Chapter 2:

Main study site and the Hill Sheep and Native Woodland project

2.0 SUMMARY

The main study site comprises two upland valleys of a large farm in the west-central Highlands of Scotland, Kirkton Glen and Auchtertyre Glen. The climate is cool and wet in winter and mild and damp in summer. Both valleys have been grazed moderately intensively by sheep for at least 100 years. The vegetation in both valleys is similar; predominantly upland acid grassland dominated by Nardus stricta*, though other grassland and mire communities occur.*

The thesis utilises a systems scale study known as the Hill Sheep and Native Woodland (HSNW) project. The HSNW project aims to integrate upland sheep husbandry and native woodland establishment. In Kirkton Glen, a large area was fenced to exclude sheep and planted with trees in 1999. Ewes have been off-wintered from the remainder of Kirkton Glen (i.e. removed during October – February) since autumn 1999. In Auchtertyre Glen, year-round grazing has continued.

2.1 MAIN STUDY SITE

2.1.1 Introduction

The main study site was at Kirkton and Auchtertyre Farm (Ordnance Survey grid reference NN 360 283), Strathfillan, at the Western end of the Breadalbane Mountains (Holland, 2001). The farm is a working research resource, managed by the Scottish Agricultural College's Hill and Mountain Research Centre. Production centres on lambs, offspring of the 2,600 breeding ewes (mainly Scottish Blackface) grazed on the farm. The mountainous topography and cool wet climate preclude production of other agricultural products, though there has been a recent diversification into tourism.

2.1.2 Topography, geology and soils

Two large adjacent upland valleys formed the basis of the study area. Kirkton Glen is bounded by Ben Challum (1025 m), the Cam Chreag (859 m) and Ben Chaorach (818 m) (Fig 2.3, Fig 2.4, Fig 2.5). Auchtertyre Glen is bounded by Ben Chaorach and Ben Odhar (901 m). The two catchments are similar in area, aspect and altitude (Table 2.1), though Kirkton Glen is somewhat larger and has a greater altitudinal range.

Table 2.1. Description of catchments.

Name	Gaelic Name	Grid Reference (centre)	Area (ha)	Aspect	Altitudinal Range (m)
Kirkton Glen	Gleann a'Chlachain	NN 372 325	804	South	350 - 1000
Auchtertyre Glen	Chaol Ghlinne	NN 351 313	596	South	250 - 800

The underlying geology is Dalradian mica-schist (British Geological Survey, 1979) with localised outcrops of calcareous rocks. The commonest soil type is the podsol, occuring on valley slopes. Patches of brown earths are present where calcareous rocks outcrop. In the valley bases, peaty podsols and deep peat occur.

2.1.3 Climate

The climate is typical of mountainous areas of western Scotland, with cool, wet winters and mild, damp summers. The average annual rainfall for the area between 1961 and 1990 was 2400 mm (met-office, online www.met-office.gov.uk), with an average of 220 rain days (defined as more than 1 mm precipitation) per year. Average maximum July temperature over the same period was 15 °C, and average minimum January temperature was 2 °C.

Weather data is collected from the Meteorological Office Record Station at SAC Kirkton, 150 m a.s.l. and 3 km south of the main study site. The Hill Sheep and Native Woodland Project was started in winter 1998/99, and data was collected for this thesis until 2001. Weather data are presented for 1996 to 2001 (Table 2.2). In 1999 there was considerably more rainfall than the six year average. 1996 was a very mild winter, and 1998 was a cool summer.

Table 2.2. Weather data from Meteorological Office Record Station, Kirkton. Temperature values are the average of daily minimum and maximum values.

Year	Temperature (°C)		Rainfall (mm)
	Jan min	July max	Total annual
1996	2.3	17.2	1791
1997	-2.2	18.1	2380
1998	0.2	15.5	2652
1999	-0.5	18.4	3101
2000	-0.4	18.5	2683
2001	-2.7	18.2	1964
6 year average	-0.5	17.6	2428

The seasonal weather patterns are marked (Fig 2.1; Fig 2.2) with a steady increase in temperatures from February to July, and a decrease from August to January. Rainfall is variable (Fig 2.2) with greater amounts falling from October to February than from March to September.

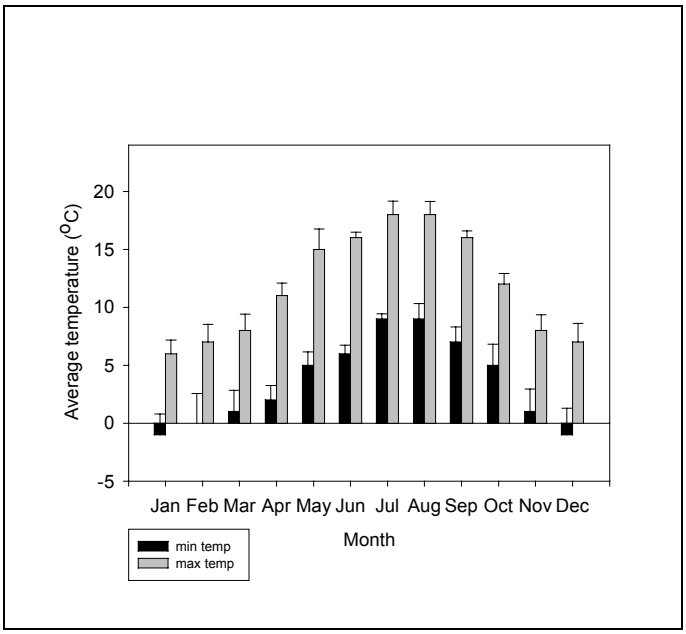

Fig 2.1. Average monthly maximum and minimum temperature. Data recorded at SAC Kirkton 1996-2001; error bars are standard deviation.

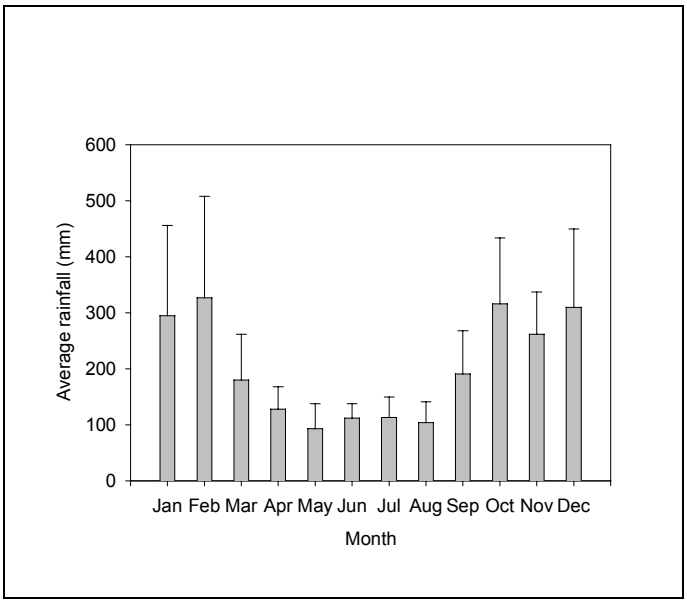

Fig 2.2. Average monthly total rainfall. Data recorded at SAC Kirkton 1996-2001; error bars are standard deviation.

2.1.4 Vegetation

Plant nomenclature follows Stace (1991) except for *Carex viridula* ssp. *oedocarpa* which is referred to as *Carex demissa*. The plant communities in the glens (Table 2.3.) are similar, with both glens largely composed of *Nardus stricta* and *Juncus squarrosus* dominated grassland, calcareous montane grass-heath and wet heath. Although broad altitudinal bands dominated by one community can be delineated (Fig 2.3) the communities are distributed in a complex mosaic (Holland, 2001). On the lower slopes, extensive swathes of U5 (Table 2.3) are broken by areas of U4 grassland and CG11 grassland, and patches of mire (Rodwell, 1991, 1992). The U4 community occurs in small patches where sheep congregate in 'camp-sites' on better drained soils. The CG11 grasslands occur in patches where calcareous rocks outcrop, and in strips below these that are flushed with base-rich water. Calcifuge mire communities (M15, M17) are common in base-free flushes and hollows throughout, and occur in extensive patches in the base of Kirkton Glen. In Auchtertyre Glen the damp valley base is dominated by the M23a community (Table 2.3), though patches of M15 and M17 occur locally. On the upper slopes, at and above 700 m a.s.l. the montane communities U7 and U10 occur. The vegetation structure of the *Nardus stricta* dominated grasslands at the study site is less tussocky than described elsewhere (Armstrong *et al.* 1997). Small tussocks of *Nardus stricta* are closely interwoven with other species: *Agrostis capillaris*, *Festuca ovina*, *Galium saxatile*, *Carex binervis*, *Juncus squarrosus*.

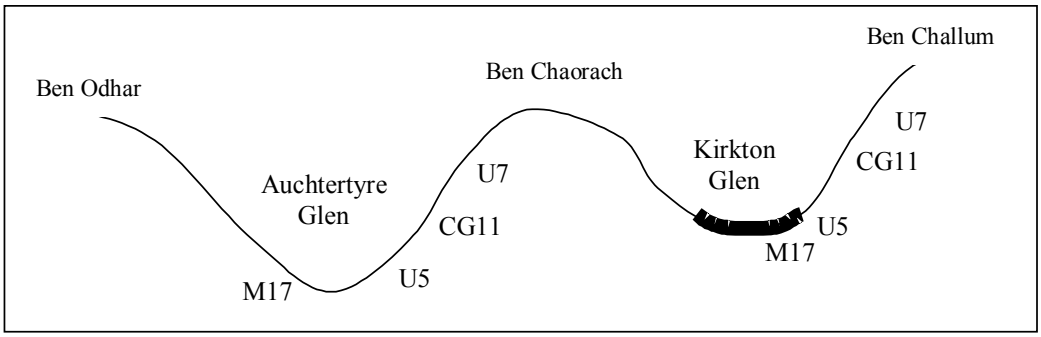

Fig 2.3. Schematic west-east cross-section through Auchtertyre and Kirkton Glens. Area recently planted with woodland (see section 2.2) shown by thick black line. Relative altitudinal positions of four of the main plant communities are indicated.

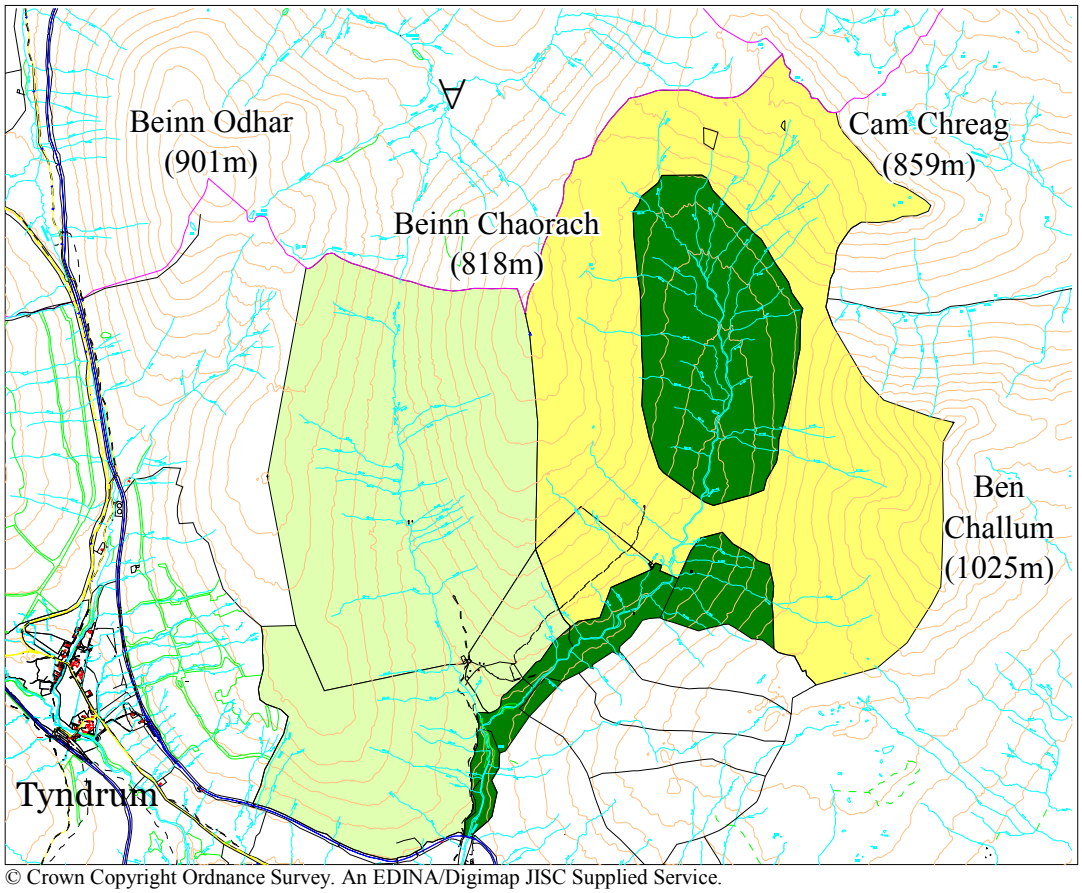

Fig 2.4. Map of main study area. Auchtertyre Glen is shown in pale green, Kirkton Glen in yellow, with recently planted woodlands coloured dark green. Contours are at 50 m spacing. GIS Map provided by John Holland.

Fig 2.5. Ben Challum from Cam Chreag. Photo by John Holland.

Table 2.3. Names and distribution of NVC community types (after Rodwell, 1991; 1992) in the two catchments (* present, ** abundant).

NVC Code	Description	Kirkton Glen	Auchtertyre Glen
U4	Upland *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland	*	**
U5	Upland *Nardus stricta-Galium saxatile* grassland	**	**
U6	Upland *Juncus squarrosus-Festuca ovina* grassland	*	**
U7	Upland *Nardus stricta-Carex bigelowii* grass-heath	*	*
U10	Upland *Carex bigelowii-Racomitrium lanuginosum* moss-heath	*	*
CG11	Calcicolous *Festua ovina-Agrostis capillaris-Alchemilla alpina* grass-heath	**	*
M15	*Trichophorum cespitosum-Erica tetralix* wet heath	**	*
M17	*Trichophorum cespitosum-Eriophorum vaginatum* blanket mire	**	*
M23a	*Juncus acutiflorus-Galium palustre* rush-pasture	*	**

2.1.5 Past Management

Historical evidence suggests that the steading of Kirkton, 3 km south of the study area, has been inhabited since at least 700 AD (Daniel, 1981) and probably before. No information is available on the numbers or locations of stock kept on the farm in these times. Some information is however available on the numbers and types of

stock that could be placed on the farm for grazing lets in 1727, before the Highland clearances occurred. At 'Kirktown of Strathfillan', 108 cows, 108 sheep and 20 horses were present throughout the year, with additional summer grazing for 120 cows, 120 sheep and 20 horses (Prof. R. Dodgshon, University of Wales, Aberystwyth, pers. com., citing records from the Breadalbane Estate). The same source stated that at 'Auchtertyre' 90 cows, 90 sheep and 15 horses were present throughout the year. If the livestock unit conversion for today's stock holds (i.e. one cow = 0.15 sheep), then the equivalent of almost 2000 sheep grazed at Kirkton and Auchtertyre in the 1700s. While the animals would have been smaller than today's (Watson, 1932), these figures do indicate that the area was grazed by relatively high numbers of stock before the clearances occurred.

A map of the area dating from the late 1700's (Stobie, 1783) shows areas of woodland to be similar in size and location to the patches of native woodland present today. Since the clearances occurred in the period after 1745, and 30-40 years is insufficient time to deforest a landscape, this offers proof that the deforestation of this area of the highlands occurred considerably before the introduction of Scottish Blackface sheep.

Large-scale sheep farming spread to the West Highlands in the early 1800s, using the Blackface sheep, a much hardier breed than those previously available (Watson, 1932). The Blackface replaced the old sheep breeds and to a large extent also the cattle. Records are available for the period 1869 to 1922, when Kirkton Glen was grazed by around one sheep per ha (Paterson, unpublished diaries). The sheep had access to the hill all year round, but could drift down to lower ground during winter as the hill parks were not fenced as they are now (John Burton, pers. com.). No written records are available for the period 1923 to 1970. Although there may have been a dip in sheep numbers during WWII, local knowledge suggests that during the 1950s and 1960s around 1,100 sheep grazed Kirkton Glen, with around 1000 in Auchtertyre Glen (John Burton, pers. com.). The area has been farmed by the Scottish Agricultural College since 1970, with the hill parks being fenced around this time. In the 1970s and 1980s, there were some increases in sheep numbers, but

between 1990 and 1996 stocking rates in Kirkton Glen only were reduced in an extensification project (Waterhouse, 1996). In Auchtertyre Glen the stocking rates were unchanged over this period.

2.2 THE HILL SHEEP AND NATIVE WOODLAND PROJECT

2.2.1 Introduction

The Hill Sheep and Native Woodland (HSNW) Project aims to:

> "combine sheep production and native woodland establishment on the same block of land and combine the benefits for the farmer, local economy and environment" (Hulbert *et al*. 1999).

A 216 ha woodland was planted in the base of Kirkton Glen (Fig 2.4) in the winter of 1998/9, and fenced to exclude stock. The sheep belonging to Kirkton Glen have been managed under an off-wintering regime since October 1999. In the adjacent Glen, Auchtertyre, sheep are managed under a 'traditional' year-round grazing regime.

This change in management allows the effects of three different management regimes to be compared (Ch 4):

i) continued year-round grazing in Auchtertyre Glen;
ii) change to off-wintering in Kirkton Glen sides;
iii) change to zero grazing in Kirkton Glen base.

At some point in the future when the trees are sufficiently tall and robust to withstand potential grazing damage, carefully controlled seasonal sheep grazing will be commenced inside the woodland.

2.2.2 Sheep Husbandry Systems

Auchtertyre Glen: year-round grazing

In Auchtertyre Glen, sheep husbandry is typical of the current system in place on most hill farms in the West of Scotland (Waterhouse, 1999). Many of the ewes are on the hill throughout the year, with the exception of young stock retained for future breeding, and ewes bearing twin lambs (Fig 2.6). 'Cast' ewes are older animals that are unlikely to survive another pregnancy in the uplands; they are sold to lower ground farms for further breeding. 'Scanning' is taking an ultrasonographic scan to determine the number of lambs carried by a ewe.
The seasonal fluctuation in numbers of sheep per hectare observed in Auchtertyre Glen (Fig 2.8) results from these movements.

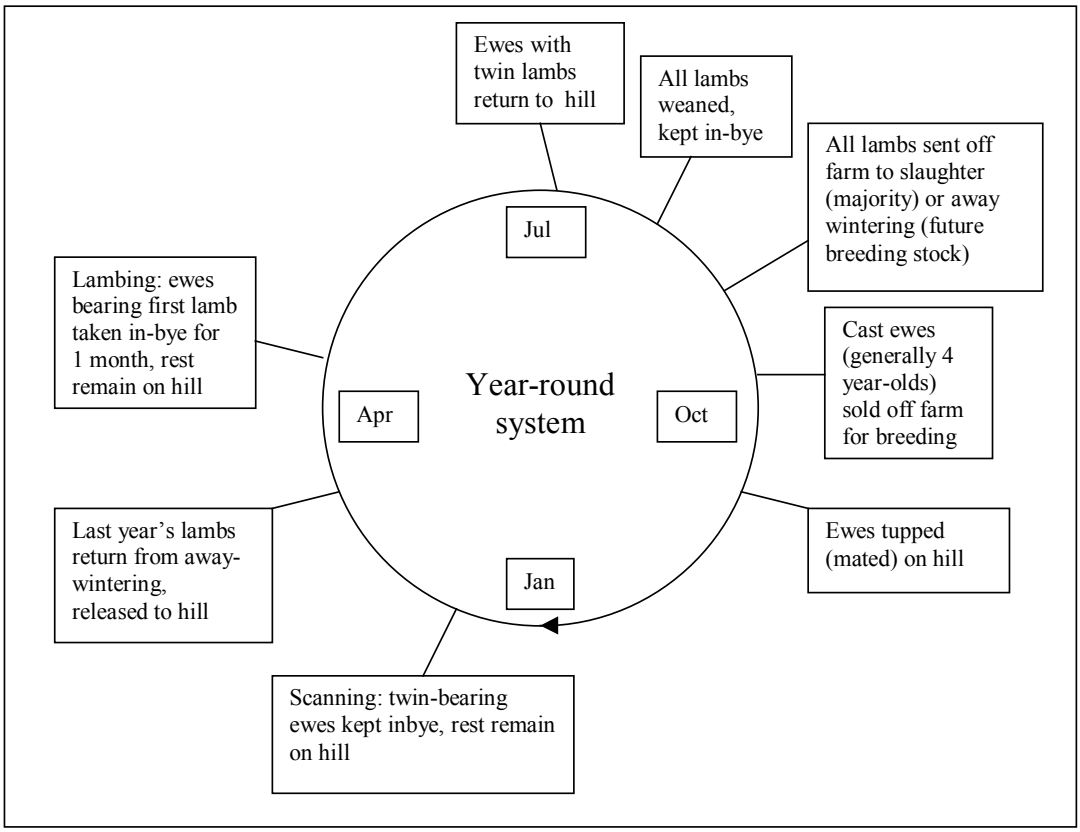

Fig 2.6. Annual cycle of sheep husbandry in 'traditional' year-round grazed system.

Kirkton Glen: off-wintering system

Before 1999, sheep in Kirkton Glen were managed under a similar system to that of Auchtertyre Glen, though at lower densities. Since 1999, sheep have been removed from Kirkton Glen during the winter months (Fig 2.7; Fig 2.8), since they are excluded by the woodland fence from the lower ground where they previously found winter grazing. Some straggler sheep that are not gathered (by accident) in October remain on the hill all winter. As the boundaries of the catchments are not fenced, sheep from Auchtertyre Glen or other adjacent catchments can drift into Kirton Glen. However, as the number of such straying sheep is low, their impact on the vegetation is thought to be negligible.

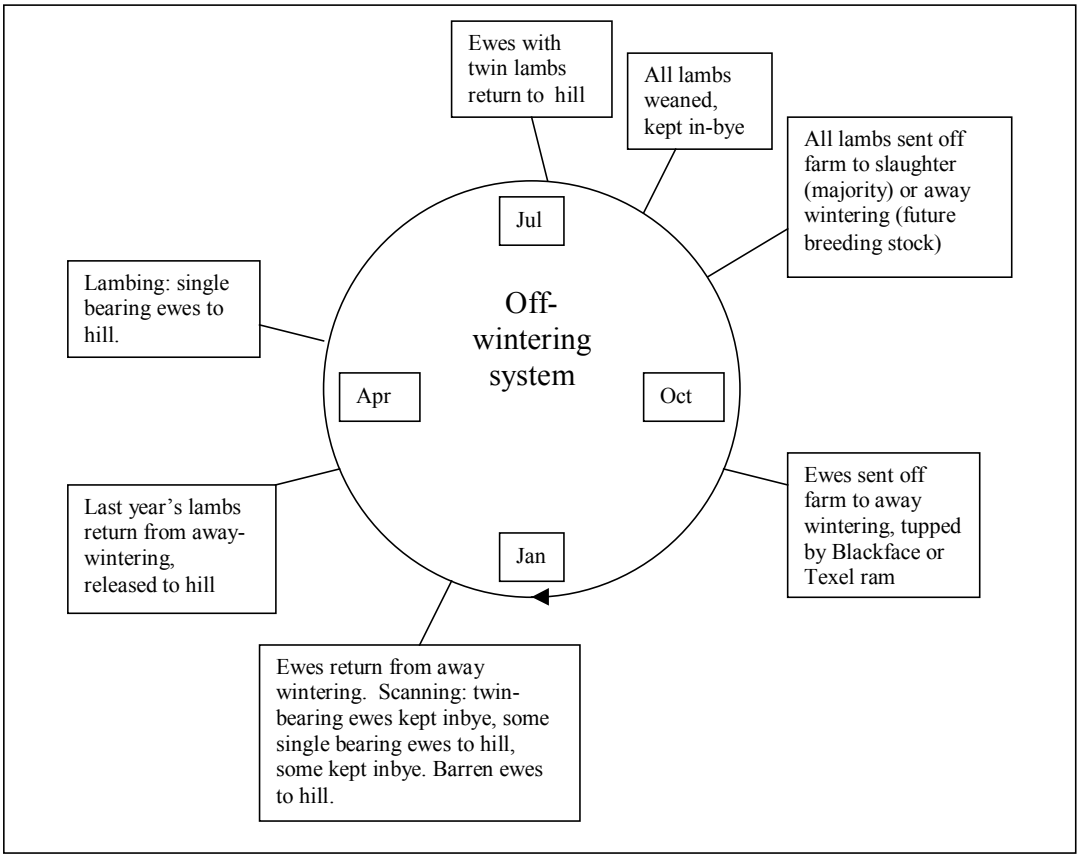

Fig 2.7. Annual cycle of sheep husbandry in off-wintered system.

The ewes are taken to low ground off the farm (typically in Stirlingshire, Ayrshire or Speyside) in October, and are tupped (mated) there in November. In February the ewes are returned home, and scanned ultrasonically to determine the number of lambs carried. Barren ewes are returned to the hill immediately. Those bearing one lamb are retained on hill parks until after lambing (in April/May), and then released onto the hill with their lambs. Ewes bearing twins are kept in-bye (better quality pasture on lower ground on the farm) until July or August, when they are also released onto the hill with their lambs. All weaned lambs are moved off the farm to winter grazing or to market by mid September. Ewe lambs selected as replacement breeding stock return to the farm and are put back on the hill in March. A proportion of the Kirkton Glen ewes are mated to Texel tups (rams). The resulting cross-bred lambs are larger and produce a better quality carcass than the pure-bred Blackface lambs. Due to the better nutritional state of the ewes at tupping time, a greater proportion of twins are conceived than if the ewes were wintered on the hill. The off-wintering system therefore produces a greater quantity of higher quality lamb. While there are greater costs involved with off-wintering the sheep, these are predicted to be offset by the greater income from the sale of lamb (C. Morgan Davies, pers. com.).

Invariably a few stragglers are not gathered from the hill in Autumn. These sheep, and any that drift in from neighbouring hefts, spend the winter on the hill. However, their numbers are small, and they probably do not have any more impact than wild herbivores present during winter.

Wild herbivores

Wild herbivores occur in both glens. Red deer (*Cervus elaphus*) are present in small numbers (J. Wyllie, unpublished data), and occasionally enter the woodland by jumping the fence. Hares (*Lepus timidus*) are present at very low densities. Field voles (*Microtus agrestis*) are also present. Their numbers are not quantified, but they are thought to have increased inside the woodland since the fence was

erected. With the exception of voles which have a localised impact, wild herbivores are not thought to have a significant impact on the vegetation.

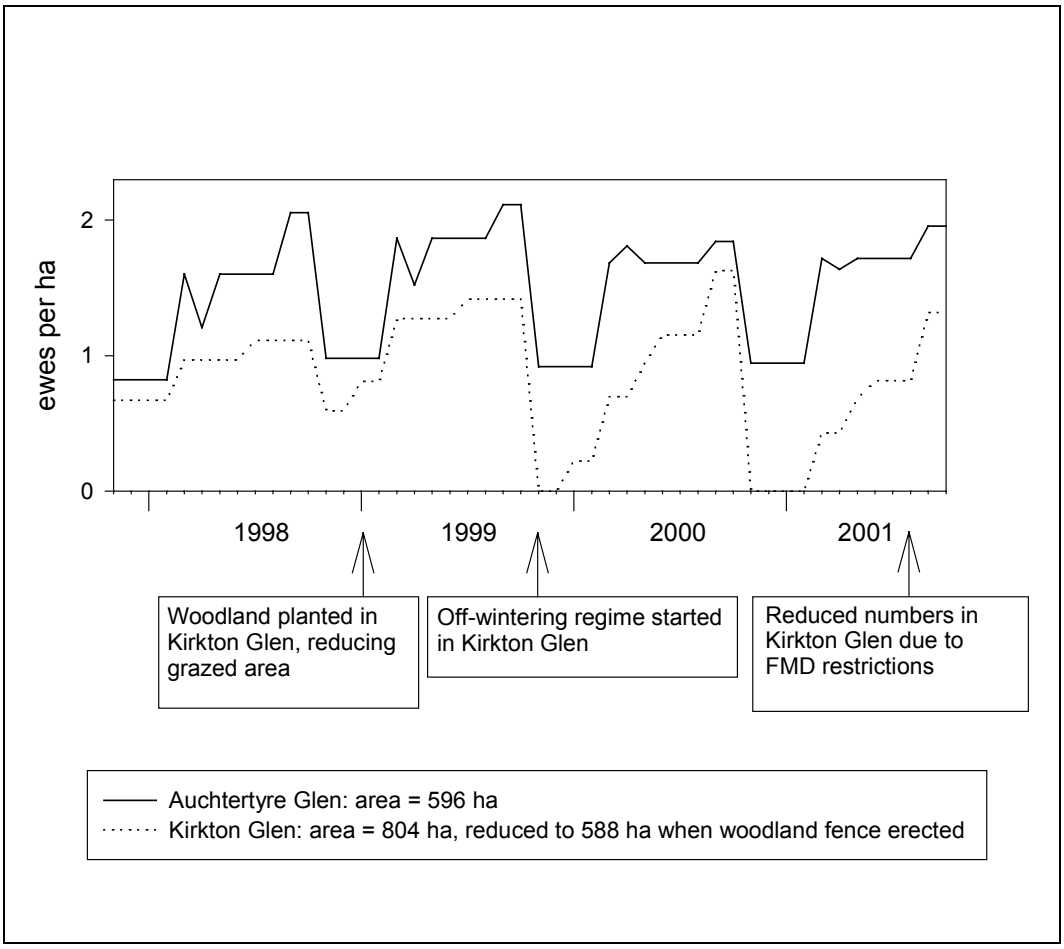

Fig 2.8. Change in sheep grazing management regimes in Auchtertyre and Kirkton Glens. Values are given for November 1997 to August 2001 and are expressed as number of adult (> 1 year old) ewes per grazed ha. The number of grazed ha in Kirkton Glen decrease in January 1999 when the fence around the newly planted woodland was erected. In 2001, some of the ewes did not return from off-wintering as a result of Foot and Mouth Disease livestock movement restrictions.

2.2.3 Woodland

In the winter of 1998/9, 216 ha of native woodland were planted in the base of Kirkton Glen. The majority of the trees planted were downy birch (*Betula pubescens*) with substantial numbers of Scots pine (*Pinus sylvestris*) and some rowan (*Sorbus aucuparia*), willow (*Salix* spp.) and alder (*Alnus glutinosa*).

Establishment of this woodland was grant-aided under the standard Woodland Grant Scheme (Forestry Commission, 2001). This scheme contributes £1050 per ha for the creation of new native woodlands over 10 ha in size, conditional on the woodland 'establishing' within 5 years. In addition, a further 40 ha were planted under the Farm Woodland Premium Scheme, which provides £60 per ha (up to a maximum of 40 ha) for 15 years. Costs from planting the woodland and re-planting trees that have died are estimated at £227,000, while the grant payment will total £263,000. The surplus, £36,000 is income for the farm. The Woodland Grant Scheme was reviewed in 2002 (Forestry Commission, 2002). From June 2003, the Scottish Forestry Grants Scheme will replace the Woodland Grant Scheme. Payments under the new scheme are only a proportion of standard costs, making woodland planting schemes less attractive to farmers.

The majority of trees were planted into mounds created by a machine that cuts a large divot of turt and inverts it on the ground adjacent. This creates a surface of mineral soil and minimises competition between the young tree and the surrounding vegetation. It also created considerable holes, still evident 4 years after the mounding was carried out.

2.2.4 Chapter study sites

The work for Chapter 4 was carried out in the grazing regimes described above: year-round grazed, off-wintered, ungrazed. The cutting experiment (Ch 3) was carried out within the woodland fence, in areas that had been neither mounded nor planted. Snow cover within the woodland during the cutting experiment was from late December 2000 until mid March 2001. The work described in Ch 6 was carried out at other geographical locations than the one described here; short descriptions of each are made in Chapter 6.