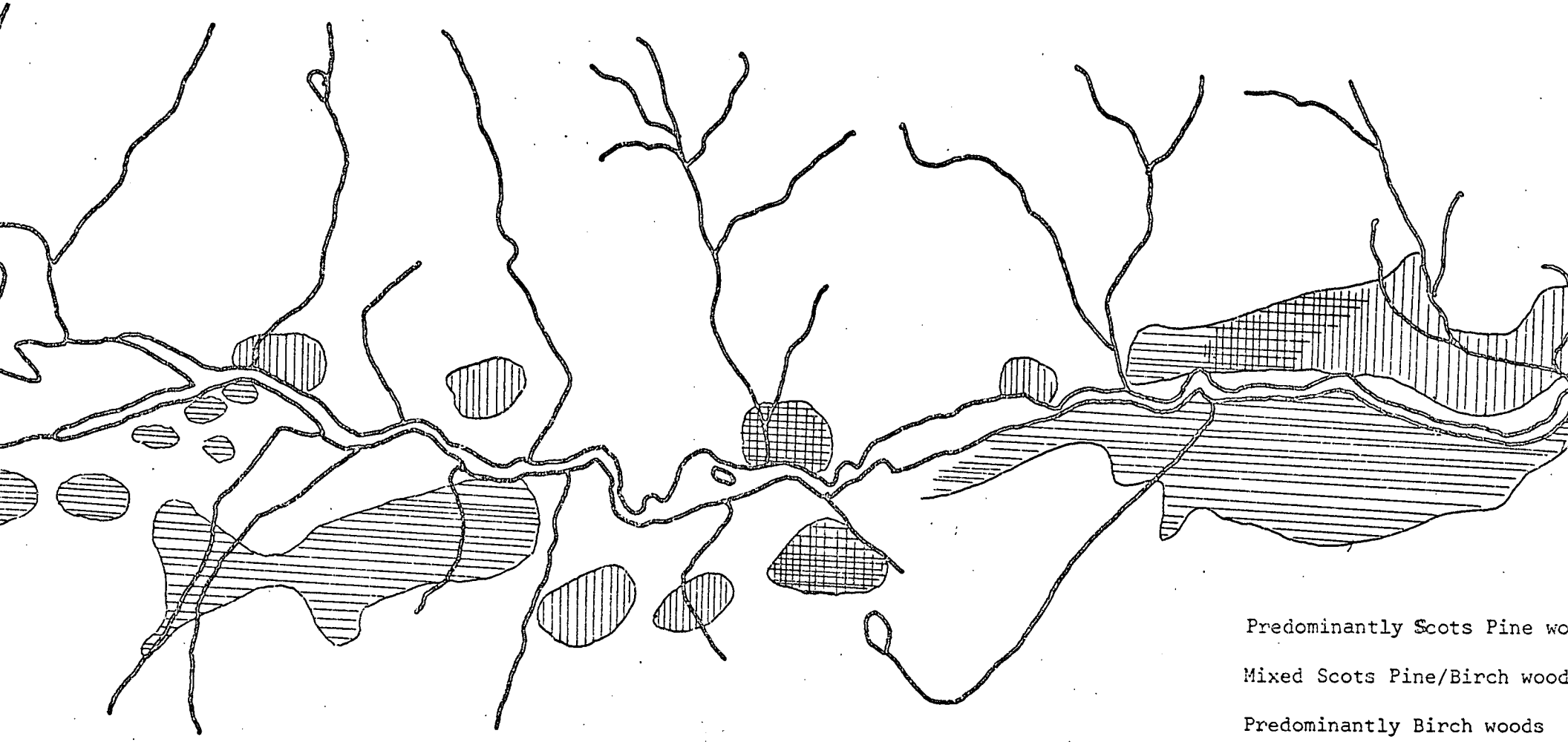
Although 'muir burn' was not practised to any very great extent before the nineteenth century, fires occurred in the glen periodically, particularly during times of civil unrest. This must have affected the woodland. Mather (1970) quotes an instance in the seventeenth century when Strath Glass and the Fraser country was devastated by the forays of Montrose's men, who left 'not a sheep to bleat nor a cock to crow', (Lees 1897, p.71). There was another extensive fire reported in 1746, after the battle of Culloden, when government troops were searching for Prince Charles. The soldiers set light to the glen and burnt every house and hut from Struy in the east to Browlin in the west. They also took all the domestic animals that had been grazing in the glen (MacKenzie 1901). The factor of the forfeited Lovat estates also mentioned this fire,

> 'A pretty large fir wood in this barony but which was much destroyed after the rebellion, good quality fir'.
>
> (FEP E/769/105/1).

After such a fire there would have been considerable regeneration, especially if the grazing pressure was low.

MAP 7 GLEN STRATHFARRAR WOODLANDS IN THE MIDDLE OF THE EIGHTEENTH CENTURY

(BASED ON MAY'S MAP OF 1758)



The map of the glen made by Roy sometime between 1747 and 1755 (scale 1 inch = 1000 yards) marks considerable woodland between Deanie and Culligran on the steep rocky ground. Roy also shows pine woods to the south of the river on Struy ground. The upper part of the glen does not appear to have been well surveyed, as the woodland distribution is shown only in a generalised way, and not all the townships that were in existence are marked. Roy's map is of too small a scale to give evidence of the 1746 fire.

A good detailed survey of the glen was made in 1758 by Peter May who was employed by the Forfeited Estate Commissioners, who were in control of the Lovat Estates from 1756-1774. He surveyed the glen and produced a map showing the woodlands and agricultural conditions. This map of 1758 was produced 12 years after the troubles of 1746 and does show evidence of a big fire. A considerable area of young scrub birch was shown in the north of Broulin, which may have grown up since the fire, but been held in check by the cattle, goats, sheep and horses that had grazed in this area through the winter. There are some other important points that become apparent from this survey. First, there were large areas of regenerating pine woodland to the south of the river; second, the woodland between Deanie and Culligran was mainly pine; third, the area to the north of the township of Culligran was classed as barren pasture and not as woodland. The importance of these points will appear later.

Map 7 , based on May's map of 1758 and Roy's map of 1747, shows the main concentration of dense wood in the glen, but does not mark the considerable areas of scrub vegetation, for example alder and birch, along the river side. Unfortunately, Struy did not form

part of the Loval Estates until the end of the nineteenth century, and, therefore, the area to the east of Muille Riach was not surveyed by Peter May in 1758. Reliance has had to be put on the work of Roy when considering the woodland in this area in the middle of the seventeenth century.

May calculated that the total area of woodland in the glen was in the order of 1,635 acres Scots[1], that is, 1,812 acres English. A very rough estimate of the present extent of woodlands in the glen, not including Struy ground, can be obtained from the O.S. map of 1957 (1 inch 1 mile), and is 1,750 acres, a drop of only 3%

The glen was again surveyed in 1873 by the Ordinance Survey and the 1st edition of the six inch to a mile map was produced. Part of the glen had been under sheep for around fifty years, from 1800 to 1850, but in 1873, the time of the survey, it was deer forest. However, there were still some cattle and sheep which belonged to the stalkers and the one crofter living there. It is difficult to tell how the Ordinance Surveyors classified woodland, but if the 1873 O.S. map is compared with May's map of 1758, there has been little change in the extent of woodland except in the area to the west of Inchvuilt.

A revised edition of the 1873 map was produced in 1901. The two editions are exactly the same except for some new areas of woodland. In the areas to the west of Cambussory, and increase in birch is shown and, what is of great interest, birch woods are marked around the old township of Culligran. The people of this township had been 'cleared' at the beginning of the century and the

1. 1 acre English = 4840 sq. yds. 1 acre Scots = 5076 sq. yds. 1 yard Scots = 37 inches English. Therefore 1 acre Scots = 1.108 acres English.

area had been described as barren pasture by Peter May in 1758. In Glen Cannich, to the south, there was also a similar increase in the amount of birch woods between 1873 and 1901.

During this time, there was not only a decrease in the number of domestic animals in the glen, but also, and possibly of more importance, there was a decrease in the number of people living in the glens and thus in the amount of timber being collected for fuel.

The latest edition of the O.S. map (scale 1:10,000), produced in 197 , shows woodland in the same areas as before, although diminished to some extent. However, if these woodlands are looked at in the field, it can be seen that there is at present very little regeneration and what there is, is being held in check by grazing animals. In the pinewoods, a deep carpet ofsphagnum moss and pine duff has developed that prevents effective germination of seeds.

Planting has been done on the Lovat Estates since the eighteenth century, and, while the estates were forfeited from 1746-1774, large areas were planted. Peter May was employed by the Commissioners of the Forfeited Estates to survey the lands and make plans. He was also employed to divide the run-rig[1] land and to measure and lay out settlements for disbanded soldiers[2], in the hope that they might set an example to the native population and thus improve the agriculture. He also had to look into the cost and feasibility of planting trees. May saw the need to build fences of at least 5 feet high to protect young trees from damage by grazing animals, or, alternatively, to employ special herders to keep the animals

1. Run-rig refers to arable land held in common, see Smout's description (1969, p.113), or Walker (1812, V.1, p.65).
2. Soldiers who had served under General Lovat in Canada were settled at Broulin (Fraser Mackintosh 1897).

out of the woods (FEP E/787/12/2). Most of the pine woodland in Glen Strathfarrar, however, is considered to be native by Steven and Carlisle (1959).

Glen Strathfarrar is often quoted as an example of an area where sheep farmers accelerated the destruction of the forests by burning woodlands. It is hard to find another example quoted in the literature. The origin of the story of the Strathfarrar fire lies in a passage in the Stuart brothers 'Lays of a Deer Forest' (1848). It has usually been quoted rather too loosely. Fraser Darling (1955) simplified the passage to emphasise his argument against the sheep farmers and the use of fire and said,

> 'The brothers Stuart describe miles of pine woods being burnt in Glenstrathfarrar in 1813 "to improve" the sheep pasture'.
> (Fraser Darling 1955, p.5).

Ritchie (1920), quoted by Anderson (1967, p.95) is more precise;

> 'the brothers Sobieski and Charles Edward Stuart concerning the occurrence of a great fire in Glen Strathfarrar "where 12 miles of pine, birch and oak woods were burned .... to improve the sheep pasture".'

The actual quote from the Stuart brothers, who were very familiar with the glen as they lived for the latter part of their lives on Lord Lovat's estate and hunted deer in Glen Strathfarrar, read

> 'Lord Lovat's deer forest of Glen Strathfarrar... where twelve miles of pine, birch and oak woods were burned in the tenantry of the late Eskedail to improve the sheep pasture'
> (Stuart 1848).

Mather (1970) was tempted to disregard this story as inaccurate, or at least not responsible for any great change in the woodlands of

the glen. He says this, because the map of 1758 and that of today are not significantly different, and any differences that there are do not confirm the destruction of a twelve mile stretch of mixed pine woodland. However, in May's map of 1758 there were considerable areas of young trees shown in the Broulin area which would have matured by 1813, a large mixed pine birch wood was shown to the east of Deanie and also to the east of Inchlary on the south side of the glen. It is not clear exactly which part of the glen belonged to Eskadale; the rental of 1802 (appendix 3) gives Inchlary to Hugh Fraser of Eskadale and Wester Muilzie and Inchvuilt to Hugh Fraser. In the Napier Report (1884, Appendix lxxx) evidence is given that 'Coilgreen was held by Eskadale until 1832'; maybe he only held the lease for this area from 1804. The fire does not seem to have been responsible for any large scale destruction of woodlands in the glen but may have been responsible for the change from pine to birch dominated woodlands; for instance on the north side between Deanie and Culligran, or on the south side to the west of Inchlary or possibly to the west of Inchvuilt.

It is difficult to tell if the woods of Glen Strathfarrar were exploited commercially. At the end of the eighteenth century, 'Many thousand fir-trees are annually cut in Lovat's, the Chisholm's and Struie's woods. These are sawn into square timber, planks, deals etc., for the home and English market'. (O.S.A. 1798, V.20, p.408). Extraction of timber would have been difficult from the steep, rocky south side of the river Farrar, and, therefore, this area is unlikely to have been exploited commercially. In the Statistical Account of the parish (Kilmorack), in 1798, the general description shows that, 'Even in the remotest parts of the parish,

hills and rocks of very considerable height appear, clothed and adorned from top to bottom with a variety of trees, Scotch fir, birch, common and mountain ash, poplars, some oaks, hazel, etc. etc.' (O.S.A. 1798, V.20, p.402). In 1845, the timber mill below the falls of Kilmorack was still in operation, but the minister then writing for the new Statistical Account could not describe the native woodlands with quite such enthusiasm.

> 'The trees idigenous to the soil are oak, birch, fir and alder. Larch, hazel and spruce were some time ago introduced, and seem to be quite congenial. In the upper districts of the country, there were formerly extensive pine forests; the only relics of which are a few solitary trees, that still cling to the precipices or trunks dug up from the mosses.'
>
> (N.S.A. 1845, V.14, p.364).

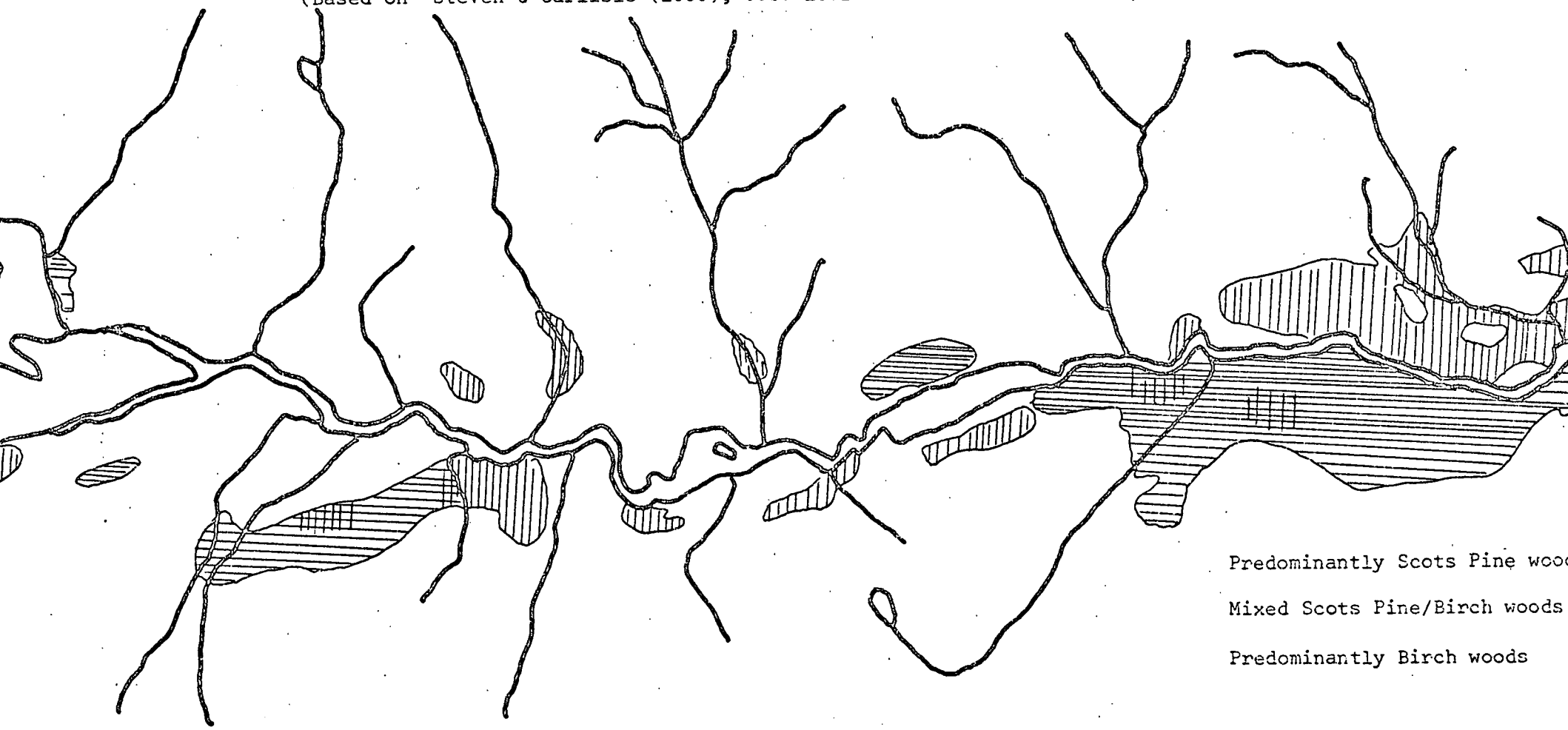
Forestry was an important industry in the parish at the beginning of the nineteenth century, but it is wrong to think that it was purely exploitive;

> 'Great attention is bestowed on the management of trees; they are thinned annually, and most of the fir trees felled are sold for railway sleepers; while the birch is manufactured into staves for barrels.'
>
> (N.A.S. 1845, V.14, p.368).

It is not at all easy to untangle the effects that domestic animals and man have had on woodlands in any one area. One way of looking into the problem in detail is by ageing trees. Steven and Carlisle (1959) studied the pine woods of Glen Strathfarrar and commented on the age structure of the woods. They did not, unfortunately, attempt to age the birch woods. They found that some of the pine trees in Coille Gharbh, on Struy ground at the foot of the glen, date back to 1659, but that most date from

MAP 8 GLEN STRATHFARRAR WOODLANDS IN 1973

(Based on Steven & Carlisle (1956), O.S. 1972 and field observations)



between 1759 and 1819 although there are younger trees. Struy woods were partially felled in the 1650's, and regeneration after this could explain the presence of trees of 300 years old. The area was under sheep until 1850, and since then it has been primarily deer forest. Sheep, however, were not totally excluded from the woodlands, and there has long been a large wintering population of deer.

Inchvuilt wood has trees in it that date from 1759, and most date from before 1829. The area of the wood has diminished considerably since 1758. Some timber was taken during the last war and these areas have now been colonised by birch. A lime-kiln was once sited to the west of Inchvuilt. The site is clearly visible as a green fertile area in the midst of wet calluna heaths. The kiln must have been in operation during the later part of the eighteenth century as the factor of the forfeited Lovat Estates reported to the commissioners that lime was not used in the area in 1755.

> 'No limestone, no grass seed sown, no inclosures made and very little progress made in raising of flax'.
> (FEP E/769/105/(1)).

The area immediately around the site is still clear of trees. Steven and Carlisle (1959) also looked at the pine woods of Glen Cannich, Glen Affric and Guisachan, the glens to the south of Glen Strathfarrar. In Glen Affric, the predominant age class of the pine trees dates from 1819 to 1870, the period when the forest was under sheep. In Glen Cannich, the trees also date from the time that the forest was under sheep, 1809-1869.

To summarise, much of the pure pine woodland on the north side of Glen Strathfarrar must have disappeared by the middle of the eighteenth century. At this time, there was still considerable tree regeneration. Birch had colonised areas where the pine had been cleared. In areas near settlements, such as Culligran, the birch woods had disappeared, probably because of clearance for fuel and the damage done to the young trees by cattle, sheep and goats. This would have been similar to the situation around Norwegian seters. Sheep do not seem to have had a great effect on the woods of the glen; they were only in the glen in large numbers for fifty years at the most. They may have reduced the diversity of species in the woods by selecting rowan, birch and hazel. However, birch woods grew up around the old township of Culligran during the period the glen was under sheep.

There is a very high stocking rate of deer in the glen at present, and regeneration of species such as pine, birch, rowan, willow and hazel is limited to inaccessible pockets which the animals cannot reach. Birch does not succeed birch in the natural situation, as species that form mull soils, such as birch, rowan and hazel, normally produce suitable conditions for pine to regenerate. The problem of the lack of regeneration of trees in Glen Strathfarrar is therefore threefold; firstly, any regeneration there is, is held in check by grazing animals; secondly, conditions are not suitable for regeneration of pine due to the build up of sphagnum and pine duff, and thirdly, that many of the trees, especially those in Glen Lochel, seem to be over mature and there is little regeneration.

The changes in land-use that have occurred over the rest of the study area are very similar to those that have occurred in Glen Strathfarrar; they are not, however, described in such detail. Farming in the study area has to be pastoral, as there is little low ground suitable for cultivation. Until the early nineteenth century sheep and goats were kept for domestic purposes, and cattle and dairy produce were sold each year; butter and cheese were sent to markets in Inverness and Glasgow and cattle were sold to drovers to take south. Skins, furs and tallow were also traded. Until the second half of the eighteenth century, the small amount of ground suitable for cultivation in the lower parts of the glens was held communially, unenclosed and divided by run-rig. There is little information on the exact system of cultivation in the area; Glen Strathfarrar, for example, had only 189 Scots acres of arable land in 1758 (May 1758; see Appendix 2), divided among 13 townships, of which Culligran, at the mouth of the glen, had 50 Scots acres. There was no rotation of crops and the only fertiliser used was human and animal manure. The main crops were bere, a form of barley, peas and the low yielding, but hardy black oats; the higher yielding white oats, suited to more fertile sheltered areas were introduced to the area in the second half of the eighteenth century.

According to the Old Statistical Accounts of the 1790's for the parishes of Loch Alsh, Kintail, Loch Carron, Kilmorack and Kiltarlity there was a general increase in population in the second half of the eighteenth century. Loch Alsh, for instance, had a population of 613 in 1755, according to the survey made by Dr. Webster, whereas

by 1794 the population was up to 1334 (OSA 1794, V.11, p.425). There are various theories to explain the rise in the population in the Highlands in the eighteenth century. Unfortunately, there are no accurate census figures prior to Dr. Webster's survey of the Highland parishes in 1755, so it is not clear at what rate the population was changing during the seventeenth century, and therefore whether the rate of change had increased in the eighteenth century. The introduction of the potato, small-pox inoculation[1] and more peaceful conditions after the rebellion of 1745 have all been suggested (Sinclair 1826; Grant 1924; Gray 1857; Smout 1969; Youngson 1973).

Potatoes were introduced to Loch Alsh in 1747 (OSA 1794, V.11, p.425) and to Strathglass a little later in 1770. Salaman 1949 in his history of the potato followed its introduction to the Highlands from its first appearance in the Hebrides in the middle of the eighteenth century. Before the introduction of potatoes, many of the townships, except perhaps those on more fertile low ground, for example of lower Strathglass, were not able to supply all the grain they needed and had to import oat meal each year from Ireland, Caithness and the Firth of Clyde. The amount that had to be brought in each year depended on the severity of the spring and on the harvest. For example, in the eighteenth century until around

1. Inoculation against small pox was introduced to England in 1718; the technique used involved inoculation with a supposedly mild form of the disease and proved useful in reducing the fatality of the disease in the person inoculated. As people inoculated with small pox were carriers, unless inoculation was widespread, it may in fact have increased the general level of mortality. It was not until 1796, when Jenner discovered that resistance to small pox could be induced by inoculation with cow pox (vaccination) that small pox was brought under control. It therefore seems unlikely that small pox was controlled by inoculation in the Highlands unless very large numbers of people were inoculated in an area.

TABLE 9.

NUMBER OF DOMESTIC ANIMALS PER FAMILY

LOCALITY	DATE	NO. OF FAMILIES	COWS	YOUNG CATTLE	HORSES	SHEEP	GOATS	TOTAL * STOCK UNITS	STOCK UNITS PER FAMILY	REFERENCES
GLEN STRATHFARRAR	1770	20	160	240	82	700	700	547	27	FEP E/769/72.6
No. per family			8	12	4	35	35			20 No. of tenants, FEP E/769/72/4, list 17.
LOCH ALSH	1794	279	994	2121	275	2475	1011	2379	8.5	OSA 1794, V.11
No. per family			3.5	8	1	9	4			
KINTAIL	1793	135	1200	4800	300	?	?	3900ca.	29	OSA 1793, V.6
No. per family			9	35	2					
KILTARLITY	1795	562	3016		719	5226	429	3420	6	OSA 1795, V.13
No. per family			5.37		1.28	9.3	0.76			

LOCALITY	DATE	NO. OF CROFTS	COWS	YOUNG CATTLE	HORSES	SHEEP			STOCK UNITS PER FAMILY	REFERENCES
LOCH ALSH	1884	198	2	1		7			$4\frac{1}{2}$	Napier Report 1884
LOCH CARRON	1884	26	5	2	1				7	Napier Report 1884

* See Appendix 1.

1770, oat meal to the value of £500 (sterling ?) each year had to be brought into Upper Strathglass. With the adoption of the potato this became unnecessary (OSA 1798, V.20, p.405).

Until the end of the eighteenth century the pastoral economy was still based partly on dairy production and partly on beef cattle. The Old Statistical Accounts for Loch Alsh, Kintail and Kiltarlity, the parish to the wouth of Kilmorach, give figures for the number of domestic animals in the parishes, and the Forfeited Estate papers for Glen Strathfarrar also give an idea of the number of animals. Table 9 shows these data; the system of stock equivalents used is the same as that used in the discussion of the changes in animal numbers in Glen Strathfarrar (Appendix 1). The table is incomplete, however; firstly it is not clear how many people there were in Glen Strathfarrar at the time, and secondly the number of sheep and goats kept in Kintail is unknown. It is interesting to see that the number of stock units per family was higher in Kintail and Glen Strathfarrar than in Loch Alsh and Kiltarlity. It may be that the people of Loch Alsh and Kiltarlity along Strathglass were not so dependent on animals as there is more arable land; fishing could have provided an additional livelihood for the people of Loch Alsh.

The average numbers of animals held in 1884 by the crofters and cottars of Loch Alsh and those in Loch Carron to the north are not comparable to the early figures, for by this time the farmers had lost their summer grazings and must have been dependent on cultivation.

Gray (1957) lists the number of cattle held in various parishes and the number per farm, but he does not consider this in respect of the amount of arable land and therefore the degree of dependence on

animals.

In Loch Alsh in 1796 the Old Statistical Account lists the number of domestic animals in the parish (OSA 1796 V.11).

Milk cows	994	Sheep	1789
Calves	597	Lambs	686
Young Cattle	1554	Goats	1011
Horses	275		

If 597 calves were born of 994 cows the calving percentage was about 60%. Using the above figures it is possible to draw a life table for the herd; 400 adult animals were sold each year to drovers.

Age of animals	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
No. of animals in each age class	597	537	516	501	150	146	141	137	130	124	108	77	45	26	15	4
		1554			1103											
% mortality	10	4	3	3	3	3	3	5	5	5	10	15	20	20	40	100
No. of animals dying	60	18	16	15	4	5	4	7	6	6	11	12	9	6	11	4
No. of animals sold from each age class				335						10	20	20	10	5		

The age of the animals is taken from the summer, the natural mortality is taken as occurring in spring and the animals sold in autumn. The number of adult animals has to be higher than the figure given as it did not include adult bulls; 10% of the adult herd is male in the model. 25% of the animals over four years old were

sold each year wereas the natural mortality was about 7%.

A large amount of butter and cheese was made in the area. Henderson (1812) stated that one Dutch stone of butter and one Dutch stone of cheese would be sold each year from the production of a cow, In Loch Alsh, therefore, at least 567 Dutch stones of butter and 567 Dutch stones of cheese could be sold. This presumes that only the cows with calves were lactating; if two cows were rearing one calf the production of butter and cheese could have been higher. The butter was probably sold for around 16s. per Dutch stone (Wight 1778-1784, V.4, p.433) and made a total of £453.60p. Probably the cheese sold for approximately half that price, £226.80p. giving a total income from dairy produce of £680. 40p. Cattle sold from Loch Alsh in 1794 for an average of three guineas, and therefore brought in about twice as much. This reckoning is very rough, but gives some idea of how important the sale of dairy produce was to the local economy. The trade in dairy produce between the Highlands and developing industrial towns of the Lowlands continued well into the nineteenth century. Campbell (1896) discussed the importance of the Highland dairy industry; it is a field that needs further research.

The domestic animals were taken to the shielings at the beginning of June and remained there until the middle of August. In Kintail the date for going to the shielings was June 1st and the date for returning was August 12th (OSA 1793, V.6, p.251). Dairy animals stoped being taken to the shielings in summer at the beginning of the nineteenth century; for example the farmers from Cambuslunie in Glen Elchaig used their shielings in Fhraoich-choire to summer horses, young cattle and sheep, in the early part of the

nineteenth century before the right was taken from them in 1852 (Napier Report, 1884, q. 31561).

The distribution of shielings at the end of the eighteenth century is shown on Map 9 and further details are given in Appendix 5. The farmers from the Loch Alsh penninsula had their summer grazings on Pait Monar, to the west of Loch Monar. This ground lies above 300 metres and although some of the low ground by An Gead Loch and Loch an Tachdaidh is peat covered with plant communities of type 7, on the higher ground over 375 metres the vegetation is of type 10a, Nardus stricta grasslands, with Rhacomitrium heaths of type 12a above.

It was probably necessary for the Loch Alsh farmers to come over 30 kilometres to Pait Monar to find summer grazings because most of the land around their farms is below 300 metres and the natural vegetation is woodland or peat communities.

The farmers from Glen Elchaig in Kintail had shielings to the west of Loch Lungard; farmers from Loch Duich had theirs in the upper part of Glen Affric, which is called Gleann Gniomhaidh. The Loch Lungard shielings were at 250 metres on alluvial soils; these have now been flooded. The farmers of upper Strathglass had shielings in Glen Affric at the east of Allt Beithe. Glen Affric opens out and becomes suitable for grazings to the west of Loch Beinn A'Mheadhoin whereas to the east the ground is steep and rocky.

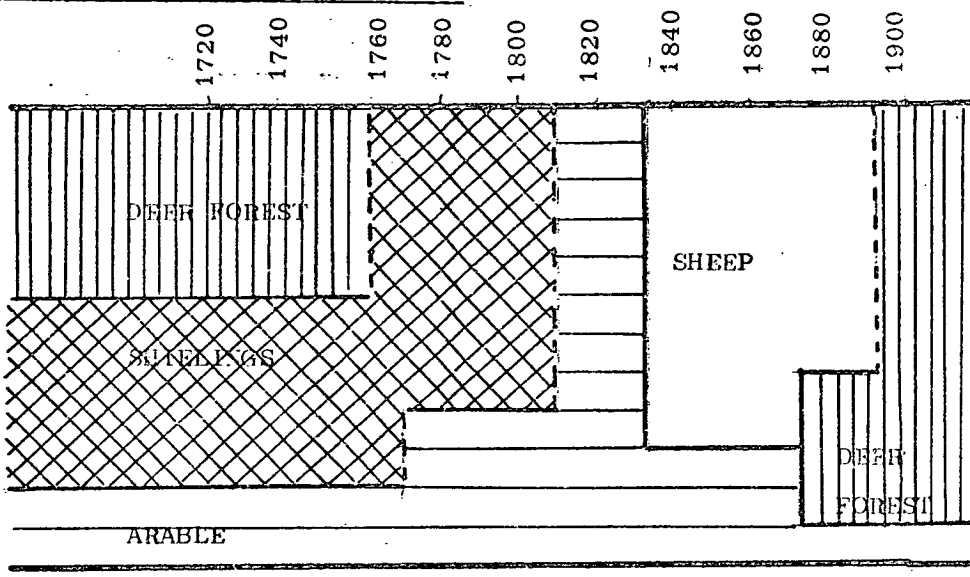
The Glen Strathfarrar shielings were in the woodlands around the farms and in the corries above the townships on the north side and above the pine woods on the south side. The geology is complex in this area, so the vegetation of the corries on the north side varies considerably. Glen Strathfarrar appears to have had a

system of spring-autumn shielings, as some of the shielings were close to the townships either on alluvial flats or in the woodlands. Above Fasknakyle, Knockfin and in the area of Guisachan the Gaelic names of the burns suggest spring and autumn grazings (see Appendix 5). The names give little indication of the location of the shielings but they appear to have been in the woodlands above the farms.

The farmers from a township shared the summer grazings, and in some instances where the grazing could support a large number of grazing animals several townships had grazing rights. By the end of the eighteenth century there were a large number of shieling areas; some had been sub-divided, and the overall stocking in summer was very high. The practice of herding the animals and concentrating them at night in the immediate area of the shieling huts must have built up the fertility of these sites. The grass swards or greens that developed around the huts were rich in Agrostis, Festuca and Poa species. The cattle and ponies reduced the amount of rushes, sedges and coarse grasses; the goats must have reduced the amount of dwarf shrubs and the sheep as well as the other animals reduced the amount of dead material in the sward. The concentrated use of the shielings in summer must have developed anthropogenic grasslands of type 4 and types 4d-4g in the immediate vicinity of the huts, and of Nardus or Molinia-dominated type 4a or 4c further away.

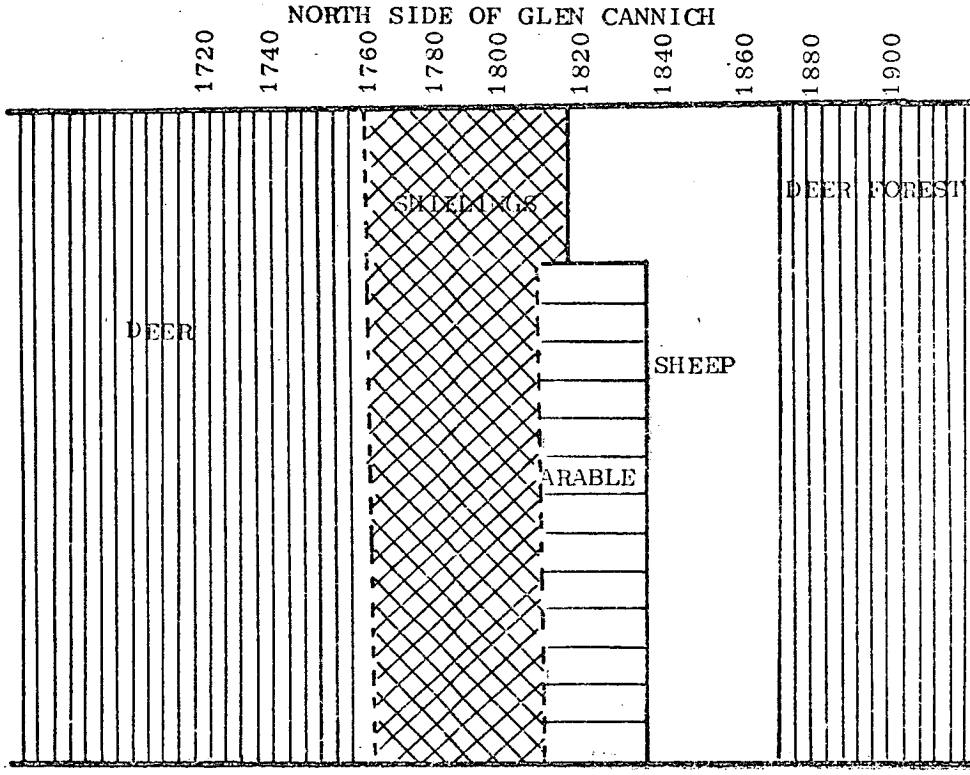
By 1800 many of the shielings along Loch Lungard and Mullardoch were cultivated and premanently settled. Table 9 shows this diagramatically. The upper part represents the north side of the lochs and the lower - the south side. Until 1795 only as far west

TABLE 9. CHANGES IN LAND-USE IN GLEN CANNICH



Am Mam
Coire na Cuilean
Glas-Toll
Allt Taige
W.Mullardoch
E.Mullardoch
Shalavanach
Lietre
Carrie
Muckarach
Craskie

NORTH SIDE OF GLEN CANNICH



Kelloch
Loup More
Coulin
Sheagy
Frith-an-acha beg
Frith-an-acha mhor
Coire Buidhe
Coire Dhomain
Lub nan damh
Lub na meann
Fraoch Coire
Cruim
Lub Ghubhais
Glascorry
Coire Dubh
Dailriach
Tombuie

SOUTH SIDE OF GLEN CANNICH

SOURCES

Rentals held by Capt. W. Mackay, Glassburn, Inverness

Brand Report 1895, q.8621 - 12,441

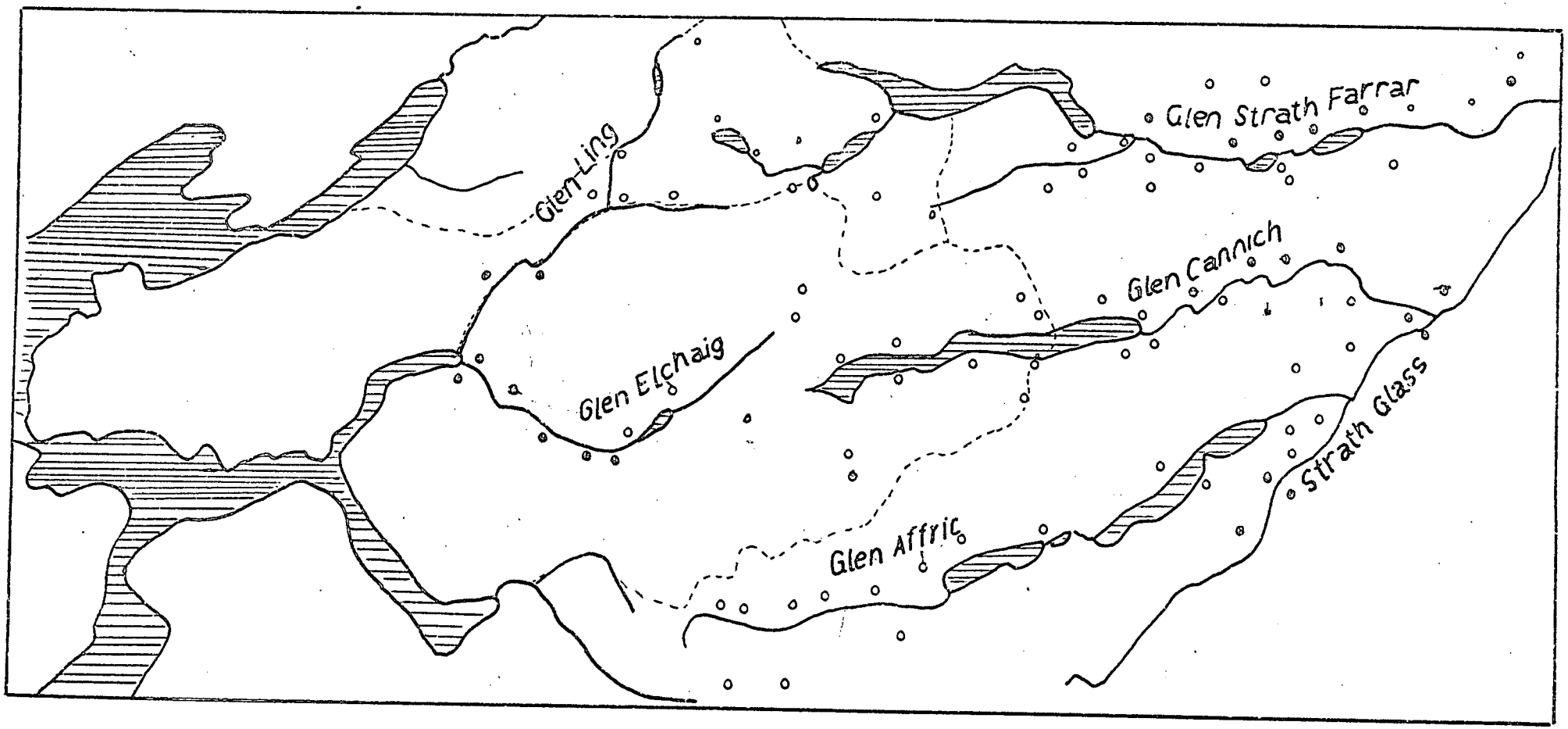
Census Returns 1841 - 1891

Mackenzie 1891

Mackay 1968

MAP 9 SOUTH ROSS-NORTH INVERNESS STUDY AREA, DISTRIBUTION OF SHIELINGS IN THE LATE EIGHTEENTH CENTURY

(⊙ Shieling site, ● Township or farm)



as Lietre was cultivated at 200 metres, whereas by the early nineteenth century all the shielings on the north side were cultivated to 250 metres. On the south side sheep were introduced at an earlier date than on the north, and these shieling areas were probably not cultivated.

The shielings fall into three types: those in woodlands, for instance in Glen Strathfarrar, those along rivers and lochs on alluvial soils and those at high altitudes on natural grasslands. In the east these high shielings are at over 600 metres, for instance in Coire Mhuillidh (grid reference 27-41-) and in the coire around Loch Mor to the north of Squrr Lapaich (grid reference 15-35-). In the west the high shielings are above 300 metres, for example those in the north of Riabhachain (grid reference 11-36-).

SHEEP FARMING IN SOUTH ROSS-NORTH INVERNESS

Sheep farming on a large scale was introduced to the study area in 1804 when Glen Strathfarrar was converted to a sheep run; the whole process took from 1804 until 1850. The grazings of Glen Affric and of Glen Cannich were advertised in 1810 and those of Killilan in Glen Elchaig, Pait Monar and Beinn Dronaig in 1813. The townwhips and shielings on the north of Glen Cannich were not cleared until they came under the direct control of the Chisholm in 1833 (Mackenzie 1901, Napier Report 1884, q.41722).

The hill ground was divided into hirsels which were let with the low ground farms. This is shown clearly in the advertisement for the Estate of Chisholm below. The shielings were not necessarily let with the low ground farms to which they belonged; they were joined together into convenient blocks and attached to a suitable

low ground farm that provided suitable wintering ground for the sheep.

THE ESTATE OF CHISHOLM

The valuable and comprehensive grazings on that portion of the Estate of Chisholm, in the barony of Strathglass, Inverness-shire and the grazings of Glasletter in Ross-shire, are to be let, and entered to at the term of Whitsunday 1810; the endurance of lease, and other conditions, as in the sequel, may be agreed upon. To facilitate the views of intending bidders, these grazings have been lotted out in separate sheep walks by the most skillful, intelligent and eminant store-master that could be found in the Highlands of Scotland, and after his favourable report, it would be quite unnecessary to enlarge upon the quality and advantages of these lots, the name of Mr. Thomas Gillespie, who has brought the sheep flock of Glen quoich to unrivalled excellence, supersedes any comment that could be added in the way of advertisement.

The lots are as follow.

1st. From the march of West Lour; including Aultgaure and Annamullach, Afrrickmullach, Coulan, Cainbain and Findglen on the south side, and likewise on the north side, from Corrigail Burn, constituting the west branch as the foot of the march, and down the burn of Aultory, including Corrigail and Cuilivy, with East and Middle Knockfins, Island of Inver on the west side of the River Glass, now attached to Fasnakyle to make part of this lot.

2nd. The north side of Cainbain Water, including Glen Grivil, Aultbeygarve and Loop-nock-dow to the west branch of the burn of Corrigail, Benevein and Revallen, with Wester Knockfin to the march of Aultgarve.

3rd. Fasnakyle, Achachyte, Dorrimore, Inchmoaney and Tomachontich and the Burn of Inchmoaney, to be the march on the east side, except the hayground all below the road at Inchvoulty.

4th. Glassletter, Sheagy and Culloch, and all to the burn of Franoch, on the south side of Cuilin and Longart on the north side, to the march of Mamglassletter, Mullardoch and the low residence of Comar, to be attached as a convenient dwelling place. The fine grazings of Corrinaquillan can be annexed to this lot, or let separately as most suitable.

5th. Carry and Muckarch.

The lots are calculated to keep from 1000-5000 or 6000 sheep each.

There is a very considerable quantity of arable land, with appropriate mills, which can accommodate superior and enterprising store masters with comfortable dwelling, or would also be let apart for agricultural farmers, to which there are already good roads and always improving.

The grazing afford great quantities of grass, which may be cut for winter provender to sheep flocks, a circumstance of great importance in inclement seasons.

The Davoch lands of Buntait, situated in the fine district of Urquhart are also to be let.

The set of these lands and grazing is to take place at Inverness in Mrs. Ettles's Hotel on Wednesday the 11th day of November next offers are directed to apply to Messrs M'Kenzie and Moneypenny W.S., Prince's Street, Edinburgh or to Mr. Arthur Cooper Writer Inverness.

Respecting any information relative to the value and quality of the grazing, the bidders are requested to apply to Mr. Thomas Gillespie at Ardochy by Fort Augustus.

Donald Chisholm the ground officer at Clachan can show the different lots.

Erchless Castle 21st April, 1809.

(Mackay 1968, p.402).

LANDS TO BE LET

Loch Alsh and Kintail, Ross-shire.
To be let in the course of this year, entry at Whitsunday 1813. Nearly the whole of the parish of Loch Alsh consisting of the following farms, vis.

Ardnarf	Conchra
Achmore	Duirnish
Achnadarroch	Erbesaig
Achtertyre	Fernaig
Ardelve	Kyle
Braindrah	Nonoch
Badycaul	Polintary
Blarower	Salach
Craig	

with sundry fishing and ferries.

With extensive hill grazing of Riochan, Patt, Corryach, Letterhar, Altnagrure, Loch Calavie, Salochroich, Luibgoile, Derepuke, Droneg, Poulifay, and Pephilapak.

There are also to be let the farms of Killilin, Corrydoine, and Fadoch in Glen Elchaig in parish of Kintail. These three farms will contain about 24,000 acres, come down to

the sea and are well worthy of the attention of persons of capital for sheep walks. Upon Killilans a new house has lately been built, two storeys high and slated. On Fadoch there is good accommodation. The whole of these grazing are of the first quality upon the west coast -- the Proprietor is inclined to grant leases 12 months or more before entry.

From the quality of these farms, which are capable of the highest improvement and the excellent new roads making through that part of the country, under the direction of the Parlimentary commissioners they are well worthy the attention of respectable and enterprising tenants who may expect every encouragement from the proprietor.

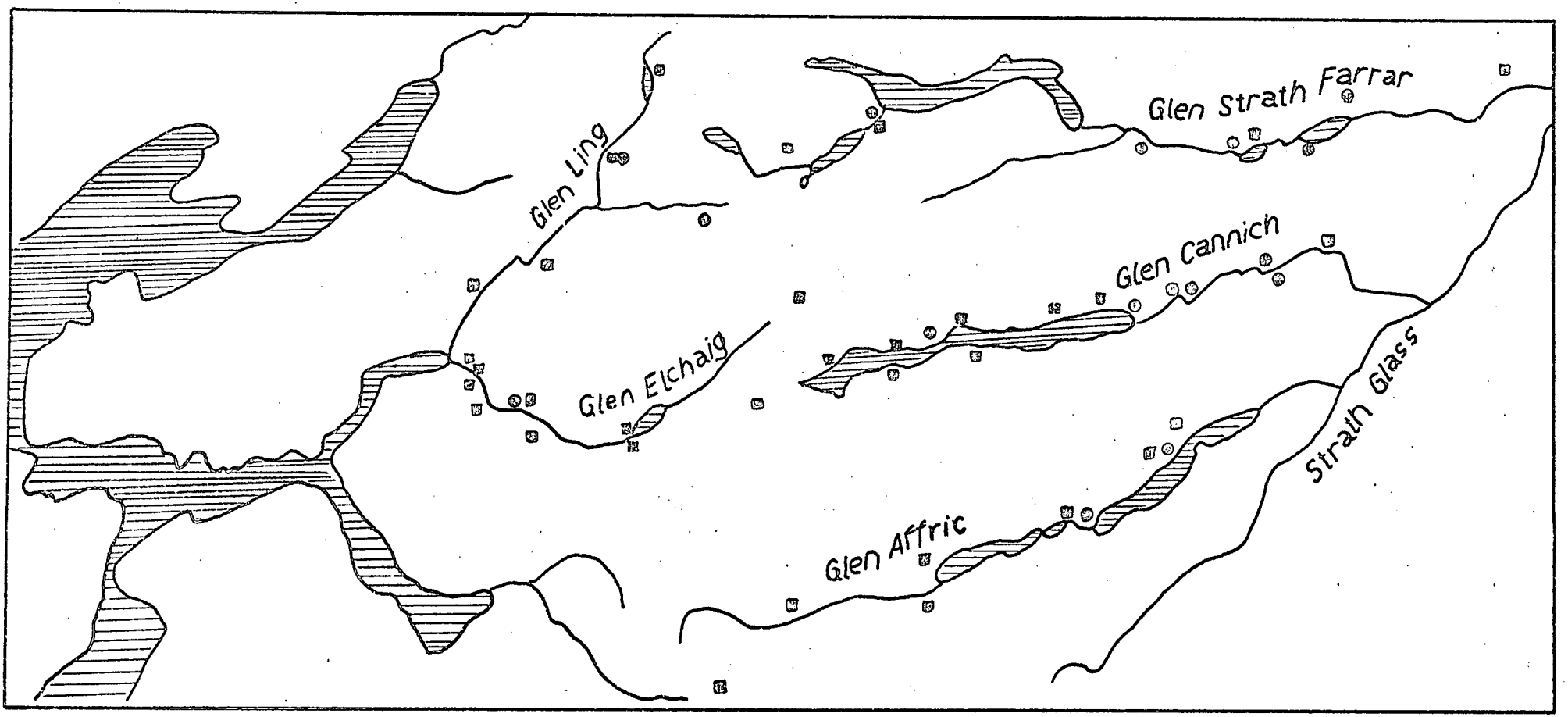
Feus and leases are granted in Burgh of Ploctoun upon Loch Carron. Offers will be received by the prop. and the names of offerer will be concealed if required. Alex. Cummingham W.S., New Street, Edinburgh.

The rents were higher than those paid by the small farmers, and this, taken with the initial high capital outlay required for stocking the hill, meant that only large farmers could take on the land. The introduction of sheep farming affected the resident population in two ways; either their arable land was taken over or their summer grazings were taken from them. In Glen Cannich and Glen Strathfarrar the farmers lost everything and had to emigrate. In the west, some of the farmers, for example those of Glen Elchaig, had to move to coastal districts but others simply lost their summer grazings. This loss was very serious for, although the problems of winter feeding had been overcome to a large extent by the use of winter fodder crops, summer pasture was still short on the Loch Alsh pennincula. The farmers had either to reduce their herd size or send their animals away in summer. The farmers from Durnish had summer grazings at Pait until 1852, and when these were taken from them, they had to send their cattle to Skye (Brand Report 1895, q. 18804).

When sheep were introduced the stocking rate could have been

MAP 10 SOUTH ROSS-NORTH INVERNESS STUDY AREA, DISTRIBUTION OF SHEPHERDS' HOUSES IN 1860'S

(□ Shepherd's house ● Gamekeeper's house)



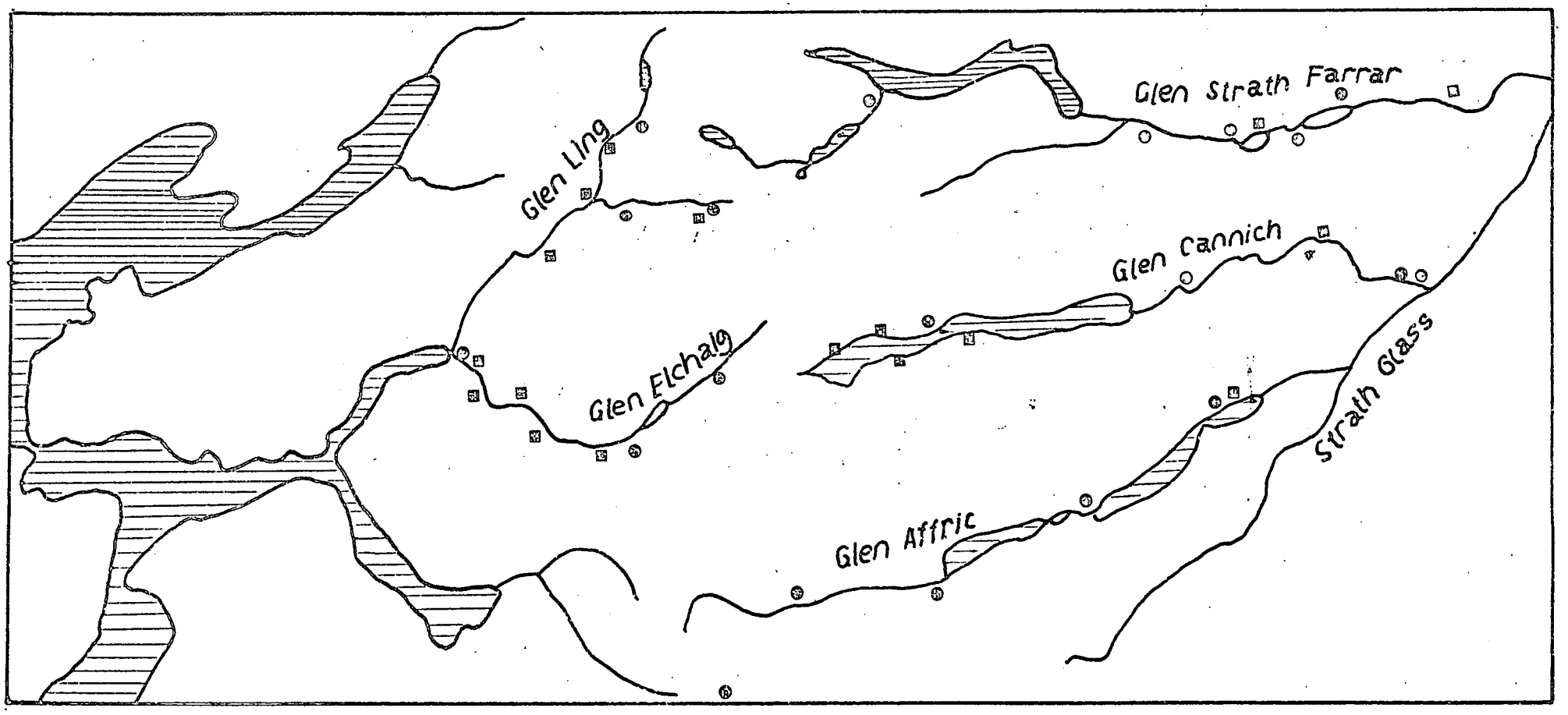
high, because the shieling areas had a high carrying capacity. The advertisement of the Chisholm lands gives some idea of the level of stocking at this time. The higher ground was used for wedder stocks and the lower ground and former arable land was used as wintering ground. In the Highlands in the early part of the nineteenth century wedders were kept all the year round on the high ground hirsels; they were put on as yearlings and sold off at four and a half or five and a half years old. Because of this low labour input the sheep could not be concentrated at the shielings in the summer. These areas therefore were able revert back to dwarf shrub heaths, woodlands or species poor grasslands depending on altitude. The wintering of sheep all the year round at the shielings at the 250 metres altitude must have affected the woodlands at this level and also the shrub vegetation. The wedders must have browsed heavily on the willows and birch of this zone. Some hay and turnips were grown for the sheep. The ewes and lambs were summered on the lower hirsels and in winter were sent either to the adjoining low ground farms or to arable farms some distance away.

Map 10 shows the distribution of shepherds houses in the study area in 1861. Each shepherd had control of between 600 and 1000 sheep, which gives some indication of the animal numbers on the ground. There were 28 shepherds, therefore between 16,800-28,000 sheep. Table 10 gives the number of sheep cleared off from each area towards the end of the century, but this may not be a true picture of the maximum initial stocking of the area.

From 1850 onwards evidence given to the Napier (1884) and Brand (1895) Commissions and in the Census Returns shows that sheep

MAP 11 SOUTH ROSS-NORTH INVERNESS STUDY AREA, DISTRIBUTION OF GAMEKEEPERS' HOUSES IN 1890'S

(⊙ Gamekeeper's house ▣ Shepherd's house or croft)



farming was given up in the area and the higher hirsels reverted to deer forest. There are insufficient data in this instance to come to any decision as to whether or not the decline in the sheep industry was the result of a fall in the level of production of the flocks or whether it was due to changes in the demand for the type of sheep the area could produce. The price of wool fell in the second half of the nineteenth century[1] partly because of the introduction of wool from Australia; also the demand for four year old wedders fell, with the increased demand for meat of younger animals. The profit margin even in the initial stages of sheep farming must have been low; a few severe winters with a high mortality of stock or a small drop in the market would have had a serious effect on the profitability of the enterprise. Also, the condition of the hill ground appears to have deteriorated under the sheep system. The Hill Farming Research Organisation has found that the viability of a sheep enterprise declines as the proportion of anthropogenic grasslands declines, especially in areas that are predominantly shrub heaths; these areas are particularly unproductive under extensive grazing systems with minimal grazing management (Cunningham 1969, p.57-59).

Map 11 shows the distribution of gamekeepers' and shepherds' houses in the study area in 1891.

THE PRESENT SITUATION IN SOUTH ROSS-NORTH INVERNESS

Traditionally the intensity of deer management in this district has been low, some areas have been and are reserved as deer

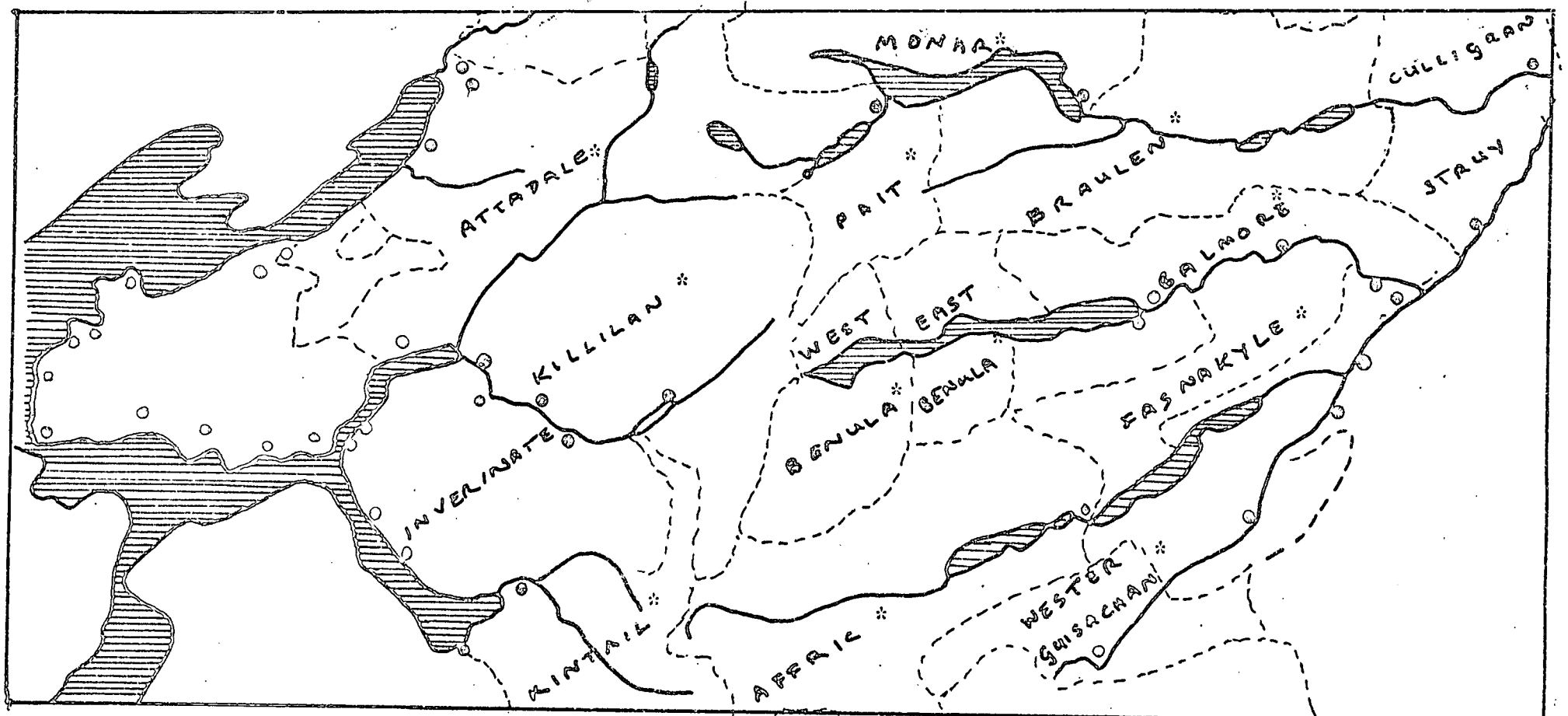
1. See figures given annually in the Transactions of The Royal Highland and Agricultural Society.

sanctuaries, and formerly (mainly in the last century) some fences were built to prevent deer straying on to neighbouring estates. These fences and those of the estate marches pay no regard to the natural boundaries of the deer ranges. Stags are shot in late summer and in early autumn for trophies and for venison, and hinds are shot for meat in winter. Although shooting attempts to be selective, conditions often make it difficult to choose, at all effectively, the animals to be shot. Little has been done in the way of habitat improvements and in some respects the habitat has often been worsened, as deer wintering areas have been cut off, for afforestation or farming, causing hardship for the herd. Nowadays, stags are sometimes given a little artificial feed in winter, but this can do more harm than good, as it concentrates the animals and interrupts their natural use of the vegetation; the fed stags often hang around in the vicinity of the feeding sites all day long, receiving only a small amount of the artificial food, much less than their normal intake of natural herbage, and they are exposed to greater risk of parasite infestation. (It is now becoming accepted that artificial feeding, to be beneficial, either should be given in the normal wintering areas and only supplement the diet, or it should replace natural feeding completely).

Many of the former shieling sites below 300 metres and the old arable land, for instance in Glen Strathfarrar, are now used as wintering areas by groups of hinds, yearlings and calves. Most of these areas are not grazed in summer (although in Glen Strathfarrar they are), and the vegetation has reverted back to the poorer anthropogenic grasslands of type 4a and 4b with bracken Pteridium aquilinum and rushes such as Juncus sp. as invaders. By winter

MAP 12 SOUTH ROSS-NORTH INVERNESS STUDY AREA ESTATE BOUNDARIES

(* Estates considered in the discussion of deer numbers)



there is a large amount of dead unutilised material in the sward, the grazing value of which is lower than it could be if the growing pasture had been grazed in summer. If these areas were heavily grazed in summer by cattle and perhaps by sheep, their value as wintering for deer would be improved. Usually it is completely impractical to consider widescale habitat improvements by the use of fertilisers, drainage or reforestation, but if effort was concentrated on the small critical areas by grazing management, reseeding and perhaps local application of nitrates, phosphates or lime, noticeable improvements would result.

Map 12 shows the estate boundaries within the study area. The deer herds in the study area have been censused by the Red Deer Commission in February and March of 1965, 1969, 1972 and 1973. The practical difficulties involved in censusing wild deer populations on the open hill are considerable and the census figures cannot be taken as absolute and they, usually, present an under estimate of the total population. The census is managed to minimise error from, for example, double counting. The figures for 1972 are considered to be particularly low, due to bad weather conditions in the census period, and the results were rejected as inaccurate after the 1973 census was made.

RED DEER COMMISSION CENSUSES OF SOUTH ROSS-NORTH INVERNESS STUDY AREA

	STAGS	HINDS	CALVES	TOTALS
1965	2,931	6,076	2,221	11,228
1969	2,531	5,872	2,098	10,501
1972*	2,844	4,951	1,649	9,444
1973	3,775	6,799	2,745	13,319

* Not including Monar.

It is impossible to detect any short term trends in the size of the deer population in the area, without additional information on the accuracy of the census technique. However, from these figures it appears that the population may be rising at present, and is approximately at the same level as 8 years ago.

Although it is difficult to get accurate figures for the total number of deer in the area, the number of animals shot legally is known. Opinions vary as to the number of animals currently taken illegally by poachers and there is no way of finding out precisely the number of animals shot but not recorded in the Red Deer Commission returns. The figures given into the Red Deer Commission each year, by the estates, for the number of deer that have been shot are divided into stags and hinds; the hind figures include some calves as estate recording is not consistent. Some calves shot are recorded as adult hinds; some calves shot are not recorded in the returns at all. Some estates claim to shoot only yeld hinds, but are often unsuccessful and shoot milk hinds as well.

Shooting takes place in autumn and winter, and the census is taken in February and March when it is hoped that the deer are on low ground and are less dispersed than at other times of the year. If the cull figures are added to the census figures for the following spring, the population size for the previous summer may be calculated. This does not take into consideration the natural mortality; mortality is highest in late spring when the food is scarce and therefore may be disregarded in this instance.

1965	STAGS	HINDS	CALVES	TOTAL
No. of deer shot 1964/65	505	774*		1,279
Census 1964	2,931	6,076	2,221	11,228
Popn. 1964 Late summer	3,436	6,850	2,221	12,507
% Culled	14.7%	11.3%	12.4%	9.8% total herd

* Includes calves shot.

1969	STAGS	HINDS	CALVES	TOTAL
No. of deer shot 1968/69	518	824*		1,342
Census 1969	2,531	5,872	2,098	10,501
Popn. 1968 Late summer	3,049	6,696	2,098	11,843
% Culled	17%	12%	15%	11%

* Includes calves shot.

1972[1]	STAGS	HINDS	CALVES	TOTAL
No. of deer shot 1971/72	449	656		1,105
Census 1972	2,819	4,646	1,545	9,010
Popn. 1971 Late summer	3,268	5,302	1,545	10,115
% Culled	13.7%	12.4%	11.3%	10.9%

1 Does not include Pait Monar.

1973[2]	STAGS	HINDS	CALVES	TOTALS
No. of deer shot 1972/73	463	619		1,082
Census 1973	3,106	6,365	2,595	12,166
Popn. 1972 Late summer	3,569	7,084	2,595	13,248
% Culled	13%	8.7%	11% adult	8.2%

2 Does not include Glen Cannich.

The % hind cull in 1973 was lower than in the other years although actual number of hinds taken was about the same; the number of hinds had risen but the number taken in the cull remained approximately the same.

If the total herd size was underestimated and the cull figures were an over estimate of the adult animals shot, the percentage of the herd culled, which ranges from 11% in 1969 to 8% in 1972 would also be an over-estimate. The level of cropping seems to be low in comparison with the production of the herd. The cull was increased in 1965: the average number of stags shot in the years 1960-1964 was 441 and the average number of hinds was 580, whereas in the years 1964/65 to 1972/73 the cull was 500 stags and 795 hinds. Although the number of animals shot has been increased the percentage of the herd culled has not changed to any extent and the population has risen; it is probable, therefore, that the cull could again be increased without affecting the reproductive potential of the herd.

The figures given in Table 10 are incomplete, espectially with respect to the deer population. Very little is known about the

TABLE 10. NUMBER OF GRAZING ANIMALS IN THE STUDY AREA

Late eighteenth century

	CATTLE	HORSES	SHEEP	GOATS	DEER	TOTAL HEAD OF LIVESTOCK	STOCK EQUIVALENTS
Loch Alsh	3,145	275	2,475	1,011	?	6,906	2,375
Kintail	6,000	300	?	?	?	6,300	3,900
Glen Strathfarrar	400	82	700	700	?	1,882	547 (incomplete)
Glen Cannich Glen Affric	?	?	?	?	?	3,000 (estimated)	1,500 (estimated)
Total	9,155	657	3,175	1,711	?	~~15~~ 18,088	8,375

1884 sheep keeping capacity estimated - Napier Report

	?	?	28,200	?	?	28,200	7,050

Late eighteenth century, number of sheep removed from the study area

	?	-	21,955	-	?	21,955	5,488

1919 Domestic stock in the study area

	1,112	-	8,982	-	?	10,094	3.357

Red Deer Commission Census

	CATTLE	SHEEP	STAGS	HINDS	CALVES	TOTALS	
1965	700	3,000	2,931	6,076	2,221	11,228	6,347
1969	"	"	2,531	5,872	2,098	10,501	5,883
1972	"	"	2,844	4,951	1,649	9,444	5,433
1973	"	"	3,775	6,799	2,745	13,319	7,603

Source - Old Statistical Accounts Vol.6, 11 & 13; FEP E/769/72/6; Napier Report 1884; Brand Report 1895; Deer Forest Report 1919; Red Deer Commission Census 1965, 1969, 1972, 1973.

size of the deer population in the study area in the sixteenth century, when the human population was low, or during the eighteenth and early nineteenth centuries when the human and domestic animal populations were high.

Under the shieling system, domestic animals from the low ground of Loch Alsh, Kintail and Kilmorack were summered in the area, but only a small proportion was wintered in it. Although the 1973 deer population is as high as the domestic animal population of the late eighteenth century, the number of animals wintering in the study area is higher, and the effect they have on the vegetation has probably been considerably greater than that of seasonal domestic grazing animals because of the pressure on browsing on trees and dwarf shrubs in winter. When the study area was under sheep from around 1800 to 1880 the summering population was very high; although some of the higher hirsels wintered wedders, it is not clear how high the over-wintering population was.

The total level of production of the study area is now lower than it was in the eighteenth century, although the level of the individual animal production seems very similar. The cattle summered in the area under the shieling system could probably calve every year but often every second calf was killed to enable two cows to rear one calf. Under the shieling system in Loch Alsh about 25% of the adult herd over four years old, was sold each year. Under the deer forest system slightly less than 15% of the adult herd is apparently taken, although this may represent an under-culling. The shieling system, except in extreme winters, when there was a high natural mortality, utilised most of the annual animal production; the animals were milked, sheep and goats were

eaten, and income was made from butter and cheese, hides and the sale of live animals.

The shieling system involved a high level of grazing management; the herding of animals, the intensive use of shielings and the cultivation of low ground, increased the fertility of these areas to the considerable benefit of the sheep system when it was introduced in the early nineteenth century. The low intensity sheep farming failed to recognise that a high level of grazing management was required to maintain the shielings and low ground arable in a productive condition; although the shielings were sited in the better areas, the system of land-use had enhanced their value.

DISCUSSION

Before settlement by agriculturalists in the late sixteenth and early seventeenth centuries Glen Strathfarrar was used as summer grazings for the farms of Strathglass and before that, it was a hunting area. There may have been people living in the glen during this period but their livelihood was probably essentially hunting. There was a settled agricultural population in the glen from about 1600 to 1850; it is difficult to put an exact figure to

the number of families living in the glen, but it is likely to have reached a miximum of over thirty at the beginning of the nineteenth century. It was at the end of the eighteenth and in the early nineteenth centuries that the largest number of people were supported by the study area. The population figures for the parishes are not a true guide to the number of people living off the study area, as all the parishes, except perhaps Kintail, included arable land.

The changes that occurred in Glen Cannich are similar to those that occurred in Glen Strathfarrar. Glen Cannich is a higher glen than Strathfarrar, so cultivation came later to the western part of the glen, when the shielings of Loch Mullardoch and Loch Lungard were farmed at the beginning of the nineteenth century. Glen Affric was never cultivated to any extent, as the eastern end is rocky and steep, and the ground to the west of Loch Beinn A'Mheadhoin is over 230 metres, which seems to have been about the limit to cultivation. Glen Elchaig and Glen Ling in the west, were probably settled earlier on as low ground is mostly below 75 metres.

Before cultivation was possible, the woodlands had to be cleared. These low ground areas, however, were winter grazing for domestic animals and for deer, which meant that much of the low altitude woodlands were destroyed at an early date. In Norway the necessity to house animals in winter, except in the west, has to some extent protected the lower woodlands. In the Highlands this was not the case, so the woodlands around the arable farms particularly on south facing slopes which were less suitable for cultivation. Woodlands at higher altitudes lasted longer and these were only used, in summer, as shielings and as grasses and herbs provided a

more attractive grazing for the animals at this season these woodlands did not suffer so much from animals browsing, especially if the deer population wintering in them was small.

Sheep farming lasted in the study area at most for eighty years; in the east of the area it lasted for an even shorter period. In the drier east the introduced sheep failed to prevent the invasion of the shieling and former arable land by the coarser grasses and heather, which had previously been controlled by herding mixed flocks of animals. The result was a rapid reversion to dwarf shrub heaths which now make a sharp contrast to the various types of grasslands in the west that supported sheep farming for a longer period.

There has been much discussion about the decline in fertility that followed the introduction of sheep to the Highlands. McVean and Lockie (1969) suggest reasons for the decline, the cessation of cultivation, the loss of cattle and their replacement by the single specialised mouth of the sheep and the drain imposed on the land by a system of agriculture which involved the sale of animals without the replacement of minerals. Watson (1932) states that from 1850 onwards many writers refer to the decline in the carrying capacity of the Highlands; but he quotes no references. There was a great deal of discussion in the Brand Report on the deterioration of pasture and the commissioners concluded that the arguments for the deterioration of pastures were founded on fact, and advised the use of mixed herds of cattle and sheep. They do not, however, quote figures for the decline in the actual carrying capacity, other than by saying that in some areas could now carry less sheep than they could previously (Brand Report 1895, p.45). Many of the

witnesses talk of the invasion of former arable areas with heather and coarse grasses. In Glen Cannich for example, by 1865 'The old green land was going under fog and needed the plough to recover it fully' (Brand Report 1895, q.91123). The decline in the carry-capacity that followed the introduction of sheep has not yet been documented fully. In any case the reason sheep farming became less attractive towards the end of the nineteenth century cannot be explained simply by a drop in the carrying capacity of the hills as economic factors played an important part.

The remaining woodlands in the Highlands are in areas that were unsuitable for cultivation through altitude, and were settled for only a short period in areas that were marginal for sheep or in areas that were reserved for game from an early date, such as Cawdor Wood in Nairnshire. In the study area there are natural pine woods on north facing slopes of Glen Strathfarrar, Glen Cannich and Glen Affric. The birch woodlands of Glen Elchaig have increased during the last thirty years (Camuslunie Crofter, pers. comm.) since the crofters gave up using ponies to collect fuel.

There is at present a high deer population in the study area for the whole year round, so it is impossible to protect areas of woodland from damage from browsing without fencing and it is difficult even with fencing because in deep snow for example deer can easily scale fences.

There is evidence which suggests that the use of hill land in the Highlands solely as deer forest, under present management, is a relatively inefficient and a low yield system of land-use. There is little control of a wild herd of animals by hunting; there is inadequate information about herd size and composition. Together these make selective culling difficult and they make it virtually impossible to control the fluctuations and periodic crashes in numbers which are generally characteristic of wild ungulate populations. If more was known about the mechanism for population control in deer, steps could be taken to reduce numbers to within the carrying capacity of the range. The carrying capacity of an area is not an absolute figure; it depends not only on the present condition of the habitat, but also on the requirements and constraint of management, on the possible level of input into the resource system and on the acceptability of the effects that the grazing animals may have on the vegetation. The carrying capacity will be lower in areas where tree regeneration is considered important and where capital is not available for fencing and artificial feeding. In other areas the carrying capacity can be increased by techniques such as grazing management or the application of fertilizers; the vegetation complex is dynamic and can be modified and maintained in a condition most suited to the requirements of the system.

The present low intensity of deer forest management provides limited employment opportunities since the only operations directly related to the deer production as such, are culling and sometimes winter feeding; some people are employed in an auxillary capacity, in the maintenance of the estate and others during the stalking

season only, but they are in no way related to the animal production system. At present most deer forests are subsidised from other income sources or are simply dependent on high sporting rents. Attempts at the intensification of the deer system by means of retail sale are made difficult by the fact that animals have to be shot on the open hill. The main advantage of the deer forest systems is that wild deer are adapted to the hill environment and can utilize high ground pastures in summer.

The sheep farming system that preceeded the deer forests also had limitations; shepherding was minimal and there was low grazing pressure throughout the year, which failed to maintain the valuable anthropogenic grasslands and which had severe effect on woodland regeneration in districts where sheep farming persisted for over fifty years. The principal advantage on using domestic animals in a grazing production system lies in the possibility of controlling the structure and the size of the flock so that the most useful thing is produced. With domestic animals it is also possible to utilise several facits of the production; beef and milk, wool and mutton, as well as breeding animals. The sheep farming system of the Highlands probably provided similar overall employment as the present deer forests; the intensity of animal management was higher but it was geared to producing a saleable product without commitment to maintaining the long-term carrying capacity of the Highland environment.

The system of shieling transhumance practised in the Highlands seems, in comparison to the systems that followed, to be the most appropriate to the Highland environment. Seasonal transhumance is essential to the use of high mountain grazing, herding and high

summer grazing pressure and the use of mixed herds of animals helped to maintain the more fertile pockets in a highly productive state. The system did not require a high input of capital although it was dependent on a high level of local knowledge and it was labour intensive. It is possible that many aspects of this land-use system could, with advantage, be incorporated into the use of the Highlands as a production area.

The old types of Highland cattle, sheep, goats and ponies were specially adapted to this type of mountain environment. Unlike the modern breeds which were developed for different circumstances, the original breeds were able to utilise the high pastures and it was obligatory that they should, so that they might gain condition in summer to make up for severe winter deficiencies. At present red deer are the only animals that can utilise these high grazings efficiently, and there is little prospect of change in this regard. However, there are disadvantages of relying on wild animals for the utilisation of these areas. Work is being done by the Hill Farming Research Organisation into the feasibility of domesticating deer to overcome some of the difficulties. It seems that it would be possible to use some of the primitive breeds of sheep and cattle in conjunction with deer. The primitive breeds have intrinsic importance as an unique gene pool and one of the values of this lies in the opportunity which it presents for utilising marginal land. On the Island of Rhum, off the west coast of Scotland, the Nature Conservancy are experimenting with Highland cattle run alongside deer; this is of limited value as the cattle used are heavy beef animals.

Under the shieling system labour was cheap and plentiful. Nowadays techniques such as herding are impossible and alternative

low labour methods have to be considered for the maintenance of productivity; among the possible methods are ploughing and fertilising followed by re-seeding with grass species such as Agrostis and Festuca. This type of work is now being undertaken by some estates. These techniques need not involve a high capital outlay if they are carefully planned.

If large numbers of grazing animals winter in an area the woodland suffers greatly from browsing and trampling and in some cases must be fenced if young trees are to survive for regeneration. If woodland regeneration is important and fencing is not undertaken the number of animals may have to be reduced. Little is known about the extent of a deer's range and the effect that cutting off one wintering area has on its survival. The interdependence of low ground and high ground is recognised but imperfectly understood; for instance the precise importance of a particular wintering area for the deer is seldom known. A great deal of research is needed into the importance of certain low ground areas to the utilisation of adjacent high pastures.

The limits to production in any natural environment are ultimately set by climate, but how nearly this maximum is reached depends on the system of management and on its intentions and constraints. Mountain land can be used in various ways, for instance for water catchment, animal production or for recreation; the attractiveness of these depends on the economic climate within which the manager's decision is taken.

In a prosperous economy tourism is a major industry. Recently there has been promotion of tourism in the Highlands; but however closely the recreational activities are related to the special

qualities of the Highland environment they only operate against the scenic back drop of the area and depend only slightly on the productive potential of the area.

At present there is probably little need to utilise the Highlands as intensively as they were two hundred years ago, but as they have long been modified and utilised by man and cannot now be considered as a wilderness area, the balance between animal and habitat has to be maintained if only to keep the Highland environment in a condition in which it can be utilised again at a high level when necessary.

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MAPS

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APPENDIX 1.

SYSTEM OF STOCK EQUIVALENTS

In order to be able to compare the differences in stocking rates under the three systems of land-use found in the Highlands in the past three hundred years, shieling transhumance, sheep farming and deer forest, a system of standard stock units based solely on body weight has been devised. This is of limited value not only because of the different metabolic rates of the animals but also because of their different feeding habits. As long as the limitations of the system are borne clearly in mind it can be usefully used as a system of stock equivalent.

The old type of Highland cattle averaged around twenty stone and the unimproved Highland sheep around two stone.[1] The cheviot and blackfaced sheep introduced to the Highlands in the eighteenth century weighed about five stone. The average weight of a red deer stag is taken to be fifteen stone and that of a hind ten stone. The Red Deer Commission census the deer in the study area in February and March when the calves are ten months old by February having been born the previous June, they can therefore be classes with the hinds.

The system of stock equivalents used is as follows:-
1 adult cow = 1 three year old heifer or stirk = 1 two year old heifer or stirk = 1 calf = 1 horse = 10 old Highland sheep = 10 goats = 4 cheviot or blackfaced sheep = 1.25 stags = 2 hinds = 2 deer calves.

1. See Chapter 4.

APPENDIX 2

FEP E769/72/6

Report of the Souming and Rouming and also of the value of the Several Farms after mentioned in Glenshiath farm not under Lease as made by Alexander M'Craw in Achayura and Alexander M'Craw in Invershiel, of Kintail

Names of Farms	Milk Cows	3 years old Stots each	2 years old Stots each	one year old Stots each	Horses	Sheep & Lambs to each Cow	Goats & Lambs to each Cow	Money rent conform to the Sums L.	Sh.	D.
...ny ——— at 4sh/ ℔ Soum	20	10	10	10	12	80	80	13	12	—
...nkhar ——— at 3sh/3 ℔ Soum	10	5	5	5	6	50	50	5	17	—
...ler Muibia — at 3s/3 ℔ Soum	10	5	5	5	8	60	60	6	10	—
...rdwhilk at 3sh/6 ℔ Soum	20	10	10	10	10	90	90	11	18	—
...chlair ——— at 3sh/6 ℔ Soum	20	10	10	10	10	70	70	11	4	—
...sler Brewline at 3sh/6 ℔ Soum	18	9	9	9	6	80	80	10	3	—
...sler Brewline at 3sh/3 ℔ Soum	18	9	9	9	6	80	80	9	8	6
...chruidt ——— at 3sh/3 ℔ Soum	18	9	9	9	6	80	80	9	8	6
...klochel, Beineiman & Lubriach at ——— at 3sh/ ℔ Soum	18	9	9	9	12	80	80	9	12	—
...nacharby — at 2sh/ ℔ Soum	8	4	4	4	6	30	30	2	16	—

...Beaufort, 5th October 1770 — We the above mentioned Alexanders ...braws do hereby Declare that the above Souming and ...praetiation has been made to the best of our knowledge ...d according to Conscience: —

Alex M...

Alexr A M'R mRa... mark

SIMPLIFIED VERSION OF PETER MAY'S CLASSIFICATION OF LAND IN GLEN STRATHFARRAR IN 1758

Farm	Arable	Meadow	Marshes	Woods	Moss	Barren (Acres Scots)
Inchlochell	6			183	68	6873
Inchvuilt	7			463		1330
W.Broulin	7	8		134		3328
E.Broulin	8	51	8	140		866
Ardteroe	4	18				793
Inchlary	17	7		112		905
Ardchuilk	16					933
Muilleriach	9	20		199		561
Upper Muille	6	30				1072
Neither Muille	9	30				1054
Bencharran	16	10				813
Deanie	29	10		88	32	2991
Culigran	50			310	3	3394

APPENDIX 3 GLEN STRATHFARRAR RENTALS

RENTAL OF LOVAT ESTATES (GLEN STRATHFARRAR) 1697 FEP E769/1/2 copy of E769/1/1 'Atrue rental of my Lord Lovat, his estate for crop and the year of God one thousand sex hundred and fourscore fifteen years'

	lib	ß	₰
The Rentall of Glenstrafarir			
The Lands of Ishlair and wester Broolinc payes yerly of money rent, The Summ of	173	06	8
Symon ffraser of Doany payes for the Lands of Wester muilzie, and Boantharran 200 merks. Ffor	133	06	8
Wherof Alexr ffraser Readdrums Brother is Reld, Lyfrents the Crout of 3000 merks, So y their remains of Superplus 20 merks.			
The Lands of Easter muilzie & muilzieriark payes yerly	133	06	8
Wherof Mr Hugh ffraser has relevin of the Crout of 3000 merks, So that there remains of Superplus 20 merks, wch is allowed for pay^th of Publick dues.			
The Lands of Easter Broolinc payes yerly	080	00	0
The Lands of Ishlorkell, Ishvaligan & the comon Grass payes yerly	120	0	0
Wherof Tonakyle has relevation in the Crout of of ane thousand pound, The Superplus payes 60 lib.			
The Lands of Ochterro. payes yerly	200	00	0
Wherof Wm Mconroy of Culbrimy has Relevation of the Crout of 2000 merks, The Superplus payable is 120 lib.			
The Lands of Inshmuill payes yerly of money Rent	93	06	08
	933	06	8

RENTAL OF LOVAT ESTATE (GLEN STRATHFARRAR) 1743 FEP E769/1/4

	St. Butter	St. Cheese	Veal	Kid	Bolls horse corn	Cows	Wedders	Goose	Hens	Doz. eggs	Win. straw	Doz. peats	£	s	d*
Inchlochell	1	2	1	2									120		
Inchvuilt	1	2	1	2									93	6	8
Inchlare	1	2	1	2									93	6	8
Two Browlins	2	4	2	4									160		
Ochteroe	2	4	2	4									200		
Culgeran	4	8	6	12									400		
½ davoch of Little Struy	2	4	2	4		2	8						240		
"Wester Aigess				4					8	8			160	13	4
Muille & Benchar													106	13	4

* Pounds Scots or pounds Sterling?

" Low ground farm in Strathglass

Inchlair	William Fraser	107 . 11 . 4
Inchchuick	John McDougal	93 . 6 . 0
Part of lands of Browline	Finlay McGlomach	80 . 0 . 0
Easter Browline	John Fraser	80 . 0 . 0
Part of Ochterow	John Fraser	33 . 6 . 8
	Donald McInish var	33 . 6 . 8
	John McDougald	33 . 6 . 8
Ardchuilt	Barbara Fraser	33 . 6 . 8
Part of Benchar	Rory Mclean	20 . 0 . 0
	Mary Mcffarquhar	20 . 0 . 0
	Thomas McEanvigg	6 . 13 . 4
	William Mcean	6 . 13 . 4
Grazings of Corricharbie		20 . 0 . 0
1757		
Deanie	William Fraser	116 . 19 . 0

		£	s	d
Grazing of Inchlochell Lubriach and Binieran	James Grant at Mains of Lovat	5	17	9 4/12
Deanie	William Fraser	9	14	11
Inchlare	Wm. Fraser of Easter Aigash	8	19	3 4/12
Inchvuilt	Rod. Mcdonald	3	6	8
	John Mcdonald	2	4	5 4/12
	Rod. Cameron	1	2	2 8/12
	Kath. Cameron	2	4	5 4/12
Grazing of Corrichory	Capt. John Forbes	1	13	4
Easter Breulins	John Fraser of Bruiach	7	13	4
	Rod. Mcdonald M'Finlay	2	11	1 4/12
Wester Breulins	John Cameron	2	11	1 4/12
	Thomas Mcdonald	2	11	1 4/12
Easter Muille and Muilliriach	Robert Fraser	9	8	10 8/12
Wester Muille	Neil Mclean	4	8	10 8/12
		1	5	6 8/12
	Alex Mclean	1	5	6 8/12
Beanchar	Dun. Mcdonald	1	5	6 8/12
	Thomas Fraser		12	9 4/12
	Peter Gormch		12	9 4/12
	James Fraser	3	3	10 8/12
	Mary Fraser	3	3	10 8/12
Ardchuilk	Duncan Forbes			
	Thomas Fraser Achnacloich	3	3	10 8/12
	Duncan Chisholm	3	3	10 8/12
Achteroe	Alex Forbes	3	3	10 8/12
	Elspeth & Alex & Wm. Roy	3	3	10 8/12

sent rent			Rent of Mr May			Rent of the Mr Graws			Tax'd rent			add'l rent		
£	sh.	d.	£	sh.	d.	£	sh.	d.	£	sh.	d.	£	sh.	d.
0.	11.	4/12	17.	3.		13.	12.		15.			4.	8.	
1.	5.	6 8/12	1.	12.	6 6/12	1.	9.	3						
1.	5.	6 8/12	1.	12.	6 6/12	1.	9.	3						
1.	5.	6 8/12	1.	12.	6 6/12	1.	9.	3	6.	10	2.	1.	7	
	12.	9 4/12		16.	3 3/12		14.	7 6/12						
	12.	9 4/12		16.	3 3/12		14	7 6/12						
5.	2	2 8/12	8.	3.		6.	10.		6.	10.		1.	7	9
0.	11	8.	12			11.	18.		11.	18.		2.	6.	4
2.	19	3 4/12	13.	10.		11.	4		11	4		2.	4	8
	13	4	11.	12		10.	3		11	12		3.	18	8
5.	8.	10 8/12	7.	16		6.	18	2						
	4	5 4/12	3.	10.	6	2.	18	4	10			2.	6.	6
1.	18	10 8/12	2.	18	5 3/12	2	7	1 6/12						
1.	18.	10 8/12	2.	18	5 3/12	2	7	1 6/12						
1.	18	10 8/12	2	18	5 3/12	2	7	1 6/12	11	13	9	2.	15.	11
1.	18	10 8/12	2	18	5 3/12	2	7	1 6/12						
5.	17	9 4/12	9.	19	3	9.	12		9.	19	3.	4.	1	5
1.	13	4.	2.	8.	4	2.	16		2.	16		1.	2	6

Names of Farms	Names of Tenants
Deanry	William Fraser
	Neil McLean
	Kathrine McDonald
Benchar	Duncan McDonald & Mary McFarqu
	Thomas Fraser
	Peter Gruamach
Wester Muilrie	Mr. Fraser
Ardchuilk	Do. Mr. Fraser
Inchlair	Capt. Hugh Fraser
Easter Brewline	John Fraser
	Arthur Stewart
Wester Brewline	Thomas McDonald
	James Michie
	John McDonald
Inchvuilt	Hugh Fraser
	John Buie
Grasing of Bunreirnan, Inchlaithel & Lubriach	Captain John Forbes
Grasing of Corracharby	Alexr Campbell of Delnies

RENTAL OF LOVAT ESTATES (GLEN STRATHFARRAR) ca.1802

Rental of the Estate of Lovat, exclusive of the Superiorites Feu--duties, and proprty lands, page 48

Parish of Kilmorack (Lovat Estate Office, Beauly, Inverness)

Land possessed on leases to expire at Whitsunday 1804 cont.

		Money rent including augmentation stipend, less Vicarage and school salary
Easter Muilzie	Wm. Stewart & others	9 . 11 . 3
Muilzierach	Hugh Fraser & others	9 . 11 . 3

Expire at Whitsunday 1803

Achteroe	William Robertson's heir	10 . 10 . 4
Deany & Benchar	Robert Fraser of Aigas	26 . 10 . 0
Wester Muilzie	Hugh Fraser	8 . 1 . 8
Ardchuilk	William Fraser Kylachie	15 . 10 . 0
Inchlair	Capt. Hugh Fraser of Eskadale	14 . 5 . 0
Easter and Wester Browlines	Maj. Gen. Simon Fraser	25 . 6 . 0
Inchvuilt	Hugh Fraser & others	12 . 12 . 6 8/12
Inchlochiel		
Benenerin	Mr. Fraser of Lovat	12 . 2 . 2 8/12
Lubreach & Lappich		

APPENDIX 4 SELL AND RENTAL OF STRATHGLASS 24 MARCH 1775 (held by Capt. Mackay, Glassburn, Inverness)

TOWNSHIPS AND SHIELINGS	RENTS	MERKS	£	s	d	No. of tenants
West of West Knockfin and grazings of the wester half of Cuilivie		274	15	4	$5^2/3$	4
East of West Knockfin and grazings of Lupchrochvuie and Aldbeamean		354	19	15	7	2
Mid & East Knockfin and grazings of Anamullach in the Heights of Keiloch and Affrickmulloch		716	39	15	7	3
Fasnakyle and grazings of Corriegail		465	25	16	8	1
Leatrea and grazings of Maum and Sheegarve		330	18	6	8	2
Carrie and grazings of Glasscourie and the easter half of Mullardich		366	20	6	8	3
Kerrow & grazings of Beinvein, Inchvuin and the easter half of Cuillivie		345	19	3	4	5
West of West Inverchannich & Craskie & grazings of wester half of Mulardich & half Glasstoul & Meikle Trienach		501	27	16	8	6
Muckerach & Dalriach & grazings of wester half of Corry na guillan		480	26	13	1	1
West Comar & grazings of Leakavie, Pollanfairn & Tomnacoinich		263	14	12	0	5
Mid Comar & Kirkton & grazings of Poullan Breck		435	24	3	6	16
Eat of West Inverchannich & grazings of Tombuie, Artaigg & half Glasstoul		267	14	16	8	3
East Inverchannich & Rinkinless & grazings of Easter half of Corry na guillan, Corygoin, Corry Buie and Shalvach		526	29	4	7	2
	TOTALS	5322	£295	15s.	5^2/3d.	57

APPENDIX 5

SHIELINGS AND TOWNSHIPS OF GLEN CANNICH AND GLEN AFFRIC AT THE END OF THE EIGHTEENTH CENTURY

	GRID REFERENCE	DISTANCE FROM Township in Kms.	PRESENT SITUATION*
LIETRE	249325		Cottage
Am Mam	125305	13	Flooded
Sheag y	102290?	15?	?
Liath Ruigh	250348	1	4
CARRIE	266337		Ruins, 4,7
East Mullard-och	204315	7	Flooded
MUCKERACH & DALRIACH	288330 & 285327		Farm
Glascorry	259326	5	4,2.
Coire na Cuilean	155310	14	Flooded
East of			
WEST INVERCHANNICH	34-31-		
Tombuie	312330	3	2
Alt Taige	180320	13	Flooded
Glas Toll	175335	14	7
West of			
WEST INVERCHANNICH & CRASKIE	34-31-		
West Mullardoch	194313	14	4,10
Glas Toll	175353	15	7
Frith-an-Acha	124299	20	Flooded
EAST INVERCHANNICH	34-31-		
Coire na Cuilean	155310	18	Flooded
Coire Goin	?		
Shalvanach	229318	9	Lodge
Choilich	102290	18?	10
Coire Buidhe	155303	18	Partly flooded 2,7
Lungard	102300	20	Flooded
Sheagy	102290?		

* Numbers refer to the type of vegetation see key 2 on page 80.

MID COMAR & KIRKTON	31-31-		
Pollanbreck	?		
COMAR	155310		
Coire na Cuilean	155310	18	Flooded
KERROW	330302		
Beinn a'Mheadhoin			2
Inchvuin	?		
East half of Coullavie	142211	20	Ruins 4
WESTER COMAR			
Leachavie	146224	19	2,4
Pollanfairn	170230	18	1,2,4
Tom a'chonich	165274	20	10
FASKNAKYLE	312289		
Coire Ghadheil	114218	23	
East half of WEST KNOCKFIN			
Lub Chrock vuie	095205	19	
Alltbeithe	080202	20	
West half of WEST KNOCKFIN			
Coulavie	136221	19	Ruins 4
Mid MID & EASTER KNOCKFIN			
Athnamulloch	130200	19	1,2,4
Choilich	09-24-	24	10

DORNIE	882264		
Loupmore	104264		25
CAMUSLOIN(Camus-longart)	880270		
Coulin	West of 130200		25?
ENVERINATE	92-21-		
Gleann Ghiomhaidh	04-20--		10
Allt Beithe Garbh	070200		
MORVICH	960210		
Camban & Fionngleann	052183	068188	7
	056184	076193	
	059180	078180	

NAMES IN THE O.S. NAME BOOKS OF 1868

Allt Ruigh Eoghainn 229330

Allt Ruighe Dhuibh 24- 28- Stream of the Black Shieling

Innis Mhor 104264 in Gleann a'Choilich

Ruigh Riabhach 274258 The Brindled Shieling, north west of W.Knockfin

Allt Ruigh Lagna Sithinn 270256 The Stream of the Shieling of the Vension Hollow

Creag Ruigh nah-Uamhach 325330 Craig of the Shieling of the Caves, north west of Comar

Allt Ruigh nan Cearmaicgean 043310 Burn of the Merchant's Shieling

Allt Loch Innis Gheamhraidh 292267 Burn of the Winter Shieling

Allt Innis an Droighinn 290300 Burn of the Thorn Shieling

Allt Ruigh an Daraich 270250 Burn of the Oak Shieling

SOURCES

Sell and rental of Strathglass 1775 (Appendix 4)

Rental of the Estate of Chisholm distinguishing the rent of 1787 from the rent by the new set, the number of services being the same 1792

Tack of Kirkton and Comar 1790

Tack of Clachan and Kerrow 1810

Rental of Chisholm Estates 1801

(The above are held by Capt. Mackay of Glassburn, Inverness)

George Brown, Plan of Intended Road from Shiel House to Beauly

West Register House

Ordinance Survey Name Books 1868-1873

TOWNSHIPS AND SHIELINGS OF GLEN STRATHFARRAR IN THE MIDDLE OF THE EIGHTEENTH CENTURY

	GRID REFERENCE	VEGETATION & DESCRIPTION
INCHLOCHEL	203384	4, Ruins destroyed by road, alluvial flats by stream.
Toulnlochin	140360	10, Om track through to Kintail
Lupac Ari Ewan	148371	10, Marked on 1850 mapof Glem Strathfarrar marches, Lovat Estate Office, Beauly, Inverness
Ruins to west of Allt an Eas/MHDr	151361	9,10,11,6, Two oval structures 3m/2m see Photo37. Large corrie
Dirrana Gillion	158372	4,7 Ruin 3.5/6m long walls .7 m thick enclosure at one end 1.8/1.6m
Inchvalikan	175373	2,4 2 huts in 1758 Peter May
Tirravida	184381	2,4 1758 'A small wood of birch on this side of river declines south with good pasture and winter shelter for cattle called Chyla Torravida! Woods now derelict.
Lubriach	221391	4,7, Sheep fold . 1758 'improvable shieling with good pasture for sheep& goats.
INCHVUILT	229387	Cottage, alluvial flats with alder & birch
Allt Innis a'mhuilt		Burn of the Wether Shieling O.S. Name Book 1868
Arie Lapigh	181379	1b,4, 1758 'A good shieling' 5 huts Peter May
Arie Helick	185371	In Coire Garbh, Goat Corry above the pine woods 7c
Arie Voam Buisk	190 370	As above
Glackranich Ruin	202380 235384	4d,4e formerly open pine woods alluvial bank Ruin 10m/4m see photo36.
EAST & WEST BROULIN	23-38-	
Foueran	220351	Above pine woodland
Arie Patn Doighk	222372	1,2,4
Lockandoul	244380	4 Alluvial flats, ruin 4m-10m

AUCHTARDE	261384	2,4, ruins
Arie Laugh Kine	255410	Above woods
ARDCHUILK	268380	2,4, ruins
Arie nan Leod	262388	3, burnt
Arie Derry Lae	262388	3, burnt
UPPER & NETHER MUILLE	28-37-	2,4, Ruins photo 33
Arie Sockkigh	278396	7,10, Large coire
INCHLARY	262379	Ruins, alluvial flats, 2,4.
MOYLEY RIACH	279379	Ruins, alluvial flat 2,4 photo
BENCHARAN	300390	Alluvial flats, modern house
DEANIE	320389	Holiday house, grassland
CAMBUSSORRAY	295375	Ruin, alluvial flats
Allt Ri-Clachy	290380	Burn of the Stoney Shieling
Loch an Airidh Fhraioch	337383	Loch of the Heathery Shieling
CULLIGRAN	387414	Farm
Arie Du	373400	2, by stream
Lachpuie	34540-	2, by stream
Neattle	36040-	2, rich birch wood vegetation
Arie Culligran	381421	
Dagye		
Culligran & Struy Shielings	397427	
Erchless shielings	403442	7,10, six ruins photo 32

SOURCES

PETER MAY'S

Peter May's Map of Glen Strathfarrar 1758

Map of the Glen Strathfarrar marches, Lovat Estate Office Beauly, Inverness. 1850.

Map of the Culligran Struy marches 1842, Lovat Estate Office, Beauly Inverness

SOME OF THE TOWNSHIPS AND SHIELINGS OF LOCH ALSH AND KINTAIL AT THE BEGINNING OF THE NINETEENTH CENTURY

ARDNARFF	8903 58	Pait Monar (West of Loch Monar)
STROME	864347	Alt-a-gre (Possibly Allt a'Ghuigh-Fhear 083380)
PORTCHULLIN	850347	Alt-a-gre, Altan Ban 062383
ACH-MORE	858337	Pait Monar & Riochan 12-36-
PLOCKTON	803336	Pait Monar
CRAIG	823330	" "
AUCHNADUROCH	801311	" "
DUIRNISH	785311	" " & Riochan
DRUIMBUIE	775310	" "
ERBUSAIG	762298	" "
KIRKTON	830271	Pait Monar, Alt-a-gre, Altan Ban & Loch Calvine
AVERNISHI	84-26-	Pait Monar & Coire Dhomain 99-32-
AUCHTERTYRE	840275	Beinn Dronaig 01-39-
ALLT-NAN-SUGH	900215	Coire Dhomain 99-32-
CAMUSLUNIE	945284	Achadh-a'Chuirn 027280 (6 ruins in Strath Duilleach 03-28-) & Fraochcoire 069288
DORNIE & CARR	883266	Longard & Mam (West of Loch Mullardoch
BUNDALLOCH	895275	Longard & Mam
INVERINATE	921216	Achadh-a'Chuirn (see above)
AIRD AN TOUL		Longard & Mam (Beinn Fhionnlaidh)
LOCH ALSH		Knockgorm (Possibly Killilan Forest)
		South of Squrr-n-Fantaig 045450

SOURCES

Napier Report 1884, Evide nce in Vols 3 &4

Brand Report 1895, Evidence q. 8,621 - 20,100

SHEPHERDS' AND GAMEKEEPERS' HOUSES IN THE STUDY AREA IN THE 1860'S

CRASKIE	301340	INCHVUILT	229327
MUCKERACH	288330	ARDCHUILK	268380
DALRIACH	285327	ARDTARDE	261384
LIETRE	249325	DEANIE	320389
LUIB GHIUBHAIS	246320	CAMBUSSORRAY	295375
SHALVANACH	229318	CULIGRAN	387414
MULARDOCH	204315	BEINVEIN	242264? Flooded?
COIRE NA CUILEAN	155310	COULAVIE	142211
LUB NA DAMBH	155303	ATHNAMULLOCH	130200
COIRE BUIDHE	155305	ALLTEEITHE	080202
FRITH-AN-ACHA	124299	CAMBAN	05-18-
AM MAM	125305	LOCH AN LAIOGH	026411
LONGARD	102300	ALLT A'GHRAIGH-FHEAR	083385
FRAOCHCOIRE	069288	POLL-AN-TARIE	950331
LETREACH	017275	LUIB A'GHAILL	002385
AULT CAUM	099290?		
ACHADH A'CHUIRN	027280		
CARNOCH	026281		
KILLILAN	947301		
FADOCH	955285		
COIRE EACH	091331 &097346		
MUILEBUIE	052360		
PAIT	124404		
CORY GORM	002320?		
COILLE-RIGH	971277		
CAMBUSLUNIE	945284		

SOURCES:

Census Returns 1841-1891 Register House H.M. Edinburgh

SHEPHERDS' AND GAMEKEEPERS' HOUSES IN THE STUDY AREA IN 1890'S

TOMBUIE	312330
CRASKIE	301340
MUCKERACH	288330
LIETRE	249325
AM MAM	125305
LONGARD	102300
LUB NA DAMBH	155303
CO IRE DHOMAIN	980342
COIRE DUBH	00-36-
MUILBUIE	052360
REANACH ?	
IRON LODGE	043293
MAMAIG	99-268
CARNOCH	026281
FADDOCH	954285
COILLE-RIGH	97227
CAMBUSLUNIE	945284
GLOMACH COTTAGE	011268
KILLILAN	947301
BENDRONAIG	014388
LUIB A'GHAILL	002385
BLACK WATER	996364?
ACHGATE	?
BEINVEIN	242264?
AFFARIC	185230
ATHNAMULLOCH	130200
ALLTBEITHE	080202
CAMBAN	05-18-

SOURCES:

Census Returns 1841-1891 Register House H.M. Edinburgh

LENGTH OF TIME THAT THE ESTATES WERE UNDER SHEEP

ESTATE	YEARS TO THE NEAREST DECADE
AFFRIC	80
ATTADALE	40
BRAULIN	50
EAST BENULA	90
FASNAKYLE	60
GLEN CANNICH	50
KILLILAN	50-80
GLOMACH	50-80
KINTAIL	80
MONAR	40
PAIT	40
STRUY	50
WEST BENULA	80
WEST GUISACHAN	90
LUNGARD(part of East & West Benula)	70
SOUTH GLEN AFFRIC	60

SOURCES

Napier Report 1884 & Evidence.

Brand Report 1895 & Evidence.

Deer Forest Report 1919 & Evidence.

PHOTOGRAPHS OF SOUTH ROSS - NORTH INVERNESS STUDY AREA

33 Glenstrathfarrar- Muille (Moyley) looking over the river to Moyley Riach, 28-37-. At least 10 ruins at Moyley Riach, several at Muille.

34 Glenstrathfarrar - Arie Patn Doighk 222372, looking north, May.

35 Glenstrathfarrar - ruin at 244380 looking northwest over to Broulin meadows, ruins possibly of Lockandoul.

36 Glenstrathfarrar - ruin at 235384 10m/4m looking westwards over Broulin meadows.

37 Oval ruin 3m/2m in a coire on the west of Sgurr na Lapaich at 700metres 151361.

38 Erchless Shielings at 40-44-, at least seven ruins, at 350 metres.

39 Glen Affric - Coulavie 142211, shepherd's hut, looking west over Loch Coulavie.

40 Glen Elchaig - Strath Duileach looking west.

41 Glen Elchaig - Mamaig 004267, 2 large two roomed houses, 1 small ruin, 2 beehive shaped folds and enclosed area by river.

42 Glen Elchaig - Mamaig looking west.

43 Glen Ling - 971342 looking east to Coire Domhain, which is now empty. Structure in the foreground may be a whiskey still.

44 Junction of the River Ling and Ulsge Dhubh 002363. Deer fence between Attadale and Killilan Estates built at the end of the nineteenth century.

45 Luib a'Ghaill 002385, rectangular sheep fold with a number of ruins. Sheep now grazed there in summer; looking north to Bendronaig

46 Luib a'Ghaill, as above, looking south.



33



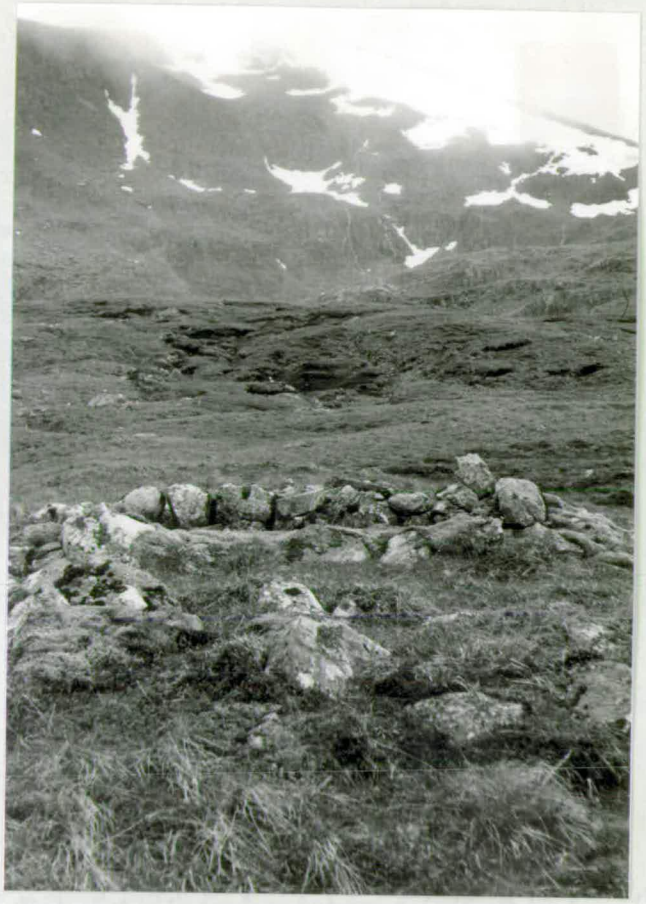
34



35



36



37



38



39



40



41



42



43



44



45



46

Kishorn Island
An Garbh-eilean
Meall na h-Airde 606
Lochan Dubha
Loch an Eich-uisge
Sgeir an Fheòir
Sgeir Bhuidhe
Loch Reraig
Reraig Ford
Reraig Burn
Rubh Alasdair Ruaidh
Eilean na Beinne
Ardaneaskan
Strome Carronach
Water Slumbay
Strome Forest
Bad a' Chreamha 1296
Mid Strome
Stromemore
Strome Castle NTS Pier
Ardnarff
Cuddies Point
Avalanche Shelter
Strathaa
River Attadale
East Bàn
Allt Feith Mhadaidh
ATTADALE
Meall Ruadh 1488
Loch na Caillich
Loch an Dochartaich 1072
Loch nam Forca
Choc nam Mult 1125
1523
Loch na Sroine
Loch Mall
Carn nan Tomaltean 1590
Loch nan Gillean
Loch nam Breac Mòra
Lochan Fuar
Loch an Iasaich 1085
Carn Ailt na Bràdh
Allt na Caime
Allt Feith Mhadaidh
River Lìr
Allt an Dorch
Coire-domhain
Allt Gleann a' Chaoruinn
Allt Loch Innis nan Seamhan
Allt na Feithe Bhuidhe
Glen Ling
Creag Mhòr 2179
Coire Dail Arteil
Sgurr na Cloiche 2466 Ben Killilan
Coire Fraineach
Bealach Mhic Bheathain
Sguman Coinntich
Allt a' Chlais-cheitein
Loch nan Ealachan
Meall an Achaidh Gharbhgein
Faddoch
Camus-luinie
Glen Elchaig
Allt Mór Eas Bàn
Coille-righ 142
Carn Loch nan Eun 1946
Coire na Caille
Creag na h-Iolaire
Eas Bàn
Carn Baò a' Chreamha 2073
Loch Fhuic Mhòir
Loch nan Eun
Carn Baò Mór 2064
Creag Rèidh Raineach 1654
Loch na Craoibh-caorainn
Loch na Faolaire
Loch Gorm Mòr
Loch a' Mhadfhinn
Coire Dhuinnid
Waterfalls
Keppoch
Boc Beag
Sgurr an Uillt Tharsuinn 1892
Beinn Bhreac
Allt an Eas Bhuidhe
Allt an Loin Ghlais
Invermoriston Forest
Beinn Bhuidhe
Dorusduain
Gleann Choinnich
Lienassie
Ruarach
Croe Br
Innis a' Chrò
Morvich
Tigh-a'-mholain
Dunan Diarmaid
Carn-gorm
GLENSHIEL
Sgurr a' Ghairbh
Allt a' Choire Mhòir
Allt na Lice
Allt Coire Mhadaidh
Creag Mhòr 1307
Carn na h-Onaich
Loch na h-Onaich
Lochan Dubha
Waterfall
Nonach Lodge
Ceann-an-òba PH
Sallachy
Sch
Creag a' Chaisil
Killilan
Loch Tholladh
Allt na Lucha
Allt-nan-Sùgh
Loch Beinn a' Mheadhoin
Loch Dubhach
Beinn a' Mheadhoin 1351
Loch Allt na Cleireach
Conchra
Bundalloch
Carndu
River Glennan
Allt a' Bhlàir Mhòir
Blue Burn
Biod an Fhithich
Allt Mór Eas Bàn
Camus-luinie
Faddoch
Glen Elchaig
Allt a' Chlais-cheitein
Loch nan Ealachan
Meall an Achaidh Gharbhgein
Allt Coire Mhadaidh
Allt Gleann a' Chaoruinn
Allt Loch Innis nan Seamhan
Allt na Feithe Bhuidhe
Glen Ling
Creag Mhòr 2179
Coire Dail Arteil
Sgurr na Cloiche 2466 Ben Killilan
Coire Fraineach
Bealach Mhic Bheathain
Sguman Coinntich
Allt a' Chlais-cheitein
Loch nan Ealachan
Meall an Achaidh Gharbhgein
Faddoch
Camus-luinie
Glen Elchaig
Allt Mór Eas Bàn
Coille-righ 142
Carn Loch nan Eun 1946
Coire na Caille
Creag na h-Iolaire
Eas Bàn
Carn Baò a' Chreamha 2073
Loch Fhuic Mhòir
Loch nan Eun
Carn Baò Mór 2064
Creag Rèidh Raineach 1654
Loch na Craoibh-caorainn
Loch na Faolaire
Loch Gorm Mòr
Loch a' Mhadfhinn
Coire Dhuinnid
Waterfalls
Keppoch
Boc Beag
Sgurr an Uillt Tharsuinn 1892
Beinn Bhreac
Allt an Eas Bhuidhe
Allt an Loin Ghlais
Invermoriston Forest
Beinn Bhuidhe
Dorusduain
Gleann Choinnich
Lienassie
Ruarach
Croe Br
Innis a' Chrò
Morvich
Tigh-a'-mholain
Dunan Diarmaid
Carn-gorm
GLENSHIEL
Sgurr a' Ghairbh
Allt a' Choire Mhòir
Allt na Lice
Allt Coire Mhadaidh
Creag Mhòr 1307
Carn na h-Onaich
Loch na h-Onaich
Lochan Dubha
Waterfall
Nonach Lodge
Ceann-an-òba PH
Sallachy
Sch
Creag a' Chaisil
Killilan
Loch Tholladh
Allt na Lucha
Allt-nan-Sùgh
Loch Beinn a' Mheadhoin
Loch Dubhach
Beinn a' Mheadhoin 1351
Loch Allt na Cleireach
Conchra
Bundalloch
Carndu
River Glennan
Allt a' Bhlàir Mhòir
Blue Burn
Biod an Fhithich
Allt Mór Eas Bàn
Camus-luinie
Faddoch
Glen Elchaig

Meall a' Chapuill
Bidein a' Choire Sheasgaich
3102
Meall Mór
3234
3190
Sàil 2533 Riabach
Creag Dhubh
Coire na Sorna
Allt a' Ghiubhais Mhóir
Allt Coire a' Chaorra
Patt Lodge
Carn na Córaige
An Gead Loch
10 feet
Ulsge Dhubh air Rìnack Water
Bendronaig Lodge
2613
Beinn Dronaig
Allt Loch Calavie
Loch an Tachdaidh
2032
Beinn Bheag
1819
Meallan Buidhe
KILMORACK
1861
Meallan Odhar
Meallan Odhar Doire nan Gillean
Allt a' Chròit Odhair
Loch Cruoshie
Allt an Lòin-fhiodha
Lochan Gobhlach
Allt Leathad an Tobair
Allt an Fheadain
Clach an Daimh
Allt an Eas Bheag Mhóir
Ràidh Breac
Lùb Chruinn
Maol-bhuidhe
2312
An Cruachan
Meall Garbh
Loch Beag
Loch Mór
3775
Sgurr na Lapaich
1903
Carn na Sean-luibe
Allt na Sean-luibe
Allt a' Chaorachain Mhóir
Loch na Maoile Buidhe
1192
Allt Coire nan Each
Allt a' Choire Dhuibh
Allt a' Choire Chuirn
3696
An Garbh-choire
An Riabhachan
3559
3508
2956
Bràigh a'Choire Bhig
3317
Loch a' Choire
K I L L I L A N F O R E S T
2854
An Creachal Beag
Carn nan Searrach
Coire Dubh
Aonach Buidhe
2949
2591
Mullach a' Ghlas-thuil
2847
Faochaig
Leac na Nighinn
Coire Mhaim
Allt Coire a' Mhaim
Allt Coire Lungard
Lochan Mhoicean
Allt Sgeotach
Allt an Eas Dubhain
Coire Lungard
Meall Shuas
Meall Bac a' Chùl-doire
Sròn na Gaoithe
1026
Coire na Breabaig
Am Màm (Ruin)
2275
Carn na Breabaig
Creag nan Eilid
447
Iron Lodge
Allt Doire Gairbhe
Allt Domhain
Strath Duilleath
Allt na Criche
Lochan Doire Gairbhe
878
Carnach
Fords
Sgurr na h-Eige
Lochan Droma
Allt Coire Beithe
Allt a' Ghrianain
Waterfalls
2156
Loch Sgurr na h-Eige
Coir' Ard
Beinn Fhionnlaidh
3294
Allt Coire an Lochain
Bealach na h-Eige
Coire Lochan
Creag na h-Eige
3006
Coire Buidhe
Allt a' Choire Dhomhain
Tom a'Choire
3644
Coire Mhic Fhearchair
Loch a' Choire Dhomhain
Meall Scouman
1781
Loch Lòn Mhurchaidh
Creag Ghlas
1668
Allt a' Ghlomaich
Falls of Glomach
Allt Coire Mhalagain
Allt Coire Ba Bàn
Allt an Fhraoich Choire
Glean Sithidh
Amhainn Sithidh
3188
Stuc Bheag
Loch an Fhraoich-choire
Meall Dubh
Allt Coire Ghaorsaic
Coire Lochan
Loch Thuill Easaich
Allt Thuill Easaich
Loch a' Chleirich
Glean Gaorsaic
Loch Gaorsaic
Sgurr nan Ceathreamhnan
3771
An Gorm-lochan
Loch Coire nan Dearcag
Coire Ghaidheil
Coire na Cloiche
Coire Allt an Tuirc
Lochan Coire Ghaidheil
An Sornach
Allt Coire Ghaidheil
Allt Beithe Mhóir
Allt na Criche
Allt Coire Lungard
Sgurr Gaorsaic
Bealach an Sgairne
Loch a' Bhealaich
Meall a' Bhealaich
NTS
Beinn an t-Socaich
Alltbeithe
Allt Gleann Gniomhaidh
Carn Glas Iochdarach
2530
Carn Eige
3880
Mam Sodhail
3862
Loch Uaine
Cairn
3508
Coire Leacharoo
Allt Coire Leacharoo
Aonach Mór
An Tudair
Coire Coulavie
Allt Coulavie
An Tudair Beag
3462
Coire nan Each
Creag a' Chaoruinn
Spùtan Bàn
Jetty
L. Coulavie
L. na Camais
Cnoc Fada
Allt a' Chaorainn
Allt Coire Leacharoo
Loch Lapaich
3401
Amhuinn Gleann Lapaich
Allt Coire Ba Bàn
Allt Coire a' Bhalaich
Allt Coire Mhalagain
Allt Coire Ghaorsaic
Allt Thuill Easaich
Allt Coire Ghaidheil
Allt Coire Ghlas Eilt
Allt Coire Mhic Fhearchair
Allt Coire Lungard
Allt Coire a' Mhaim
Allt Coire Leacharoo

Fhuar-thuill
Creag Ghorm a'Bhealaich 3378
Gobhar
3554
Sgurr a-Choire Ghlais
Sgùrr na Ruaidhe 3254
Beinn a' Bha'ach Ard 2822
Loch Toll a'Mhuic
Allt Toll Seasile
Coire Mhuillidh
Corry Deanie
Carn 2410 Bàn
Loch na Beiste
2915 ùrr na Muice
2478 Meall a'Gheur-fheadain
Garbh-chàrr 2801
Allt Toll a'Mhuic
an Daimh Bhain
Carn an Lt-Snàth
Culligran
Dunmaglass
Allt Coire Mhuillidh
An Sithean
Deanie Lodge
Cave
Culligran Falls
Creag a' Bhruic
Gulligran Wood
River Farrar
Strathfarrar
Allt Lechd Fhoidhe
1734 An Càrnais
Coille an Ath
Broulin Lodge
Coille Garbh-leac
Loch Beannacharan
Coille Gharbh
Loch an Airidh Fhraoich
Inchvuilt
River Farrar
Cambussorray
Ardchuilk
Loch a' Mhuilltidh
Coille na Leitire Duibhe
Allt Toll na Lurach
Inchvuilt Wood
Meall 2239 a'Mhadaidh
Loch na Meine
Càrn Mòralg
Struy Forest
1782
Crelevan
2168 Càrn a'Mhuilt
Loch Meall a'Mhadaidh
Allt Coire nam Brèbhain
Sgòr na Diollaid 2676
Sgòr na Ruadhraich
Inchvilly
Carnoch
KILMORACK
2331
2535
2276 Meallan Odhar
Loch Càrn na Toiteil
Càrn Gorm 2218
Coire na Feithe Seilich
Loch Coir'an Uillt Ghlubhais
Càrn Cùl-sgòr
Carnoch Wood
Easter Crochail
An Soutar
Càrn na Toiteil 1661
Toll Odhar Mòr
2218
Allt Chorralaidh
Glassburn
Mid Crochail
Craskie
Loch Craskie
Muchrachd
River Cannich
Wester Crochail
Loch Cartie
Balmore
Coire Eoghanna
Lochan a'Mhill Dhuibh
1236
Càrn Dubh-ghlaic
Lochan na Craoibhe-fearna
Liatrie
Runivroid
Invercannich
Kerrowwood
Allt Coire Eoghainn
Eas Maol Mhairi
Eas an Fhlithich
Lochan Dubh
Cozac 686 Lodge
Loch Sealbhanach
Beinn a' Chlaidheimh 2120
Coire Dubh
Hotel
Cannich
Millness
FASNAKYLE FOREST
Creag na h-Ialaire
Càrn Loch na Gabhlaig 2342
Loch na Gobhlaig
Comar
Comar Wood
Kerrow Ho
Clachan Comair
Upperton
Loch Ruthnachain
Grange
Chambered Cairn
Corrimony
Corrimony Ho
Inchnacardoch Stone
Aultmullach
Allt an Loin Ghiubhais
Allt Coire Beithe
Allt an Ruighe Dhuibh
Allt an Com-allt
Allt Innis an Roilleachain
River Glass
Balnahaun
Balnahaun Wood
Carn Bingally
Allt Feith Bhlarbhachain
Allt a'Chorrie
Corrimony Falls
Coille na Ceardaich
Affric Forest
Creag Liath
Fasnakyle
Dog Fall
Badger Fall
Meallan na Ceardaich 1845
Meall Mór 2276
River Affric
Coire Loch
Loch Carn Bingally
Lochan Marbh
1214 Meall a'Choire
Loch Comhnard
Tomich
Loch Gaoireach
Allt Glac na Dromme
River Enrick
Knockfin
Loch nam Freumh
Druim na h-Aimhne
Cairn 1896 Suidhe Ghuirmain
Loch Innis Gheanhraidh
Càrn Fiaclach
Coille Ruigh na Cuileige
Loch an Amair
Kaoloy Wood
Balcladaich
Loch na Beinne Móire
Loch na Greidil
Allt Dubhaig
Abhainn Dhubhaig
Beinn Mhór Mon 1318
Loch nan Each
Amhainn na Ruighe Duibhe
Loch na Gabhlach
Loch Càrn na Glas-leitire
Guisachan Ho
Tòrr na Muic
Loch na Beinne Bige
1960
BALMACARA
Guisachan Fall
Beinn nan Sparra 1462
Hilton Catt
Loch a'Mhuilinn
Càrn Loch a'Mhuilinn
LOCH BEINN A' MHEADHOIN
Ford
Càrn na h-Earbaige Bige 1320
1754 Sliabh an Ruighe Dhuibh
2007
Càrn na Ruighe Duibhe
Fiodha Falls
Loch nam Fiodhag
Allt nam Fiodhag
Loch an Eang
Coille an Leth-uillt
Coille an Tuathanaich
Lochan na Craoibhe
Loch na Ruighe Dubhe
Loch a'Chaidhnimh
Coille na h-Ulaidh
Loch a'Mhuilinn
Loch na Leitrisdeh
Coille Mhór
Eas Socach
1802
Meall an Daimh 1580
Meall nan Oighreagan
Càrn Tarsuinn 2010
Loch na h-Eirbh
Garve Br
1919
2226
Meall a'Chrathaich
Càrn Dubh na Burrich
Loch ma Stac 2061
Drochaid na Luib
Leitir Beithe
Allt Coir a'Chuirn
Càrn Loch a'Bhothain
Loch a'Chràthaich
Lochan an Ruighe Dhuibh
Càrn a'Mheallain Odhar
1761 Meall nan Aighean
GUISACHAN FOREST
1887 Cloch-bheinn
Loch na Leitir-beithe
1876 Loch nan Eun

Creag a'Chaobh
Càrn an Daimh Bhàin 2043
Allt Coire na Feàrna
Allt Toll a'Mhuic
Sealg
2478 Meall a'Gheur-fheadain
Garbh-chàrr 2801
Càrn an t-Sàbh
Monar Lodge
2272 Beinn na Muice
Creag an Fhir-eòin
Meall an Tàirbh 1125
Allt Lèabaidh Rodhaig
An Sithean
Allt Coire Mhuillidh
Deanie Lodge
Cave
399
371
274
1935
1926
Beinn Dubh an Iarainn
Garbh-uisge
Meall Innis an Loichel
Broulin Lodge
Inchvuilt
470
Coille Garbh-leac
1734 An Càrnais
Strathfarrar
River Farrar
Coille an Ath
Loch Beannacharan
1051
Loch an Airidh Fhraoich
Coille Gha
471
431
Cambussarray
Ardchuilk
468
Loch a' Mhuillidh
Coille na Leitire Duibhe
Uisge Misgeach
Allt Garbh-uisge
Càrn Mòr
Gleann Beag
Inchvuilt Wood
Allt Innis a'Mhuith
Allt na Feàrna Baine
Allt Innis na Lorgain
1782
Meall a'Mhadaidh 2239
2168 Càrn a'Mhuilt
2032
Loch Meall a'Mhadaidh
Allt Coire nan Brathan
Càrn nam Fiaclan
Sgòr na Diollaid 2676
Sgòr na Ruadhraich
K I L M O R A C K
2331
2535
2276 Meallan Odhar
Loch Càrn na Tòiteil
Càrn Gorm 2218
Loch Coir'an Uillt Ghiubhais
Càrn Cùl-sgòr
Coire na Fèithe Seilich
3102
Creag Dhubh
Toll Odhar Mòr
An Soutar 2218
Càrn-na-Toiteil 1661
Càrn nan Gobhar 3251
2675
Allt Chaorainn
Liatrie Burn
Croskie
Loch Croskie
2824
G L E N C A N N I C H F O R E S T
Muchrachd
River Cannich
502
616
Mullach Torsuinn
Glas Toll
Coire an t-Sith
Coire Loch Càrnie
Coire Eòghainn
1236
Mullach na Maoile 2482
Creag Feusog
638
Lochan a'Mhill Dhuibh
Càrn Dubh-ghlaic
481
Liatrie
665
Runivaroid
Allt Coire Eòghainn
Eas Maol Mhairi
Eas an Fhilthich
Allt Taise
Allt Mullardoch
Cozac
686 Lodge
Waterfall
Loch Sealbhanach
Loch a' Bhàird
Beinn 2120 a'Chàirein
Coire Dubh
Lochan na Guidhe
534
Hotel
Cannich
214
234
Comar
Comar Wood
Glass
Creag na h-Iolaire
Càrn Loch na Gabhlaig 2342
Loch na Gobhlaig
Allt an Leòib Ghiubhais
Allt Coire Beithe
Allt Fraoch-choire
Creag Dhubh
Creag a' Bhàca
Balnahaun
Creag Liath 823
Fasnakyle
Affric Forest
Dog Fall
Badger Fall
River Affric
Balnahaun Wood
Càrn Bingally
Allt Toll Easa
Doire Tana
2884
2927
3455 Toll Creagach
Coire an t-Sneachda
Meall Mòr 2276
Meallan na Ceardaich 1845
Allt an Eòrna Dhuibh
Coire Loch
Tomich
Knockfin
387
1496
Loch Gaoireach
Loch nam Freumh
1262
Druim na h-Aimhne
Allt na h-Imrich
Coille Ruigh na Cuileige
Beinn Eun
Càrn Fiaclach
Loch an Amair
Kaaloy Wood
Balcladaich
Loch na Beinne Mòire
Loch na Greidil
Beinn Mhòr 1318
Loch nan Euch
Amhainn na Ruighe Duibhe
Beinn 2004 a'Mheadhoin
Loch na Gabhlach
Loch Càrn na Glas-leitire
Tòrr na Muic
Guisachan Ho
Loch na Beinne Bige
Guisachan Fall
2136 Am Meallan
794
Beinn nan Sparra 1462
Hilton Cott
LOCH BEINN A' MHEADHOIN
Ford
Càrn na h-Earbaige Bige 1320
1754 Sliabh an Ruighe Dhuibh
Plodda Falls
Loch nam Fiodhag
Coille an Tuathanaich
Loch an Eang
Loch a' Chaoidemh
Coille an Leth-uillt
Coille na h-Ulaidh
Lochan na Craoibhe
Affric Lodge
Pollan Buidhe
Loch Pollain Buidhe
Coille Mhòr
Meall an Daimh 1580
Loch nan Sean-each
Loch na h-Eiridh
Eas Soaich
1802
Garve Br
Loch na Caillich
Allt an Lasgair
Drochaid na Luib
1769 Creag Dhubh
Leitir Beithe
Càrn Dubh na Burrich
Loch ma Stac
206
Cougie
Doire Damh
Creag nan Calman 2167
Feith na Leitreach
Allt Coire Chuirn
1887 Cloch-bheinn
1876
Loch nan Eun
G U I S A C H A N F O R E S T
Loch na Leitir-beithe
R O C H
Glen Cannich
Affric
Glen
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
W Long 5°
55′
50′
45′