Reducing the Impact of Livestock Parasite Control Products on Dung Beetles and Other Beneficial Insects in Wales

By

James Byrne – Wildlife Trusts Wales / Dung Beetle Trust

Dr Sarah Beynon FRES – The Bug Farm

Dr Claire Whittle BVSc MRCVS & Dr Rob Howe BVSc MRCVS - LLM Farm Vets and Dung Beetles for Farmers / Dung Beetle Trust

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Introduction

In 2019, there were 1.1 million cattle and calves and 9.53 million sheep and lambs in Wales[1, 2]. On average[3], cattle may produce 9 tonnes of dung each year, and sheep may produce more than 800kg of dung each year [4]. That's a lot of waste to recycle, and dung beetles, and other dung insects, can do it throughout most of the year, as some are even active in winter.

The UK has ~50 native species of dung beetles, **which may currently be saving the Welsh cattle and sheep industries ~£84.6 million each year[5] ***.

There is growing concern about the conservation of dung beetles, with many species in decline due to **various threats, including the use of veterinary medicines such as parasiticides (endectocides for internal and/or external parasite control, ectoparasiticides for external parasite control and endoparasiticides/anthelmintics for internal parasite control).** A review in 2016[6] identified 25% of dung beetle species as nationally rare, four as being extinct and more than 16 that are either endangered, vulnerable or near threatened. These patterns follow declines in other species in Wales: for example, 60% of Welsh butterflies are in long term decline[7], 7 species of Welsh bees are known to have gone extinct, and 5 more are at risk of extinction[8]. **This is part of a global ecological emergency[9] in which over 40% of insect species are threatened with extinction[10].** We need to mitigate the ecological impact of parasiticides whilst protecting animal health and welfare and environmental health.

Approximately 40 British dung beetles are associated with domestic livestock dung, and the majority of these species are generalist feeders. However, some show a preference for certain dung types[11,12,13]. **By tunnelling and breeding within dung, feeding upon it and burying it below ground, dung beetles break down and swiftly recycle it, making nutrients available for the grass to grow to feed grazing animals.** At certain times of the year, dung beetles can dispose of a pile of horse dung or a cow pat in just a couple of days[14].

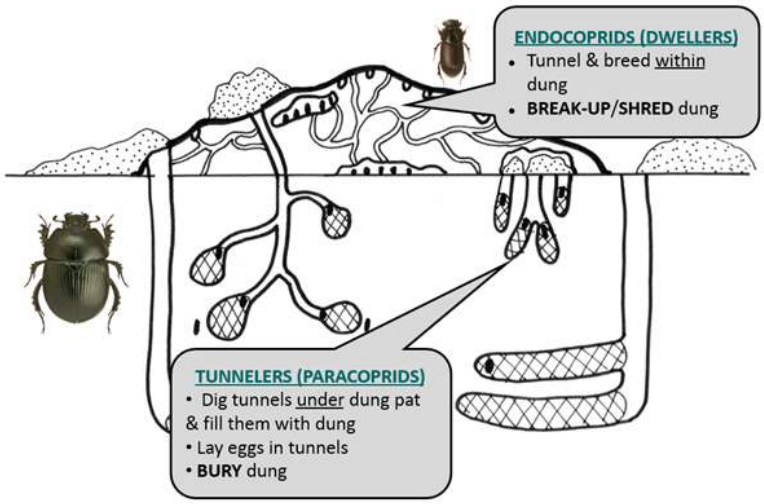

Figure 1. Dung beetle functioning – taken from Dr Beynon's Bug Farm.

By providing dung insects with a habitat, cattle and sheep have the potential to benefit biodiversity. A cow in the UK could support up to 7 million dung beetles and other dung insects each year*. A sheep could potentially support over half-a-million dung beetles and other dung insects each year*[15] (Beynon, *Pers. Comm*., 2021). **All the sheep and cattle in Wales could be supporting 14 trillion dung insects each year*.**

**Please note that these figures are indicative only, and further work is required to quantify them more accurately. We have also not included pig farming in this report and dung beetles are known to feed on pig dung.*

Ecosystem Services Delivered by Dung Beetles on Farms

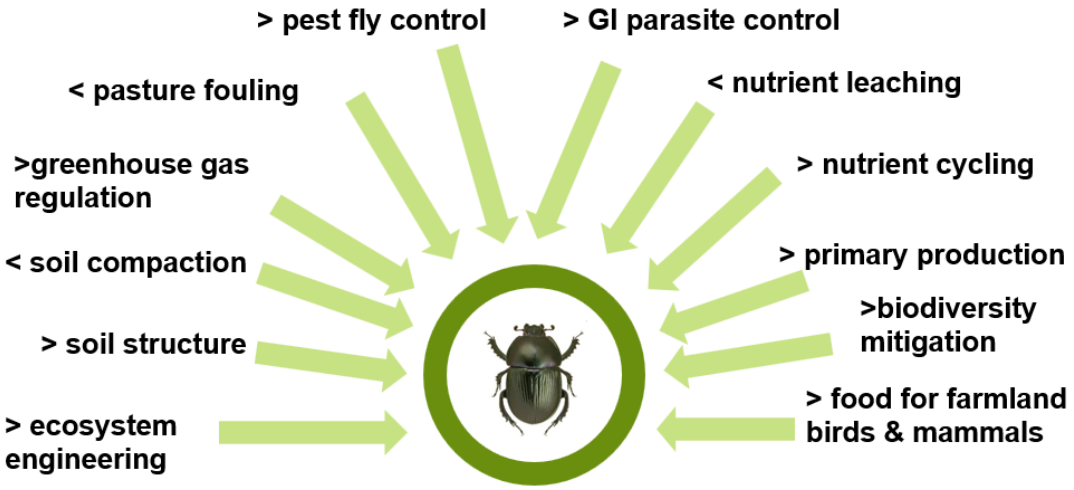

Figure 2: Ecosystem services and functions delivered by dung beetles in the UK[16]

Some of the many ecosystem services dung beetles deliver on farms include:

- **Reducing pest fly populations** by transporting phoretic mites that eat fly eggs and burying the dung which can act as a fly-breeding habitat[17].
- **Acting as biological control agents for gastrointestinal parasites of livestock**[18] by making the dung unsuitable for parasites to complete their lifecycles[19]. Many cattle parasites require dung to complete their lifecycles and burying infected dung can considerably reduce the numbers of these parasites. Studies show a significant reduction of *Ostertaia osteragi* (stiles) larvae as a result of the burying activity of dung beetles[20]. This activity helps prevent the build-up of unsuitable, 'wormy' pastures and the spread of disease[21,22].
- **Consuming dung**, thereby removing it from the fields and **reducing pasture fouling**.
- **Burying dung, thus returning essential nutrients to the soil** and, in turn, improving grass growth for grazing animals. **The nutrient cycling includes the sequestration of carbon and nitrogen directly into the soil and the recycling of phosphates found within animal dung[23,24,25,26].**
- **Enhancing the soil structure** by tunnelling through the soil, which breaks up the ground, and thus **has a positive influence on the hydrological properties of soil**. As such, dung beetles help improve the water drainage by improving infiltration and soil porosity, so reducing surface runoff water[27,28,29]. Larger species, such as the Minotaur beetle, can tunnel over one metre deep. The more common dor beetles can tunnel up to 50cm deep. Dung beetles thus help to offset soil degradation, which is estimated to cost £1.2bn per year in England and Wales, mainly linked to loss of organic content of soils (47%), compaction (39%) and erosion (12% of total cost)[30].
- **Acting as an important food source for birds, mammals, reptiles and amphibians**[31]; for example, dung beetles are an important food source for the internationally protected greater horseshoe bat[32] and chough. Dung beetles are also a valuable tool to measure biodiversity and habitat change and are recognised as key indicator species[33,34,35,36].

- Having a role to play in **secondary seed dispersal** as well as a more **limited role in pollination** and trophic regulation[37]. Other beneficial dung insects, such as yellow dung flies, also play an important role in pollination.
- **Raising the carrying capacity of the grazing area**, so less total land is needed for grazing animals and livestock can re-graze pastures more quickly.
- **Reducing greenhouse gas emissions (GHGs)**. Dung beetles can reduce GHGs from cattle dung on pasture by at least 12%[38] other studies cite a 39% reduction. In Wales, many livestock are grass-fed and therefore a high proportion of their dung falls directly on pasture. Thus, at the lifecycle assessment level of milk and meat, dung beetle contributions to reducing GHGs are likely to be more significant than in countries where livestock are kept indoors for more of the year.
- **Reducing nitrogen loss**. It is also likely that, without dung beetle activity, there would be significantly more nitrogen loss in farming than there is today – one study highlighted the cost of nitrogen loss to the US without dung beetles would be approximately $58 million a year[39].

Veterinary Medicines

Control of 'worms' (e.g. control of roundworms, fluke and lungworm) and external parasites (e.g. flies, lice, ticks and mites) with parasiticides is a vital part of health and production management in current livestock farming in the UK.

Parasites can affect animal performance and welfare in many ways; by reducing feed intake, growth rates, carcase weight and composition, fertility and milk yield[40]. They can be an important constraint on efficient, high welfare livestock production and must be actively controlled.

Parasite management is largely the responsibility of the farmer and their advisers. It is based on administering endectocides (such as ivermectin) and/or anthelmintic drugs (wormers, such as fenbendazole, levamisole) and ectoparasiticides (such as deltamethrin). However, **the presence of many livestock parasiticides in dung can slow dung degradation due to harmful effects on dung insects including dung beetles**[41]. At high parasiticide levels, larvae and adult insects can be killed or paralysed. At lower levels, insect metamorphosis can be inhibited, and behaviour altered, resulting in decreased adult emergence and significant morphological abnormalities, as well as impacts on breeding success, dispersal and functioning.

Dung beetles and other dung insects are especially sensitive to avermectin-based products, such as ivermectin, eprinomectin and doramectin, which can influence dung beetle species richness and diversity[42,43,44,45,46,47]. For example, Finch *et al.* (2020)[48] state that adult dung beetles tend to be attracted to dung parasiticide residues (eprinomectin, doramectin, ivermectin and moxidectin) but, conversely, larvae are less likely to occur in the presence of residues. Thus, either adults that colonise dung with residues do not lay eggs or, more likely, the larvae that hatch from these eggs die early in development. As such, the abundance of adult and larval stages of dung beetles can be significantly reduced in dung containing many parasiticide residues[49].

Dung beetles are an important food item at key times of the year for protected species such as the chough[50]and greater horseshoe bat. The dung beetle *Geotrupes spiniger*, which has been shown to be the most sensitive species to ivermectin and most efficient in terms of dung removal per mg of bodyweight, is a key food source for chough[51]. More recent research has shown detrimental effects on chough populations from the use of deltamethrin (for the control of flies), triclabendazole (for the control of liver fluke) and ivermectin, as they reduce much of the dung fauna on which the chough feed, including flies and beetles[52].

Parasiticides can be excreted in the dung for many weeks after treatment. For (non-sustained-release) applications of ivermectin, doramectin and eprinomectin, **faecal residues in dung have a negative impact on dung beetles for, on average, 14 days**[53]. Such effects include slower beetle larvae development, reductions in the size attained at adulthood and reduced breeding capacity[54]. Retarded decomposition rates of dung are also likely to have impacts on other decomposer species[55,56].

A reduction in dung beetle abundance and species richness can reduce dung beetle functioning accordingly[57]. Not all species of dung beetle are equally sensitive to parasiticides and, concerningly, **the species of dung beetle that are most sensitive to ivermectin are also the most functionally efficient**. If they were to go extinct, even if dung beetle biomass remained the same, the function of dung removal from pastures would be impaired[58].

We can see the impacts of parasiticides on dung beetles at a landscape level. Intensive farms (those with higher inputs of fertiliser, pesticides, labour and capital) may support up to 38% fewer dung beetle species than organic farms, and a likely contributing factor is the use of parasiticides[59]. Conversely, higher species richness, diversity and functional diversity of dung beetles have been found on farms with no history of parasiticide use[60].

Resistance

We are now all very familiar with the serious risks of indiscriminate use of antimicrobials and parasiticides regarding the development of resistance[61]. Unfortunately, a direct and unavoidable consequence of using parasiticides is selecting individual parasites resistant to the chemical group used[62,63]. This resistance is passed on through generations of parasites as a genetic trait so, once it is present on a farm, it is difficult to reverse.

Annual losses attributed to anthelmintic resistance in gastrointestinal nematodes across the UK cattle and sheep industries may be around £7.4m[64,65,66].

Due to the combined impacts of parasiticides on dung insects and parasite resistance, we should, therefore, only use these products when absolutely necessary. Professor Morgan, School of Biological Sciences at the Institute for Global Food Security, states that: "***Scientific opinion supports the promotion of best practice parasite management programmes that will reduce the indiscriminate use of wormers. It also supports wider use of testing to inform anthelmintic treatment decisions***"[67].

Soil Biota

There is also an adverse impact of parasiticides on non-target soil organisms and on below and above-ground food webs[68,69,70,71,72,73,74,75]. For example, ivermectin can be toxic to a variety of soil invertebrates. Many parasiticides also come into contact with soil fauna via sheep dip spread on land or the application of slurry or manure containing residues[76].

Impacts on Grass Growth

Ivermectin may have indirect negative effects on beneficial plant species. When aged dung (stored as farmyard manure for 4 months) containing ivermectin residues is spread on soil that is then sown with perennial ryegrass, the subsequent perennial ryegrass biomass may be reduced by 18-22% (Figure 3)[77].

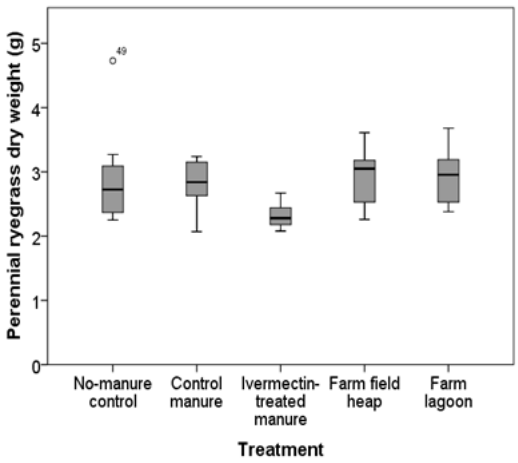

Figure 3. The effect of ivermectin residues in 4-month aged manure on the dry weight of perennial ryegrass

Economics

The estimated value of stored manure in the UK (in 2002) was £200 million per year[78], but this does not take into account the value of dung dropped on pasture. **It is estimated that dung beetles' economic value to the UK cattle industry is £367 million per year[79], with control of gastrointestinal parasites as a key contributing factor**. This breaks down as a saving of £43.47 per cow per year and can be extrapolated to £3.86 per sheep per year. **Therefore, dung beetles may currently be saving the Welsh cattle industry £47.8 million per year* and the Welsh sheep industry £36.8 million per year*.**

However, the economic contribution of dung beetles could be much greater if we put in practical measures to protect them.

Dung beetles could save the Welsh cattle and sheep industries:

- An additional ~£8.2 million each year* if they were protected on all farms
- An additional ~£842,000 each year* if they were protected under all agri-environment schemes (£40.2 million across the UK cattle industry)
- An additional ~£1.8 million per year* if adult cattle were not largely treated unnecessarily with parasiticides (£6.2 million across the UK cattle industry)
- An additional ~£70,594 per year* if dung beetles were protected in all organic agreements (£378,000 per year across the UK cattle industry).

Evidence suggests that functionally diverse dung beetle assemblages deliver many ecosystem services over and above those quantified in the figures above, highlighting the importance of species-rich dung insect communities[80].

*Please note that the figures for the Welsh cattle industry are indicative only, and further work is required to quantify them more accurately. The data and model used to calculate these figures is from: Beynon, S. A., Wainwright, W. A. and Christie, M. E. (2015) The application of an ecosystem services framework to estimate the economic value of dung beetles to the UK cattle industry. *Ecological Entomology* 40, 124-135. It is likely that these figures are conservative estimates. Figures for sheep have been extrapolated from cattle figures and should therefore be seen as a guide only. We assume that ~10% of all Welsh livestock are in agri-environment schemes and 2.9% are organic. It should be noted that these figures for reducing the treatment of adult cattle

does not include the savings on the parasiticides themselves, making on-farm savings significantly greater and these figures are draft figures that need to be finalised.

'Maintaining and Enhancing' Dung Beetles

Given all the above, we believe that the use of veterinary parasiticides needs to be reduced and only used as part of a more holistic suite of treatment and management options – similar to the controls on antibiotics and the Integrated Pest Management guidance on the use of pesticides (Figure 4).

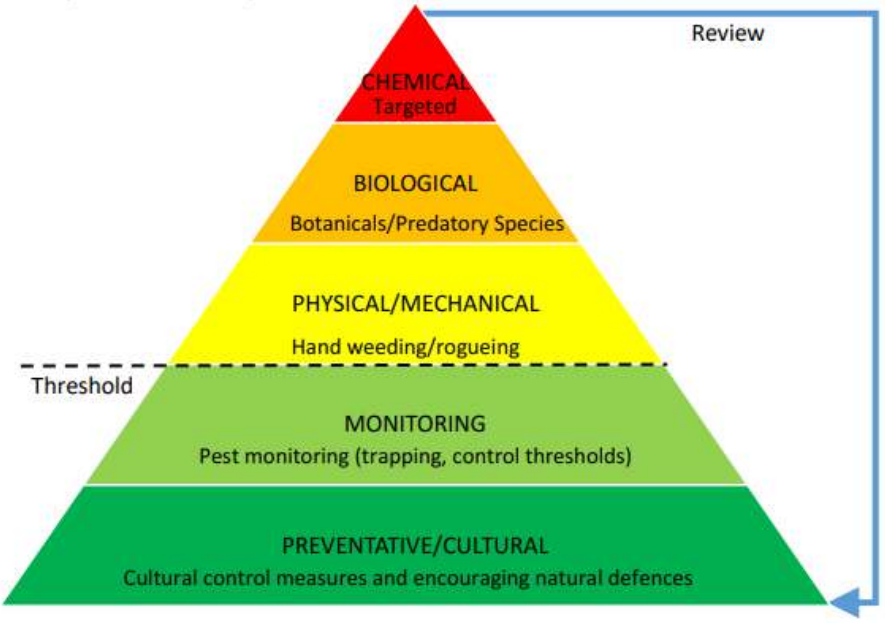

Figure 4. Integrated Pest Management: 5 step approach to pest control. Taken from the consultation on the 'Revised National Action Plan for the Sustainable Use of Pesticides (Plant Protection Products)' December 2020.

Adopting a risk assessment based approach at the level of the individual animal would be a good step in the right direction. This would involve moving away from blanket prophylactic treatment, and instead considering that individual animal's circumstances[81]. What is their parasite risk, based on their lifestyle, their environment, the local prevalence of the parasites, their geographical location and the season? What products would be most appropriate for protection, and which may have the lowest ecotoxicity but still be efficacious and safe?

The reduction of the use of livestock parasiticides aligns with the Environment (Wales) Act, section 6, *"**A public authority must seek to maintain and enhance biodiversity** in the exercise of functions in relation to Wales, and in so doing **promote the resilience of ecosystems**, so far as consistent with the proper exercise of those functions."*

Mitigating our Impact on Dung Beetles - Sustainable Parasite Control Policy

The mitigation of our impact on dung beetles needs to be targeted with policy level intervention carried out concurrently alongside farmer-led changes in parasiticide usage.

Policy Change

Parasite control strategies should already be integrated as part of a farm health plan, which is a requirement of the Red Tractor Scheme. However, the Red Tractor herd/flock health planning scheme does not currently include recommendations for reducing parasiticide usage as it does for antibiotics.

Action needs to be taken now and as part of a Sustainable Farming Scheme (SFS). Areas we would like to see addressed now are:

1. Education and support to farmers, e.g. via Farming Connect
2. Education of vets and Suitably Qualified Persons (SQPs) so that they are made aware of the importance of dung beetles and how to offer dung beetle-friendly advice
3. The incorporation of sustainable control of parasites on relevant university or agricultural college syllabuses
4. The incorporation of action to protect dung beetles into the SFS.

Farmer-led Action

There are many ways farmers can mitigate their impact on dung beetles on-farm, thus **maintaining and enhancing dung beetle populations and enhancing the significant ecosystem services** they provide. There are draft guidelines available online to help farmers reduce the impact of parasiticides on dung insects and the wider environment[82, 83]. Farmers must consider their specific farm situation, and any action should be taken in collaboration with a vet/SQP.

The **NADIS parasite forecast** should also be taken into consideration and is kept up-to-date regularly with new information. Nematodirus in lambs, for example, can have a high mortality rate, so knowing when it could be a problem on-farm can help reduce losses.

A vet should be consulted on any parasite control planning on the farm. Depending on the results, combined with worming history and clinical signs, a vet can advise whether treatment is required. Advice must be consistent across sources, so collaboration with, for example, Sustainable Control of Parasites (**SCOPS**) and Control of Worms Sustainably (**COWS**) is vital. **We recommend on-farm discussions with an Integrated Parasite Management (IPM) trained vet*.** This will enable the implementation of sustainable parasite control strategies including gastrointestinal worms, lungworm, liver fluke and ectoparasites such as flies, which will include strategies to reduce overuse of parasiticides. This is common practice for other veterinary areas e.g. Bovine Viral Diarrhoea (BVD) and Johne's disease control plans.

*The **Dung Beetle for Farmers** team and/or the forthcoming **Dung Beetle Trust** aim to create and provide appropriate training for farmers, vets and SQPs.

We recommend that on-farm parasite control planning is split into **'Prevention/Assessment'** and **'Treatment'** with an indicative approach outlined below.

Prevention / Assessment

1. **Quarantine purchased stock.** Bought-in animals can bring parasites such as liver fluke and lungworm which may not already be present on the farm not to mention infectious disease. Vets/SQPs can advise on effective quarantine testing.
2. **Breed homebred replacements where possible.** This reduces the risk of bringing new parasites onto the farm and homebred stock are more likely to have resilience to parasites present on

their home farm. It is also possible to breed genetically resistant livestock over a long period. More information is available from the SCOPS website regarding sheep.

3. **Avoid grazing youngstock on the same paddocks each year.** Youngstock act as 'multipliers' for gastrointestinal worms and lead to increased parasite burdens if grazed on the same pasture year on year. The use of defined youngstock paddocks is common practice as these paddocks are often close to the farm where animals can be easily monitored. Adult animals can be used as 'vacuums' (as they should have natural resistance, provided they were not over treated with parasiticides as youngstock).
4. **Create pasture risk maps.** Creating maps of grazing pastures and assigning each pasture with a 'risk' value can assist with reducing heavy parasite burdens year on year. See www.dungbeetlesforfarmers.co.uk for more information.
5. **Vaccinate for lungworm.** For farms that have active lungworm, vaccination can be a useful tool to reduce parasiticide use.
6. **Carry out diagnostic tests.** Farmers should be encouraged to check for parasite burdens and parasite resistance with **faecal egg counts (FECs)** and other diagnostic tests such as blood tests for liver fluke**.** Carrying out regular FECs:
    - Allows treatments to be targeted to the specific parasites, avoiding polypharmacy and a 'one treatment for all parasites' approach
    - Enables Faecal Egg Count Reduction Tests (FECRT) to be used to assess the efficacy of treatment and presence of anthelmintic resistance
    - Provide veterinary practices with an alternative income (which may balance reduced parasiticide sales).

    Increased diagnostic testing would not only have the potential to reduce the usage and thus the environmental impact of parasiticides but would also help to reduce the development of parasite resistance. It would be beneficial to provide ongoing support to farms that take up diagnostic testing so that they are correctly used. Farmers should talk to their vet and/or SQP who can support them with:
    - Interpreting results
    - Supporting the effective use of the most efficacious parasiticides
    - Suggesting other ways to reduce the need for parasiticides.

7. **Delay turnout.** Delaying turnout (especially onto silage aftermath) can reduce parasite infection levels on the pasture, especially for first time grazers and often avoids the serious build-up of infective larvae.

8. **Rotate stock around fields.** Where possible, pasture rotation and resting can help break parasite lifecycles. However, for livestock farmers, this may not be easy and some parasites can survive not only within the same season but can also overwinter. It's worth noting that weather conditions and different parasite species can affect the amount of time required before grazing the same pasture again – the hotter and wetter the weather, the faster the parasite lifecycle, and conversely, dry weather can desiccate parasites.

9. **In grasslands, mix up cattle and sheep grazing**. Rotating stock reduces the stocking density of the parasite host: cattle and sheep parasites are largely different species. For example, sheep grazing on a recent cattle-grazed pasture may help remove cattle parasites from the sward and vice versa. However, this may not be suitable in many systems and some parasites, such as liver fluke, affect both cattle and sheep.

10. **Longer sward length may also help**. Parasite eggs are often found at the base of grass stalks (although this is not always applicable in many ryegrass-based grazing systems). Longer recovery periods between grazing can help to increase sward height.

11. **Consider using herbal leys**. Sainfoin, birdsfoot trefoil, yarrow and chicory all have anthelmintic properties. For example, chicory has been shown to **reduce gastrointestinal parasite burdens in sheep by as much as 40%** [84,85,86,87,88,89]. These plant species can be found in specialist 'worming paddock mixtures'.

    Traditionally, 'Cae Ysbyty' or 'Hospital Fields' are part of the cultural heritage of Welsh farming. In the past, Welsh farms often kept a wildflower-rich field where sick or recuperating animals were grazed so they could benefit from the mixture of herbs to aid their recovery.

    There is now a growing body of evidence and recognition that grassland with a complex mix of native species has multiple benefits[90]. Many farmers are now opting to restore semi-natural, species-rich pastures on their farms. Scientists have found that restoring species-rich pastures increases the overall yield of the forage, as different species grow in adjacent spaces, both above and below ground, and throughout the growing season. Trials have shown that complex mixtures can out-yield monocultures and simple mixtures even when the monocultures have received a nitrogen application. Such species-rich pasture may also reduce the need for antibiotics and anthelmintics which in turn can lower veterinary bills, increase yields and improve the quality of meat and dairy products.

    An excellent example of herbal lay use is found via the Welsh Government funded, Pasture for Pollinators project[91]. Six Calon Wen farmers have been growing multi-species herbal leys, including flowering herbs, legumes and grasses, for a three-year European Innovation Partnership (EIP) Wales project. In 2018, each of the farmers sowed a herbal ley from Cotswold Seeds which includes birdsfoot trefoil, clovers (red, white, sweet and alsike), sainfoin, and other species which can help to enhance pollinator populations.

12. **Encourage agro-forestry.** Planting a group of trees and allowing grazing within them provides a variety of forage and shelter for livestock. Scrub and tree forage, especially willows, can be high in condensed tannins and minerals (e.g. cobalt – which is linked in deficiency with systemic pasteurellosis and parasitic gastroenteritis (PGE) in lambs). Agro-forestry also supports shade-loving dung beetles and, when trees are planted alongside rivers, the resulting riparian strips may have additional benefits for biodiversity and water quality.

13. **Out-winter some stock.** It is worth noting that you can help dung beetles by keeping some stock out over winter. This will help provide much needed dung in winter and early-spring months when some species are active.

Treat

Treating animals only when necessary will save money and also slow the rate of parasiticide resistance. This is consistent with the IPM strategy for pesticide use.

It is important to remember that **most mature cattle should not require any routine treatment for gastrointestinal parasites** as they should have developed natural resistance as long as they are grazed each season[92]**.**

Therefore, we recommend the following:

1. **Weigh animals** to ensure they receive the correct doses of parasiticides: overdosing is wasteful, while under-dosing will not be effective and is an easy way to accelerate parasite resistance. At a minimum, dosing for the heaviest animal in the group should be standard protocol.

2. **Avoid treating with the most harmful parasiticides such as ivermectin, doramectin and eprinomectin during the grazing season (unless there is resistance to other groups of the farm) and treatments with fewer non-target environmental impacts (see below).**

3. **Substitute the most toxic parasiticides with less toxic parasiticides.** Anything ending in 'mectin' is harmful to dung beetles i.e. doramectin, ivermectin, eprinomectin, moxidectin (although moxidectin is somewhat less harmful). Insect growth regulators, including dicyclanil and cyromazine, are less toxic and most products ending in 'ole' are unlikely to harm dung beetles (although they can have other impacts on soil biota). These include:
    - Albendazole
    - Fenbendazole
    - Levamisole
    - Mebendazole
    - Oxfendazole
    - Ricobendazole.

Nevertheless, with additional research, the lack of negative impacts of chemical groups previously thought of as 'safe' for dung invertebrates are being disproven. **Thus, the focus should be on reducing the use of all parasiticides**. For example, this list specifically excludes triclabendazole which recent studies have shown determinantal effects on dung beetles. As far as we are aware, there are no data currently available for derquantel or oxyclozanide. However, diazinon is an OP used in fleece dips. It is excreted in the urine so, whilst it is unlikely to impact dung beetles, it may have a negative impact on beneficial soil or aquatic invertebrates.[93]

4. **Avoid treating all stock with parasiticides at the same time:** This ensures that there is always some non-toxic dung available to dung beetles. The use of Targeted Selective Therapy (TST) should also be promoted in sheep to reduce risk of anthelmintic resistance.

Conclusion

We suggest the following actions:

Immediate Action

1. Support

Support farmers to:

- Carry out 4-6 weekly FECs from turnout
- Perform a FECRT after every treatment
- Carry out at least 1 blood or faeces test for liver fluke per year

This could be contingent on training through the following:

- Dung Beetles for Farmers (DBFF)
- Dung Beetle Trust (DBT)
- Farming Connect Officers trained by DBFF or DBT

2. Educate & Enthuse

Educate and enthuse farmers, vets and SQPs about:

- The importance and economic value of dung beetles
- How to monitor dung beetle population on farms
- How to look after dung beetles with a leaflet to be disseminated to all farmers in Wales. This could be part of a wider program of highlighting other tests farmers could do (e.g. alongside earthworm counts[94]).

3. Improve

Integrate the wider environmental impacts of antiparasitic treatment into the training of vets, SQPs, and within agriculture-based courses at college and university levels. Any education should include information on the impact of parasiticides on dung beetles and other treatment options, as discussed above.

Future Action

Integrate All Farming Systems

1. Protect

Protect dung beetles in **all farming systems** by reducing the use of parasiticides known to affect dung beetles during the March-October grazing season – this will enhance ecosystem services delivered by dung beetles over and above current value. Currently dung beetles may be:

- **Saving the Welsh cattle industry £4.7 million per year***
- **Saving the UK sheep industry £3.5 million per year*[95].**

2. Change Practice

Protect dung beetles in **all farming systems** by educating farmers to avoid treating adult cattle with parasiticides. This could:

- **Save the Welsh cattle industry £1.8 million per year** (£6.2 million per year across the UK)*[96].

If protection under all farming systems were not possible, there are the following options:

Sustainable Farming Scheme & Organic Farming Scheme

1. Sustainable Farming Scheme

Protect dung beetles under the new **Sustainable Farming Scheme** by restricting the use of parasiticides known to affect dung beetles during the March-October grazing season (unless under veterinary guidance) – this could:

- **Save £4.36 per cow per year** in farms with agri-environment agreements in place, saving the Welsh cattle industry **~£479,600 per year*** (£40.2 million per year across the UK)
- **Save ~£0.38 per sheep per year***[97] with agri-environment agreements in place **saving the Welsh sheep industry ~£362,140 per year***[98].

2. Organic Farming Scheme

Protect dung beetles under all new **organic** agreements by restricting the use of parasiticides known to affect dung beetles during the March-October grazing season (unless under veterinary guidance) – this could:

- **Save £1.26 per organic cow per** year saving the Welsh cattle industry **~£40,000* per year*** (£378,000 across the UK)
- **Save ~£0.11 per organic sheep per year, saving the Welsh sheep industry ~£30,000 per year*.**

**Please note that the figures for the Welsh cattle industry are indicative only, and further work is required to quantify them more accurately. It is likely that these figures are conservative estimates. Figures for sheep have been extrapolated from cattle figures and should therefore be seen as a guide only. We assume that ~10% of all Welsh livestock are in agri-environment schemes and 2.9% are organic. It should be noted that these figures for reducing the treatment of adult cattle does not include the savings on the parasiticides themselves, making on-farm savings significantly greater and these figures are draft figures that need to be finalised.*

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