# *Potential Implication For Livestock Used In Bracken Control*

August 2025

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Ruminant Revival

## Contents

## Background

Bracken (*pteridium*) is the fifth most abundant weed in the world (O'Driscoll et al. 2016). Bracken, the common fern, is a common sight across much of the UK's upland farming landscape. A plant up to 200cm tall, grows in dense swards often out competing all vegetative growth that surrounds it, reducing biodiversity and encroaching on land used for grazing livestock.

***Figure 1 Bracken mid-August on a south facing hillside in Northeast Northumberland***

This invasion is set to become more aggressive considering that a ban on Asulam, the most effective herbicide for bracken control, came into effect in 2012 across the EU (O'Driscoll et al. 2016). Some use within Scotland has been permitted under emergency access but this has since stopped from 2023 (FAS, 2023). Bracken can provide a habitat for wildlife and has other positive benefits such as the use for fuel, bedding and thatching. From an agricultural perspective bracken can be poisonous to livestock and is a breeding ground for the common tick which carries zoonotic diseases such as Lymes Disease as well as other vector transmissible livestock pathogens.

Since the ban on Asulam in 2012 there has been a focus on alternative, nonchemical, measures for control of bracken – these include cutting, bruising and grazing. The focus of this paper is to explore the potential implications for livestock used for bracken control.

## Bracken anatomy and lifecycle

A *rhizome* is a horizontal underground plant stem that stores all the protein and carbohydrate needed for new growth. Bracken dominated areas of land have an extensive network of rhizomes that are capable of producing a root and a shoot. The new shoots are called croziers, they unfurl and grow to form fronds (large leafy branches). In north-western Europe, croziers typically surface in mid-May reaching mature fronds from late July to early September followed by spore formation on fertile fronds and then die back. When the plant dies back it forms a dormant state over the winter months with the nutrients stored in the rhizome ready to grow again in the spring.

# Livestock for bracken control

One of the significant concerns when using livestock for bracken control is the toxins that exist within the plant that can cause illness and death.

There are three toxins that can be detrimental to livestock. Bracken contains many other phytochemical armaments for its own protection.

1. Thiaminase is an enzyme that affects non ruminant herbivores such as pigs and horses.
2. Prunasin is a cyanogenic glycoside – usually only present in small amounts and not a concern.
3. Ptaquiloside is highly water soluble which is unstable in mildly acidic (<4) and alkaline (>6.5) environments. It can survive months as low as 5°C in soil between pH 4 and 6.5. It has two lethal effects; firstly, it supresses bone marrow (of which the mechanism of action isn't fully understood), secondly, it is a carcinogen.

Ptaquiloside accumulation in bracken is variable and subject to species, location in the plant and the stage of growth but certain risk factors for bracken Ptaquiloside content are known, see table 1.

| Location | Range $\mu g \cdot g^{-1}$ | Time of year |
|---|---|---|
| **Fronds** | 0-9800 | Spring – in newly surfaced croziers. This deceases after the crozier stage to 10-20% of the maximum level |
| **Rhizome** | 2-7000 | Peak after fronds have reached maturity |
| **Spores** | 4.5- 23.5 | |
| **Litter** | 0.09 – 23.5 | |
| **Mineral soil below rhizomes** | 0-5 | More stable in clay soils |
| **Ash** | 0 (Bates, 2023) | |

Table 1 Ptaquiloside concentrations in different plant stages (Ramussen et al. 2008)

It must be noted that as plant concentrations change so does palatability, and this will affect the animals overall Ptaquiloside intake. Rhizomes and young fronds are more palatable and toxic to cattle. It is strongly advised not to allow cattle to graze ploughed or plunged land the following spring when rhizomes may be exposed and young fronds are growing. Ptaquiloside has been found to be higher in cut, mowed or grazed fronds (O'Driscoll et al . 2016). It has been suggested this may be due to environmental stress.

## Cattle

Cattle grazing effectively tramples and bruises the bracken. The plant is left intact but with a damaged root system. It then forces its efforts into repair and survival rather than reproduction. In effect this is biological crushing rather than mechanical crushing.

Historic England conducted a study in the Ingram Valley, Northumberland the evidence suggests that winter grazing, and foddering reduced bracken cover, frond height and bracken vigour (Oatway, 2020). Foddering was described as rolling out two bales a day in tractor accessible areas. However, the report does not provide specific information on the stock density used in the study. Foddering and associated poaching damages the rhizome network and exposes the rhizomes to frost over the winter months.

***Figure 2 6 weeks post bracken crushing***

Cattle do not generally choose to eat bracken leaves, unless other forage is scarce. Cut dried bracken is also poisonous and this is a risk factor if used for bedding. Green shoots and rhizomes are more attractive to cattle and more toxic than the mature leaves.

Bracken ingestion occurs when:

1) Used for bedding
2) Lush grass present and cattle seek lignified fibrous material
3) Hay or silage is contaminated with bracken

4) Draught or over grazing when other food sources are unavailable

***Acute Haemorrhagic Syndrome (AHS)*** through bone marrow suppression (myelosuppression).

AHS is caused from consumption of a large amounts of bracken in a short period of time. The clinical signs can be seen a few weeks after consumption (Andrews et al. 2008).

Bone marrow is responsible for the production of new red blood cells, platelets and white blood cells without these cells, animals become weak, lethargic, have spontaneous bleeds and are susceptible to infection.

Specific signs include diarrhoea, high temperature, anorexia, depression, pale mucous membranes, haemorrhage from capillaries (petechiae), vagina, nose, haematoma formation, laryngeal oedema (laboured breathing with an audible roar), secondary bacterial infections from low white blood cell counts and a prolonged clotting time, and often a rapid death.

Laboratory diagnosis is through analysing the numbers and ratios of specific red and white blood cells and platelets.

***Enzootic Haematuria*** **(EH)** – can result from small quantities of bracken ingestion over time, 2-3 years (Perez-Alenza et al. 2006) and therefore is often seen in cattle exceeding 4 years of age (Bates, 2023). Disease can be seen weeks and even months after the exposure to bracken has stopped. The result is blood in the urine, often as clots which has come from neoplastic (cancer like) changes in the lining of the bladder. As well as red tinged urine there may be difficulty in urinating and associated straining if the cancerous changes have grown to a substantial tumour within the bladder. The tumours may metastasise to other sites in the body such as the lymph nodes and lungs.

Laboratory diagnosis – affected animals have high protein and haemoglobin levels in the urine. Blood parameters show and increase in urea and creatinine as well as low platelets and white blood cells. Changes in the bladder wall may be visible through ultrasound examination per rectum.

***Upper Alimentary Tract Squamous Cell Carcinomas*** – like Enzootic Haematuria these tumours result from prolonged exposure to bracken. Tumours can be in the oropharyngeal cavity (mouth and throat), oesophagus and rumen, with clinical signs dependent on the location of the tumour. It is thought that tumours are seen in the upper gastrointestinal (GI) tract (mouth to rumen) rather than the lower GI tract (intestines) due to the higher pH which activates Ptaquiloside into a highly reactive dianone that interferes with DNA replication and results in tumour formation.

Diagnosis is based on the clinical signs associated with the tumour location with the potential for diagnostic imaging such as ultrasound.

All three conditions listed above are non-reversible and untreatable and as the conditions progress death results. Milk from dams grazing bracken has been found to contain the toxin Ptaquiloside, so even young animals are at risk from AHS, EH and gastrointestinal tumours. Affected animals may suffer from more than one of the three diseases, with bladder tumours and upper GI tumours often found in animals at post-mortem examination (Bates, 2023).

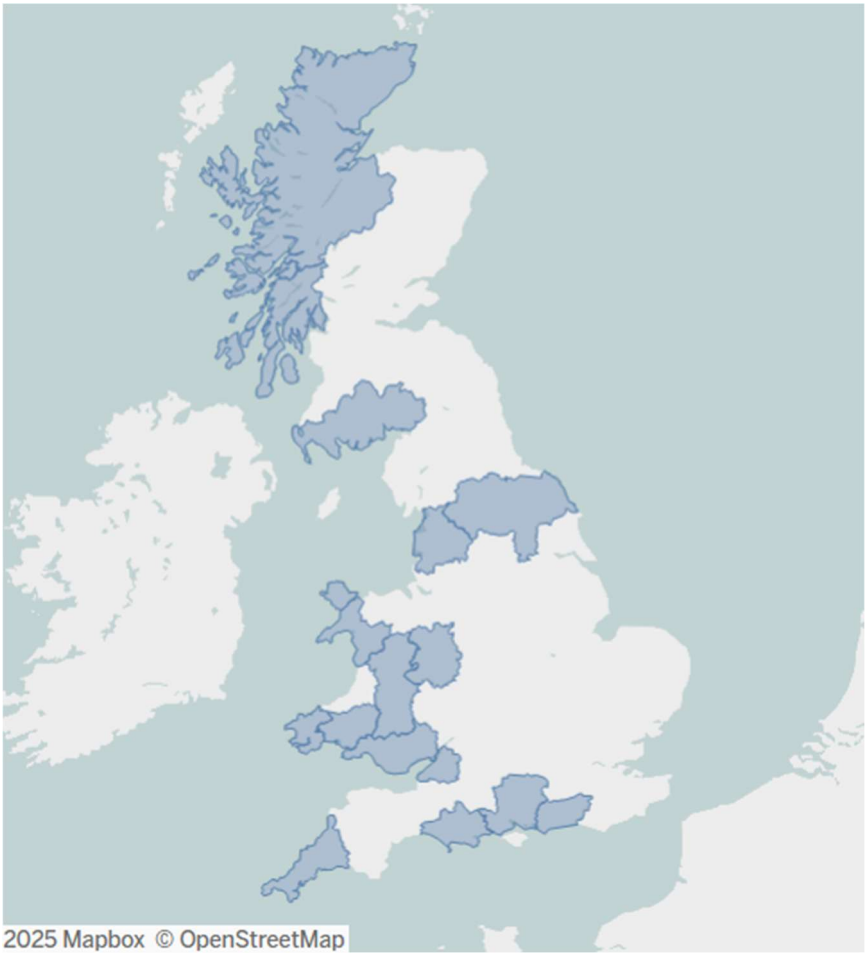


***Figure 3 Distribution of 36 cases of bracken poisoning in the UK since 2012 from APHA and SRUC cattle disease surveillance dashboard*** ***Cattle Dashboard | Tableau Public***

Cases within the literature from the UK include an outbreak in the New Forest in 2024 where 9 cattle died out of a group of 80 grazing bracken (APHA and SRUC, 2024). There have been 36 cases across the UK between 2012 and 2024, the distribution is shown in figure 3.

Changes in specific blood cell parameters (haematology) can be used to monitor for signs of disease, but they are not consistent in every affected animal, changes are not detectable until pathology is significant and by then the disease is not reversible by removing bracken exposure at that point.

## Pigs

Pigs have been reported to be effective in bracken control. Studies report pigs in the Autumn and Winter gathering bracken litter for bedding and rooting up, eating and disrupting the rhizomes which are responsible for the following years growth. Breaking up and destroying the bracken has allowed other species to germinate increasing biodiversity (RBST).

Pigs are not affected by AHS, EH or upper alimentary tract tumours. Thiaminase is the toxin in bracken that causes disease in pigs causing Avitaminosis B1. Thiaminase inhibits thiamine carrying out its normal metabolic role in the body, producing the symptoms of thiamine deficiency. Thiamine deficiency causes pigs to become anorexic, depressed and struggling to

breath and often but not always ataxic (uncoordinated) (Bates, 2023). Clinical signs are seen within a few weeks after bracken ingestion occurs.

Unlike the conditions affecting cattle and sheep, thiaminase toxicity can be treated by administering thiamine by injection. If the disease is left to progress without treatment, death will result from respiratory and heart muscle failure (Mayer, 1990). Supplementing pigs grazing bracken with regular thiamine injections as a prophylactic could be considered (APHA,2018).

Thiaminase is concentrated in the rhizome and young fronds. In rhizomes, it is higher in autumn and winter, declines in Jan to April, increases again in May. Young fronds are highest in April and then decline in May. Thiaminase concentration is 20-30 times higher in rhizomes in the autumn and winter than it is in fronds in June. (Bates, 2023).

There have been 13 cases of Bracken poisoning in pigs between 2007 and 2017 (APHA, 2018).

### Horses

Similar to pigs, horses are affected by induced thiamine deficiency due to thiaminase ingested from the bracken, the disease in horses is called *Bracken Staggers*. The lack of thiamine causes the surface coating of peripheral nerves (myelin) to degenerate. Clinical signs come on progressively over a couple of months, weight loss, weakness, incoordination, muscle tremors and eventually recumbency, convulsion and death. Like with pigs the condition is treatable with intravenous thiamine injections (Mair et al. 1998).

### Sheep and Goats

These species are not considered effective in bracken control as they move through the bracken and don't harm the plants themselves. Their lower body weight doesn't have the same crushing and bruising effect of cattle. However, goats are relatively resistant to bracken poisoning (Bates, 2023).

Acute Haemorrhagic Syndrome and Bright Blindness are the two most common toxic effects of bracken ingestion for sheep. Enzootic Haematuria and gastrointestinal tumours do occur but at a lesser incidence than in cattle.

*Bright Blindness* is a progressive and irreversible degeneration of the retina of the eye. This occurs when sheep have ingested bracken for a period of at least 4 months (Bates, 2023). The sheep are blind, they appear glassy-eyed and have dilated pupils. The term bright blindness is due to the dilation of the pupils allowing light to reflect off the back of the eye, it often looks as though the eyes are shining light themselves.

## Human health risks

It has been documented that gastric and intestinal tumours have been induced in rats fed milk experimentally from cattle grazing bracken. In addition, there have been links between upper gastrointestinal cancers and human farming populations associated with heavy bracken infestations such as in Central America and South America. This is thought to have been from drinking locally produced milk (Alonso-Amelot et al. 1998). Inhalation of dried spores, Ptaquiloside contaminated drinking water and meat from animals grazing bracken have all been

postulated as a carcinogenic risk to humans (O'Driscoll et al . 2016). Galpin et al. (1986) investigated if there was a link between stomach cancer and Ptaquiloside contamination of water courses in Wales, no link was found.

When bracken poisoning has been diagnosed as the cause of death on farm it is reportable to the food standards agency (APHA, 2018). Due to the risk to human health, cattle, sheep and pigs should be removed from access to bracken for 15 days pre slaughter for human consumption (APHA and SRUC, 2024)

## Conclusion

The literature suggest that livestock have been effective in bracken control in the UK without detriment to their health and welfare. Where livestock are to be used, careful consideration needs to be given to when and how this is implemented. Careful planning is required as any control method needs to consider many factors such as invertebrate population, the historic architectural environment, soil erosion, ground nesting birds, water courses and human health.

For example, cattle are used for their trampling effects, similar to mechanical control methods such as crushing and rolling that are carried out in June/July for maximum effect. However, Ptaquiloside levels are still high at this time of year. There needs to be provision of an alternative forage or plenty of biomass on the pasture for the cattle to eat, while at a high enough stock density to trampling the bracken to avoid toxicity. 'Foddering' used effectively in the Ingram Valley allows bracken control without associated toxicity risk, although there may be an implication of soil erosion and damage to archaeological features.

Given the complexity of the nonchemical control of bracken a bespoke farm by farm control plan is required taking into consideration the scientific information available the context of the farm.

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