Understanding the perception of biosecurity measures surrounding sheep scab disease and round worm control on the island of Lewis and Harris.

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Executive Summary

Text box 1. Main findings from the workshops:

- The phrase 'biosecurity' was not commonly recognised, but when talking, some participants described good biosecurity practices.
- "Best-fit" biosecurity practices are adopted on the island
- Awareness of the issues, available diagnostics and control options for sheep scab and roundworm vary considerably
- Few participants were familiar with the Sustainable Control of Parasites in Sheep recommendations (https://www.scops.org.uk/)
- Leisure users were identified as a risk to livestock
- Disease risks posed by wild geese and red deer are believed to be a threat to livestock (and human) health.

Workshops with members of the crofting communities on the island of Lewis and Harris offered an ideal opportunity to better understand sheep keepers' attitudes to sheep scab and roundworm control. The workshops also explored participants understanding of the term 'biosecurity,' barriers to implementing 'best practice' biosecurity and the 'best fit[1]' for their situation.

Changes in crofting behaviours

Few crofters keep sheep for financial gain. There is a sense of pride, culture and heritage to keeping sheep that many hold dear. Crofters would habitually work together when gathering sheep for management tasks e.g. scanning, however these communal behaviours have become less prevalent in recent years. The demographic of the crofting population has changed, many aging keepers are no longer able to undertake physical work and the majority of active crofters are in full time employment with limited time and/or labour available. In addition, some participants stated that a number of newcomers do not have adequate husbandry skills and just keep a few sheep as a hobby or to meet crofting regulations and are not fully engaged with the community.

Traditionally crofters from each township grazed their flocks on hill areas know as 'common grazing'. Historically sheep would be 'hefted' to their own area of the hill and flocks tended only to mix at gathering times. Now there are fewer sheep on the grazing's which has a direct implication on disease spread as sheep are no longer hefted to an area but are travelling further afield and mixing with more distant flocks. Reduced stocking density means land is under-grazed, resulting in poor quality, unpalatable vegetation. This ground is harder for people to cover at gathers and along with a reduction in the number of shepherds, means that flocks may not be gathered as frequently. Due to the challenging conditions, a small proportion of sheep are not re-captured, these un-managed animals therefore miss parasite interventions, providing a reservoir of disease for re-infection.

[1] The level of biosecurity that the crofter feels is most appropriate for their particular situation

Wildlife and disease

Under grazing and unpalatable vegetation is also thought to be the reason for red deer and sheep coming into closer proximity on better grazing nearer to townships. Participants believed that this interaction results in sheep (and humans) facing a heavier tick burden and increasing the risk of tick-borne disease transmission. Deterioration of the grazings make managing deer number more difficult as moving carcasses can be impossible over boggy areas. Interesting to note crofters did not consider transmission of roundworms between deer and sheep as a risk

Biosecurity and stockmanship

Biosecurity as a term was not well recognised, but further questioning showed that participants were aware of practices they could take to protect their flocks. Although many acknowledged that the quarantine of incoming animals was the best way to protect livestock, it would appear that it is not common practice. Crofters described traditional practices and were unwilling to consider change to mitigate risk to a lower level. For example sheep have always been purchased and turned out immediately, they saw no reason to change a practice that has 'always been so' that has worked in the past. Very few areas have fencing and where there is fencing it is generally in very poor condition and double fencing almost unheard of. Participants believed that disease risk was lower when purchasing livestock from local or known vendors through private sales and the Stornoway auction market compared to mainland sales. Some people seemed unaware that sheep could carry scab mites and roundworm without showing any obvious signs. Despite previous outbreaks of scab on the island, the majority of participants felt that the risk was low, and that any disease incursion would soon become common knowledge, at which point keepers would take measures to mitigate the risk of further spread.

Roundworm

Knowledge of roundworm biology, treatment options and disease risk was variable. Diagnostics were not commonly used either as monitoring tool or for efficacy testing, faecal egg counting is not readily available on the island. Participants had limited awareness of the different anthelmintic drug classes, their ability to control both sheep scab and roundworms with ML products and the potential impact that might have on the development of resistance. Anthelmintic resistance was not widely considered and purchasing options were often dictated by availability within the single agricultural stockist on the island, some also bought products online.

Economics and training

Financial constraints play a significant role in the ability of crofters to carry out best practice biosecurity measures. Many community dipping facilities have not been maintained since compulsory dipping was stopped, to repair or renew these were require investment, as would large sheds or hard standings for quarantining or isolation livestock post treatment. There is also a requirement for training and peer to peer knowledge exchange between keepers and new keepers as the traditional crofting culture is changing.

Introduction

The focus of this project was the awareness and implementation of biosecurity practices within remote and island settings. Sheep scab and roundworms were used as case studies due to the

interplay between the control of these diseases when using macrocyclic lactones (ML's). Both diseases can be controlled using ML's but the difference in timing and optimal control practices could result in unintentional selection pressure for scab mites or roundworms.

Sheep scab

Sheep scab, caused by infestation with the ectoparasitic mite, *Psoroptes ovis*, is highly contagious, resulting in intense pruritus (itching) and represents a major welfare and economic concern for the sheep sector in Scotland. Control relies on injectable macrocyclic lactone (ML) endectocides and organophosphate (OP) plunge dips. However, concerns over residues, environmental contamination, and the recently reported resistance to the MLs, threatens the sustainability of this approach. Scab is endemic in the UK and notifiable in Scotland and recent estimates show that the disease costs the UK sheep sector £80-200 million per annum. The recent development of a blood test for the early detection of sheep scab has changed the way disease control is approached, facilitating targeted treatments to preserve future drug efficacy enabling a more collective, community-led approach, getting on top of scab and then using the blood test, as part of a good biosecurity programme, to ensure areas remain free of scab in the future. Effective biosecurity measures reduce the spread of scab between flocks, through direct contacts or indirect movements and although larger commercial sheep producers routinely adopt robust biosecurity measures, it is not known how readily similar measures are used by smallholders and crofters.

The islands of Lewis and Harris in the Scottish Outer Hebrides predominantly consists of crofting communities. Sheep movements occur within the islands and between the islands and mainland UK, typically the importation of tups and overwintering of lambs on the mainland. It offers an excellent opportunity to gather data on the occurrence of sheep scab, the associated attitudes to treating the disease, the use of biosecurity measures in daily routines and the degree to which sheep mix within and between the island's townships.

Roundworms

Roundworms are ubiquitous throughout the UK and threaten the health, welfare and productivity of sheep production. Commonly controlled using anthelmintics, the development and dissemination of resistance to these compounds and variation in the epidemiology of roundworms resulting from changes in climate and farm management are making the sustainable control of these parasites more challenging. Best-practice recommendations for roundworm control in sheep have been set out by the industry advice group "Sustainable Control Of Parasites in Sheep" (SCOPS), these are aimed at producers and are freely accessible online. Roundworm biosecurity practices have been designed to prevent the introduction of anthelmintic resistant worms with new and returning stock. Due to the prevalence of resistance within the UK national flock, the "gold-standard" is to yard animals for 48hours, treat them with one of the new anthelmintic classes (Zolvix or Startect) and inject with moxidectin. Producers are advised to isolate animals for 3 weeks and conduct a faecal egg count 10-14 days after treatment to check it was effective.

Figure 1 Map of Scotland showing the location of the Island of Lewis and Harris (red circle)

Understanding keepers' knowledge and attitudes to roundworm risk, available control options and how treatments can target multiple disease causing agents is important and highlights where knowledge exchange efforts should be targeted.

Researchers were able to build a picture of attitudes to biosecurity in general as well as the case study diseases in particular. Identifying the challenges faced by crofters in implementing current recommendations within remote and island settings highlights the need for tailored advice and will inform the development and dissemination of this. The workshops also assisted in the design of a proposed scheme for the broader control of sheep scab across the Western Isles.

Method

A series of five workshops were held across the island, one each at West Harris (Pairc Niseaboist), North Lochs (Balallan), North Lewis (Bragar), Ness and Stornoway. In total 35 crofters attended. Numbers of sheep kept ranged from zero to around 700.

During the workshops participants were asked to share:

- their opinion on the greatest disease risk to their holding,
- their understanding of the term 'Biosecurity',
- attitudes to sheep scab and roundworm control,
- the barriers to implementing 'best practice' biosecurity and the 'best fit[1]' for their particular situation.

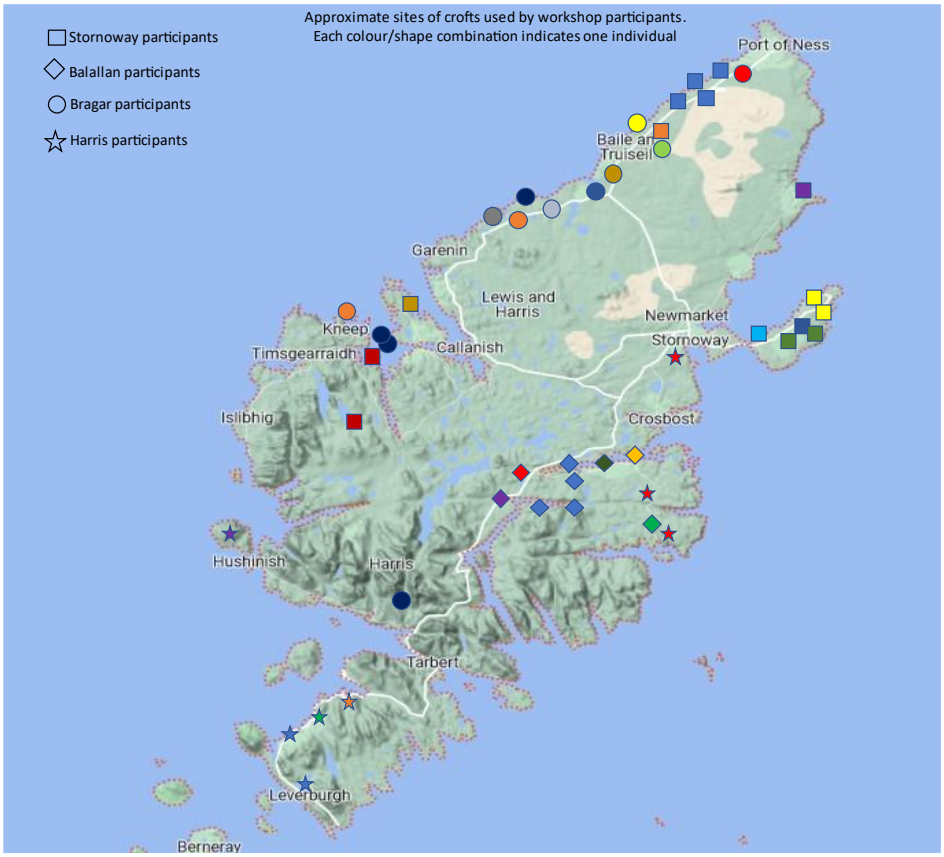
Prior to the start of the workshop participants were given time to consider an information sheet and sign a consent form. Information was shared in plenary and breakout groups and was collected via notes and audio recordings.

Results

Areas where sheep are kept

As the number of people keeping sheep on the island is reducing, opportunities have arisen for keepers to take over the grazing on unused crofts. The map below (Fig 1) shows areas where workshop participants kept sheep. Each colour/shape combination represents an individual keeper. Some crofters keep sheep on multiple areas and are regularly moving between their flocks. In addition sheep may be regularly moved around the island increasing the risk of any disease being spread.

Figure 1: Map of crofts held by workshop participants



Greatest disease risks to their holding

Sharing common grazing and importing livestock, particularly tups, were believed to be the most significant risk to introducing disease into existing flocks (Fig.2). Participants also cited human visitors, contractors (e.g. scanners, shearers) and wildlife as risks.

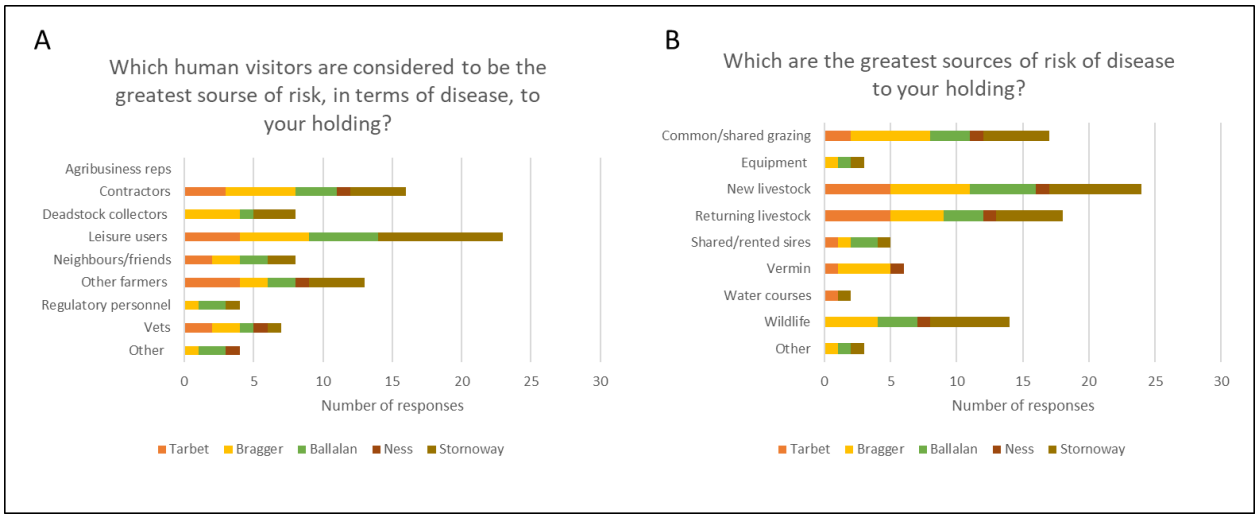


Figure 2. Poll results from participants regarding which human (A) and non-human (B) factors posed the greatest risk of disease to their holding.

Common grazing

The crofting community traditionally run their sheep together on large areas of hill or common grazing during most of the year. Sheep are generally 'hefted' to an area, i.e. they typically stay within one area of the hill, mixing with a limited number of other flocks. However as sheep numbers on the hill are declining, sheep are expanding their ranges; grazing larger areas and mixing more widely, potentially increasing disease risk.

Due to flocks ranging much further, and the decrease in the number of active crofters, gathering flocks for routine management tasks is becoming increasingly difficult. In some areas the communities or townships have few locals actively involved. Here there is a tradition to arrange community activities like gathers where the number of bodies helping is critical. Availability of labour was cited as a challenge due to the reduced number of crofters and the willingness and/or ability of those remaining individuals to help. Subsequently sheep may be missed for many years and are highly likely to be a continuing source of disease.

Leisure users

Participants highlighted an increase in leisure users of the land, particularly dog walkers in recent years. Awareness of the link between dog fouling and abortive diseases was voiced but the main concern was worrying of animals from uncontrolled animals. It was felt that new paths, including the Hebridean way, that have been introduced encouraged sheep to move further from their grazings straying onto roads and increasing mixing with other hefts that would not have otherwise been encountered, this could lead to increased disease transmission.

Communal activities

Variable engagement at township level on sheep and to some extent disease management within crofting regions and less inter-township communication was described. The crofters are in a unique position, where they may have small numbers of sheep, but these are held with others on the common grazing. They are not treated on an individual basis and often not at a flock or farm level but in most cases at a community level. Although this practice is diminishing as the traditional community

practices reduce and the community come together less often, except during the gathering, the community wide caring for livestock has to some extent disappeared. In the past their remoteness has helped isolate them from the greater agriculture community but the lack of control of livestock arriving on the islands leaves them open to disease. On some of the islands, Shetland for example, ancient bye-laws allow incoming livestock to be checked by vets and some treatments to be administered prior to dispersal to livestock holdings. Island-level interventions were considered an area of interest by crofters. Newcomers were considered to be largely unaware of expectations and/or regulations within a crofting community that help the smooth running of livestock management.

Some townships arrange communal activities, such as dipping, on a set day each year, allowing extended family members and friends to plan ahead in order to be available to help. Subsequently there is pressure to carry out planned dipping, even when the weather is suboptimal. Due to the non-crofting commitments of these individuals, the flexibility to arrange dipping for drier periods can be problematic. This requirement, to adhere to a set times, may have a direct impact on the efficacy of dipping due to over dilution of the active ingredients in the dip, and may, as a result, increase the risk of sheep scab.

The reduced number of crofters, along with demographic change on the islands, means that not only are there fewer individuals available to help with communal activities, but also that those who are available may be less physically able to contribute. Therefore biosecurity practices which involve communal effort are increasingly less likely to be undertaken, and indeed have all but ceased in some townships.

Importing stock and overwintering on the mainland

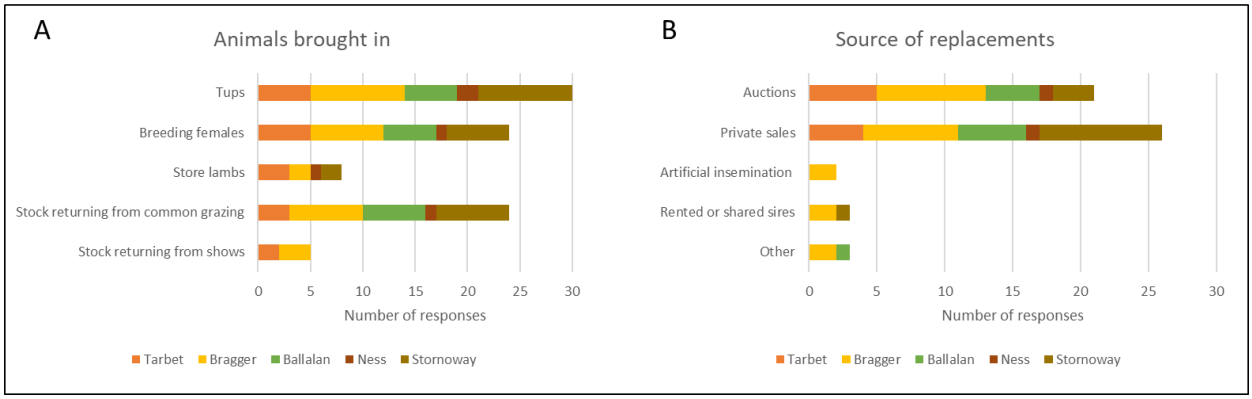


Figure 3. Poll results describing the type of animals introduced onto island crofts (A) and where newly purchased stock are typically sourced from (B).

Breeding tups are generally purchased from marts (auction sales), either on the island or on the mainland e.g. Dingwall (Fig. 3). Animals are often mixed at marts and buyers regularly share transport from the mainland to the island to reduce costs. While participants said buyers were often acquainted with and may trust the vendor, it seems it is not common practice to enquire about a vaccination or treatment record before purchasing the animal. It is also not common practice to quarantine tups before introducing them to the main flock or to areas of common grazing, representing a significant breakdown in disease control.

Traditionally crofters with large numbers of weaned lambs send them to farms on the mainland where the climate is milder, and winter grazing is better. This practice means feeding costs are reduced and lambs return the following spring in better condition than they would have had they wintered on the hill. During this period on the mainland and the process of transportation, there is a risk that these lambs are mixing with other animals carrying disease, which may then be transferred to flocks on the island. Quarantining on return was largely unheard of and often not considered a practical option.

Wildlife

Red deer

The number of red deer on the island was seen as a big issue. One participant said that *'they are overrun with deer'.* Deer carry ticks and the increasing tick burden on sheep was believed to be a result of escalating deer numbers. Participants spoke of losing lambs to tick infestation and expressed concern for their own health. Increasing woodland plantations and decreasing sheep numbers has resulted in hill grazing becoming increasingly unavailable and/or unpalatable. This drives sheep and deer into closer proximity on better ground around crofts and nearer more populated areas, including the outskirts of the main town of Stornoway.

Geese

The Outer Hebrides is on the migratory route for large flocks of geese which stop there to feed on the improved pastures and machair[2]. Historically geese moved on fairly quickly or were moved on by the crofters. However large numbers are now staying on the island throughout the year. Participants spoke of spoiled hay and silage crops due to trampling and soiling, and the fear of disease incursion.

White-tailed eagles

White tailed eagles were re-introduced to the West coast of Scotland some years ago and their numbers are increasing. They are seen as a disease risk as they *'drop bits of carcasses all over the island'* and are also blamed for taking young lambs as prey.

Contractors

Routine husbandry is generally carried out by the keeper, but in some cases when large gathers are necessary e.g. shearing, pregnancy scanning, or there are too many animals for one person to deal with, contactors are brought in from the mainland. While they are seen as a risk, in general their good biosecurity practices meant that the risk was perceived to be low.

Human visitors

There are an increasing number of tourists visiting the island. While in the main they were not perceived to be a significant disease risk, practically all participants voiced concerns about dogs worrying sheep and walkers inadvertently disturbing livestock, moving them off their hefted areas. Many participants felt that visitors showed a lack of respect for the countryside and the people working in it and some had received verbal abuse when requesting that dogs be placed on leads and kept under control.

[2] Machair is a fertile, low lying, grassy plain formed over thousands of years from sand washed up by the sea and eroded from dunes.

Biosecurity

Understanding of the term Biosecurity

Policy makers commonly use the term biosecurity. When participants were asked 'what do you understand by the term biosecurity' people mentioned footbaths and changing their clothes and one person immediately said *'bees and trees'* suggesting that they were thinking of biodiversity. However, when questioned further on practices and sheep handling people were clearly aware of good biosecurity, e.g. quarantining and treating before mixing with other sheep, although they were not necessarily aware of the term. They did not seem to equate good fencing or double fencing with the term biosecurity. Fencing is limited to the in-bye areas on the crofts and then not always maintained, crofters described livestock breaking out and being retrieved from neighbours. When introducing new stock to the island it appears that good biosecurity is not common practice, livestock are generally added to existing flocks as they arrive. The crofters described traditional practices, where they have 'always worked in this way' and lack of resources make it not a practical option. When asked why tups aren't routinely quarantined or treated before being released into the flock, one person said, *'it's aye been like that'* and said they believed that '*treating tups would cause a reduction in fertility'*.

Learning from other Islands

One area raised by a number of participants at different workshops was the desire to use the opportunities afforded to them by living on an island in order to get a better handle on biosecurity. Comparisons were made to Shetland, which by way of bylaws implements the Shetland Animal Health Scheme (SAHS), where animals, are checked, tested and treated for various diseases/conditions. There was an understanding that this was easier on Shetland where there was only one port of entry but it was felt a system could be implemented on Lewis and Harris. All animals' movement on the ferries require paperwork to be completed, if more importance was afforded to this rule the paperwork could provide means for animals to be identified and monitored.

"The Scheme [SAHS] is provided as a service for the agricultural community at large, and makes no charge nor levy for testing of imported stock — Aid provided under this scheme is granted in kind by means of subsidised services, and will not involve direct payment of money to producers." https://www.shetland.gov.uk/environmental-health/shetland-animal-health-scheme

Best practice and best fit

Key biosecurity practices as defined by the Scottish Government biosecurity practices for animal health guidance (https://www.gov.scot/publications/biosecurity-practices-for-animal-health-guidance) are; separation and isolation, good practice when buying stock, good hygiene, clean food and water and traceability and identification.

In general, best practice is not being adhered to on Lewis and Harris and many crofters appear to have a very light touch on biosecurity. There is a perception that the non-intensive nature of hill farming, remoteness and flock sizes of many crofts serve as a natural level of protection against disease, hence rendering much of the biosecurity guidance either unnecessary or inappropriate. In some areas, fencing is non-existent or in poor condition and few crofts have a double fence system. As highlighted earlier, participants spoke about the challenges of a lack of manpower, the older demographic, financial constraints and that there are fewer crofters in general keeping sheep which means that some biosecurity practices are increasingly problematic to undertake. There seems to be a general

lack of understanding around the correct use of drugs, particularly anthelmintics and scab treatment. Participants spoke of restricted choice of anthelmintics in the local farm merchants, and '*just using what was available'*, which may not always comply with current best practice advice. Diagnostics for disease was not common due to limited on island services and gaps in knowledge on these practices.

There was a concern that people coming into crofting aren't receiving enough or relevant information around livestock keeping and how to 'integrate' into the community and that these changes are impacting the community as a whole. There may be a requirement to develop more one-to-one meetings with the crofting commission and/or grazing clerks or a 'welcome to the community' package so that newcomers better understand the expectations of them by their neighbours.

Attitudes to sheep scab and roundworm

Sheep scab

As alluded to earlier, scab is considered to be the most contagious endemic ectoparasite disease affecting sheep in the UK. It is identified as one of the most important diseases for UK sheep farmers from both financial and welfare perspectives due to the costs associated with reduced performance, preventative measures and treatment, coupled with the apparent distress, irritation and/or pain caused. Outbreaks have been previously reported across the Western Isles on the island, with six notifications in 2018; ten in 2019; fewer than ten in 2020; three in 2021 and no notifications to date during 2022. Due to the highly connected nature of crofts and the use of common grazing, the disease is able to spread very quickly in the current situation and control of the disease in this setting can be very challenging.

Animals in the same flock can exhibit different stages of the disease, the obvious signs being loss of wool and scratching while others may appear unaffected without closer inspection (Fig 4.).

Figure 4. Sheep exhibiting different stages of scab (Picture courtesy of NADIS- animal health skills).

Despite previous outbreaks of scab on the island, most participants felt that the risk was low and that many people were not quarantining animals coming onto the island. However participants in Ness, where there had been a more recent outbreak (2017-18), showed a greater awareness of biosecurity measures e.g. keeping fences in good repair and quarantining incoming stock, although some people felt that complacency was creeping back in. It also seems that in Ness more keepers gather their sheep for pregnancy scanning (60-70%). While this will enable closer inspection of animals there is also a risk of spreading infection.

Participants believed that they could tell if an animal was healthy by observation alone and many seemed unaware that sheep could be carrying mites without showing any obvious signs. Participants commented that there are a large number of keepers on the island that don't understand sheep husbandry or just have a few sheep on the hill that they never see, which are not being treated effectively or at all.

Dipping

As only around 20-30% of keepers in general gather their sheep for scanning, and OP plunge dipping[3] is rare in some townships, it is highly likely that early scab infestations may be missed. When scab outbreaks do occur, most farmers treat the disease using either an OP plunge dip, collectively as part of an affected township or with an injectable ML[4], such as doramectin (Dectomax). However, many seemed unaware that Dectomax is only effective for treating the disease and offers no continued protection against reinfestation in the way that OP dipping, or more long-acting ML compounds do, e.g., cydectin-based compounds. Consequently, many were unaware that once treated with Dectomax, animals must be moved to clean pasture. In many cases this may not be an option due to the limited pasture available in the crofting systems so reinfestation is likely. It appears that treatment choices and outcomes can clearly be improved with increased knowledge around best practice control.

Historically dipping was seen as a communal effort with each township coming together to gather and dip their sheep, using community maintained fanks (Fig 5). More recently however, due to a move towards injectable medication and large gathers becoming less feasible (fewer keepers and the population demographic being older) many dipping facilities have fallen into disrepair.

[3] Submersing the animal in an organophosphate-based plunge dip
[4] Macrocyclic lactone -products or chemical derivatives of soil microorganisms belonging to the genus Streptomyces

Figure 5. Sheep handling facilities (fanks) on Lewis

Participants thought that there would be interest in a mobile dipping contractor either from the mainland or someone on the island. However actually gathering the sheep would still be an issue. At present there are few keepers with large numbers of sheep using the hill many of whom rely on paid help, often from the mainland, at gathering times.

Roundworms

Roundworms are estimated to cost the UK sheep industry approximately £84 million per annum in lost productivity, treatment and diagnostics. Production losses are associated with reduction in live weight gain, as well as a reduction in both the quality and quantity of meat and wool (Fig 6). While a lack of treatment may lead to production losses and, if severe, a welfare issue, there is an increasing concern around resistance to anthelmintics.

Figure 6. Sheep exhibiting signs of roundworm e.g. scouring. Picture courtesy of Moredun Research *Institute)*

There was a high level of awareness of the general need to treat sheep for worms, however these were typically not evidence-based interventions. Knowledge of anthelmintic classes, resistance to the products and how they may be used optimally was patchy. Awareness of different types of worm treatments was low, with most individuals using the term 'wormer' in a generic capacity. This means

that individual crofters may be using ineffective worm treatments on their flocks. A small number of crofters were aware of different groups of anthelmintics and would seek to alternate use to avoid resistance developing.

None of those present at the workshops carried out faecal worm egg counts before or after treatment and there was little focussed treatment of sheep, with many keepers preferring blanket treatments of the whole flock. Some participants questioned if the cost-benefit of the unnecessary or suboptimal treatment of the flock as a whole, when weighed against the time and handling required to test and treat individuals more appropriately, was worth it.

Few participants were familiar with the SCOPS (Sustainable Control of Parasites in Sheep) website. https://www.scops.org.uk/

Next Steps

Interviews with crofters

In order to gain a deeper understanding of the challenges facing crofters, one to one semi-structured, virtual interviews will be conducted. Participants will be invited to give their expert opinion on sheep scab and round worm control, and the issues surrounding disease control and biosecurity on Lewis and Harris. If you are interested in taking part please contact Carol Carol.kyle@hutton.ac.uk or Claire Claire.Hardy@hutton.ac.uk

Blood testing flocks for scab

Following the workshops, further discussions were held between scientists at Moredun and the Lewis & Harris Sheep Producers Association (LHSPA) with regard to blood testing some of the islands flock for scab.

It was felt that the best opportunity for a large-scale serological testing using the sheep scab ELISA developed at the Moredun, would be at pregnancy scanning. Approximately 250 farmers scan their sheep across Lewis & Harris, using a single scanning contractor with the activity being coordinated by the LHSPA. This provides an excellent opportunity to serologically test a large number of flocks across the island and will help to identify areas where further support could be focused during the second phase of the Scottish Government funded project should further funding be secured. In order to achieve this we will aim for the local vet to sample ~100 flocks in geographically distinct areas of the islands, with 12 animals being sampled and tested from each flock. Any positive cases will be confirmed by skin scraping samples and coordinated treatments arranged using a long-acting macrocyclic lactone injectable. If you would like to know more about this opportunity please contact Stew (Stewart.burgess@moredun.ac.uk)

Glossary of terms:

- **Basic practice -** the minimum required practice in a given domain
- **Good practice -** a recommended approach in a given domain because it has been proven to work before, sometimes across multiple domains
- **Best practice –** considered the superior practice in a given domain because it has been shown to deliver superior results consistently
- **Best-fit practice –** the optimal practices for a given farm within its socio-ecological context.

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Dave.bartley@moredun.ac.uk (round worm enquiries)