Animal &
Grassland Research
& Innovation
Programme

Teagasc

Hill Sheep Conference 2016

Jackson's Hotel, Ballybofey, Co. Donegal
Wednesday, 17th February 2016

teagasc
Agriculture and Food Development Authority

Hill Sheep Conference

Teagasc Hill Sheep Conference 2016 Programme

Venue: Jackson's Hotel, Ballybofey, Co. Donegal

Date: Wednesday, 17th February 2016

Conference Outline

17.00	**Conference Opening** Ben Wilkinson (Chairperson), *Regional Manager, Sligo/Leitrim and Donegal*
17.10 – 17.40	Sustainable Liver Fluke Control on Hill Farms *Dr. Barbara Good, Teagasc, Athenry, Co. Galway.*
17.40 – 18.10	Hill Sheep Sector in County Donegal: Current Profile and Potential. *Seamus Campbell, Teagasc, Carndonagh, Co. Donegal.*
18.10 – 18.40	Importance of Managing Upland Habitats on Hill Farms *Dr. Eileen McCloskey, CAFRE, Northern Ireland.*
18:40 – 19:10	Budgets and Targets for Finishing Hill Lambs. *Professor Michael Diskin, Teagasc, Athenry, Co. Galway*
19:10 – 19:20	**Close Conference** *Michael Gottstein, Teagasc, Macroom, Co. Cork.*
19:30	Refreshments

Organising Committee:
Philip Creighton, Michael Diskin, Frank Hynes, Michael Gottstein & Ciaran Lynch

Foreword

The Irish Hill Sheep sector plays an important role in the economic health of rural economies and the maintenance of the natural landscape in many of Ireland's most scenic areas. However, low margins coupled with reduced support payments and often depressed markets for store hill lambs has seen the sector decline over the last two decades. Notwithstanding this, the Scottish Blackface hill ewe is very hardy and resilient breed and is hugely responsive to improved nutrition. The hill ewe has a significant untapped potential both in the hill environment and as the dam of prolific cross bred ewes for the lowlands. This Teagasc Hill Sheep Conference focusses on liver fluke control, maximising the potential of the hill sheep industry in Donegal, managing upland habitats and options for finishing hill lambs. Notwithstanding the physical and land quality issues that operate in the hill areas, it is clear from the results emerging from the BETTER Farm Hill sheep programme that significant improvements in productivity and profitability are possible from relatively small changes in the main drivers of productivity. The results emerging from on-going studies with finishing of hill lambs in Athenry provides a clear roadmap for increasing the value of the hill lamb.

I welcome the increase focus of this year's Teagasc Sheep Conference on Take Home Messages. Its only when knowledge is applied at farm level will you see the benefits in terms of efficiency, productivity and ultimately profitability.

Teagasc is strongly committed to its sheep research and advisory programmes. The expanded BETTER Sheep Farm Programme, the commencement of new studies on genomic selection, in conjunction with Sheep Ireland, mineral nutrition, meat quality is relevant to hill land lowlands sheep producers. Teagasc is also committed to recruit further Hill Sheep BETTER farms. The increased collaboration between Teagasc, UCD, Department of Agriculture, Food and the Marine and Sheep Ireland as well as overseas collaborators will be of further benefit the sheep industry.

I would like to express my gratitude to all of the speakers who contributed both oral and written presentations and to you the attendance. This booklet collates and summarises a significant body of knowledge on technical issues in sheep production and should prove an invaluable reference to hill sheep producers. I would like to thank all the Teagasc Staff who assisted with the organisation of this Hill Sheep Conference and to especially thank the organising committee without whose efforts we would not be here today – they are; Michael Diskin, Frank Hynes, Phil Creighton, Ciaran Lynch and Michael Gottstein along with Ben Wilkinson and his colleagues in the Sligo/Leitrim/Donegal Advisory Region.

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Sustainable Liver Fluke Control in Hill Flocks

Barbara Good
Teagasc, Mellow Campus, Athenry, Co. Galway.

Take Home Messages

- Sustainable liver fluke control demands a clear understanding of the life cycle and how to optimise fluke treatment with the right product at the right time. Liver fluke have a complex life cycle and is dependent on 2 hosts, the ruminant and the snail. Temperature and moisture levels have a major impact in determining the successful completion of the life cycle. Peak fluke challenge on pasture will be in late August to October.
- Liver fluke can be diagnosed based on clinical signs, examination of faeces for fluke eggs and at post mortem
- Currently, there are six chemical 'actives' available to treat fluke in sheep (namely albendazole, closantel, nitroxynil, oxycloznide, rafoxanide, and triclabendazole) but not all flukicides are equal in terms of efficacy against the different stages of fluke. Triclabendazole should be reserved for when there is a high risk of immature stages.
- The effectiveness of flukicides should be monitored.
- Consult your veterinary practitioner for treatment specific to your farm

Introduction

Throughout much of Ireland, sheep are at risk of fasciolosis, caused by the leaf-like parasite *Fasciola hepatica* (liver fluke). In recent years, there has been anecdotal evidence to suggest that liver fluke has spread to non-fluke endemic regions and atypically observations of fluke infection in lambs earlier in the season. This may be a consequence of a number of factors associated with climate change including milder warmer weather and changing rainfall patterns plus the inadvertent introduction of infected sheep to these regions. The hill flock enterprise represents a different challenge/ opportunity in terms of fluke control compared to lowland flock enterprises given that the majority ewes are outwintered coupled with much fewer opportunities to treat as the flocks are grazed on the hill. Given the demands of this very pathogenic parasite, the delivery of sustainable liver fluke control measures warrants a clear understanding of the life cycle and how to optimise the timing of fluke treatment with the appropriate product.

Parasite

Fasciola hepatica (liver fluke) infects the liver in both cattle and sheep. The mature fluke reside in the bile duct from where they shed eggs which are subsequently shed in the animal's faeces. Once conditions are wet and warm (above 10 °C) (typical of an Irish summer) the eggs will develop (usually takes two to four weeks) and hatch releasing a larval stage called a miracidium. To be successful, the miracidum needs to penetrate the foot of the mud snail; *Galba* (*Lymnaea*) *truncatulata* within a few hours. In the mudsnail, further development and multiplication occurs to form many cercariae which subsequently leave the mud snail to encyst as metacercariae on the herbage. Metacercariae are highly resilient and can remain viable on the pasture for

several months, particularly in cool, damp conditions and have been shown to survive freezing and thawing conditions. Once ingested by the sheep, the metacercariae hatch in the gut and penetrate the intestinal wall and migrate to and through the liver becoming more mature as they makes their way to their final destination the bile ducts. This migration may take 8 to 12 weeks and, as mature adults, are capable of living for years producing many eggs which are released with the bile into the small intestine where they are excreted in faeces onto the pasture.

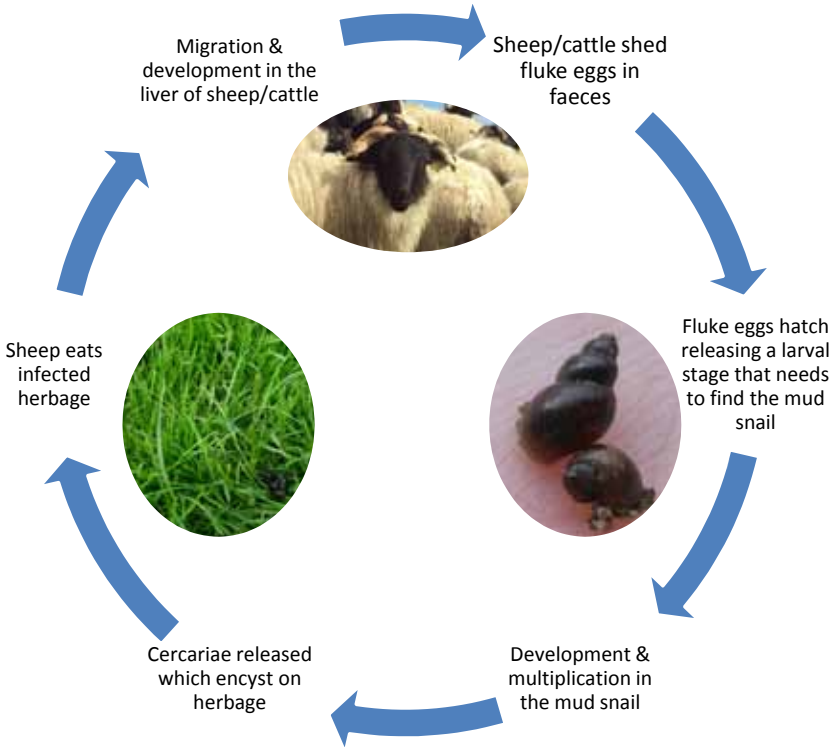

Figure 1. Summary of liver fluke infection life cycle

Presentation of the disease in sheep

There are three clinical manifestations of disease; acute, sub-acute and chronic which are largely reflective of the level of challenge the sheep ingests. Sheep never develop immunity to liver fluke. The late spring early/summer infection of the snails with miracidiae will result in a build-up of challenge on the pasture in the autumn (late August / September). Depending on the level of challenge, acute disease, and sub-acute disease may occur over the following weeks, or chronic disease a few months later.

Acute fasciolosis

Acute fasciolosis (fluke disease) is caused by the migration of large number do young or immature fluke resulting in severely damaged liver. Often this disease is only noticed with the onset of sudden deaths caused by haemorrhage and liver damage in a previously healthy flock between August and October. Inspection of the rest of the flock will reveal inappetance (poor appetite) , lethargy / weakness and reluctance to being herded. At post mortem the body cavity will be full of blood stained fluid, while the liver is enlarged, soft and very easily broken.

Sub-acute fasciolosis

Sub-acute fasciolosis presents as rapid weight loss, anaemia (pale mucous membranes observed in lower eyelid), bottle jaw and ascites (fluid build-up) in some cases. Some sheep in the flock will present as being severely depressed, not eating and weak. This typically occurs between October

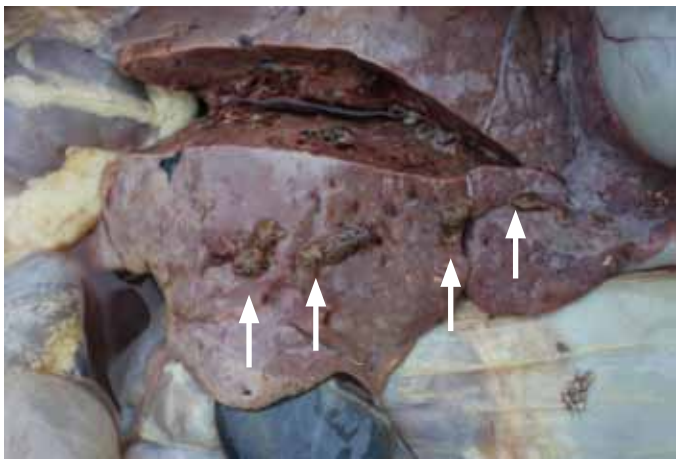

Figure 2. *Photograph showing the liver of a sheep which died from acute fluke. Arrows point to fluke found in the liver tissue. (Courtesy of Colm O'Muireagáin, Sligo Veterinary Laboratory, DAFM)*

and January. At *post mortem* a mixture of both immature and mature fluke will be observed. Faecal egg count will generally be less than 100 eggs per gram of faeces.

Chronic fasciolosis

Chronic disease is probably the most common form of disease observed with symptoms ranging from more severe anaemia, weight loss and swelling from fluid manifested as bottle jaw, poor fleece quality (brittle, easily pulls away) to subclinical signs where a gradual loss of body condition is observed. Sheep can die in an emaciated state especially when the disease is being compounded with an extra metabolic demand associated with pregnancy /lactation. Disease can be confirmed by the examination of faecal samples for the presence of fluke eggs. Post-mortem will reveal grossly thickened bile ducts with the liver substance being more hard / leathery in appearance plus the presence of adult fluke in the bile ducts and gall bladder.

Epidemiology (Development of the disease)

In Ireland the summer infection of snails as described above accounts for the majority of liver fluke infection on the farm. To a lesser extent infection can arise on pasture as a result of infection that overwintered in the snail population. In affecting snail abundance, weather clearly affects the success of the life cycle. A wet summer plus temperature above 10 ^{0}C will provide ideal conditions for snails to multiply. So with more intermediate hosts to cycle the infection, there is the potential to have a greater fluke burden on the pasture. Moreove,r a mild winter will result in favourable conditions for the overwinter survival of the snail while a hot dry summer will impede its development / reproductive success which will result in fewer metacercariae on the pasture in the autumn. The Department of Agriculture Food and the Marine (DAFM) releases a fluke forecast every autumn which predicts the level of fluke risk around the country based on results collated by Met Éireann of the Ollerenshaw index.

Snails feed on algae and for many years in Ireland we only associated the mud snail *Galba (Lymnaea) truncatula* as the intermediate host for liver fluke. Results from our studies in the hill research farm at Leenane highlighted the potential for other snail species such as Radix spp to maintain parasite development in the peaty acidic environment of the hill (Relf et al 2009). *Galba. truncatula* favours a non-acidic temporary aquatic environment and is found for example on the surface of mud e.g. muddy banks, poached areas surrounding water troughs wheel ruts and areas where temporary flooding may occur. In contrast, Radix spp were found in a slightly acidic permanent aquatic environment in slow moving bodies of water under floating vegetation.

Treatment of sheep and control options

Given that the snail plays an integral role in the life cycle of liver fluke, a number of recommendations aimed at reducing snail numbers or depleting their habitat have been advocated as part of integrated fluke control strategies on farm. These include drainage and restricting access of livestock to high risk wet areas. From our studies on the hill farm in Leenane, the evidence would suggest that exposure to fluke was greatest on the greenland (reclaimed pasture) compared to the hill. So ewes managed on greenland / low lying areas used for joining with rams and lambing will be vulnerable to picking up fluke. Treatment can diminish the clinical and economic cost of infection and used strategically can also be used to suppress the faecal egg output of the ruminant host at critical times of the year e.g. spring / early summer which limits infection of the intermediate snail host and reduces subsequent infection on pasture with metacercariae.

There are six chemical 'actives' available to treat fluke in sheep (namely albendazole, closantel, nitroxynil, oxycloznide, rafoxanide, and triclabendazole). These are the names to remember as many of the actives are sold under different trade names and not all flukicides are equal in terms of efficacy against the different stages of fluke (see Table 1 below). It is important that any decision on treatment is based on the active ingredient and degree of risk. Meat and offal withdrawal periods vary from 4 to 77 days depending on the product. No flukicide has residual protective activity, so if sheep are treated and return to the same ground there is the risk of reinfection and development of clinical disease. Post treatment it is preferable to move animals to low risk grazing and for some this may mean housing or returning to the hill post mating. Without this option re-infection will occur and further treatments may be necessary.Triclabendazole is currently the only 'active' that works against early immature (as early as 2 days of age) through to the mature fluke stages and so a flukicide with this active (if resistance isn't an issue) is preferable as the first treatment in the autumn and possibly early winter depending on the fluke risk for that year. Closantel, Rafoxanide and Nitoxynil are effective against mature liver fluke and depending on the product brand name have variable claims of working against immature fluke stages. Closantel, for example, is affective against immature F. hepatica aged 6 weeks and older but not against younger immature fluke. If it is used as an alternative to Triclabendazole then two treatments are required at an interval of 10-12 weeks but in years where the risk of challenge is high it is advisable to retreat after 6 weeks. Likewise, if Nitroxynil is used as an alternative to Triclabendazole then two treatments are required with a minimum interval of 7 weeks between them. Oxyclozanide and Albendazole are only effective against mature liver fluke and these would be suitable where the fluke population is predominantly at a mature stage in sheep and there is little risk of challenge e.g post housing or early summer to supress the faecal egg output of the sheep on pasture. It is advised that Albendazole is not administered to 'ewes at the fluke and worm dose rate (7.5 mg/kg) during tupping or for 1 month after removing rams'.

Flukicide resistance

As observed in sheep gut roundworm populations, the development of anthelmintic resistance in fluke populations has been reported (Mooney el al 2009). Given it broader efficacious ability against young immature and adult flukes, Triclabendazole, has been a popular drug of choice in fluke control and so it may not be surprising that resistance should appear in this group first. As such, knowledge of the resistance status of fluke population to triclabendazole pertaining to your farm is important.

Table 1. Flukicide efficacy in sheep

Flukicide Active component	Brand Names†	Meat Withdrawal period(days)	Age of flukes (weeks)											
			Early Immature‡				Immature					Mature		
			1	2	3	4	5	6	7	8	9	10	11	12+
Triclabendazole	Cydectin Triclamox, Endex, **Endofluke, Fasifree,** Fasimec duo, **Fasinex, Tribex, Triclaben**	27 - 56		90-99%				99-99.9%				99-99.9%		
Closantel*	Closamectin, Closiver, Combifluke, Duotech, **Flukiver,** Flukiver Combi, Parefend, Supaverm	28 - 77			23-73%		91-95%					97-100%		
Nitroxynil	**Trodax**	60							50-90%			91-99%		
Rafoxanide	**Chan Broad Spec, Curafluke, Fenafluke, Levafluke, Orafluke, Rafazole, Ranide, Ridafluke, Triazole, Univet Mulitdose Fluke**	54 - 60							50-90%			91-99%		
Oxyclozanide	Levafas C, LevafasDiamond, Pharmazan, **Zanil**	6 -28										50-70%		80 - 99%
Albendazole	Albex, Endospec, Keelogane, Osmonds, Flexiben, Tramizole, Valbazen	4										50-70%		80 - 99%

This table is adapted from Fairweather & Boray Chapter 7 in Fasciolosis Ed Dalton J., 1999, and CPD seminar by Prof Mike Taylor (2009) on Liver Fluke Control Newbridge,Co. Kildare sponsored by Janssen Animal Health. Brand names and withdrawal periods sourced from Health Products Regulatory Authority http://www.hpra.ie DOI Sept 2015).

† Brand names which are not highlighted contain an active ingredient efficacious against anthelmintic susceptible gut roundworms also.

‡ Location of fluke stages in the liver: early immature are found in the liver tissue (parenchyma), immature fluke are transitioning from parenchymal tissue to the bile ducts and mature fluke are found in the bile ducts

*Closantel: Increased efficacy shown is achieved at the higher dose rate (10mg/kg) which is the rate recommended if using the oral formulation

Table 2.	Faecal egg count reduction test as an indication of Triclabendazole resistance/susceptibility on sheep farms
	Faecal egg count reduction test method
1	Assemble the adult flock and remove 24 sheep at random to be tested. Split into 2 groups of 12 per pen. Differentiate the 2 groups by marking the groups with a different colour marker spray.
2	Allow to remain undisturbed for at least a couple of hours to allow time to defecate.
3	Collect ten individual fresh faecal samples from each pen. Place each sample in separate containers and label which pen of sheep the sample came from (e.g. orange group / purple group).
4	Dose sheep with triclabendazole in accordance with manufacturer's recommendations.
5	Submit samples to an approved laboratory within 24 h of collection.
6	At 21 days later, reassemble the same sheep and pen according to their original groups. Repeat the faecal sampling process as described above and again submit these individual samples clearly marked with their group identification (e.g. orange group / purple group to the same laboratory).

A summary of this validated protocol (Daniel et al 2012) which is based on determining faecal egg counts from composite faecal samples taken pre and post drenching following a 21 day interval is summarised in Table 2. This test should be carried out in conjunction with your veterinary practitioner. In keeping with recommended practices of delaying the development of resistance, triclabendazole administration should now be reserved for use early in the fluke season when there is risk of acute disease in response to migration of large number of immature stages through the liver. Where triclabendazole resistance has been identified in fluke populations, use should be restricted to times of high risk only. In such circumstances it would be important that another product capable of killing immature fluke would support fluke control measures. Closantel and Nitroxynil (which are affective against juvenile but not immature fluke) may be used but two treatments would be required with a minimum interval of 6/7 weeks between them.

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The Hill Sheep Sector in County Donegal: Current Profile and Potential

John J. Cannon[1], Seamus Campbell[2], Michael G. Diskin[3] and Ciaran Lynch[3]
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Take Home Messages

- Potential to improve weaning % through better ewe condition and weight at mating.
- Improve income by cross-breeding at least 33% of all flocks weaning at least 0.8 lambs per ewe.
- Improved marketing by using Producer Groups for replacement and store lamb sales.
- Improved genetics from breeders who record with Sheep Ireland.

Introduction

Drystock farming predominates in the West and North West of Ireland. Within that sector hill sheep is a very important component. This paper will examine the sheep sector in Donegal, profile its current position and discuss its potential for improvement. While it is quite difficult to predict what the sector will look like in 5-10 years' time it is important to provide information and knowledge to those who will be farming the hills in the coming years.

Sheep Numbers

Donegal is part of the Sligo/ Leitrim/ Donegal Teagasc Region and sheep farming is very important enterprise therein. The sheep numbers in the region for 2014 are summarised in Table 1. The national figures are included to put this in context. According to the 2014 Sheep Census data, published by the Department of Agriculture, Food and Marine (DAFM) in 2015, the region had 462,344 ewes in 8,127 flocks with an average flock size of 57 ewes (DAFM, 2015a). This compares with national total of 2,420,374 ewes in 34,549 flocks and an average flock size of 70 ewes. In 2014 Donegal had 305,651 ewes (448,575 sheep) in 5,607 flocks and an average flock size of 55 ewes. The flock figures of 104 nationally and 80 for Donegal are often incorrectly referred to as ewe figures.

Table 1. Ewes Numbers in Sligo, Leitrim, Donegal and Ireland 2014

Location	Flocks	No. Ewes	Total Sheep	Ave. Flock Size	Ave. No Ewes
Donegal	5,607	305,651	448,575	80	55
Sligo	1,498	86,600	119,416	80	58
Leitrim	1,022	70,093	96,920	95	69
Region	8,127	462,344	664,911	82	57
National	34,549	2,420,374	3,581,818	104	70

Source: DAFM Sheep and Goat Census 2014

Since 2008, Donegal is the county with the largest sheep flock and is expected to remain in that position for the foreseeable future. Hill Sheep account for 36% of the sheep population in the Donegal (Carty, 2016 pers. comm.). Therefore there are approximately 100,000 to 110,000 hill breeding ewes in Donegal. Because the majority of sheep farmers are small the impact of improvements may seem small in the overall context. Conversely, this would also indicate the need to maximise return from smaller flocks. This is important when attempting to improve or even implement in change in the industry.

The changes in sheep numbers between 2008 and 2014 within the region are outlined in Table 2. Between 2009 and 2014 ewe numbers in the region (Donegal, Sligo and Leitrim) increased by 17.6% while the average number of ewes per flock has only increased by 3.3%. In that period ewe numbers in Donegal have increased by 19.2% to 305,651 ewes, with flock size showing a modest increase of 5.8% from 52 ewes to 55 ewes per flock (DAFM, 2015a). During the same period the national sheep flock has increase by 10.5% with the average flock size increasing by 2.9% from 68 to 70 ewes per flock. While there is no published data specifically on the Hill flocks, based on local knowledge, it is fair to assume that the picture is similar in relation to hill flock size.

Table 2. Changes in Breeding Ewe Numbers 2009 to 2014

	Ewes Nos.	Ewes Nos.		Ave Ewe Nos. Per Flock		
Year	**2009**	**2014**	**% Change**	**2009**	**2014**	**% Change**
Donegal	256,394	305,651	19.2%	52	55	3.3%
Sligo	74,616	86,600	16.1%	56	60	7.1%
Leitrim	62,247	70,093	12.6%	72	71	-1.4%
Region	393,257	462,344	17.6%	60	62	3.3%
National	2,189,504	2,420,374	10.5%	68	70	2.9%

Source: DAFM Sheep and Goat Census 2014

Distribution of Hill Sheep in Donegal

The landscape of Donegal is quite variable. The centre of the county is mainly hill, mountain and blanket peat terrain. There are also similar land types in the Inishowen and Fanad peninsulas, to the west around Mount Errigal, to the south west from the Glenties to Glencolumbkille and to southeast around Pettigo. It is in these areas that hill sheep breeds predominate. According to DAFM (2015b) there are 832 commonages in Donegal with 5032 shareholders. If one excludes commonages of less than 10 hectares the picture changes to one of 603 commonages with 4429 shareholders. According to AFT (1969) pp.23,24 "likely that commonages of 10 acres or less may not refer to grazing grounds but to other property such as gravel quarries or turf-stacking grounds held in common by farmers". While commonages are associated with mountain terrain it should be noted that there is a significant amount of privately owned hills in Donegal. This is especially true in the southwest in the area bounded by the towns of Ardara, Glencolumbkille and Killybegs (AFT, 1969). It is worth stating that many incorrectly assume that all hill sheep are kept on commonages.

It is difficult to ascertain how many sheep are currently grazing on commonages. However, it is fair to state that since the 30% compulsory destocking in 1999 that there is significantly less sheep

on commonage areas since then. This has resulted in some commonages being described as under-grazed Bleasedale (2013). The consequences of this is potential reductions in the reference areas of these commonages or worse still loss of good agricultural and environmental condition (GAEC) status and the area being considered as "abandoned" Smyth (2013). The majority of hill lambs produced in this region are sold as stores with a smaller proportion taken to heavier weights suitable for slaughter for the French market on the farms of origin. Hill sheep are sold in marts located in Carndonagh, Milford, Ballybofey & Stranorlar, Brockagh and Donegal town.

Hill sheep are critically important in the management of hill and mountain areas that are not generally grazed by other stock types. The Blackface Mountain Breed is well recognised for its hardiness and ability to survive in mountain and peatland areas where species such as heather (Calluna vulgaris, Erica cinerea & tetralix), black Bog Rush (Schoenus nigricans), purple Moor Grass (Molinia caerulea.) and mosses (Sphagnum species) predominate. While the fear during the nineties was of overgrazing, soil erosion and loss of habitat especially on western commonage areas, "where the natural vegetation has been over-grazed to such an extent that it will not regenerate until current farming practices change" (DAFF, 1996 P1.). In contrast the main concern over the past 5 years has been of under-grazing with the consequent risks of loss of habitat Bleasedale (2013) and uncontrolled fires (Casey & Nugent, 2014).

Breeds and Breeding Groups

The main hill breed is the Scotch Blackface but there is a Cheviot population too. While the Perth strain predominates within the Scotch Blackface there is a significant population of Lanark and shorter wooled types. In later years there are more Mayo-Connemara Blackface ewes being brought into the county and these are being crossed with the local strains. The Cheviot population in Donegal is predominantly made up of the Wicklow strain with some North Country influence. The hill breeds are generally bred 'pure' on the hills and while there is some crossbreeding this is not widespread and there are no organised sales of prolific crosses such as Mules or Belclare crosses. There are a number of breeding groups or societies within Donegal and each group has at least one annual sale in the following locations:

- Brockagh Perth Blackface Sheep Breeders Association - Annual Sale held in Brockagh
- Donegal Blackface Breeders Association - Annual Sale held in Stranorlar
- Tirconaill Scotch Blackface Breeders Society - Annual Sale held in Raphoe
- Brockagh Swaledale and Mayo Blackface Sheep Breeders Group - Annual Sale held in Brockagh
- Wicklow Mountain Sheep Breeders Society - Annual Sale held in Stranorlar

Sheep Marts hold breeding ewe sales aimed at lowland farmers but at these sales all breeds and crosses are found together with the predominant breeds being Suffolk and Texel Crosses. There are no marketing or specific sales of hill crosses as replacements taking place within Donegal at present.

Potential for Improvement

There are a number of areas where potential improvement could be made either at an individual flock or at an industry level and these are briefly discussed.

Increasing Weaning %

Typically output from hill flocks is low, in the order of 0.8 lambs weaned per ewe joined. However, through better management there is potential to improve this figure substantially. Research carried out by Teagasc at Leenane and more recently by Teagasc as part of the Sheep BETTER Farm Programme has demonstrated potential for improving output from hill flocks by improving ewe condition and weight at joining (Lynch & Diskin, 2014). This centres on a management plan for the flock and the farm. The results coming from the work on the BETTER Farm Hill flocks clearly shows that it is possible to increase ewe output in Hill flocks from a current figure of 0.8 lambs per ewe mated to over 1.1 lambs per ewe. This improvement has also been shown to be economically advantageous (Lynch et al, 2013). For hill flocks the aim should be to have ewes in a condition score of 3 at ram joining and with a target mature weight of 45 kg. for 'harder' hills and 50 kg for those with greener hills or access to lowland areas (Lynch & Diskin, 2014). The steps taken to improve output in hill flocks in the BETTER farm programme will be described in later sections.

Cross Breeding

For the majority of hill flocks (weaning 0.8 lambs per ewe or greater) unless they have a specific market for 'pure' females there is potential for more cross breeding. There benefits from adopting this approach are as follows:

- Prolific females for lowland farms such as Mule, Greyface and Belclare crosses, ewe lambs or hoggets.
- More saleable cross bred wether and ram lambs.
- Heavier lambs (3-4 kg at weaning)
- Improved selling price
- Better performance during the finishing period

The potential for crossbreeding within each flock ultimately depends on the replacement requirement and for the most part is determined by the existing level of ewe and flock productivity. A guideline for the percentage of a flock that is required for producing replacements is outlined in Table 3.

Table 3. Potential breeding strategies for hill flocks at different levels of output

Lambs reared per ewe joined	Pure breeding (%)	Crossbreeding (%)
0.80	66	34
0.85	62	38
0.95	56	44
1.00	53	47
1.05	50	50
1.10	48	52

Source: Adapted from Lynch 2012

Crossbreeding a part of their hill flock is an option that Donegal hill producers should be giving more active consideration to. Within Donegal from the 100,000 plus hill breeding ewes, even at low levels of output (ie. 0.8 – 0.9 lambs per ewe joined) there is potential to produce 30,000 crossbred lambs. This would give 14,000 ewe lambs suitable for replacements and for sale each year. This would be sufficient to meet the replacement requirements for approx. 30% of the

Donegal lowland flock or for the entire flocks of Monaghan and Louth combined. There is clearly a valuable resource within the hill flocks of Co. Donegal that could be exploited if there were more organised sales of crossbred females such as Mules, Suffolk cross Cheviot, Belclare cross and Hilltex within the county. These females are in demand by lowland producers seeking quality prolific replacements.

An example of the potential of these sales is consistently highlighted in Mayo with a Producer Group sales of Mayo Mules and Greyface females held each year. Ewe lambs command premium prices at these sales. Similar developments are now occurring in Connemara and in Sligo. It is reasonable to assume a similar type of demand with consequential price improvement for Donegal producers. Increasingly, at these sales lambs are being offered for sale that are already vaccinated against the clostridial diseases and against pasturella pneumonia. Linkages can also be established between the primary producer and the lowland farmer which will be to the ultimate benefit of both.

Producer Groups

There is significant scope to establish producer groups not only to market prolific crossbred ewe lambs but also to market hill and crossbred males and hill ewes. Specialised, well-promoted, sales could be organised or the producer groups could arrange direct contact between producers and prospective buyers thereby facilitating on-farm sales. Many purchasers of sheep, particularly those that are very conscious of flock biosecurity and flock health, prefer to purchase directly from known sources rather through marts. Frequently, these are annual repeat purchases from the same flock. Many purchasers are now anxious to acquire and are willing to pay extra for sheep that are vaccinated and are known high health status. Therefore, the establishment of producers groups to assist with the marketing of hill land crossbred lambs has significant potential. The challenge is: who are willing to establish and run these groups?

Genetic Improvement

Within each breed there are individual animals that are capable of outperforming their counterparts. The progeny of some rams are faster growing while some ewes are more productive that others and are better able to survive their environment. In this regard hill sheep are certainly no different. Some of these differences are due to the environment (farm, feeding, management) while some is due to their genetic makeup. From a breeding perspective the challenge is to identify the ewes and rams that are genetically superior (possess the genes that are responsible for the desirable traits) to their flock mates. The concept of genetic improvement or breeding better sheep is not new. However, through Sheep Ireland the potential to record and evaluate breeding sheep is a now becoming a reality for breeders. Since the introduction of the Eurostar index for sheep in 2009 there is now the potential to select genetically superior sheep for maternal and terminal traits. For lowland producers, using higher genetic merit rams in their flocks has resulted in significant performance benefits (McHugh et al, 2016). Briefly, these are:

- Lower lambing difficulty
- Better lamb survival
- Improved growth rate
- More productive females

Potentially these same benefits are possible for hill farmers to exploit. However, one of the major limiting factors facing the genetic improvement of hill sheep is the absence of flock-books with

parentage records. The practical limitations with collecting this type of information have been a major constraint. Over the past number of seasons full EID recording from birth has been possible on the BETTER farm hill flocks. Within each seasons lamb crop over 50% of lambs produced have parentage records. However, for most flocks this will prove unrealistic. Therefore for the hill breeding industry to move forward efforts must be focused on specific areas. Central to this is the involvements of ram breeders who are providing the breeding stock for the hill farmers.

Finishing Lambs

The findings of a major research project on the finishing of hill lambs indoors on concentrates are being discussed in a separate paper here today. It is suffice to say that there a potential benefit for hill farmers to explore the 5 options outlined, especially those with suitable facilities such as slatted sheds and significant lowland. As the potential is influenced by various factors such as the price of store lambs, the cost of concentrate feed and lamb mortality, the tools are now available for a farmer to assess the potential for him/herself each year when the hill flock is being weaned. For many the best option may be to sell them as store lambs so the saleability of hill lambs being offered for sale would be increased if they were grouped properly by weight and type, EID tagged and vaccinated against clostridial diseases.

Hill Land Management

The issue of over / under-grazing of hill and commonage areas with consequent risk from wild-fires has been well documented in recent years (Casey & Nugent, 2014). One way of reducing or managing this risk is by sustainable grazing management of these upland areas (McCloskey, 2016). This topic is being addressed in in detail at this conference by Eileen McCloskey.

Current Initiatives

BETTER Farm Sheep Programme

The Teagasc BETTER farm Sheep Programme currently has four hill flocks in counties Donegal, Mayo, Cork and Wicklow. The Donegal-based farm is operated by David and Linda McLaughlin. Located in Hillhead, Greencastle they have been part of the programme since it began in 2008. They and the other participants have consistently demonstrated that the targets set for hill farms are consistently achievable. A summary of the performance of the McLaughlin Hill flock is shown in Table 4 below. These improvements are as a result of adopting better management practices. These were:

- Improve ewe weight and body condition at joining by managing grazing area
- Managing thinner ewes separately prior to and after mating
- Better nutritional management during pregnancy – based on scanning results
- Suitable lambing date – matching feed supply
- Addressing flock health issues

Table 4. Summary of Flock Productivity on the McLaughlin Farm 2008 - 2015

	Season					
	2008/09	**2009/10**	**20011/12**	**2012/13**	**2013/14**	**2014/15**
Ewes Mated	223	233	240	243	262	245
Litter Size	1.15	1.36	1.38	1.43	1.46	1.39
Ewes Lambed/Ewe Mated (%)	86.5	81.5	88.8	93.8	94.3	94.8
Lamb Mortality (%)	15.4	4.6	5.1	12.8	10.5	9.7
Lambs Reared/Ewe mated	0.92	1.06	1.10	1.17	1.23	1.18

Discussion Groups

Following the introduction of the Sheep Technology Adoption Programme (STAP) in 2012 the number of hill sheep discussion groups in Donegal increased to 16. The discussion group concept is seen as a key method of technology / knowledge transfer to farmers (Bogue, 2013, Boyle 2013 and Moran 2013). These groups are being facilitated by Teagasc and private agricultural consultants. It is hoped that these groups will be continued and indeed increased, now with the expected launch of the Knowledge Transfer (KT) Programme for sheep.

Hill Sheep Parentage Initiative

In the autumn of 2014 Teagasc in conjunction with Sheep Ireland began the process of establishing parentage records and performance recording through the 'Hill Sheep Parentage Initiative'. The efforts within Co Donegal will be discussed in a later section. This process has been used in counties, Mayo, Galway, Kerry, Waterford (McDermott, 2016). The aim of the initiative is to help facilitate farmers in the process of gathering the necessary parentage information to allow for the establishment of flock-books and subsequently the generation of genetic indices for the various Blackface and Cheviot breeders involved.

What's required? At a basic level knowing the parentage is a must – this can be facilitated through single sire mating individual rams with batches of ewes and recording this with Sheep Ireland. However, in order to get evaluations, live weight and mortality information must also be measured. This is a challenge for many hill flocks because they are managed extensively. If breeders concentrate efforts on a nucleus group within each flock that they anticipate will produce saleable breeding rams it will provide an opportunity to establish firstly parentage and subsequently genetic values for the progeny produced.

There is also a role for commercial producers. Their information is vital to validate the index and indeed its relevance for the hill sector. The Teagasc hill sheep BETTER farms have been used to evaluate the progeny of a number of recorded Blackface and more recently Cheviot rams. Currently there are 10 Blackface (Lanark & Mayo-Connemara types) and 4 Cheviot rams being evaluated. This process will allow for the direct comparison of sires within these commercial flocks. The information generated will feed directly into Sheep Ireland which will improve the evaluation process for these hill breeds.

Hill Sheep Parentage Initiative in Donegal

In 2013 Teagasc became involved in promoting awareness of this concept at local level through joint meetings with Sheep Ireland and the executive members of the breed societies. In 2014 Teagasc followed up with further meetings prior to the breeding season when recruitment of interested farmers was the focus. Teagasc have offered the services of an administrator based in Athenry to help with data transfer from paper to a digital format in the initial period in order to 'kick start' the process.

Summary of the current process

Step 1: Famer completes a simple application form and records the tag numbers of the ewes and rams he wishes to record and sends these to Sheep Ireland / Teagasc.

Step 2: Farmer ensures that single sire mating is practiced at least for a number of breeding / heat cycles.

Step 3: Farmer identifies lamb at birth either by marker paints or preferably with permanent ear tags and records these numbers in a note-book. This record includes: lamb birth date, the ID of the dam and sire, male or female, single or twin, etc. This can be photocopied, photographed or scanned later and forwarded to Sheep Ireland / Teagasc.

Step 4: Record lamb weaning weight and survival to weaning

Step 5: Production of sale information / catalogue by Sheep Ireland.

Step 6: Full ancestry in few years and Flock Books established by Sheep Ireland.

At present there are 12 hill sheep farmers participating in this initiative in Donegal with 6 breeders managing to achieve Eurostar records. It is hoped to build on this progress in the coming years. Nationally there are over 9000 recorded Blackface Mountain (all strains included) hill sheep with parentage records born since 2013 in the Sheep Ireland data base in 81 different flocks (McDermott, 2016). This number is growing but it is ultimately dependent on the commitment of individual breeders to help drive this process forward. Sheep Ireland and Teagasc are committed to helping breeders continue with their efforts.

Summary

The hill sheep sector plays a vital role in the Irish sheep industry particularly in Co. Donegal. There is scope to improve output through adopting better management practices on farm. With the scale of the hill sheep sector in Donegal there is great potential for farmers to work together in producer groups to develop markets for the lambs they produce through organised breeding sales, be a point of contact for direct farmer to farmer sales. This initiative could be further built up by guaranteeing that lambs were dosed, dipped and vaccinated. In terms of breed improvement there is the potential to make real gains that will benefit farmers. The initial steps have been taken through the efforts of Sheep Ireland, breeders and local Teagasc personnel. The future focus must be devoted to driving this process forward by having more hill farmers participating. The change in market demands is an area that farmers can adapt to and may in fact help generate better linkage between hill and lowland producers and help the sheep industry overall to improve the sustainability of supply. While it is quite difficult to predict what the sector will look like in 5-10 years' time it is important to provide information and knowledge to those who will be farming the hills in the coming years.

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Importance of Managing Upland Habitats on Hill Farms

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Take Home Messages

- Hill farms are an integral aspect of rural communities, the hill sheep sectors plays a vital role within the agricultural industry and in maintaining valuable habitats.
- Appropriate management is essential; sheep grazing has a key role to play in maintaining upland habitats in a favourable condition for both production and biodiversity.
- A better understanding of the relationship between grazing sheep and uplands, and identifying the role of specific breeds is crucial in developing management prescriptions.
- Improving performance and productivity through genetic improvement is crucial to ensure the hill sheep sector remains economically viable, performance recording is a fundamental aspect of this process

Introduction

The hill sheep sector is a major contributor to lamb production in Europe. Over 90% of the 65.8 million breeding ewes in the EU-25 are located within Less Favourable Areas (LFA) (European Commission 2010). In Northern Ireland, 70% of the land used for agriculture is classified as LFA. With 80% of the sheep population found within LFA's the hill sheep sector is a major component of the Northern Irish sheep industry.

Table 1. Total sheep and breeding ewe numbers by land classification on June 2014

Land Classification		Number of sheep	Number of breeding ewes
LFA	Severely Disadvantaged (SDA)	1,087,000	524,000
	Disadvantaged (DA)	440,000	202,000
Non LFA	Lowland	396,000	184,000

(DARD 2015)

Productivity in hill sheep flocks is typically lower than those on lowland flocks, contributing to poor economic returns. Gross margins for hill flocks benchmarking during 2014/15 range from £2-£24 per ewe with an average of £13 per ewe, compared to an average of £35 and £45 per ewe for upland and lowland flocks respectively. This leads to an increasing reliance on direct payments to ensure the viability of the majority of hill flocks.

Table 2. Net farm income and direct payments to Cattle and Sheep farms in LFA's 2013/14

	£'s per farm	Percentage of total income
Net Farm Income	7,716	20.5
Direct Payments	30,056	79.5

(DARD 2015)

The decoupling of direct payments from production and increased emphasis on environmental objectives reinforces the importance of environmentally sustainable grazing regimes to be integrated within sheep farming on upland habitats. This paper will focus on factors which may impact appropriate management of upland habitats.

Management of upland habitats

Upland habitats have been grazed and managed by herbivores for many years, and although primarily managed for production, there has been a shift to align with environmental objectives alongside production. Agricultural policies such as the Common Agriculture Policy (CAP) have played a large part in shaping the structure of agriculture in the uplands. While Agri-environment schemes such as the Environmentally Sensitive Area scheme (ESA) and Countryside Management scheme (CMS) were introduced in Northern Ireland to incorporate environmental objectives into agriculture.

Many of the management prescriptions and components of these schemes are based on pre-determined stocking rates tailored to specific habitats. With cross-compliance requiring land owners to maintain land in 'good agricultural condition', both over-grazing and under-grazing are in breach of this directive. Therefore, understanding grazing behaviour and interactions between grazers and plants and between species and specific breeds is essential to refine and produce appropriate management prescriptions to comply with cross-compliance. Vegetation on heather moorlands is relatively unstable and in the absence of any management it would return to scrub and ultimately, given appropriate time to woodlands depending on climate and location. Traditionally grazing was the predominant method of managing upland habitats and has been shown to be the principal factor controlling vegetation change. Hence, degradation of uplands has been attributed to inappropriate grazing or overgrazing.

Historically, breeds have been selected to graze on uplands habitat, based on their ability to survive and thrive under harsh and in some cases extreme environments, with many breeds being of importance to a local area or environment. This highlights the importance of establishing a breed-environmental link. As previously mentioned, many hill flocks return poor financial margins. Production efficiency is a vital factor in sustainable sheep systems and influences breed selection across all systems. Poor returns from traditional systems have lead to an increase in producers keeping crossbreeds in a bid to improve financial returns. Studies looking at the introduction of crossbred replacements sourced from blackface ewes can lead to improvements in the productivity of hill flocks (Annett *et al.,* 2010). However, less attention has been paid to breed selection for grazing management, foraging ability and improving biodiversity, which may adversely affect the biodiversity of upland areas.

Case Studies

The following case studies looked at the implications of changing breed structure on hill farms. The relationship between different ewe breeds and upland habitats, how the breeds adapt and interact to upland environments and the potential for upland management based on:

- Habitat preference
- Selected vegetation for grazing
- Grazing patterns

The first study looked at grazing patterns and habitat selection of pure Scottish Blackface ewes compared with Scottish Blackface x Texel ewes on the CAFRE hill farm at Glenwherry. Ewe movements and locations were monitored via global position systems (GPS) collars worn by a number of ewes, as seen in Figure 1.

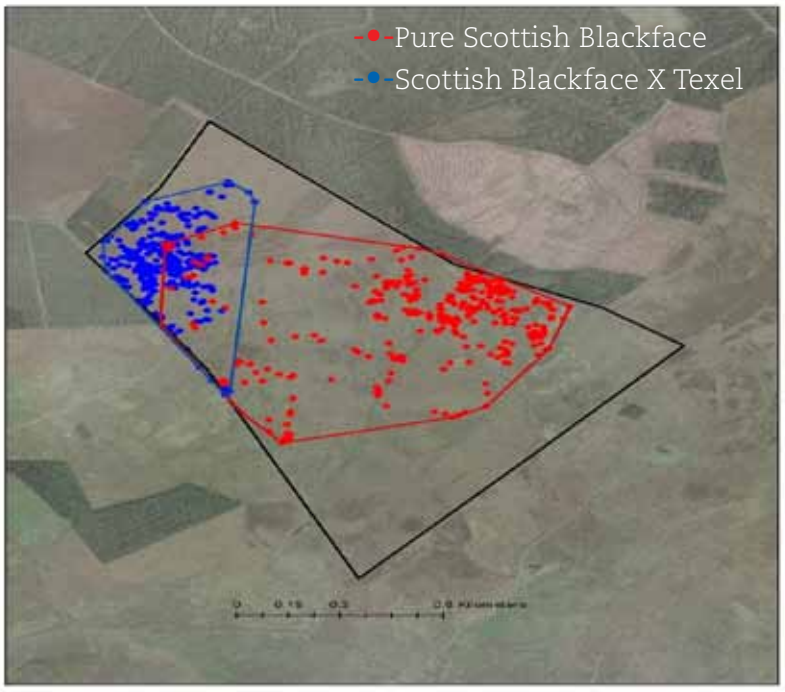

Figure 1. *Movement and location of the pure Scottish Blackface compared with Scottish Blackface x Texel ewes on the Creeve at Glenwherry Hill Farm monitored via GPS.*

The position of the ewe was linked to the vegetation type at that location. The results in Table 3 are presented as percentage occurrence of breed on a particular habitat established from GPS points recorded per habitat. Percentage occurrence is taken as an indication of preference for habitat selection. The habitat preferred by both breeds was marshy grassland, followed by unimproved grassland, degraded blanket bog and blanket bog. Both sheep genotypes had lowest preference for blanket bog, although blanket bog made up almost half (49%) of the area. This preference for grass-based habitats supports findings from previous studies (Fraser *et al.*, 2009). Pure Scottish Blackface ewes were recorded significantly more often in heather habitats than the Scottish Blackface x Texel ewes, this may be taken as an indication of a higher preference or lower avoidance for heather by the crossbred ewes. This is vitally important as a proportion of grazing is required in order to manage heather.

Table 3. Proportion of time spent by pure Scottish Blackface and Scottish Blackface X Texel ewes on upland habitats

	Ewe Genotype	
	Pure Scottish Blackface	**Scottish Blackface X Texel**
Blanket bog (%)	12.58	9.60
Degraded blanket bog (%)	20.67	18.78
Marshy Grassland (%)	40.02	52.47
Unimproved (%)	26.73	19.15

Another aspect studied was the grazing/foraging behaviour. This may be affected by environmental factors such as vegetation and social factors such as distance of nearest animal. In many situations animals must make choices between food and social bonds. In this study the forage area was the area (ha) the ewe covered on a daily basis. Pure Scottish Blackface ewes foraged over a larger area than Scottish Blackface X Texel (Table 4). Studies have shown that interaction in social groups can influence foraging behaviour, as sheep are motivated to feed near each other.

Studies found that social attraction decreased foraging efficiency, the more sociable the sheep, the more they tended to aggregate and the less likely they are to explore the environment and discover new feeding sites (Hewitson *et al.*, 2005). This may explain the smaller foraging area of the Scottish Blackface X Texel as a more sociable breed chooses to feed close to other members and the flock and shares the same home range. This may also explain why they travelled less on a daily basis, as animals are not prepared to move any considerable distance from each other trading foraging behaviour for social behaviour.

This study suggests that different breeds have stronger social preferences which can interfere with foraging ability. Pure Scottish Blackface sheep are known to have a lower social attraction function than other breeds. This enables them to move further away from other sheep and disperse more. This is especially important in upland areas and under free ranging. Results indicate that pure Scottish Blackface ewes display better characteristics for grazing and managing vegetation on upland environments.

Table 4. Altitude reached, area covered and distance travelled by pure Scottish Blackface and Scottish Blackface X Texel ewes based on monitoring via GPS Collars

	Ewe Genotype	
	Pure Scottish Blackface	**Scottish Blackface X Texel**
Area covered (ha)	5.99	4.62
Distance Travelled (m)	1.89	1.20

The second study looked grazing patterns and diet selection of the pure Scottish Blackface compared to a number of crossbreed ewes, Swaledale X S.Blackface, Cheviot X S.Blackface, Lleyn X S.Blackface and Texel X S.Blackface on 4 hill farms across Northern Ireland by examining plant material present in feces.

The diet selected by grazing animals is affected by animal preferences and the vegetation available. Vegetation on uplands is a mosaic of many species and distinguishing diet selection by observations has limitations. The results of this study (Table 5) support the previous study. Grass made up the largest proportion of the faeces for all breed types, showing all breeds will selectively graze grass first when available. However, the percentage of grass in faeces collected from pure Scottish Blackface and Scottish Blackface X Swaledale ewes was lower than the other 3 breed types. While the percentage of heather was higher in the faeces of pure Scottish Blackface and Scottish Blackface X Swaledale ewes compared with the other 3 breed types.

Table 5. Average composition of vegetation type as a percentage present in the faeces of the pure Scottish Blackface and four other S.Blackface cross ewes

Breed	**Grass**	**Heather**	**Rush**
Pure Scottish Blackface	69.98	23.29[a]	6.73
Scottish Blackface X Swaledale	70.04[a]	23.28[a]	6.68
Scottish Blackface X Cheviot	73.94[b]	19.36[b]	6.70
Scottish Blackface X Lleyn	76.53[c]	16.87[c]	6.60
Scottish Blackface X Texel	77.61[c]	16.18[c]	6.21
SEM	0.833	0.613	0.456
P-value	<0.001	<0.001	0.942

In both studies the findings demonstrate the selective grazing habits of foraging ewes. The preference for grass vegetation when present shows that animals are selecting vegetation of the

highest nutritional value to ensure energy requirements are met. The higher presence of heather in the diet of the pure Scottish Blackface and Scottish Blackface X Swaledale is an indication of diet and suggests these perceived traditional breeds grazed and selected heather vegetation at a higher rate than the other three breeds.

There are some published studies on direct comparisons between grazing behaviour of sheep breeds. Osoro *et al.*, 1999 suggested the differences are simply due to animal size with smaller breeds within the same species in general, better adapted to the poorer vegetations conditions. The breed differences observed in this study largely confirm these findings and support the theory that traditional (and in this case smaller) livestock breeds such as the pure Scottish Blackface are better suited to certain environments. Other arguments for this are anecdotal such as 'perceived hardiness' however it is possible that certain traits differ between traditional breeds originally selected for such environments and commercial breeds initially selected for intensive production systems (Hessle *et al., 2008*). There for use of non-traditional commercial breeds could pose a threat to the environment, affecting biodiversity through ill-adapted grazing behaviour and the subsequent under grazing which would follow.

Management versus productivity

Selecting ewe type to improve the management of upland habitats does not mean productivity needs to suffer. It is essential that both factors are considered when selecting breeding stock for hill flocks. The most efficient way to improve productivity within any system is to breed from the most productive stock. This can only truly be achieved through reliable performance recording. Measuring factors such as fertility, mothering ability, growth rate, longevity and health issues will allow you to select breeding stock based on proven performance of individual animals.

The Glenwherry Hill farm currently runs 1100 ewes split into a hill and upland flock. The hill flock contains 350 pure Scottish Blackface ewes, 250 are crossed pure, and these are the corner stone of the flock as all breeding stock descends from them. The remaining 100 ewes are crossed to Swaledale rams to produce crossbred replacements for the upland flock. The upland flock is made up of 750 ewes, 230 ewes are crossed with a Texel to produce a crossbred female; the best of which will be retained and crossed with various sires to produce fat and store lambs, the remaining females and all males will be sold fat or store. The rest of the flock 530 ewes are of the above cross, Scottish Blackface X Swaledale X Texel these are also crossed with various sires to produce store and fat lambs. Sires currently being used are Primera, Texel and Lleyn. The highest performing Lleyn cross females are also selected as replacements for CAFEE lowland sheep flock.

The main objectives of all CAFRE sheep flocks is to:

- Breed more efficient sheep using genetic performance information and management records.
- Improve the maternal performance of breeding females which are fundamental to the breeding structure.
- Reach target efficiency rates of:
  - Hill flock - wean 0.6kg lamb/1kg ewe
  - Upland flock - wean 0.8kg lamb/1kg ewe

All ewes are performance recorded via EID and through the Shearwell management system. All lambing and weaning data is processed through AFBI recording system. The pure Scottish

Blackface ewes are recorded with AHDB Signet, which allows comparison of individual ewes with other flocks in the programme, across the UK. This enables the identification of the best genetics across the breed.

The most important aspect of the recording enables selection of breeding stock from the most efficient ewes based on:

- Maternal ability
- Achieving target lamb numbers
- Longevity
- Improved lamb growth rates
- Improved carcass value
- Minimal input
- Health

This is an integral component of the sheep systems, all breeding decisions are based on reliable recorded proven performance, which is essential to ensure production efficiency and sustainability. The use of EID tags and related farm recording systems improved data collection, aids management and data analysis, and is also integral to ensuring data collection is complete from birth to death.

Conclusion

Management is an essential aspect of maintaining heather moorland to keep it in good agricultural condition, and preserve a habitat which is beneficial to grazing animals, wildlife and birds. In order to achieve such management through grazing we need an understanding of the relationship between plants and animals.Specific breeds of livestock may possess important characteristics potentially valuable for management of specific environments, especially the uplands. An understanding of the differences between breeds in their foraging ability in the uplands will help develop management prescriptions.Improving performance and productivity through genetic improvement is crucial to ensure the hill sheep sector remains economically viable, performance recording is fundamental aspect of this process

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Budgets and Targets for Finishing Hill Lambs

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Take Home Messages

- If good quality autumn grass is scarce or not available, it is advisable to sell the store lambs in August and prioritise available grass and feed supplies to improve the body condition of ewes and ewe replacements.
- If purchasing, quarantine procedures should be followed once lambs arrive on the farm
- Lambs should be vaccinated against clostridial diseases and pasturella, possibly orf (if purchased) and dosed for internal parasites including liver fluke.
- Maximise weight gain from autumn grass. Best liveweight gains are achieved in August to end of October but grass quality must be good and well managed at all times.
- If planning to put lambs on an all concentrate diet prepare a budget in advance.
- If finishing lambs on an all concentrate diet, ensure diet is formulated for this purpose, initially offer 300 g/lamb/day and increase by 200 g/lamb/days every 3 days until full feeding, and continue to offer a small quality of long roughage (hay, silage, or straw). Ensure that lambs have water at all times
- When on a full concentrated feeding, regularly weigh lambs and market as they become fit.
- Differences between different strains of Scottish Blackface lambs are small and almost all hill lambs are capable of meeting French market specification.

Introduction

The Scottish Blackface breed accounts for approximately 22% of the 2.5 million ewes in Ireland. The majority of these Blackface sheep are maintained on hills or marginal land that is not suited to other sheep breeds or other farm enterprises. The majority of the hill breeds are bred pure with an emphasis on producing flock replacements for retention or for sale. A proportion of the ewes, particularly in the better hill areas are crossed with either maternal breeds to produce quality replacements or crossed with terminal breed producing lambs for slaughter.. Typically the cross bred lamb would be 3-4 kg heavier at weaning than the purebred hill lamb. Profits from these hill sheep enterprises is very much dependant on prices obtained for lambs sold. A large proportion of these lambs become available for sale annually from August onwards. Many hill lambs are sold to lowland finishers and reappear in the spring as hoggets. In recent years, prices for hill lambs and in particular light hill lambs in the autumn have been disappointing. This paper summarises the results of recent Teagasc studies and examines the options to improve the marketability and profitability of store hill land cross bred lambs.

Market

Traditionally, Ireland has been relying on the Mediterranean markets including Portugal, Spain and Italy to take the lambs from the hill flocks. In the past, these markets required carcases

from 10kg and upwards, with preferences for carcases from 12 to 15kg. While hill lambs meet these weight requirements, demands from these markets have declined in recent years. There has been a 54% decline in the level of exports to the three Mediterranean countries, and an 87% decline in the combined Portuguese and Spanish markets. In the past number of years purchasers of store hill lambs in the autumn achieved good margins on these lambs because of good lamb and hogget prices in late winter early spring.

Performance of hill lambs on lowland pastures.

In the autumn of 2014 Teagasc purchased Scottish Blackface wether and ram lambs from 5 farms in Mayo, Galway and Sligo area. On arrival lambs were dosed for fluke and worms, and received an 8:1 clostridial and orf vaccinations. Lambs were placed on pasture and their performance measured until December 2015. Interestingly, the performance of the light lambs (<25kg) surpassed the performance of the heavier lambs. This might indicate that there was some compensatory growth in the lighter lambs. From Mid-October to mid-November the performance of all lambs declined to an average of 45g/day. After mid-November daily liveweight gain declined to 0g /day. During the autumn grazing period the performance of ram and wether lambs was similar.

Table 1. Performance of Scottish Blackface male lambs on lowland Pastures Athenry 2014

	Lamb Weight Category (kg)		
	<25	**25.1-30**	**>30**
Wt on 1st August (kg)	24.3	27.3	30.5
ADG to 10th October (g/day)	145	110	104
10 week gain (kg)	10.2	7.7	7.3
Wt 10th October (kg)	34.9	35.30	38.10

Options for dealing with hill lambs

Because of the variability among hills and in the amount of green land available, there is no single option that best fits all hill farms. Therefore, a number of options are discussed in terms of their advantages, disadvantages and expected lamb performance.

Option 1: Sell at weaning

If good quality autumn grass is scarce or not available, it is advisable to sell the store lambs in August and prioritise available grass and feed supplies to improve the body condition of ewes and ewe replacements.

Advantages:

- Extra grass made available for ewe lambs and breeding ewes.
- Savings on flock health costs
- Improved cash flow

Disadvantages

- Poor prices for light lambs
- Limited markets.
- Lamb potential not exploited by primary producer

Option 2: Graze and sell mid-November

This requires excellent quality grass and grassland management. Usually lambs fail to perform for the first 2 weeks after going onto new pasture or are purchased in.

Advantages

- Heavier lambs
- Greater sale options
- Possibly higher prices

Disadvantages

- Less grass for ewe lambs and breeding ewes.
- Additional flock health costs
- Delayed cash flow

Expected Lamb performance

August – end Sept: 115g/day or 0.8kg/week
1st Oct – Mid Nov:: 60g/day or 0.4 kg/week
Total liveweight gain**:** After 12 weeks = 7.2 kg

This option would apply to purchasers of store hill lambs. Where lambs are being bought for autumn grazing it is important that they are purchased early in the autumn to maximuse the gain from grazed grass.

Option 3: Graze + Supplementary meal feeding at pasture and sell mid-November

This also requires excellent quality grass and grassland management + meal feeding (300g/ lamb/day) by trough

Advantages

- Heavier lambs
- Greater sale options
- Possibly higher prices

Disadvantages

- Less grass for ewe lambs and breeding ewes.
- Additional flock health costs
- Cost of concentrates (€6.30/lamb)
- Delayed cash flow and cash to purchase meal

Expected Lamb performance

August – End Sept: 155g/day or 1.1 kg/week
1st Oct – mid Nov: 100g/day or 0.7 kg/week
6-9kg concentrates required for 1 kg liveweight gain.
Total gain after 12 weeks = 11kg.

The direct cost of the meal consumed per lamb will vary from €6.30 per lamb (€250/ tonne) to €8.82 (€350/ tonne). The key question is will the extra liveweight gained (expected to be about 4 kg) by the lamb more than covered by price obtained for the lamb in November.

Option 4: Finish lambs on all-meal diet after weaning

This requires housing the lambs and finishing them on an-all meal diet.

Advantages

- Extra grass for ewe lambs and breeding ewes.
- Heavier lambs
- French lamb prices

Disadvantages

- Cost of meal
- Large quantity of meal required particularly for light lambs
- A long finishing period for light lambs
- Additional flock health costs
- Facilities
- Delayed cash flow and cash to purchase meal.
- Lambs finished before price rise in spring.

Option 5. Graze for a period followed by finishing on all-meal diet

With this option the lambs are grazed until end of October or even longer when kept at a low stocking rate. During this period lambs would be expected to gain on average about 7-10 kg if grazed on very good quality grass. At the end of grazing period lambs would be housed and finished on an all meal diet. This is in fact the system that is followed by many lowland farmers. Store hill lambs are purchased in the autumn and grazed on grass until December.

Advantages

- Heavier lambs at start of meal feeding period
- Reduced meal requirement
- French lamb prices
- Higher prices in January-March.
- Reduced finishing period

Disadvantages

- Less grass for ewe lambs and Breeding Flock.
- Additional flock health costs
- Facilities
- Cash flow?

Performance of Scottish Blackface and Texel X Scottish Blackface lambs on an all concentrate diet (Study1).

In recent years, Teagasc at Athenry have conducted a number of studies on the finishing of wether and ram Scottish Blackface and Texel cross Scottish Blackface store lambs on an all concentrate diet. The ration fed was 70% cereal ration with 15% protein and a UFL =1. The diet was formulated for this purpose and contained 0.5% ammonium chloride to mitigate the risk of urinary calculi. The ration was initially offered at 300 g/lamb/day and increased by 200 g/lamb/days every 3 days until full feeding was achieved. This usually took 12-14 days. A small quality of silage (400g/day wet weight) was offered to lambs. The performance of light and medium Scottish Blackface and Texel cross lambs are summarised in Table 2.

The Texel cross lambs had higher performance than the Scottish Blackface lambs, had higher intake and were more efficient converters of ration to liveweight gain and had better carcass conformation. Almost all lambs reached French market specification

Rams lambs of both breed types had a higher daily gain and were more efficient converters of ration to liveweight gain than castrated wether lambs. As expected rams lambs had lower killing out rates, particularly Scottish Blackface ram lambs. Scottish Blackface lambs had significantly poorer conformation than Texel cross lambs with rams lambs. At carcass weights of 20.5 kg, the carcasses from Scottish Blackface lambs were becoming over fat. This would suggest that when finishing Scottish Blackface wether lambs on an all concentrate diet the target carcass weight should be not more 18.5-19 kg. Rams lambs can be brought to a heavier carcass weight without becoming over fat.

Table 2. Performance of light and medium weight Scottish Balckface and Texel cross Scottish Blackface when finished on an all concentrate diet.

	Scottish Blackface		Texel x Scottish Blackface	
	Light	**Medium**	**Light**	**Medium**
Starting weight (kg)	24.8	29.1	24.9	29.9
Days on full diet	73	61	65	60
Total meal intake (kg)	89.4	72.6	82.2	77.6
Daily intake (kg)	1.24	1.19	1.26	1.3
ADG (g/day)	206	197	277	230
FCE	6.4	6.8	4.6	5.7
Liveweight gain (kg)	14.2	11.3	17.0	13.2
Slaughter weight (kg)	39.0	40.4	41.9	43.1
Carcass weight (kg)	17.1	17.6	17.4	19.3
Carcass Conformation				
% 'U'	0%		20%	
% 'R'	80%		80%	
% 'O'	20%		0%	
KO%	43.81	43.63	41.60	44.60
% Carcass > 15 kg (French	96		100	

Table 3. Performance of heavy Scottish Blackface and Texel X Scottish Blackface lambs on an all concentrate diet.

	Scottish Blackface		Texel X	
	Ram	Castrate	Ram	Castrate
Start weight(kg)	36.9	36.0	40.8	41.2
Final live weight(kg)	46.3	43.8	54.1	52.9
Days on full diet	36	36	36	36
ADG (g/day)	255	218	364	315
Total Gain(kg)	9.2	7.8	13.1	11.3
Daily feed intake(kg)	1.42	1.41	1.66	1.63
FCE	6.29	7.08	4.73	5.51
Carcass weight (kg)	20.65	20.47	25.60	25.82
Kill out (%)	45.0	47.1	47.0	48.1
Carcass fat score (1-5)	3.22	4.21	3.04	3.77
Carcass grade (1-5)	2.57	2.57	3.72	3.68

Comparative performance of Cheviot, Mayo-Connemara, Lanark and Perth type males lambs. Teagasc have recently undertaken to examine the performance of Cheviot, Mayo-Connemara, Lanark and Perth type males lambs when finished on an all-concentrate diet. All lambs were castrated. Prelemlinary results are presented in Table 4.

Table 4. Comparative performance of Cheviot, Mayo-Connemara, Lanark and Perth type males lambs on an all-concentrate diet.

	Breed type			
	Cheviot	Mayo-Connemara Scottish Blackface	Lanark Scottish Blackface	Perth Scottish Blackface
Weight at Start (kg)	29.5	29.9	29.0	28.9
Days on diet	62	62	62	62
ADG (g/day)	226	191	200	202
Final weight (kg)	42.6	40.9	41.4	41.5
Carcass weight (kg)	19.2	18.3	17.8	17.7
Kill out (%)	45.0	44.7	43.0	42.5
Conformation score	2.5	2.2	2.5	2.6
Fat Score	3.0	3.3	2.9	2.8

The performance of the Cheviot lambs, measures as average daily gain (ADG), was significantly higher than the 3 Scottish Blackface breed types which were all similar. The Mayo-Connemara Scottish Blackface had a similar kill out percentage (KO %) to the Cheviot lambs. However, both Cheviot and Mayo-Connemara Scottish Blackface lamb types had significantly higher KO% that

the Lanark and the Perth types. Mayo-Connemara Scottish Blackface bred type tended to be fatter and have poor conformation that the other 3 breed types which were all similar. Data on feed conversion efficiency are not yet available. All lambs were deem suitable for the French market and achieved premium price.

Shearing of lambs

Results from a study just completed in Athenry recorded no effect of shearing of the lambs at the start of the indoor feeding period had no effect on average daily gain, feed intake feed conversion efficiency or final carcass weight. Not surprisingly kill out percentage was 1.2 percentage points higher in shorn lambs. Based on these results there is no benefit to shearing lambs at start of indoor feed period. If contemplating shearing of hill lambs it is probably best to do it in August.

Variation in lamb performance

A significant feature of all of the recent studies at Athenry has been the observed significant variation in the liveweight performance of lambs on an all concentrate diet. Much of this variation in performance is directly related to the intake of concentrate feed by the lamb. Lambs with high intakes of 1.8-2.0 kg per day will perform at close to 450-500 g per day while lambs eating less that 1 kg per day will perform at about 100 g per day. Therefore, in any group of lambs there is going to be a mixture of low and high performing lambs. To avoid lambs becoming overweight and over fat it is vitally important to weigh lambs on a regular basis particularly as they approach slaughter weight.

Factors affecting margins per lamb

The impact of varying meal prices, factory lamb price and mortality on margin per lamb is presented in Table 5.

Table 5. The impact of varying meal prices, factory lamb price and mortality on margin per lamb

	Lamb starting Weight (kg)		
	25	**30**	**35**
€20 increase in meal price	€-1.78	€-1.24	€-0.70
20 cent increase in lamb factory price	€3.80	€3.80	€3.80
1 Percentage point increase in lamb mortality	€0.56-0.59	€0.63-0.70	€0.69-0.75
Impact of grass quality (August to Mid Oct) on margins			
Poor-Average	€4.11	€4.11	€4.09
Average – Good	€3.18	€3.18	€4.41
Total Poor-Good	€7.29	€7.29	€8.50

The impact of changes in meal prices is most significant when feeding lighter lambs and aiming to bring them to "French" weights reflecting the fact that they require larger meal inputs. Increasing factory lamb price has a consistent effect across the different lamb weight ranges. The impact of increased lamb mortality is greatest with heavier lambs reflecting the increased value of a heavier lamb at the start of the feeding period.

Lamb Health

If purchasing lambs, it is always preferable to purchase lambs from a known source and with a known flock health and vaccination records. Purchased lambs should, on arrival on the farm, be given a "quarantine" dose for gastrointestinal worms and liver fluke, foot bathed, housed for 48 hours, vaccinated against clostridial diseases and pasturella pneumonia and isolated from other sheep on the farm for 2 weeks.

Conclusions

A decline in demand for light hill lambs in recent years has led to poor prices being paid for these lambs. However, through careful management, value can be added to these lambs. Every effort should be made, through planned grassland management to maximise weaning weight. There are then a number of options open to deal with these weaned hill lambs. They can be sold directly for slaughter for the limited light carcass market, they can be sold as stores for further feeding or they can be successfully fattened by the producer on a high concentrate diet to achieve the French type carcass. Greater than 95+% of male Scottish Blackface lambs are capable of producing carcasses of > 16kg. Even light hill lambs can be finished on an all concentrate diet. To improve the economics of the system the objective should be to maximise the lamb gain from autumn pasture. The latter requires excellent sheep husbandry to minimise lamb loss and maximise lamb performance. It's vital to be able to obtain a quality ration at a competitive price. The ration must be formulated for intensive feeding of lamb.

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