Investigating unexplained lamb loss in Scottish hill flocks

FIONA MCAULIFFE

A. MCLAREN, A. KENT, F. BRÜLISAUER, N. SARGISON, D. MCCRACKEN

THE UNIVERSITY of EDINBURGH
The Royal (Dick) School of Veterinary Studies

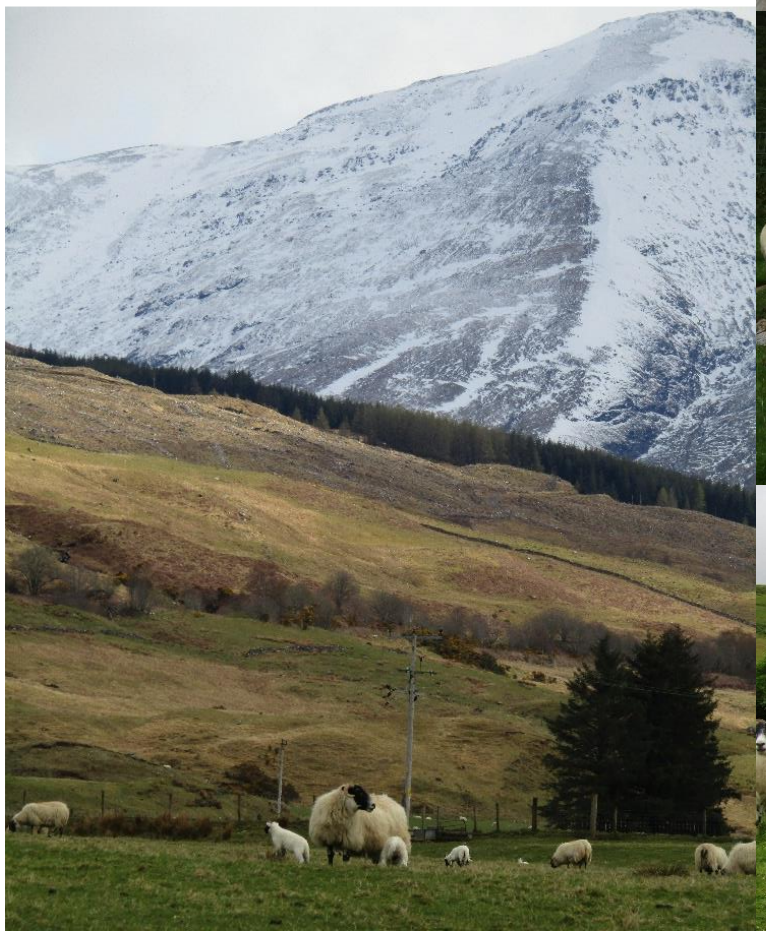
Fiona.mcauliffe@sruc.ac.uk

SRUC

NatureScot
Scotland's Nature Agency
Buidheann Nàdair na h-Alba

SCOTTISH HILL SHEEP

- Extensive, unenclosed upland grazing areas
- Use hardy, native breeds
- Not housed/outdoor lambing
- Flocks usually handled at least 5 times a year
  - pre-mating (Nov)
  - post-mating (Jan)
  - marking (Jun)
  - shearing (Jul)
  - weaning (Sep)
- Lambs typically sold store

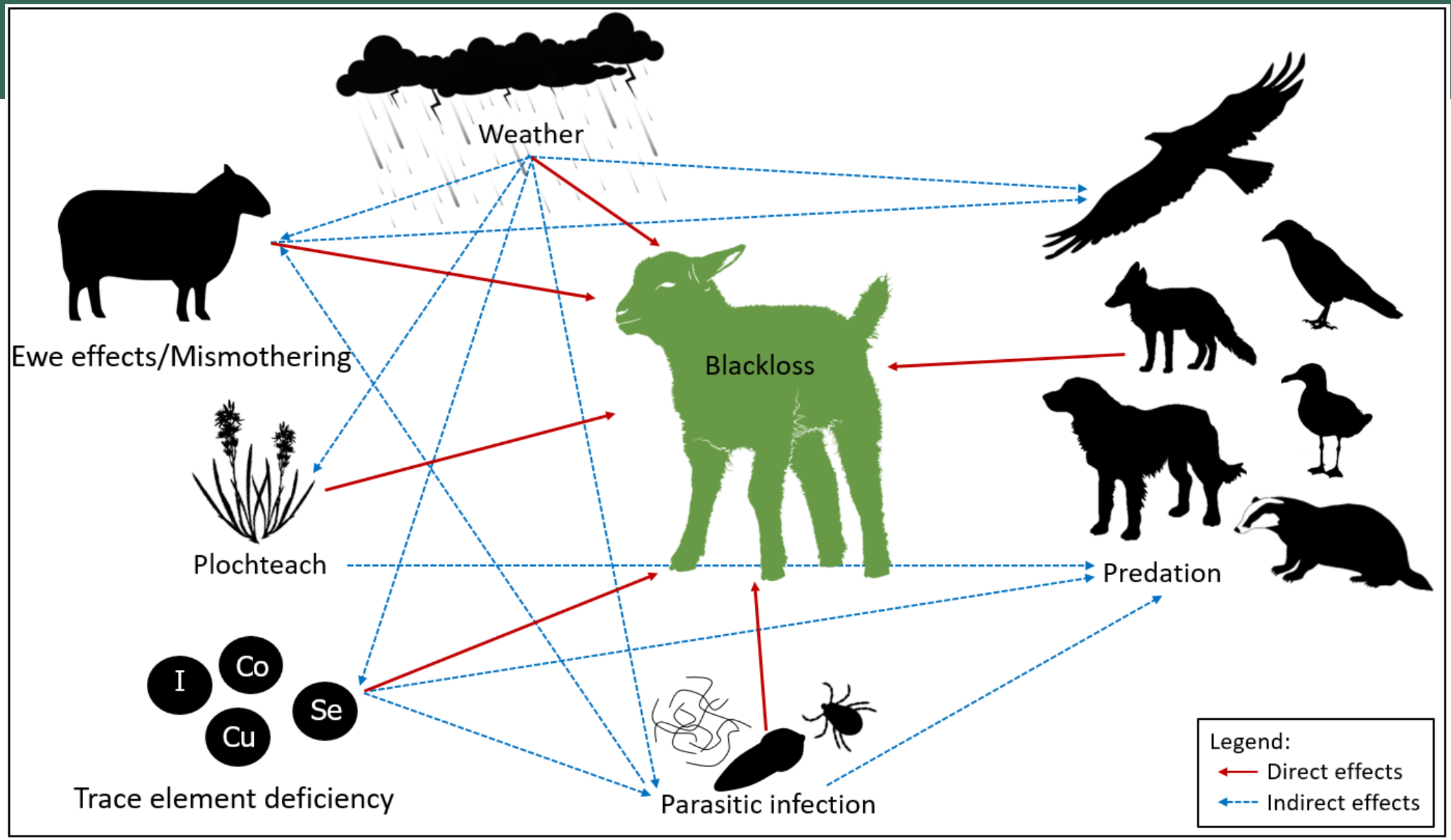


BLACKLOSS PHD PROJECT

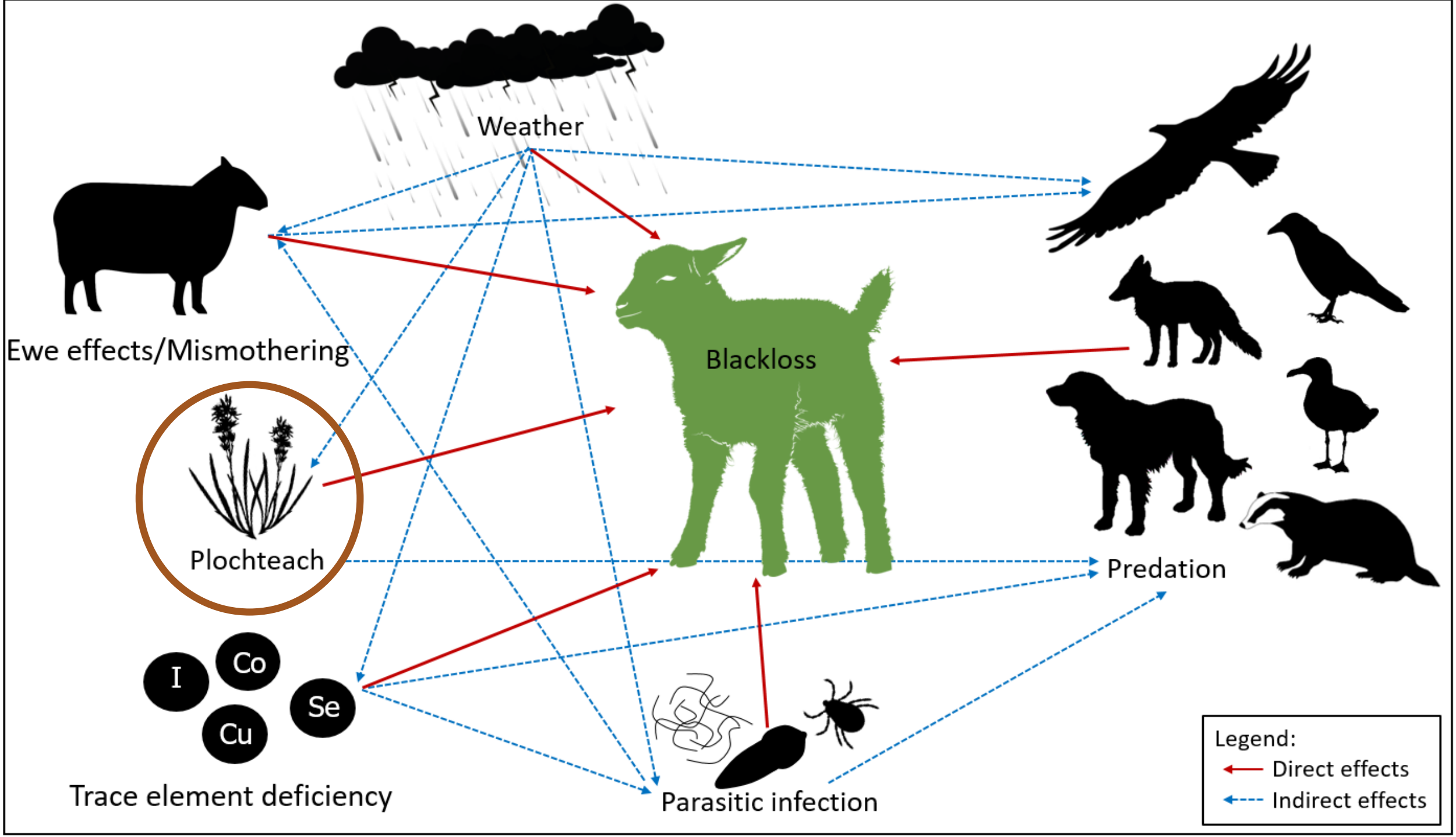
- Blackloss is the term used for the unexplained loss of lambs on extensive hill grazings in the Highlands of Scotland.
- My PhD project focused on losses between marking (6-8 weeks) and weaning (4-6 months).
- Average mark-wean blackloss of 18.6%

  (range 8.4 – 25.8%). (Tongue *et al.*, 2016)
- Lambs are not regularly supervised across extensive grazings, resulting in a lack of information on where and why lambs disappear.

PROJECT BACKGROUND- LAMB HEALTH ISSUES AND BLACKLOSS



PART 1:
INVESTIGATING FACTORS FOR LAMB LOSS AND PHOTOSENSITISATION


Weather
Ewe effects/Mismothering
Blackloss
Plochteach
Predation
I
Co
Se
Cu
Trace element deficiency
Parasitic infection
Legend:
Direct effects
Indirect effects

LAMB HEALTH ISSUES- PLOCHTEACH

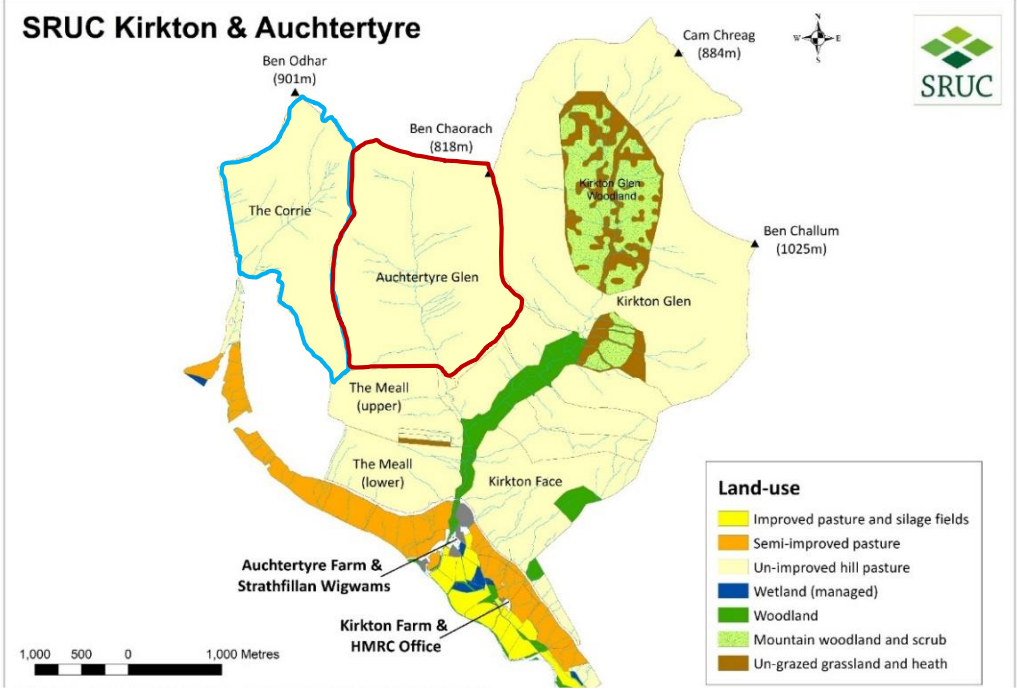
- ‘yellowses’, ‘saut’, ‘head geet’, ‘alveld’, ‘hard lug’
- Outbreaks: June and July in wet upland habitats
- A suspected cause is ingestion of saponins found within bog asphodel (*Narthecium ossifragum*)
- Prevalence of 11% and 20% in lambs from SRUC’s Auchtertyre flock during 2013 and 2014. (G.V. Cuthill, unpublished data- Pollock *et al.*, 2015)

LAMB HEALTH ISSUES- PLOCHTEACH

- A disease which damages the liver
- Photosensitisation on exposed skin
- Lambs become dull, cease eating, seek shade and can damage the skin further by scratching
- Lambs may also die of shock or secondary infection
- There is no specific treatment, however providing shade can prevent further photosensitisation

METHODS- STUDY SITE

- SRUC's high hill flocks: Auchtertyre and the Corrie
- Managed as three groups:
  - AT: Auchtertyre hill singles
  - AC: Corrie hill singles
  - TW: Ewes from both hills with twins, reared in-bye and in parks
- Anecdotal observations suggest that there is a greater abundance of bog asphodel in the Auchtertyre glen than in the Corrie grazing area, semi-improved parks and improved fields.



METHODS- DATA COLLECTION

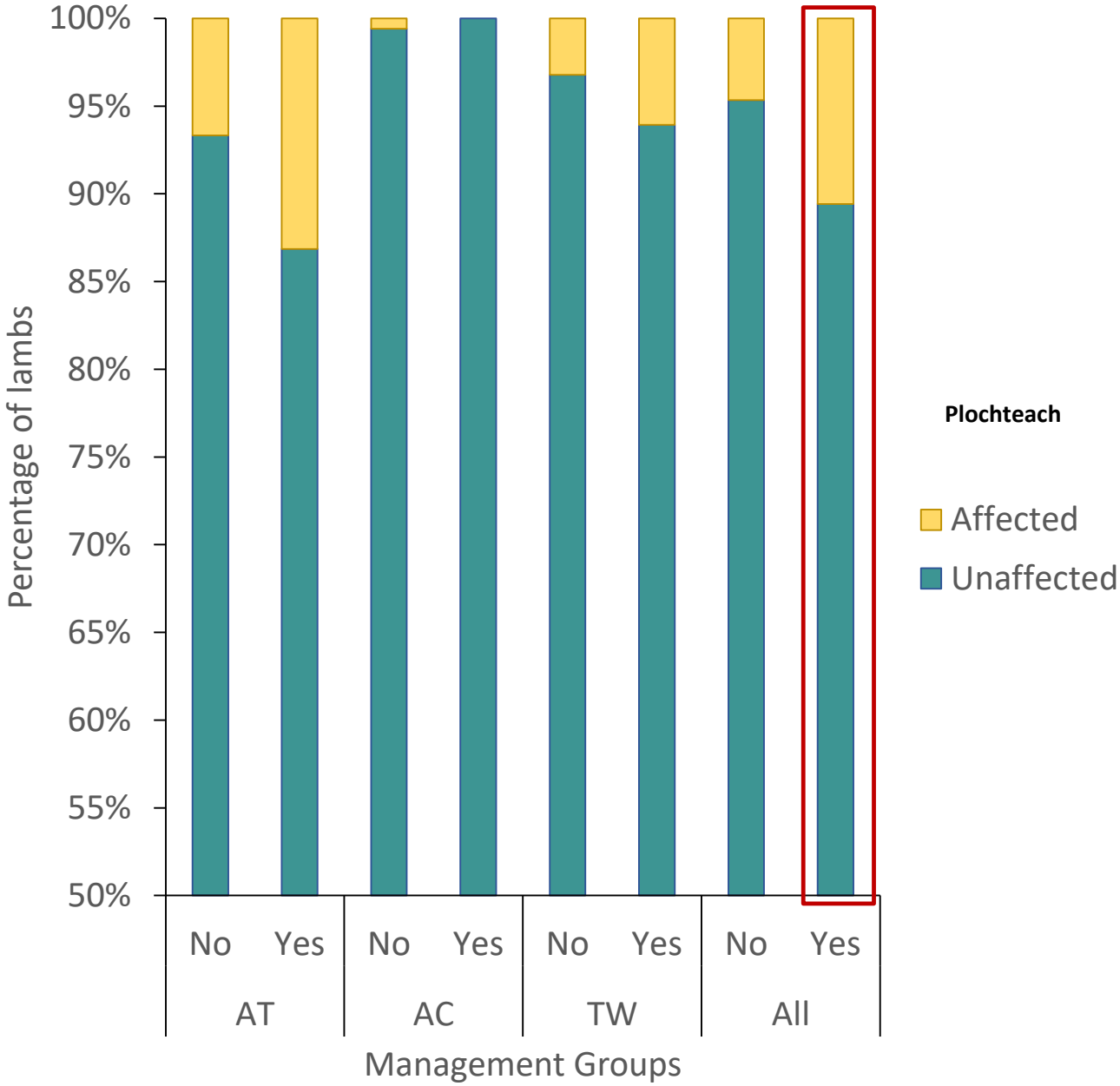
- AT: 2014-2021, 1629 lambs
- AC: 2017-2021, 353 lambs
- TW: 2014-2021, 1092 lambs
- Breeds: Scottish Blackface and Black Welsh Mountain
- Recording events: lambing (May), marking (June), shearing (July) and weaning (August).
- DNA samples to determine dam and sire
- Presence/absence was recorded using EID tags
- Individual lamb weights recorded using EID weigh crate
- Plochteach was diagnosed through clinical signs of photosensitisation on the ears and/or back

	Ears		Back
1		A	
2		B	
3		C	

4		D	
5		E	
6		F	

PLOCHTEACH AND BLACKLOSS

- The eight-year average blackloss: 8.3%.
- Total lambs affected by plochteach: 5.1%.
- Prevalence of plochteach in the blackloss populations was 10.6%



METHODS- ANALYSIS 1

- Blackloss determined between marking and weaning using presence/absence

Lamb ID	Lambing	Marking	Shearing	Weaning
1	✓	✗	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✗
4	✓	✓	✗	✗

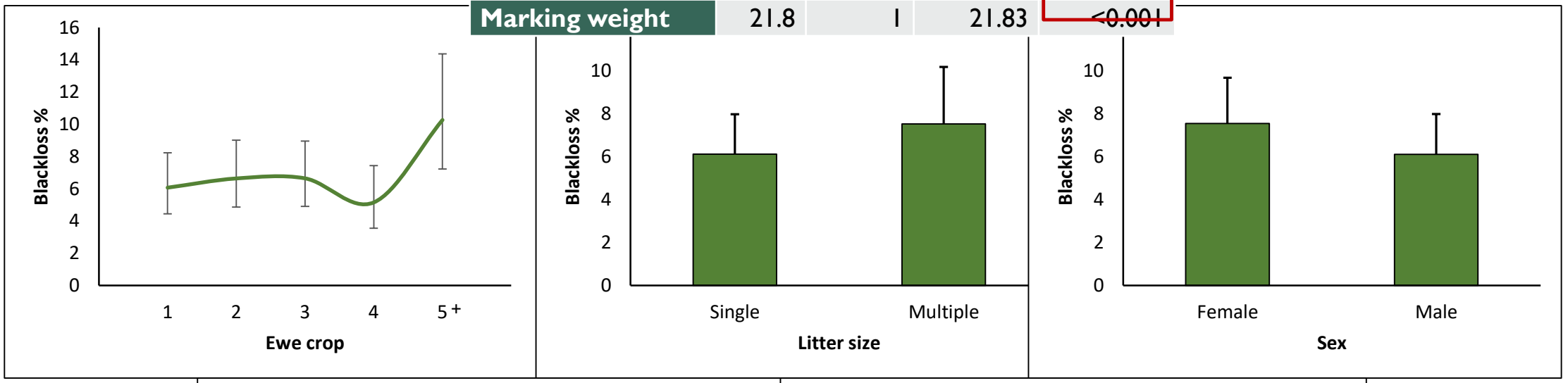
Binary GLMM: **Blackloss** ~

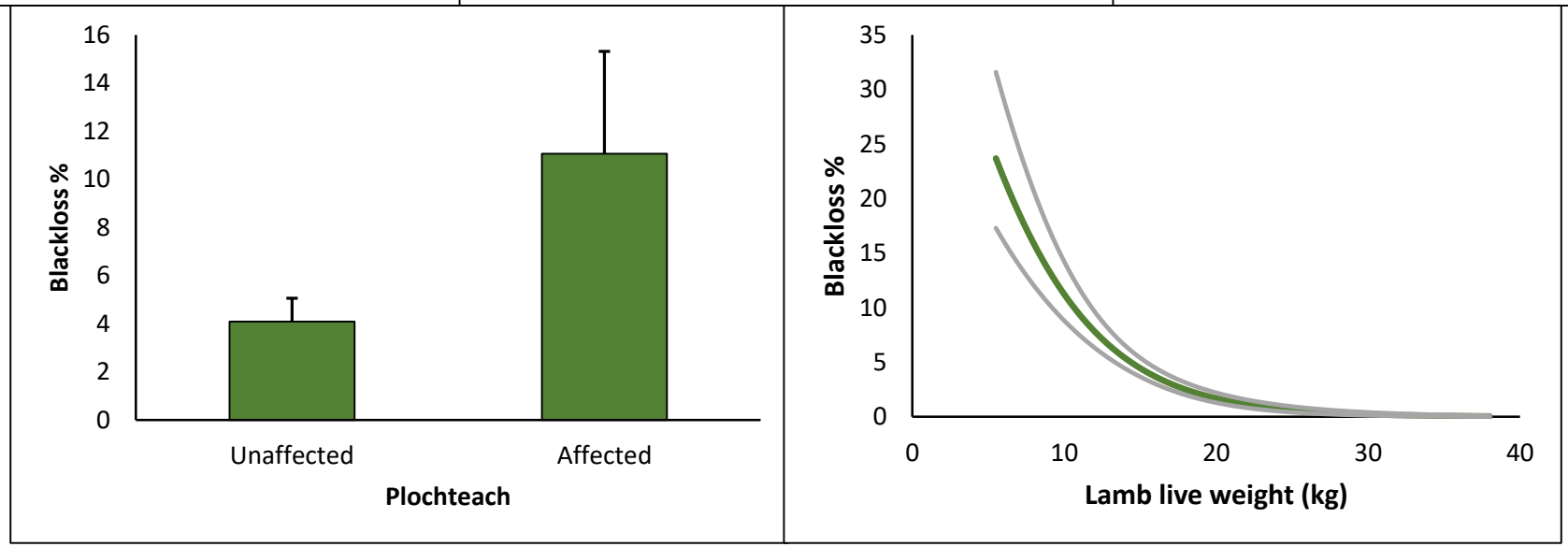
Fixed effects model: **Ewe Crop** (5 levels; 1, 2, 3, 4 & >5) + **Litter** (2 levels; single and multiple) + **Sex** (2 levels; male & female) + **Plochteach** (2 levels; affected or unaffected) + marking **weight**

Random effects model: **Year** (8 levels; 2014 to 2021) x **Management Group** (3 levels; AT, AC & TW) + **sire** + **dam** + **dam** x **group** x **year**

RESULTS- BLACKLOSS

	Blackloss			
Fixed effects⁺	ndf	ddf	F stat	P
Crop	3.4	4	0.85	0.495
Litter	0.4	1	0.43	0.511
Sex	2.8	1	2.76	0.097
Plochteach	12.9	1	12.87	<0.001
Marking weight	21.8	1	21.83	<0.001





METHODS- ANALYSIS 2

- Plochteach determined between marking and weaning using clinical signs

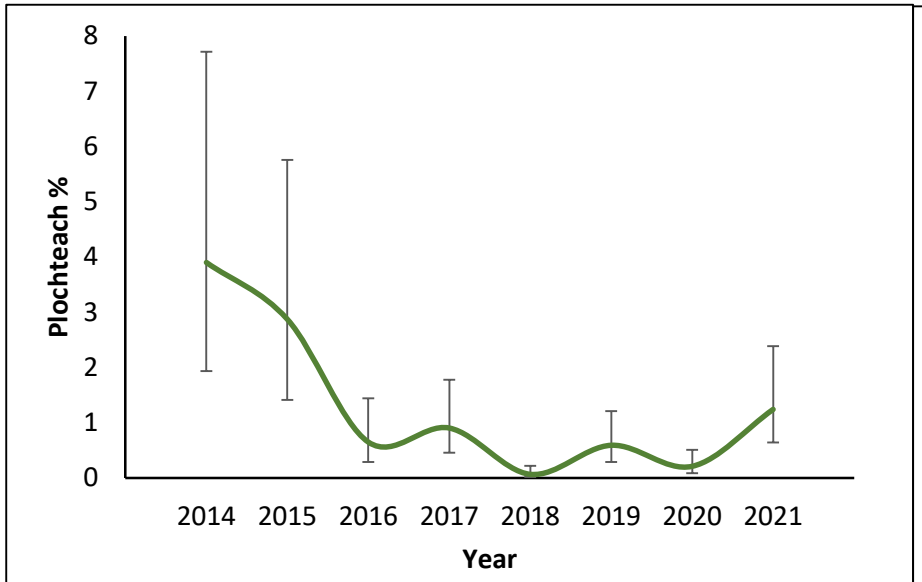
Binary GLMM: **Plochteach ~**

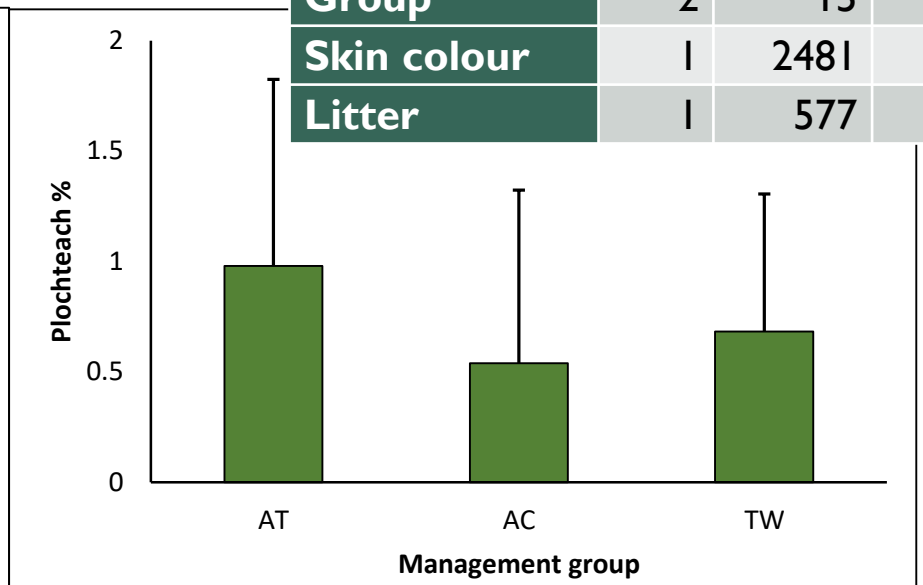
Fixed effects model: **Year** (8 levels; 2014 to 2021) + **Management Group** (3 levels; AT, AC & TW) + **Skin Colour** (2 levels; black or white) + **Litter** (2 levels; single and multiple)

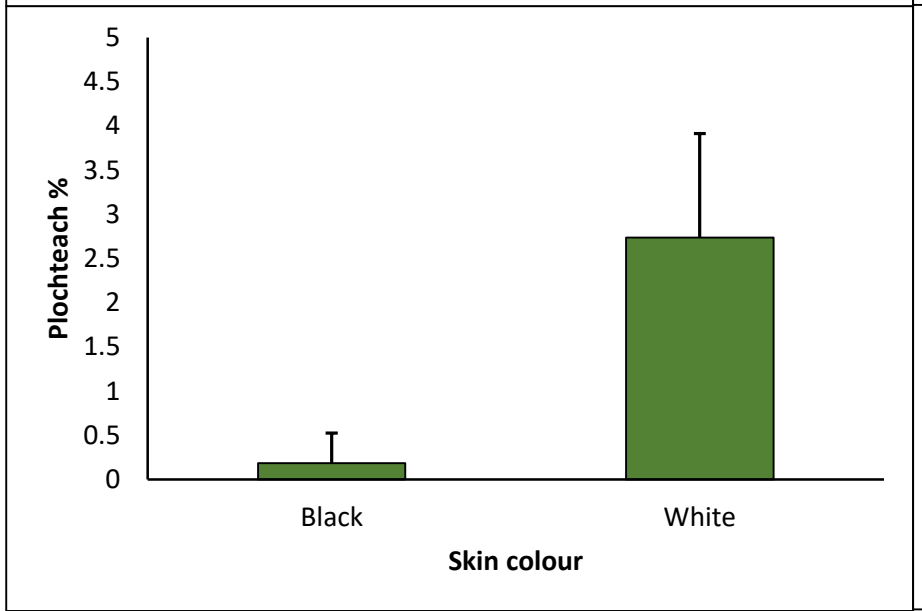
Random effects model: **Year** x **Group** + **sire** + **ewe** + **ewe** x **group** x **year**

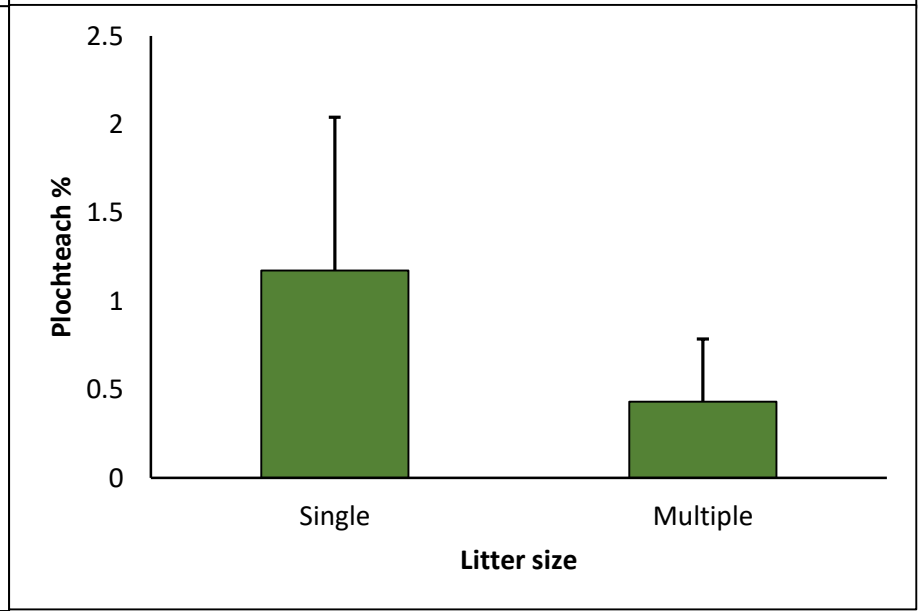
RESULTS- PLOCHTEACH

	Plochteach			
Fixed effects⁺	ndf	ddf	F-stat	P
Year	7	6	3.43	0.071
Group	2	15	4.11	0.037
Skin colour	1	2481	6.08	0.014
Litter	1	577	10.34	0.001









FURTHER IMPACTS OF PLOCHTEACH

- Wool will grow back over affected areas
- Lambs affected by plochteach are typically **>4kg** lighter than unaffected lambs at weaning.
  - Impacts sale price
  - Longer time to finish lambs
    - Added feed costs
    - More methane

Plochteach

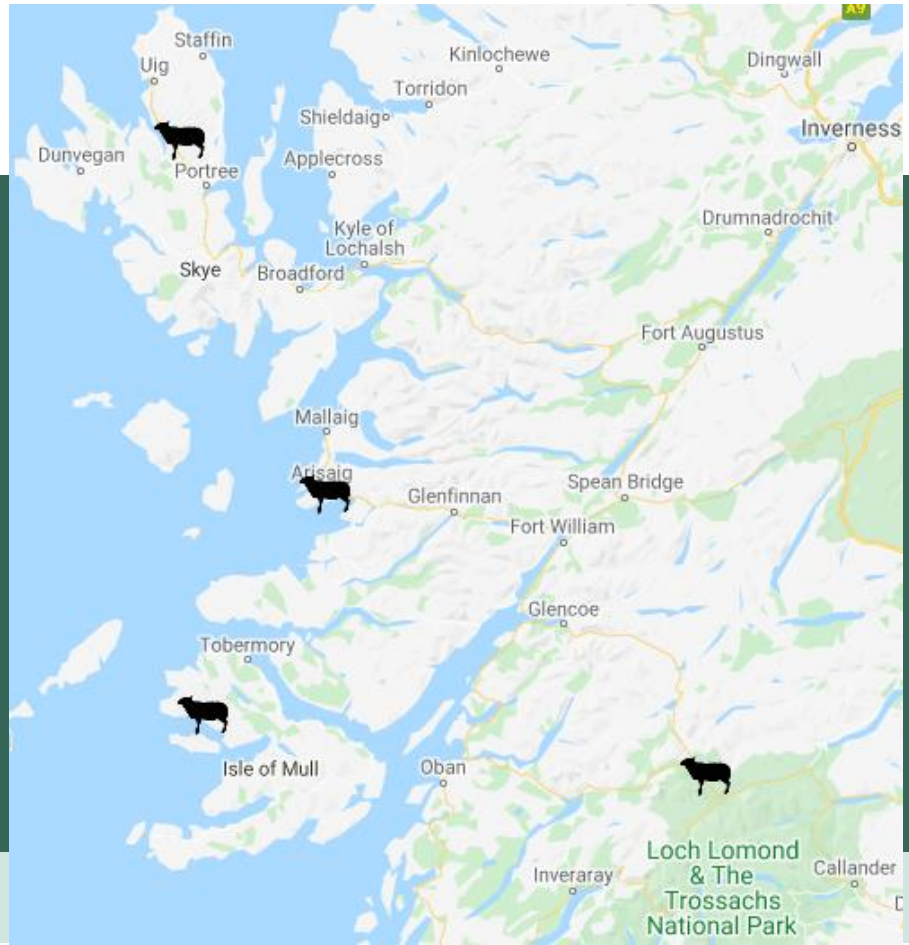
- This study method does not account for lambs that may be affected by plochteach but do not show external symptoms.
  - AC lambs
  - Tip of the iceberg

CONCLUSIONS

- The data shows that plochteach is a cause of blackloss within lambs.
- White skinned, single lambs raised in a hill environment were at a higher risk of photosensitisation.
- Shade/shelter provision in upland areas essential (e.g. native scrub/woodlands)
- Further investigation to improve our understanding of plochteach, to reduce the impact of the disease and identify appropriate treatment options, would be beneficial.




PART 2:
ON-FARM STUDIES



STUDY FLOCKS

- Holding 1- SRUC flocks, ~550 ewes, Blackface and Welsh Mountain
  - 3 ewe management groups
- Holding 2- Isle of Mull farm, ~1000 ewes, Cheviots and Blackface crosses
  - 5 ewe management groups
- Holding 3- Lochaber farm, ~360 ewes, Cheviots and Blackface
  - 2 ewe management groups
- Holding 4- Isle of Skye croft, ~260 ewes, Cheviots and Blackface
  - 2 ewe management groups


Holding 4


Holding 1


Holding 2

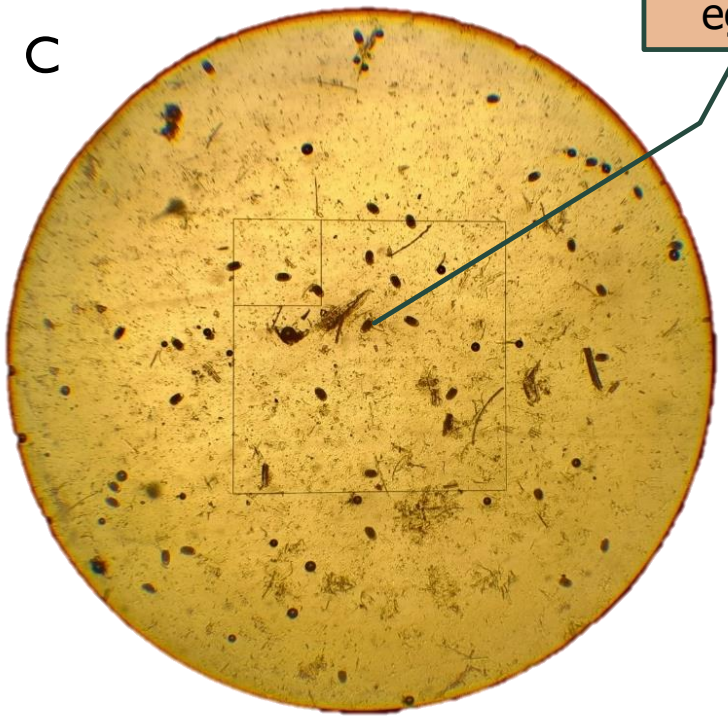

Holding 3

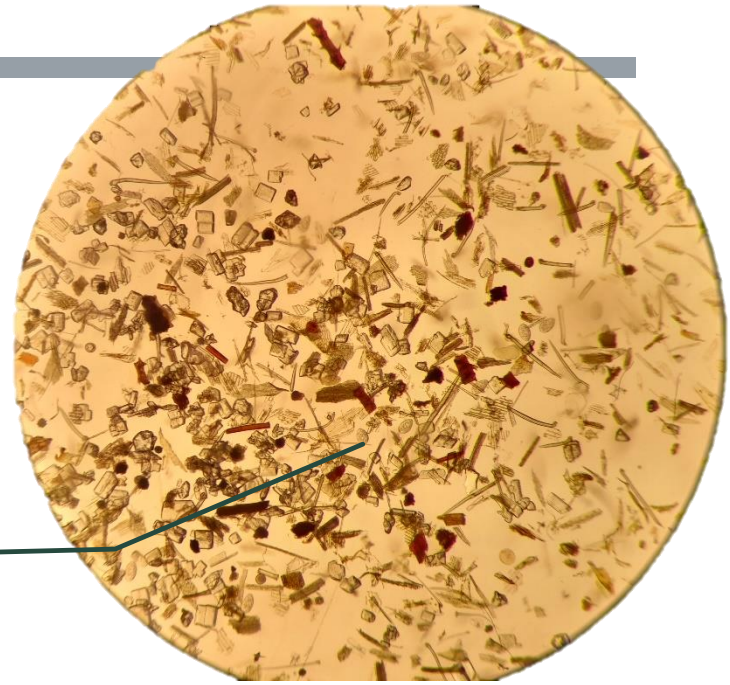
METHODS: PARASITES, PLOCHTEACH AND ILL HEALTH

- Lamb health information was recorded at gathers, such as tick burden, wounds, infections, and photosynthesisation which may indicate plochteach.

Methods: Gastrointestinal Parasites

- Dung samples were regularly collected from ewes and lambs to follow the gastrointestinal worm and fluke burden.





Methods: Trace elements and nutrition

- Ewes were assessed pre-lambing for energy and protein levels
- Lambs were assessed at weaning for cobalt or selenium deficiencies

FINDINGS- BLACKLOSS

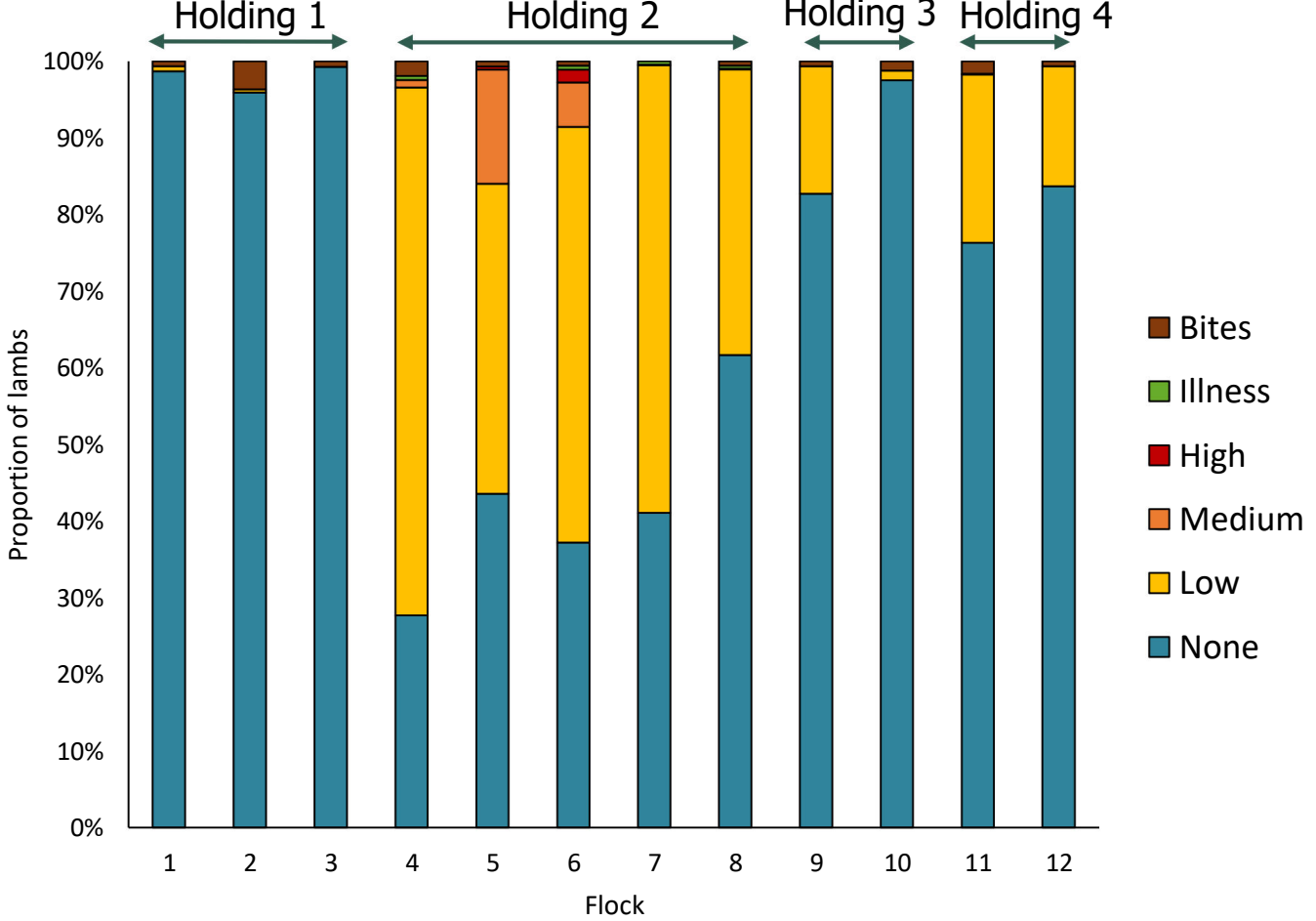
- Holding 1, and Flock 1 in particular, had higher levels of loss than the other study Holdings
- Difficult to gather accurate lamb counts
- Higher than expected scanning to marking losses

		Blackloss %			
Holding	Flock	Scan to Mark	Scan to Wean	Mark to Wean	Tag to Wean
1	1	29.1	34.7	27.3	33.2
	2	16.3	24.2	8.5	21.5
	3	15.3	20.1	5.8	
2	4	36.5	31.7		3.5
	5			3.2	3.8
	6			13.4	18.9
	7			7.2	3.1
	8	15.0	18.3	9.1	1.5
3	9	17.4	22.5	6.2	5.8
	10	17.6	22.3	5.7	5.7
4	11	8.0	19.9	7.5	15.9
	12	4.6	4.6	1.9	9.5



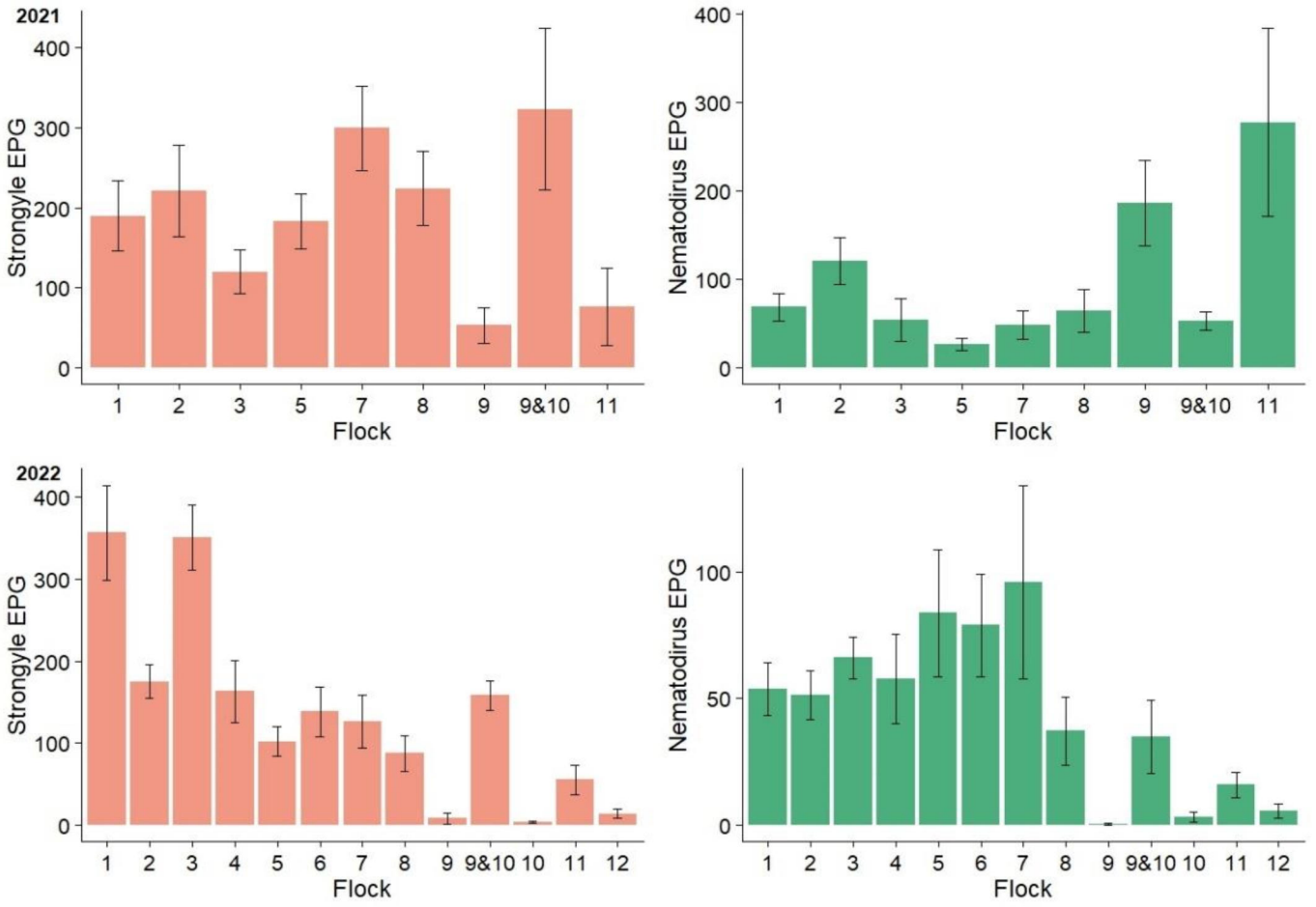
FINDINGS- TICKS

- Flocks differed significantly in the proportions of lambs affected by ticks
- Holding 2 flocks most impacted
- Ticks are a potential cause of blackloss within each of the study flocks



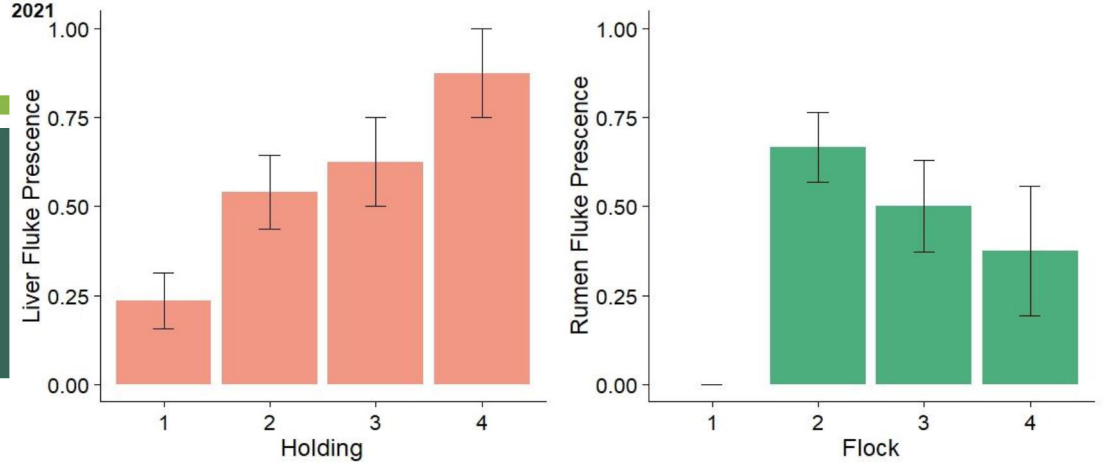
FINDINGS- NEMATODES

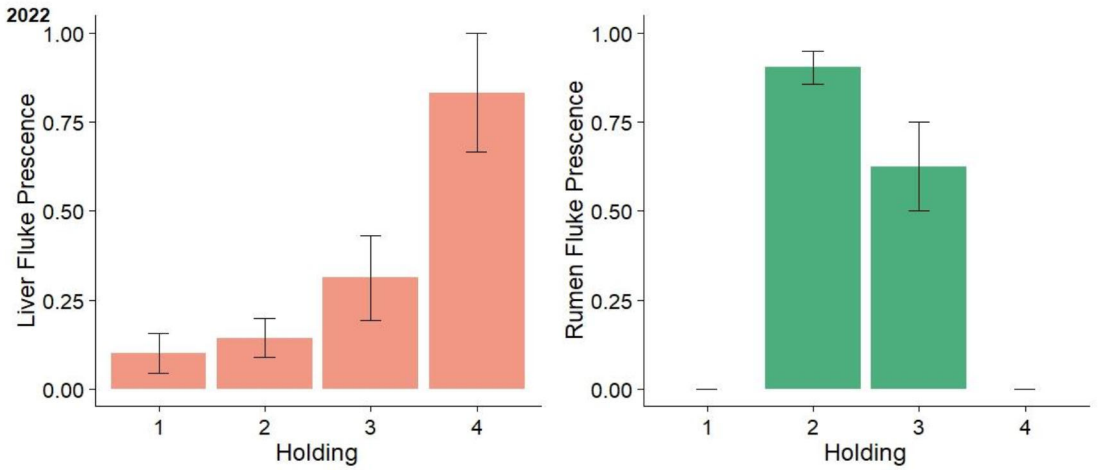
- All the holdings have pressures from nematode worms within their flocks. Holding 1 most impacted
- Strongyle FECs differed significantly between flocks
- Appropriate management and treatments required to prevent losses.



FINDINGS- LIVER FLUKE

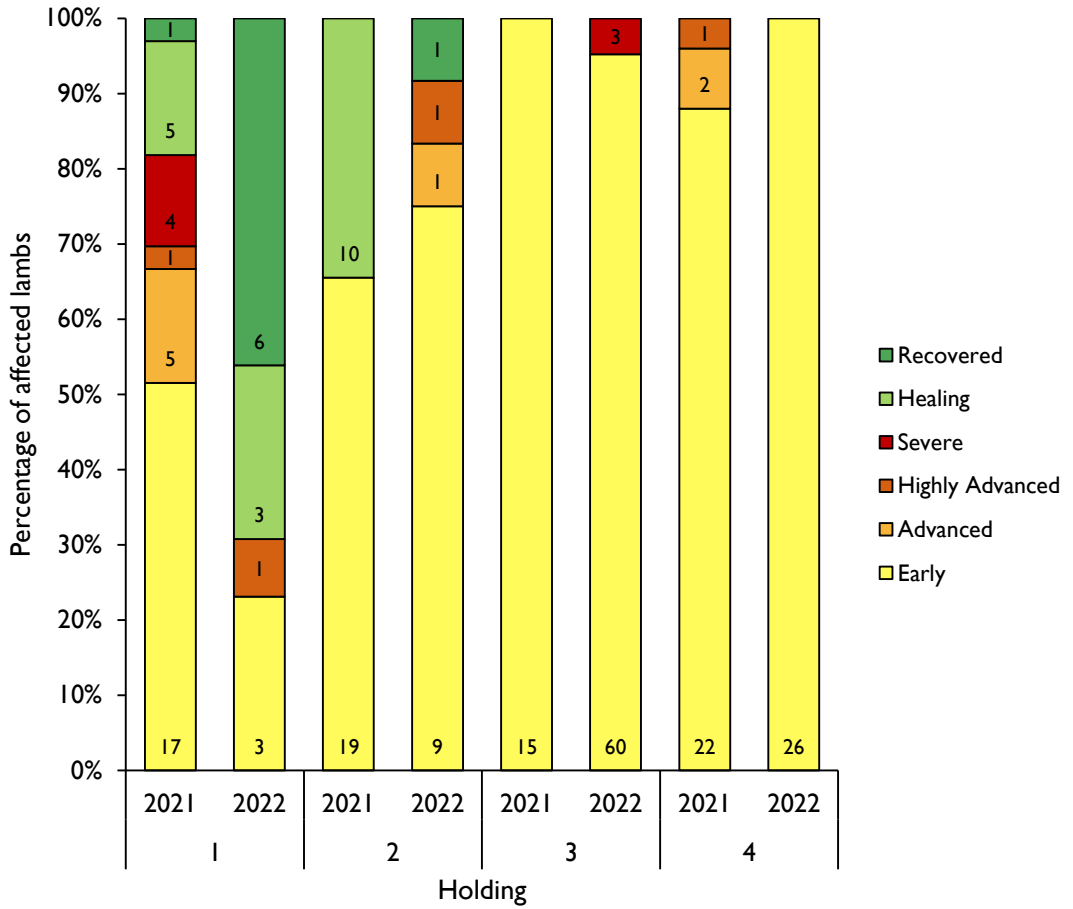
- The presence of liver fluke differed significantly between holdings
- Presence was highest on Holdings 3 and 4
- Not likely to result in losses before weaning





FINDINGS- PLOCHTEACH

- The majority of affected lambs showed early signs of plochteach
- Greatest range of signs were recorded on Holding 1
- Plochteach can impact lamb growth and survival



FINDINGS- EWE NUTRITION

- Ewe energy and protein is important for colostrum production and giving lambs a good start to life
- In general ewes were in good condition and had sufficient pre-lambing nutrition
- Holding 2, Flock 5 was in a negative energy balance (BOHB), whilst Flocks 4, 5 and 6 had albumin levels below the threshold of 30-40 g/l.

Holding	Flock	Supplementary Feed	BCS	BOHB mmol/l	Urea mmol/l	Albumin g/l
1	1	No	2.90	0.5	6.3	32.7
	2	No	2.95	0.4	7.9	32.3
	3	Yes	2.85	0.4	7.9	31.4
2	4	No	2.28	0.6	7.2	**28.4**
	5	No	2.60	**1.3**	7.5	**29.2**
	6	No	2.43	0.5	7.0	**28.9**
	7	Yes	2.63	0.8	9.8	32.4
	7.5	Yes	2.58	0.8	7.0	32.1
	8	Yes	2.58	0.7	6.4	32.9
3	9	Yes	2.88	0.8	6.8	35.3
	10	Yes	2.80	0.5	7.8	34.0



FINDINGS- TRACE ELEMENT DEFICIENCIES

- Selenium/Vitamin E: prevents and repairs cell damage, supports growth and fertility, and is involved in immune functions.
- Cobalt: used by micro-organisms in the rumen to create vitamin B12, which is required for energy metabolism.
- Most flocks had sufficient cobalt and selenium status
- Flock 6 fell below of the reference range, suggesting cobalt deficiency, whilst Flock 6 and 10 were low in selenium

Holding	Flock	Cobalt Vitamin B12 pmol/l	Selenium GSH-Px u/ml RBC
1	1	738.0	142.2
	2	738.0	199.6
	3	651.5	82.5
2	4	643.0	156.3
	5	728.0	133.4
	6	**204.0**	**68.0**
	7	599.5	94.6
	8	379.0	118.3
3	9	616.0	84.1
	10	698.5	**62.5**



CONCLUSIONS- IT'S COMPLICATED!

- Plochteach and ticks still suspected as a large cause of blackloss
- Gastrointestinal parasites (worms and fluke) do not seem to be as large an issue on these flocks as the farmers originally suspected.
- Other issues we had not suspected, such as late castration and tail ringing or "killing through kindness", may be contributing to blackloss.



PROJECT IMPACT

- This study helped identify the 4 P's of blackloss: **parasites, predators, plochteach and poor nutrition**

- This might improve the productivity of hill sheep farming by reducing the financial and genetic losses to flocks, increasing the sustainability and welfare of hill sheep systems.

- Farmers and crofters are an integral part of rural life in the western Highlands and provide valuable ecosystem services.

Acknowledgements

- This PhD was funded by SRUC and NatureScot and registered at the University of Edinburgh's Royal (Dick) School of Veterinary Studies. It involved close collaboration between SRUC, The Royal (Dick) School of Veterinary Studies, NatureScot and SRUC Veterinary Services.

- Thanks to the SRUC farm and technical staff involved in data collection.

- Huge thanks to the farmers and crofters involved.

- All photos and graphics are the from F. McAuliffe

PUBLISHED RESEARCH

PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

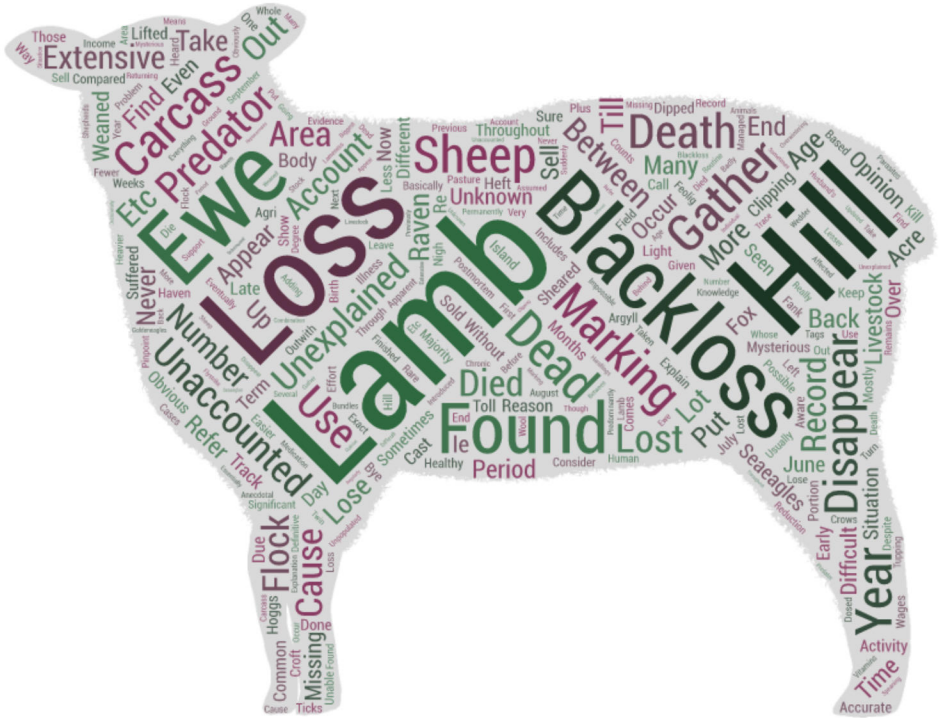
Investigating hill sheep farmers and crofters' experiences of blackloss in the Highlands and Islands of Scotland

Fiona McAuliffe, Ann McLaren, Neil Sargison, Franz Brülisauer, Andrew Kent, Davy McCracken

Published: March 27, 2024 • https://doi.org/10.1371/journal.pone.0298255

Abstract

Hill sheep farming is an important component of Scottish agriculture and comprises a significant land use in much of the Highlands and Islands. However it faces significant challenges due to the natural constraints of the landscape. Hill sheep farming uses hardy traditional breeds, such as the Scottish blackface and North Country Cheviot to graze extensive areas, where the sheep are not housed and tend to lamb on the open hill. Flocks are gathered several times a year for stock checks, husbandry, and health treatments. Between these handling events, stock will disappear and be unaccounted for. These unexplained losses are known as blackloss in the Highlands and Islands. Previously reported figures for annual lamb blackloss give an average of 18.6%. These losses are in addition to the known losses of lambs and represent a significant welfare and sustainability issue. High parasite burdens, predation, a photosensitisation disease known as plochteach or yellowses, and poor nutrition are often given as presumed reasons for blackloss. A questionnaire was developed to assess the experiences, impacts and understanding flock managers have of blackloss. Typology analysis using partitioning around medoids was used to cluster respondents into three distinct groups: 1- very large extensive farms and Sheep Stock Clubs, 2- medium sized farms, and 3- small-scale crofts. The responses of these groups were subsequently analysed to see if their experiences and perceptions of blackloss differed with relation to lamb health challenges and predation impacts. The groups reported similar health challenges, apart from Group 1 which had a significantly higher plochteach challenge. In terms of predators, Group 1 also perceived white-tailed eagles (*Haliaeetus albicilla*) as a much higher threat to their lambs than the other groups. It was observed that many of the respondents believed blackloss is inevitable and that predators pose a large threat to lambs. However, most agreed that reducing these losses is important and that understanding the causes would enable them to do so.



FIONA.MCAULIFFE@SRUC.AC.UK

McAuliffe, F. 2024. Investigating causes of lamb loss on farms and crofts within the Highlands and Islands of Scotland
Thesis Link