Draft

UplandsManagementGroup

Reports from Task & Finish Groups

Vegetation Transfer

Introduction

This is the first of what is expected to be a series of reports produced by the Uplands Management Group (UMG).

Much of the work of the UMG is carried out through Task and Finish Groups (T&F Groups). Members of these groups are drawn from within the UMG, but other people with relevant, specialist knowledge are also invited to contribute to the work of the groups.

The UMG establishes the T&F Groups to consider a particular topic and to provide a report for consideration. After it has been accepted, the Report may be published on the UMG website (www.uplandsmanagement.co.uk).

The aim of these reports is to collate and present the best available information. They should not be seen as the final answer to the topic, as due to the nature of the likely subject matter, it is expected that additional information will come to light. The reports will be reviewed from time to time, and they may be revised so that they reflect the latest thinking.

Draft

Report from the Vegetation Transfer Task Group

1.0 Issue

There are increasing concerns that the movement of harvested vegetation (principally: heather brash, heather seed and sphagnum moss) around the country as part of peatland and moorland restoration projects carries a risk of spreading diseases and insect pests from one part of the uplands to another part. Cryptosporidium in grouse is currently perceived to be the main disease threat and heather beetle the principal insect pest.

More research is likely to be required to quantify the threat posed by the movement of vegetation, but initially the potential for transfer and the scale of the problem will be assessed, based on current knowledge.

This short report examines the biosecurity measures in place already, the life cycles and transfer routes of the pests and disease organisms and asks what more do we need to know or do to limit the risk.

2.0 Objectives:

- To provide a summary of the state of current knowledge about this issue.
- To provide an estimate of the potential scale of the problem, based on knowledge about the quantities of vegetation that are being harvested and moved around the country.
- To make recommendations for additional investigation if this is required.

3.0 Timescale:

Start 18th May 2015, finish 7th July 2015.

4.0 Task Group

Chairman – Amanda Anderson, Moorland Association

Members from the UMG and others outside UMG were asked to contribute mainly by email and telephone to inform this report. The Chairman retained the role of Task Group Secretary and approached those known or recommended as having specialist knowledge in the fields of peatland restoration, Cryptosporidium and/or Heather Beetle. Some acted as conduit to others in their organisation to ensure the fullest breadth of knowledge was fed into the process in the timescale.

UMG members
Geoff Eyre – Moorland Restoration Consultant
Nick Sotherton – GWCT (Dave Baines and Dave Newborn)
Andrew Walker – Yorkshire Water

Non-UMG members
Matt Buckler – Moors for the Future (including Mark Osborne feedback)
Patrick Laurie – Heather Trust
Alan Beynon BVM&S MRCVS – St David's Specialist Poultry Vet
Michaela Giles - Bacteriology Department of Animal and Plant Health Agency (APHA)

5.0 Summary of current knowledge

It has been a general principal, where possible, of any moorland restoration project to source vegetation including heather brash, seed and moss, from as close to the area as possible. There does not appear to be a defined radius but 10 miles has been quoted in some instances and 'within the National Park' in others. This is primarily to keep costs down and ensure provenance of the same plant genetics appropriate to the location. This may have helped limit the risk of disease and pest transfer. When there has been a shortage of material, or indeed a disease outbreak, has vegetation been sourced from further afield? Seed, moss and brash is occasionally moved over very long distances of several hundred miles.

That said, all moorlands are open access and used by a variety of people for a variety of purposes and transfer of pests or infectious disease could occur by any means other than vegetation transfer: wind, livestock, people or their dogs and vehicles, mountain bikes…the list is almost limitless.

Without understanding fully the life cycles and characteristics of the organisms involved, it is natural to perceive that there is a high risk inherent in 'bringing in' foreign material to any area. This perception can cause recipient sites for material to halt restoration projects for fear of contamination, or at least, very rightly, demand biosecurity safeguard measures.

There is a passport system in place for the harvesting and transfer of vegetation, which has been established and operated for some years by Moors for the Future. It logs donor sites and recipient sites. It details the physical checks that trained staff must carry out on vegetation at donor sites for Phytophthora, ticks and heather beetle. Recently (2015) a further verbal check has been added to the passport system to ensure the area to be harvested of brash is free of any visible outbreak of Cryptosporidiosis in the grouse. (The specific area of a grouse moor is known as a beat.) This passport system has recently been promoted and made more readily available to other contractors, donors and recipient site land managers and other restoration partnerships as an example of good practice.

It is accompanied by a recently added clause in the associated tender and contract paperwork:

"The heather brash sought through this tender is to be used as the first stage in stabilising and restoring bare peat areas on the uplands of the Peak District and South Pennines. The land it will be transported to and spread on is often agricultural land, which may be managed for grouse shooting. As such, it is imperative that the contractor provides assurance that there is no known history of pest or disease at the donor site which may affect any agricultural or sporting interests."

5.1 Heather Beetle

The Heather Beetle life cycle is well known and so harvesting material at certain times of year to coincide with its behaviour would help to reduce or even eliminate transfer risk. This cycle being properly explained to both donor and recipient sites will do much to undo the perceived threat of transfer. There have been cases of recipient sites having an outbreak of disease following brash transfer and contractors being accused of introducing beetle on machinery and in the vegetation because there has been no knowledge of the behaviour of the beetle at brash harvest time, nor a passport system and checks put in place before harvesting. Simple washing down of machinery between sites would also help allay fears.

Heather Beetles are dormant (underground) from the first frost until early spring (March/April). Therefore, heather brash is thought to be free of beetle over winter and could be harvested with little transfer risk after the first frost.

If daily average temperatures of 8^{o}C or more are attained, harvest should stop because beetles climb up into the heather leaf to warm up in the sun. They would be easy to gather up by accident at this stage, even when harvesting heather at 20cm/30cm off the ground, which appears to be common practice to avoid damaging the moss layer or buried archaeology.

Eggs are laid in wet areas including Sphagnum mosses in late spring/early summer depending on the weather once the adults have emerged. A really good hatch of eggs follows a warm and moist period. The pupating grubs are a few cm down in the moss in late summer, (generally between the end of July and late Aug/early September), which poses a transfer risk if Sphagnum is harvested during any of this time. However, over winter the beetles seek drier hibernation sites such as amongst heather roots and under dry mosses. Harvesting Sphagnum moss, which is naturally wet, over winter would therefore limit the risk of transfer. Heather roots and drier mosses would normally be avoided in harvesting vegetation due to the risks of causing damage to, and reducing any ability of, the heather plants to regenerate and exposing the peat surface to oxidation and erosion.

Heather seed for re-seeding projects is best harvested from November to February. So long as there has been a frost, there should be minimal risk of harvesting viable beetle with the stripped heather tips used for such re-seeding projects. 'Beetled heather' produces very few flowers so these areas are not generally harvested for seed but can still be effective.

It is believed that heather beetles are ubiquitous across all moors but in low numbers. Each moor is said to have some damage if studied hard enough. Beetle damage is hard to spot whilst in progress which involves the grubs of the beetles effectively 'ring barking' the heather stalks, or otherwise damaging the protective outer coating of leaves and shoots, leading to dehydration and death. Only once the damage is done do the leaves and stems turn russet red and indicate an attack. Even this is not a good indicator of where the beetles reside at that time as they may have moved on. A major beetle outbreak is considered to be due to climatic conditions and the availability of egg laying habitat. An approved bug repellent powder applied to all brash by one specialist contractor is effective against moth egg hatch and may be useful against heather beetles too. However, this should be unnecessary, if harvesting is carried out at the right time of year, as laid out above.

Natural England's Heather Beetle Review published in summer 2015 – a desk review of burning and other management options for the control for heather beetle (NEER009 download[1]) - recommends that brash used in moorland restoration should be screened for larval infestation before use.

5.2 Cryptosporidium

The knowledge of *Cryptosporidium baileyi* transfer routes in the moorland setting between wild birds, and grouse in particular, is poor. Therefore, assessing the level of threat of transferring brash or moss from a moor with a prevalent infection in grouse to a moor with no obviously infection, is currently guesswork. There is clearly a potential risk and with this

[1] http://publications.naturalengland.org.uk/category/5968803

in mind, it is felt by most that moss from a known Cryptosporidium problem site, should only be used back on the same site.

Cryptosporidium baileyi is a ubiquitous protozoa which can occur in the gut of all birds, including poultry, without the host bird necessarily showing symptoms. The transmission of the disease is by ingesting or inhaling the infective sporulated oocysts. These are passed out in grouse droppings and secretions from the respiratory tract and eyes and anything contaminated with these are a potential risk of infection. Oocysts passed out of the gut are known to be viable for at least a year in moist conditions and are killed by 65^0C of heat/steam or a strong specific concentrated disinfectant and with prolonged contact – they survive in full strength household bleach. Hydrogen peroxide 5% for 5 minutes will also kill them. UV light is known to contribute to making them non-viable but minimum exposure times will vary.

When the host is under stress (in grouse the cause of this stress in as yet unknown) they can start to show symptoms as the parasitic burden becomes a heavy infection in the respiratory system. In this way, the disease is not initially 'spread' as such, but developed in individual birds. However, respiratory mucus is highly infectious and can spread the disease between birds that come into contact with each other or mucus/faeces in their environment. With a heavy enough dose of infection, healthy birds (not stressed) will show clinical disease. Young immunologically naive birds seem to be the most prone to developing infection in the grouse population.

Cryptosporidium oocysts will most probably occur in areas across all moorland regardless of visible symptoms of disease but no studies of the abundance in moss, soil or heather (harvested or in situ) have been conducted. Environmental samples are expensive and difficult to test as the infective load for *C. baileyii* is very small. Equally, abundance of oocysts and any differences has not been compared and contrasted across apparently 'disease free' to 'diseased' areas i.e. those where grouse show symptoms. An infectious dose is very low, (compared to the numbers shed in faeces), so relative abundance in the environment may be less important compared to the opportunity of transfer.

It is likely that there will be hot spots across a moor that have a higher abundance of viable oocysts anywhere where birds congregate and defecate such as roosting sites, and water sources such as pools and scraps. Equally, grit trays developed to sufficiently hold and withdraw medicated grit could act as a focal point for the oocysts as they allow for defecation onto a product destined for ingestion and is a place where birds may also congregate. Grit trays have been analysed and found to contain significant amounts of oocysts at the microscopy level. Vegetation surrounding grit trays are likely to be affected in the same way and should be avoided for harvesting vegetation. Finding out further sources of potential infection is an important part of assessing the risk of Cryptosporidium transfer through any harvested medium. Faecal contamination of vegetation to be harvested should be quantified and form part of any risk assessment.

The difference between gut or respiratory oocysts in terms of their virulence and ability to cause damaging disease is the same. 50% of moors surveyed by GWCT were found to have visible symptoms of the disease; the figure rises to 80% in the North Pennines area. Infection rate was however recorded at 15% in grouse bags in 2014 and work is continuing on detection. Natural mortality of those infected is greater than half, (GWCT). Actual cause of death is often a secondary reason due e.g. predation or starvation due to impairment. Both the North York Moors and the Peak District have had very few if any visible signs of the

disease and naturally don't want to have any threat of transfer imported. With so little known about the disease transfer routes in grouse it is difficult to allay fears when it comes to importing wet moss – a medium oocysts may well thrive in.

Encapsulation of filaments, capitula and spores is one way of using harvested Sphagnum for inoculation on a donor site. In this process, sterile nutrients can be used along with coating agents that may prevent oocyst hatch. This has not yet been tested. Micropropagation of moss in sterile culture media will reduce the risk of transfer of Cryptosporidium in Sphagnum.

6.0 Potential Scale of the problem.

The task group was asked to look at the scale of the movement of vegetation around the country to assess the associated risk of biosecurity and disease/pest transfer.

Despite the importance put upon climate change mitigation, biodiversity improvement, the health of blanket bog, carbon lock up, flood mitigation and water quality, under so many government agendas, there appear to be no readily accessible collated figures. In some cases even regional, project-level data is hard to extract. Hundreds of millions of pounds of both HLS and EU Life funding having been spent in trying to achieve very laudable results and the information must exist to justify the costs. Natural England have undertaken to pull together this information as a matter of urgency.

6.1 Quantities of heather brash harvested and moved about the country.

Not all projects for re-vegetation have used heather brash, although it has been extensively used on large areas of bare peat. Currently, Moors for the Future and United Utilities (who have undertaken most of the bare peat restoration work, working in the Peak District and South Pennines) regard heather brash as essential to the stabilisation of extensive areas of bare and eroding peat.

As a best guess, since 2002 over 700 hectares of bare peat have been re-vegetated with heather brash (approximately 110,000 bags) as part of the process. It takes approximately 20 tonnes of brash to cover 1 hectare to sufficient depth to create the right conditions for seeds falling from the brash and additional nursery crop seeds to germinate and help knit the eroding peat surface together. With programmed and estimated works for the next 5 years, a further 300 hectares of bare peat will be stabilised, requiring approximately 50,000 bags of brash.

6.2 Quantities of Sphagnum harvested and moved about the country

The amount of Sphagnum moved (separate to that contained in heather brash) is considerably smaller, with probably less than 1000 builder's bags harvested. Due to the potential impact of collecting this material on the donor sites, some projects are producing this material by micro-propagation rather than collecting and translocating, and most translocation is also done very locally.

6.3 Future trends

There are still 300 hectares of bare peat to be re-vegetated in the north of England. In the Peak District they predict a drop in brash requirement as they have stabilised most of the bare peat sites. As far as Heather Beetle is concerned, harvesting brash in winter should pose no threat.

We do not know if Cryptosporidium is present on brash in areas that do not show visible signs of disease. It may be that the donor site already has similar levels of Crypto oocysts in the heather but the all-important factor is the general health and stress levels of the grouse on the donor site as to whether this is a great risk or not.

We should also take in to account that applying dry heather brash to a site that has been bare peat for some considerable time is unlikely to be frequented by grouse as there is nothing there for them. Adding dry brash harvested in winter is unlikely to make it any more attractive until there is something to eat which could take years to establish. Will any oocysts still be residual and viable? Would their ingestion by a healthy grouse cause disease?

What is perhaps of greater concern is that there are 400,000 acres of vegetated blanket bog under grouse moor management that are in need of varying degrees of improved functionality to meet EU targets and deliver ecosystem services. This requires a raised water table and the introduction of Sphagnum moss to aid water filtration, carbon capture and reduce erosion. Wet conditions and Sphagnum moss are an incubator for both Cryptosporidium oocysts and Heather Beetle eggs and grubs. Without some answers to the questions raised in this report, the lack of knowledge will naturally make landowners cautious about fully embracing peatland restoration as the unintended consequences could be damaging to their primary objective.

7.0 Recommended Immediate Actions

It would be highly beneficial for all involved in peatland restoration that includes vegetation transfer to implement the use of the Moors for the Future passport and its sensible checks. Communication of its existence and operation will go some way to reassure donor and recipient sites that biosecurity is taken seriously.

This report may inform the Moors for the Future Q&A (see Appendix) and it may be beneficial to update it accordingly. Or this document, kept up to date, may be used in preference.

Having first checked that it is a convenient time to harvest for donor estates in terms of work programmes and without causing damage by harvesting machinery over potentially wet sites, it would be highly beneficial to communicate clearly to contractors, peatland partnerships, donor and recipient sites the known science about the life cycle of the heather beetle and to ensure all brash is harvested in the winter after the first frost only and above the litter layer. Checks of brash to be harvested should still be carried out in case climatic conditions cause a change in the beetle's behaviour. Ticks should also be dormant in the litter layer at this time of year*. Do they 'wake up' at the same temperature of 8^0C?*

Clear communication to all grouse moor managers that Cryptosporidium is ubiquitous and probably present but in unknown quantities and in unknown hot spots on most moorland would be helpful. Often at low levels of ingestion of oocysts, a visible disease does not present itself. Birds that congregate and/or are in some way immunosuppressed or naïve are most likely to pick up infection in a quantity to become debilitating. Guidance on grit tray hygiene and design is required.

Record keeping of peatland restoration work at the local and peat partnership level is detailed, but different regions use different measurement methodology and there is little collation at the English level despite important progress towards:

- climate change mitigation
- Biodiversity 2020
- SSSI favourable condition
- Natura 2000 favourable conservation status
- The USF Peatland Restoration Strategy
- Flood mitigation planning
- Water Frame Work Directive Section 7 requirements.

Every help should be given to Natural England to create a robust and reliable datatset.

Peat partnerships and GWCT (Crypto) and Heather Trust (Heather Beetle) could work closer together to advise on proposed harvest sites and any known risks. Mapping has been suggested as potentially helpful tool to plot incidences of outbreaks, but often these are at a very small scale (one bit of one beat of a moor) so the effort to benefit of the exercise needs weighing up.

8.0 Recommendations for further investigations.

1. Do moors with a higher water table/Sphagnum cover have a greater rate of heather beetle attack due to more egg incubation sites?

2. What is/are the main cause(s) of stress which allows Cryptosporidium emergence in grouse i.e. from normal pathogen burden to visible symptoms and can it be avoided by husbandry/management techniques?

3. Continue to monitor occurrence and scale of heather beetle, tick and Cryptosporiduim.

4. Where do oocysts occur on the moors; in the heather, soil, moss and do moors with a higher water table/Sphagnum cover have more oocysts?

5. What is the main route of transfer of Cryptosporidiosis between grouse and what can be done to reduce/eliminate this route?

6. Does heather brash contain viable oocysts, possibly in caecal or faecal material, at an abundance that can cause visible symptoms of disease in healthy grouse?

7. What methods of Sphagnum moss harvesting would most reduce the transfer of viable oocysts? For example, does spore or filament encapsulation with sterile nutrients render oocysts incapable of hatching?

8. Explore other techniques of restoration that have used medium other than brash and their success.

9. Explore techniques of growing Sphagnum off-site in sterile conditions.

Appendices

1. Moors for the Future Brash Passport
2. Moors for the Future Crypto Q&A

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Appendix 1

Heather Brash Passport

Moors for the Future Partnership, The Moorland Centre, Fieldhead, Edale, Hope Valley, Derbyshire S33 7ZA

MFF - Donor Site Information Sheet			
Date		Name	
Cutting Site			
Site Details			
Owner			
Contractor			
Site Contact			
Contact details	Tel:		
	email		
Permissions			
SSSI	NE Officer		
	Approval		
	File Ref		
Archaeology	Arch Service/Officer		
	Survey Surveyor		
	Approval		
	File Ref:		
Phythophora	Surveyor		
	Survey Date		
	Clear		
	File Ref:		
Heather Beetle	Surveyor		
	Survey Date		
	Level		
	File Ref:		
Tick	Clear		
	File Ref:		
Approved	MFF CM		Client

Heather Brash Passport

Moors for the Future Partnership, The Moorland Centre, Fieldhead, Edale, Hope Valley, Derbyshire S33 7ZA

Cutting Details			
Approval granted			
Posters installed		Removed	
Start date		Finish date	
Bags cut			
Recipient Site			
Recipient Site		Lift Site	
Land Owner		Approved	yes
Start date		Finish date	
Amount			
Recipient Site		Lift Site	
Land Owner		Approved	
Start date		Finish date	
Amount			
Recipient Site		Lift Site	
Land Owner		Approved	
Start date		Finish date	
Amount			
Recipient Site		Lift Site	
Land Owner		Approved	
Start date		Finish date	
Amount			
Recipient Site		Lift Site	
Land Owner		Approved	
Start date		Finish date	
Amount			
Recipient Site		Lift Site	
Land Owner		Approved	
Start date		Finish date	
Amount			
Contract Ref			
Signed:			