Control of liver and rumen fluke in cattle

This document is part of the COWS Technical Manual aiming to provide a sound basis for advice to industry. The manual also comprises chapters on controlling parasitic gastroenteritis, lungworm, ectoparasites and insect pests, and integrated control of parasites on cattle farms

COWS is an industry initiative promoting sustainable control strategies for parasites in cattle

Section 1: Top 10 tips for controlling liver fluke in cattle

Sound and informed preparation will minimise liver fluke infections with positive effects on enterprise returns.

Identify Risk	1. **Identify high risk areas of fluke** and consider if grazing these pastures in the late summer /autumn can be avoided. Practical steps include fencing off wet areas, attending to leaking troughs and pipes, drainage or even consider housing early.
	2. **Ask for abattoir feedback on any liver rejections**. This is a free and invaluable option for getting an early warning that there may be a fluke problem on a farm. Early action will minimise reduced performance due to sub-clinical liver fluke infections.
	3. Investigate losses in sheep if you have sheep on your farm, as this can be an indication of fluke risk for your cattle.
Treat Appropriately	4. **Treat your cattle using the most appropriate medicine, most suitable for time of year and management of cattle involved.** Be sure to understand the product choices available in terms of the age or stage of liver fluke to be targeted because there are distinct differences in the effect of flukicides. Consider meat and milk withdrawal periods as well. Only use a combination product if appropriate – at housing for example, when fluke, lungworm and gut worms may all need to be controlled, but check with your vet or suitably qualified person (SQP) and make it part of your parasite control plan.
	5. **Always treat effectively**. Under-dosing is a major issue, leaving parasites alive in the animal which will cause damage to the liver and encourage resistance to develop. Weigh, don't guess, and be prepared to split cattle groups if there is a wide variation in liveweight to ensure the dose rate is accurate. Calibrate equipment regularly for all means of administration (drench, pour-on or injectable). If the product is orally administered ensure the drench is delivered over the back of the tongue. Follow the prescriber and manufacturer instructions for storage and administration accurately.
	6. Consider if you need to reduce pasture contamination levels in spring/summer by using a treatment with a drug that specifically kills adult fluke to reduce eggs passing onto pasture. This should be based on individual risk factors and abattoir feedback.
	7. Remember to repeat the treatment if necessary. If you leave cattle on infected pasture after treatment you may need to re-treat them in 6 to 12 weeks depending on the product you use. None of the flukicidal products are protective so animals can pick up infection straight away after treatment.
Avoid Resistance	8. **Resistance** to some flukicides is increasingly prevalent in sheep, and so, because the same parasite affects sheep and cattle, it is important to have an effective fluke control plan for cattle that reduces the risk of resistance spreading. If you suspect resistance, arrange a drench test, i.e. a Faecal Egg Count Reduction Test (FECRT), with your vet/SQP.
	9. Quarantine all incoming stock (sheep as well as cattle) from potential fluke areas for liver fluke as well as roundworms. This will take considerable planning but failure to do so could result in importing resistant liver fluke from another farm as well as losses and/or reduced performance in the animals themselves. Refer to guidelines on the COWS/SCOPS website (www.cattleparasites.org.uk & www.scops.org.uk) and discuss with your vet/SQP.
	10. Be Prepared. Don't wait until the losses are mounting up. Act now to work with your vet or SQP to plan ahead in terms of management control options, treatments and monitoring that can be put in place.

Section 2: Trematodes – (1) *Fasciola hepatica*
Liver fluke: a problem parasite

Introduction

Fasciola hepatica, the liver fluke, is a common and ubiquitous parasite affecting the health and welfare of cattle worldwide.

Fluke infection is estimated to cost the UK agriculture industry about £300 million a year. Liver condemnations alone cost £3.2 million in 2010.

Evidence from various sources suggests that the prevalence of infection has increased considerably in recent years for a variety of reasons including:

- changing climate
- changing farming practices
- increased animal movements.

There are growing concerns about anthelmintic resistance, particularly to triclabendazole.

Key concerns

- Costs UK agriculture £300m a year
- Prevalence of infection increasing
- Evidence that resistance to triclabendazole is on the increase

Fluke has also been shown to modulate the host's immune system; this affects diagnosis and susceptibility to other infectious agents, including bovine tuberculosis.

Control of fluke in cattle requires a thorough understanding of the biology of the parasite, its life cycle and epidemiology and the control options available for each individual farm.

Disease

The disease caused by *F. hepatica* is known as fasciolosis. Cattle typically develop chronic disease and classically show loss of weight, condition and become anaemic. Sometimes cattle develop diarrhoea, but whether this is a direct consequence of fluke infection or due to other reasons, such as co-infection with *Salmonella* Dublin is not clear.

Severity of disease depends on the number of parasites that infect the animal. Livestock become infected by ingesting the infective stage, the metacercaria, which contaminates grass and other vegetation. These hatch in the small intestine and migrate across the gut wall and directly into the liver. The juvenile flukes migrate through the liver tissue, feeding and growing until they reach the bile ducts. The migrating flukes cause liver damage, destruction of tissue and haemorrhage. In sheep, this causes acute disease and commonly the death of animals, but acute disease is seen rarely in cattle in the UK.

Signs of fasciolosis

- Weight or body condition loss
- Anaemia
- Reduced milk yield
- Increased susceptibility to other infections

Once the fluke reach the bile ducts, they mature into adult egg-laying parasites. The spines on the surface of the flukes damage the mucosa as they move and the adults feed on blood. This causes biliary hyperplasia, calcification of the bile ducts and enlargement of the gall bladder. The greater the number of fluke present, the more severe the liver damage and the more serious the disease.

Cattle infected with lower fluke numbers may not show overt signs, but sub-clinical effects may become apparent. In dairy cattle, this may manifest as reduced milk yield and changes in milk quality. In younger stock, sub-clinical infection may result in reduced feed

conversion ratios, poor growth and reduced carcase value, including liver condemnation. Whilst these effects on health may be subtle, the economic impact can be considerable.

Cattle infected with *F. hepatica* are thought to be more susceptible to other infections, including *Salmonella* Dublin and *Clostridium* spp. There is recent evidence to suggest that the diagnostic test for bovine tuberculosis may be also compromised in fluke-infected cattle.

Liver showing fluke damage

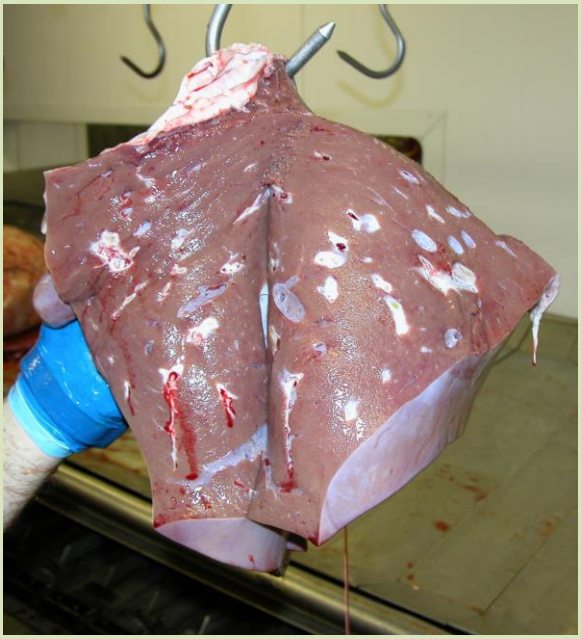


Photo courtesy of Merial

Section 3: Liver fluke: the parasite

Liver fluke biology

Liver fluke (*F. hepatica)* are trematodes, i.e. they are in a different group to the nematodes (roundworms) and have very different life cycles. Other trematodes include:

- The paramphistomes (rumen fluke) (See section 7 of this chapter)
- *Dicrocoelium dendriticum* (lancet fluke).

Mature *F. hepatica* are large, leaf-shaped flatworms; 3 to 5cm long and 1cm wide. They are hermaphrodite, i.e. each parasite has both female and male sex organs. They feed by secreting and excreting enzymes which break down blood and tissues.

F. hepatica parasitize a range of animals. Sheep and cattle are the main hosts in the UK, but deer and hares can also be infected. Elsewhere, *F. hepatica* causes disease in llamas, alpacas, reindeer, donkeys, and buffalo. The World Health Organisation considers *F. hepatica* to be an important threat to human health in some developing countries.

A liver fluke

Photo courtesy of Sinclair Stammers, Micromacro.

Liver fluke life cycle

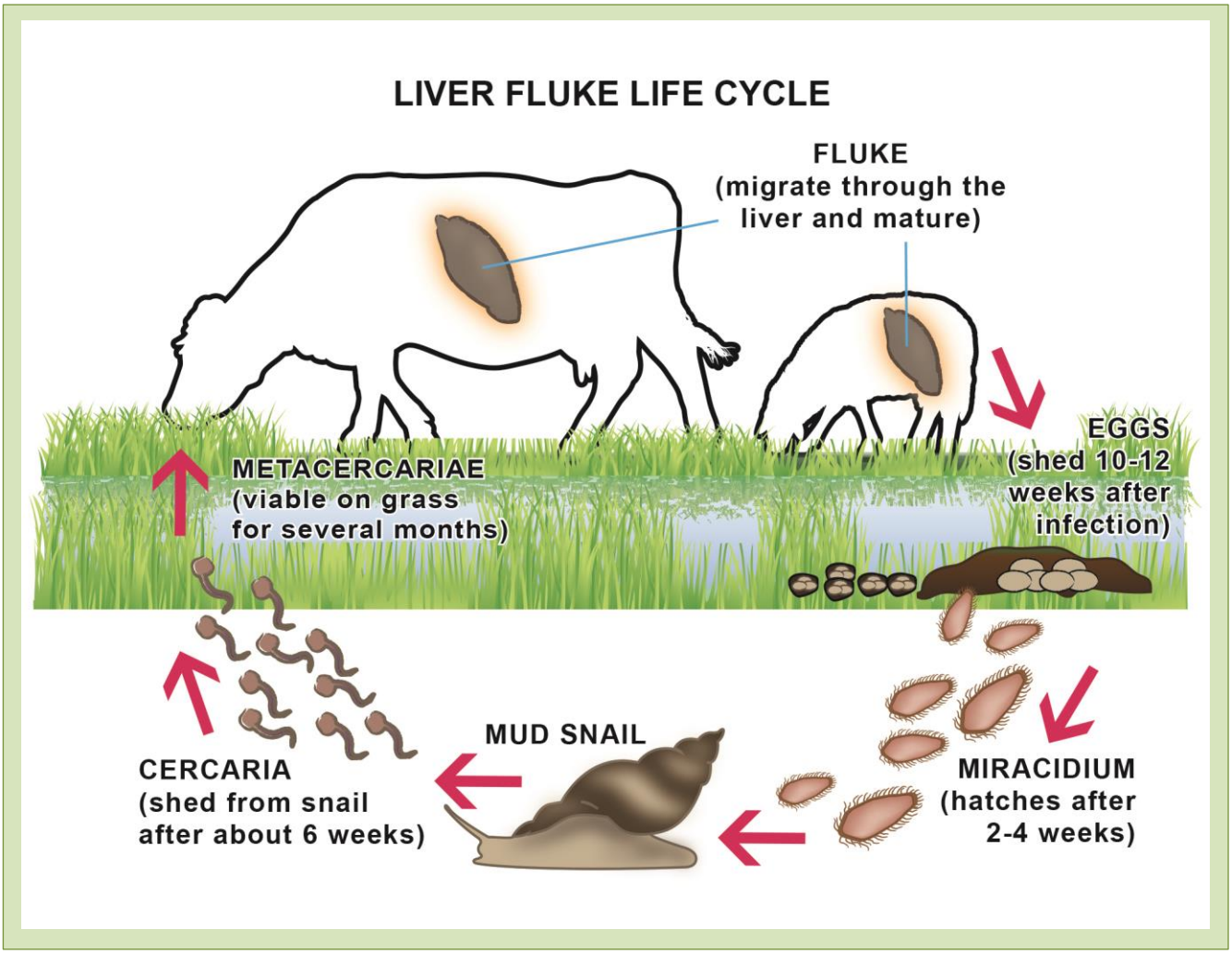
Liver fluke have a complex life cycle involving an intermediate host, which is a **mud snail** called *Galba truncatula*. This snail species is an essential part of the life cycle.

Eggs are passed out in the dung of infected hosts. Eggs can take up to one month to develop and the rate of development is dependent on the external temperature. If it is warm (i.e. summer), development is more rapid. Little development occurs in the winter when temperatures fall below 10^{o}C.

When the egg has developed, it hatches and the microscopic **miracidium** is released. The miracidium only lives for a few hours and requires water to swim through to reach a snail. Once it finds a suitable snail, it burrows through the snail's foot and into the body cavity. Here the fluke grows and multiplies. This takes about six weeks and again is dependent on temperature – the warmer the weather, the faster the development. After about six weeks the next stage of fluke, the **cercaria,** is released from the snail. A snail infected with a single miracidium can produce hundreds of cercariae as there is an amplification of parasites in the snail.

Cercariae swim through water and reach grass and vegetation around the habitat where the snails are found. Here, they form infective cysts: the **metacercariae.** These can remain viable on pasture for several months, depending on the weather. When eaten by a grazing animal, the cysts are swallowed, hatch and burrow through the gut and into the liver.

It takes about eight weeks for flukes to complete their migration through the liver and reach the bile ducts. Eggs can be detected in the dung about 10-12 weeks after infection.


LIVER FLUKE LIFE CYCLE
FLUKE
(migrate through the liver and mature)
EGGS
(shed 10-12 weeks after infection)
METACERCARIAE
(viable on grass for several months)
MUD SNAIL
CERCARIA
(shed from snail after about 6 weeks)
MIRACIDIUM
(hatches after 2-4 weeks)

Section 4: Liver fluke environment and epidemiology

Environment

For fluke to be found on a farm, mud snails, *Galba truncatula,* must be present. These live on mud around the edges of ponds, streams, rivers and hoof prints or tractor ruts in muddy fields. Snails prefer slow moving water with a neutral pH. They also need calcium and other minerals for good shell growth.

Snails reproduce rapidly in warm, wet summers. Warm temperatures increase development of the fluke as well. Both the snail and the fluke need water, so warm summers with high rainfall increase the risk of fluke infection.

High risk conditions

- Wet muddy areas
- Warm summer weather
- High summer rainfall

UK winter months are generally too cold for liver fluke to develop. Snails go into hibernation and stages of the parasite in the snail at the start of winter also stop developing. Eggs can survive on pasture over winter and when the weather warms up in spring, the eggs develop, snails come out of hibernation and the parasite life cycle resumes.

Epidemiology

Fasciolosis is a seasonal disease, with a peak of infective cysts on pasture in late summer/autumn leading to disease in cattle over the winter.

Liver fluke can only develop in the environment and snail at temperatures >10^{o}C, and the snail requires temperatures of >10^{o}C to reproduce. Hence, most development occurs from May to October in the UK and, if conditions are ideal over the summer, large numbers of metacercariae are released from snails onto pasture from late August to October. This leads to disease associated with the adult flukes in bile ducts, normally in late winter to early spring and can occur in housed cattle if they have not been treated with an appropriate flukicide after housing.

When the weather is less favourable (e.g. after a very dry summer), development of the snail and fluke is slower. The result is fewer cysts on pasture in the autumn and their release is more gradual. Cattle become infected and although they may not develop clinical disease, there may be sub-clinical effects on productivity.

Peak risk periods

- Stock infected late summer and autumn
- Disease seen late autumn and winter
- Risks lower after very dry summers

Whilst there is a peak in the number of infective cysts on pasture in late summer/early autumn, low numbers of infective cysts can be present on pasture all year, including over winter. This is because cysts can survive on pasture for several months when conditions are neither too dry nor too hot. Infected snails that have hibernated over winter can release low numbers of metacercariae onto pasture when they come out of hibernation in the spring.

Cows grazing contaminated pasture, even early in the season, are at risk of infection. This may not lead to clinical disease but these animals pass eggs that develop and infect snails, perpetuating infection. When winters are mild, fewer snails perish and more will be present in spring, ready to become infected as eggs develop and hatch.

There is little evidence that cattle develop immunity to fluke infection. Infection can be picked up at any time and animals can be repeatedly infected.

Survival of metacercariae

It is thought that metacercariae can survive on pasture for a year or more, but a proportion will die off over that time. Experimental studies suggest that 10% of metacercariae survive for one year at temperatures of 2-5^{o}C. Their survival depends on moisture and moderate temperatures; metacercariae will not survive for more than six weeks at 25^{o}C, but can survive for eight weeks at temperatures of -2^{o}C. It has been estimated that 50% of metacercariae will survive a normal UK winter. Heat and drought will kill metacercariae.

It is unlikely that metacercariae will survive in silage. There is no information about survival of metacercariae in haylage and the survival of metacercariae in hay is equivocal. One study conducted in 1927, suggested that metacercariae survived for eight months in hay that had been harvested in rainy weather, that had a relative humidity of >90% and that was stored at low temperatures. Another study showed that metacercariae, when placed in hay, survived 2-3 months when stored at low temperatures. It is not clear if metacercariae will survive in hay produced under normal farm conditions.

Freshly cut grass should be regarded as a potential source of infection if harvested from fluke-contaminated pasture.

Section 5: Liver fluke diagnosis

Diagnosis in individual cattle is important to establish if fluke is the cause of disease or production loss.

Diagnosis can also be performed at the herd level to establish if the parasite is present on a farm as a possible cause of production loss. Herd tests should be regarded as a first step in the control of fluke and are useful monitoring tools. Valuable information can be obtained from abattoir reports, which provide evidence that fluke is present, even when clinical signs are absent.

For individual cows, two diagnostic tests are used widely:

1. Detection of fluke eggs in dung. This method lacks sensitivity, can only detect adult parasites and does not give much information on numbers of parasites within an animal.

2. Antibody detection (ELISA). Clotted blood or milk samples can be sent for analysis. This test can detect early infection, but antibodies persist for a short while after treatment, so it does not prove that an infection is actually present, just that the cow has been infected recently with fluke.

For dairy herds, bulk tank milk ELISAs are routinely used to establish if a herd has been exposed to fluke. They indicate high, moderate and low levels of exposure and can be done routinely to monitor infection and efficacy of control programmes.

Diagnostic tests

- Antibody detection via blood or milk samples
- Checking dung samples
- Abattoir reports

For beef herds, composite faecal egg counts can be informative. Normally dung samples are collected from 10 animals and a single (composite) egg count performed at the lab. This gives information about whether the parasite is present in the herd and allows further investigation. However, fluke egg shedding can be intermittent and the absence of eggs does not necessarily mean that animals are fluke-free, they may be harbouring immature liver fluke, which are too young to lay eggs.

A relatively new test, the faecal (or copro-) antigen ELISA is available commercially. This test detects fluke secretions in the host's faeces. This is a useful test for individual cattle, but it has not yet been fully evaluated on composite faecal samples.

Other factors should be taken into account when diagnosing infection, these include:

- herd fluke history
- presence of snails/snail habitat
- treatment history
- time of year.

Section 6: Liver fluke control

Control of fasciolosis depends on the type of farm, the history of the herd and should involve both management and chemical treatment options. Infection pressure will depend on prevailing weather conditions and varies year to year.

Each programme should be tailored to a particular farm; designed in consultation with their veterinary surgeon considering grazing and treatment plans for the whole year. It is important to:

- establish if fluke infection is present
- to identify 'flukey' pastures (i.e. those with marshy/muddy areas which provide suitable snail habitats)
- design a programme for the whole farm, taking into consideration all stock, regardless of age and species.

Most programmes will require both the use of flukicides to prevent disease and reduce contamination of pasture with eggs, plus grazing strategies to avoid heavily contaminated pasture, particularly in autumn.

There is a range of products available for use in cattle, but care must be taken to select the right product for the specific purpose required, to dose animals according to the product information leaflet and to observe meat and milk withdrawal periods.

Triclabendazole is the only product effective against very early immature fluke i.e. two weeks and older, through to adults. It is used extensively to control fluke in sheep and, as a result, triclabendazole resistance has been reported in some parts of the UK. Although resistance has predominantly been reported in fluke populations in sheep, it is important to remember that the same parasite affects both cattle and sheep. There is one published report of triclabendazole resistance in fluke in cattle in the UK.

It is very important that care is taken to reduce selection pressure where possible by only using triclabendazole-containing products when no other option is suitable. Other medicines including closantel, clorsulon, nitroxynil, oxyclozanide and albendazole are effective against adult flukes and some (nitroxynil and closantel) are effective late immature stages between six and eight weeks old. Thus far, there have been no reports of resistance to these classes of medicine in the UK. See Section 4: Parasiticide resistance, in the COWS Integrated Parasite Control chapter for additional information.

Control

- Must be farm specific
- Consider livestock species together
- Choose treatments strategically
- Consider quarantine treatments

Most flukicides have no persistent activity and allowing cattle onto fluke infected pasture after treatment re-exposes them to the risk of infection. If cattle are housed after treatment, then there is a very low risk of picking up new infection until they are turned out again. If cattle are turned back out after treatment, use tactics such as moving to 'low risk' areas or fencing off risky areas. If cattle remain on highly contaminated pasture, then monitoring for infection is essential, as further treatments may be needed.

Many flukicidal medicines are sold in combination with medicines used to treat roundworms as well as fluke. It is important to use these only when both roundworms and fluke need to be targeted, for example, around housing, treatments that target all stages of fluke and hypobiosed (or arrested) nematode larvae should be given two weeks after housing, for optimum fluke control.

Treatment of milking cattle is problematic. Two products are licenced for use in milking animals: albendazole and oxyclozanide, which have withdrawal periods of 60 hours and 72

Information on individual products is available in the NOAH Compendium of Data Sheets for Animal Medicines at www.noahcompendium.co.uk or from the product manufacturer. Always check the latest product data sheet and/or product label before advising or administering products.

hours, respectively. Fasinex 240 can be used at drying off, but not within 48 days of calving and milk for human consumption may only be taken from 48 hours after calving. Should a cow calve earlier than 48 days after treatment, milk for human consumption may only be taken from 50 days after the last treatment is administered.

Liver fluke take approximately 10-12 weeks to mature following ingestion of infective stages and not all flukicides are effective against all immature stages. It is important to choose an appropriate product and to administer it at the correct dosage and at the most suitable time according to the life cycle of the parasite.

The COWS group is strongly advising that farmers discuss product choice with their vet or suitably qualified person (SQP) as part of their herd health plan. Also see the COWS Integrated Parasite Control chapter.

Choice of drug will be influenced not only by risk of infection, but also by its meat/milk withdrawal, risks posed by other parasites that may be present and ease of administration. The table below summarises the main treatment options in relation to when they are best used post-housing.

Summary of different flukicidal products licensed for use in cattle*

Active ingredient	Administration route	Stage of fluke killed
Triclabendazole	Oral	2 weeks onwards
	Pour-on	6-8 weeks onwards
Closantel	s/c injection or pour-on	7 weeks onwards
Nitroxynil	s/c injection	8 weeks onwards
Clorsulon	s/c injection	Adults only
Oxyclozanide	Oral	Adults only
Albendazole	Oral	Adults only

*Note: This information was correct as when this document went to press (December 2013) and current data sheets must always be checked before treatment.

Use the product most suitable for the time of year and management of the cattle involved.
See www.cattleparasites.org.uk for products available

Quarantine treatments

Buying in cattle or sheep brings the risk of introducing fluke, possibly those which are triclabendazole resistant, onto a farm. If there are no snails on the farm, then the life cycle cannot be propagated and there is no risk. However, *Galba truncatula* are found throughout the UK, so it is important to check there are no suitable habitats on the farm, rather than assume they are not present.

Even where fluke is already on the farm, consideration should be given to treating bought-in cattle and sheep, as there is a risk of introducing triclabendazole resistant populations.

Avoid use of products containing triclabendazole, but be aware that other products will not kill immature flukes (< 6 weeks old), so a second treatment will be required 4-6 weeks later to remove residual flukes.

More information on quarantine is included in Section 5 of the COWS Integrated Parasite Control chapter.

Section 7: Trematodes – (2) Paramphistomes
Rumen fluke

Introduction – The Paramphistomes or rumen fluke have a worldwide distribution and are considered to be important parasites in a number of ruminant species, particularly in tropical and subtropical areas. They are approximately 1cm long and resemble pink, fleshy maggots on the surface of the rumen and reticulum. Rumen fluke have been found increasingly in British and Irish livestock over the past ~5 years.

Diagnosis – Rumen fluke are diagnosed through the presence of rumen fluke eggs in dung samples or rumen fluke parasites in the intestine or rumen at post-mortem. Dung samples are processed in exactly the same way as for liver fluke samples e.g. sedimentation in water. Their eggs do appear similar, but rumen fluke eggs tend to be more variable in shape and clear as opposed to the golden colour of liver fluke eggs.

Disease – Generally, mature rumen fluke do not cause clinical disease. Where disease has been reported, it has invariably involved large numbers of immature rumen fluke in the intestine, usually the duodenum, and typically in young stock. This results in severe enteritis characterised by ill-thrift and profuse, fetid diarrhoea. In severe cases, it has proved fatal, in both cattle and sheep.

Whilst the clinical importance of rumen fluke is under debate, these parasites are significant from a diagnostic perspective. Liver fluke and rumen fluke are often found as co-infections and, because their eggs are similar, this could lead to misdiagnosis and/or misinterpretation of liver fluke treatment outcome. A differential diagnosis is important because there are only a small number of flukicides that can kill rumen fluke. Treatment of livestock for rumen fluke, in the absence of confirmed clinical signs, is not recommended.

Treatment – Only one flukicide, oxyclozanide, has reported activity against adult and immature rumen fluke, although none of the commercial flukicides containing oxyclozanide, either on its own or in combination with levamisole, have a specific label claim for rumen fluke. Oxyclozanide is a medicine that kills liver fluke in its own right but is only capable of killing adult liver fluke, so using it on its own at certain times of the year may leave stock, especially sheep, unprotected against acute liver fluke infections.

Adult paramphistomes on the surface of a bovine rumen

Epidemiology – For decades it has been assumed that the principal rumen fluke species infecting British and Irish livestock is *Paramphistomum cervi*, which has a wildlife reservoir in deer and buffalo and is known to favour aquatic snails as their intermediate host. Recent DNA analysis of rumen fluke specimens from homebred sheep and cattle indicates that the major species is *Calicophoron daubneyi*, the dominant rumen fluke found on mainland Europe. This may have implications for rumen fluke epidemiology in the UK as, at least in Europe, this species is known to favour *Galba truncatula*, the same mud snail used by liver fluke, as its intermediate host. This remains to be confirmed in the UK and Ireland.