

All-island Animal Disease Surveillance Report 2015

A joint AFBI / DAFM Veterinary Laboratories publication

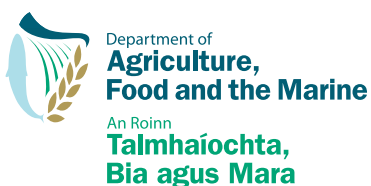


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John Fagan (Editor)

Introduction

Surveillance for disease in food-producing animals is generally undertaken to support animal health goals such as the control of endemic disease, early detection of new and emerging disease patterns, or to substantiate claims of disease freedom. However, it also has an important “One Health” dimension, and specifically in respect of the major societal challenge posed by antimicrobial resistance (AMR). The UK Government-sponsored O’Neill report on AMR (*“Tackling drug-resistant infections globally”*, published in May 2016) highlights the need for better surveillance data on drug resistance and antimicrobial consumption in both human and animal populations, whilst the Irish Government’s Inter-Departmental initiative on AMR includes a commitment on sharing and joint reporting of information on antimicrobial usage and resistance patterns. In both human and veterinary medicine, the availability of effective antibiotics is a privilege that we have grown accustomed to, and perhaps take for granted.

The emergence of AMR was an inevitable outcome of the selection pressure that antimicrobials exert on the microbiome. The development of each successive new class of antimicrobial group has rapidly been succeeded by the emergence of bacterial resistance to it, and ominous concepts have been floated in the media like ‘a post-antimicrobial world’. While this prospect may

not be immediately imminent, the control of antimicrobial-resistant strains of bacteria requires constant vigilance for changes in the occurrence and prevalence of markers of resistance.

One important element of good antimicrobial stewardship is the necessity for reliable information to support prudent usage. Prudent use begins with a better understanding of which infectious diseases are prevalent, the implementation of alternative strategies to control and prevent disease so as to reduce the reliance on antimicrobial therapy and accurate diagnosis of these diseases to ensure appropriate treatment when necessary. The animal disease surveillance services undertaken by the laboratory services north and south provide definitive diagnoses and information on resistance/sensitivity for therapy, as well as information on patterns of antimicrobial resistance in clinical isolates obtained from food-producing animals.

Monitoring of antimicrobial resistance provides excellent value for money. In the first place the practitioner is informed of the patterns of resistance, and the best course of treatment in the cases they refer, and perhaps more importantly from an overall public health context, it helps to reduce overall usage, especially of critically-important antibiotics. Furthermore in many cases monitoring data provides reassurance that older drugs are

sufficient for particular applications. These data may also be used to inform government policy on combating antimicrobial resistance.

In addition to the implications for therapeutic strategies and prescribing policies, some antimicrobial-resistant strains of pathogenic bacteria are regarded as a serious threat to public health, the most familiar of these being methicillin-resistant *Staphylococcus aureus* (MRSA). All *S. aureus* isolates are screened in both jurisdictions for significant resistance patterns. This report highlights the first detection in animals in the UK or Ireland of an antimicrobial-resistant strain of *S. aureus* with a specific virulence factor (LA-MRSA CC30), detected by Agri-Food & Biosciences Institute (AFBI NI) at Stormont. This highlights the ability of passive surveillance to deliver early detection of novel trends and threats in this field as well as in its more traditional field of animal disease detection and monitoring.

Other topical emerging issues for food animal production on the island include the detection of besnoitiosis for the first time on the island by the UCD veterinary hospital on a farm in Co. Tipperary. The results of a follow-up serological survey confirm that the disease is not widely disseminated, and investigations into its route of introduction and distribution continue. Bluetongue

is another vector-borne disease which poses a risk of incursion into Ireland, given its continued presence in Northern Europe, and were this to happen it would likely have far greater impact on the island of Ireland than besnoitiosis. This report summarises the surveillance activities monitoring these and other threats to food animal production, and presents the results of this work from 2015.

We salute the work of laboratory staff in both jurisdictions, whose work is summarised here, for their work in animal disease surveillance and in producing this report. We also acknowledge and thank our partners in animal disease surveillance — the farmers and veterinary practitioners who supplied and referred the specimens tested.

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Animal demographics and the weather

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Cattle and sheep demographics

The national cattle herds in both Ireland and Northern Ireland increased in 2015 from the numbers recorded in 2014. In Ireland an increase of 5.4% was recorded with 6.42 million cattle present in the national herd in December 2015. This change was driven primarily by an increase of 7.7% in the numbers of 6-12 month old cattle. In Northern Ireland the increase was more modest with an increase of 0.6% recorded in the national cattle herd. Dairy cow numbers in Northern Ireland increased by 5.8% during this time (Figure 1).

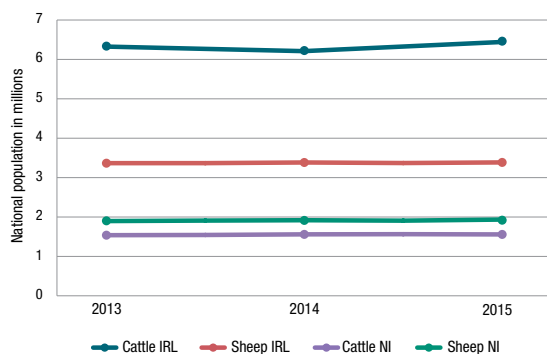


Figure 1: Trends in the national cattle and sheep populations in Ireland and Northern Ireland from 2013 to 2015 (Source: Central Statistics Office www.cso.ie; Department of Agriculture, Environment and Rural Affairs for NI)

The national sheep flock in Ireland was unchanged relative to 2014 with 3.3 million sheep. In Northern Ireland there was growth of 3.9% in the national sheep flock compared to 2014. This growth was driven by an increase in ewe and shearling (hogget) numbers by 3.1% during this time.

Weather

Similar to 2014, 2015 proved a very wet year with unseasonal levels of rainfall recorded in May, November and December in particular. (Figure 2).

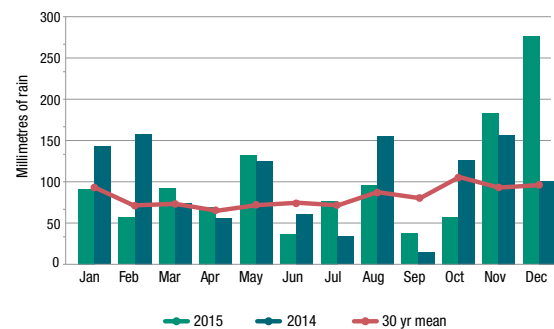


Figure 2: The monthly rainfall recorded during 2015 in Mullingar compared to 2014 and the 30-year monthly average rainfall (red line). (Source: www.meteireann.ie)

The rainfall in September and October was below the 30-year average. However excessively wet conditions during May and to a lesser extent during August contributed to heavy burdens of fluke on pasture in the early autumn and losses were experienced on sheep farms in some parts of the country as a result.

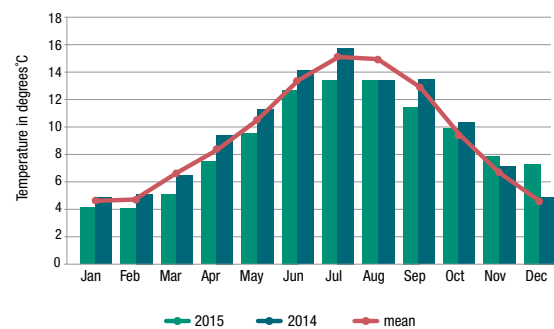


Figure 3: The monthly average temperature as recorded in Mullingar during 2015 compared to 2014 and the 30-year average temperature (red line). (Source: www.meteireann.ie)

Temperatures throughout 2015 were cooler than average with the exception of November and December which were warmer than the 30-year average (Figure 3). Cooler and wetter conditions can facilitate a number of conditions of farm animals including parasitic gastroenteritis, fasciolosis and pneumonia.

Diseases of Cattle

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The most frequently diagnosed causes of mortality in cattle submitted for *post mortem* examination to the Agri-Food and Biosciences Institute (AFBI) and the Department of Agriculture, Food and the Marine (DAFM) laboratories are presented in this section. The causes of mortality in cattle vary markedly by age, therefore the data in this section are presented by age category. For comparative purposes, the age categories used are standardised for both laboratory services and consist of neonatal calves (less than one month of age), calves (1 to 5 months of age), weanlings (six to twelve months of age) and adults (greater than twelve months of age).

Despite the myriad of possible causes of mortality in cattle, the common causes of death remain remarkably consistent from year to year and for each jurisdiction. To facilitate the presentation of results, conditions are grouped into general categories. More specific details on some of these conditions can be obtained in other sections of the report.

Neonatal Calves (0-1 month old)

Gastrointestinal infections continue to be the most frequently identified cause of mortality among neonatal calves on the island of Ireland, accounting for 38 *per cent* of neonatal deaths in Ireland and 40 *per cent* in Northern Ireland (Figure 4). Further details can be found in the bovine neonatal enteritis section.

Septicaemia was the second most commonly diagnosed cause of neonatal mortality in both jurisdictions (13 *per cent* in Ireland and 14 *per cent* in Northern Ireland; Figure 4) with colisepticaemia the most frequently recorded cause, representing 56 *per cent* of septicaemia cases in Northern

Ireland and 48 per cent of septicaemia cases in Ireland. *Salmonella spp.* were isolated in 22 per cent of septicaemia cases in Northern Ireland and eight per cent of septicaemia cases in Ireland.

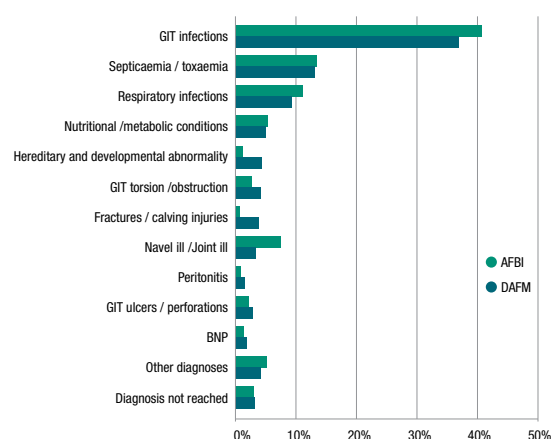


Figure 4: The conditions most frequently diagnosed on *post mortem* examination of neonatal calves (less than one month old) by DAFM (n=958) and AFBI (n=652) in 2015. GIT = Gastrointestinal tract; BNP = Bovine neonatal pancytopenia; DAFM = Department of Agriculture, Food and the Marine; AFBI = Agri-Food and Biosciences Institute.

Respiratory tract infections were the third most commonly diagnosed cause of neonatal mortality in both Ireland (10%) and Northern Ireland (11%) (Figure 4). *Mycoplasma bovis* was the most frequently recovered respiratory pathogen in this age cohort in Northern Ireland (27%; n = 20, increased from 19.5% in 2014) while this pathogen was identified in 10 per cent (9 cases) of respiratory tract infections in Ireland. *Mannheimia haemolytica* was diagnosed in 12 per cent (11 cases) of respiratory tract infections in Ireland and in 13.5 per cent (10 cases) in Northern Ireland, while *Pasteurella multocida* was diagnosed in 11 per cent (10 cases) of respiratory tract infections in Ireland and in 3 per cent (2 cases) in Northern Ireland. Bovine herpesvirus 1 (IBRV) was detected in eleven cases of respiratory tract infections in Ireland but was not detected in any respiratory cases in Northern Ireland.

Hypogammaglobulinaemia was the most frequently recorded nutritional/metabolic condition in neonatal calves in Northern Ireland, accounting for 81 per cent of cases, while in Ireland it accounted for 38 per cent of the nutritional/metabolic conditions recorded. Ruminal drinking (3 cases) was the second most frequently recorded diagnosis in this grouping in Northern Ireland while ruminal drinking/rumenitis accounted for 23 per cent (12 cases) of nutritional/metabolic condition in neonatal calves in Ireland.

In Ireland there were 46 cases of hereditary and developmental abnormalities recorded, representing 5 per cent of neonatal mortality examined in 2015. Intestinal atresias were the most frequently diagnosed congenital abnormality accounting for 46 per cent of cases (21 cases) while various congenital heart defects, including ventricular and atrial septal defects, accounted for 28 per cent of cases (n=13). Hereditary and developmental abnormalities were attributed to just two per cent of mortality examined in this age category in Northern Ireland.

CASE REPORT: VENTRICULAR SEPTAL DEFECT

A ventricular septal cardiac defect was diagnosed at the necropsy of a three-week-old Limousin-cross bull calf that was presented for necropsy. The calf had refused to suckle after birth and was tube-fed until it began suckling on its own after a few days. However, it was described as being lethargic and having a poor appetite. It died after developing some respiratory signs that failed to resolve despite antimicrobial therapy. A 6cm diameter defect between the left and right ventricles was identified upon opening the heart (Figure 5). There was an accompanying hepatomegaly, pulmonary oedema and pleural effusion related to poor cardiac function. The severity and duration of clinical signs depends on the site and size of the defect. Most cases of ventricular septal defect cause congestive heart failure, eventually resulting in pulmonary hypertension, anoxia and death.

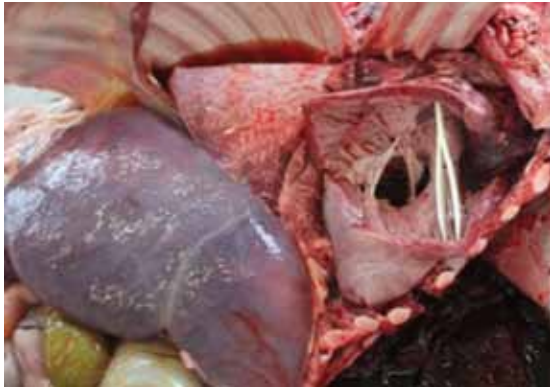


Figure 5: A ventricular septal defect in the heart of a three-week-old bull calf. (Photo: Colm Ó Muireagáin)

Calves (1-5 months old)

Following the same pattern as reported in previous years, respiratory infections were the most frequent cause of death in calves aged 1 to 5 months old in both Northern Ireland (45% of cases) and Ireland (32% of cases) (Figure 6). Bacterial infections were most frequently diagnosed. The most frequently identified bacterial pathogen in respiratory infections in Northern Ireland was *Mycoplasma bovis* (26% of cases) followed by *Pasteurella multocida* (16%), *Mannheimia haemolytica* (13%), *Trueperella pyogenes* (12%) and *Histophilus somni* (3%). The most frequently identified bacterial pathogen in respiratory infections in Ireland was *Pasteurella multocida* (25% of cases) followed by *Mycoplasma bovis* (18%), *Mannheimia haemolytica* (15%), *Histophilus somni* and *Trueperella pyogenes* (both 10%). In both jurisdictions, hoose was the most frequent non bacterial cause of pneumonia detected in 10 per cent of cases in Ireland and two per cent of cases in Northern Ireland.

Enteric infections were diagnosed in just under 15 per cent of calves in this age category examined at *post mortem* in Ireland (Figure 6). Coccidiosis was recorded in 21 per cent of cases, *Salmonella spp.* in 5.5 per cent of cases and parasitic gastroenteritis in 3 per cent of cases. In Northern Ireland, enteric infections were diagnosed in 11 per cent of 1 to

5 month old calves examined at *post mortem*. Coccidiosis was recorded in 20 per cent of cases and *Cryptosporidium spp.* in 9 per cent of enteric infections. BVD/mucosal disease was recorded in six cases (1.5% of overall cases in this category) in Northern Ireland and there was one case in Ireland.

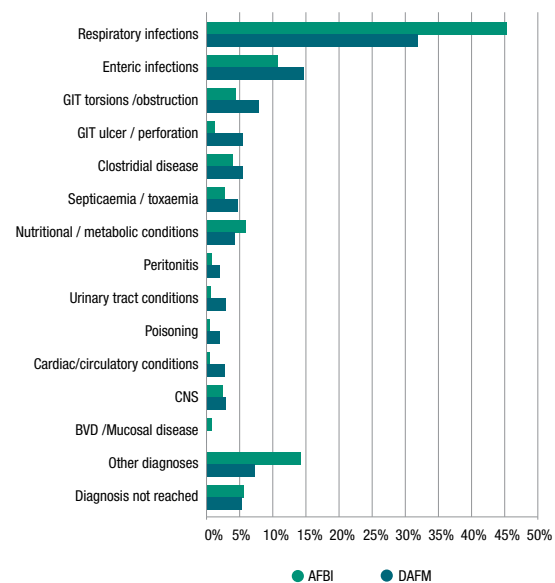


Figure 6: The conditions most frequently diagnosed on *post mortem* examination of calves one to five months old by AFBI (n=182) and DAFM (n=217) in 2015. GIT = Gastrointestinal tract; CNS = Central nervous system.

There were 53 cases of gastrointestinal torsion/obstruction diagnosed in Ireland and 18 cases in Northern Ireland in 2015. These include mesenteric, gastric and intestinal torsions, intussusceptions and other intestinal obstructions. Gastrointestinal ulceration and/or perforation leading to peritonitis was a relatively common diagnosis in this age cohort in Ireland with 36 cases recorded but only 6 cases were diagnosed in Northern Ireland.

Nutritional and metabolic conditions were diagnosed in 5.8 per cent (23 cases) and 4 per cent (28 cases) of calves in Northern Ireland and Ireland respectively in 2015. Ruminal acidosis was the most frequent diagnosis in this category

in Northern Ireland with 10 cases diagnosed and there were 7 cases in Ireland.

CASE REPORT: POLYARTHRTIS DUE TO *MYCOPLASMA BOVIS*

A one month old calf with lameness and swelling of multiple limb joints was euthanised on welfare grounds and submitted for necropsy. Thirteen animals out a group of sixty were affected with swollen joints and concurrent diarrhoea. Necropsy revealed a fibrinous polyarthritis (Figure 7). *Mycoplasma bovis* was isolated from the synovial fluid and also confirmed by PCR assay. Cryptosporidial oocysts were detected in the intestinal contents and were considered the likely cause of diarrhoea in the calf group. The feeding of milk from cows treated for mastitis was thought to be the origin for the outbreak of polyarthritis in this particular group of calves.



Figure 7: Fibrinous synovitis in a calf with *Mycoplasma bovis* polyarthritis. (Photo: Denise Murphy)

Weanlings (6-12 months old)

Respiratory tract infections continue to be the most significant cause of mortality in weanling cattle on the island of Ireland, accounting for 43 *per cent* of deaths in this age category in Northern Ireland and 32 *per cent* in Ireland (Figure 8). Bacterial infections were the most frequent cause of respiratory tract infections. In the cases diagnosed in Northern Ireland, *Mycoplasma bovis* was the most frequently detected pathogen (26% of respiratory

tract infections) followed by *Pasteurella multocida* (14%), *Mannheimia haemolytica* (9%), *Trueperella pyogenes* (3.5%) and *Histophilus somni* (2%). Among the viral pathogens identified, there was one case of bovine respiratory syncytial virus (BRSV) and one case of infectious bovine rhinotracheitis (IBR, caused by Bovine Herpesvirus-1) recorded. In Ireland, *Pasteurella multocida* was the most frequently detected pathogen (31% of respiratory tract infections) followed by *Mannheimia haemolytica* (16%), *Histophilus somni* (13.5%) and *Mycoplasma bovis* (12.5%). A viral aetiology was identified in 22 cases (23%) of respiratory tract infections in weanlings with BRSV detected in 9 of those cases. Parasitic pneumonia (hoose/husk) was detected in 11 cases (19%) and 22 cases (23%) of respiratory infections in weanlings in Northern Ireland and Ireland respectively. All cases of parasitic pneumonia (husk/hoose) in weanlings in Ireland were diagnosed between July and November with the greatest number of cases diagnosed in August and October.

Clostridial diseases represented another important cause of death in weanlings, responsible for 16 *per cent* of deaths in Northern Ireland and 9.8 *per cent* in Ireland in this age cohort. Losses due to diseases caused by clostridial infections & enterotoxaemia continue to occur despite being preventable by the use of a low-cost multivalent clostridial vaccine. Clostridial myositis (blackleg) occurred most commonly in this age range and was diagnosed in 16 cases in Northern Ireland and 15 cases in Ireland. Further information on clostridial disease can be found elsewhere in this report.

Parasitic gastroenteritis accounted for 50 *per cent* (4 cases) and 34 *per cent* (19 cases) of enteric infections in weanlings in Northern Ireland and Ireland respectively. There were 2 cases of coccidiosis diagnosed in weanlings in Northern Ireland and 7 cases in Ireland.

Nutritional and metabolic conditions were the third most commonly diagnosed cause of death in 6-12 month old calves in Northern Ireland accounting for

7 per cent of deaths, with five cases of subnormal vitamin E / selenium or cardiomyopathy associated with this condition being recorded. In Ireland, there were five cases of ruminal acidosis.

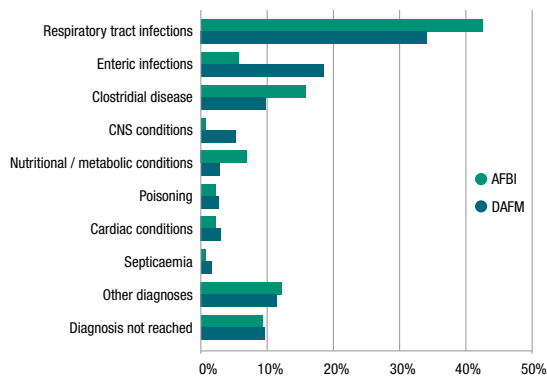


Figure 8: The conditions most frequently diagnosed on *post mortem* examination of weanlings (six to twelve months old) by DAFM (n=297) and AFBI (n=134) in 2015. GIT = Gastrointestinal tract; CNS = Central nervous system.

CASE REPORT: IDIOPATHIC NECROTISING ENTERITIS

Idiopathic necrotising enteritis (INE) was diagnosed in a six-month-old bought-in Friesian calf by Dublin RVL in April 2015. The small intestine contained multifocal mucosal necrosis, heavily infiltrated by mixed bacterial colonies and depletion of Peyers patches. There were markedly dilated crypts filled with mucus and necrotic inflammatory cells. The calf also had severe ulcerative and necrotising oesophagitis with submucosal oedema, thrombosis and vasculitis.

INE is typically seen in suckled two- to three-month-old calves at grass though cases have been seen in younger calves and up to seven months of age. The condition has also been described in a six-week-old dairy calf. INE was first described in Scotland (Penny et al., 1994). Clinical signs are variable and may range from some animals being found dead with no previous signs of illness, to others exhibiting a protracted period of malaise with diarrhoea. Most cases have diarrhoea, though clinical signs suggestive of pneumonia can also be

seen. Haematological examination typically shows a severe non-regenerative neutropaenia. The underlying aetiology of this condition is unknown.

Adult Cattle (over 12 months old)

There is generally more variation in the causes of mortality in this age group than in the younger age groups. Looking at past years, respiratory tract infections are usually the most frequent cause of mortality diagnosed in adult cattle in both jurisdictions, and in 2015 this was again the case in Ireland accounting for 17 per cent (n=84) of deaths in this age group (Figure 9). However, in Northern Ireland, clostridial infections were the most frequently diagnosed cause of death in adult cattle, responsible for 15 per cent (n=79) of deaths there in 2015, increased from 12 per cent in 2014 and 2013 and from 8.9 per cent in 2012. Respiratory tract infections accounted for 13 per cent (n=68) of adult deaths examined at *post mortem* in Northern Ireland. *Mannheimia haemolytica* was the most frequently detected bacterial pathogen in cases of respiratory tract infection in adult cattle in Ireland (21 cases), followed by *Pasteurella multocida* (12 cases), *Mycoplasma bovis* (9 cases) and *Histophilus somni* and *Trueperella pyogenes* (4 cases each). There were 21 cases of parasitic pneumonia (husk/hoose) recorded in adult cattle in Ireland, 52 per cent of them in cattle more than two years old and three cases in animals more than 5 years, highlighting the increasing trend toward clinical outbreaks of parasitic pneumonia in older cattle. Four cases of IBR were recorded. In the cases of respiratory infection diagnosed in adult cattle in Northern Ireland, *Mannheimia haemolytica* was most frequently detected (12 cases), followed by *Mycoplasma bovis* (8 cases), *Trueperella pyogenes* (5 cases) and *Pasteurella multocida* (4 cases). Eight cases of parasitic pneumonia were recorded in cattle more than 12 months old, and significantly 50 per cent of these cases were recorded in cattle more than two years old. There were also three cases of IBR recorded.

Botulism was the most commonly diagnosed clostridial disease in adult cattle in Northern Ireland (56 cases), and black disease was diagnosed in 13 cases with blackleg accounting for 12 cases. Clostridial disease was responsible for 5 *per cent* (24 cases) of deaths in adult cattle in Ireland with 9 cases of botulism, 6 cases of blackleg and 3 cases of black disease.

Gastrointestinal ulceration/perforation or penetrating foreign bodies were a relatively significant cause of adult cattle mortality in both jurisdictions accounting for 4 *per cent* of mortality in this age group in Ireland and 6 *per cent* in Northern Ireland. Abomasal ulceration and/or perforation accounted for 13 cases in Ireland and 18 cases in Northern Ireland and there were seven cases of reticulitis/foreign body reticulitis in Ireland and six cases in Northern Ireland.

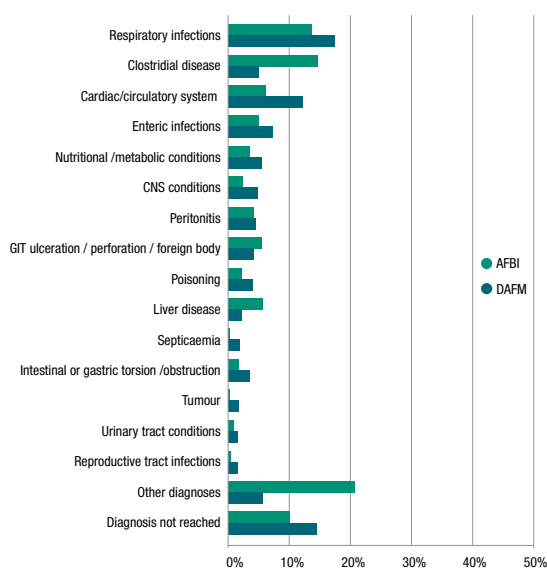


Figure 9: The conditions most frequently diagnosed on *post mortem* examination of adult cattle (older than twelve months old) by DAFM (n=484) and AFBI (n=513) in 2015. GIT = Gastrointestinal tract; CNS = Central nervous system.

Cardiac and circulatory system conditions accounted for 12 *per cent* of deaths in Ireland while in Northern Ireland they were attributed to six *per cent* of diagnoses in this category. There

were sixteen cases of haemorrhage, eleven cases of vegetative valvular endocarditis, eight cases of pericarditis, five cases of babesiosis and four cases of thrombosis of the posterior vena cava confirmed in Ireland. In Northern Ireland, there were ten cases of vegetative valvular endocarditis, eight cases of thrombosis of the posterior vena cava, 6 cases of pericarditis, 4 cases of myocardial abscessation and four cases of myocarditis reported.

The most commonly diagnosed nutritional/metabolic conditions diagnosed in Northern Ireland were hypocalcaemia (8 cases), hypomagnesaemia (7 cases) and ruminal acidosis (4 cases). In Ireland, hypomagnesaemia was attributed to 42 *per cent* (13 cases) of adult deaths due to nutritional/metabolic conditions and there were 11 cases of ruminal acidosis.

Liver disease was diagnosed in 6 *per cent* of adult cattle in Northern Ireland and just over 2 *per cent* of adult cattle in Ireland. In Northern Ireland, hepatic abscessation (9 cases) was most commonly diagnosed followed by fasciolosis (liver fluke infestation) (8 cases) and fatty liver (4 cases). Hepatic abscessation was also the most common liver disease diagnosed in Ireland with seven cases and there were two cases of liver fluke infestation.

CASE REPORT: BOVINE MULTICENTRIC LYMPHOMA

A nineteen-month-old bullock was submitted for necropsy following euthanasia. The bullock had been purchased four weeks earlier and soon after arrival on the purchaser's farm, a white spot was noticed in the right eye. Within days the animal had stopped eating and was lying away from the herd. At this stage, the other eye had started weeping. Veterinary treatment failed and the condition worsened. Malignant catarrhal fever (MCF) was suspected as a differential diagnosis by the attending vet but the slow insidious onset of clinical signs and absence of mucosal ulceration was not considered typical of MCF. At the time of necropsy in Athlone RVL, the right eye

had ruptured and there was exophthalmus and severe keratoconjunctivitis identified in the left eye. Dramatically enlarged retrobulbar lymph nodes were present bilaterally and had intruded into both orbits. Lymphadenopathy was noted in other carcass lymph nodes, with mediastinal, hepatic and iliac lymph nodes most severely affected (Figure 10). Histopathology confirmed a diagnosis of multicentric bovine lymphoma.



Figure 10: Dramatically enlarged hepatic lymph nodes in a bullock with multicentric bovine lymphoma. (Photo: Athlone RVL)

CASE REPORT: MALIGNANT CATARRHAL FEVER (MCF)

A five-year-old cow was presented for necropsy with a history of protruding eyes and blindness. There was an exudate covering both eyes and a distinct blue corneal clouding was observed. The skin of her nose was ulcerated and there was a catarrhal (Figure 11) discharge from both nostrils. Severe tracheitis and oesophagitis were evident, with a thick exudate lining both the trachea and oesophagus. Histopathology revealed a lymphoplasmacytic vasculitis in trachea, bronchus and kidney. These lesions are highly suspicious of malignant catarrhal fever. Ovine herpes virus 2 (OHV-2) was detected by PCR, confirming the diagnosis.

Sheep-associated MCF cases mostly occur when cattle have had contact with lambing ewes and while clinical signs usually start 1-2 months later, the incubation period can vary from as little as

14 days to as much as 6 months. Cases without any apparent or recent overt exposure to sheep occur but are uncommon. The disease is almost invariably fatal. EDTA blood samples taken from clinical cases can be tested for OHV-2 by PCR.



Figure 11: Erosive lesions and catarrhal exudate on the muzzle of a cow with MCF. (Photo: Maresa Sheehan)

References:

Penny, C.D., Scott, P.R., Watt, N.J. & Greig, A., 1994. Necrotic enteritis of unknown aetiology in young beef calves at pasture. *Vet Rec.* 134: 296-299.

CASE REPORT: JEJUNAL HAEMORRHAGE SYNDROME IN A DAIRY COW

A five-year-old dairy cow was submitted to AFBI Stormont with a history of sudden death following a brief period of dullness and fall in milk yield over the previous three milkings. Clinical examination had detected abdominal pain and undigested grain had been noted in the faeces. Five other cows in the herd had died over a short period of time. On gross examination there was a fibrinous peritonitis associated with the small bowel and there was a large adherent blood clot present in the distal jejunum and proximal ileum. There were multiple perforations of the bowel wall in the same region and intestinal contents were free in the abdomen. The rumen pH was low (5.27) and a diagnosis of acidosis and jejunal haemorrhage syndrome was made. The aetiology of this condition is uncertain but it is likely to be associated with feeding a diet high in fermentable carbohydrate. The role of

Clostridium perfringens type A toxin, *Aspergillus fumigatus*, other mycotoxigenic fungi and Shiga toxin producing *E. coli* is subject to debate. Risk reduction involves the maintenance of normal abomasal and intestinal motility, consistent diet in high feed intake cows, stress reduction and possible vaccination with polyvalent clostridial vaccines.

Clostridial disease in cattle in 2015

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Clostridial disease remained a significant cause of cattle losses in 2015. Clostridial myositis (blackleg), botulism, clostridial enterotoxaemia and black disease were the most frequently diagnosed clostridial diseases recorded in Ireland in 2015 (Figure 12).

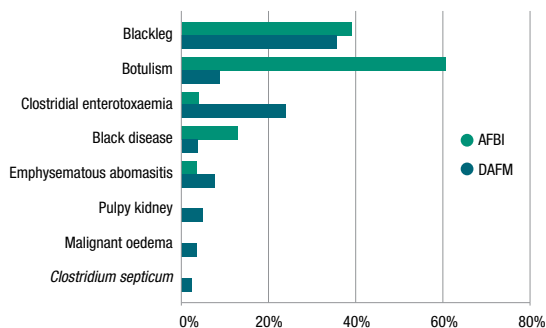


Figure 12: The relative frequency of Clostridial diseases diagnosed by AFBI (n=122) and DAFM (n=90) laboratories in 2015.

CLOSTRIDIAL MYOSITIS (BLACKLEG)

Blackleg is caused by *Clostridium chauvoei*. *C. chauvoei* is a soil-associated spore forming bacterium. After their accidental ingestion by cattle, spores of the bacterium become located within muscle groups within the body including skeletal and cardiac muscle. With favourable conditions these spores may germinate and as the bacteria multiply they produce a potent toxin which causes a myositis (Figure 13). The favourable conditions of lowered oxygen which allow the spores to

germinate are typically produced by traumatic damage or bruising.

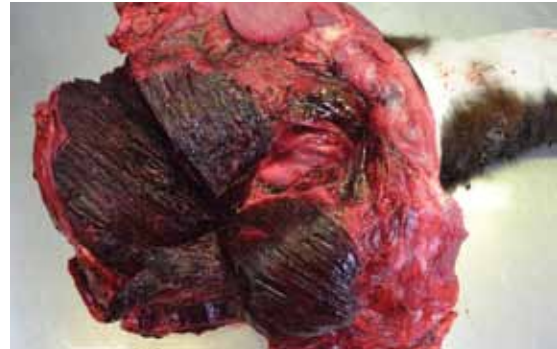


Figure 13: Blackleg (clostridial myositis) in the hind quarter of a calf. (Photo Seán Fee)

Seventy-four cases of clostridial myositis (blackleg) were recorded in 2015. Typically cases were most frequently recorded in cattle less than 18 months old and 58 cases (78% of blackleg cases) were recorded in cattle less than one year old (Figure 14).

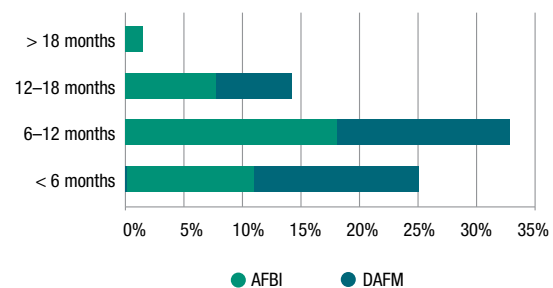


Figure 14: The relative frequency of cases of blackleg by age on the island of Ireland in 2015 (n=74).

As in previous years most cases of blackleg were diagnosed in grazing animals between the months of May and November with the highest number of cases being recorded in August and September (Figure 15).

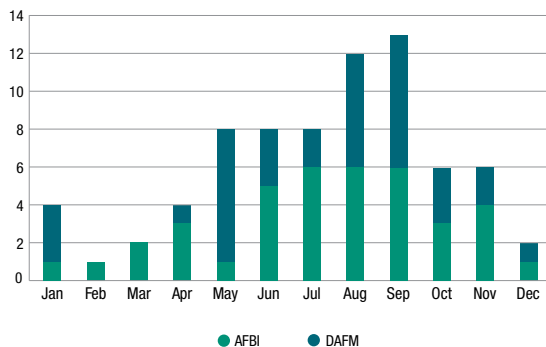


Figure 15: The number of cases of blackleg by month on the island of Ireland in 2015 (n=74).

BOTULISM

Botulism is a clostridial disease characterised by progressive paralysis, causing recumbency and generally leading to death within days to weeks. Recovery is uncommon. Whilst many species are susceptible most cases in Ireland are recorded in cattle. The onset of disease usually follows the ingestion of preformed botulinum toxin which has been produced by *Clostridium botulinum* bacteria in decaying vegetation or in animal or bird carcasses. Botulinum toxin inhibits normal electrical conductivity at neuromuscular junctions and flaccid paralysis results. In Ireland most cases are associated with the ingestion of toxin associated with broiler litter or carrion. Notable risk factors include cattle gaining access to broiler litter or the spreading of broiler litter in fields near to or in which cattle are grazing or likely to graze.

The number of cases of botulism diagnosed annually rose dramatically in 2015 with 70 cases recorded compared to 42 cases in 2014 (a rise of 67%) (Figure 16). The majority of cases were observed in adult cattle with 60 cases (86%) observed in cattle more than 24 months old and only five cases (7%) recorded in cattle less than one year old.

The increase in diagnosis of Botulism could be due to the following factors among others; an actual increase in the cases of Botulism, an increase in awareness of the disease with an associated

increase in diagnostic submissions and the use of a new and improved in vitro ELISA diagnostic technique developed at AFBI which is more sensitive than the previously used in vivo (mouse) tests. However there are still existing limitations of the diagnostic tests and their interpretation and a diagnosis of Botulism should rely on a combination of clinical signs, evidence of exposure, the ruling out of other conditions and laboratory confirmation of the presence of the organism.

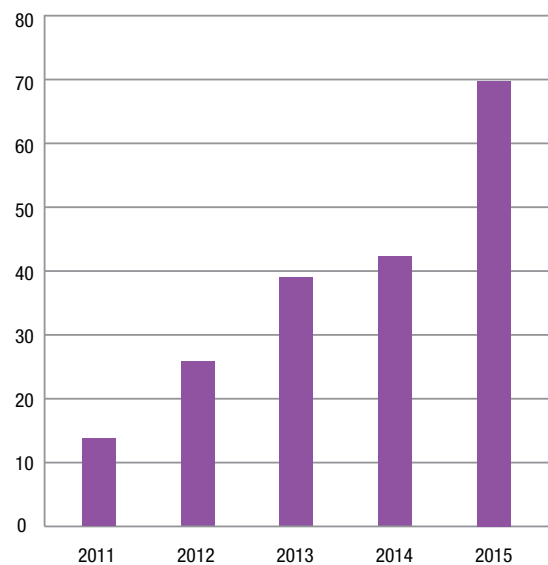


Figure 16: The number of cases of botulism by year on the island of Ireland from 2011 to 2015.

ENTEROTOXAEMIA

Clostridial toxaeemias are diseases caused by an overgrowth of toxin-producing clostridia in the gastro-intestinal tract. These diseases are well controlled by multivalent clostridial vaccines. Several different clostridial bacteria can cause clostridial enterotoxaemia, with varying presentations depending on the specific species and toxin. Most present as sudden deaths and are only readily confirmed by *post mortem* examination. Twenty eight cases of clostridial enterotoxaemia were recorded in 2015 making it the third most frequently diagnosed clostridial disease on the island of Ireland and the second most recorded clostridial disease of cattle by DAFM laboratories (Figure 12).

BLACK DISEASE (INFECTIOUS NECROTIC HEPATITIS)

Black disease was the fourth most frequently diagnosed clostridial disease in 2015 with 18 cases recorded. Fourteen cases were recorded by AFBI and four cases by DAFM. Black disease occurs when dormant spores of the bacterium *Clostridium novyi* are activated, an event often associated with migrating liver fluke, which are believed to cause tissue damage & anaerobic conditions in tissues. Most cases were observed in the late summer and autumn with a peak of cases in September (Figure 17). Eleven cases (61% of black disease cases) were diagnosed in animals older than 24 months (Figure 18).

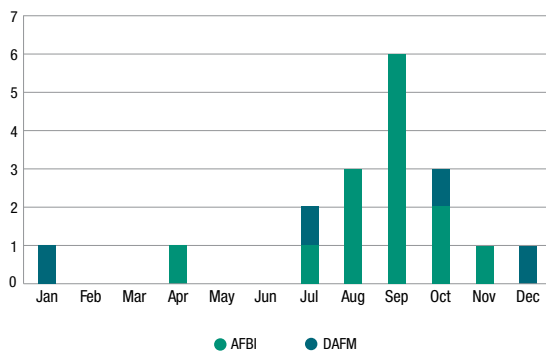


Figure 17: The number of cases of black disease recorded each month on the island of Ireland in 2015, showing the strong seasonal pattern (n=18).

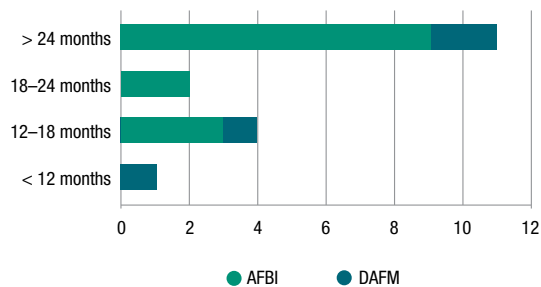


Figure 18: The number of cases black disease by age on the island of Ireland in 2015 (n=18).

CALF ENTERITIS

FIONA MCKEEVER, DAFM RVL, SLIGO.
MARESA SHEEHAN, DAFM RVL, KILKENNY.
SIOBHÁN CORRY, AFBI, OMAGH.

Infectious neonatal enteritis is the most common cause of illness and death in young calves less than one month of age. The most common clinical presentation is watery diarrhoea, occasionally containing blood, and usually leading to dehydration, and in severe cases, (Figure 19) progressing to profound weakness and death.



Figure 19: A calf with sunken eyes (enophthalmos) as a result of moderate to severe dehydration caused by diarrhoea. (Photo: Sligo RVL)

The most commonly identified pathogens in neonatal calf enteritis are routinely screened in all faecal samples received from calves less than 1 month old and the results of these analyses are shown in Table 1.

Enteric Pathogen	Total	Total Pos	% Pos
<i>Cryptosporidium parvum</i>	4668	1169	25.0%
Rotavirus	4629	1402	30.3%
Coronavirus	4629	109	2.4%
Salmonella culture	4674	109	2.3%
<i>E. Coli</i> K99	2744	51	1.9%

Table 1: The absolute and relative frequency of pathogens identified in both *post mortem* submissions and faecal clinical samples from calves less than one month of age submitted to DAFM and AFBI laboratories during 2015.

As is customary *Cryptosporidium spp.* and rotavirus are the two most frequently detected pathogens (Figure 20). *Cryptosporidium parvum* is a small single-celled parasite which causes damage to the intestinal epithelial cells of the lower small intestine resulting in mild to severe enteritis, typically recorded in calves in the second week of life. *Cryptosporidium* oocysts present in the environment are highly resistant and can survive up to several months under favourable conditions. Transmission is by the faecal-oral route, often via a contaminated environment. Control of *C. parvum* relies on segregation of infected animals and good hygiene practices such as proper cleaning and disinfection of calf houses, particularly at the end of the calving period. Ammonia-based disinfectants are most effective and leaving the house to dry out completely is important.

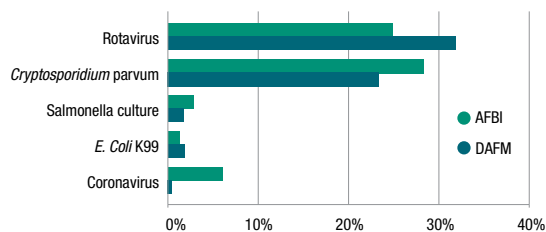


Figure 20: The relative frequency of enteropathogenic agents identified in neonatal calf carcass submissions by DAFM and AFBI laboratories during 2015.

Rotavirus and coronavirus infections are typically recorded in calves from 1-3 weeks of age. The severity of clinical signs depends on several factors including the age of the animal and the immune status of the calf which depends on the absorption of colostrum antibodies immediately after birth. These viruses cause a malabsorptive diarrhoea due to the destruction of intestinal enterocytes causing shortening of the villi, hence reducing absorption from the intestine. Large amounts of soft watery faeces are produced, occasionally with mucus. Symptomatic treatment based on fluid and electrolyte therapy and adequate nutritional support is required to treat affected animals.

Enterotoxigenic *E. coli* is an important cause of diarrhoea in calves during the first week of life. The toxins produced by this pathogen cause hypersecretion of water and electrolytes from the intestinal mucosa leading to rapid dehydration. Prevention of infection is key in the management of neonatal enteritis, with the feeding of adequate quantities of good quality colostrum at the correct time central to control. An average calf weighing 40kg would need at least 3L of first colostrum within 2-6 hours of birth. Continued proper feeding is also essential, it is recommended to feed 13-15 *per cent* of the calf's birth weight per day of whole milk or good quality milk replacer. Reducing exposure through good hygiene and management practices as well as vaccinating dams to improve colostrum quality are also important steps in effecting control.

An analysis of the DAFM data for rotavirus and cryptosporidium for the first five months of 2015 was carried out. Figure 21 shows that the frequency of detection of rotavirus falls in the April/May period while the cryptosporidium detection rate peaks in April.

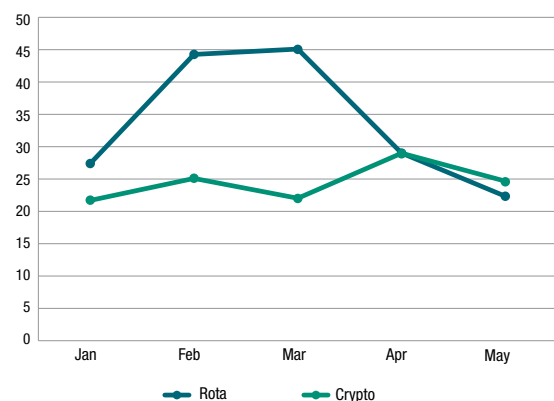


Figure 21: The frequency of detection of rotavirus and *Cryptosporidium* during the first five months of 2015.

Zinc sulphate turbidity test

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SIOBHÁN CORRY, AFBI, OMAGH.
IAN HOGAN, DAFM RVL, LIMERICK.

CALVES

The Zinc Sulphate Turbidity (ZST) test is an indirect measurement of the passive transfer of immunoglobulins via the colostrum from the dam to the neonate. The adequate delivery of good quality colostrum is an important part of calf management. This transfer of immunity provides protection to neonates from common infectious diseases that contribute to illness and death.

Ideally the first feed of colostrum should be given to the calf within two hours of birth and certainly no later than six hours after birth. After 24 hours of life the lining of the intestine becomes impermeable to large protein molecules so the absorption of colostrum immunoglobulins ceases. Poor transfer of colostrum immunity may be due to poor quality colostrum, low colostrum intake or poor colostrum absorption or a combination of these factors.

Factors to ensure each calf receives adequate colostrum include:

- Observe parturient animals carefully and intervene where necessary.
- Ensure colostrum feeding takes place as soon as possible after birth to allow maximum absorption.
- An average calf weighing 40kg would need at least 3L of first colostrum which may not be achieved if calf is merely allowed to nurse to satiety.
- Supplementary feeding using a stomach tube or oesophageal feeder may be necessary.
- Use frozen colostrum when necessary; artificial or freeze-dried colostrum is much less effective but may be used as a last resort.

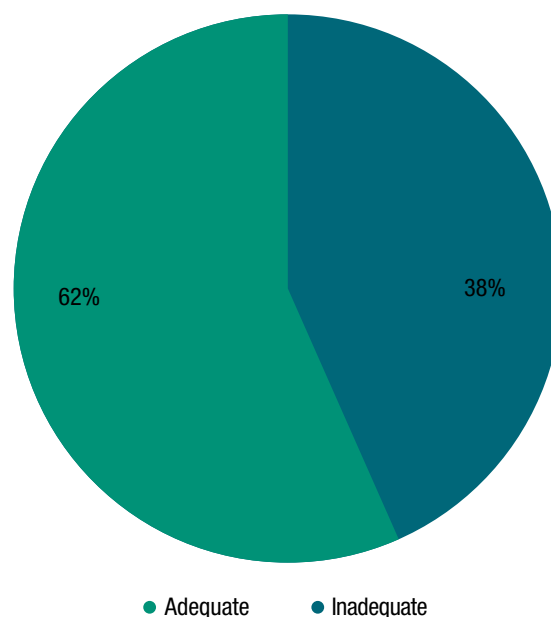


Figure 22: The results of zinc sulphate turbidity tests performed by AFBI and DAFM laboratories in 2015 from submitted bovine calf serum samples (n=1614). Adequate colostrum immunity is defined as a ZST result greater than or equal to 20 units and inadequate as less than 20 units.

During 2015 a combined total of 1614 ZST tests were performed by AFBI and DAFM laboratories on bovine samples submitted from live calves less than two weeks of age by private veterinary practitioners. Around 38 *per cent* of these samples had values less than 20 units indicating a failure of passive transfer (Figure 22). Although the results have remained relatively stable over the last few years, there has been a noticeable trend of a decrease in the prevalence of inadequate colostrum transfer. It has decreased from 50 *per cent* in 2013, to 46 *per cent* in 2014 and this has decreased again in 2015 to 38 *per cent*. This trend is encouraging and is suggestive of an increasing awareness of the value of this aspect of animal management in disease control on farms north and south.

When ZST testing was performed on 807 samples taken from bovine carcasses during *post mortem* examinations, 62 *per cent* of samples showed failure of passive transfer.

LAMBS

During 2015 a combined total of 119 ZST tests were performed by AFBI and DAFM laboratories on ovine samples submitted by private veterinary practitioners and on neonatal lamb carcasses examined *post mortem*. Around 58 per cent of these samples had values less than 20 units indicating a failure of passive transfer. However the findings varied between the two services, with 63% of ovine ZST tests in DAFM returning findings of failure of passive transfer but only 44% of findings in AFBI doing so (Figure 23). The number of lamb samples tested was relatively small and the degree of variation is unlikely to be significant.

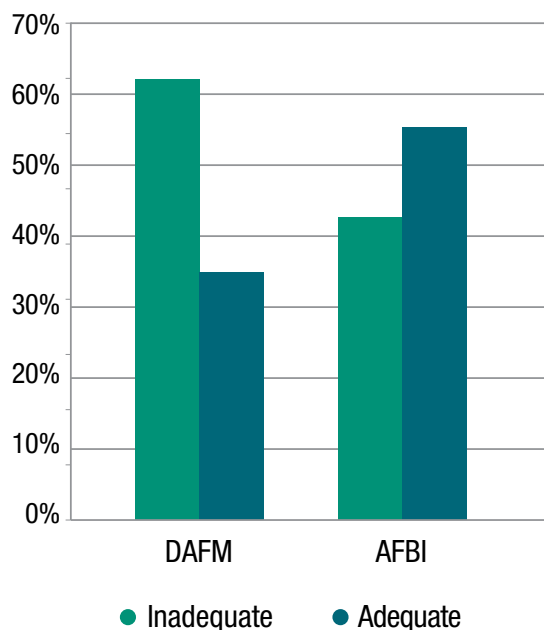


Figure 23: The results of zinc sulphate turbidity tests on lamb serum samples performed by AFBI and DAFM laboratories in 2015 (n=119). Adequate colostral immunity is defined as greater than or equal to 20 units and inadequate as less than 20 units.

Finally the failure of passive transfer in calves or lambs is best assessed on a herd/flock basis. It is recommended that multiple (up to twelve) samples be taken from healthy calves or lambs less than a week old for testing.

Bovine abortion

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CLARE HOLMES, AFBI, STORMONT, BELFAST.

In an episode of bovine abortion, statutory regulations in Ireland require farmers to seek advice from their private veterinary practitioner (PVP) who will sample the aborted cow for a serological test for *Brucella abortus* antibody and may refer the foetus to DAFM for necropsy. Since Ireland achieved official Brucellosis-free status annual herd serological testing and screening of bulk milk samples for *Brucella* antibodies has ceased. In an episode of bovine abortion in Northern Ireland statutory regulations require the farmer to notify their DAERA veterinary office who will sample the aborted cow for *Brucella abortus* antibodies. Their PVP may refer the foetus to AFBI for necropsy. Since Northern Ireland achieved official Brucellosis-free status herd serological screening takes place on a two to three yearly basis with continued bulk milk screening. Currently, passive surveillance plays an important role in the early warning system for the detection of any future incursion of bovine brucellosis or other infectious agents that may cause abortion, as was the case with the detection of Schmallenberg virus in 2012.

This passive surveillance system relies on the notification of bovine abortions and therefore requires motivated and compliant farmers and practitioners. The risk of introduction of bovine brucellosis still persists and, recent reports of outbreaks in European countries, emphasizes the importance of an effective surveillance system. However, under-reporting stands as one of the main limitations of passive surveillance networks and may impede the early detection of infectious agents that cause abortion.

In 2015, 2884 bovine foetuses, stillbirths and foetal material (placenta, foetal organs, abomasal contents) were submitted to the Regional Veterinary Laboratories of DAFM from different parts of

Ireland and 412 to AFBI laboratories in Northern Ireland. The location of the DAFM submissions based on their District Electoral Division (DED) are plotted on the map of Ireland (Figure 24). Counties were colour-coded based on the number of bovine foetal submissions. By examining the plotted map, firstly, it is clear that foetal submissions numbers are closely linked to the location of a RVL; secondly, there is a marked division between the north and south of the country with evident under-reporting in some counties. Submissions by county varied greatly, ranging from six in Co Dublin (which as a highly urbanised county has a tiny cattle population) to 861 in Co Cork (median, 67).

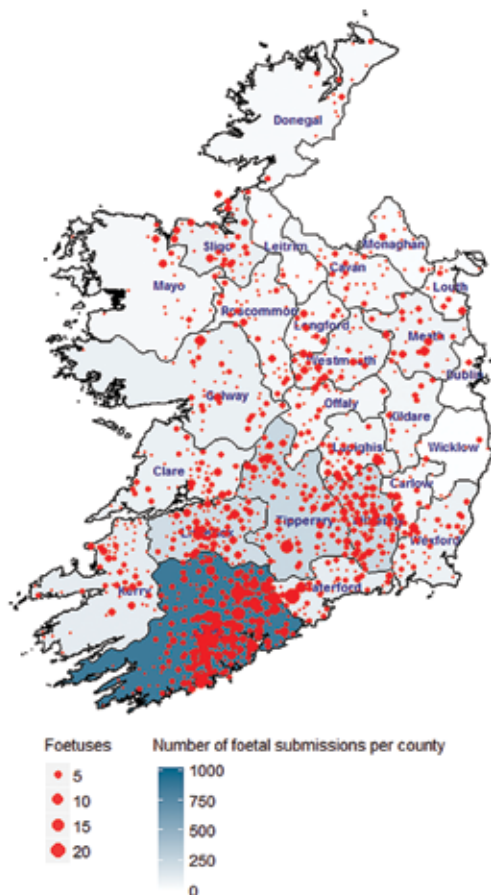


Figure 24: Location (District Electoral Division, DED) of bovine foetal submissions plotted by red dots on the map of Ireland. The diameter of the red dots reflects the number of submissions from that DED. Counties are shaded (blue gradient) based on their number of submissions.

Foetal submissions in Northern Ireland for 2015 came predominantly from within the low lying areas of the province as would be expected as these areas contain the highest cattle populations and the larger herds. Submissions were evenly distributed between those that were brought to Omagh (green circles) and those that were brought to Stormont (red circles).

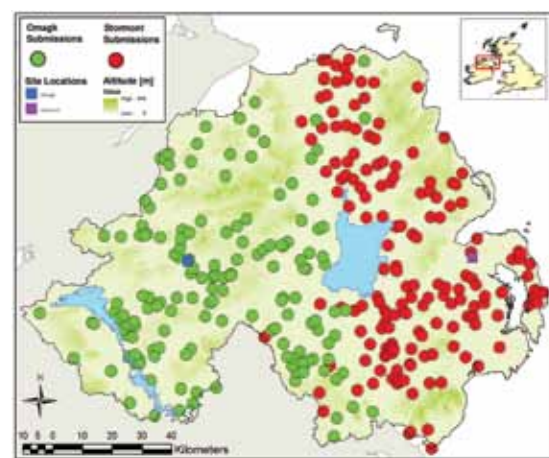


Figure 24b: The location of bovine foetal submissions for 2015 in Northern Ireland. Individual sample locations have been anonymised spatially within the source locality. Green dots indicate those submissions that were brought to Omagh laboratory for analysis and the red dots indicate those submissions that were brought to Stormont laboratory.

An annual abortion rate from 3 to 5 *per cent*, in cows beyond 42 days of pregnancy, is considered acceptable as there are many sporadic and spontaneous causes of pregnancy loss in cattle, apart from infectious abortion. Several endemic diseases may also cause abortion and cause direct economic losses for farmers of which salmonellosis is the most important. *Salmonella enterica* subsp. *enterica* serovar Dublin is the serotype most commonly involved in Salmonella abortions, with 158 cases diagnosed during 2015, representing 4.8 *per cent* of the total foetal submissions (and a small percentage decrease compared to 2014). From time to time, other serotypes were also isolated in 2015, four of which were *S. Montevideo*.

The annual temporal distribution of *Salmonella* Dublin abortions consistently produces a distinct peak around November (the pattern observed in DAFM laboratories is shown in Figure 25). This pattern is independent of the general pattern of foetal submission distribution, the peak of which occurs from December to February. Stress factors such as drying off, slurry spreading and housing may play an important role in the seasonal increase of *Salmonella* infections at this time as well as the closer contact between animals. It has also been speculated that migrating immature liver fluke *F. hepatica* may trigger the recrudescence of latent infection, with shedding and spread of infection within the herd.

The atypical bimodal distribution seen in 2015 is skewed by the effect of multiple submissions from a single herd in the month of June and a slight decrease of the incidence of abortion due to salmonellosis in November 2015 compared to other years.

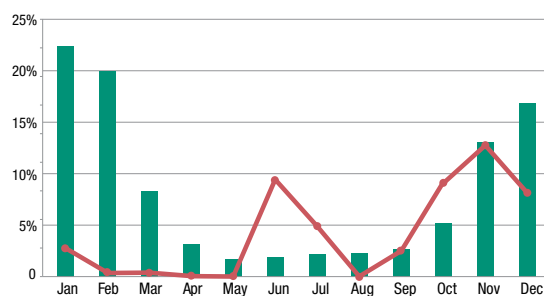


Figure 25: Monthly relative frequency of *Salmonella* Dublin isolates from foetal bacterial cultures in DAFM laboratories (line graph), compared to the monthly relative frequency of foetal submissions (bar graph) during 2015.

The sporadic abortions caused by a diverse group of bacteria and fungi such as *Trueperella pyogenes*, *Bacillus licheniformis*, *Listeria monocytogenes* and *Aspergillus spp.*, which are normally associated with opportunistic infections of the placenta and foetus, displayed very little change in 2015 compared to 2014 as is shown in Table 2.

Abortifacients	Positive samples		Total positive samples	Percentage of total samples	
	DAFM	AFBI		2015	2015
<i>Trueperella pyogenes</i>	176	30	206	6.3	6.8
<i>Salmonella</i> Dublin	122	21	158	4.8	6.5
<i>Bacillus licheniformis</i>	120	33	153	4.6	4.4
<i>Listeria monocytogenes</i>	81	4	85	2.6	2.4
<i>Aspergillus spp</i>	24	2	26	0.8	0.9
	(n=2882)	(n=412)	(n=3296)		

Table 2: The frequency of detection of selected abortion agents by foetal culture in the AFBI and DAFM laboratories during 2015 (n=3296) compared to 2014 (n=2633).

Similarly, other sporadic opportunistic pathogens of lesser importance were also isolated from foetuses and aborted material (Table 3). An area-proportional visualisation is represented in Figure 26 based on the percentage of the total number of foetal cultures undertaken in the AFBI or DAFM laboratories.

Organism	Total
<i>E. coli</i> and coliforms	371
<i>Streptococcus spp</i>	97
<i>Bacillus sp</i>	33
<i>Staphylococcus spp</i>	29
Fungi	12
<i>Pasteurella spp</i>	12
<i>Listeria spp</i>	8
<i>Salmonella spp</i> (other than <i>S. Dublin</i>)	7
<i>Campylobacter spp</i>	2
<i>Yersinia spp</i>	2

Table 3: The number of diagnosed abortions associated with other bacterial and fungal agents in AFBI and DAFM during 2015.

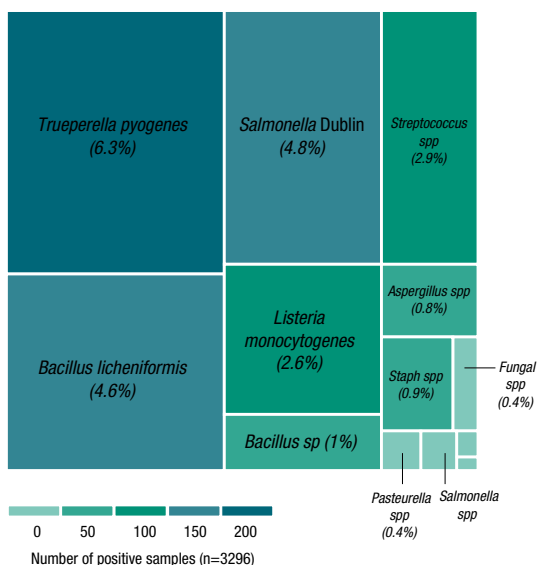


Figure 26: Mosaic plot representing area-proportional visualisation of the percentage of diagnosed organisms (*E. coli* and coliforms were excluded).

Leptospira interrogans serovar *Hardjo* is the most common serovar in bovine abortion associated with leptospirosis (Table 4), having adapted to cattle which serve as maintenance host. Abortion is the main manifestation of chronic leptospirosis and often the only clinical sign observed. Leptospirae are labile and difficult to culture. Thus, the diagnosis of leptospirosis relies on the detection of antibodies in foetal fluid and/or alternatively, the use of fluorescent antibody test (FAT) on kidney, lung and/or adrenal glands impression smears by using multivalent antisera.

	DAFM	AFBI	DAFM	AFBI
<i>Neospora caninum</i>	61	31	2.1%	7.5%
<i>Leptospira Harjo</i>	37	16	1.3%	3.9%

Table 4: The total number of positive diagnoses and relative frequency for *Neospora caninum* and *Leptospira Harjo* during 2015. * The percentages were calculated with the total number of foetal submissions as denominator, but not all those foetuses were tested for both pathogens.

Neospora is also a major cause of abortion in cattle (Table 4) and can follow an enzootic or epizootic pattern. Diagnosis is based on histopathological findings (Figure 27) (protozoal infections typically cause histological lesions of multifocal non-suppurative encephalitis and myocarditis) and/or by foetal serology (ELISA). It is important to bear in mind that a positive ELISA result may not be definitive, since calves congenitally infected with *Neospora* are born clinically normal with a positive precolostral titre. In addition, an infected foetus may produce a negative titre because of its gestational age, the overwhelming severity of infection or autolysis of the carcass. Maternal serology is of negligible help in the diagnosis of a single case of abortion, and it should only be used on a herd basis to investigate the association between maternal seropositivity and abortion.

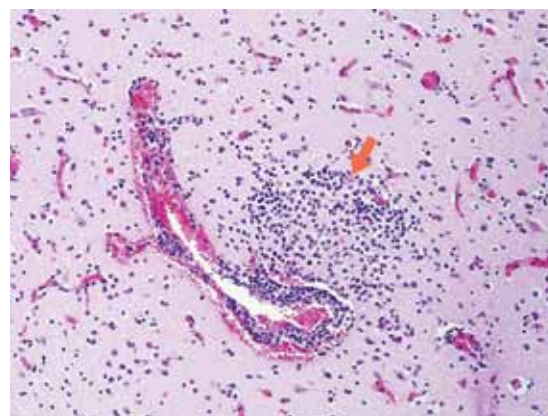


Figure 27: Non-suppurative encephalitis (orange arrow) typically associated with *Neospora caninum* infection in the brain of a bovine foetus. (Photo: Cosme Sánchez-Miguel)

Hereditary and developmental abnormalities

Serious hereditary defects in foetuses and stillbirths were diagnosed in 67 cases out of 2882 bovine carcasses submitted to the DAFM veterinary laboratories during 2015 representing 2.3 per cent of the total number of submissions. Defects of the

musculoskeletal system (21 cases) were the most frequent developmental abnormality recorded during 2015, ranging from scoliosis and torticollis to severe arthrogryposis or absence of limbs (amelia), Figure 28. Six of the cases included in this group were described as congenital joint laxity and dwarfism (dwarf calves).



Figure 28: Congenital absence of hind limbs (amelia) in a newborn calf. (Photo: Cosme Sánchez-Miguel)

Circulatory defects were diagnosed in fourteen carcasses. Nine of them were due to cardiac septal defects, mainly atrial septal defects. The remaining cases were the result of passive congestion instigated by different abnormalities such as a large lung cyst, large hepatic cysts, an adenomatoid hamartoma, etc.

Abnormalities of the digestive system were recorded in fourteen animals. Ten of those were affected by intestinal atresia, mainly affecting the jejunal tract. Three calves had some degree of congenital hepatic fibrosis. One calf that presented with an enlarged liver was found to have a hepatic lymphoma on histological examination.

Seven CNS abnormalities were diagnosed; they consisted of four cases of hydrocephalus (Figure 29) and three cases with microcephalus and meningocele. Other findings in DAFM laboratories during 2015 included two schistosomus reflexus and one calf with congenital polycystic kidney. Congenital goitre was diagnosed in seven animals.



Figure 29: Calf with domed skull as a result of congenital hydrocephalus (inset). The cerebral hemispheres consist of thin-walled sacs filled with cerebrospinal fluid. (Photo: Cosme Sánchez-Miguel)

Bovine mastitis

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CLARE HOLMES, AFBI, STORMONT, BELFAST.

The abolition of milk quotas in April 2015 heralded the beginning of a new era for Irish dairy farming. The expansion of dairy herds to maximise productivity in terms of the volume of milk produced and the increasing number of cows on individual farms is likely to increase the prevalence of dairy production diseases, especially mastitis. Concurrently, increased awareness of antimicrobial resistance and the need for responsible use of antibiotics especially dry cow therapy are likely to increasingly limit the mastitis disease control options available to the dairy sector. The increasing risks due to dairy industry intensification and antimicrobial resistance highlight the continued requirement for accurate diagnostic tests and expert interpretation of results to control and limit the economic and animal welfare impact of mastitis.

According to work carried out by Teagasc and published on the Cellcheck section of the Animal Health Ireland website (www.animalhealthireland.ie), the implementation of a mastitis control programme can improve farm profitability by at least €0.01 (Stg£0.008) per litre. The Department of Agriculture, Food and the Marine (DAFM) and Agri-Food and Biosciences Institute (AFBI) laboratories have been central to provision of such control programmes by providing mastitis testing services to the dairy industry in cases of mastitis breakdowns and by assisting private laboratories that test milk samples.

Inflammation of the bovine mammary gland usually follows infection by bacteria or less frequently fungi which can be contracted from other cows or from the environment. Mastitis control programmes are based on monitoring and reviewing each segment of the lactation cycle. The identification of the pathogen responsible for mastitis is essential to understanding and controlling the disease at each stage.

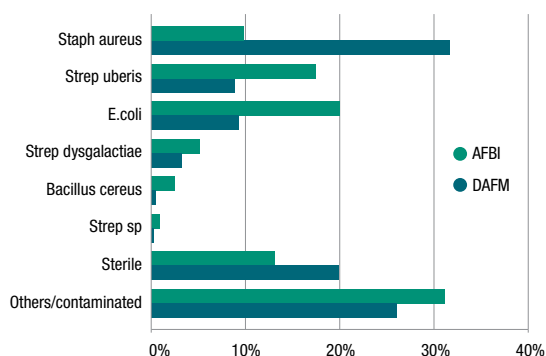


Figure 30: The relative frequency of detection of selected mastitis pathogens by DAFM (n=2452) and AFBI (n=1279) veterinary laboratories during 2015.

AFBI and DAFM laboratories tested a total of 3731 bovine milk samples for mastitis pathogens during 2015 that were submitted by private veterinary practitioners investigating outbreaks of mastitis in dairy farms. Data collected from mastitis cultures are represented in Figure 30.

E. coli and *Streptococcus uberis* were the most frequently identified pathogens in milk samples submitted to AFBI laboratories whereas *Staphylococcus aureus* was the most frequently identified pathogen in DAFM samples. *E. coli* and *Streptococcus uberis* are considered environmental pathogens and can occur as a result of an opportunistic infection following contamination of the teat. Correct management of environmental conditions during the dry period are likely to be important in the prevention of mastitis due to environmental pathogens. *Staphylococcus aureus* is an important cause of contagious mastitis which is transmitted from cow to cow and may result in subclinical infections that increase somatic cell counts without grossly detectable changes in the milk or the udder.

It is considered unlikely that the differences in the relative frequencies of the various mastitis pathogens displayed in Figure 30 represent a true geographical difference in causes of mastitis on the island of Ireland but is more likely to be a reflection of differences in cows chosen for sampling. It is probable that the increased relative frequency of *Staphylococcus aureus* in DAFM laboratory results is due to sampling bias where cows with persistent high somatic cell counts are chosen for submission. Another factor contributing to increased testing for, and detection of *S aureus* mastitis by DAFM, is the rollout in Ireland of the Animal Health Ireland Cell-Check programme, which has done a lot to raise awareness of *S. aureus* mastitis.

The identification of *E. coli* or coliforms in milk samples taken for bacteriological analysis strongly suggests contamination at sampling. Farmers and vets are reminded that proper sampling technique is essential to obtaining an accurate result from a milk sample submitted to a laboratory.

Aseptic technique for milk sample collection

Materials

- Disposable gloves.
- Sterile screw top tubes to contain at least 20 ml of milk.
- 70% alcohol spray or wipes.
- Cotton wool.
- Paper towels.

Technique

1. Samples should be taken prior to milking.
2. Tubes should be labelled prior to sampling.
3. Using a paper towel, loose hair and dirt should be removed from the underside of the udder and teats.
4. Teats should be washed using running water being careful not to wet the udder.
5. All teats should be dipped with teat dip and allowed to dry for at least one minute.
6. Beginning with the teats on the far side of the udder, teats should be cleaned thoroughly with alcohol spending at least ten seconds on each teat after all dirt has been removed. Change wipes or cotton wool as they become dirty and between each teat.
7. Using fresh clean gloves begin sampling with the teats on the near side of the udder. Remove the cap of the sampling tube and keep the top face down in the palm. Hold the open tube at an angle of 45 degrees.

Using the free hand, discard a few streams of milk to the ground before collecting three or four streams in the tube. Do not allow teat ends to make contact with the tube. Close the tube immediately after collection of each sample.

8. If contamination occurs repeat the process using a fresh tube.
9. Place tubes at 4 degrees Celsius.
10. Dispatch samples to laboratory as soon as possible.

Bovine Respiratory disease

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PAULINE BAIRD, AFBI, OMAGH.

Bovine Respiratory Disease (BRD) is the most significant cause of morbidity and mortality in cattle of all ages and was diagnosed as the cause of mortality in 21.1 *per cent* of all bovine carcasses submitted to the DAFM and AFBI laboratories during 2015. BRD has a multifactorial aetiology involving the interaction between environmental factors (such as stress), host factors (e.g. immune status, intercurrent disease) and pathogens.

The costs associated with BRD can be either direct or indirect. Direct costs include the costs associated with animal loss and disposal, veterinary costs, the potential loss of specialist markets (AI, export), and increased time required by cattle in reaching their slaughter weight.

A wide range of infectious agents have been associated with BRD; many of the potential bacterial pathogens may also be found in the respiratory tract of healthy animals which can complicate the identification of the causal agent in the clinically ill

animal. Typically, the pathogenesis of disease relies on an invading primary pathogen which colonises the respiratory tract, altering the host's immune response or compromising structural barriers to infection, thereby facilitating the establishment of infection by secondary invaders. Secondary infections can greatly increase the severity of disease resulting in higher mortality rates and longer recovery times.

During 2015, bacterial pathogens were the most frequently identified respiratory pathogens in cattle of all age groups (64 per cent), with parasitic and viral agents identified less frequently (10.3 per cent and 9.8 per cent respectively) (Figure 31).

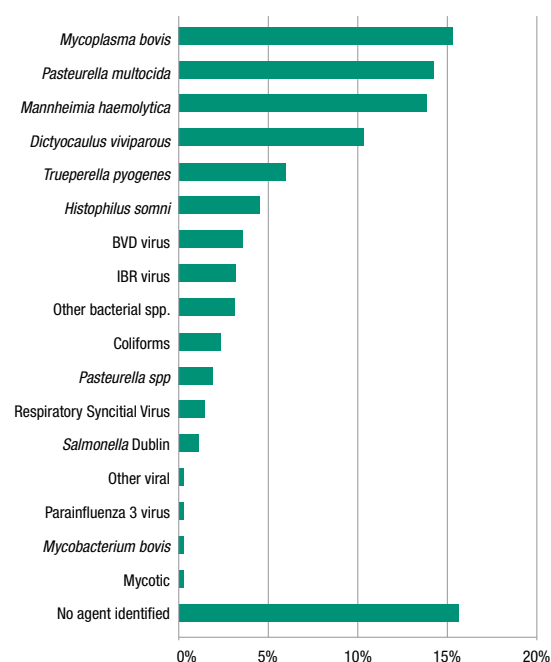


Figure 31: The relative frequency of diagnosed respiratory bovine pathogens as a percentage of the total respiratory disease cases in DAFM and AFBI laboratories during 2015.

Control of BRD can be achieved through the targeted use of vaccination against primary respiratory pathogens together with the implementation of good husbandry practices to minimise environmental stresses. Management considerations should focus on reducing stressors that contribute to

the development of disease such as the mixing of different groups of cattle, prolonged transport time and overcrowding and poor ventilation. Good hygiene, an adequate plane of nutrition and strategic parasite control are also important factors.

The use of vaccines confers clinical protection and more importantly reduction of pathogen circulation. Due to the complex nature of the disease, the use of vaccines in highly stressed cattle can lead to suboptimal performance; furthermore vaccines against some of the common bacterial causes of respiratory disease are not available on the market.

Infectious Bovine Rhinotracheitis (IBR) caused by Bovine Herpesvirus-1 was the second most common viral cause of BRD. It is a pathogen that targets the upper respiratory tract and trachea. The respiratory form of the disease causes multifocal areas of necrosis to develop in the nose, pharynx, larynx, and trachea causing the epithelial lining to become necrotic and slough off, narrowing the lumen (Figure 32). The virus is slow spreading and sets up latent infections in recovered animals, which will shed the virus and become sources of infection for others in times of stress.



Figure 32: Longitudinal section of trachea showing tracheitis caused by Bovine Herpesvirus-1 (Infectious Bovine Rhinotracheitis). (Photo: Colm Ó Muireagáin)

Mycoplasma bovis was the respiratory pathogen identified with the greatest frequency on *post mortem* examination of cattle diagnosed with BRD during 2015. It causes chronic bronchopneumonia

with typical caseonecrotic lesions in a cranioventral distribution and can act as a primary invader facilitating secondary infections due to its immunosuppressive role (Figure 33). This year, in DAFM laboratories, 59 per cent of *M. bovis* cases were diagnosed in animals less than one year of age. In young cattle, *M. bovis* is also occasionally associated with concurrent otitis media. In older cattle *M. bovis* can manifest as a concurrent polyarthritis leading to severe chronic lameness. *M. bovis* is commonly isolated from both sick and apparently healthy carriers; the subclinical animals are thought to be the source of introduction of infection into some herds. In young calves, infected milk and infection from other calves are the considered the most important sources of infection. The pathogen is highly susceptible to heat but can survive for long periods in cool humid conditions and may persist in ponds or organic matter where it is protected from desiccation.



Figure 33: Bronchopneumonia with cranioventral distribution typical of a *Mycoplasma pneumoniae* with concurrent *Trueperella pyogenes* infection. (Photo: Athlone RVL)

Parasitic pneumonia (caused by *Dictyocaulus viviparus*) is regularly diagnosed over the summer and autumn months, peaking in late August and early September and occasional cases with adult lungworms in the airways were detected in November and December. The mild and wet autumn experienced during 2015 is likely to have contributed to some of these late cases (Figure 34).

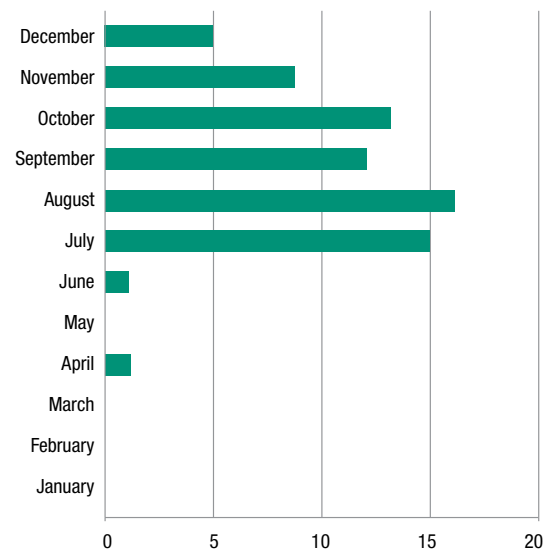


Figure 34: The number of cases of parasitic pneumonia (Hoose / *Dictyocaulus viviparus*) by month of diagnosis in AFBI and DAFM veterinary laboratories during 2015.

Adults of *D. viviparus* inhabit the large mainstem bronchi and trachea (Figure 35), producing larvated eggs which hatch in the trachea. The larvae are coughed up and swallowed and passed out in the faeces. As a result of partial blockage of the trachea, emphysema (Figure 36) is a common lesion in lungworm infection.



Figure 35: Longitudinal section of trachea showing infection with *Dictyocaulus viviparus*. (Photo: Colm Ó Muireagáin)



Figure 36: Sub-pleural and interstitial emphysema secondary to pneumonia in a bovine weanling. (Photo: Colm Ó Muireagáin)

Immunity to lungworm is relatively short lived and a constant low level exposure is most effective in order to maintain high levels of immunity. Reinfection syndrome may occur if cattle with strong acquired immunity are exposed to a large number of larvae and such animals can show clinical signs of coughing and laboured breathing without developing a patent infection. The clinical signs arise from inflammatory changes associated with the immune response. Patent lungworm infection (with adult worms laying eggs in the airways) may also occur in adult cattle. It is thought that management practices such as the use of long-acting anthelmintics may prevent the development of natural immunity thereby increasing the vulnerability of adult animals to patent lungworm re-infection.

Calf Mortality in a Group of Expanding Dairy Herds — A Pilot Project

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BACKGROUND

With the publication of the ambitious targets for milk production in Harvest 2020 and Food Wise 2025, and the abolition of milk quotas in Ireland in spring 2015 concerns have been raised about the

possible impact of rapid herd expansion on animal health and welfare. DAFM regional veterinary laboratories (RVLs) with the support of Pathology & Virology Divisions in Backweston agreed to run a pilot surveillance programme to explore the patterns and causes of calf mortality on a sample of rapidly expanding dairy farms

METHODS

Eighteen expanding dairy herds situated close to four Regional Veterinary Laboratories were selected. The farmers were requested to submit all 2015-born calf mortalities for a full *post mortem* examination. A free carcass collection service was organised where possible.

RESULTS

Eighteen farms took part, whose herd size ranged from 24 to 473 milking cows. Herd expansion in these farms averaged 29.4% between 2013 and 2015. There were 2,980 calf birth events in the first nine months of the year. By October 1st 2015, 231 (7.7%) of the calves that were born on the studied farms were dead, 1,364 (45.8%) were sold, and 1,386 (46.5%) remained alive and on the farm of birth.

Of the 1,364 calves sold, 1,129 (83%) went to another farm in the Republic of Ireland, 227 (17%) were exported, and 8 (<1%) were slaughtered having been positive for BVD virus.

Of the 231 calf deaths, 93 (40.3%) were classified as abortions (deaths up to 270 days of gestation) or perinatal deaths (from 270 days of gestation to one day of age), with the remaining 138 (59.7%) classified as neonatal (1-30 days of age) or older calf mortalities (>30 days of age).

The incidence of calf mortality on the monitored units ranged from 1.7% to 29.0% of births recorded, with a group average of 7.7%. Of the 231 calf deaths recorded, 145 (63%) were submitted to an RVL for *post mortem* examination and 86 (37%) were sent to a knackery.

There were fifteen calves submitted to an RVL that were classified as abortions (i.e. calves up to 270 days of gestation). No cause of abortion was diagnosed in 11 of the 15 cases. A bacterial aetiology was identified in two, fungal in one and BVDV in one.

There were thirty-nine calf submissions to an RVL that were classified as perinatal (i.e. calves from 270 days of gestation to 24 hours of age). No cause of death was established in 15 cases, while asphyxiation/anoxia related to birth (15 cases), leptospirosis (3), neosporosis (2), bacterial sepsis (1) dystocia (2), and Q fever (1) accounted for the remaining losses in this group.

There were 66 neonatal calf (calves from 1-30 days of age) submissions from these farms to an RVL. Of these, enteritis was the most common cause of death diagnosed (33 cases), followed by septicaemia (9), navel/joint ill (5), pneumonia (5), peritonitis (3), BVD (3), developmental defect (3), birth-associated injury/dystocia (1), mesenteric torsion (1) and no diagnosis (1). Of the 33 cases of enteritis diagnosed, rotavirus was detected in 10 and cryptosporidia in 8. These are the most commonly diagnosed causes of neonatal enteritis detected in the RVLs every year.

There were 26 calf submissions to an RVL classified as older calves (31–150 days of age). BVD was diagnosed in 10 of these cases and other diagnoses were: pneumonia (6), clostridial disease (3), perforated abomasal ulcer (2), developmental defect (1), enteritis (1), navel/joint ill (1), ruminal acidosis (1) and septicaemia (1). Of the six cases of pneumonia *Mannheimia haemolytica* was detected in two, *Mycoplasma bovis* in two, *Pasteurella multocida* in one, IBR in one, bovine coronavirus in one and *Trueperella pyogenes* in one.

DISCUSSION

Differences were noted between the pattern of causes of death established in this pilot project and those reported in the 2013 and 2014 All-Island Animal Disease Surveillance reports.

In neonatal calves (1–30 days old) a higher prevalence of enteric conditions, navel/joint ill and BVD-associated deaths was observed on these rapidly expanding units compared to the 2013 and 2014 surveillance reports.

In older calves (31–150 days old) a higher prevalence of clostridial disease and BVD-associated deaths was a feature of this study compared to the 2013 and 2014 surveillance reports. 14 BVD Pi calves were identified on two of the project farms, despite the fact that both of these farms were participating in the third year of the BVD eradication scheme.

Some of the study herds experienced a high level of calf mortality in 2015. This may be because of the increased number of calves on the farms and the impact on calf care from the increased pressure on labour associated with that. Sixteen of the eighteen herds participating in the study sold calves (78% male, 22% female) to reduce numbers. It was noted that not all of the calf deaths (only 63%) were sent to an RVL for examination, despite the offer of a free transportation service. This was more obvious on the farms with higher levels of calf mortality. The cause of this has not been established but RVL staff suggest that some embarrassment about mortality rates on these farms may have inhibited ongoing submissions after earlier cases were submitted and reported.

Of the 1,137 calves sold farm-to-farm (either directly or through a mart), 30 (2.6%) died before the end of September 2015. When the figure is broken down by source farm the mortality ranged from 0.0% to 13.3%, the highest number being in calves sourced from the farm where mortality was highest before sale. The numbers are too low to draw any firm conclusions but they would suggest that calf health problems experienced on a farm will continue with the calves following sale, and that calves from farms with high mortality are affected by ongoing risk factors.

CONCLUSIONS

Significant challenges face dairy farmers expanding their herds and increasing milk production rapidly. Careful planning for expansion is necessary. Calf health and welfare should be an important part of this planning process if calf management standards are to be maintained and losses to morbidity and mortality minimised.

Eradication programmes for bovine viral diarrhoea (BVD)

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INTRODUCTION

Eradication programmes for bovine viral diarrhoea (BVD) are overseen by Animal Health Ireland (Republic of Ireland) and by Animal Health and Welfare Northern Ireland (AHWNI) in Northern Ireland. Private laboratories carry out the main bulk of the testing and the veterinary laboratory services provide support by way of oversight of standards in these laboratories and check testing ear notch positive calves.

Republic of Ireland

RESULTS

2015 was the third year of the compulsory phase of the national eradication programme. Consistent with previous years, the level of compliance with the requirement to test neonatal calves remained very high. At the end of the year, 2,235,034 calves had been registered compared with 2.08 million at the end of 2014 (an increase of 155,000 calves [7.5 *per cent*]), with results recorded on the programme database, provided by the Irish Cattle Breeding Federation (ICBF; www.icbf.com) for 99.1 *per cent* of these.

0.33 *per cent* of calves born in 2015 were considered to be persistently infected (PI) based on either an initial positive or inconclusive result without a retest, or with a positive retest result, representing a decrease of approximately one third from 2014 when 0.46 *per cent* of calves were PI (see http://www.animalhealthireland.ie/?page_id=229 for up-to-date results). The change in the prevalence and distribution of the birth of PI calves over this period is evident from Figure 37 and Figure 38. 10.6 *per cent* of calves with an initial positive or inconclusive result that were subject to a retest gave a negative result, indicating that they had been transiently infected (TI). 6 *per cent* of the dams of calves considered to be PI were positive when tested, consistent with them being PI dams. At a herd level, 5.9 *per cent* of approximately 83,000 breeding herds had one or more positive or inconclusive results in 2015, representing a decrease of approximately one quarter from 2014. Approximately 75 *per cent* of these herds had a single PI animal, with more than 95 *per cent* having 5 or less PIs.

Analysis of figures at a national level indicated that the proportion of the national breeding herd with a direct or indirect negative status on the ICBF database stood at 98.1 *per cent* (of 5.6 million animals) in mid-December, while the proportion of animals whose status was not known stood at 1.8% (approximately 101,000). Of these, 16,000 were recently-born calves that were still in the process of being tested.

RETENTION OF PI ANIMALS

During 2015, the BVD Implementation Group continued to emphasise the importance of prompt removal of PI calves once identified (particularly in advance of the breeding season), with strict isolation where the option to conduct a confirmatory re-test was applied. This reflects the understanding firstly that PI animals typically fail to survive or to thrive relative to non-PI comrades. Secondly, and of greater concern, is the fact that they are a continued source of infection for

animals in both their own and in neighbouring herds. Pregnant animals are at particular risk, since infection between approximately 30 and 120 days can result in the creation of further PI calves to be born in 2016. Two peer-reviewed papers published in 2015 and based on Irish data confirmed these messages (Graham D.A. et al., 2015a; Graham D.A. et al., 2015b). Key findings from these papers included: PI calves had a higher death rate than their non-PI comrades, while those that were sent to slaughter had a 89kg-lower slaughter weight; herds that retained PIs into and beyond the breeding season had a significantly higher probability of have PIs the following year.

At the start of 2015, 1,986 and 1,182 PIs born in 2013 and 2014 respectively were still alive (3,168 in total), representing 8.5 *per cent* and 20.5 *per cent* of all PIs born in each of those years. By the end of 2015, only 201 of these remained alive. The rate of removal of PIs born in 2015 was higher than in previous years, with only 12 *per cent* (891) remaining at the start of 2016. This increased rate of removal, coupled with a decrease in the absolute number born, contributed to an overall decrease in the infection pressure. However, the failure to remove all PIs prior to the start of the breeding season in 2015 has provided the opportunity for the creation of further PI calves to be born in 2016.

NEGATIVE HERD STATUS (NHS)

At the end of 2015, approximately 6,000 herds that had taken part in, and complied with the guidelines of, the voluntary phase of the programme in 2012 had acquired negative herd status (NHS) by satisfying the following conditions:

1. Completion of a minimum of three years of tissue tag testing on calves born into the herd in each of these three years;
2. Existence of a negative BVD status for every animal currently in the herd (on the basis of either 'direct' or 'indirect' results);
3. Absence from the herd of any animal(s) deemed to be PI in the 12 months preceding the acquisition of NHS.

The acquiring of NHS is an important milestone for herds in the context of the national programme and also confers an economic benefit through access to reduced-cost testing.

For 2016, it is expected that the majority of herds will acquire NHS, with 49,087 of 83,298 satisfying these criteria at the end of December. A further 28,598 herds would also be potentially eligible once the status of untested animals (an average of approximately three per herd) was determined. From the start of December onwards, ICBF began issuing SMS messages to these herds, identifying these animals and advising them that the absence of a status for them would prevent the award of NHS on 1st January 2016.

ICBF DEVELOPMENTS

During 2015 considerable work was undertaken to further improve the presentation of herd results to farmers, including the incorporation of herd status information and the development of tools to support herd investigations following positive test results. This information is available to all herdowners, free of charge.

TECHNICAL WORKING GROUP (TWG) ACTIVITY

A key focus for the TWG in 2015 was on the monitoring options that would be available in 2016 to herds that had achieved NHS, with particular emphasis on the cost-effectiveness of introducing a serological option, based on blood sampling of a limited number of younger animals in each herd. Significant effort was put into developing a national BVD model to provide an evidence base for this analysis, which was led by a visiting researcher from the Helmholtz Centre for Environmental Research in Leipzig, with input from the Centre for Veterinary Epidemiology and Risk Analysis (CVERA) at University College Dublin and supported by data

extracts from ICBF. The outputs from this work were presented to the BVDIG in July. Key outputs from the model were:

- The programme as originally designed would have resulted in around 100 herds with PI animals at the end of 2015 (Figure 39), with eradication anticipated in 2018.
- Retention of PI animals has delayed the programme, increasing the time and cost to eradication.
- In the absence of any further retention of PIs, eradication by 2020 remains achievable.
- For larger herds, a switch to targeted serological testing would be cheaper than continued tag testing, although for smaller herds the most cost-effective option continues to be tag testing.
- At the current level of infection, the introduction of serological testing as an option for herds with NHS would only be viable where all contiguous farms also have NHS, bio-security is assured and the risk of trade-based BVD introduction is zero.

Taking these points into account, the BVDIG decided that tissue tag testing should remain as the only testing option for 2016. The TWG have continued this modelling work to consider the options for BVD testing that will be available to farmers in 2017 and beyond and the threshold prevalence of PI births below which it would be safe to introduce them.

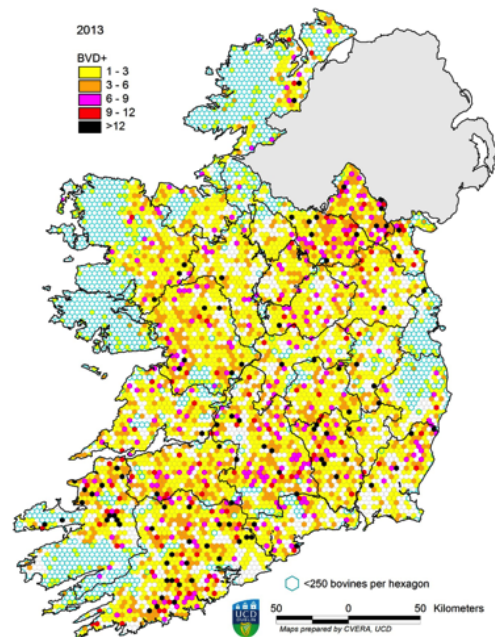


Figure 37: The distribution of calves born persistently infected (BVD+) with BVD virus in 2013. Each hexagon covers an area of approximately 10km². Hexagons in which there are fewer than 250 cattle (e.g. mountainous/urban areas and lakes) are shown with a blue border.

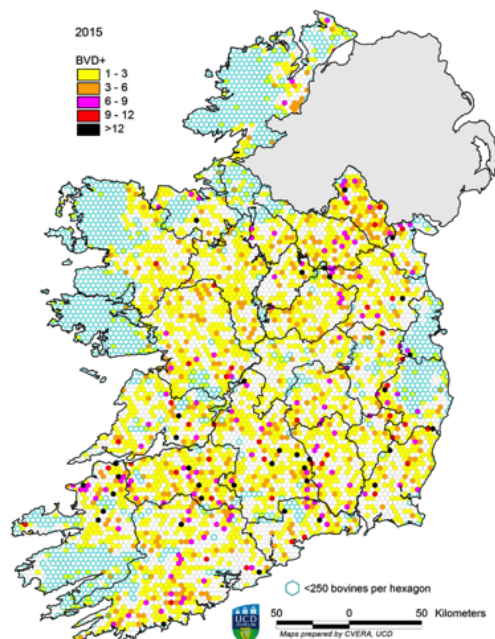


Figure 38: The distribution of calves born persistently infected (BVD+) with BVD virus in 2015.

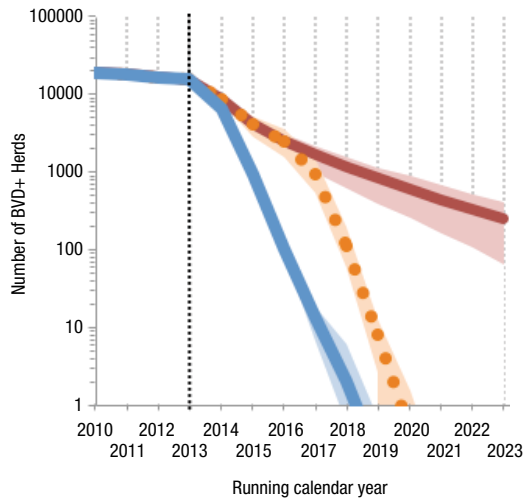


Figure 39: Model outputs showing the influence of retention of PIs on the time to eradication (blue line — no retention from 2013 onward; dotted line — no retention from 2016 onward; brown line — continued problem with retention).

DEVELOPMENT OF A TARGETED ADVISORY SERVICE ON ANIMAL HEALTH (TASAH)

In November 2015, AHI was awarded a contract by DAFM to develop a Targeted Advisory Service on Animal Health (TASAH) following a public procurement exercise. The initial focus of the service is on BVD, with the intention of providing a funded investigation by a trained veterinary practitioner to all herds with a PI calf born in 2016. The service consists of two parts: firstly, training of veterinary practitioners and secondly the setting up and organising of the delivery of the On-Farm Animal Health Advisory Measure. Approximately 100 practitioners underwent training in 2015, with the training of a further 300 scheduled to be completed by early February 2016. In parallel with this, significant work was put into developing a portal on the AHI website to manage the service. This provides a list of trained veterinary practitioners and allow herd owners either directly (http://animalhealthireland.ie/?page_id=5009), or through the AHI office (071 9671928), to request an investigation and to select the practitioner that they wish to conduct it. It also allows practitioners to manage requests for investigation, including

the reporting of key findings. The TASAH is funded under the Rural Development Programme and in the first instance will run for three years, covering the cost of up to three hours of veterinary time per investigation. In addition to BVD, it is intended that it will develop to address Johne's disease, infectious bovine rhinotracheitis (IBR) and elevated somatic cell counts.

Northern Ireland

Animal Health and Welfare Northern Ireland (AHWNI) was formed in 2012 as an industry led not-for-profit partnership between livestock producers, processors, animal health advisers and government. It is overseen by a board of directors drawn from across the cattle related agri-food sector. Its remit is to facilitate the control and wherever possible the eradication of diseases and conditions of cattle which are endemic in Northern Ireland but which are not currently subject to regulation or coordinated programmes of control.

In 2013 AHWNI launched its voluntary BVD control programme for cattle herds within Northern Ireland. This programme is based on a tag and test approach using Department of Agriculture, Environment and Rural Affairs (DAERA) approved identity tags which take a small section of ear tissue which can then be used to identify the presence of BVD virus. Where positive test results are found, further follow-up testing is required, the details of which can be found at www.animalhealthni.com.

Up to the end of December 2015, 4,654 herds had joined the programme. In total 605,017 animals had been ascribed either a direct or an indirect disease status. Of the 387,643 animals with a direct test result, 1,923 (0.50 *per cent*) were identified as infected. 217,374 dams were ascribed an indirect BVD status. Of these, 225 (0.10 *per cent*) were given an infected status (DAMPI). 11 additional offspring from persistently infected dams were identified.

During early December the Agriculture Minister agreed to legislate for the compulsory control of BVD in Northern Ireland. On 8th December 2015, the Agriculture and Rural Development Committee of the NI Assembly received a briefing from DAERA and AHWNI outlining what would be the components of the compulsory BVD programme. Following that meeting the committee expressed its contentment with the merits of moving to the compulsory phase of the BVD programme which is scheduled to commence in the spring of 2016.

References

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Fatal Poisonings

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JOHN FAGAN, RVL, ATHLONE.

In 2015 fatal cases of poisoning were recorded in cattle, sheep, horses, dogs, wild birds, a cat and a fox. Cases of poisoning were most frequently recorded in sheep (78 cases) followed by cattle (63 cases).

Cattle

Sixty-three cases of fatal poisoning were diagnosed in cattle on the island of Ireland in 2015, broadly similar to previous years (Table 5). The poisonous agents identified in cattle in 2015 are presented in Table 6.

Year	Number of cases
2011	47
2012	61
2013	75
2014	64
2015	63

Table 5: The number of poisoning cases in cattle, diagnosed on the island of Ireland, by year, since 2011.

Poisonous agent	DAFM	AFBI
Lead	28	5
Copper	7	6
Ragwort (<i>Senecio spp.</i>)	7	1
Yew	0	3
Selenium	2	0
Paraquat	1	0
Urea / Nitrate	0	1
Pieris	0	1
Cobalt	1	0

Table 6: The agents responsible for fatalities in cattle as diagnosed by DAFM (n=46) and AFBI (n=17) laboratories in 2015.

LEAD

Lead was the most common cause of fatal toxicity in cattle in 2015 with 33 cases recorded. Cases occurred most frequently during the spring and summer months when animals were likely to have been at grass (Figure 40). For this reason, it is recommended that herd owners walk their fields at the beginning of each new grazing season to check for sources of lead. Most of the cases of lead toxicity were recorded in young cattle less than one year old (21 cases or 64% of the cases recorded in 2015) though older cattle were also affected (Figure 41). Cattle are naturally inquisitive and are at risk of lead poisoning by licking or otherwise consuming common sources, such as discarded batteries, lead based paints or crankcase oil.

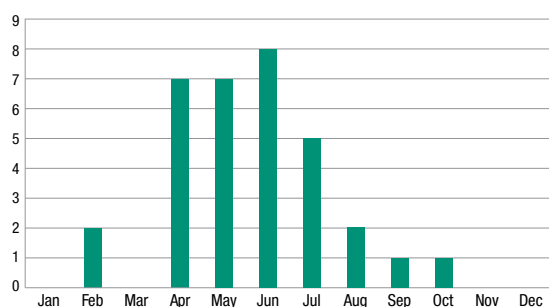


Figure 40: The number of cases of fatal lead toxicity on the island of Ireland by month in 2015 (n=33).

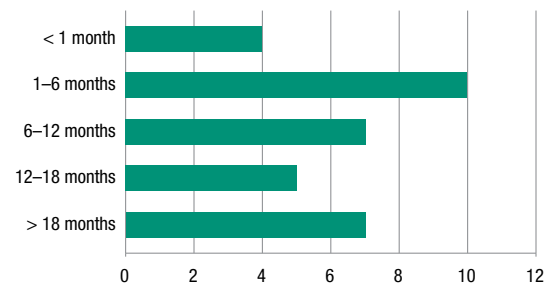


Figure 41: The number of cases of fatal lead toxicity by age group in 2015 (n=33).

COPPER

Copper is an essential trace element required for growth and production. Copper metabolism is complex however and is influenced by various factors including the presence of antagonists e.g. sulphate, molybdenum and iron in the diet. Copper toxicity can result from over-supplementation. Supplementation of copper in Ireland is potentially harmful except in herds with a history of copper deficiency or in those herds where the copper status of the herd has been assessed and found to be low. Thirteen cases of copper poisoning were diagnosed in cattle in 2015 (Table 7) and, as in previous years, it was the second most commonly diagnosed fatal toxicosis of cattle. Both calves and older cattle were affected (Figure 42).

Year	Number of cases of copper toxicity
2011	8
2012	9
2013	3
2014	11
2015	13

Table 7: The number of cases of fatal copper toxicity recorded on the island of Ireland since 2011.

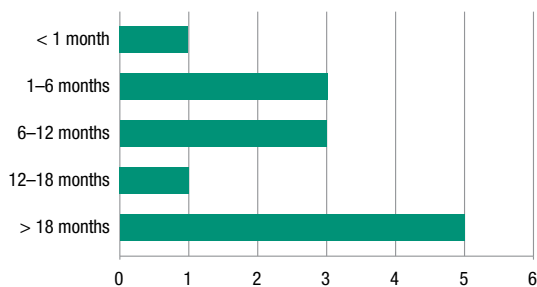


Figure 42: The number of cases of fatal copper toxicity by age group in 2015 (n=13).

RAGWORT

Eight cases of ragwort (*Senecio* spp.) toxicity were diagnosed in 2015. Ragwort was the most frequently diagnosed cause of fatal plant intoxication in cattle in 2015 and is a common plant found throughout Ireland. The toxic principles, pyrrolizidine alkaloids, are found throughout all parts of the weed and at all stages of growth. Ragwort is not a very palatable plant and is usually left uneaten if there is an adequate supply of grass. Cattle grazed on very bare pastures may be forced to eat the plant. In the weeks after mowing and spraying however, ragwort appears to be more palatable. When ragwort is incorporated in hay and silage cattle are no longer able to selectively disregard the plant and outbreaks of intoxication may result.

While grazing by sheep is often advocated as a control measure, they are also susceptible to ragwort poisoning albeit that they are more resistant to ragwort than cattle or horses.

YEW

Three cases of yew (*Taxus baccata*) toxicity were recorded in 2015. Yew is an evergreen tree quite often found in graveyards and ornamental gardens. All parts of the plant except the fleshy red part of the fruit are toxic and, if ingested in even small amounts, may result in rapid death. Yew contains toxic alkaloids which have a depressive effect on electrical conduction within the heart causing death by cardiac failure.

PARAQUAT

Paraquat is a herbicide that was formerly commonly used for the control of weeds but has been banned in the EU since 2007. Oral poisoning has been recorded in several farm species and also in humans. In 2015, a case of paraquat toxicity in two calves was recorded by DAFM involving the consumption of water and feed contaminated by paraquat. The calves presented with acute respiratory distress and died shortly afterwards and the case is currently under investigation by the Gardaí.

NITRATE

Common sources of nitrate toxicity include plants, accidental ingestion of fertiliser and using contaminated water sources. One case of nitrate poisoning was recorded in 2015 in a cow which gained access to a bag of pelleted urea being used as a dietary source of non-protein nitrogen. Two other cows were also affected in this incident.

SELENIUM

Two cases of selenium toxicity were recorded in 2015. Selenium has a narrow margin of safety and unnecessary supplementation can lead to toxicity. Clinical signs of toxicity include abnormal posture, unsteady gait, abdominal pain, diarrhoea and death. Hoof sloughing occurs in chronic toxicity. Some areas of Ireland are recognized as having excessively high levels of soil selenium, where natural or spontaneous selenium toxicity has been recorded.

CASE REPORT: UREA TOXICITY

Urea toxicity was diagnosed in a three-year-old cow submitted to AFBI Omagh which had gained access to urea pellets by dislodging a wooden pallet behind which a bag of pellets had been stored. Clinical signs included scleral haemorrhage, generalised congestion and bloating with froth and fresh blood presenting from the nostrils. Three animals in total were affected and all died. On gross post-mortem examination there were a large number of pellets present in the rumen and the rumen contents smelt

strongly of ammonia, the rumen pH was 9.0 which is consistent with urea toxicity.

Sheep

Seventy-six cases of fatal toxicoses were recorded in sheep during 2015 which represents a significant increase when compared to 2014 (39 cases) or 2013 (31 cases) but just slightly more than 2012 (75 cases). The poisonous agents identified in sheep in 2015 are presented in Table 8.

Poisonous agent	AFBI	DAFM
Copper	16	13
Pieris	20	3
Cobalt	0	9
Rhododendron	4	4
Ivy	4	0
Cherry laurel	1	0
Selenium	0	1
Brassica	0	1

Table 8: The poisonous agents responsible for fatalities in sheep, as diagnosed by DAFM (n=31) and AFBI (n=45) laboratories in 2015.

COPPER

Copper was the most frequently recorded cause of fatal poisoning in sheep with 29 cases recorded in 2015, considerably higher than the 16 cases recorded in 2014. Copper is a trace element essential in healthy sheep production. Due to peculiarities of the excretion of copper from the ovine liver, sheep are particularly susceptible to the toxic effects of copper. All breeds of sheep are susceptible to copper toxicity with Texel, Charolais and Suffolk among the breeds most susceptible, and Blackface Mountain sheep considered the most resistant. Cases of copper toxicity were diagnosed throughout the year with a peak in August (Figure 43). Cases of copper toxicity are

frequently associated with feeding concentrates supplemented with copper and therefore, toxicity tends to manifest during winter and spring months when concentrate feeding is increased to store lambs, and to pregnant or recently lambed ewes. It also occurs during late summer and early autumn when rams are fed concentrates to prepare them for sales. This was reflected in the diagnoses of copper toxicity recorded by AFBI whereby all cases of copper toxicity recorded up to the 5th August 2015 were observed in female sheep (8 cases) whereas all cases observed throughout the remainder of August to the end of year were recorded in rams and ram lambs (8 cases). Grazing pasture dressed with pig slurry or excessive administration of copper may also result in cases of copper toxicity.

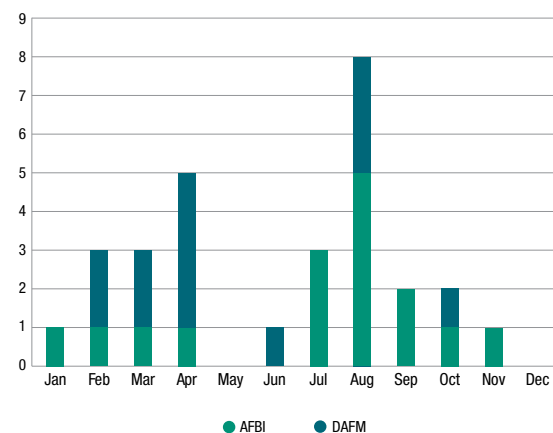


Figure 43: The number of cases of fatal copper poisoning in sheep diagnosed by DAFM (n=13) and AFBI (n=16) laboratories by month in 2015.

COBALT

Nine cases of cobalt toxicity were recorded by DAFM in 2015, representing three poisoning incidents. In two of these, the dead lambs were less than five weeks of age while in the other, store lambs recently purchased were dosed with excess cobalt. Cobalt is a constituent of vitamin B12 which is manufactured by micro-organisms in the rumen and is an essential trace element for ruminants. As cobalt is absorbed by bacteria in the rumen, supplementation by the administration of cobalt

sulphate to young animals with immature rumens can lead to toxicity. Signs of toxicity include loss of weight, listlessness, rough hair coat and anorexia.

POISONOUS PLANTS

Ingestion of plant poisons accounted for 39 of the fatal ovine toxicoses recorded in 2015 (50%). As in previous years, ingestion of *Pieris* spp. (23 cases) was the most frequent cause of plant toxicosis followed by *Rhododendron* (8 cases). Sheep are susceptible to andromedotoxin which is the toxic principle in both *Pieris* spp. and *Rhododendron* spp.

Four cases of ivy (*Hedera helix*) poisoning were diagnosed in 2015. Although ivy may be given to livestock as a folk tonic, ingestion of large quantities may cause death in sheep.

As in previous years, in 2015 plant intoxication was a feature during the autumn and winter months with peaks observed from January to March and again from October to December (Figure 44). Sheep are more likely to eat noxious plants when other sources of food are scarce and cases may be observed during particularly inclement weather. Snow is a particular risk factor when sheep may eat whatever meagre vegetation is available which may include decorative shrubs.

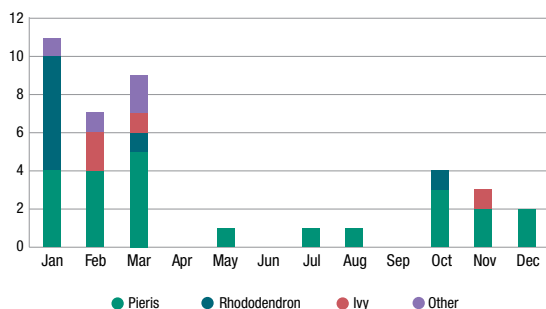


Figure 44: The number of cases of fatal poisoning of sheep by ingestion of poisonous plants on the island of Ireland by month in 2015.

Dogs

Four cases of fatal poisoning due to anticoagulant rodenticide toxicity were detected in dogs in 2015. (Figure 45)

Two cases of poisoning due to ingestion of nitroxylnil were also detected in 2015. Nitroxylnil is widely used as a flukicide in cattle and sheep, but is toxic to dogs, with clinical signs of hyperthermia, agitation, hypersalivation, and vomiting frequently occurring within hours of ingestion.

Cats

Carbofuran toxicity was diagnosed as the cause of death in one cat in 2015. Carbofuran is an insecticide and nematocide and its use is banned in the EU.

Horses

Two cases of fatal poisoning due to ragwort ingestion and two cases of fatal poisoning due to the ingestion of yew tree were diagnosed in horses in Ireland in 2015.



Figure 45: Anticoagulant rodenticide toxicity in a dog. (Photo: Seán Fee)

Diseases of sheep

COLM Ó MUIREAGÁIN, DAFM RVL, SLIGO.
JASON BARLEY, AFBI, STORMONT, BELFAST.

The most frequent causes of sheep mortality diagnosed at laboratory necropsy in Northern Ireland and Ireland during 2015 by AFBI and DAFM respectively, are shown in Figure 46. The data are presented on a disease category basis and as a percentage of the total number of submissions in each catchment area, excluding abortions which are reported separately.

There was a small increase (+2%) in the number of sheep submissions in Ireland in 2015 compared to 2014. The numbers declined in Northern Ireland reflecting the economic problems facing the Northern Ireland sheep sector during the year.

As in 2014, parasitic and respiratory diseases were the most commonly diagnosed causes of death in sheep of all ages in Northern Ireland and Ireland. The relative importance of central nervous system (CNS) disease, clostridial diseases and poisoning increased in 2015 compared to 2014.

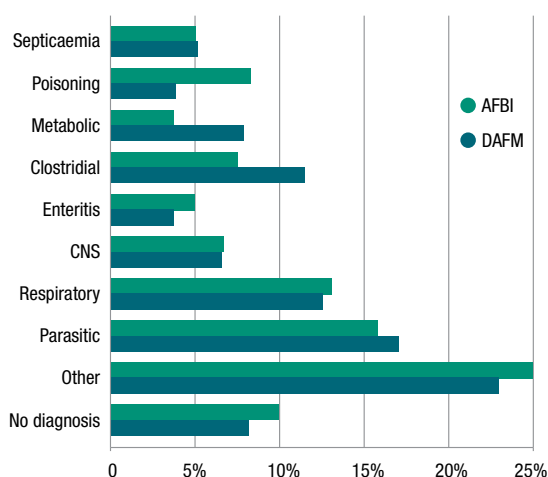


Figure 46: The relative frequency of causes of mortality in sheep of all ages submitted for *post mortem* examination to AFBI (n=552) and DAFM (n=905) laboratories in 2015.

Respiratory disease

Mannheimia haemolytica remains the most common cause of bacterial pneumonia in Northern Ireland and Ireland accounting for 36% (AFBI) and 45% (DAFM) of all diagnoses of respiratory disease in sheep. Other bacterial causes of pneumonia including *Pasteurella multocida*, *Trueperella pyogenes*, *Bibersteinia trehalosi* and *Mycoplasma ovipneumoniae* are much less commonly diagnosed in both jurisdictions.

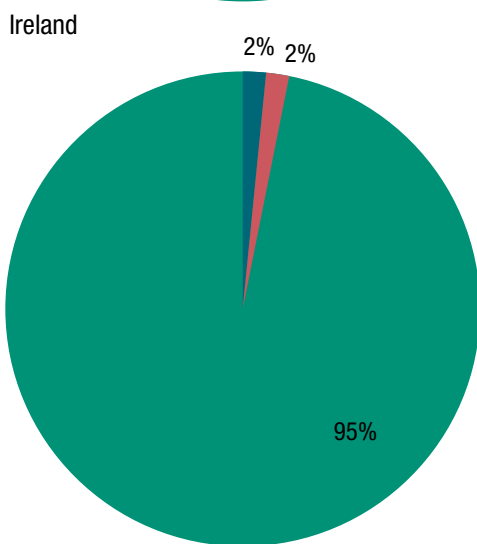
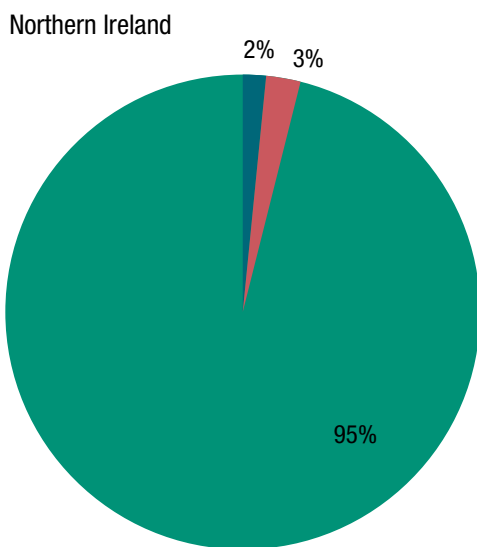
Jaagsiekte (ovine pulmonary adenocarcinoma) remains relatively commonly diagnosed in Northern Ireland and in 2015 it represented 29% of all respiratory disease diagnoses compared to 3% in Ireland. The total number of diagnoses of Jaagsiekte in Northern Ireland increased to 3.8% of all submissions excluding abortions from the 2014 level of 3.2%.

Enteric disease

Colibacillosis, ovine neonatal enterotoxaemia ('watery mouth') and cryptosporidiosis remained common causes of enteric disease in young lambs with *Salmonella spp.* being more common in older lambs and adults. Enteric viral infections (rotavirus and coronavirus) were uncommon diagnoses in Northern Ireland and Ireland.

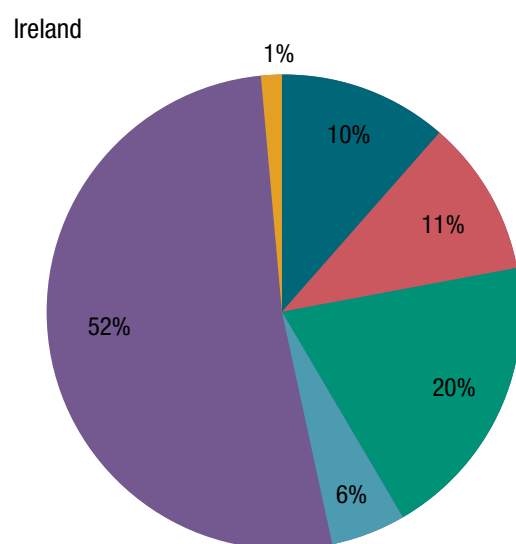
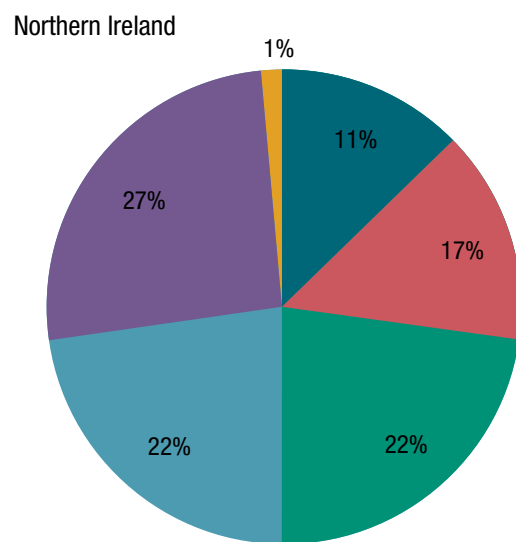
Parasitic disease

The diagnostic data for *Fasciola hepatica* (liver fluke) infestation in sheep carcasses examined *post mortem* in Northern Ireland and Ireland in 2015 are shown in Figure 47. The 2015 laboratory submissions highlighted ongoing problems with fasciolosis due to favourable weather conditions suited to the development of the mud snail intermediate host, which emerged as the year progressed.



● Acute Fasciolosis ● Chronic Fasciolosis
● Non Fasciolosis

Figure 47: The percentage of all ovine mortality caused by acute and chronic liver fasciolosis diagnosed in Northern Ireland (NI) and Ireland (IRL) in 2015.



● Acute Fasciolosis ● Chronic Fasciolosis ● Coccidiosis
● Nematodirosis ● Trichostrongylosis Ostertagiosis
● Rumen Fluke Infection

Figure 48: Specific endoparasitic conditions diagnosed in 2015 in sheep as a percentage of all ovine endoparasitic disease diagnoses made in Northern Ireland (NI) and Ireland (IRL).

Figure 48 shows the data for all endoparasitic disease in sheep examined in Northern Ireland and Ireland during 2015. Each disease is represented as a percentage of the total number of *post mortem* submissions in which parasitic disease was recorded as the cause of death.

In Northern Ireland and in the North West of Ireland during 2015, there was a relative increase in the importance of fasciolosis (liver fluke disease) in sheep of all ages compared to 2014, reflecting the occurrence of suitable weather conditions. Coccidiosis and nematodirosis in lambs remain commonly diagnosed conditions.

Clostridial Diseases

Clostridial organisms are naturally present in the soil, where the spores can survive for a long time but they can also live in the gut of healthy animals. They are a significant cause of mortality in sheep. Table 9 below shows the prevalence of clostridial diseases diagnosed in sheep by AFBI in Northern Ireland and DAFM in Ireland during 2015.

	DAFM		AFBI		Totals	
	Lambs	Adults	Lambs	Adults	Lambs	Adults
Blackleg	2	1	0	1	2	2
Black disease	1	1	2	6	3	7
Abomasitis	4	2	0	0	4	2
Malignant oedema	1	5	0	0	1	5
Enterotoxaemia	74	32	0	4	74	36
Pulpy Kidney disease	23	0	17	0	40	0

Table 9: The frequency of diagnosis of clostridial disease in sheep on post mortem examination in AFBI and DAFM veterinary laboratories in 2015.

The overall pattern remains similar to 2014 with pulpy kidney disease the most commonly diagnosed clostridial disease on the island of Ireland. Pulpy kidney disease is caused by infection with *Clostridium perfringens* type D. It is commonly identified in fast-growing lambs, typically over one month of age that are consuming high concentrate rations, or suckling high-yielding ewes. Losses in a flock often coincide with a sudden change in feed or an increase in the plane of nutrition which causes proliferation of the organism with release of toxin. The finding of rapidly autolytic kidneys ('pulpy kidneys'), glucosuria and the presence of a serous clot in the pericardium of a lamb that has died suddenly are highly suggestive of pulpy kidney disease.

Miscellaneous Disease

Listeriosis remained the most frequently diagnosed CNS disease. Copper and *Pieris* spp. shrubs (commonly marketed as 'Forest Flame' & 'Mountain Fire') were the most commonly diagnosed causes of ovine poisoning in 2015 in Northern Ireland and Ireland. More information on poisonings can be found in the Fatal Poisonings section.

CASE REPORT: UROLITHIASIS IN RAM LAMBS

Severe urolithiasis and hydronephrosis were diagnosed in a group of young pedigree ram lambs submitted to AFBI, Stormont. Lesions were present in the kidneys, bladder and penile urethra. There was massive swelling of the renal cortex and medulla and distension of the pelvis with urine, fine sand and large crystals (Figure 49). In the bladder, mucosal hyperaemia, necrosis and haemorrhage were associated with the presence of fine sand and crystals whilst the serosa showed ecchymotic haemorrhage and fibrin tagging. The crystals were confirmed as magnesium ammonium phosphate by chemistry.



Figure 49: Urolithiasis in a ram. (Photo: Jason Barley)

CASE REPORT: TICK PYAEMIA WITH ENCEPHALITIS IN A LAMB

A ten-day-old lamb, with a history of swelling on the nasal plenum and sudden onset of seizures and unconsciousness was presented for examination at AFBI Stormont. On gross postmortem examination there was abscessation of multiple

tissues including the nasal plenum, oesophagus, heart, lungs and kidneys. Histologically the lesions consisted of bacterial clumps bordered by degenerate and degenerating neutrophils.

Similar lesions were detected histologically in the cerebrum, midbrain and cerebellum thus explaining the seizures. *S. aureus* was cultured from multiple tissues. Pyaemia due to *S. aureus* in young lambs is usually associated with tick borne fever (TBF: *Anaplasma phagocytophilum* infection). TBF leads to leucopaenia and prolonged neutropaenia causing immune compromise during which time secondary infections and tick pyaemia are not uncommon. Septicaemia due to *S. aureus* in young lambs in the absence of TBF has also been described.

FLOCK HEALTH AND PRODUCTION PLANNING

The concept of flock health planning is not new, but the idea has had a variable history and opinion on how best to achieve widespread uptake remains divided.

Originally, flock health planning was very much focused on disease prevention and the production benefits of such plans were rarely highlighted. This thinking has now changed with the contribution of health planning to the improved financial position of the enterprise being seen as very important. Thus the original concept has changed into one of health and production planning focused on better returns. Furthermore health planning is now seen as an essential part of the proactive approach necessary to support current EU and UK animal health and welfare strategy and to achieving the production targets DAFM set out in the 'FoodWise 2025' strategy document. Importantly these health and welfare strategies are linked to food chain safety through the concept of Welfare Quality at European level. Another important area in which there is a role for health and production planning is as a part of the UK Five Year Antimicrobial Resistance Strategy 2013 to 2018.

CASE REPORT: CONTRECOUP INJURY IN A RAM

A ram died after fighting with another ram and was found to have a lepto-meningeal haematoma on gross post-mortem examination at AFBI Omagh. There was mild haemorrhage into the sinus of the frontal bone and significant haemorrhage into the lepto-meninges around the brainstem. The changes were considered consistent with contrecoup injury which can be produced by fighting in rams.



Figure 49b: Contrecoup injury in a ram. The frontal sinus (coup) and lepto-meningeal haemorrhage (contrecoup) lesions are both visible. (Photo: Seán Fee)

Ovine Abortion

JIM O'DONOVAN, DAFM RVL, CORK.
CATHERINE FORSYTHE, AFBI, STORMONT.

An ovine abortion case is defined as a submission consisting of one or more ovine foetus(es) and/or foetal membranes. In Ireland 201 ovine abortion cases were concluded during 2015 whereas in Northern Ireland 225 cases were closed. Individual farms may have submitted more than one case. The percentage of cases in which the cause of abortion or stillbirth was identified (the diagnostic rate) in the two jurisdictions was comparable at 74.1 *per cent* for Ireland and 60.1 *per cent* for Northern Ireland.

The diagnosed causes of abortion in sheep during 2015 were broadly similar in Ireland and

Northern Ireland (Table 10). As in previous years, toxoplasmosis and enzootic abortion of ewes (EAE) were the two most common diagnoses in both jurisdictions. Bacterial causes of abortion accounted for the remainder of diagnoses; with rates broadly similar between Ireland and Northern Ireland.

During 2015, leptospirosis was diagnosed as the cause of abortion in four *per cent* of cases of ovine abortion in Northern Ireland and one *per cent* of cases in Ireland. Testing for leptospirosis is not routinely carried out in Ireland which may account for the lower diagnostic rate. Abortion due to salmonellosis was diagnosed in a small number of sheep flocks in Ireland; all cases were due to *Salmonella* Dublin (n=4).

Looking at the diagnostic rate for the two main causative agents between 2013 and 2015, toxoplasmosis has been consistently between 26 and 29 *per cent* in Ireland and between 20 and 23 *per cent* in Northern Ireland. The diagnostic rate for EAE in Ireland has gone back up again in 2015 to 21 *per cent* following a dip to approximately nine *per cent* in 2014.

It is worth noting that many of the agents causing abortion in sheep are zoonotic agents i.e. these agents may also infect people. The most important of these are *Chlamydia abortus*, *Toxoplasma gondii*, *Coxiella burnetti*, *Listeria spp.* and *Salmonella spp.* Together these agents accounted for 57 *per cent* of cases of ovine abortion in Ireland and 44.5 *per cent* in Northern Ireland. This data further supports the advice that pregnant women and those otherwise immunocompromised by disease, drug therapy or age should never attend pregnant and lambing sheep. Furthermore sheep farmers should assume that the products of abortion and lambing are infectious both to them and sheep in the flock and take appropriate precautions (e.g. protective clothing, handwashing before eating, drinking or smoking to avoid infection, safely disposing of aborted foetuses, dead lambs and afterbirths).

	N. Ireland	%	Ireland	%
Toxoplasmosis	51	22.7	58	28.9
Enzootic Abortion of Ewes	40	17.8	42	20.9
<i>E.coli</i> infection	14	6.2	12	6
Campylobacteriosis	6	2.7	10	5
Listeriosis	9	4	6	3
<i>Coxiella burnetti</i>	0	0	4	2
<i>Salmonella</i> Dublin	0	0	4	2
Leptospirosis	9	4	2	1
<i>Trueperella pyogenes</i>	0	0	2	1
<i>Bacillus lichenformis</i>	0	0	2	1
Others	6	2.7	7	3.5
No diagnosis reached	89	39.9	52	25.9
Total cases	225	100	201	100

Table 10: Summary of the diagnosed causes of ovine abortion in Northern Ireland and Ireland in 2015.

Diseases of Pigs

SIOBHÁN CORRY, AFBI, OMAGH.
MÁIRE MCELROY, CVRL DAFM, BACKWESTON.

During 2015 there were a total of 181 submissions of pig carcasses to AFBI for diagnostic purposes (with each submission containing up to three pigs) and 121 carcass submissions to DAFM totaling 309 pigs. A diagnosis was reached in over 90% of submissions across both jurisdictions. (This figure does not include the fifteen abortion submissions; a diagnosis for the cause of abortion was made in 53% of submissions).

PNEUMONIA

As in previous years the most frequent diagnosis made was pneumonia with 24% of all pig submissions on the island of Ireland in 2015 diagnosed with pneumonia. Figure 50 shows the causes of pneumonia diagnosed on the island of Ireland in 2015 separated into each jurisdiction.

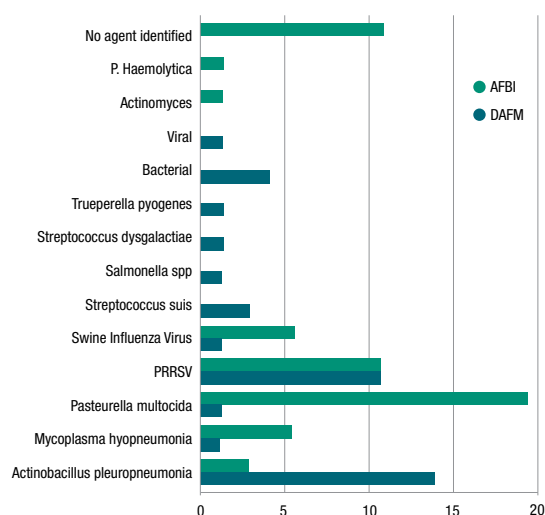


Figure 50: The causes of pneumonia diagnosed in pigs on the island of Ireland in 2015 n=73. PRRSV = Porcine reproductive and respiratory syndrome virus.

Pasteurella multocida was the most common pathogen identified as the primary cause of bacterial pneumonia; the majority of these cases were from pigs submitted in Northern Ireland.

However this year porcine reproductive and respiratory syndrome virus (PRRSV) was detected much more frequently than previously. This finding was similar in both AFBI and DAFM labs with eight submissions diagnosed as due to PRRSV in each jurisdiction. PRRSV is a notifiable disease in both jurisdictions. It is an economically important disease as it causes pneumonia in young pigs (as part of the porcine respiratory disease complex) and reproductive failure in sows. It is sometimes referred to as “blue-ear disease” due to cyanosis of the ears which is a clinical feature of the disease’s presentation. It is now endemic in nearly all swine producing areas of the world. Its success as an infectious agent arises from its highly infectious nature with only a few viral particles capable of causing disease. Transmission is by close or direct contact. The specific clinical picture seen in any particular herd will depend on the strain of the virus that is involved (as there are varying degrees of virulence between strains), the immune status of the herd and management factors. On introduction to a naive herd it produces reproductive failure characterised by abortions and still births. In neonatal pigs it causes respiratory problems and facilitates infection of the lungs with secondary bacterial agents such as *P. multocida*. In endemically infected herds the predominant presenting signs are reduced growth, increased mortality and respiratory signs with sporadic reproductive failure.

ENTERITIS

Forty-one submissions diagnosed as enteritis were investigated by AFBI and DAFM in 2015 (14% of total submissions). Twenty-two of these submissions totaling sixty-four pig carcasses were investigated by DAFM with the highest number of submissions coming from the farrowing house age group as would be expected, as this age of pigs are considered the most susceptible to enteritis. *Salmonella enterica* subsp. *enterica* serovar Typhimurium was the most frequently diagnosed aetiological agent in all age groups (Figure 51).

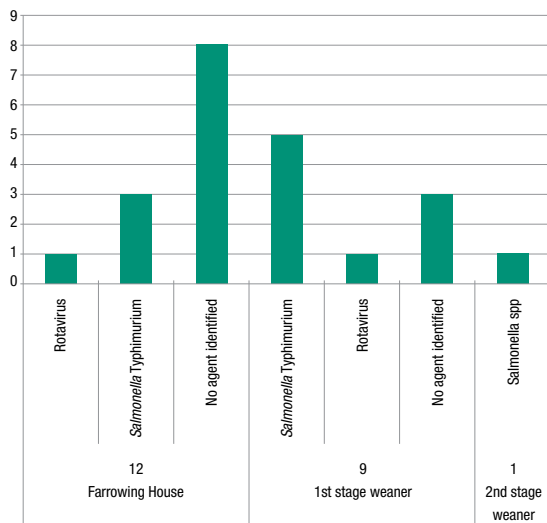


Figure 51: The causes of enteritis in pigs by age group diagnosed by DAFM in 2015.

SEPTICAEMIA

Thirty-seven submissions diagnosed as septicaemia were recorded by AFBI and DAFM in 2015 (12% of total submissions). The most commonly diagnosed agent was *Streptococcus suis* (Figure 52). *Streptococcus suis* is an important pathogen of pigs causing significant worldwide losses. It is associated with septicaemia, meningitis, abortions, endocarditis, arthritis and bronchopneumonia. It can also cause septicaemia and meningitis in humans and is an important zoonotic pathogen in parts of the world where uncooked or incompletely cooked pork products are consumed.

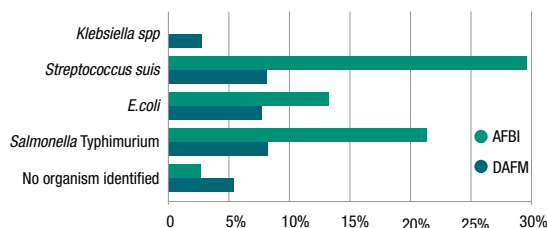


Figure 52: The causes of septicaemia in pigs diagnosed on the island of Ireland in 2015 (n=37).

TORSIONS/ GASTRIC PROBLEMS

Thirteen submissions to AFBI and DAFM in 2015 were recorded as having an intestinal torsion (4.3% of total submissions) and five submissions were

recorded as having gastric ulceration. Four torsions were diagnosed by DAFM in 2015 all of which were mesenteric torsions. Nine torsions were diagnosed by AFBI in 2015 of which five were mesenteric and there was one case of torsion of each of the liver, spleen, stomach and large intestines. One case of gastric ulceration was diagnosed by DAFM and four by AFBI of which one had ruptured. Abdominal torsions and gastric ulceration are due to multi-factorial causes but management factors including feed type and feeding frequency are thought to be implicated in both events.

ABORTIONS

Fifteen cases of abortion were investigated by AFBI and DAFM in 2015 (Figure 53). No agent was identified in seven cases. An outline of the steps taken and the tests carried out when investigating a porcine abortion can be found in the 2014 All-island Surveillance Report.

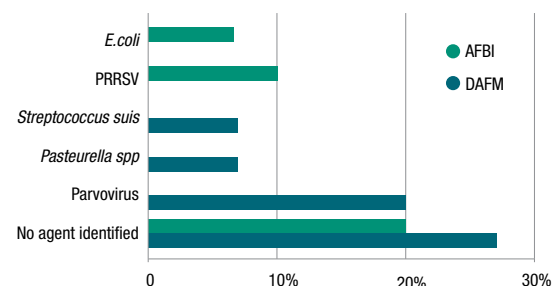


Figure 53: The causes of abortion in pigs diagnosed on the island of Ireland in 2015 (n=15).

MENINGITIS

Twenty one cases of meningitis were diagnosed in 2015. *Streptococcus suis* was the most commonly diagnosed pathogen in both jurisdictions (Figure 54).

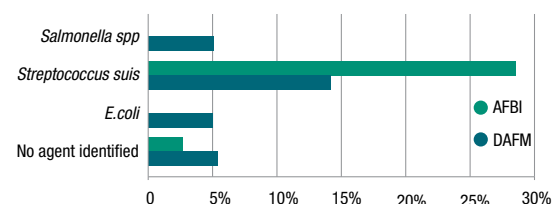


Figure 54: The causes of meningitis in pigs diagnosed on the island of Ireland in 2015 (n=21).

OTHER DIAGNOSES

Porcine proliferative enteropathy

This is an enteric disease of pigs approximately 6 to 12 weeks of age. Lesions occur in the ileum, caecum and colon and include thickening of the mucosa and blood clots in the lumen (Figure 55). Clinical signs range from chronic intermittent diarrhoea to sudden death in severe cases. The disease is caused by the bacteria *Lawsonia intracellularis* which produces proliferative and inflammatory changes in the intestinal mucosa (Figure 56). *Lawsonia intracellularis* can be demonstrated in the faeces by PCR or immunofluorescence techniques or it can be demonstrated in sections by immunohistochemistry (Figure 57). A single case of porcine proliferative enteropathy was diagnosed in a pig submitted to AFBI Omagh for post mortem examination.

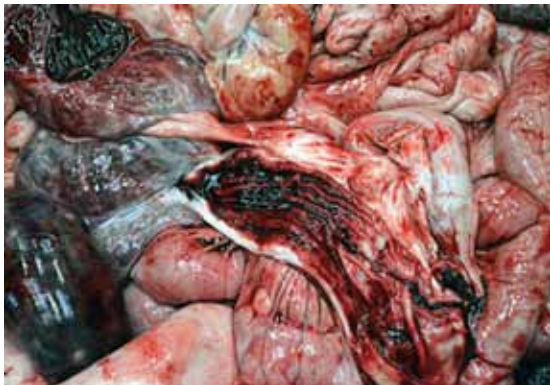


Figure 55: Haemorrhagic ileitis due to *Lawsonia intracellularis*. (Photo: P. Baird)

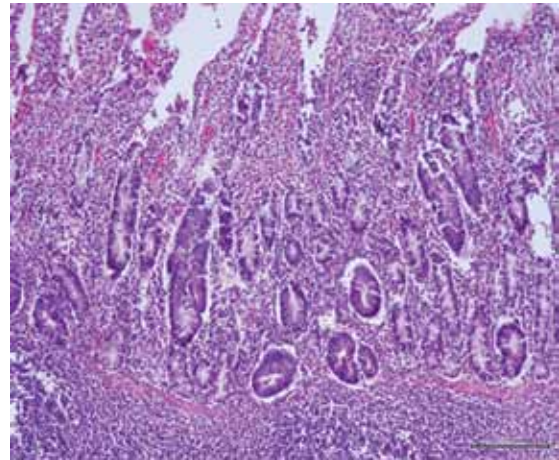


Figure 56: Neutrophilic and eosinophilic infiltration of the intestinal mucosa in response to *Lawsonia intracellularis* infection. (Photo: P. Baird)

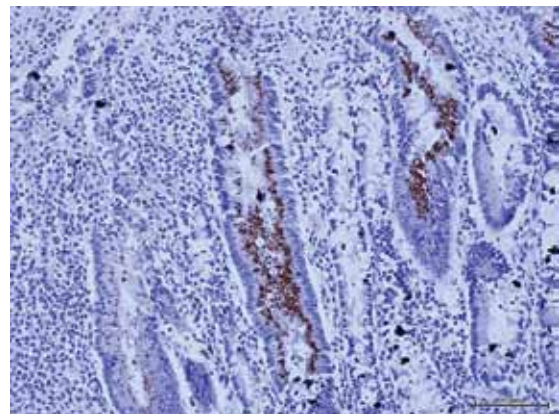


Figure 57: Immunohistochemistry showing the presence of *Lawsonia intracellularis* organisms in dark brown. (Photo: P. Baird)

Diseases of Poultry

CATHERINE FORSYTHE, AFBI, STORMONT.
ANN SHARPE, CVRL DAFM, BACKWESTON.

A total of 273 poultry submissions were made to AFBI for *post mortem* examination in 2015. As in other years these submissions were from both commercial and backyard flocks and zoological collections as well as wild birds. Occasionally, particularly in the case of wild and zoo birds, submissions were comprised of single carcasses, but often multiple carcasses were submitted from each case involving commercial flocks. Once again, in 2015 similar to 2014, diseases and conditions affecting the liver were the most common category (18%); this category included conditions such as hepatic necrosis and fatty liver, as well as specific diagnoses such as Inclusion Body Hepatitis. In a change from 2014 septicaemia was the next most commonly diagnosed category of diseases (11%), which included conditions like pasteurellosis, colisepticaemia, egg peritonitis, and those affecting baby chicks such as yolk sac infections. Musculoskeletal conditions were the third most frequently diagnosed category (9.9%). Parasitic (9.9%), respiratory (9.5%) and digestive conditions (7.3%) were all diagnosed relatively less frequently than in 2014 (Figure 58).

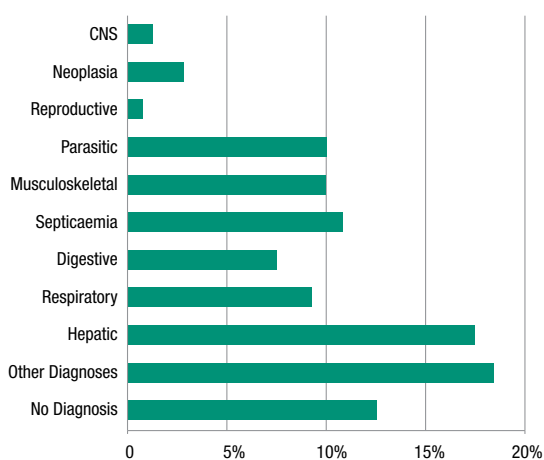


Figure 58: The relative frequency of the most commonly diagnosed causes of mortality in poultry in AFBI in 2015 (n=273). CNS = Central nervous system.

During 2015, 226 poultry carcasses from commercial and backyard flocks were examined by DAFM. Septicaemia (40%) was the most common diagnosis (Figure 59) the most frequent cause was *E. coli*. The surge in septicaemia diagnoses by DAFM was due to an outbreak of *Salmonella enterica* subsp. *enterica* serovar Enteritidis infection. DAFM confirmed the infection of chickens with *Salmonella* Enteritidis on seven poultry farms in 2015. The organism was isolated from 10-day-old broilers with a history of a sudden increase in mortality. Yolk sacculitis, peritonitis and pericarditis were observed in affected birds. The infection posed an occupational health risk to those who closely handled the birds. All of the birds were subjected to prescribed controls, either destruction on-farm or to a process of controlled sanitary slaughter. *Salmonella* Enteritidis is the strain of *Salmonella* normally associated with hen eggs, although other strains such as *Salmonella* Typhimurium have also been linked to contamination of eggs. Infected hens can lay infected eggs; therefore it is important that caterers receive assurance from their suppliers that the hen eggs they buy come from *Salmonella*-controlled flocks i.e. those that are subjected to routine testing for *Salmonella* and where no *Salmonella* has been detected. Chicken farms in Ireland are tested and monitored for *Salmonella* and any flocks with confirmed *Salmonella* Enteritidis or *Salmonella* Typhimurium infections are slaughtered and effective cleansing and disinfection of the premises are carried out, including safe disposal of manure and litter. However, not all hen eggs on the Irish market originate in Ireland. Hen eggs produced under the Egg Quality Assurance Scheme, set up by Bord Bia and the Irish Egg Association, in 1999, are subject to enhanced *Salmonella spp.* controls in addition to the regulatory requirements and are ink-jet marked with the Quality Assurance logo.

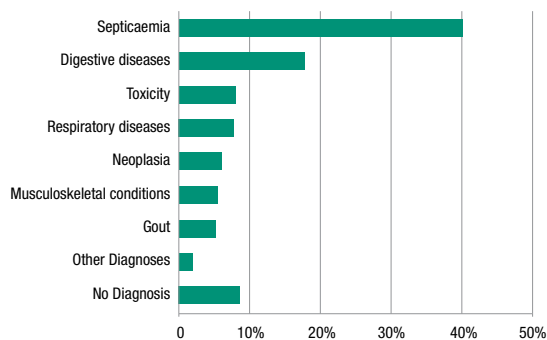


Figure 59: The relative frequency of the most commonly diagnosed causes of mortality in poultry in DAFM laboratories in 2015 (n=226).

Eight *per cent* of DAFM cases were due to lead toxicity in geese in a flock that was the subject of a field investigation conducted in 2015. A flock of 1000 geese experienced a sudden increase in mortality. Approximately 400 geese died over a period of four weeks. The geese were housed beside a group of ducks in a similar environment, which were not affected. Unlike the group of ducks, the geese had access to an outdoor fenced paddock. Avian Influenza and PMV1 were ruled out following routine testing. The clinical signs were vague (prostration and stupor followed by death). Seven to ten birds were affected and died daily. The only common histological lesion found in the birds examined was marked renal tubular necrosis (Figure 60) and occasionally visceral gout. Marginally high levels of lead indicative of low-grade exposure were detected in some of the birds. A battery in an old car was found close to the field where the geese were grazing. It was thought that some dissolved lead salts may have leaked onto the ground with the heavy rain experienced prior to the outbreak and contaminated a small pond of rain water close to the car, where the geese were grazing. Casualties in the flock ended shortly after the area around the pond was fenced off, and the car and battery were removed from the field.

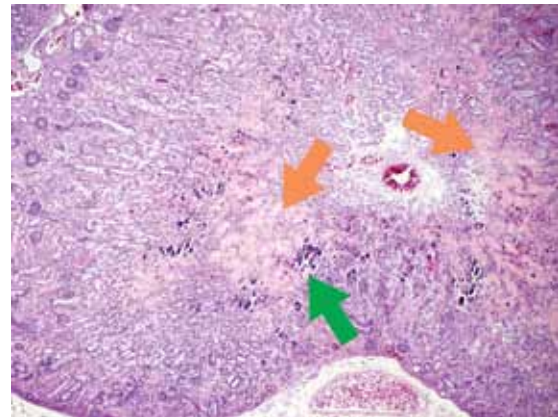


Figure 60: Histological appearance of acute renal tubular necrosis (orange arrow) and associated dystrophic deposition of calcium (green arrow) in a goose with suspected lead toxicity. (Photo: Cosme Sánchez-Miguel)

Spironucleosis was diagnosed by DAFM in nine and 13-week-old pheasants with a history of increased mortality. The clinical signs were lethargy, decreased food intake and ill-thrift over the previous few days. The intestines and caeca were dilated with watery contents. Feathers were missing along the back and vent suggesting cannibalism and vent pecking. Some birds also had evidence of infections with *Syngamus trachea*, *Heterakis gallinarum* and *Capillaria* sp. Wild birds had access to the affected pens. *Spironucleus meleagridis* (formerly called *Hexamita meleagridis*) is a motile protozoan found in the small intestine of infected birds and is very common in summer months. Infection can lead to weight loss, frothy yellow diarrhoea, dehydration and death. At *post mortem* examination, the intestinal contents were watery with small bolusues of semi-solid material and the caecal contents were frequently frothy and yellow. Spironucleosis is seen in pheasants and partridges in the rearing and releasing stages and also in adult partridges. Historically the control of motile protozoal infections of game birds such as spironucleosis relied on the inclusion of dimetridazole in the feed, however this is no longer authorised for use. As an alternative, tetracycline antibiotics administered in the feed or drinking

water may be used as part of treatment and control measures, sometimes in conjunction with electrolytes. The effect of the tetracyclines may be on the bacteria that have over proliferated in affected gut, rather than on the protozoa themselves. A resistant non-motile *Spironucleus* cyst was also present in the intestinal mucus, therefore it may be possible that gamebirds that survive may become carriers, contaminating drinking water. These cysts could adhere to boots, equipment, feeders, drinkers etc. If the shells of the eggs laid by carrier hen pheasants become contaminated by intestinal mucus, chicks hatching from the eggs could perhaps become infected, helping to explain the unexpected occurrence of disease in the rearing pens. Hence improved hygiene, reduced stocking density and increased biosecurity may be very important in the control of spironucleosis. Simple measures such as regularly moving rearing pens may reduce the degree of environmental contamination and challenge.

DAFM examined tissues from a large outbreak of infectious runting-stunting syndrome (RSS) in numerous broiler flocks which caused poor weight gain, poor litter quality and uneven growth in final carcase size. Some flocks also reported increased mortality, lameness and huddling. The aetiology of RSS is associated with different enteric viruses, including reovirus, rotavirus, enterovirus, parvovirus, calicivirus and others. These viruses are commonly isolated from RSS-affected chickens but a single agent has not been established as the cause. Whether the underlying pathogenesis is based on either mal-digestion or mal-absorption or both is still unknown. The birds also had gizzard erosion which was thought to represent a separate entity, the cause of which was unknown. A disease similar to RSS, poult enteritis and mortality syndrome (PEMS) was diagnosed in eight-week-old turkeys with ill thrift, unevenness, increased mortality and diarrhoea. Histopathological changes included small crypts lined by flattened epithelium, pericryptal fibrosis, crypt abscesses, lymphoid cell infiltrates in the lamina propria and some villous

blunting. Biosecurity is of primary importance to control PEMS. Biosecurity features advised to control PEMS include the management of dead bird disposal, litter management, controlling traffic patterns of people and vehicles, rodent control and water sanitation. All-in/-all out production or separate brooding and finishing units are also helpful.

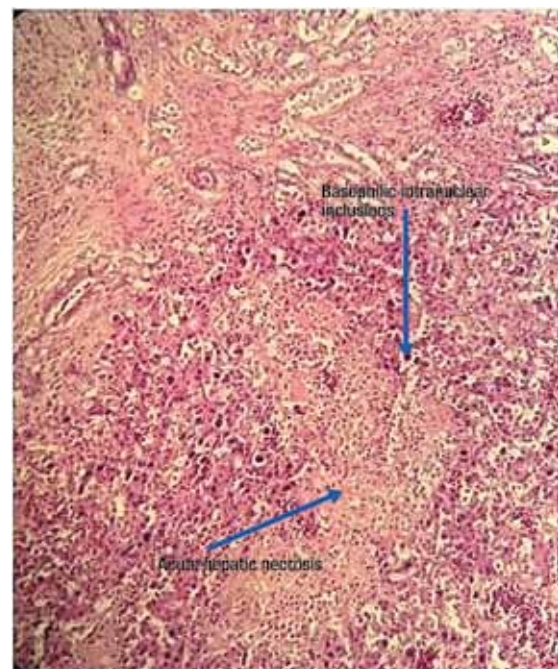


Figure 61: Acute hepatic necrosis with large intranuclear inclusions in chicks with IBH. (Photo: Catherine Forsythe)

Inclusion body hepatitis (IBH) was diagnosed by DAFM in 10 day old broiler breeders and in a 35 day old free range broiler from a site with one house of 11,000 birds. Increased mortality was reported and, on the free range farm, was attributed to a number of problems such as coccidiosis and bacterial infections. Affected birds had pale yellow livers which, on histopathological examination, contained multifocal coalescing acute necrosis. Hepatocytes contained a mixture of large basophilic and smaller eosinophilic intranuclear inclusion bodies (Figure 61). IBH is an adenovirus infection and outbreaks are encountered primarily in meat type chickens, most commonly at the age

of 3-8 weeks. Avian adenoviruses in chickens also cause hydropericardium syndrome. Although in some cases each disease is observed separately, the two conditions have been frequently observed as a single entity; therefore, the name hepatitis hydropericardium has been widely used to describe the pathologic condition. The syndrome is an acute disease of young chickens associated with anaemia, haemorrhagic disorders, and hydropericardium. It is a common disease in several countries, where broilers are severely affected, resulting in high mortality rates. Historically, infections with infectious bursal disease virus (IBDV) and chicken anaemia virus (CAV) have been known to suppress the immune system of broilers and make them more susceptible to a secondary disease such as IBH. Recently, however, it has been reported that virulent adenoviruses are able to cause IBH as a primary disease in broilers without apparent involvement of IBDV and CAV. The birds in these cases had been vaccinated against IBDV at approximately 18 days of age. Since adenoviruses are commonly found in healthy poultry, isolation alone does not confirm that they are the cause of a particular problem. The transmission of adenoviruses is realised vertically by breeder eggs and horizontally, via excreta (mainly faeces). Infected birds remain carriers for a few weeks. Progeny of high health status breeding flocks appear to be at greater risk, perhaps because they have lower levels of maternal antibody. The access of wild birds should be prevented as they are potential carriers and distributors of the virus.

A number of outbreaks of Inclusion Body Hepatitis were also investigated by AFBI in 2015; these were all in broiler chickens, approximately 3 weeks old from large commercial units. In all cases hepatitis was seen in the absence of any pericardial lesions. Virus isolation undertaken in-house identified Fowl Adenovirus in infected tissues. There were no indications that IBDV or CAV were present.

AFBI investigated a case of sudden death in three mallard ducks belonging to a backyard flock

comprising small numbers of ducks and chickens. On gross examination there were widespread petechial haemorrhages on serosal surfaces of the carcasses, and larger haemorrhages within livers. The intestinal serosae were congested and there was bloody material within proventriculae, gizzards and intestines. On histological examination of tissues occasional fibrinoid necrosis of vessels was identified in multiple organs in all carcasses, and there were eosinophilic intranuclear inclusions within hepatocytes and enterocytes in one bird. A diagnosis of Duck Viral Enteritis (Duck Plague) was made based on the history and gross and histopathological findings; this highly contagious disease of Anatids (duck, geese and swans) is caused by Anatid herpesvirus 1 which induces vascular damage in small blood vessels producing haemorrhage and degenerative changes in parenchymatous organs. Infection is by direct contact with an infected duck, or by indirect contact with a contaminated environment, particularly water and, as was likely in this case, outbreaks are frequent in duck flocks with access to water co-habited with wild waterfowl. Although Avian influenza and Newcastle Disease are infrequently reported in ducks, these notifiable diseases can produce similar changes and were ruled out by PCR testing.

Diseases of Equines

DAFM & AFBI Surveillance

SIOBHÁN CORRY, AFBI OMAGH.
SEAMUS FAGAN, RVL DAFM, ATHLONE.

The majority of equine *post mortem* examinations on the island of Ireland are carried out at the Irish Equine Centre (IEC), which specialises in equine diagnostic pathology, which are reported separately in this Report. Nevertheless, AFBI and DAFM carry out a significant number of equine *post mortem* examinations and diagnostic tests throughout the year, sometimes on behalf of the relevant competent authorities as part of animal welfare investigations.

AFBI received submission of sixteen equine carcasses for *post mortem* examination in 2015. This was down on the thirty-one equine *post mortem* examinations carried out in 2014.

Five submissions were from cases of equine abortion. One (in which three foals were submitted from the same farm) was diagnosed as abortion due to equine herpesvirus 1, one was diagnosed as abortion due to umbilical torsion, one was diagnosed as abortion due to *Streptococcus zooepidemicus* and two had no agent or other cause identified as the cause of the abortion.

Equine herpesvirus 1 (EHV1) is widespread throughout the world and causes abortion as well as generalised disease in neonatal foals. Young animals become exposed to the virus and as with other herpesviruses latency can be established, whereby the virus remains inactive in infected animals. Recrudescence of a latent infection or the infection or re-infection of a pregnant animal can result in an abortion. This can occur any time from nine days to several months after the exposure. However 95 *per cent* of abortions due to EHV1 infections occur in the last three months of pregnancy. The foetus is usually aborted in a

fresh state indicating death occurring just before the abortion. Gross lesions include oedema of the subcutis and fluid in the body cavities, but these signs may also be present in other causes of abortion. Pulmonary oedema is a consistent gross lesion. Greyish foci of necrosis may be seen beneath the liver capsule (Figure 62) in about 50% of cases.

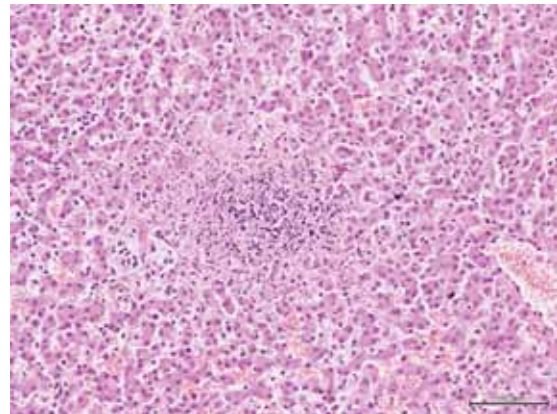


Figure 62: Focal, acute, necrotising hepatitis in an aborted foal in which equine herpes virus 1 was identified as the aetiological agent. (Photo: Seán Fee)

619 samples were submitted to AFBI laboratories in 2015 by practitioners for diagnostic testing. 277 samples were tested for contagious equine metritis (CEM, caused by *Taylorella equigenitalis*) in 2015. These samples were also tested for *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. All 277 samples were negative. Eleven samples were submitted to AFBI for testing for methicillin-resistant *Staphylococcus aureus* (MRSA) and all 11 returned negative results. Nearly 400 faecal samples were submitted for parasitology examination with the majority submitted in the first quarter of the year.

DAFM Laboratories carried out 38 *post mortem* examinations on equine carcasses: six foetuses, 11 foals, 15 horses, five ponies and one donkey. *Post mortem* findings are summarised in Table 11.

Diagnosis	Number of cases
Enteric	8
Reproductive	7
Poisoning	4
Tumour	2
Pneumonia	1
Septicaemia	2
Haemorrhage	5
Other	4
No Diagnosis	5

Table 11: The findings on *post mortem* examination of equine carcasses by Department of Agriculture, Food and the Marine laboratories in 2015 (n=38).

The poisoning cases were plant poisonings; two due to ragwort (*Senecio jacobea*) and two horses died in one incident of yew (*Taxus baccata*) poisoning. The category "Other" includes suspected neonatal isoerythrolysis, trauma, malnutrition and multisystemic eosinophilic epitheliotrophic disease (MEED). MEED is a rare, chronic wasting disease of horses characterized by development of granulomas (nodules or masses) in numerous organs. Although the cause and pathogenesis are unknown, possibilities include an exaggerated Type 2 hypersensitivity response involving helper T-lymphocytes and a hypersensitivity response to nematode parasites. MEED has also been reported in cases with concurrent lymphoma.

Irish Equine Centre Surveillance

URSULA FOGARTY, IRISH EQUINE CENTRE.

In total 430 equine *post mortem* procedures were performed by the Irish Equine Centre (IEC) during 2015. In addition to this figure there were also 73 placental membranes examined. Across all age groups those cases diagnosed with enteritis

and colitis were also screened for *Campylobacter*, *Cryptosporidium*, *Listeria*, *Salmonella spp.* and *Clostridium difficile*. All adults and foals were also screened for the presence of parasitic larvae in their faeces. Foals less than six months of age were also screened for rotavirus.

ABORTIONS

A total of 154 equine abortions were examined at the IEC during 2015. Examined material comprised foetuses and placental membranes. All cases are screened for equine herpesvirus 1 (EHV1) and equine herpesvirus 4 (EHV4) with 12 cases of EHV 1 and no case of EHV 4 detected. Abnormalities of the placenta/umbilicus, including placentitis, placental insufficiency, premature placental separation, haemorrhage and torsion of the cord were commonly recorded. About 30 foetuses were diagnosed with congenital abnormalities, the most common ones being glomerulocystic lesions and contracted tendons, brachygnathia inferior and cleft hard/soft palate. Other congenital defects diagnosed included renal dysplasia, enlarged thyroid, interventricular septal defect and anomaly of umbilical cord blood vessels.

NEONATAL FOALS (0-1 MONTH)

During 2015, a total of 131 *post mortem* examinations on newborn foals up to one month of age were carried out. They were all screened for EHV1, EHV4 and equine viral arteritis (EVA). Seven were positive for EHV-1 and one was positive for EHV-4. The most frequent causes of neonatal foal mortality were related to trauma during delivery, with asphyxiation, fractured ribs and intracranial haemorrhage often related to placental pathology. In addition to the 131 foals, 91 placental membranes were examined from compromised births. Two cases each of neonatal isoerythrolysis, actinobacillosis (sleepy foal disease) and Tyzzer's disease were diagnosed and one case of *Pneumocystis carinii* pneumonia. One additional foal on the same premises as the latter also had *Pneumocystis carinii* diagnosed by broncho-alveolar lavage (BAL).

The congenital abnormalities found in newborn foals were glomerulocystic lesions (16), flexion/extension/contraction of the limbs (8), scoliosis of thoracic/cervical region (3), congenital cranial bone abnormalities (3), microphthalmia (3), diaphragmatic hernia (2) and one case each of cerebellar dysplasia, interventricular septal defect and small intestinal septum.

FOALS (1-6 MONTHS)

During 2015, there were a total of 23 foals aged between one month and six months old were examined *post mortem* at the Irish Equine Centre. Thirteen of the cases were associated with sudden death, including traumatic injuries, pneumonia including *Rhodococcus equi* abscessation and gastric rupture among others. There was also one case of Yew (*Taxus baccata*) poisoning. 10 out of the 23 foals examined showed the presence of parasitic nematode eggs including strongyles, *Strongyloides westeri* and ascarids in their faeces. Foals less than six months of age were also screened for rotavirus. There were cases of septicaemia (16), enterocolitis (16), joint ill (1), urachal abscess (6), foreign body pneumonia (11), acute interstitial pneumonia (1) and *R. equi* abscessation (2) detected.

ADULTS

There were 86 adult horse carcasses examined in total during 2015. All horses were screened for equine dysautonomia (grass sickness), one of which was positive. Among the adult horses submitted to the IEC for *post mortem* examination common findings included hepatic fibrosis (19), enteritis/colitis/typhlitis (5), uterine-related haemorrhage (n=10). Findings in adult horses submitted for *post mortem* examination with a history of sudden death, were usually related to head/neck trauma, other types of bone fracture and coagulopathy. Tumors detected were abdominal carcinoma (1), melanoma (1), pulmonary granular cell tumour (1) and granulosa or granulosa/theca cell tumor (5) (confirmed on histopathology). Forty-six out of the 86 faecal samples examined

had no parasitic eggs detected. The remainder had strongyle eggs present. There were also two cases of pyrrolizidine poisoning from ingestion of ragwort (*Senecio jacobea*) exposure, two cases of water dropwort (*Oenanthe crocata*) poisoning, one case of atypical myopathy and one case of pancreatitis. There were two deaths from ruptured blood vessels – one involving the aorta and the other the posterior vena cava. There were also two cases of arterial occlusion by parasites/infarction. There were also four cases of exercise-induced pulmonary haemorrhage. Among the conditions of the gastro-intestinal tract diagnosed were ruptured colon, ruptured stomach, impaction of large intestine (2), impacted rectum (1), rectal tear (1). Torsions of the small intestine (1) and of the double colon (2) were also diagnosed. Examples of central nervous system conditions diagnosed were cervical stenotic myelopathy (3), encephalitis affecting the brain stem (1), myelitis (1), EHV -1 myeloencephalitis (1) and hepatic encephalopathy (1). There was one case of ruptured bladder diagnosed.

DONKEYS

The IEC carried out 36 *post mortem* examinations on donkeys. All donkeys submitted for *post mortem* examination were screened for asinine herpesvirus-2 (AHV) and equine dysautonomia (grass sickness) which were negative. The more common findings included dentition issues (22 donkeys), hepatic fibrosis (21 donkeys), chronic laminitis (21 donkeys) and enteritis/typhlitis/colitis (20 donkeys). There were also two cases of pyrrolizidine poisoning, two cases of pancreatitis and three cases of abdominal adenocarcinoma. Twenty four out of the 36 had strongyle eggs in their faeces. *Fasciola hepatica* was detected in the bile ducts of two donkeys but eggs were not detected in their faeces.

Diseases of Aquatic Animals

1. Ireland

NEIL RUANE, DEBORAH CHESLETT,
MARINE INSTITUTE.

LEGISLATION

The Fish Health Unit (FHU) at the Marine Institute is the National Reference Laboratory in Ireland for diseases of finfish, molluscs and crustaceans and it performs surveillance programmes for diseases listed under EU Directive 2006/88/EC. In addition to this, Commission Decision 2010/221/EU has granted Ireland additional guarantees in relation to freedom from the finfish diseases bacterial kidney disease (BKD), spring viraemia of carp (SVC) and gyrodactylosis (infestation with *Gyrodactylus salaris*). Following surveillance programmes, Commission Decision 2013/706/EU confirmed the disease free status of both the Republic of Ireland and Northern Ireland in relation to koi herpesvirus disease. Commission Decision 2011/187/EC approves the national measures for preventing the introduction of Ostreid herpesvirus 1 μ var (OshV-1 μ var) into those areas of Ireland which remain free of the disease. At the end of 2015, in accordance with Annex IV of 2009/177/EC, Ireland submitted a declaration for disease-free status for Ostreid herpesvirus (OshV-1 μ Var) detailing the areas free of the disease. This declaration relates to six compartments, five of which have been subject to targeted surveillance over the five year period since the surveillance programme was introduced and which have remained free of the virus. The other compartment relates to a newly established hatchery which operates independently of the surrounding water. In addition to this, the FHU also provides a diagnostic service for the aquaculture industry, the wild fish sector, Inland Fisheries Ireland and veterinarians, in relation to diseases currently not listed under EU Directives or by the OIE. The FHU laboratory is also accredited to ISO

17025 standards for a number of test methods, including those used for testing the above listed diseases.

TESTING

In 2015 over 3,500 finfish were tested for disease pathogens either as part of surveillance programmes, diagnostic samples received into the laboratory or screening tests for the aquaculture industry. The majority of the finfish species tested were Atlantic salmon (*Salmo salar*), 80%, wrasse species (7%) and rainbow trout (*Oncorhynchus mykiss*), 5% along with a smaller number of brown trout (*Salmo trutta*) and carp (*Cyprinus carpio*). The most significant disease to affect marine farmed finfish in 2015 continues to be amoebic gill disease (AGD) caused by the amoeba *Neoparamoeba perurans*. Mortalities due to the disease are low primarily due to the improved management practices common within the industry (regular screening and treatment). Other diseases affecting marine farmed Atlantic salmon in Ireland were pancreas disease, and a single case of heart and skeletal muscle inflammation (HSMI) which is caused by the piscine reovirus. Bacterial diseases have also been reported from a small number of sites with furunculosis, caused by *Aeromonas salmonicida*, causing mortality on one marine site and winter ulcer syndrome, caused by *Moritella viscosa*, reported from three sites.

In the same period, approximately 5,800 molluscs principally Pacific oysters (*Crassostrea gigas*) were tested by the FHU under surveillance and research programs as well as in response to reports of abnormal mortality. High mortality was reported from Co. Donegal and the South and South west coast affecting predominantly adult pacific oysters. *Vibrio aestuarianus* was identified in association with these mortality outbreaks in 14 bays. This represented a significant increase in mortality associated with this pathogen in Ireland. High rainfall across the country over the summer months is believed to have been a factor in the increased mortality observed. Reports of mortality

in spat associated with OsHV-1 μ Var were low in 2015 with reports received from only 6 of the 33 bays considered to be infected with the virus. The virus was however detected at low levels in the absence of mortality in a new area in 2015 bringing the number of infected sites to 34.

An outbreak of the Crayfish Plague (*Aphanomyces astaci*) was recorded in the Bruskey River in 2015. This represents the first confirmed outbreak of the plague in Ireland. Over 600 dead white clawed crayfish (*Austropotamobius pallipes*) were found in a 1.34 km stretch of the river in July. Whilst the outbreak spread rapidly up this river so far the plague appears to be confined to the Bruskey River. To date there is no evidence of non-indigenous crayfish species (NICS) in the Bruskey, which can act as carriers of the plague. Further surveys will be carried out in 2016 to investigate potential spread of the plague and to search for evidence of non-indigenous crayfish.

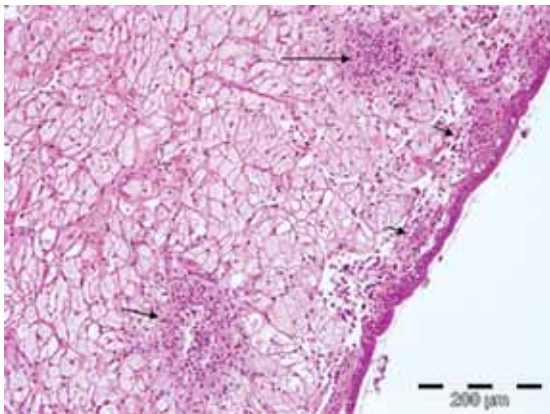


Figure 63: Haematoxylin-eosin stained histological cross-section of *Crassostrea gigas* showing moderate haemocytic infiltration in the mantle (long arrow) and haemocytic infiltration and necrosis of the mantle epithelium (short arrow). Photo: E. Collins (MI)

RESEARCH

Under the Marine Institute Fellowship Programme, the FHU is collaborating with Galway & Mayo Institute of Technology on a PhD study entitled “Gill disease in Atlantic salmon with particular emphasis

on amoebic gill disease”. The study is currently involved with the industry providing a non-lethal screening service for early detection of the amoeba using the real-time assay developed in the early stages of the project. Together with the Fisheries Ecosystems Advisory Services team, the FHU also worked on describing a microsporidian parasite infecting monkfish, an important commercial species for the Irish fishing industry.

In 2015 the FHU began work on a DAFM-FIRM funded project in collaboration with University College Cork focusing on the diseases believed to be of most significance for the Irish Pacific oyster industry namely OsHV-1 μ var and *Vibrio aestuarianus*. Sentinel oysters were deployed in 4 bays in 2015 in order to track the diseases and mortality associated with their presence over the summer months. The pathogenicity and genetic diversity of the isolates collected from the study sites are now being investigated in laboratory based studies.



Figure 64: An example of a healthy *Crassostrea gigas* oyster (top) and one in poor condition (bottom). Photo: C. Hickey (MI)

Scientific Publications

O.H. Donohoe, K. Henshilwood, K. Way, R. Hakimjavadi, D.M. Stone and D. Walls (2015) Identification and characterization of cyprinid herpesvirus-3 (CyHV-3) encoded microRNAs. *PLOS ONE* 10(4): e0125434.

N.M. Ruane, S.J. McCleary, L.J. McCarthy and K. Henshilwood (2015) Phylogenetic analysis of infectious pancreatic necrosis virus in Ireland reveals the spread of a virulent genogroup 5 subtype previously associated with imports. *Archives of Virology* 160: 817-824.

N.M. Ruane, M. Bolton-Warberg, H.D. Rodger, D.J. Colquhoun, M. Geary, S.J. McCleary, K. O Halloran, K. Maher, D. O Keeffe, L. Mirimin, K. Henshilwood, F. Geoghegan and R.D. Fitzgerald (2015) An outbreak of francisellosis in wild-caught Celtic Sea Atlantic cod, *Gadus morhua* L., juveniles reared in captivity. *Journal of Fish Diseases* 38: 97-102.

S. McCleary and K. Henshilwood (2015) Novel quantitative TaqMan® MGB real-time PCR for sensitive detection of *Vibrio aestuarianus* in *Crassostrea gigas*. *Diseases of Aquatic Organisms* 114: 239-248.

T. Morrissey, S. McCleary, E. Collins, K. Henshilwood and Deborah Cheslett (2015) An investigation of ostreid herpes virus microvariants found in *Crassostrea gigas* oyster producing bays in Ireland. *Aquaculture* 442: 86-92.

J.K. Downes, K. Henshilwood, E.M. Collins, A. Ryan, I. O Connor, H.D. Rodger, E. MacCarthy and N.M. Ruane (2015) A longitudinal study of amoebic gill disease on a marine Atlantic salmon farm utilising a real-time PCR assay for the detection of *Neoparamoeba perurans*. *Aquaculture Environment Interactions* 7: 239-251.

T. Yatabe, S.J. More, F. Geoghegan, C. McManus, A.E. Hill and B. Martinez-Lopez (2015) Characterization of the live salmonid movement network in Ireland: implications for disease prevention and control. *Preventive Veterinary Medicine* 122: 195-204.



Figure 65: Gross anatomy of xenomas in a monkfish infected with the microsporidian parasite *Spraguea lophii* (arrow). Photo: D. Stokes (MI).

2. Northern Ireland

LOUISE COSBY, AFBI STORMONT.
PAUL SAVAGE, AFBI STORMONT.

STATUTORY TESTING

The Fish Diseases Unit (FDU) at the Agri-Food and Biosciences Institute (AFBI) in Northern Ireland carries out surveillance programmes for diseases affecting finfish, molluscs and crustaceans listed under EU Directive 2006/88/EC. Under this directive, AFBI carry out routine surveillance for the following viral diseases affecting finfish: infectious haematopoietic necrosis (IHN), viral haemorrhagic septicaemia (VHS), infectious salmon anaemia (ISA) and koi herpesvirus (KHV). Under the same Directive, AFBI also carry out routine surveillance for the two molluscan diseases caused by the parasites *Bonamia ostreae* and *Marteilia refringens*. Under Commission Decision 2010/221/EU the UK and Ireland have been granted additional guarantees in relation to freedom from the finfish pathogens spring viraemia of carp (SVC), bacterial kidney disease (BKD) and infection with *Gyrodactylus salaris* (GS). Northern Ireland has approved zone status in respect of the listed fish diseases IHN, VHS, ISA, *Bonamia ostreae* (except for Lough Foyle and Strangford Lough), *Marteilia*, SVC, BKD and GS and routine surveillance must be carried out

to confirm/maintain this disease free status. Under Commission Decision 2011/187/EC, the FDU is undertaking a surveillance programme for the early detection of ostreid herpesvirus-1 microvar (μ var) in pacific oysters (*Crassostrea gigas*). There is a surveillance programme underway with the aim of achieving disease freedom for KHV in the near future.

ACCREDITATION

The FDU laboratory is ISO 17025 accredited for the following range of real-time RT-PCR and PCR assays: SAV (salmonid alphavirus), IHN, VHS, ISA, KHV and GS. All other work in the laboratory is carried out at ISO 9001:2008 standard. The laboratory is currently working on ISO 17025 validation packs for OSHV-1 and *Bonamia* sp for submission to UKAS in 2016.

DIAGNOSTIC TESTING

Aside from the statutory surveillance programmes, the FDU provides a diagnostic service for the international aquaculture industry, the wild fish sector and local veterinarians, for diseases currently not listed under EU Directives or by the OIE.

In 2015 almost 1,000 finfish were tested for disease pathogens as either part of statutory surveillance programmes or diagnostic samples received into the laboratory from the aquaculture industry and private veterinarians. The finfish species tested were Rainbow trout (73%), Atlantic salmon (15%), Brown trout (5%), common carp including koi carp (3%) and roach (4%). Northern Ireland remains free of finfish diseases listed under EU Directive 2006/88/EC and Commission Decision 2010/221/EU.

The only diseases that were detected in finfish in 2015 are not listed under EU directives or by the OIE. These diseases are pancreas disease (PD) (infection with salmonid alphavirus is now listed by OIE but not by the EU), infectious pancreatic necrosis (IPN), Heart and skeletal muscle

inflammation (HSMI), cardiomyopathy syndrome (CMS) and amoebic gill disease (AGD) caused by *Neoparamoeba perurans*. All of these diseases are commonly diagnosed in Atlantic salmon reared in sea cages. PD and IPN are detected in the laboratory by virus neutralisation and virus isolation in cell culture, real-time RT-PCR, IFAT and genetic sequence analysis. *N. perurans*, CMS and HSMI infections are detected in the laboratory by real-time PCR and genetic sequence analysis.

In 2015 a total of 450 molluscs and crustaceans were tested for disease pathogens by the FDU. 60 Pacific oysters (*Crassostrea gigas*) from Larne Lough were screened for ostreid herpesvirus-1 μ var (OSHV-1 μ var) for the statutory surveillance programme. These tested negative for OSHV-1 μ var by real time PCR. 150 native oysters (*Ostrea edulis*) and 90 mussels (*Mytilus edulis*) were screened for *Bonamia ostreae* and *Martiellia refringens*; both these diseases are listed by the OIE. The entire coastline of Northern Ireland is designated free from *Martiellia refringens* and *Bonamia ostreae* (with the exception of Strangford Lough and Lough Foyle where *Bonamia ostreae* has been found previously). 150 Green crabs were screened for white spot syndrome virus (WSSV) and they all tested negative by real-time PCR.

RESEARCH

The lab has received an Invest NI Innovation Voucher and is currently conducting an examination of the presence and prevalence of European eel (*Anguilla anguilla*) viruses in the Lough Neagh native eel population). Real-time (RT) PCR tests have been established to test for the presence and prevalence of eel virus European (EVE), eel virus European X (EVEX) and herpesvirus anguillae (HVA) in Lough Neagh.

Parasitic Diseases

SEAMUS FAGAN, DAFM RVL, ATHLONE.
BOB HANNA, AFBI, STORMONT, BELFAST.

LIVER AND RUMEN FLUKE

Recent analysis of rumen flukes collected in Ireland has shown that *Calicophoron daubneyi* appears to be the dominant species in cattle and sheep. This species of rumen fluke uses the mud snail (*Galba truncatula*) as its intermediate host, as does the liver fluke (*Fasciola hepatica*).

CATTLE

Rumen fluke eggs are detected more often in bovine faecal samples than liver fluke eggs (Figures 66 and 67). While the percentage of samples with rumen fluke eggs detected has stayed static since 2013 at just over 40 per cent, the percentage with liver fluke eggs detected has fallen from just under 20 per cent in 2010 to around five per cent in 2015 (Figure 68).

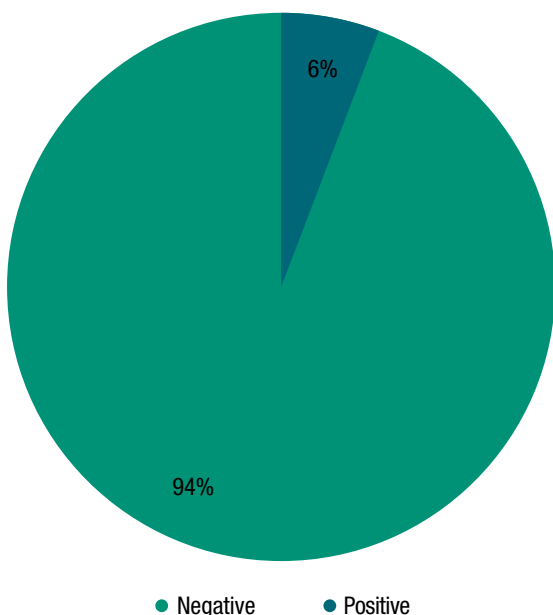


Figure 66: The relative frequency of detection of liver fluke eggs in bovine faecal samples examined on the island of Ireland during 2015 (n=6599).

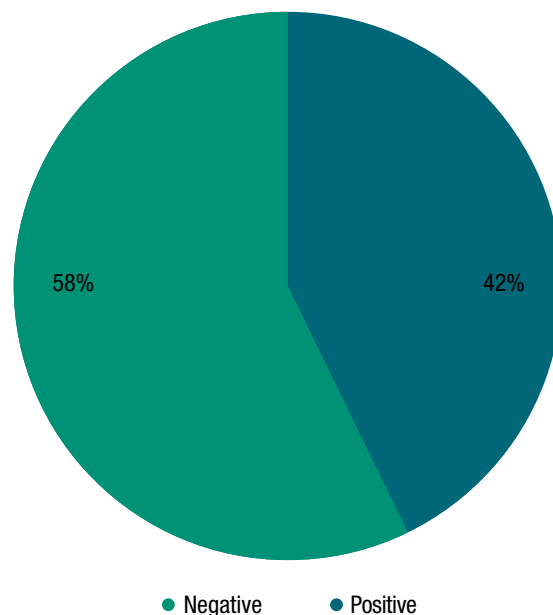


Figure 67: The relative frequency of detection of rumen fluke eggs in bovine faecal samples examined on the island of Ireland during 2015 (n=6617).

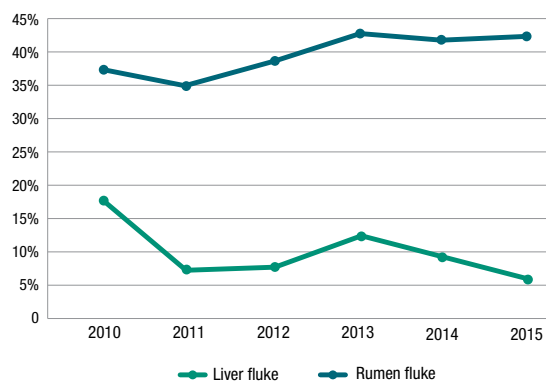


Figure 68: The percentage of bovine faecal samples containing liver and rumen fluke eggs in the island of Ireland 2010–2015.

SHEEP

In the ovine faecal samples examined rumen fluke eggs were more frequently detected than liver fluke eggs (Figures 69 and 70). The percentage with liver fluke eggs detected, only showed a slight increase in 2015 from 2014 while rumen fluke egg detections increased from 20 to 23 per cent (Figure 71).

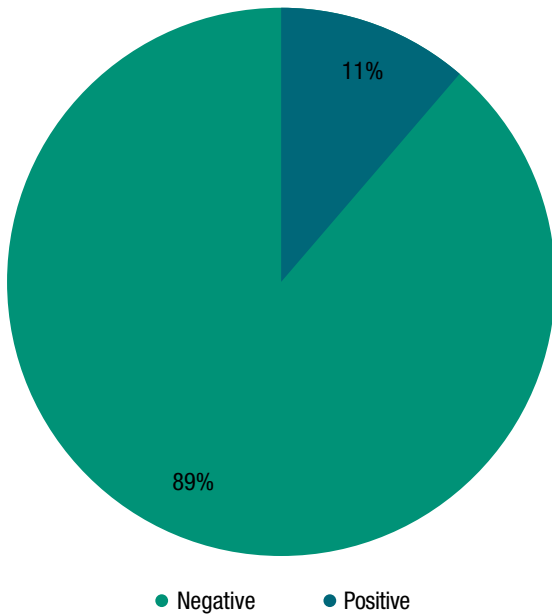


Figure 69: The relative frequency of detection of liver fluke eggs in ovine faecal samples examined on the island of Ireland during 2015 (n=1541).

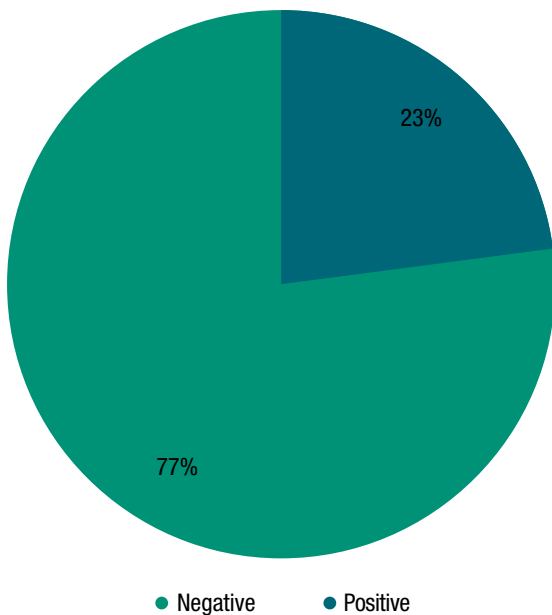


Figure 70: The relative frequency of detection of rumen fluke eggs in ovine faecal samples examined on the island of Ireland during 2015 (n=1541).

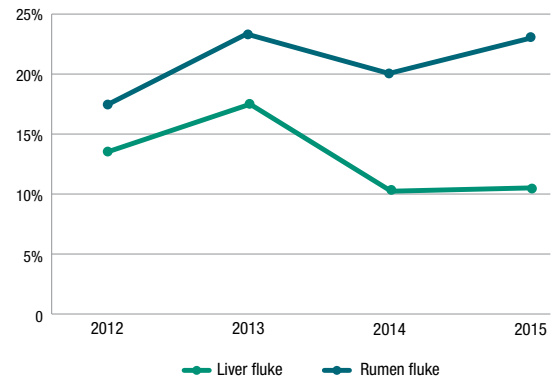


Figure 71: The percentage of ovine faecal samples containing detectable liver and rumen fluke eggs in the island of Ireland 2012–2015.

It should be stressed that the finding (or failure to find) fluke eggs in a faecal sample needs careful interpretation. Both liver fluke and rumen fluke are capable of causing significant clinical disease before either parasite is mature enough to lay eggs (pre-patent disease). On the other hand, a large proportion of those animals with rumen fluke eggs in their faecal sample show few if any clinical signs of disease.

FLUKE ELISA SURVEY

The objective of this DAFM project was to assess the usefulness of the detection of antibodies to *Fasciola hepatica* as an early indicator of liver fluke infestation in sheep flocks. Serum samples were collected in three slaughter plants from five 2015-born lambs from each of 18 flocks, which were randomly selected. These 90 samples were tested using a commercially available ELISA for the presence of antibodies to *Fasciola hepatica*. This was repeated every two weeks from late May until early December 2015. The results, outlined in Table 12 show an increasing prevalence of *F. hepatica* antibody-positive lambs as the season progresses, with the first significant evidence of liver fluke exposure occurring in September. This work is continuing in 2016 with a view to it being of assistance in assessing the timing of first *F. hepatica* challenge during a season.

	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Light	0	1	3	2	16	10	2	5	39
Moderate	0	0	2	2	17	7	9	6	43
Heavy	0	0	1	0	12	8	7	11	39
Neg	90	179	172	150	196	178	159	67	1191
Total	90	180	178	154	241	203	177	89	1312
% Pos	0	0	3.4	2.6	18.7	12.3	10.2	24.7	9.2

Table 12: The results of ELISA tests for *Fasciola hepatica* antibodies which were carried out in a pilot project to evaluate this test’s ability for early detection of liver fluke infestation during 2015.

ROUNDWORMS AND COCCIDIA

Faecal samples are examined for trichostrongyle eggs, nematodirus eggs¹, lungworm larvae and coccidial oocysts.

The number of trichostrongyle eggs detected is consistently higher in sheep when compared to cattle (Figures 72 and 73). There may be a number of reasons for this, such as inherent resistance, age profile of the animals sampled, type of pasture grazed and that it is more common for sheep to be out-wintered than cattle. Further, the number of ovine samples tested is much smaller than the number of bovine samples. It is likely that sheep farmers are more selective in the submission of samples and therefore they are more likely to contain worm eggs. However, it may also point towards a greater focus on parasite control in cattle herds and suggests that this is an area which requires further attention among sheep producers.

¹ In this report the term “trichostrongyle eggs” will be used instead of the more traditional term “strongyle eggs”. This is technically correct for gutworms of ruminants (the term “strongyles” is more commonly associated with equine nematode parasites). The Trichostrongyloidea superfamily includes *Ostertagia*, *Teladorsagia* and *Cooperia* as well as *Trichostrongylus* spp

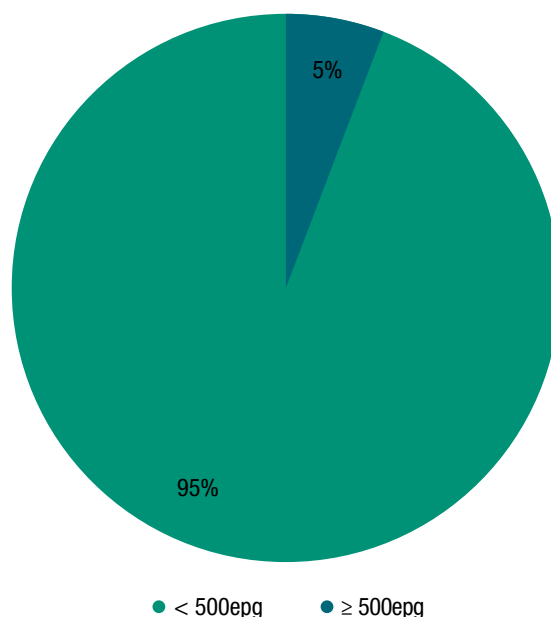


Figure 72: The relative frequency of detection of trichostrongyle eggs in bovine faecal samples during 2015, in relation to a commonly used threshold of significance – 500 eggs per gram (epg) (n=7451).

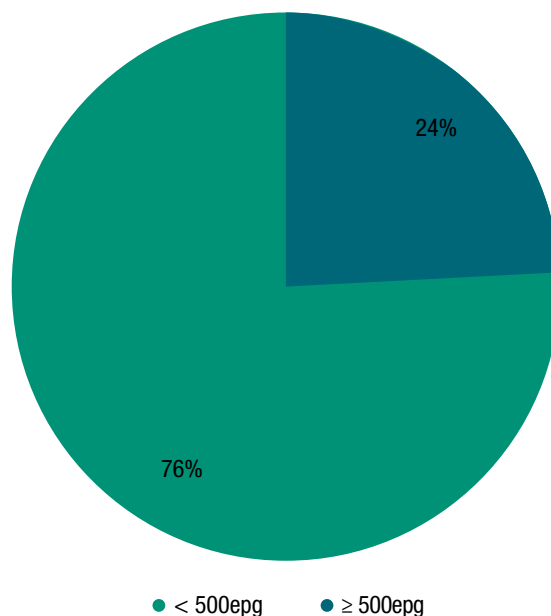


Figure 73: The relative frequency of detection of trichostrongyle eggs in ovine faecal samples during 2015, in relation to a commonly used threshold of significance – 500 eggs per gram (epg) (n=3236).

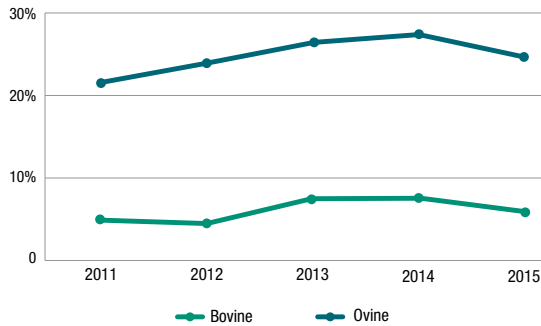


Figure 74: The percentage of bovine and ovine faecal samples with a *Trichostrongyle* egg count in excess of 500 eggs/gram 2011–2015.

Pilot survey of worm egg counts in weanlings entering Irish livestock marts

Three visits to livestock marts in Co. Roscommon were made in November 2014. During these visits faecal samples were collected from 76 beef suckler weanlings aged from five to 14 months of age from 56 herds in counties Roscommon, Galway, Westmeath, Longford, Sligo and Leitrim. The animals were chosen at random as the ear tags were being read in the mart crush at reception of animals for sale. Results are shown in Table 13.

Egg Count	Number of weanlings
<50	54
100	9
200	6
300	5
400	1
500	1
Total	76

Table 13: The trichostrongyle egg counts in 76 weanlings from herds in the midlands and west sampled at marts in Co Roscommon during November 2014.

While worm egg counts do not perfectly correlate with intestinal parasite burdens (e.g. will not detect pre-patent infections, hypobiotic nematodes) they are both a convenient and fairly reliable estimate. This study confirms the ‘received wisdom’ that suckler calves are not a high risk for parasites up to the time of weaning, as their herbage intake, and thus their exposure to parasitic nematodes is very low, because of the amount of suckled milk in their diet.

NEMATODIRUS

Nematodiriosis can be a significant cause of diarrhoea in sheep, particularly in young lambs (Figure 75).

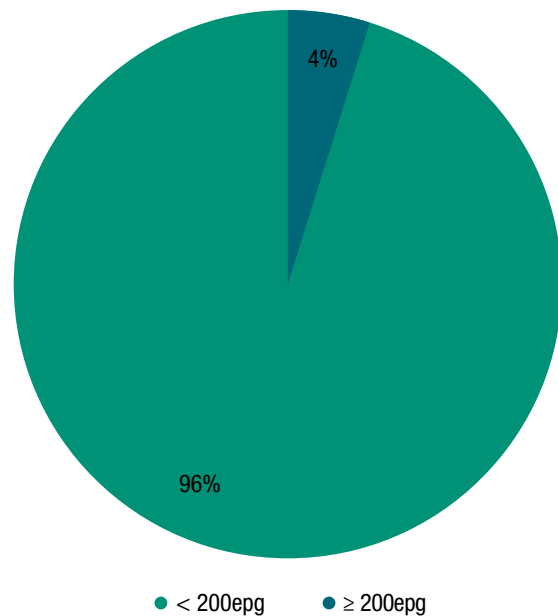


Figure 75: The relative frequency of detection of *Nematodirus* eggs in ovine faecal samples during 2015, in relation to the commonly used threshold of significance of 200 eggs/gram (n=3009).

Development to the L3 larval stage takes place within the egg, and in the case of *Nematodirus battus* (the most significant species seen in Ireland), a prolonged cold period is required before hatching from the egg occurs. It is common therefore that large numbers of L3 larvae appear on infected pastures in April, May and June when

young suckling lambs are beginning to ingest more grass. If young naïve lambs ingest enough of these larvae, severe clinical disease can result. Faecal egg counts of more than 200 characteristic *Nematodirus* eggs per gram are considered clinically significant in sheep.

COCCIDIOSIS

Coccidial oocysts were detected more frequently in ovines than in bovines in 2015 (Figures 76 and 77). It is an insidious disease and is frequently associated with poor thrive in lambs and calves as well as more serious clinical disease. Figure 78 shows that it is detected in ovines more frequently than in bovines since 2013.

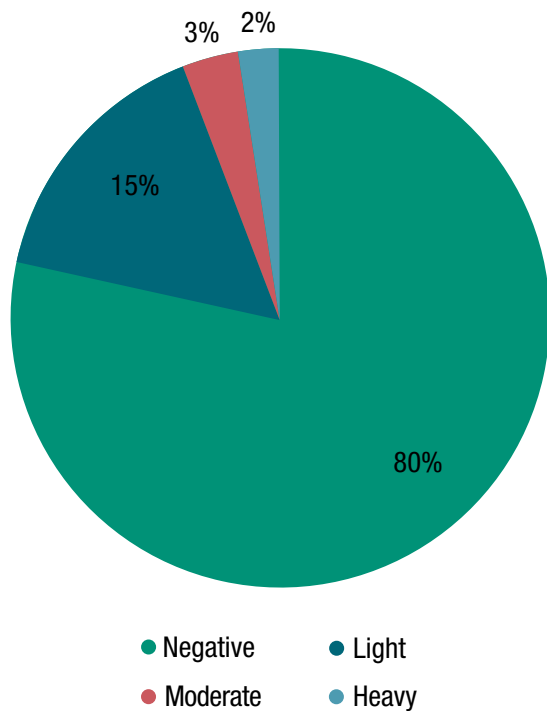


Figure 76: The results of bovine faecal samples tested for coccidial oocysts during 2015 (n=5,875) in AFBI and DAFM laboratories.

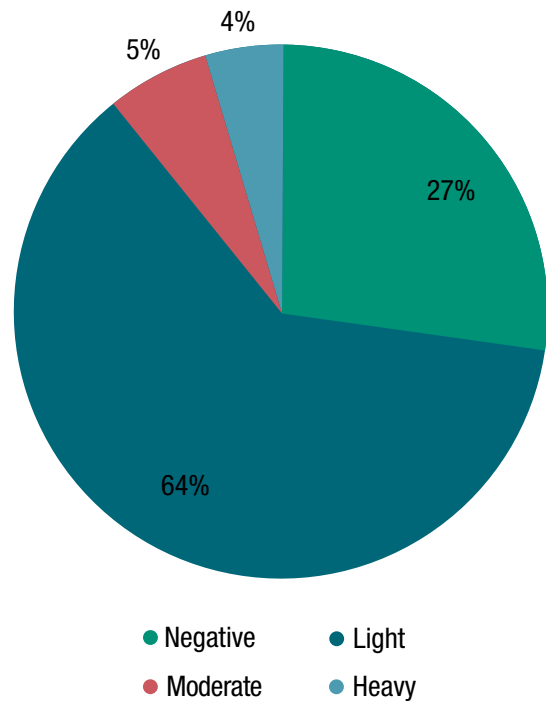


Figure 77: The results of ovine faecal samples tested for coccidial oocysts during 2015 (n=3,247) in AFBI and DAFM laboratories.

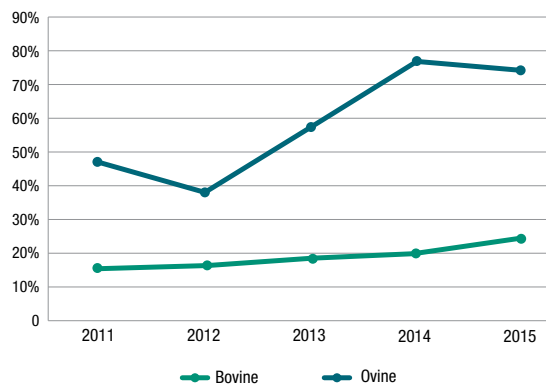


Figure 78: The percentage of bovine and ovine faecal samples containing detectable coccidial oocysts in AFBI and DAFM laboratories for the years 2011–2015.

Clinical Chemistry

COLM BRADY, DAFM, RVL KILKENNY.
JASON BARLEY, AFBI STORMONT, BELFAST.

INTRODUCTION

Clinical chemistry is an important adjunct to assist diagnosis for the veterinary practitioner while investigating individual sick animals or problems at a herd or flock level. Monitoring blood concentrations of minerals and trace elements is also a valuable tool in a herd/flock health programme. Pro active identification and correction of a nutritional problem early can prevent more substantial problems developing later. Problems identified are mainly deficiencies but on occasion toxicities can be occurring usually due to over supplementation. Both AFBI and DAFM laboratories provide analyses for a number of minerals which play a role in maintaining good health and thrive in farm animals. While the samples submitted to the laboratories are somewhat biased, because they are taken to investigate disease incidents, the collation of the data gathered gives a picture of the overall situation in the country in relation to mineral/trace element status. Following analysis of the 2015 data the following are the results of some of the more requested mineral analyses.

COPPER

A diagnosis of copper deficiency in a herd or flock relies on interpretation of clinical history, together with laboratory analyses on serum and liver samples. While the concentration of copper in liver is the best marker of the copper status of the animal, the determination of copper in serum is a more practical approximation. A bovine serum copper value of 9.4 micromoles per litre or less is suggestive of copper deficiency. When assessing the copper status of a herd, it is important to take samples from a number of animals in each age group.

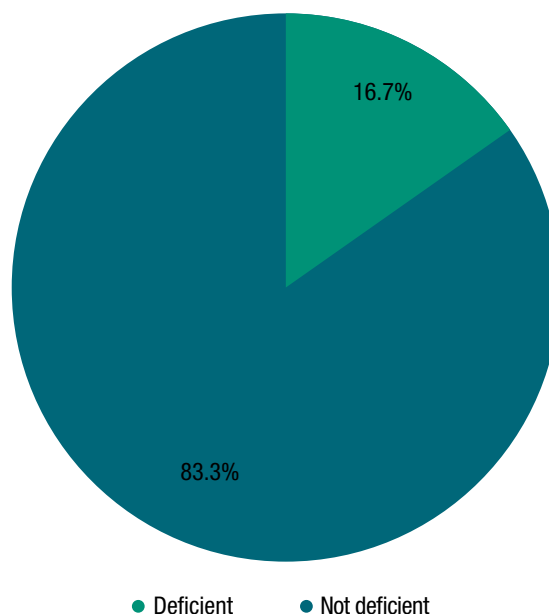


Figure 79: The number of bovine blood samples submitted to AFBI and DAFM laboratories during 2015 which were analysed for copper status and were identified as deficient or not deficient (n=11,275).

SELENIUM

Selenium is an element which forms part of the enzyme glutathione peroxidase (GSH-Px) which catalyses the reduction of hydrogen peroxide and lipid hydroperoxidases and limits oxidative damage to body tissues. The selenium status of cattle can be determined either by directly measuring blood selenium levels or by measuring GSH-Px activity in red blood cells. GSH-Px activity reflects incorporation of selenium into erythrocytes during erythropoiesis and therefore is an indicator of selenium status sometime earlier than the time of sampling. Submission of whole blood samples is required for selenium or GSH-Px analysis.

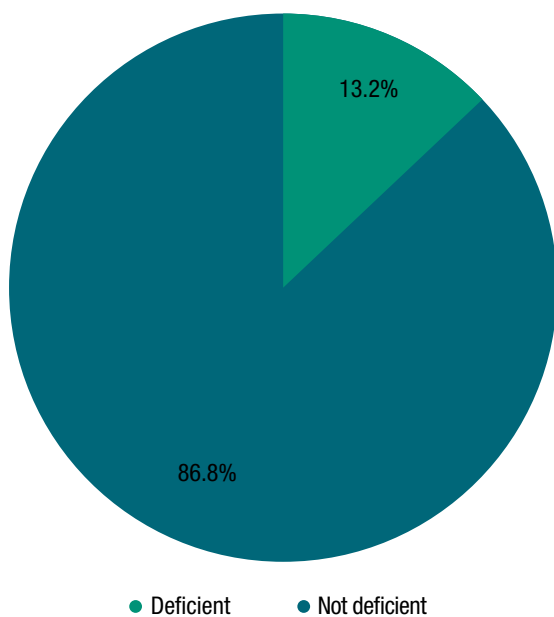


Figure 80: The number of bovine blood samples submitted to AFBI and DAFM laboratories during 2015 which were analysed for selenium status (either by blood selenium analysis or measurement of glutathione peroxidase activity) and were identified as deficient or not deficient (n=9100).

IODINE

Plasma inorganic iodine is used by the AFBI laboratories to assess iodine status and gives an indication of current iodine intake. Plasma inorganic iodine of less than 60 micromoles per litre indicates low recent iodine intake. Results should be interpreted on a herd basis as an individual low result does not necessarily mean that an animal is deficient and has not enough stored iodine to satisfy the needs of short term thyroxine production. A low result does indicate however that iodine intake on the day of sampling was low and prolonged intakes of this level are likely to result in deficiency. DAFM Regional Veterinary Laboratories do not carry out iodine analysis.

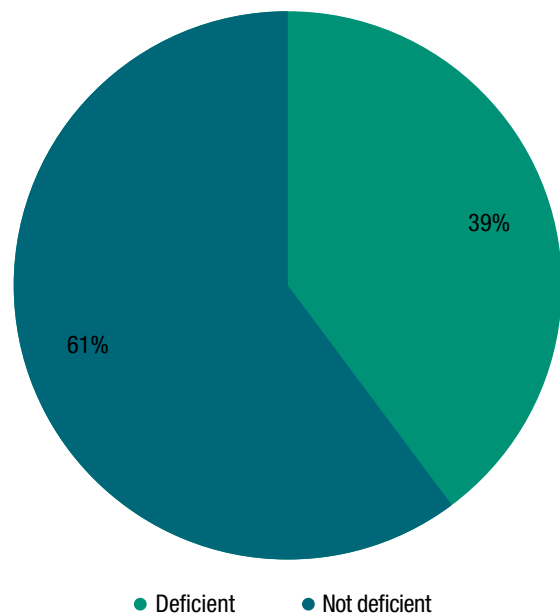


Figure 81: The number of bovine blood samples submitted to AFBI laboratories during 2015 which were analysed for inorganic iodine status and were identified as deficient or not deficient (n=3001).

COBALT

Cobalt deficiency in ruminants occurs primarily in areas in which the soils are deficient in cobalt. In ruminants cobalt is needed in the manufacture of vitamin B12 which is in turn required for the metabolism of propionate through the gluconeogenesis pathway, an important source of energy for the animal.

Liver cobalt concentrations of less than 0.7 micromoles per kilogram wet weight are considered deficient. Figure 82 demonstrates the bovine results for 2015.

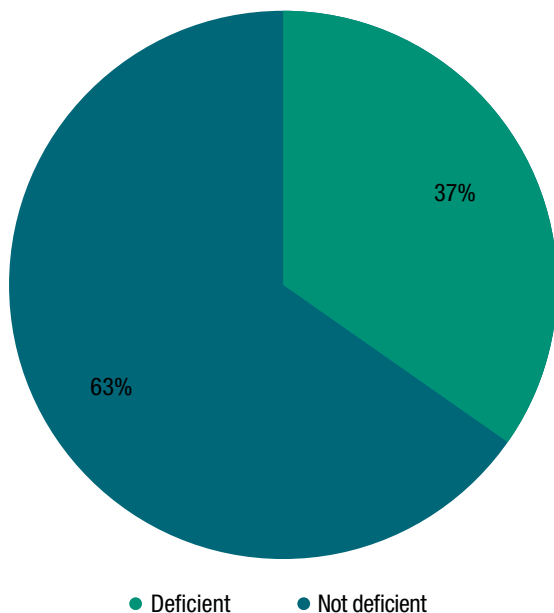


Figure 82: The total number of bovine liver samples submitted to DAFM laboratories during 2015 which were analysed for cobalt status and which were identified as deficient or not deficient (n=246).

In sheep a specific condition associated with low liver cobalt levels and low plasma concentrations of vitamin B12 is recognised. At necropsy the liver looks pale, swollen and greasy as a result of severe fatty infiltration causing hepatic failure. Figure 83 demonstrates the ovine results for 2015.

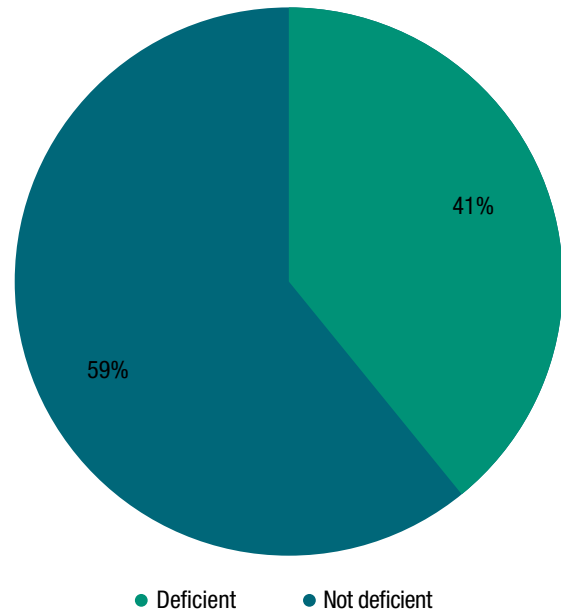


Figure 83: The total number of ovine liver samples submitted to by DAFM laboratories during 2015 which were analysed for cobalt status and which were identified as deficient or not deficient (n=231).

Haematology

COLM BRADY, DAFM, RVL KILKENNY.
JASON BARLEY, AFBI STORMONT, BELFAST.

Haematology testing is available in all AFBI and DAFM laboratories. Haematological examination may be performed as part of a general health assessment of an animal, but is also useful for identifying animals with systemic inflammatory responses, anaemias or leukaemias. Blood should be drawn from the animal at rest with minimal stress to minimise physiological variations in cell counts, the blood should be collected into an EDTA blood tube and submitted to the laboratory as soon as possible, preferably within 12 hours but certainly no later than 24 hours after collection. The fresher the sample, the more reliable the results, in particular in relation to white cell parameters as white cells degrade more quickly. Abnormal findings on a haemogram are often non-specific; therefore it is important that findings are interpreted in conjunction with a thorough history and consideration of the clinical signs. The laboratories can also examine blood films; these are useful in the diagnosis of haemoparasitic diseases such as tick-borne fever or babesiosis.

Wildlife Surveillance

ALAN JOHNSON, RVL LIMERICK.
SEÁN FEE, AFBI, OMAGH.

During 2015 the wildlife species submitted to DAFM veterinary laboratories for examination included deer, hares, an otter, a rabbit, wood pigeons, swans, starlings, gulls, a Daubenton's bat and a number of raptor species including one hen harrier, three peregrine falcons (Figure 84), two white-tailed sea eagles, seven common buzzards, two sparrowhawks, three kestrels, one long-eared owl, and one barn owl.



Figure 84: Peregrine Falcon (*Falco peregrinus*).
(Photo: Mícheál Casey)

AFBI and DAFM carry out surveillance on a range of wildlife species to detect the incursion of exotic diseases such as avian influenza. All wild bird samples tested negative for H5 and H7, high-pathogenic strains of avian influenza virus. One sample set, collected from a small group of lesser black-backed gulls (*Larus fuscus*), found dead on a Wexford beach, tested positive for H16N3, a low-pathogenic strain of avian influenza.

AFBI and DAFM also assist in carrying out investigations into suspected wildlife crimes, in association with the Partnership for Action against Wildlife Crime in Northern Ireland (PAW) and the

National Parks and Wildlife Service (NPWS) in the Republic of Ireland. Illegal poisoning and shooting are amongst the most common crimes investigated. X-ray, necropsy and toxicology testing all play an important role in these investigations. Samples collected at necropsy from a number of wildlife species were submitted to the State Laboratory for toxicology tests under the terms of a joint DAFM-NPWS-State Laboratory protocol. Traces of rodenticide poisons were detected in seven of the raptors sampled (three buzzards (*Buteo buteo*), one peregrine falcon (*Falco peregrinus*), one long-eared owl (*Asio otus*), one barn owl (*Tyto alba*) and one kestrel (*Falco tinninculus*). These rodenticide results were qualitative rather than quantitative so it was not possible to determine conclusively whether these toxicants had contributed to the death of the birds. Raptors can suffer from secondary poisoning when they consume poisoned rodents.

Carbofuran, an insecticide formerly used to spray on field crops, is banned in the European Union. It is potentially toxic to vertebrates, and to birds in particular. A buzzard found in a distressed state beside a dead rabbit in Wexford was submitted to Kilkenny laboratory for necropsy. A sample of the gizzard contents and liver tested positive for carbofuran. The rabbit was found to have died as a result of shotgun injuries and was considered to have been used as a bait to attract and poison the bird.

Alphachloralose is only licenced for control of mice. However, a buzzard submitted to Cork in January, and a group of starlings (*Sturnus vulgaris*) submitted to Athlone laboratory in September, tested positive for the poison. Of more serious conservation concern was the positive alphachloralose result in a White-tailed Sea Eagle (*Haliaeetus albicilla*), found dead on its nest in the Connemara area in April (Figure 85). It was a six-year-old female that had been released in Killarney in 2009 as part of the national re-introduction project. Lamb parts recovered from the crop and gizzard, as well as the bird's liver, tested positive for alphachloralose. It is likely that a dead lamb was laced with poison

and used as bait to attract the bird. The second white-tailed eagle that was examined during the year was a young chick. It had not been poisoned. Instead, it had died from starvation, the result of the stomach and oesophagus being obstructed by stiff flight feathers from a prey item consumed in a previous feed.



Figure 85: 6-year-old female White-tailed Sea Eagle (*Haliaeetus albicilla*) found dead in Connemara, County Galway. (Photo: Michael McManus)

Carnivores are similarly susceptible to secondary intoxication and a case of anticoagulant rodenticide intoxication was recorded in a juvenile red fox (*Vulpes vulpes*).

In some wildlife cases, deaths resulting directly or indirectly from shotgun injury were diagnosed during 2015. One example of this was the death of a 1½ year old female Hen Harrier (*Circus cyaneus*) in county Kerry. The bird was one of two sisters that the National Parks and Wildlife Service (NPWS) had been satellite tracking since fledging in mid 2013. The first sister (Sally) had died from starvation at just 72 days of age. Ireland has a higher Hen Harrier juvenile mortality rate than anywhere else in Europe, which is thought to be symptomatic of a poorer landscape for finding food. It is one of Ireland's most threatened species of wildlife as just one out of every six Hen Harriers in Ireland makes it through its first winter. There are currently only approximately 100 pairs remaining here. The second sister (Heather) defied the odds and was managing successfully, having travelled the length and breadth of the country, from Kerry to Wicklow,

Antrim to Cork and Dublin to Mayo. She visited virtually every county in Ireland. Heather became a star on the 'Hen Harrier Ireland' website, which was visited by over a quarter of a million people around the globe, including the local school children who had named Heather and Sally. However, having returned to the area of her birth, data from the satellite tracker showed that Heather's movements had stopped and that her body temperature had dropped to that of the environment. A search by a NPWS ranger led to the discovery of her carcass. Necropsy revealed that the bird was in excellent body condition and had fed a short time before death (Figure 86). There was a fractured right wing (radius and ulna) and three ribs, with haemorrhage from a ruptured liver. There was no evidence of any shotgun pellets either on necropsy or radiographic examination. However, an indentation on the right side of the satellite tag on the bird's back was suspicious and ballistic examination by the Gardaí concluded that a shotgun pellet had more than likely caused the damage (Figure 87).



Figure 86: Hen Harrier (*Circus cyaneus*) with satellite tracker found dead in County Kerry. (Photo: Alan Johnson)



Figure 87: Damaged satellite tracking device (arrows) removed from the Hen Harrier. (Photo: Alan Johnson)

ECHINOCOCCUS SURVEILLANCE OF WILD FOXES

Echinococcus multilocularis, the alveolar hydatid tapeworm, also called the small fox tapeworm, is a tapeworm parasite that has dogs and other canids (red foxes, wolves, coyotes, etc.) and occasionally cats as final hosts, and several rodent species (mice, rats, voles, shrews, etc.) as intermediate hosts. For the final hosts, *Echinococcus multilocularis* infections are mostly benign, without clinical signs. Humans can become infected as intermediate or dead-end hosts by accidentally swallowing eggs of the parasite. Infection can cause a potentially fatal condition called alveolar echinococcosis, one of the most important zoonotic diseases globally. Alveolar echinococcosis is mainly seen in northern hemisphere countries and although human infection may be considered rare in comparison to some other zoonotic diseases, there are an estimated 0.3 to 0.5 million cases per annum.

As Ireland is considered to be free from *E. multilocularis* it is a requirement under the EU pet travel scheme (PETS) that all dogs entering the country are given an anthelmintic treatment effective against *Echinococcus* spp. prior to entry. Ireland must provide scientific evidence to the EU of Ireland's *Echinococcus multilocularis* free status, by annually carrying out surveillance of the wild fox population to detect a prevalence of *E. multilocularis* of 1% at a confidence level of 0.95.

In 2015, the intestinal contents of 742 foxes (344 by AFBI and 398 by DAFM) were examined using either PCR (DAFM) or the sedimentation and counting technique (AFBI). All were negative for *Echinococcus multilocularis*.

Anthelmintic Resistance

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BACKWESTON.

INTRODUCTION

Anthelmintic resistance (AR) is said to exist when parasitic nematodes survive a normally effective dose of an anthelmintic. As this is a heritable trait, this ability to withstand treatment is passed onto the next generation of nematodes. The nematode genes that code for resistance to anthelmintics appear to exist in all parasitic worm populations, and as a result cases of AR begin to appear within a few years of a new anthelmintic being introduced on to the market.

Anthelmintic resistance is common in small ruminant nematode populations worldwide and is mainly due to either the highly fecund *Haemonchus contortus* or *Teladorsagia circumcincta*. The associated economic costs of AR in sheep production systems can be considerable. It has been estimated that costs can amount to ten *per cent* of the market price per lamb sold.

In Ireland, cases of AR among small ruminant nematode populations have been known to occur for some time. In contrast, AR in cattle nematode populations was first detected in Ireland in 2014. The size of the *refugia*-based population is the main reason why AR occurs less frequently in cattle than in sheep. *Refugia* refers to that portion of the nematode population not exposed to treatment. This can include unexposed nematode eggs and larval stages (L₁, L₂ and L₃) on pasture, as well as nematodes in untreated cattle. The greater anthelmintic treatment frequency in sheep is another factor that might explain the difference between the two species. The greater use of anthelmintics in sheep is likely to represent recognition of the fact that sheep are more susceptible to nematode challenge compared to

cattle. Other reasons for fewer reports in cattle may include the shorter survival time of some cattle nematodes and the fewer number of studies that have been undertaken to detect AR in cattle nematode populations. A further consideration that may explain differences between the two species is the size of the faecal pat. The larger bovine faecal pat may confer a longer environmental survival advantage to susceptible bovine nematodes thus increasing the size of the population in *refugia*.

Cases of AR in cattle most commonly involve *Cooperia* species showing resistance to macrocyclic lactone (ML) anthelmintics (ivermectin etc.). Indeed, the first Irish report of AR in cattle nematodes was of *Cooperia* resistance to ivermectin. As *Cooperia* are regarded as the dose-limiting genus for these ML anthelmintics, resistance of this genus to anthelmintics such as ivermectin is always likely to develop. Given that ML anthelmintics achieve higher concentrations in abomasal mucosa compared to the intestinal mucosa, this may further help to explain the poorer efficacy of this anthelmintic class against intestinal-dwelling parasites such as *Cooperia*. Nonetheless, ML anthelmintics are popular with producers, both beef and dairy, and their continued use as the anthelmintic class of choice in many cattle-producing countries only serves to hasten the development of AR to them. Their popularity may be explained by both their ease of use and their persistent action against the common gastrointestinal nematodes such as *Ostertagia ostertagi* and *Cooperia oncophora*.

FACTORS LEADING TO THE DEVELOPMENT OF ANTHELMINTIC RESISTANCE

A number of management practices actively contribute to the development of AR. Chief among these are the over-use of anthelmintics, the practice of under-dosing, the speed of re-infection after dosing, the size of the *in-refugia* population and the purchase of animals carrying resistant nematodes. With regard to anthelmintic use, the greater the frequency of treatment the greater the selection pressure for these resistant nematodes.

Under-dosing allows the survival of partially resistant nematodes (heterozygous resistant) that would normally be killed at the correct dosage rate. Under-dosing can result from inaccurately estimating animal live weight, use of faulty equipment or poor dosing technique such as placing the dose of oral anthelmintics into the mouth as opposed to over the back of the tongue.

The speed with which animals are re-infected after dosing can potentially be influenced by many factors. These include the degree of pasture contamination that animals experience after dosing, the type of dose given (long or short-acting) or if the animal is relatively resistant to re-infection. With this in mind, one traditional dosing practice is now regarded as highly selective for AR. This is the 'dose and move' system whereby animals are treated and moved straightaway onto clean aftergrass. In such a situation, the only nematodes to survive treatment will be resistant, ultimately resulting in the 'clean' pasture being contaminated with eggs from these resistant nematodes.

The size of the *in-refugia* population can be affected by treatment frequency, but also by other factors such as weather conditions. Although this is not commonly the case in Ireland, when using anthelmintics, account should be taken of the environmental conditions as this can lead to an increase in the rate at which AR develops. In periods where rainfall is minimal, the size of the free-living population is expected to be small. Therefore, any anthelmintic treatments during this period will also encourage the development of resistance.

Purchasing livestock can inadvertently result in the introduction of resistant nematodes onto a farm. Thus, farmers need to be made aware of this and also on how best to combat this potential risk.

TESTING FOR THE PRESENCE OF ANTHELMINTIC RESISTANCE

One way to test for the presence of AR on a farm is to conduct a drench test. A number of animals,

typically ten or more, which have been treated with an anthelmintic, are sampled post-treatment to determine their faecal egg counts. The interval between treatment with the anthelmintic and the day of sampling is dependent on the anthelmintic used (7 days for levamisole and 14 days later if a benzimidazole or ML is used). The test can be further improved by also sampling animals on the day of treatment to determine their faecal egg counts. This test will only give an indication of how effective the anthelmintic treatment is and cannot be used to definitively state that resistance is present. A more formal approach to testing is to conduct a faecal egg count reduction test where multiple anthelmintic classes are tested together.

PRACTICES TO REDUCE THE THREAT OF RESISTANCE DEVELOPING

As a starting point, there needs to be regular contact between the farmer and his/her vet on how best to achieve this goal. A farm-specific plan needs to be drafted and subject to regular review, given the numerous factors that determine the level of parasitism in cattle and sheep at pasture from season to season.

Aside from the regular veterinary input, there is a clear need to establish whether the products that are currently used on the farm are effective. This can be done by conducting a drench test or a faecal egg count reduction test to give an indication of anthelmintic efficacy.

The farm should have a dosing strategy for purchased livestock. The choice of products used is important as it must be effective against both susceptible and resistant nematodes. Purchased stock should then be held off pasture for 48 hours after treatment so as to allow any nematode eggs produced before the treatment to be shed before moving onto pasture. After this, these animals should be turned out onto contaminated pasture.

It is very important to ensure that all dosing equipment is working correctly. With regard to the

volume of dose administered, it is important to dose according to the heaviest animal in the group. However, in situations where there are significant differences in live weights between animals within the group, such that some animals might receive twice the recommended dose, farmers should split the animals into two or more groups and dose according to the heaviest in each category.

There should be a conscious effort to avoid the overuse of anthelmintics and to treat only when necessary. The decision to treat, where possible, should be based on a number of indicators such as faecal egg counts or live weight gain. These indicators for treatment should be regularly monitored and be used as aids to decide when treatment is necessary.

It must be borne in mind when deciding to dose that not all animals in a group may warrant treatment. For example, consider only dosing the young or ill-thrifty ewes pre-tupping as opposed to the entire group. In cattle, the same is also true as animals with the best live weight gains can potentially be left untreated. However, two potential exceptions to this should be noted. If some of these better performing cattle have high faecal egg counts, i.e. they are resilient; it may be potentially beneficial to the group to treat them as they will be adding significantly to pasture contamination levels. Secondly, in situations where there is an outbreak of dictyocaulosis, treatment is warranted for all animals in the group.

Grazing management strategies can be used on farms to potentially reduce the number of anthelmintic treatments needed. This is especially the case in farms that are not overstocked. Young stock can be grazed on pasture previously grazed by adults (as opposed to by other young stock). This should allow for exposure to nematode challenge to encourage a buildup of immunity whilst reducing the risk of clinical disease. Nonetheless, monitoring of animal performance and faecal egg counts should be conducted periodically.

Anthelmintic Treatment Failure on Irish Sheep Farms

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This research was carried out as a collaborative project involving Animal & Bioscience Department, Teagasc, Kilkenny Regional Veterinary Laboratory, Central *Veterinary Research* Laboratory, Backweston and the School of Veterinary Medicine, University College Dublin.

Between 2013 and 2015 the Irish Department of Agriculture Food and the Marine (DAFM), managed a sheep technology adoption programme (STAP). Participants in the programme had the option to test the efficacy of their anthelmintic treatment by means of a drench test. In order to conduct the test, between 15 and 20 lambs were placed in a clean pen and left for a period of time to allow them to defecate. A minimum of 10 fresh faecal deposits (representing different lambs) were collected and each placed in a separate container. The lambs were dosed with an anthelmintic product of the farmer's choice from the Benzimidazoles (1-BZ), Levamisole (2-LV) or Macrocylic Lactones (3-ML) classes of anthelmintic. It was advised to weigh the three largest lambs in the group being tested and treat to the weight of the heaviest lamb in accordance with the manufacturer's recommendations. Ten fresh faecal samples were collected in a similar way from the same group of lambs post-treatment. Samples were sent to DAFM approved laboratories where a composite faecal sample was generated for each group of lambs pre and post anthelmintic treatment and the eggs/gram determined in the composite sample. The timings of the post treatment samples were based on the product used — 4-7 days if a 2-LV product was used, 10-14 days post-treatment if a 1-BZ product was used or 14-18 days post treatment if a 3-ML product was used.

Of the 1434 drench tests that fulfilled the criteria for establishing treatment efficacy ie had an initial

composite trichostrongyle faecal egg counts >200 epg, only 51% of treatments were effective i.e. the post-treatment faecal trichostrongyle egg count (FEC) was reduced by more than 95%. As anthelmintic resistance is less frequently reported for moxidectin (MOX) than for avermectins (AVM), the 3-ML products were split into AVM and MOX containing products. MOX was the most effective anthelmintic overall resulting in a greater than 95% reduction in trichostrongyle FEC in 84% of cases. This was followed by AVM which was effective in 62.5% of cases. Treatments with 2-LV were effective in 51.9% of drench tests. Despite being the most common anthelmintic class used by sheep producers, 1-BZ treatments were found to be effective in only 31.5% of cases. Additionally, over 10% of 1-BZ treatments administered each year resulted in no reduction in egg count.

The efficacy of treatment against *Nematodirus* spp. could be established for 338 drench tests, and an overall efficacy of anthelmintic treatment of 96% was observed. Due to the significant difference between the efficacies of the anthelmintic classes against trichostrongyles in addition to the high level of efficacy against *Nematodirus* spp., a genus for which anthelmintic resistance is rarely reported, it is likely that anthelmintic resistance is responsible for the majority of anthelmintic treatment failures observed.

There were 26% of samples where the pre-treatment trichostrongyle egg count was < 200 epg and these flocks could be considered to have low levels of parasitism at sampling. If treatments of these flocks were delayed it would have had a negligible impact on productivity considering the low FEC.

In a previous survey of Irish sheep producers, 86% reported treating their animals according to a set program (Patten et al., 2011). This practice may explain the relatively high number of treatments being conducted on minimally parasitized animals and reflects a departure from best practice for

gastrointestinal nematodes management, as well as a waste of money spent on unnecessary treatments.

Given the high level of treatment failure, it is imperative that sheep producers know what products are effective on their holdings and become aware of the improvements and adaptations that need to be made to their worm control strategies in order to decrease the selective pressure leading to the development of anthelmintic resistance.

References

Patten, T., Good, B., Hanrahan, J.P., Mulcahy, G., de Waal, T., 2011. Gastrointestinal nematode control practices on lowland sheep farms in Ireland with reference to selection for anthelmintic resistance. *Ir. Vet. J.* 64, 4. doi:10.1186/2046-0481-64-4.

Antimicrobial Resistance (AMR) in 2015

Ireland

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The World Health Organisation defines AMR as ‘resistance of a microorganism to an antimicrobial drug that was originally effective for treatment of infections caused by it’. Although AMR also refers to resistance to drugs designed to treat diseases like HIV, Malaria and fungal infections like *Candida* spp, in the context of Irish agriculture, AMR is broadly synonymous with antibiotic resistance.

Antimicrobial resistance has been known for some time but in recent years it has assumed greater media and public attention both from the human and animal treatment standpoints. The occurrence of AMR amongst bacteria is believed to be hastened by the overuse and misuse of antibiotics, and by poor infection control practices which increases dependence on antibiotics. The emergence and detection of so-called ‘superbugs’: resistant strains such as vancomycin-resistant *Staphylococcus aureus* (VISA) or *Klebsiella pneumoniae* carbapenemase (KPC) have sharpened the public focus on the appropriate use of antibiotics in the fields of medicine and veterinary medicine.

In the DAFM regional veterinary laboratories, in 2015, the vast majority of bacteria on which antimicrobial sensitivity testing was performed came from samples taken from cattle (Figure 88).

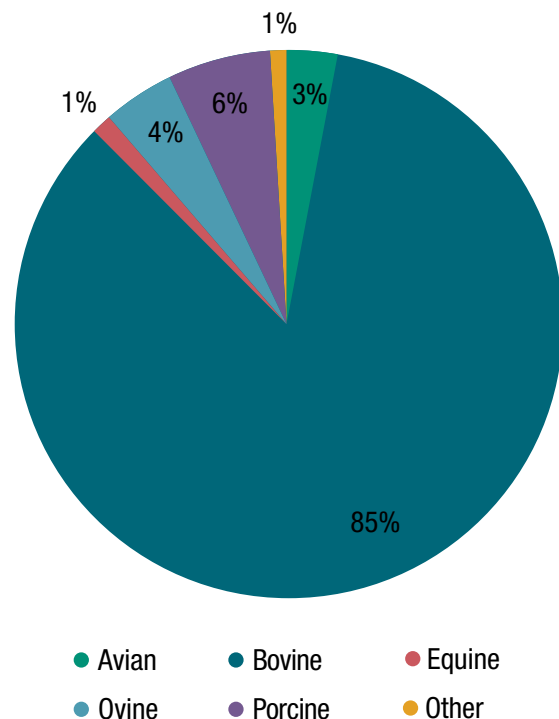


Figure 88: The proportions of antimicrobial testing performed on isolates originating from the various domestic animal species by DAFM in 2015 (n=1594).

AFBI and DAFM carry out antimicrobial sensitivity testing according to the relevant OIE Laboratory methodologies. Within the DAFM Veterinary Laboratory Service, particular attention is paid to a number of bacterial species, considered to be important disease-causing pathogens, and their resistance patterns. These bacteria include *Staphylococcus aureus*, *Streptococcus uberis*, *Pasteurella multocida*, *Mannheimia haemolytica*, *Salmonella* Typhimurium, *Salmonella* Dublin and bacteria showing evidence of extended spectrum beta-lactamase (ESBL). Table 14 lists some of the criteria used to identify suspect bacterial isolates for further antimicrobial resistance testing. A similar methodology is used in AFBI in Northern Ireland.

Bacterial Species	Criteria used to identify isolates for further examination	No. of DAFM isolates identified in 2015
<i>Staphylococcus aureus</i>	Any isolate resistant to ceftiofur	1
<i>Streptococcus uberis</i>	Any isolate resistant to penicillin	2
<i>Pasteurella multocida</i>	Any isolate resistant to enrofloxacin, ceftiofur, tilmicosin or tulathromycin	0
<i>Mannheimia haemolytica</i>	Any isolate resistant to enrofloxacin, ceftiofur, tilmicosin or tulathromycin	2
<i>Salmonella</i> Typhimurium	All isolates	5
<i>Salmonella</i> Dublin	Isolates showing resistance to any antibiotic within the panel	1
Extended spectrum beta-lactamase (ESBL)	Enterobacteriaceae showing resistance to ceftiofur	9

Table 14: The criteria used to flag isolates for further antimicrobial resistance testing, and the number of isolates flagged in 2015.

STAPHYLOCOCCUS AUREUS

One isolate from a bovine milk sample was resistant to ceftiofur, and on further testing, was found to be positive for the *mecA* gene, confirming methicillin-resistant *Staphylococcus aureus* (MRSA) status. The *mecA* gene confers resistance to β -lactam antibiotics as it encodes one of the penicillin-binding proteins.

PASTEURELLA MULTOCIDA / MANNHEIMIA HAEMOLYTICA

No *Pasteurella multocida* isolate of concern was isolated during 2015. There were two *Mannheimia haemolytica* isolates that were resistant to enrofloxacin. Both of these isolates were cultured from samples collected from calves at *post mortem* examination. The first calf, one of a batch of four, had died of severe pneumonia and had been co-infected with *Mycoplasma bovis*. All of the

three other calves in the group had been infected with BVDV. In the other highlighted case, also a calf, pneumonia was also diagnosed. The isolate from that case also showed resistance to other antimicrobials, including tilmicosin.

SALMONELLA TYPHIMURIUM

Five isolates of *Salmonella* Typhimurium were identified. Two isolates were from a single pig farm, of which one of the isolates was confirmed as the potentially zoonotic DT104 serotype. The remaining three isolates were bovine in origin and were all classified as phage type "untypeable". One of the porcine isolates was resistant to amoxicillin clavulanate.

EXTENDED SPECTRUM β -LACTAMASE (ESBL) BACTERIA

Nine *Escherichia coli* isolates of concern were identified. Five of these were from bovine milk samples. Of the remaining four, two were from cattle (one from a faecal sample and one from a persistent skin wound), and two were from poultry.

Northern Ireland

ANGELA LAHUERTA-MARIN, AFBI STORMONT.

The following outlines the AMR test characteristics of *E. coli*, *Staphylococcus aureus* and *Streptococcus uberis* isolates from passive surveillance in livestock populations in Northern Ireland

ESCHERICHIA COLI

Background

Escherichia coli isolates are not collected routinely from healthy livestock in Northern Ireland. Only clinical cases submitted for post-mortem investigation of colibacillosis, or similar diseases, will proceed to the isolation of pathogenic *E. coli*. AMR testing on *E. coli* isolates are mainly performed if samples are coming from calves less than two weeks old and cattle with mastitis.

Methodology

A CLSI method is used for testing and interpreting zones of inhibition. Different panels of antimicrobials are used depending of the livestock species from which *E. coli* has been isolated.

Data limitations

Please note that data provided on pathogenic *E. coli* from Northern Ireland for 2015 correspond to isolates and not individual animals. In fact, several colonies may have been taken from an individual animal sample/s.

STAPHYLOCOCCUS AUREUS**Background**

Staphylococcus aureus isolates are not collected from healthy livestock in Northern Ireland. Only samples from clinical disease in highly susceptible animal species e.g. pigs or horses submitted for post-mortem investigation will be processed. In addition, microbiological isolation of *Staphylococcus aureus* would also be indicated from milk samples from environmental mastitis from cattle submitted for investigation. This work is carried out by veterinary pathologists and microbiologists based at the Disease Surveillance and investigation Branch of AFBI (DSIB).

Methodology

A CLSI method is used for testing and interpreting zones of inhibition. Colonies are tested to a panel of 18 antimicrobials.

STREPTOCOCCUS UBERIS**Background**

Streptococcus uberis isolates are not routinely collected from healthy cattle in Northern Ireland. Only milk samples from suspect mastitis cases submitted by PVP's are routinely tested for the presence of *Streptococcus uberis*. As *Streptococcus uberis* can also be a commensal organism in milk samples its presence does not necessarily give rise to mastitis. In milk samples

from which three or more different bacteria are isolated then the *Streptococcus uberis* would be considered a commensal organism and AMR testing would not be carried out. All other *Streptococcus uberis* isolates from milk samples undergo AMR testing. This work is carried out by veterinary pathologists and microbiologists based at the Disease Surveillance and Investigation Branch of AFBI (DSIB).

Methodology

Streptococcus uberis isolates are tested according to CLSI guidelines against a panel of 18 antibiotics of veterinary and surveillance interest.

References

1. OIE Manual of diagnostic tests and vaccines for terrestrial animals 2015. Volume 2 Part 3 Guideline 3.1 Laboratory methodologies for bacterial antimicrobial susceptibility testing.
2. CLSI Performance standards for antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals. VET01-A4. Fourth edition July 2013.
3. CLSI Performance standards for antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals. VET01-S2. Second informational supplement July 2013.

LA-MRSA CONFIRMED CASE IN NORTHERN IRELAND 2015

In 2015, there were a total of 168 isolates of *Staphylococcus aureus* from different animal species, which had an antibiogram profile test performed to a 11-antimicrobial panel. LA-MRSA (livestock associated methicillin resistant *Staphylococcus aureus*) was isolated from three different post-mortem submissions and one clinical sample (milk) to the disease surveillance and investigation facility in AFBI. Pigs were the main species from which the pathogen was isolated (n=3) plus a case detected in a mastitic cow.

Further molecular characterisation of LA-MRSA strains showed the LA-MRSA CC398 spa type 034 was the predominant strain as it was detected in three out of four of the cases and in the 2014 case.

A second strain LA-MRSA CC30 was isolated from the remaining case from pigs. Molecular typing showed that this strain was an animal associated clone of *Staphylococcus aureus* with a specific virulence marker, lukM[1]. This was the first time that LA-MRSA CC30 was detected in the UK.

References

1. Lahuerta-Marin A, Guelbenzu-Gonzalo M, Pichon B, Allen A, Doumith M, Lavery JF, Watson C, Teale CJ, Kearns AM. (2016) First report of lukM-positive livestock-associated methicillin-resistant *Staphylococcus aureus* CC30 from fattening pigs in Northern Ireland. *Vet Microbiol* 182:131-134.

	Bovine milk n=145
Ampicillin	32
Erythromycin	30
Trimethoprim/ Sulphonamides	27
Tetracycline	50
Cefoxitin	19

Table 15: Antimicrobial susceptibility of *Streptococcus uberis* isolates from bovine milk submissions to AFBI laboratories during 2015 showing the total percentage of non-sensitive isolates.

	All species, all samples n=1210	Bovine milk n=222	Bovine enteric n=634
Ampicillin	73	37	88
Erythromycin	100		100
Streptomycin	100	100	
Trimethoprim/ Sulphonamides	54	13	70
Tetracycline	68	23	84

Table 16: Antimicrobial susceptibility of *Escherichia coli* isolates from all samples, bovine milk and bovine enteric submissions to AFBI laboratories during 2015 showing the total percentage of non-sensitive isolates.

	All species, all samples n=165	Bovine milk n=93	Bovine all other samples n= 19
Ampicillin	55	49	25
Erythromycin	16	10	29
Trimethoprim/ Sulphonamides	2	1	0
Tetracycline	27	8	12
Cefoxitin	7	3	0

Table 17: Antimicrobial susceptibility of *Staphylococcus aureus* isolates from all species, all samples, bovine milk and bovine all other submissions to AFBI laboratories during 2015 showing the total percentage of non-sensitive isolates.

Zoonoses

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Introduction

Zoonotic diseases are defined by the World Health Organisation (WHO) as “a group of infectious diseases that are naturally transmitted between vertebrate animals and humans”. The greatest risk for zoonotic disease transmission occurs at the human-animal interface through direct or indirect human exposure to animals, their products and/or their environments. More than 60 *per cent* of the newly identified infectious agents that have affected people over the past few decades have been caused by pathogens originating from animals or animal products. The emergence of zoonotic disease is complex and multifactorial, driven by factors which include evolving ecology, microbial adaptation, human demographics and behaviour, international travel and trade, agricultural practices, technology and industry. As a result, the agriculture industry is at the forefront of zoonotic threat and therefore must remain vigilant at all times to prevent the spread and perpetuation of these diseases.

“How well informed are animal keepers on zoonotic diseases and their transmission?” is a frequently asked question. Attempting to answer this the South Eastern Zoonoses committee conducted a survey of farmers examining their knowledge of zoonoses and infection prevention practices. This was carried out across all the regional veterinary laboratories in 2015. The main findings were:

- Only 30% of farmers knew what a zoonosis was.
- There were high levels of awareness that pregnant women should not help birthing animals and that aborting animals are a source of infection.

BUT

- There wasn't the same level of awareness that non-birthing animals are also possible sources of infection to pregnant women.
- Younger farmers were more likely to identify sources of infection on the farm.

BUT

- Older farmers were more likely to wash their hands after handling sick animals and before eating and drinking on the farm.
- 60% of farmers have a private well water supply to their homes and one third of those with a private water supply get their water tested annually.
- 40% of dairy farmers drink unpasteurised milk at least once a week.

During 2015, DAFM and AFBI laboratories isolated and positively identified a number of zoonotic agents in the course of disease diagnostics. A few of the most common and unusual diseases are discussed in this section.

LEPTOSPIROSIS

AFBI carry out fluorescent antibody tests (FAT) on tissue and in 2015 four *per cent* of the bovine (n=493) and ovine (n=292) samples were positive. Smaller numbers of samples were tested from other species but none were positive. In DAFM laboratories there were 154 bovine samples tested using RT PCR and 12 (7.8%) were positive. In addition 12 ovine samples were tested by RT PCR and 1 (8.3%) was positive. *Leptospira* FATs are not carried out in DAFM laboratories. There were 7997 *Leptospira hardjo* antibody ELISA's carried out on serum of which 425 (5.3%) were inconclusive and 3497 (43.7%) were positive. This organism has become endemic and is frequently challenging the cattle population. Spillover to humans in close contact is a constant threat.

CAMPYLOBACTERIOSIS

During 2015, DAFM isolated *Campylobacter jejuni* in 175 bovine herds, including one isolate from foetal stomach contents. It was also isolated in 12 ovine flocks and in two poultry flocks.

In AFBI laboratories most campylobacter isolates were recovered from aborted ovine fetuses (Table 18).

Type	Ovine	Bovine	Porcine	Caprine	Canine
<i>C. fetus fetus</i>	5	0	0	0	0
<i>C. jejuni</i>	4	0	2	0	0
<i>C. laridis</i>	1	0	0	0	0

Table 18: The AFBI detected campylobacter isolates during 2015.

Campylobacteriosis due to *Campylobacter jejuni* is mostly asymptomatic in animals but it can cause gastrointestinal symptoms in humans. Campylobacteriosis is recognised as the most common cause of food-borne gastroenteritis worldwide. Asymptomatic carriers can shed the organism in their faeces for prolonged periods of time, contaminating food and water. As is the case with most intestinal pathogens, the main routes of infection are faecal-oral and through ingestion of contaminated food and water. *Campylobacter jejuni* can cause diarrhoea in young animals. In calves, signs vary from mild to moderate. Isolation of *C. jejuni* from diarrhoeic faeces is not, in itself, an indication for antibiotic therapy, but an indication of a zoonotic risk to anyone regularly handling such animal.

Campylobacteriosis in humans is typically characterised by abdominal pain, fever and diarrhoea. Symptoms last between 24 hours and one week; the disease is usually self-limiting.

CRYPTOSPORIDIOSIS

During 2015, DAFM detected *Cryptosporidium spp.* in 393 bovine herds and 18 ovine flocks

There were 32.5 *per cent* of bovine samples (n=1263) and 19.4 *per cent* of ovine samples (n=98) positive for cryptosporidia in AFBI laboratories.

Cryptosporidia are parasitic protozoal organisms found in the intestine of mammals worldwide. *Cryptosporidium spp.* are found primarily in neonatal calves but it is also present in lambs, kids, foals and piglets. Many reports associate infection in calves with diarrhoea occurring at 5 to 15 days of age. *Cryptosporidium spp.* is also a common enteric pathogen in young lambs and kids.

In humans, *Cryptosporidium spp.* is a relatively common non-viral cause of self-limiting diarrhoea, particularly in children and the elderly. Clinical manifestations vary from asymptomatic to watery diarrhoea, stomach cramps and a mild fever. Symptoms can appear 2-10 days post-infection and last approximately two weeks. Infection is predominantly transmitted from person to person, although direct infection from animals, and indirect, waterborne infection from contamination of surface and drinking water by faeces of domestic and wild animals, can also be important.

GIARDIASIS

In 2015 DAFM found positive Giardia faecal samples in six bovine herds and one ovine flock. Giardiasis is an intestinal infection caused by a protozoon that affects mammals and birds worldwide. *Giardia duodenalis* (also known as *G. intestinalis* and *G. lamblia*) is the species most associated with domestic animals and humans. Giardia has no intracellular stage. Flagellated protozoa (trophozoites) attach to the mucosa of the small intestine; trophozoites then form cysts within the mucosa and these cysts are excreted in faeces. Excretion is often intermittent. Direct (contact with infected host) or indirect (contaminated environment) faecal-oral route is the most common

transmission method. *Giardia* cysts are infectious immediately after excretion, are resistant to environment and are helped by high humidity. Infection is facilitated by large numbers of cysts excreted and the low dose needed for infection. The pre-patent period is 3-10 days. *Giardia* causes a malabsorptive diarrhoea, which is non responsive to antibiotics or coccidiostats and the faeces can be pasty. Experimental infection of goat kids, lambs, and calves resulted in a decreased feed efficiency and, subsequently, a decreased weight gain.

LISTERIOSIS

Listeria monocytogenes was isolated on 83 occasions in 77 bovine herds in DAFM Laboratories, mainly from cultures of foetal fluids. It was also isolated from a neonatal calf and from carcasses from three different bovine herds. In ovines *Listeria monocytogenes* was isolated from six carcasses, four of which were foetuses. In one flock, it was identified as causing septicaemia in lambs. *Listeria ivanovii* was isolated on four occasions – two each from bovine and ovine foetuses. In AFBI laboratories there were 22 isolates of *Listeria monocytogenes* from ovines and 12 from bovines. In addition *Listeria ivanovii* was isolated from two ovine samples.

Listeriosis is a sporadic bacterial infection that affects humans and a wide range of animals. One of the most pathogenic species is *Listeria monocytogenes*. The natural reservoirs of *L. monocytogenes* are soil and the mammalian intestinal tract, which contaminates the environment.

In adult ruminants, encephalitis and meningoencephalitis are the most common forms of listeriosis. Aborted foetuses and necropsy of septicaemic animals present the greatest infection risks to handlers; there are reported cases of fatal meningitis, septicaemias and papular exanthema on arms after handling infected aborted material. Pregnant women should be protected from infection due to the danger to the foetus, and

the possibility of abortion, stillbirth and neonatal infection. While human listeriosis is rare, mortality can reach 50 *per cent*, particularly among the elderly, the immunocompromised and pregnant women.

Q FEVER

During 2015, eight bovine herds tested by DAFM had positive serological samples. There were no ovine abortions reported by AFBI in 2015.

Coxiella burnetti is the aetiological agent of Q fever, a zoonotic bacterial infection associated, primarily, with parturient ruminants. Infection is usually subclinical, although it can cause infertility and sporadic abortions (necrotising placentitis). The greatest risk of infection occurs at parturition by inhalation, ingestion or direct contact with birth fluids or placenta. *Coxiella burnetti* is also shed in milk, urine and faeces. Ticks may also transmit the disease among ruminants; there is no evidence that ticks can transmit the disease to humans.

In humans, the majority of outbreaks have been associated with wind dispersal of contaminated, desiccated, reproductive materials. Clinical presentation of Q fever in humans can range from a self-limiting influenza-like illness to pneumonia, hepatitis and endocarditis.

SALMONELLOSIS

Salmonellosis is caused by many species of *Salmonella*. Clinically it is characterised by one or more of three major syndromes; septicaemia, acute enteritis and chronic enteritis. Young animals usually develop the septicaemic form, adult animals commonly develop acute enteritis, and chronic enteritis is more often seen in growing pigs and, occasionally, cattle. Pregnant animals may abort. Asymptomatic carriers are a zoonotic risk in all host species. The most common pathogenic species are *S. Dublin* and *S. Typhimurium*.

The importance and incidence of *Salmonella spp.* in abortions has been discussed in other sections

of this report, see bovine and ovine abortions. In humans, the incidence of salmonellosis has increased in recent years. Transmission occurs via contaminated water and foodstuffs such as poultry and eggs which are a significant source of infection. Symptoms tend to be more severe in the very young, the elderly and those immunocompromised.

In samples, other than foetuses, submitted to DAFM laboratories during 2015, *Salmonella* spp. was isolated in 142 bovine herds, 11 ovine flocks, nine herds of pigs and one poultry flock. *Salmonella* spp. isolated by AFBI laboratories are outlined in Table 19.

Type	Ovine	Bovine	Porcine	Avian
<i>S. Bredeney</i>	0	1	0	0
<i>S. Choleraesuis</i>	0	0	1	0
<i>S. Derby</i>	0	0	1	0
<i>S. diarizonae</i>	6	0	0	0
<i>S. Dublin</i>	8	74	1	0
<i>S. Enteritidis vaccine strain</i>	0	0	0	3
<i>S. Enteritidis</i>	0	1	0	0
<i>S. Kentucky</i>	0	0	1	0
<i>S. Kottbus</i>	0	1	0	0
<i>S. Montevideo</i>	0	3	0	0
<i>S. Newport</i>	0	1	0	0
<i>S. Typhimurium</i>	0	6	8	2
<i>S. Typhimurium monophasic</i>	0	1	7	0
<i>Salm. spp</i>	4	5	1	0

Table 19: The number of isolates of *Salmonella* spp detected by AFBI laboratories.

TOXOPLASMOSIS

During 2015, DAFM diagnosed toxoplasmosis as the cause of abortion in 58 ovine flocks and AFBI reported 51 ovine abortions due to *Toxoplasma* infection. *Toxoplasma gondii* is a protozoan parasite that infects humans and other warm-blooded animals, including sheep and goats. Members of the family Felidae are the only definitive hosts of *Toxoplasma gondii*; wild and domestic cats serve as the main reservoirs of infection. There are three infectious stages in toxoplasmosis; tachyzoites (rapidly multiplying forms), bradyzoites (in tissue cysts), and sporozoites (in oocysts). Toxoplasmosis can be transmitted by accidental ingestion of infectious oocysts in cat faeces, consumption of tissue cysts in undercooked infected meat, and by transplacental transfer of tachyzoites from mother to foetus. *Toxoplasma gondii* is a significant cause of foetal death and resorption, abortion, and stillbirth in ewes and goats; which are particularly at risk when moved late in pregnancy to areas heavily contaminated with cat faeces (e.g. barns). Toxoplasmosis is an important zoonosis and a major concern for people with immunodepression and pregnant women (tachyzoites can migrate across the placenta and cause birth defects). Infection of women with toxoplasmosis may occur by the methods outlined above or through contact with infected materials/fluids produced in ovine/caprine abortions.

ERYSIPELOTHRIX

Erysipelothrix rhusiopathiae was isolated from sheep (1), pigs (5) and avians (10) in AFBI laboratories.

Surveillance for epizootic disease (OIE-listed diseases)

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INTRODUCTION

The health status of animals on the island of Ireland benefits from our island status and the geographical buffer provided by Great Britain and Western Europe. However, there is a real and ongoing threat posed by OIE-listed diseases (formerly known as Class A diseases) which can spread rapidly, damage animal health and devastate trade and the agri-food sector. Globalisation has led to more frequent and longer distance movements of animals, animal products and people, while in many areas the international disease control situation has deteriorated.

Ireland and Northern Ireland carry out on-going surveillance for such diseases under a range of programs, each tailored to the specific risk factors relevant to the disease. These fulfill an essential role in providing evidence to our trade partners and stakeholders to substantiate our disease-free status and to provide the necessary confidence in our high animal health status. In addition, they form part of a critical early warning system which, in the event of an outbreak, would be a crucial factor in disease detection and control.

AVIAN INFLUENZA

No outbreaks of H5 or H7 avian influenza were detected in Ireland in 2015. 6,165 sera were screened for H5 and H7 antibodies using haemagglutination inhibition; a further 15,608 samples were tested for antibodies using the agar gel immunodiffusion (AGID) test. 892 samples were tested for avian influenza by PCR.

Low pathogenic H3N8 virus was detected in 11 month old Pekin ducks on a farm that had reported several ducks ill and standing on one leg. There were 7 deaths out of 1,000 egg-laying ducks and all 7 were submitted for *post mortem* examination. At *post mortem* examination, the ducks were in good condition but were dehydrated and had severe bilateral, ulcerative pododermatitis. Histopathological examination also revealed hepatic and intestinal amyloidosis. Amyloidosis may occur as a sequel to many chronic inflammatory diseases, and in this case, may have been secondary to the chronic pododermatitis. Investigation of the environmental conditions for predisposing factors of foot damage was recommended. The H3N8 virus probably had no role in the demise of these birds.

H16N3 virus was detected in a seagull; this was the first detection of this influenza sub-type in Ireland.

NEWCASTLE DISEASE (PARAMYXOVIRUS 1)

No cases of Newcastle disease were detected in Ireland in 2015. 458 samples were tested for this disease by PCR. One pigeon paramyxovirus (PPMV-1) was detected in a wild woodpigeon (*Columba livia*).

FOOT-AND-MOUTH DISEASE

Ireland had one foot-and-mouth disease suspect in 2015. A farmer sought veterinary attention for a calf which was salivating, lame and appeared unwell. A private veterinary practitioner examined the calf and came to the opinion that these signs were potentially consistent with foot-and-mouth disease (FMD). The practitioner contacted the local Regional Veterinary Office, and veterinary inspectors immediately took action, applying a restriction notice to the farm and initiating the Department's procedures for handling a suspected case of FMD. Shortly afterwards, a DAFM veterinary laboratory sampling team led by Kilkenny Regional Veterinary Laboratory staff went to the farm and examined the suspect calf and other farm stock. Diagnostic samples were taken and delivered

that night to the Central *Veterinary Research* Laboratory, Backweston, which hosts the Irish National Reference Laboratory for FMD. A team of laboratory staff worked overnight to conduct the necessary tests, and a negative result was reported early the following morning. The farmer was informed and the restriction notice lifted. Other potential infectious causes such as BVD and bluetongue were also tested for, with negative results. No final diagnosis was reached in this case, although chemical irritation by an unidentified substance could not be ruled out.

Northern Ireland had no FMD suspects in 2015.

BLUETONGUE DISEASE

In Ireland in 2015, 3,870 bovine sera (including 54 imports) were tested for Bluetongue virus (BTV) antibodies by ELISA; ten imports tested positive for antibodies; no active infection was detected. 166 samples were tested for BTV by PCR; 51 of these were imports and the rest general surveillance samples. All tested negative. In addition, 2,976 bulk tank milk samples were tested for BTV antibodies; all tested negative. Four deer and 13 sheep were also tested for BTV antibodies; all tested negative.

In Northern Ireland, 2,617 indigenous cattle were tested for the presence of Bluetongue virus antibody under the BT surveillance programme, all of which tested antibody negative. There were 177 imported cattle and nine sheep tested for the presence of BT virus antibody; 66 of the cattle and the nine sheep were also tested by PCR. There was no evidence of active BT infection detected. There was no BTV suspect case in either Ireland or Northern Ireland in 2015

ENZOOTIC BOVINE LEUCOSIS (EBL)

In Ireland, 1,569 serum samples were tested for antibodies to EBL in 2015; no cases were detected. 45 bovine tumours detected at slaughter or during *post mortem* examination were submitted for investigation by histopathology and PCR; no EBL virus was detected.

CLASSICAL SWINE FEVER (CSF)

In Ireland in 2015, 1,643 porcine serum samples were tested for CSF antibodies by ELISA, and 65 samples were tested by PCR for CSF viral genome. No cases of CSF were detected.

AFRICAN SWINE FEVER (ASF)

During 2015 in Ireland, 95 samples were tested for ASF virus by PCR and 2,601 serum samples were tested for antibodies to ASF by ELISA. No cases of ASF were detected.

Emerging and Re-emerging Diseases in 2015

WILLIAM FITZGERALD, DAFM RVL, LIMERICK.

INTRODUCTION

The island of Ireland has a natural maritime firewall against many infectious diseases of livestock that occur in the United Kingdom and in Europe. However the island as part of the EU must contend with an inflow of livestock from the United Kingdom and mainland Europe. As a result, the agricultural industry must maintain vigilance for diseases that occur in the UK and Europe and may be transported here with ease, be it by the movement of an infected animal, vector or contaminated fomite.

BSE

In Ireland, samples from 13 BSE suspects were examined in the National Reference Laboratory for TSE agents in 2015, 12 clinical suspects and one suspect from the active surveillance system detected on a dairy farm in Co. Louth. All clinical suspects were negative. The active surveillance suspect was confirmed in June 2015 as a case of classical BSE in a 2010-born Rottbund cow. The cow was part of a herd that had BSE in the early 2000s.

In line with normal protocols, the Department of Agriculture, Food and the Marine identified all animals potentially exposed to the BSE agent that caused this incident – those born and reared on the birth-farm one year either side of the birth date of the positive animal, and her progeny. They were slaughtered, tested and excluded from the human and animal feed chains.

An epidemiological investigation was undertaken which confirmed that:

- The confirmed case was an isolated case in a

single animal.

- All cohort and progeny animals were slaughtered, tested, disposed of and were negative for BSE.
- Both the dam and grand-dam of the infected animal tested negative for BSE at slaughter, and therefore vertical transmission was not considered to be a factor in this case.
- Whilst the grand-dam of the positive animal was imported, this is not of any significance in epidemiological terms.

The investigation has not identified anything to distinguish this case from the other cases of classical BSE that have been seen in Ireland or elsewhere. As a result of this information, the OIE have reassigned a 'controlled risk' status to Ireland.

In Northern Ireland in 2015 there were no clinical suspects or confirmed cases of BSE.

BESNOITIA

Bovine besnoitiosis, caused by the apicomplexan protozoan parasite *Besnoitia besnoiti*, was diagnosed in an Irish dairy herd in June 2015 and reported to the Department of Agriculture, Food & the Marine by the UCD Veterinary Hospital Herd Health Unit who were investigating skin lesions in dairy cows on a farm in Co. Tipperary. Histopathological examination of skin samples from a number of affected cows revealed changes consistent with cutaneous besnoitiosis with large numbers of cysts containing bradyzoites evident (Figure 89).

Besnoitia besnoiti is an obligate intracellular apicomplexan protozoan parasite. Cattle are considered to be an intermediate host and as yet the definitive host is unknown. This is the first diagnosis of besnoitiosis in Ireland. There are no known instances of the disease on the near continent and the source and route of infection remains under investigation. It is not a zoonosis.

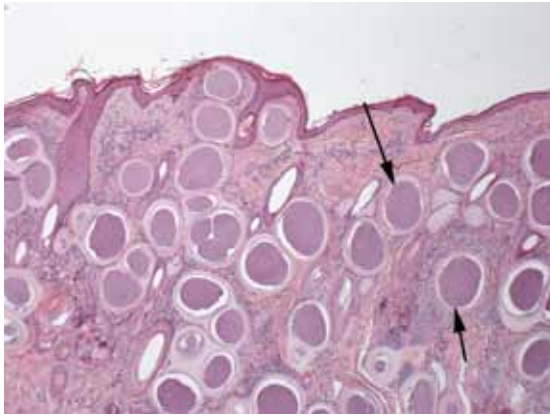


Figure 89: Photomicrograph illustrating large numbers of *Besnoitia besnoiti* cysts (black arrows) at all levels in the dermis. (Photograph courtesy of Eoin Ryan, UCD)

Mechanical transmission by bloodsucking arthropods, especially Tabanid flies (horse flies) and *Stomoxys* spp, and iatrogenically, by repeated use of hypodermic needles, are experimentally proven.

There is some epidemiological evidence of direct transmission between animals possibly via mucosal contact and it would appear that by the presence of cysts in the genital mucosa, transmission during natural mating is also distinctly possible. Recovered and subclinically infected animals are believed to carry the disease for life must be considered as a source of infection.

The disease is characterised by three different stages, as described in Table 20.

Stage of Disease	Days Post Infection	Characterised by
Acute	11-24	Fever, stiffness, milk drop, respiratory distress
Sub-Acute	24-34	First appearance of tissue cysts histological examination
Chronic	>34	Large tissue cysts >300µm on histological examination

Table 20: The stages of disease associated with Besnoitiosis and how they are characterised.

On an annual basis since 2011, some of the cows in the herd had exhibited clinical signs that included thickened skin, alopecia, weight loss, poor performance, pyrexia, limb oedema, milk drop and respiratory distress. All of these clinical signs have been described in cases of besnoitiosis. Other signs that have been associated with the disease are abortion, diarrhoea and sterility in bulls (due to orchitis). Grossly, sclerocysts (cysts on bulbar/scleral conjunctiva containing bradyzoites) can be seen in endemically infected herds and are a strong indicator of infection when found (Figure 90). Similar cysts occur under the vaginal mucosa of infected cows and heifers.

There is no treatment for infected animals nor is there any vaccine available. Control measures are limited due to the fact it can be spread by vectors. However, keeping a closed herd and maintaining control of biting flies are recommended



Figure 90: Sclerocysts (cysts on bulbar/scleral conjunctiva containing *Besnoitia besnoiti* bradyzoites) highlighted with blue arrows.

Bluetongue

DENISE MURPHY, DAFM RVL, ATHLONE.
WILLIAM FITZGERALD, DAFM RVL, LIMERICK.

Bluetongue disease is a non-contagious, insect-borne, viral disease of most domestic and wild ruminants including sheep, cattle, goats, deer, and antelope. It is caused by the bluetongue virus (BTV). The virus is mainly transmitted by vectors

(biting midges of the *Culicoides* species), although transplacental transmission has also been recorded in cattle in the case of serotype 8. The midges that spread infection are most active between April and November in Ireland and are commonly found around farms. BTV has never been recorded in Ireland, but recent events in northern Europe mean that there is the potential for this to happen.

There was large outbreak of BTV in France in 2015 with 148 confirmed detections of the virus and the outbreak has continued into 2016 (Figure 91). The virus has been identified as serotype 8 (BTV-8). BTV-8 caused an unprecedented disease epizootic in sheep and cattle in 2006 and 2007 starting in the Netherlands, Belgium, and Germany, and spreading to a total of 10 European countries. It was a new serotype in Europe having been previously been detected in sub-Saharan Africa. Cattle are less likely to show signs of the disease than sheep. In affected cattle herds in northern Europe, the average morbidity was 5% and mortality was less than 1%. In sheep flocks, the average morbidity was 30%, and mortality was 8%. The disease was more severe in the second season than in the first. Clinical signs (Figures 92 and 93) vary from peracute to chronic. In the initial stages there may be fever, oedema of the tongue, lips, face, eyelids, ears with hyperaemia of mucosa and skin (face, teats). A serous nasal discharge, salivation; lacrimation, lameness due to hyperaemia and oedema at the coronary band as well as erosive lesions of mucosa and muzzle can occur. In more chronic cases the following lesions may be seen — diphtheritic necrotising lesions of mucosa, muzzle, a mucopurulent oculonasal discharge, encrustation of the muzzle, cyanosis and protrusion of the tongue, secondary bacterial infections (pneumonia), anorexia, emaciation (muscle wasting), weakness and death.

In acute cases, pulmonary oedema and frothing at the mouth and nostrils may be seen prior to death in 8 to 10 days. Chronic cases may die in 3 to 5 weeks with secondary bacterial infections

or have a prolonged recovery. Mild cases may make a complete recovery. Differential diagnoses include foot-and-mouth disease, contagious ecthyma (orf), bovine viral diarrhoea, malignant catarrhal fever, infectious bovine rhinotracheitis and photosensitisation.

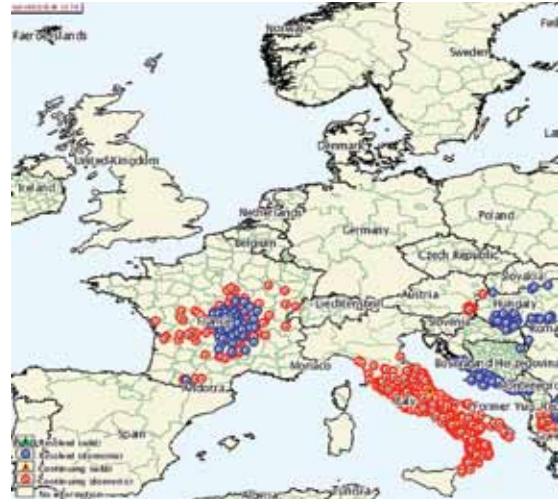


Figure 91. Bluetongue disease outbreak map July to December 2015. (Source: <http://www.oie.int>)



Figure 92: Cow with Bluetongue showing depression, conjunctivitis (red eyes), and nasal discharge. (Photo: Dutch Ministry of Agriculture, Nature, and Food Quality)

BTV could be introduced to Ireland by three possible routes. Firstly by importing an animal that is carrying the virus in its bloodstream. If this animal was bitten by the right species of midge and the environmental conditions were favourable, the midge could transmit infection to other animals. The second

potential route of introduction would be via infected midges blown to Ireland from another country such as France or the UK. Again the environmental conditions would have to favour survival of the midges and allow transmission. The least likely route of introduction is through the importation of infected semen or other biological products.



Figure 93: Sheep affected by clinical bluetongue showing crusting around the nostrils and nasal discharge, a swollen face and lips. (Photo: Arbovirology group, IAH Pirbright, UK)

There is both EU and Irish legislation to deal with the control of Bluetongue. Measures include the establishment of control, protection and surveillance zones around infected holdings, movement restrictions within and from these zones, the confinement of animals indoors during vector active periods, the control/eradication of the vector by destruction of habitats and use of insecticide, the slaughter of infected/suspected animals only where necessary to prevent spread of the disease with the destruction of carcasses, vector monitoring (light traps to capture flying insects) and vaccination.

The Department of Agriculture, Food and the Marine (DAFM), has a surveillance programme (both random and post-import testing), import control measures are in place and DAFM regularly updates its contingency arrangements and legislative basis for dealing with a potential outbreak. DAFM also continues to monitor any developments very carefully, particularly over the summer months. The Department also carries out regular risk

assessments on the risk of introduction and spread of BTV in Ireland.

Paratuberculosis

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MARIA GUEL BENZU, AFBI, STORMONT, BELFAST.

Johne's disease is caused by infection with *Mycobacterium avium* subsp. *paratuberculosis* (MAP) and is a notifiable disease, primarily of cattle, but can occur in sheep and goats. The clinical signs include chronic diarrhoea and weight loss. Most cattle acquire infection early in life, through the ingestion of colostrum or milk containing MAP, or by exposure to feed, water or environments contaminated by MAP. The disease is often introduced to a MAP-free herd through the purchase of an infected animal.

AFBI tested 176 cattle faecal samples in 2015, 22 (13%) tested positive for *Mycobacterium avium* subsp. *paratuberculosis* (MAP). 17524 blood samples were tested using ELISA for antibodies to MAP, many of these would have come from herds in the CHCS programme for Johnes eradication. 1841 (11%) of these were positive and 346 (2%) returned inconclusive results. 79 milk samples were tested using ELISA for antibodies of which 11 were positive (14%) and 7 returned inconclusive results (9%).

Infected animals can be negative on all tests, but as the disease progresses, an infected animal will shed MAP in its faeces and seroconversion generally occurs subsequently. Clinical signs often appear when the animal is 3 to 6 years old and relate to the development of a granulomatous enteritis. Clinically affected animals shed very large numbers of MAP in their diarrhoeic faeces and will heavily contaminate their environment.

In 2015 there were 992 samples submitted from cattle for culture, typically collected from clinical suspects or animals displaying positive reactions in ELISA. The organism was isolated from 104

(10.5%) animals (89 cows, 6 bulls, 6 steers, 3 heifers), which originated in 70 herds, with dairy and beef enterprises equally represented. Sixty-three of the cows were of a dairy breed and five of the bulls were of the Limousin breed. The disease is also significant for dairy goat enterprises and was identified in three goat herds.

The age of the infected bovine animals at the time of sample submission ranged from 15 months to 13 years. Animals aged 36-60 months represented 45% of infected animals, while those aged 61 to 84 months years accounted for 29.8% of infected animals. None of the infected animals were imported and 69 were located in their herd of birth.

Survival analysis was conducted on the infected cattle. Forty-eight *per cent* of these were dead within three months of sample submission and this increased to 68% by six months after submission. Of the infected animals which are not alive, 50% were submitted to a knackery or laboratory. Fifty-one *per cent* of infected animals were classed as high shedders and would cause extensive contamination to the farm environment.

Because the disease is very difficult to eradicate from a herd, it is essential for herd owners and their PVP to develop a plan to prevent the introduction and spread of MAP on the farm. Critical points include maintaining a closed herd, maternity pen hygiene, colostrum management, the use of milk replacer or pasteurised milk to feed calves and preventing the exposure of younger stock to faeces from adult animals both at housing and at pasture. In herds with no history of MAP infection, it is critical to perform faecal culture of ELISA-positive animals to ascertain their true infection status.

Owners of herds with a confirmed diagnosis of MAP infection face a significant challenge to prevent its spread within the herd and will have to operate an effective control programme for several years, before being confident that the disease is no longer present in the herd. In 2015, an investigation into a Johne's disease outbreak in a pedigree beef herd

found 13 of 35 adult females to be MAP-positive when cultured, illustrating how this disease can become established in a herd.

Schmallenberg virus

JOHN FAGAN, DAFM RVL, ATHLONE.
SIOBHÁN CORRY, AFBI, OMAGH.

There was no evidence of new Schmallenberg virus (SBV) infections having occurred during 2015, nor were any deformed calves or lambs confirmed as Schmallenberg cases during the year (which would be expected if the virus were circulating in late 2014). Tissues were taken from foetuses that were found to have suspect abnormalities at *post mortem* and examined using the RT-PCR. There were 143 PCR tests carried out during the year on various tissues taken from animals and all were negative for SBV. There were 127 tests carried out on calves, 13 on lambs and the remainder on piglets (2) and a goat kid (1). Samples were tested from many counties including Cork (34), Meath (23), Kilkenny (11) Limerick (10) and Wexford (10).

AFBI examined tissues from 11 bovine foetuses and 7 ovine foetuses that had deformities at post mortem examination that could possibly have been due to Schmallenberg virus. A total of 86 tissue samples from these cases were tested for Schmallenberg via a RT-PCR test and all were negative.

In addition serological investigation was also carried out. There were 1096 SBV antibody ELISA tests carried out during the year. In total 123 (11.2 *per cent*) were positive, only one of which was a pleural fluid from a foetus. This foetus had developmental abnormalities that were suggestive of the syndrome associated with Schmallenberg virus. An SBV PCR was also carried out on this animal and it was negative. Positive SBV antibody results were found in samples originating in Cork (38), Meath (34), Wicklow (14), Tipperary (8), Kilkenny (5), Wexford (5) and Kildare (4).

A summary of on-farm investigations carried out during 2015

COMPILED BY IAN HOGAN, DAFM RVL, LIMERICK.

Animal Health Issues in a Dairy Herd

The cause of continuing high mortality in a 300 animal dairy herd was investigated by Athlone RVL in conjunction with UCD Farm Animal Clinical Medicine Department. Over the previous five years the overall herd mortality had been running at 10 to 20 *per cent*, with cow mortality calculated to have been 6-8 *per cent*. IBR had been diagnosed in the herd in late 2012 and a vaccination programme was initiated at that time.

Prior to the farm investigation, pneumonia in calves from 1-12 months old which had been bought in during the late spring was the main cause of loss. *Histophilus somni*, *Mycoplasma bovis* and *Pasteurella multocida* were detected during necropsies but there was no evidence of any of the respiratory viruses.

Poor ventilation, overcrowding and mixing of age groups were considered to have predisposed to the pneumonia outbreak which at that point had become endemic. Advice was given about calf purchase, housing, ventilation, feeding and management.

Lack of available feed space for both dry and lactating cows was also found and it was considered to have led to a reduction in intake of pre-calving minerals; copper and selenium status had been marginally low and the use of boluses was advised to ensure that an adequate status was reached. Feeding the minerals through a diet feeder was an alternative strategy advised. Based

on the results of post-mortem examinations and clinical history it was considered that the iodine status was satisfactory.

Calcium metabolism in the dry and transition cows was considered less than optimum. In addition to milk fever, this can have a dramatic effect on immune function in the periparturient period leading to a high incidence of retained placenta, toxic mastitis and toxic metritis. In addition low blood calcium also affects feed intake predisposing to displaced abomasum. The herdowner was advised to ensure that the dry cows are fed 100g/head/day of a dry cow mineral that contains at least 20% magnesium — the target is for the dry cows to be taking in at least 40g of magnesium per day. Alternatively calcined magnesite (calmag) at 40g/head/day can be fed to cows.

The owner was advised to monitor body condition scores ensuring that cows are not too fat or too thin, with special attention to be paid to ensuring an adequate diet for the cows in the two weeks before and the three weeks after calving. The cubicle housing for the cows and heifers was found to be inadequate; he was advised not to expand the herd any more until he had sufficient housing.

Calf morbidity on a suckler farm

A visit was carried out by Limerick RVL to investigate calf morbidity on a suckler farm. Neonatal calf diarrhoea, considered to be associated with cryptosporidiosis, had historically been a problem in the young calves. However, in the two previous years, pneumonia in calves had been the most serious problem reported. Calves as young as one day of age had high temperatures and varying degrees of respiratory distress. Antibiotic and anti-inflammatory treatment over a number of days was required to achieve a clinical response. As a preventative measure all newborn calves were injected with a long acting macrolide antibiotic before they reached 24 hours of age. There were

no calf deaths recorded and sick calves recovered but only with heavy and prolonged treatment.

Dry cows were inspected at grass and observed to be over fat. Suckling calves were inspected indoors. Two calves which had been treated recently for pneumonia were observed to be hyperventilating. Lactating cows were inspected in the house and all were in good form.

Biochemistry results showed that three of the four cows tested were had low blood selenium, so supplementation was recommended. Serum copper levels were normal so further copper supplementation was discouraged. Previous iodine supplementation appears to have elicited a good response so a supplementation with a selenium/iodine product was suggested.

Four of nine cows tested had antibodies to *Leptospira hardjo*; if infection was active in the herd most if not all cows would be expected to be positive. Resampling the negative cows in the spring/summer was suggested.

Two of the nine cows tested were positive for IBR (non-vaccine-associated IgE) antibodies and were possible carriers of the virus. The seven negative results showed that the infection did not appear to be active in the herd. Because of the risk of viral reactivation in carrier animals, and the fact that an IBR vaccination programme was already in place in the herd, continued vaccination was recommended.

All nine cows tested were positive for RSV and PI3 viral antibodies; the weanlings were also positive for RSV, but negative for PI3 antibodies. The cows were being vaccinated against RSV; it was recommended that a booster vaccine be given to the cows at a suitable time in pregnancy to raise the concentration of antibodies in the colostrum, also that young calves be vaccinated against RSV from two weeks of age. It was recommended that older calves and weanlings sharing the same air

space should also be vaccinated to minimise the risk of viral replication and spread within the house.

A farm visit to investigate a BVD outbreak

Limerick RVL carried out an on-farm investigation in a herd where eight calves born in the spring 2015 had tested positive for BVDV. On subsequent retests one was positive (persistently infected, PI) and two were negative while the other five had died before a retest was carried out. Some of these calves had been born dead and were undersized. The confirmed PI animal was retained on the farm, in a shed, mixing with animals in the early stages of pregnancy for a number of weeks. During the following autumn twelve more calves were born which tested positive for BVDV. On retests 10 of the 12 were still positive, and one stunted calf was sent to the knackery without a retest and one retested negative. A BVD vaccination programme was initiated in early May 2015, following the confirmation of the first PI animal on the farm. All animals had tested negative for BVDV in 2013 & 2014.

During the visit in July 2015, fifteen animals were selected for blood sampling and all were negative for BVD virus including one retest of an animal which had already tested positive. Based on this information there was a minimum of one and a maximum of six PIs born during the spring period and poor management led to the further infections found in the autumn. It appears likely that the original source of infection was external (either direct or indirect) during late summer/early autumn of 2014. If infection was direct, the most likely source was a stray BVDV infected animal breaking in and mixing with the cattle for a short period of time. An examination of the BVD test results from neighbouring farms showed some evidence of BVDV circulating in the area in autumn 2014. Indirect sources of infection that were considered were off-farm work with animals by the herdowner

with transmission of the virus via infected clothing, equipment or vehicles.

Factors which were considered to have worked together to cause this severe outbreak were: (i) the timing of the original introduction of infection on to the farm, (autumn of 2014), (ii) the division of the animals into two separate groups (autumn and spring calving) (iii) the subsequent housing of these groups together during the winter, and (iv) the retention of the PI calf on the farm for a number of weeks after diagnosis and allowing it to mix with pregnant animals.

The following recommendations were made (i) test any calves born before the end of 2015 as soon as possible after birth, (ii) remove virus-positive animals from the herd as soon as is practically possible, (iii) continue the BVD vaccination programme for the foreseeable future (iv) check and maintain the security of the boundaries with neighbouring livestock farms. (v) keep separate the protective clothing and equipment used for off-farm work and the farming businesses, and (vi) ensure that any lorry used to transport cattle is cleaned and disinfected before entering the farm.

Dystocia and metritis in heifers

Kilkenny RVL investigated a mixed (dairy and suckler) farm where an elevated prevalence of dystocia and metritis was reported in two-year-old heifers calving in spring 2015. Neonatal calf mortality was high, with 17 deaths out of 33 births (49.5%). The PVP reported that the calves were not oversized for the heifers' size but that the vulva appeared tight at calving resulting in calving difficulties. Calving resulted in vaginal tears and metritis and retained foetal membranes occurred in a number of heifers. The PVP reported a rapid loss of body condition in the heifers post calving and a very poor response to veterinary intervention. Similar but milder problems had been observed during the previous year.

Necropsy of two heifers found evidence of metritis in both. One had a severe toxic metritis, and the other had a purulent metritis. One heifer returned a positive PCR for BHV-1 and BVD viruses. Two heifers, clinically examined on-farm, revealed a purulent metritis in one and a tear of the lateral vaginal wall in the other. Purulent material was observed in several of the cow cubicles. Blood samples were taken and eight out of ten displayed copper values below normal parameters.

A number of recommendations were made to the owner. Based on PCR findings it was recommended to commence vaccination against BHV-1 (IBR) and BVD. The role of IBR in reproduction (can cause infertility and abortions), respiratory disease and calf health was stressed.

In addition the herdowner was advised regarding the suspected role of parturient hypocalcaemia in the problems seen in the heifers. He was advised to ensure that heifers get sufficient pre-calving mineral supplementation including copper and that animals are not over conditioned at calving. A suitable pre-calving mineral supplement should contain at least 20% Magnesium (Mg) at 100 grams per cow per day feeding rate. It was also recommended to scan the 1st calvers for any reproductive in-efficiencies and to check that they are cycling. Potassium levels were acceptable in the silage fed that spring but it was recommended to test that year's silage again in the autumn for K levels.

Cows presenting with lesions of photosensitisation

Kilkenny RVL along with UCD and the veterinary practitioner visited a farm where a number of cows from a group of 15 presented with photosensitisation-like clinical signs over the month of September. Three cows, between five and nine years old, presented with a swollen head followed by various signs including bruxism,

jaundice, tenesmus, aggression, recumbency, as well as diarrhoea with very dark-coloured faeces and crusting around the muzzle and darkening and thickening of the skin on the mammary gland. Two had been euthanased and the skin around the muzzle area had begun to slough (Fig 1) in a third cow that was present on the day of the visit. The examining clinicians concluded that photosensitization was the most likely diagnosis.

During the examination of the paddocks which followed, a number of plants were encountered throughout the pasture which may be associated with outbreaks of photosensitisation. These included *Hypericum perforatum* (St John's Wort) and possibly Buckwheat (*Fagopyrum esculentum*).

The herd owner acknowledged that during the summer time, particularly in July 2015, the paddocks were heavily grazed which may have resulted in cows foraging for grass in hedgerows and exposing themselves to a number of plants including *Hypericum* that predispose to photosensitisation. In the future, this may be remedied by either allowing the cows access to fresh grass on a more regular basis or by supplementing their intake with hay.

Acute IBR cases may resemble photosensitisation. Blood testing identified infected animals in the herd so vaccination for IBR was recommended.

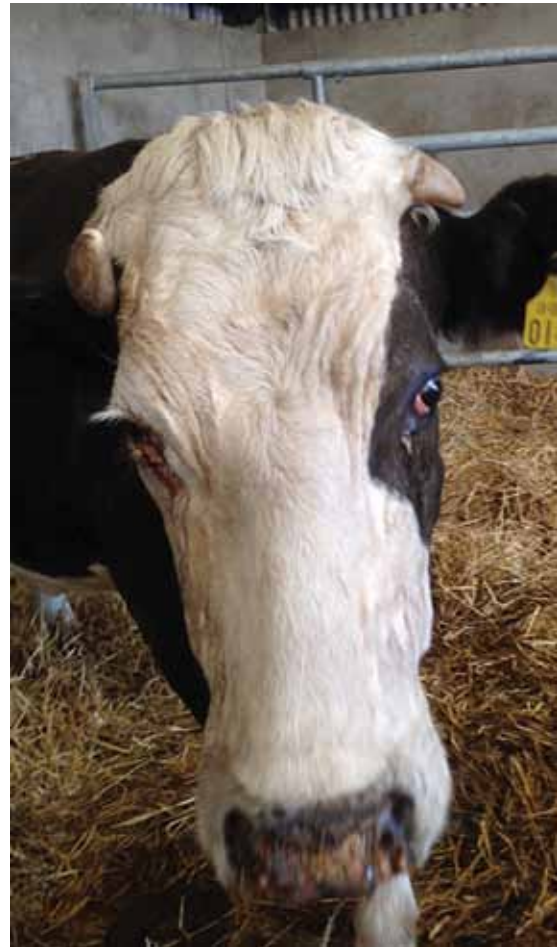


Figure 94: A cow from a farm where photosensitisation was diagnosed showing some of the constellation of clinical signs observed including a swollen head and crusting around the muzzle. (Photo: Kilkenny RV)

A selection of abstracts from scientific papers published during 2015

COMPILED BY JOHN FAGAN, DAFM RVL, ATHLONE.

Exposure to Schmallenberg virus in Irish sheep in 2013. D. J. Barrett, S. J. More, R. G. O' Neill, D. M. Collins, C. O'Keefe, V. Regazzoli, D. Sammin.

Reprinted from *Veterinary Record* 2015; 177:19-494. Open Access.

Abstract

The objectives of this study were to determine the geographical distribution of SBV exposure in Irish sheep before and during the 2013 vector season, and to determine if SBV was active in 2013 in flocks where SBV infection was previously confirmed.

The study concluded that the incomplete seroconversion in flocks exposed to SBV during 2012 and the lack of SBV seroconversion among 2013-born lambs in those flocks would suggest that a sizeable proportion of the current sheep population in south-east Ireland is immunologically naïve to SBV should re-emergence or reintroduction occur.

Prevalence and distribution of exposure to Schmallenberg virus in Irish cattle during October 2012 to November 2013. D. Barrett, S. J. More, R. O'Neill, B. Bradshaw, M. Casey, M. Keane, G. McGrath and D. Sammin.

Reprinted from *BMC Veterinary Research* (2015) 11:267 Open Access.

Abstract

The objectives of this study were to determine the seroprevalence and distribution of exposure to Schmallenberg virus (SBV) in Irish cattle from November 2012 to November 2013.

This study concluded that at the end of the 2012 vector season, there was widespread exposure to SBV among herds in southern and south eastern Ireland. During 2013, there was little or no evidence of further outward spread, unlike the situation in several other European countries. Given the lack of evidence for circulation of the virus since 2012, it is likely that the younger age cohort in herds previously exposed to SBV and substantial proportions of animals of all ages on the margins of affected areas are immunologically naïve to SBV, and would be susceptible to infection if the virus were to re-emerge.

Comparison of rapid laboratory tests for failure of passive transfer in the bovine. Ian Hogan, Michael Doherty, John Fagan, Emer Kennedy, Muireann Conneely, Paula Brady, Clare Ryan, Ingrid Lorenz.

Reprinted from *Irish Veterinary Journal*. 2015, 68(1):18 with permission.

Abstract

Failure of passive transfer of maternal immunity via colostrum can occur in the bovine, and a number of blood tests have been developed to test calves for this failure. It is not clear which test is most suitable for this purpose. The objective was to examine the most commonly used tests for failure of passive transfer and to decide which is most suitable for routine laboratory use. Five different tests were compared against radial immunodiffusion which is considered the appropriate reference method. These tests were serum gamma-glutamyltransferase levels, serum protein levels, serum globulin levels, an enzyme linked immunosorbent assay and the zinc sulphate turbidity test. The tests examined

displayed high sensitivity but widely varying specificity. Examination of the use of different cut-off points allowed some improvement in specificity at the expense of sensitivity, but the tests which had performed best at the original cut-off points still displayed the best performance. Gamma-glutamyltransferase levels as a measure of colostrum absorption returned, in this study, the best balance between sensitivity and specificity. The ELISA used in this study and serum globulin levels displayed performance similar to the gamma-glutamyltransferase levels. Serum total protein was less successful than others examined at providing both sensitivity and specificity but may, when performed via refractometer, be useful for on-farm testing. As currently performed the poor sensitivity for which the zinc sulphate turbidity test is most often criticized is evident. Modification of the cut-off point to increase specificity is less successful at balancing these parameters than the ELISA, gamma-glutamyltransferase levels, and globulin levels.

Profiling oral and digital lesions in sheep in Ireland. William G. FitzGerald, Joseph P. Cassidy, Bryan K. Markey, Michael L. Doherty.

Reprinted from *Irish Veterinary Journal* 68:30 Open Access.

Abstract

During the FMD outbreak in Ireland and the UK in 2001, there was significant uncertainty amongst veterinary practitioners and government veterinary inspectors surrounding the clinical diagnosis of FMD in sheep. This situation was complicated by reports of idiopathic oral ulcers that closely resembled FMD on gross appearance which at that time were referred to as ovine mouth and gum obscure disease. A field and abattoir study was carried out to determine the frequency, appearance and significance of oral and digital lesions in sheep in Ireland. A total of 3,263 sheep were examined in 22 flocks, including 969 lambs

and 294 adults. A further 2,403 animals were examined by abattoir inspections. Animals bearing lesions of interest were identified, samples of the lesions were taken and subsequently examined by bacteriology, electron microscopy, serology, immunohistochemistry and histopathology. Forty four oral and 20 digital lesions were identified and characterised. Oral lesions were recorded most frequently in lambs, where the most common cause was orf virus infection. The majority of the oral lesions recorded in the adults were idiopathic and consistent with a diagnosis of idiopathic oral ulceration. A variety of digital lesions was observed, consistent with scald, foot-rot and contagious ovine digital dermatitis (CODD). All of the animals with lesions were seronegative to FMD virus (FMDV). There was no difficulty in differentiating these lesions from those caused by FMDV on the basis of flock history and careful clinical examination.

Bovine and ovine rumen fluke in Ireland—Prevalence, risk factors and species identity based on passive veterinary surveillance and abattoir findings. Dónal P. Toolan, Gillian Mitchell, Kate Searle, Maresa Sheehan, Philip J. Skuce, Ruth N. Zadoks.

Reprinted from *Veterinary Parasitology* Volume 212, Issues 3–4, 15 September 2015, Pages 168–174 with permission.

Abstract

The prevalence of rumen fluke, the incidence of clinical paramphistomosis and the trematode's species identity were studied in cattle and sheep in the Republic of Ireland using passive veterinary surveillance (faecal examination and necropsy results; 2010–2013) and abattoir data. Based on faecal examination, the prevalence of rumen fluke was higher in cattle than in sheep. Rumen fluke prevalence in cattle and sheep fluctuated over the year and in most years (2011–2013), prevalence was higher in winter (December–February) than in summer (June–August). For 3 of

4 years studied, there was no correlation between monthly prevalence of rumen fluke and prevalence of liver fluke as estimated by faecal examination. At sample level, joint occurrence of rumen fluke and liver fluke was 1.1–2.0 times more common than would be expected under the assumption of independence. Based on necropsy data, a spike in deaths attributed to paramphistomosis was observed in 2012, when rainfall was unusually high. This spike in mortality was not accompanied by a spike in faecal prevalence, emphasizing that the incidence of disease, which is due to high burdens of juvenile rumen fluke in the gut, is not correlated with prevalence of infection, which is measured by faecal examination and reflects presence of adult fluke in the rumen. At slaughter, 52% of 518 cattle from 101 herds were positive for rumen fluke, compared to 14% of 158 sheep. Prevalence in cattle was higher than reported in most studies from mainland Europe and varied by animal category, age, sex, abattoir visit and location (county) of farm from which the animal was submitted for slaughter, but in multivariate analysis, only sampling month and county were significantly associated with detection of rumen fluke. The identity of rumen fluke in cattle and sheep was confirmed as *Calicophoron daubneyi*. Although *C. daubneyi* is thought to share an intermediate host snail with *Fasciola hepatica*, the differences in prevalence between host species and over time suggest that the epidemiology of *C. daubneyi* is distinct from that of *F. hepatica*. Further studies of the *C. daubneyi* life-cycle in ruminant hosts, intermediate snail hosts and the environment will be needed to gain a better understanding of modes of transmission and options for control of rumen fluke infection and disease.

Controlling nematodes in dairy calves using targeted selective treatments. O’Shaughnessy J, Earley B, Mee JF, Doherty ML, Crosson P, Barrett D, de Waal T.

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Abstract

With increasing concerns of anthelmintic resistance in cattle nematode populations worldwide, there is a need to explore alternative approaches to nematode control. One alternative approach is the use of targeted selective treatments (TST) where only individual animals are treated instead of the entire group. This study reports the findings of a TST approach in dairy calves conducted over their first grazing season (FGS) to control both gastrointestinal nematode and lungworm challenge. Ninety-six calves with an initial mean (s.d.) age and live weight of 130 (28.3) days and 120 (23.6)kg, respectively, were randomised by breed, age and live weight to one of two treatments; Control (n=24; ×2) and TST (n=24; ×2). Control calves were treated three times at pasture with ivermectin by subcutaneous injection. Individual calves in the TST group were treated at pasture with ivermectin when one of the following thresholds was met: (1) positive for lungworm larvae using the modified Baermann technique or (2) positive or negative for lungworm larvae using the modified Baermann technique with plasma pepsinogen concentration (PP) \geq two international units of tyrosine/litre and faecal egg count (FEC) \geq 200 trichostrongyle eggs per gram of faeces. Calves were rotationally grazed from July 3rd 2012 (day 0) to November 2nd 2012 (day 122) when calves were housed. Calves were weighed and sampled (blood and faecal) every three weeks. There was an effect of treatment and time on both FEC [treatment (P=0.023), time (P<0.001)] and PP [treatment (P=0.002), time (P<0.001)]. Both FEC and PP were higher in TST calves. There was a 50% reduction in anthelmintic use in TST calves compared to control calves. Clinical signs of lungworm infection, confirmed by the modified Baermann technique, were evident in TST calves on days 62 and 63 of the study. The average daily live weight gain for control and TST calves was 0.50 (0.02) kg day⁻¹ and 0.47 (0.03) kg day⁻¹, respectively (P=0.41). Thus, performance in dairy calves can potentially be maintained with fewer anthelmintic treatments but farmers need

to be vigilant of the challenge posed by lungworm. Any future approach into the use of TST in FGS calves must take into consideration the relative importance of lungworm as a pathogen.

***Fasciola hepatica*: A comparative survey of adult fluke resistance to triclabendazole, nitroxylnil and closantel on selected upland and lowland sheep farms in Northern Ireland using faecal egg counting, coproantigen ELISA testing and fluke histology.** R.E.B. HANNA, C. MCMAHON, S. ELLISON, H.W. EDGAR, P.-E. KAJUGU, A. GORDON, D. IRWIN, J.P. BARLEY, F.E. MALONE, G.P. BRENNAN, I. FAIRWEATHER, 2015.

Reprinted from *Veterinary Parasitology* 207, 34-43 with permission.

Abstract

In order to investigate the incidence and distribution of adult fluke resistance to the fasciolicide triclabendazole (TCBZ) amongst populations of *Fasciola hepatica* in sheep flocks in Northern Ireland (NI), individual rectal faeces samples were collected from 3 groups of 20 sheep, before (pre-dose), and 21 days after (post-dose) treatment of the animals with TCBZ, nitroxylnil or closantel, on each of 13 well-managed sheep farms distributed across the province. The efficacy of each flukicide was determined for each farm, using faecal egg count reduction (FECRT) and *F. hepatica* coproantigen ELISA testing. In certain flocks, 2 sheep with high pre-dose faecal egg counts (FEC) were killed 3 days and 21 days respectively after TCBZ treatment, and the histology of the fluke reproductive organs was compared with that of flukes from untreated sheep, and from sheep treated with nitroxylnil or closantel 2 days prior to death, using haematoxylin and eosin (H&E) staining and an in situ hybridisation method (TdT-mediated dUDP nick end labeling [TUNEL]) to demonstrate apoptosis. Results from FECRT revealed that in all flocks with a high fluke burden, TCBZ was ineffective in treating chronic fasciolosis, and this

finding was generally supported by the results of the coproantigen reduction test (CRT). The histology of reproductive organs of flukes from TCBZ-treated sheep in these flocks was normal, when compared with untreated flukes, and this, together with the FECRT and CRT findings, indicated a likely diagnosis of TCBZ resistance in all the flocks with a high fluke burden. In contrast, nitroxylnil and closantel were found to be fully effective against TCBZ-resistant flukes in each of the flocks bearing a high chronic fluke burden. All of the flocks with a high fluke burden and TCBZ resistance were managed on lowland in the South and East of NI. Upland flocks, in the North and West, had low fluke burdens, or were clear of infection; and FECs were too low to allow valid resistance testing. The study highlights the high level of penetration of TCBZ resistance throughout *F. hepatica* populations in areas of intensively managed sheep production with a high level of fluke challenge. Further, it emphasises the importance of pre-emptive chemotherapeutic action against chronic fasciolosis, using flukicides effective against the egg-producing adult flukes to minimise pasture contamination for the next season's lamb crop. This study also exemplifies the use of several complementary methods (FECRT; CRT; fluke histology; comparative anthelmintic efficacy testing) for confirmation of a diagnosis of fluke drug resistance.

***Fasciola hepatica*: Specificity of a coproantigen ELISA test for diagnosis of fasciolosis in faecal samples from cattle and sheep concurrently infected with gastrointestinal nematodes, coccidians and/or rumen flukes (paramphistomes), under field conditions.** P.-E. KAJUGU, R.E.B. HANNA, H.W. EDGAR, C. MCMAHON, M. COOPER, A. GORDON, J.P. BARLEY, F.E. MALONE, G.P. BRENNAN, I. FAIRWEATHER, 2015.

Reprinted from *Veterinary Parasitology* 212, 181-187 with permission.

Abstract

Chronic fasciolosis is often diagnosed by faecal egg counting (FEC), following concentration of the eggs in the sample by a zinc sulphate floatation method. However, concentration by a sedimentation technique gives improved sensitivity. Interpretation of FEC results for fasciolosis is complicated by factors such as the long pre-patent period and irregular egg shedding. Thus, FEC reduction tests (FECRT), when used alone, are not completely reliable for diagnosis of anthelmintic susceptibility or resistance in local fluke populations, especially when parasite burdens are small. A *Fasciola hepatica* coproantigen ELISA test has been introduced which more accurately reflects the presence of flukes in the host bile ducts in late pre-patent infections, and absence of flukes following successful chemotherapeutic intervention. The aim of the present study was to elucidate the specificity of the *F. hepatica* coproantigen ELISA technique, particularly regarding potential cross-reactivity with rumen fluke (paramphistome), gastrointestinal nematode and coccidian infections. The method involved parallel testing of a large battery of faecal samples from field-infected cattle and sheep using floatation and sedimentation FECs and coproantigen analysis. No evidence was found for significant false positivity in the *F. hepatica* coproantigen ELISA due to paramphistome, coccidian and/or gastrointestinal nematode co-infections. With sedimentation FECs less than 10 *F. hepatica* eggs per gram (epg), the likelihood of a positive coproantigen result for the sample progressively decreased. Diagnosis of fasciolosis should be based on consideration of both FEC and coproantigen ELISA findings, to ensure optimum sensitivity for pre-patent and low-level infections.

Other Publications

The impact of infection with Schmallenberg virus on weaning rate in Irish sheep flocks. Damien Barrett, Ronan O'Neill, Donal Sammin, Tracy A. Clegg, Simon J. Moore. *Preventive Veterinary Medicine* (2015) In Press.

Disease screening profiles and colostrum management practices on 16 Irish suckler beef farms. O'Shaughnessy J, Earley B, Barrett D, Doherty ML, Crosson P, de Waal T, Mee JF: *Irish Veterinary Journal* 2015, 68(1):1.

Nematode control in suckler beef cattle over their first two grazing seasons using a targeted selective treatment approach. O'Shaughnessy J, Earley B, Mee JF, Doherty ML, Crosson P, Barrett D, de Waal T: *Irish Veterinary Journal* 2015, 68:13.

A comparative study on the impact of two artemisinin derivatives, artemether and artesunate, on the female reproductive system of *Fasciola hepatica*. J.F. O'NEILL, R.C. JOHNSTON, L. HALFERTY, R.E.B. HANNA, G.P. BRENNAN, I. FAIRWEATHER, 2015. *Veterinary Parasitology* 211, 182–194.

***Fasciola hepatica*: Histology of the reproductive organs and differential effects of Triclabendazole on drug-sensitive and drug-resistant fluke isolates and on flukes from selected field cases. (Review).** ROBERT HANNA, 2015. *PLOS Pathogens* 2015, 4, 431-456.



