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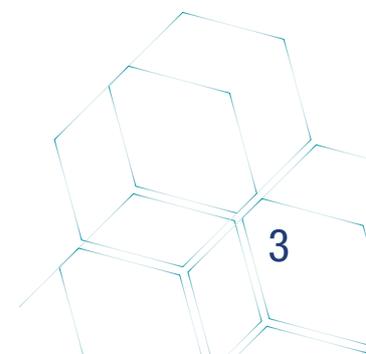
Acknowledgements

This report is the sixth edition of the All-island Animal Disease Surveillance Report. It has been put together by a diverse group of talented and dedicated people from the Agri-Food and Biosciences Institute (AFBI), Department of Agriculture, Environment and Rural Affairs (DAERA), Animal Health and Welfare Northern Ireland (AHWNI), Department of Agriculture, Food and the Marine (DAFM), Marine Institute, the Irish Equine Centre and Animal Health Ireland (AHI).

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Damien Barrett and Alan Johnson
Editors



Introduction to the 2016 All-island Animal Disease Surveillance Report

The agri-food industries in Ireland and Northern Ireland have been the success story of the recent recession and the volume and value of trade in food and drink continue to fuel the current economic recovery. Branding and marketing of food from the island of Ireland are all based on the consumer accepting the premise that the food grown, processed, and sold from this island is wholesome, nutritious and safe. That message has been successfully translated and transmitted to a wide variety of cultures and markets as our industry has developed a reputation for quality and traceability.

Changes in world trading conditions are a constant and we need to be attuned to the specific concerns of a wide range of target markets. Regardless of how the negotiations on the UK's exit from the EU proceed in coming months, there is the potential for significant disruption to trade in livestock, livestock products and food from both parts of our island, prompting more intensive efforts by food businesses at marketing and an increasing requirement to substantiate the marketing claims that are made. An unspoken but implicit part of the deal made with each consumer is that our food comes from healthy animals, reared in optimal conditions, and whose products are safely processed and quality-controlled. These claims must have scientific underpinnings, and our animal disease surveillance systems north and south provides a critical part of that evidence base.

While veterinary laboratory diagnostic investigation provides valuable support in the control and prevention of disease at herd level, it also provides a valuable source of aggregate data for the wider industry. The annual publication of this report combined with other published outputs of our veterinarians and scientists throughout the year (in the peer-reviewed literature, the farming press and via other communication channels), supports the claims made about the health status of food-producing animals

and continuing freedom from specific infectious diseases.

In addition, disease surveillance provides our industries with an early warning system against the introduction of exotic disease, or the impact of novel or emerging diseases. Typically, we observe the same pattern and frequency of diseases in farmed animals from year-to-year, North and South, reflecting endemic stability. Our surveillance network, including regular contact with the private veterinary practitioners that avail of the diagnostic services we provide, is focused on detecting any deviations from this baseline. This might provide the first indication of a new or emerging disease or of incursion of a novel or exotic infectious agent, thus facilitating a rapid response.

International trade considerations may seem a long way from the laboratory bench, but our official controls, surveillance activities and laboratory supports at home must match the ambitions of our industries' marketing attempts abroad – they must be world class, and seen to be so.

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November 2017

Animal Demographics and the Weather

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Following the trend of recent years, the national cattle herds in both Ireland and Northern Ireland continued to increase during 2016. In Ireland, an increase of 5.5 *per cent* was recorded, with 6.50 million cattle present in the national herd in December 2016 (Figure 1). In Northern Ireland, the change was more modest with an increase of 0.6 *per cent* recorded in the national cattle herd, bringing the total cattle numbers to 1.62 million in December 2016.

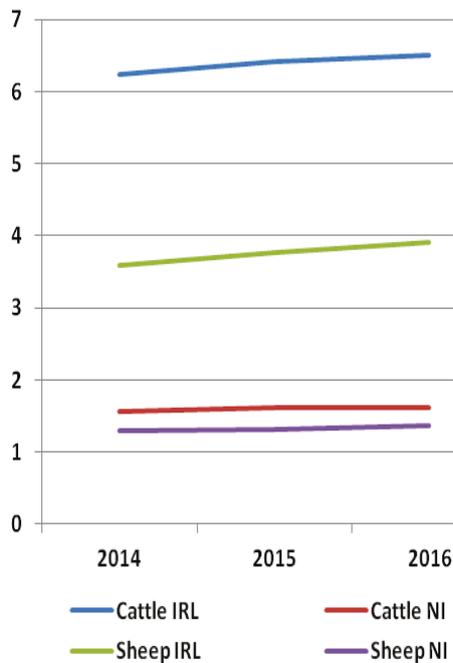


Figure 1: National cattle and sheep populations (measured in millions) in Ireland and Northern Ireland from 2014 to 2016 (Source: Central Statistics Office www.cso.ie; Department of Agriculture, Environment and Rural Affairs for NI)

The national sheep flocks in Ireland and Northern Ireland increased by 2.9 *per cent* and 0.4 *per cent* respectively during 2016. The growth recorded in Ireland is part of a cumulative growth in sheep numbers of 27 *per cent* since 2009.

Weather

The unseasonably high levels of rainfall recorded in November and December 2015, continued into the early months of 2016

(Figure 2). June was also a particularly wet month.

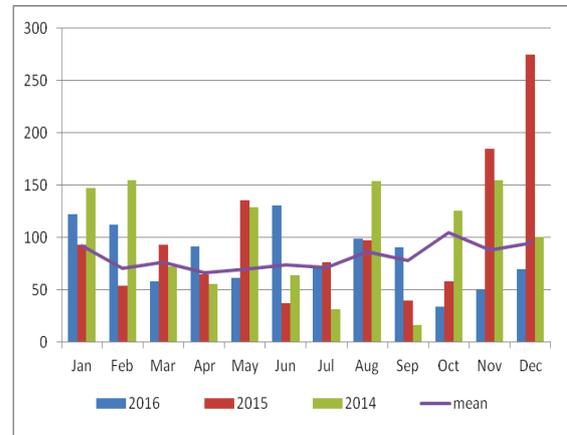


Figure 2: Monthly rainfall recorded during 2016 in Mullingar compared to 2014 and 2015 and the 30-year monthly average rainfall (purple line) (Source: www.meteireann.ie)

The autumn recorded rainfall fell below the 30-year average. The excessively wet conditions during the summer however contributed to heavy burdens of fluke on pasture in the early autumn and losses were experienced on many sheep farms as a result.

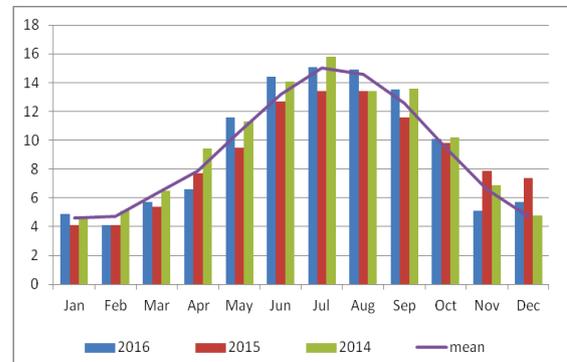
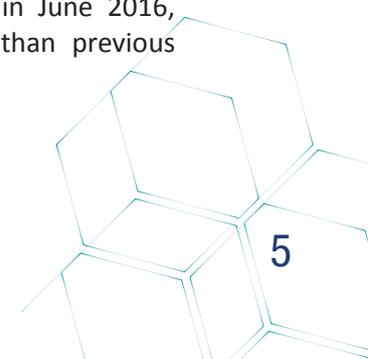


Figure 3: Monthly average temperature as recorded in Mullingar during 2016 compared to 2014 and 2015 and the 30-year average temperature (purple line) (Source: www.meteireann.ie)

Temperatures in the early summer in 2016 were warmer than average (Figure 3). Warm and wet weather can be particularly conducive to the survival and spread of parasites. It is notable that a significant number of parasitic bronchitis cases (hoose/husk) were diagnosed in June 2016, which is considerably earlier than previous years.



Cattle Diseases

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Neonatal Calves (0 – 1 month old)

The trend of gastrointestinal infections being the most frequently diagnosed cause of death in neonatal calves continued in 2016 (Figure 4). Looking at the data for the three years ending 2016, the percentages of deaths due to gastro-intestinal infections have varied from 32 *per cent* for DAFM laboratories (Ireland) in 2016 to 41 *per cent* for AFBI laboratories (Northern Ireland), also in 2016. Not surprisingly, a number of these cases had hypogammaglobulinaemia recorded as well, indicating failure of passive transfer of maternal immunity (See sections on Neonatal Enteritis and Zinc Sulphate Turbidity Test).

Systemic infections continued as the second most frequently diagnosed cause of death in the DAFM laboratories, but were replaced in second place by respiratory infections in AFBI laboratories. While the trend had been for frequencies of 11 to 15 *per cent* for systemic diseases in both sets of laboratories, the DAFM figure exceeded this in 2016 reaching 24 *per cent*, while AFBI laboratories recorded deaths due to systemic infections in 12 *per cent* of the calves examined. The most common infectious agent isolated in cases of systemic disease was *Escherichia coli* in 51 and 52 *per cent* of cases in Ireland and Northern Ireland respectively. *Salmonella* species were diagnosed more frequently in Northern Ireland than in Ireland (33 versus 7 *per cent*).

Respiratory infections are normally responsible for about 10 *per cent* of deaths in neonatal calves, and 2016 was no exception. The most frequently detected pathogens in Ireland and Northern Ireland respectively were *Trueperella pyogenes* (12.5 and 4.5 *per cent*), *Mannheimia haemolytica* (10 and 15.2 *per cent*), *Mycoplasma bovis* (10 and 38.4 *per cent*), *Pasteurella multocida* (8.8 and 7.1 *per cent*), and bovine herpesvirus 1 (BHV-1) (2.7 and 8.8 *per cent*) (see section on Bovine Respiratory Disease).

Nutritional and metabolic conditions equate to 4 *per cent* (DAFM) and 9 *per cent* (AFBI) of

diagnoses in neonatal calves. The failure of passive transfer or hypogammaglobulinaemia occurred in 43 and 71 *per cent* of carcasses in this category in Ireland and Northern Ireland, respectively, while ruminal feeding was recorded in 25 and 23 *per cent* respectively. Hereditary and developmental abnormalities were recorded in DAFM laboratories in 5 *per cent* of carcasses submitted. These were divided mostly into atresia cases (58 *per cent*) and cardiac defects (8 *per cent*). Cardiac abnormalities most commonly noted were ventricular and atrial septal defects and patent foramen ovale. Atresia was recorded in four (0.5 *per cent*) submissions to AFBI laboratories.

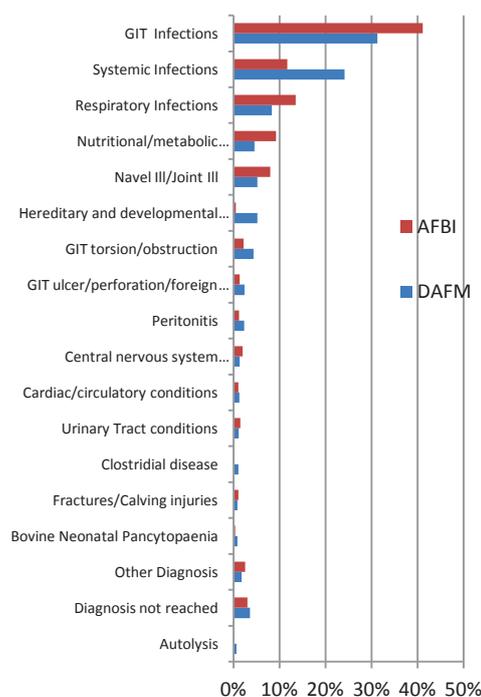


Figure 4: Conditions most frequently diagnosed in neonatal calves (less than one month old) by DAFM (n=963) and AFBI (n=832) in 2016. GIT= gastro-intestinal tract

Navel ill/ joint ill has stayed at a consistent level from 2014 to 2016, at 5 *per cent* and 8 *per cent* for DAFM and AFBI respectively. *Escherichia coli* and *T. pyogenes* were the infectious agents most frequently isolated, with no infectious agent detected in the majority of cases.

Similarly, peritonitis cases have stayed at between 2 *per cent* and 3 *per cent* for both DAFM and AFBI, with *T. pyogenes* and *Escherichia coli* detected in just under half of these cases.

Calves (1-5 months)

Respiratory infections are by far the biggest cause of mortality among 1-5 month old calves in both parts of Ireland (Figure 5). They accounted for 49 and 33 per cent of deaths in this age group in Northern Ireland and Ireland respectively. Examination of the data for the last few years shows that respiratory infections are responsible for an increasing percentage of deaths in this age category. The percentage of respiratory infections in this age category in both DAFM and AFBI has risen by 8 and 11 per cent respectively since 2014.

Mycoplasma bovis was the most frequently detected respiratory pathogen, occurring in 29 per cent of cases in Northern Ireland while it was detected in 13.3 per cent in Ireland. Other bacterial agents detected in AFBI and DAFM laboratories were *P. multocida* (13.4 and 14.8 per cent), *M. haemolytica* (13.8 and 12.5 per cent), *T. pyogenes* (9.2 and 9.5 per cent) and *Histophilus somni* (4.1 and 6.5 per cent). Parasitic pneumonia was diagnosed in 4.6 and 9.5 per cent of cases. Bovine respiratory syncytial virus (BRSV) was the most frequently detected virus (3.7 and 4.2 per cent), PI3 also occurred (1.4 and 1.5 per cent) while BHV-1 virus was detected in 1.4 and 2.3 per cent of cases.

Gastro-intestinal tract (GIT) infections (DAFM 15 per cent, AFBI 8.8 per cent) and systemic infections (DAFM 9 per cent, AFBI 5 per cent) remain similar to the trend of previous years as the second and third most frequently diagnosed conditions. The most frequently recorded agents associated with systemic infections in Northern Ireland and Ireland, respectively, were *Salmonella* Dublin (54 and 13.7 per cent) and *E coli* (18 and 31.5 per cent).

Coccidial species (28 and 29 per cent) were by far the most frequently detected GIT pathogens in this age group. *Salmonella* Dublin was isolated from 2.5 per cent of carcasses with GIT infections in both Northern Ireland and Ireland.

Navel ill/ joint ill, consequences of navel infections at birth, were diagnosed in 9 calves (1 per cent) presented to DAFM laboratories. The most common aetiological agent was *T. pyogenes*.

The diagnosis of peritonitis in this age category has remained at a consistent level, between 1 and 3 per cent, from 2014 to 2016 in both DAFM and AFBI. The pathogens identified in these cases were *Escherichia coli*, *M. haemolytica*, *T. pyogenes* and systemic mycosis.

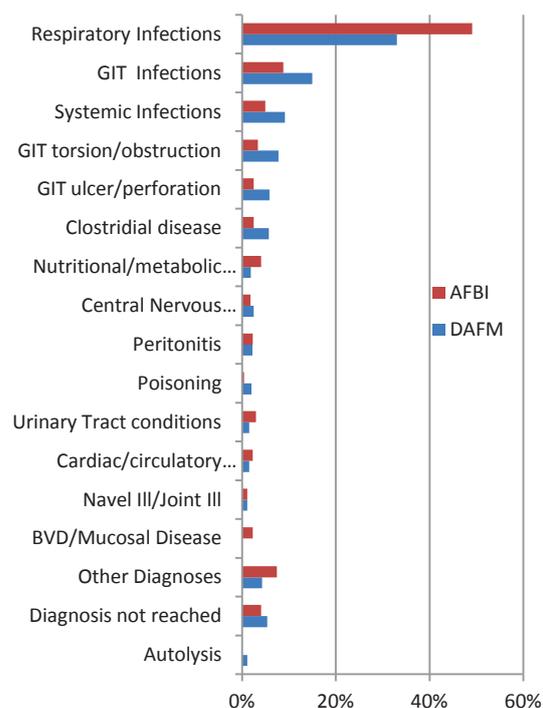


Figure 5: Conditions most frequently diagnosed on post-mortem examination of calves one to five months old by DAFM (n=800) and AFBI (n=442) in 2016. GIT= gastro-intestinal tract

GIT ulcers and perforations continued to be a frequent diagnosis, with more cases seen in DAFM laboratories than in AFBI laboratories (6 per cent and 2.5 per cent respectively). Abomasal ulcers or perforations leading to peritonitis from spillage of intestinal contents accounted for the majority of these cases (Figure 6). GIT torsion/obstruction was recorded in eight and three per cent of calves from Ireland and Northern Ireland respectively; torsions of the intestines, full mesentery, abomasum, omasum and reticulum were recorded. There was no fluctuation in their occurrence from the two previous years.

Nutritional and metabolic conditions were diagnosed in two per cent of DAFM calves and four per cent of AFBI calves. The leading diagnoses in this category were ruminal acidosis (10 and 46 per cent respectively) and

malnutrition (11 and 33 *per cent* respectively). In comparison to previous years there has been a decrease in the frequency of diagnosis of ruminal acidosis in both DAFM and AFBI data, from 4 *per cent* of DAFM cases and 8 *per cent* of AFBI cases in 2014.



Figure 6: Abomasal ulcer in a calf (Photo: John Fagan)

Weanlings (6-12 Months)

As in previous years, respiratory infections were the most commonly diagnosed cause of mortality in this age group and in DAFM and AFBI respectively accounted for 31 and 42 *per cent* of deaths, a marginal decrease from the previous year (Figure 7). As expected from previous years' data, *P. multocida* (15 *per cent* DAFM and 10 *per cent* AFBI) and *M. haemolytica* (15 *per cent* DAFM and 14 *per cent* AFBI) were the two most frequently diagnosed bacterial causes; other bacterial causes included *T. pyogenes* (6.7 *per cent* DAFM and 5.7 *per cent* AFBI), *Mycoplasma bovis* (6 *per cent* DAFM and 23 *per cent* AFBI) and *Histophilus somni* (3 *per cent* DAFM and 3 *per cent* AFBI). Parasitic bronchitis caused by *Dictyocaulus viviparus* continues to be a frequent diagnosis (21 *per cent* DAFM and 20 *per cent* AFBI). Viruses were also detected in cases of respiratory disease as follows: BRSV (13 and 1.5 *per cent*), BHV1 (1.5 and 0 *per cent*) and parainfluenzavirus-3 (PI3) (1.5 and 0 *per cent*) in Ireland and Northern Ireland respectively.

GIT infections were identified as the second most common cause of death in weanlings in Ireland, at 21 *per cent*, while in Northern Ireland the figure was just three *per cent*. Common pathogens isolated were mainly parasitic, with parasitic gastroenteritis accounting for 30 and 67 *per cent* of cases in

DAFM and AFBI respectively, and coccidia spp. associated with fewer than 10 *per cent* of cases in both jurisdictions.

Clostridial diseases were identified as the second biggest cause of mortality in Northern Ireland at 19 *per cent* while they only accounted for 11 *per cent* of mortalities in the same age category in Ireland. This is in keeping with the trend of previous years, 2014 and 2015, where clostridial diseases in Northern Ireland are diagnosed at a consistently higher level, on average 6 *per cent* higher each year.

There were CNS conditions diagnosed in 2.6 *per cent* of carcasses in Ireland this year in comparison to Northern Ireland where the figure was 2.4 *per cent*. Common diagnoses included cerebro-cortical necrosis (45 *per cent* of DAFM cases, none in AFBI), encephalopathy (18 *per cent* DAFM), encephalitis (18 *per cent* DAFM and 50 *per cent* AFBI) meningitis and thrombotic meningo-encephalitis. *Histophilus somni* and *Listeria monocytogenes* were isolated from cases of encephalitis.

There were no cases of bovine viral diarrhoea (BVD)/mucosal disease in this age category for Ireland while it was recorded in two *per cent* of diagnoses in Northern Ireland (4 cases).

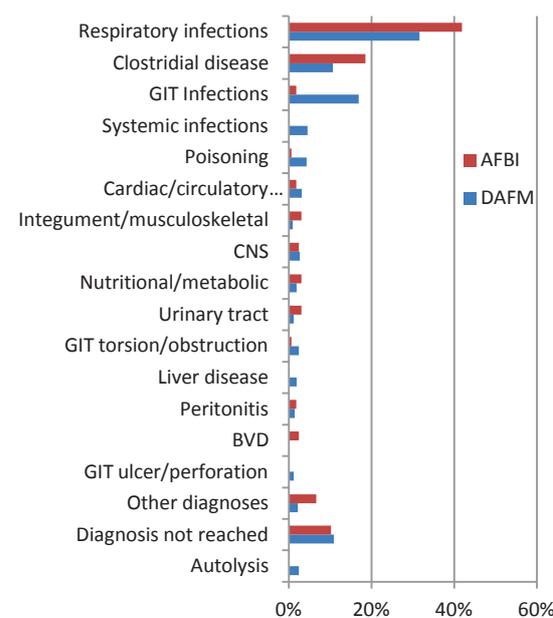


Figure 7: Conditions most frequently diagnosed on post-mortem examination of weanlings (six to twelve months old) by DAFM (n=421) and AFBI (n=167) in 2016. GIT= gastrointestinal tract; CNS = central nervous system; BVD = bovine virus diarrhoea

Adult cattle (> 12 months)

Similar to previous years, respiratory diseases accounted for a large proportion of adult deaths, 17 and 21 *per cent* in Ireland and Northern Ireland respectively (Figure 8). This proportion has remained static in Ireland since 2014 but has been increasing in Northern Ireland in this same period (14 *per cent* in 2014). *M. haemolytica* was isolated from lesions in 22 and 16 *per cent* of cases followed by *D. viviparus* in 16 and 20 *per cent* and BHV-1 in 12 and four *per cent* of cases in Ireland and Northern Ireland respectively. In Ireland, 70 *per cent* of the diagnoses of BHV-1 or infectious bovine rhinotracheitis were from animals over 24 months old, while 64 *per cent* of cases of parasitic bronchitis were diagnosed in animals under 24 months old, which varies from last year's figure of 48 *per cent* in animals under 24 months old.

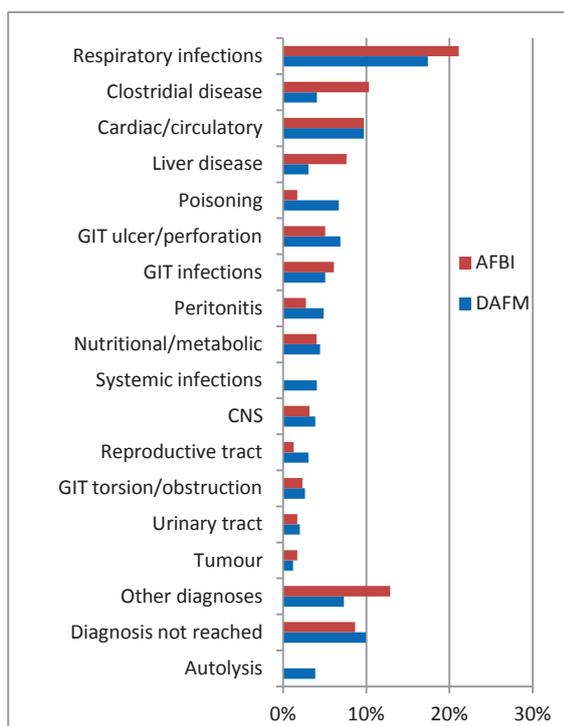


Figure 8: Conditions most frequently diagnosed on *post-mortem* examination of adults (>12 months old) by DAFM (n=494) and AFBI (n=474) in 2016. GIT= gastrointestinal tract; CNS = central nervous system

Cardiac/circulatory system conditions were the second biggest diagnosis in adult cattle in Ireland, occurring in 10 *per cent* of cases, while in Northern Ireland both circulatory infections and clostridial disease accounted for 10 *per cent* each of diagnoses recorded.

Endocarditis, pericarditis, caudal vena cava thrombosis, haemorrhage and haemolysis were common diagnoses in this category. *T. pyogenes* was regularly isolated from cases of endocarditis, pericarditis and caudal vena cava thrombosis (Figure 9).

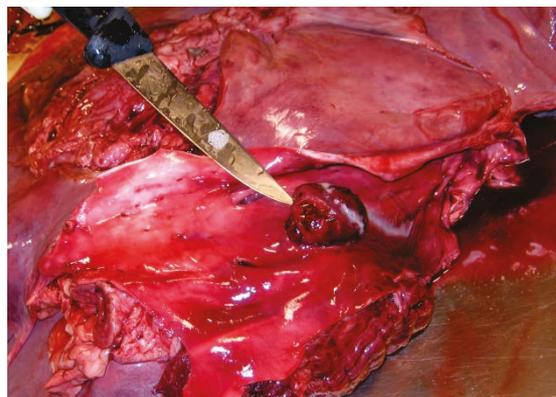


Figure 9: Thrombus in the posterior vena cava of a cow (Photo: John Fagan)

Clostridial disease only accounted for four *per cent* of adult deaths in Ireland while it accounted for 10 *per cent* of adult deaths in Northern Ireland. Aetiological agents detected in association with these conditions included *Clostridium novyi* (15 *per cent* DAFM and 24 *per cent* AFBI), *Cl. chauvoei* (15 *per cent* DAFM and 16 *per cent* AFBI), *Cl. sordellii* (10 *per cent* DAFM and 2 *per cent* AFBI) *Cl. perfringens* type C (10 *per cent* DAFM, 0 *per cent* AFBI) *Cl. septicum* (10 *per cent* DAFM, 2 *per cent* AFBI) and *Cl. perfringens* type D (10 *per cent* DAFM, 0 *per cent* AFBI). *Cl. botulinum* (type C and D) cases accounted for 56 *per cent* of clostridial disease diagnoses in Northern Ireland while in Ireland there were four cases in three herds which represented 20 *per cent* of all clostridial disease diagnoses in adults. GIT ulceration/perforation and foreign body accounted for 7 and 5 *per cent* of deaths in Ireland and Northern Ireland, showing no variation from previous years. Hardware disease or traumatic reticuloperitonitis accounted for 38 and 41 *per cent* of this category in Ireland and Northern Ireland respectively. Abomasal haemorrhages were also identified as a cause of mortality in both jurisdictions.

The most frequently diagnosed nutritional/metabolic conditions (4 *per cent*) were ruminal acidosis and hypomagnesaemia. GIT infections only accounted for 5 and 6 *per*

cent of mortalities in Ireland and Northern Ireland respectively, with parasitic gastroenteritis at 32 and 3 per cent for DAFM and AFBI respectively. In Northern Ireland, mycotic rumenitis was a common diagnosis at 6.8 per cent.

Peritonitis diagnoses equated to five per cent in Ireland and three per cent in Northern Ireland, in keeping with the trend of previous years. The main bacterial aetiologies implicated in Ireland were *E coli* (29 per cent of DAFM cases), *T. pyogenes* (25 per cent of DAFM cases) and *Streptococcus dysgalactiae* (4 per cent of DAFM cases).

Other miscellaneous diagnoses included one case of BVD, six of babesiosis, six of Johne's disease, three of tuberculosis, six of abscessation, six of tumours, six of musculoskeletal conditions, seven of trauma and six cases of mastitis. There was also one case of malignant catarrhal fever caused by ovine herpesvirus 4 (OHV-4). In Northern Ireland, this category included a case of myositis, a case of splenitis, and a case of *T. pyogenes* abscessation.

Johne's Disease

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Diagnostic samples

DAFM tested 1,822 blood samples for *Mycobacterium avium* subspecies paratuberculosis (MAP) antibody using an enzyme-linked immunosorbent assay (ELISA). 299 (16.4 per cent) of these, from 228 herds, were positive. AFBI tested 14,823 blood samples for MAP antibody (also using an ELISA test), of which 1,377 (9.3 per cent) were positive. A further 251 of the samples yielded an inconclusive result.

DAFM carried out MAP culture on 491 bovine faecal samples. MAP was isolated from 84 of the samples, involving 69 herds. The shedding status of the infected animals was classed as high (58 per cent), moderate (23 per cent) or low (19 per cent). AFBI carried out MAP culture on 49 bovine faecal samples, two of which were positive. AFBI also carried out

MAP PCR on another 704 bovine faecal samples, 42 of which were positive.

Study herds

Five herds which have been infected for several years submitted 105 samples from seropositive and suspect animals to DAFM for mycobacterial culture. MAP was isolated from 58 of these samples. An additional 471 samples were submitted from animals in five herds participating in a research project. MAP was isolated from 10.4 per cent of these research samples, and based on the culture results the herd faecal culture prevalence was estimated at 1.6, 2.2, 5.2, 18 and 26.5 per cent within these five individual herds.

Other species

A herd of farmed deer in Ireland disclosed multiple cases of MAP infection. The disease was also recorded in an Irish goat herd during 2016.

Clostridial Disease in Cattle

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JOHN FAGAN, DAFM, RVL ATHLONE

Clostridial disease remained a significant cause of cattle losses in 2016. Blackleg, botulism, clostridial enterotoxaemia and black disease were the most frequently diagnosed clostridial diseases recorded in 2016 (Figure 10).

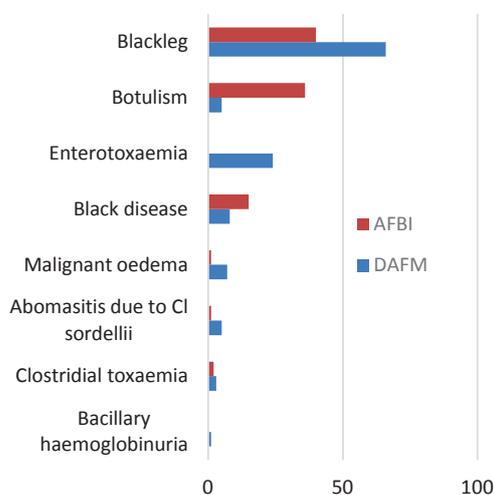


Figure 10: Number of cases of disease caused by clostridial bacteria diagnosed by AFBI (n= 95) and DAFM (n= 119) laboratories in 2016

Blackleg

Blackleg is caused by the soil-associated bacterium *Clostridium chauvoei*. Cases are most frequently observed in rapidly growing young animals in good body condition. One hundred and six cases of blackleg were recorded by DAFM and AFBI laboratories in 2016, an increase on the seventy-four cases confirmed in 2015. Cases were most frequently recorded in younger cattle, with 95 cases (90 per cent) recorded in animals less than one year old (Figures 11 and 14).

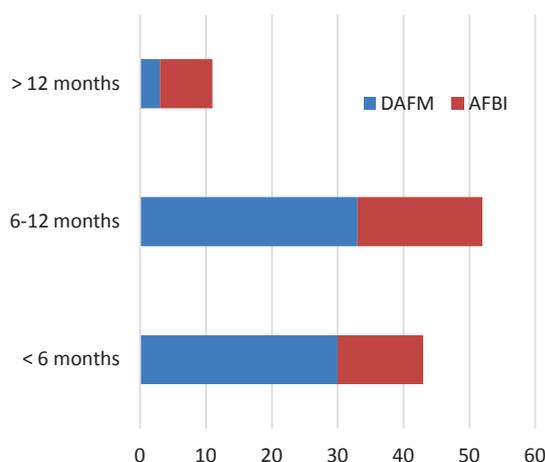


Figure 11: Number of cases of blackleg by age on the island of Ireland in 2016 (n=106)

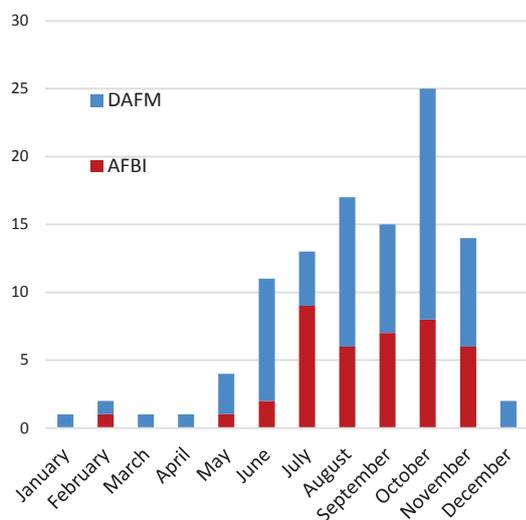


Figure 12: Number of cases of blackleg by month on the island of Ireland in 2016 (n=106)

As *Clostridium chauvoei* is a soil-associated bacterium, most cases of blackleg are observed during the summer and autumn months, when cattle are at pasture. In 2016,

October was the month in which most cases of blackleg were recorded (Figure 12).

Botulism

Forty-one cases of botulism were recorded in 2016, significantly lower than the number of cases recorded in 2015 (70 cases) and similar to the number of cases described in 2014 (42 cases) and 2013 (39 cases). Most cases occurred in adult animals with only nine of the 41 cases (22 per cent) recorded in 2016 being in cattle less than one year of age (Figure 13).

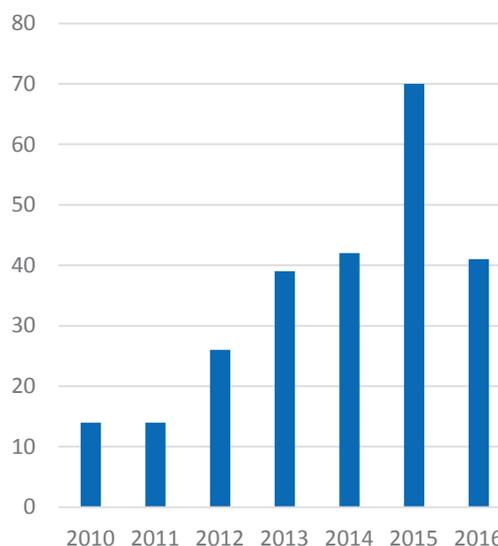


Figure 13: Number of recorded cases of botulism on the island of Ireland between 2010 and 2016

Enterotoxaemia

Enterotoxaemia is caused by the various types of *Clostridium perfringens*, classified according to the production of four major toxins. Twenty-four cases of clostridial enterotoxaemia were confirmed in 2016 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 10).



Figure 14: Blackleg lesion in the hind-limb musculature of a bovine weanling (Photo: Cosme Sánchez-Miguel)

Infectious Necrotic Hepatitis (Black Disease)

Black disease was the fourth most frequently diagnosed clostridial disease in 2016, with 23 cases recorded. Black disease is caused by *Clostridium novyi*, the spores of which are widely distributed in soil. Dormant spores of *Clostridium novyi* in the liver can be activated by the ideal anaerobic conditions created by migrating immature liver fluke, causing a peracute, usually fatal, toxæmia. Most cases are seen in the late summer and autumn, and in 2016 the peak number of cases was observed in August (AFBI) and September (DAFM) (Figure 15). Most cases were found in adult animals with only six cases (26 per cent) recorded in cattle less than twelve months old.

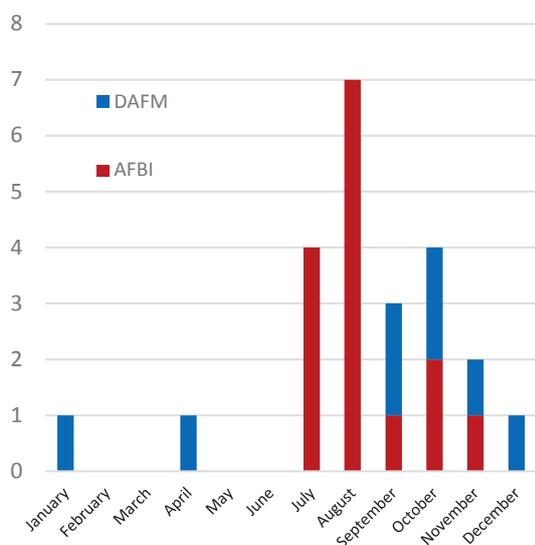


Figure 15: Number of cases of black disease by month on the island of Ireland in 2016 (n=23)

Bovine Neonatal Enteritis

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Approximately 5,000 calf faecal samples were examined in AFBI and DAFM laboratories in 2016. The samples were typically submitted by veterinary practitioners or taken from calf carcasses at post-mortem. As seen previously in the cattle diseases chapter, enteritis continued to be a significant illness in calves

less than one month of age in 2016. The relative frequency of the agents identified is shown in Figure 16, with *Cryptosporidium* and rotavirus continuing to be the main aetiological agents detected in faecal samples. In addition to the routine enteropathogen tests, DAFM laboratories carried out 1,460 tests for *Giardia* spp. in calves less than one month of age. Of these samples, 89 (6.1 per cent) tested positive.

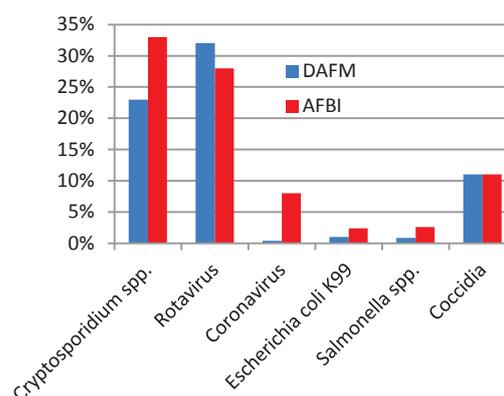


Figure 16: Relative frequency of enteropathogenic agents identified in calf faecal samples tested by AFBI and DAFM laboratories in 2016

Giardia spp. are protozoan parasites that inhabit the small intestines of a large number of vertebrates. Marked histological abnormality is not found in many cases of giardiasis in humans and this also appears to be the case in calves. There may be blunting of the villi, associated with a moderate inflammatory infiltrate into the core of the villus or a heavy population of intra-epithelial lymphocytes. It is recommended that a diagnosis of giardiasis should be reserved for those cases in which no other explanation for the syndrome can be identified. In a Swedish study, Bjorkman *et al.* (2003) found *Giardia intestinalis* in 42 (29 per cent) diarrhoeic samples and 29 (23 per cent) samples from healthy calves.

Pen-side tests are now being used more frequently by private veterinary practitioners (PVP) for testing calf faecal samples; however, additional laboratory assistance may be required in these situations for tests such as bacterial culture and the staining of faecal smears for *Cryptosporidium* oocysts. In older calves, the examination of faecal samples for coccidial oocysts may also assist in the

diagnosis. It should be remembered when interpreting results of coccidial oocyst examinations, that some of the most pathogenic strains may produce small numbers of oocysts and that most non-pathogenic strains can produce large quantities of oocysts. In addition, the peak of shedding may be over before clinical signs appear. With this in mind, when sampling a group of calves for evidence of coccidiosis, it is advisable to take samples from healthy in-contact animals in addition to clinical cases and if possible to speciate the oocysts. Occasionally, histological examination can also assist with the diagnosis of coccidiosis by facilitating the detection of early stages of *Eimeria* spp. in the pre-patent period, before oocysts are detectable in faecal material (Figure 17).

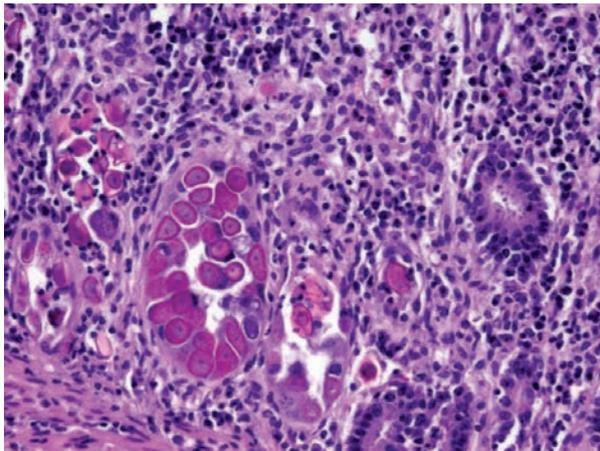


Figure 17: Coccidial macrogametocytes in the intestines of a calf visible under the microscope (Photo: Maresa Sheehan)

Reference:

***Cryptosporidium parvum* and *Giardia intestinalis* in Calf Diarrhoea in Sweden.**

Björkman, Svensson, Christensson and de Verdier. Acta Veterinaria Scandinavica (2003). 44:145

Zinc Sulphate Turbidity Test

IAN HOGAN, DAFM RVL, LIMERICK
HELEN GIBNEY, AFBI, STORMONT

Bovine

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.

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

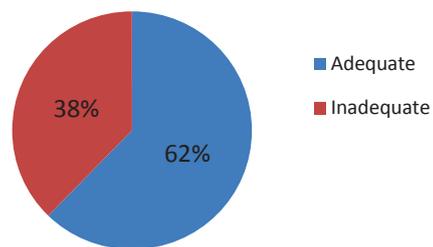


Figure 18: Results of zinc sulphate turbidity tests performed by AFBI and DAFM laboratories in 2016 from submitted bovine calf serum samples (n=1,199). Adequate colostrum immunity is defined as greater than or equal to 20 units and inadequate as less than 20 units

During 2016 a combined total of 1,199 ZST tests were performed by AFBI and DAFM laboratories on bovine samples submitted by private veterinary practitioners (PVP). Around 38 per cent of these samples had values less than 20 units, indicating a failure of passive transfer (Figure 18). This is the same proportion of samples displaying inadequate colostrum transfer as was found in 2015, following a drop from 2014 (46 per cent) and 2013 (50 per cent). The number of samples submitted for ZST testing decreased from 2015 to 2016 for the first time in several years (Figure 19).

When ZST testing was carried out on 807 samples taken from bovine carcasses during post-mortem examinations carried out by AFBI and DAFM, 67 per cent of serum samples from calves had results indicating a failure of passive transfer.

From 1st January 2016 DAFM laboratories changed the concentration of zinc sulphate solution used in the test, from 208 mg/L to 350 mg/litre in response to research which found that this would increase the specificity of this test (Hudgens *et al.*, Hogan *et al.*). The effect of this change should most likely be a

reduction in samples returning a false finding of suboptimal colostrum-derived immunity.

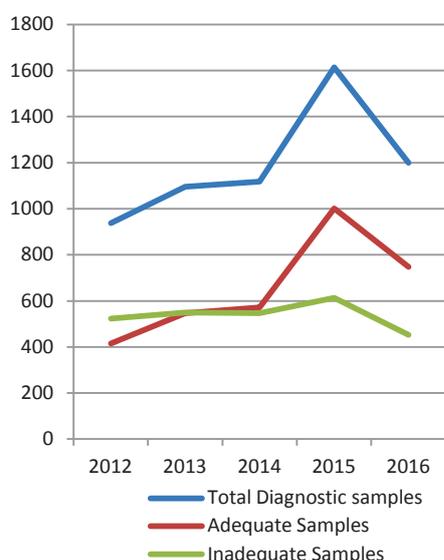


Figure 19: Annual submission numbers of bovine diagnostic samples for ZST testing in AFBI and DAFM laboratories

Ovine

During 2016 only 17 ZST tests were performed by AFBI and DAFM laboratories on ovine samples submitted by PVPs from live lambs. Around 24 *per cent* of these samples had values less than 20 units, indicating a failure of passive transfer. However with such low numbers it is difficult to draw firm conclusions. The number of samples taken from lamb carcasses during post-mortem was much higher, especially in DAFM where a survey into sheep mortality greatly increased the number of lamb carcasses submitted to participating RVLs. Sixty one *per cent* of 299 samples taken from these carcasses had ZST results less than 20 units, while 41 *per cent* out of 41 samples taken from ovine necropsies at AFBI had results less than 20.

While lambs and calves from beef breeds will usually receive adequate colostrum by suckling, dairy calves require herdowner intervention in order to consume enough colostrum to give sufficient protection. 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. The quantity required should be based on weight, with the typical 35-45kg dairy calf needing 3 litres, and smaller cross-bred calves needing less. Poor transfer of colostrum immunity may be due to poor quality colostrum, low

colostral intake or poor colostrum absorption or a combination of these factors.

Supplementary feeding may be required, using a stomach tube or oesophageal feeder. Frozen colostrum can be used; artificial colostrum is less effective but may be used as a last resort.

References:

Optimizing performance of a qualitative zinc sulfate turbidity test for passive transfer of immunoglobulin G in calves. Hudgens KAR, Tyler JW, Besser TE and Krytenberg DS. American Journal of veterinary research (1996) 57, 1711-1713.

Optimisation of the zinc sulphate turbidity test for the determination of immune status. Hogan I, Doherty M, Fagan J, Kennedy E, Conneely M, Crowe B and Lorenz I. Veterinary Record (2016) 178:169.

Bovine abortion

**COSME SÁNCHEZ-MIGUEL, DAFM RVL, CORK
CLARE HOLMES, AFBI, STORMONT**

Bovine abortion causes considerable losses to the cattle industry and efforts should be made to investigate any abortion episode. In addition, the early detection and prevention of primary cases and prevention of any potential bovine brucellosis outbreaks (the whole island is officially free of the disease) remain crucial for both public and animal health considerations. A threshold of five *per cent* or greater for foetal mortality rate has been recommended to instigate an investigation, though in some instances, a cluster of cases in quick succession may be more critical in deciding to submit aborted material to the laboratory and initiate an investigation. Most foetuses (95 *per cent*) submitted for abortion diagnosis to the AFBI and DAFM laboratories were from the fourth month of pregnancy onwards.

The aetiology of bovine abortion is broad and the diagnostic success rate is low; however, appropriate laboratory testing, submission of clinical and vaccination history, epidemiological information and proper sampling, increase the chances of reaching an aetiological diagnosis. An aborted foetus,

placenta and maternal serum samples constitute the standard requirement for an abortion submission. Inclusion of the placenta is critical in the diagnosis of some mycotic and bacterial abortions where the placenta is the primary tissue affected. On many occasions, submission from several abortions may be needed to reach a definitive diagnosis. Occasionally, prudent sample collection and storage (without immediate analysis) from sporadic cases can be useful should further cases be submitted from the same herd.

Salmonella abortion is associated predominantly with the serovar *Salmonella* Dublin. In 2016, as in the previous year, 4.8 per cent of bovine abortions were attributed to *S. Dublin* (Table 1). This type of abortion usually occurs in the second half of the pregnancy. Bacteraemia, usually originating from an intestinal tract infection, leads to the localisation and proliferation of infection in the placentomes. Typically, aborted foetuses are autolysed and often, emphysematous.

Agent/Year	Positive samples		Total positive samples	Percentage of total samples	
	DAFM	AFBI		2016	2015
<i>Trueperella pyogenes</i>	191	33	224	7.1	6.3
<i>Salmonella</i> Dublin	119	33	152	4.8	4.8
<i>Bacillus licheniformis</i>	103	27	130	4.1	4.6
<i>Listeria monocytogenes</i>	87	4	91	2.9	2.6
<i>Aspergillus</i> spp.	12	6	18	0.6	0.8
Totals	n=2,707	n=436	n=3,143		

Table 1: Frequency of detection of selected abortion-causing pathogens by foetal culture in AFBI and DAFM laboratories during 2016 (n=3,143) compared to 2015 (n=3,296)

S. Dublin abortions have a well-documented seasonal distribution, with a peak of cases seen late in the year, characterised by a steady increase towards October/November as shown in Figure 20. The seasonal distribution of this graph reveals the importance of choosing the appropriate time point for vaccination, if a regime is implemented against *S. Dublin* on farm.

Like *S. Dublin*, *Listeria* spp. are widespread in the environment and clinical disease is associated with the ingestion of poorly fermented silage. Following ingestion by the

dam, *Listeria monocytogenes* proliferates firstly in the placenta, and then infection affects the foetal liver. This is followed by septicaemia, and finally death ensues. The proportion of diagnosed abortions attributed to *L. monocytogenes* infection is normally low, amounting to 2.9 per cent of the total abortions during 2016 (Table 1). Most listerial abortions have a sporadic occurrence, and they are rarely associated with listerial encephalitis. An autolysed foetus is usually aborted in the third trimester of gestation.

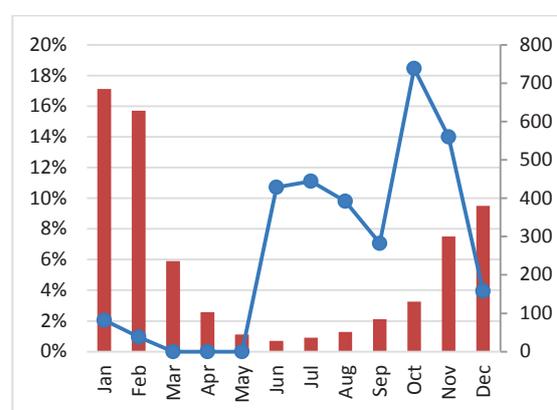


Figure 20: Seasonal distribution of *Salmonella* Dublin isolates from foetal bacterial cultures in DAFM laboratories as a percentage of monthly bovine submissions (line), and total foetal submissions presented as the number of monthly bovine abortion submissions (bars) during 2016

A diverse group of bacteria are also associated with opportunistic infections of the placenta and foetus. Since their presence is widespread in the environment or on mucosal or dermal surfaces, they can potentially cause maternal bacteraemia, reach the gravid uterus and progress to cause sporadic abortions. Included in this are *Trueperella pyogenes*, with 224 isolates in 2016, representing 7.1 per cent of all the microorganisms detected in foetal material, *Bacillus licheniformis* (130 cases), *Streptococcus* spp. (86), *Staphylococcus* spp. (22), *Pseudomonas* spp. (12), *P. multocida* (9) and *Yersinia pseudotuberculosis* (4). Tables 1 and 3 summarise the number of cases in 2016. To be considered as the primary cause of abortion, bacteria and fungi must be isolated from foetal material as a pure growth and generate representative bacterial microscopic lesions. Although usually sporadic, multiple sporadic abortions in a herd can be related to maternal health issues that facilitate haematogenous bacterial infections.

Other important agents include *Leptospira* Hardjo and the protozoan parasite *Neospora caninum* (Table 2). *L. Hardjo* is adapted to cattle which serve as the maintenance host. *Leptospira* spp. are labile and difficult to culture, thus diagnosis normally relies on the detection of antibody titres by foetal serology (DAFM) or on a fluorescent antibody test on foetal kidney smears using multivalent antisera (AFBI).

	DAFM	AFBI	DAFM	AFBI
<i>Neospora caninum</i>	94	31	3.5% *	7.1% *
<i>Leptospira Hardjo</i>	23	14	0.8% *	3.2% *

Table 2: Number of positive diagnoses and relative frequency for *Neospora caninum* and *Leptospira Hardjo* during 2016

* The percentages were calculated with the total number of foetal submissions (n=2,707 and n=436 respectively) as denominator, but not all those foetuses were tested for both pathogens.

Leptospirosis is likely to be an under-diagnosed cause of abortion in cattle due to the different performance characteristics of the diagnostic tests applied. This may explain the variability in the percentage of diagnosed cases between DAFM and AFBI (Table 2). Abortion is frequently the only clinical sign observed in a herd, although in dairy cattle, signs of acute leptospirosis may also include agalactia, mastitis, fever, haemolytic anaemia, haemoglobinuria and icterus.

Organism	Total No.
<i>Coliforms</i>	363
<i>Streptococcus</i> spp.	86
<i>Staphylococcus</i> spp.	22
<i>Bacillus</i> spp	19
<i>Pseudomonas</i> spp.	12
Yeasts and Fungi	9
<i>Listeria</i> spp. (other than <i>L. monocytogenes</i>)	5
<i>Mannheimia haemolytica</i>	5
<i>Pasteurella multocida</i>	9
<i>Salmonella</i> spp. (other than <i>S. Dublin</i>)	4
<i>Yersinia pseudotuberculosis</i>	4
<i>Histophilus somni</i>	2
<i>Bordetella bronchiseptica</i>	1
<i>Campylobacter</i> spp.	4

Table 3: Number of diagnosed abortions associated with other bacterial and fungal agents in AFBI and DAFM during 2016

Cows chronically infected with *Neospora caninum* will transmit the parasite transplacentally. Some infected cows abort, but foetal infections can also produce a live congenitally infected calf which, when reaching adulthood and pregnancy will transmit the parasite onto the next generation and perpetuate the infection in the herd. *N. caninum* infection is originally acquired by the ingestion of oocysts shed in the faeces of dogs, the definitive host. An infected herd typically experiences an endemic low rate of abortions, with some of the cows repeatedly aborting in subsequent years, but occasionally epidemic episodes of neosporosis also occur, especially in naïve herds. Protozoal abortion is normally diagnosed using a combination of foetal serology and histological examination, depending on the foetal age and degree of tissue autolysis. Typical histological findings include a non-suppurative interstitial infiltrate in the CNS and myocardium. Maternal serology can be useful on a herd basis to investigate the association between seropositivity and abortion.

Congenital Defects

Congenital defects occur during foetal development and most of them are incompatible with life. During post-mortem examination of abortion and stillbirth submissions to DAFM in 2016, serious congenital defects were recorded in 63 cases (2.3 per cent) of the total number of submissions. This percentage is similar to the prevalence rate of congenital defects observed in a previous study in foetus and stillbirths submitted to the Cork RVL from 1989 to 2003, in which an overall prevalence rate of 2.6 per cent was found to be the average between those years.

Musculoskeletal system defects are easily detected by the farmer, so it is not unusual that these abnormalities are submitted more frequently to the Regional Laboratories. In 2016 these accounted for 18 cases out of the total 63 recorded defects. There were a wide range of skeletal defects with different degrees of severity, ranging from palatoschisis, congenital failure of fusion of

the midline of the palate (Figure 21), to more complex sets of deformities affecting the same animal such as scoliosis, arthrogyposis and kyphosis. Additional CNS defects, including hydrocephalus (hydrocephaly), cranium bifidum and meningoencephalocele were occasionally present.

Gastro-intestinal defects were also common. Fifteen cases of atresia at various locations, from jejunum to colon, were recorded. The aetiology of this intestinal abnormality is not fully understood. Evidence suggests that Holstein-Friesian calves may be at greater risk. Eleven foetuses were affected with defects related to the central nervous system. Four of them were accompanied by musculoskeletal defects as stated above. The most commonly diagnosed defect of the nervous system was hydrocephalus (hydrocephaly).

Defects of the cardiovascular system (6 cases) included atrial and ventricular defects. However, on some occasions, undefined cardiovascular abnormalities were suspected based on the observation of lesions specific of congestive heart failure such as misshapen heart, ascites, or an enlarged and fibrotic liver.

Thyroid hyperplasia with varying degrees of severity was recorded in 11 cases. In one foetus the gland was 16 times the normal weight. They all were suspected to be related to iodine deficiency. Schistosomus reflexus, a condition where the body cavities fail to close at the midline during embryological development, was recorded on two occasions.

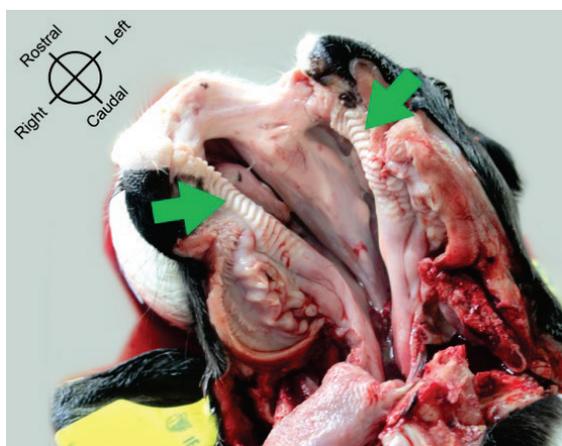


Figure 21: Newborn calf with palatoschisis, exposing the nasal cavity. (Photo: Cosme Sánchez-Miguel)

References:

Abortion investigations – can practitioners do better? Mee JF and Sánchez-Miguel C. Proc. CAVI Conf. (2015), Ireland, p. 91-101

Bovine abortion/stillbirth investigation: a practitioner-focused approach. Mee JF. Proc. of the 29th World Buiatrics Congress (2016), Ireland.

Bovine mastitis

**ALAN JOHNSON, DAFM, RVL LIMERICK
CLARE HOLMES, AFBI, STORMONT**

With the rapid expansion of the Irish dairy industry since the abolition of milk quotas in 2015, the risk of disease has risen on most dairy farms. Mastitis, both clinical and sub-clinical, has long been considered to be the single most costly disease of dairy herds in Ireland, as it significantly reduces profitability by depressing milk yield through damage to mammary gland secretory tissue. There are additional losses resulting from failing to achieve payment bonuses, milk being discarded during antibiotic treatment and increased culling rates of chronically infected cows.



Figure 22: Inoculation of agar plates for the culture of a milk sample in Limerick RVL (Photo: Alan Johnson)

Milk culture (Figure 22) is a valuable tool that can be used as part of a mastitis control programme. Bacterial infection is responsible for the vast majority of cases of mastitis (clinical and subclinical), and identifying the agent responsible gives important information about the possible source of infection (contagious or environmental) and where to

focus control measures to achieve success in improving milk quality.

Bacteriological examination was carried out on 3,950 milk samples by AFBI and DAFM in 2016. Figure 23 illustrates the isolation rates of the most commonly encountered mastitis pathogens in 2016.

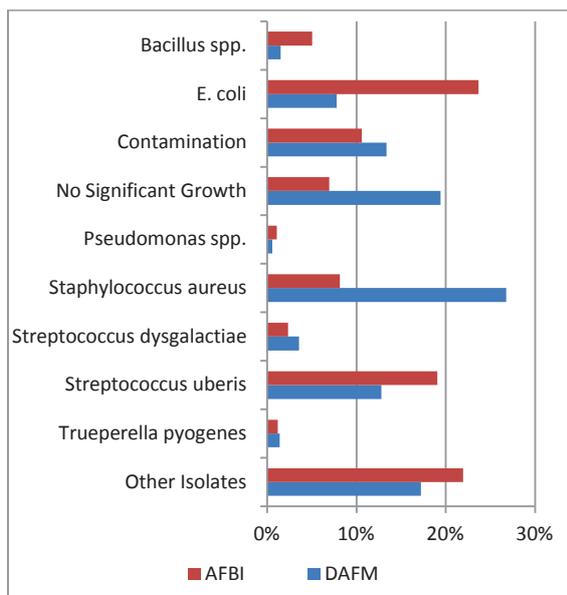


Figure 23: Relative frequency of detection of selected mastitis pathogens by AFBI (n=934) and DAFM (n=2887) laboratories during 2016

Staphylococcus aureus was the most common mastitis-associated pathogen isolated by DAFM in 2016. It was identified in 773 (26.8 per cent) of the 2,887 samples cultured. This has been the case for a number of years and it illustrates how significant a role the pathogen has to play in the udder health of dairy cows in Ireland. *S. aureus* is a ‘contagious’ mastitis pathogen, typically spread from cow to cow via the milking equipment or the milker’s hands. The *S. aureus* isolation rate has been far lower in AFBI laboratories in recent years, and was 8.1 per cent in 2016. Data generated in Great Britain has shown that the isolation rate of *S. aureus* from milk samples examined there has declined significantly over the last 10-20 years, probably as a result of the more diligent application of proven mastitis control measures on dairy farms. With many milk processors in Ireland implementing more stringent bonus and penalty schemes and the setting up of Animal Health Ireland’s national mastitis control programme (Cellcheck), milk quality has improved considerably since 2013.

Figure 24 illustrates the relative frequency of detection of *S. aureus* in AFBI and DAFM laboratories since 2010, and the reduced detection that has occurred in DAFM laboratories since 2014.

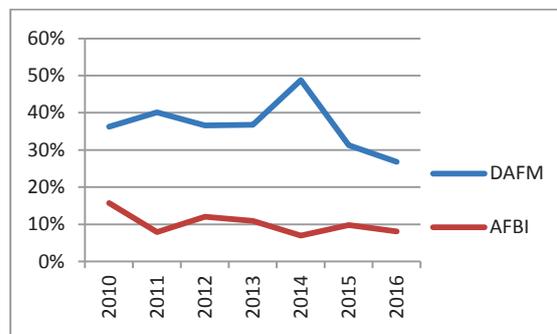


Figure 24: Relative frequency of detection of *Staphylococcus aureus* in AFBI and DAFM laboratories between 2010 and 2016

Escherichia coli was the most common mastitis-associated pathogen isolated by AFBI in 2016. It was identified in 221 (23.7 per cent) of the 934 samples cultured. DAFM laboratories isolated *E. coli* less frequently, in 7.8 per cent of the samples cultured. *E. coli* is typically considered to be an environmental pathogen. The findings follow the pattern seen in recent years (Figure 25).

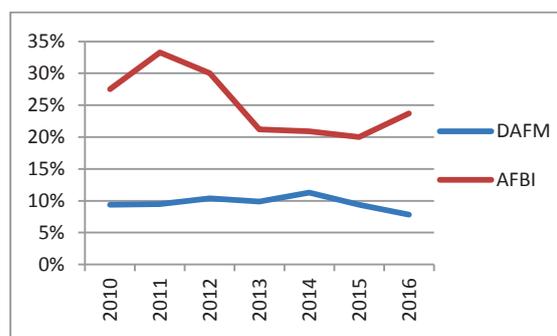


Figure 25: Relative frequency of detection of *Escherichia coli* in AFBI and DAFM laboratories between 2010 and 2016

Contamination of samples remains a significant issue for laboratories. 10.6 per cent of AFBI samples and 13.4 per cent of DAFM samples were considered to be contaminated. The percentage of contaminated samples has been falling over recent years, probably as a result of better education on the importance of a good sampling technique, the use of sterile containers and the prompt refrigeration and testing of samples.

Bovine Respiratory Disease

GERARD MURRAY, DAFM, RVL SLIGO

PAULINE SHERIDAN, AFBI, OMAGH

During 2016 bovine respiratory disease (BRD) was diagnosed as the cause of mortality in 23.4 per cent of all bovine carcasses submitted to the DAFM and AFBI laboratories. BRD is consistently the most significant cause of morbidity and mortality in cattle of all ages worldwide. Owing to the multifactorial aetiology of BRD which involves the interaction between environmental factors (such as stress), host factors (e.g. immune status, intercurrent disease) and pathogens, control of the disease can be difficult to effect within specific herds.

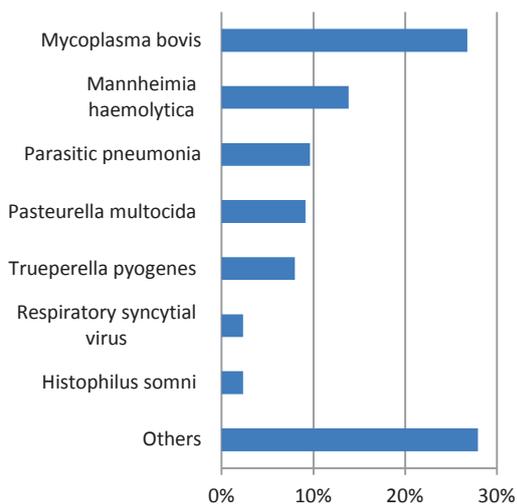


Figure 26: Relative frequency of pathogenic agents detected in bovine respiratory disease cases diagnosed on post-mortem examination by AFBI during 2016 (n=426)

BRD can be caused or contributed to by a wide range of infections. 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 2016, bacterial pathogens were the most frequently identified respiratory pathogens in cattle of all age groups, with parasitic and viral agents identified less frequently (Figures 26 and 27).

Bovine respiratory syncytial virus (BRSV) was the viral pathogen identified with greatest frequency in BRD cases on post-mortem examination. 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. 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.

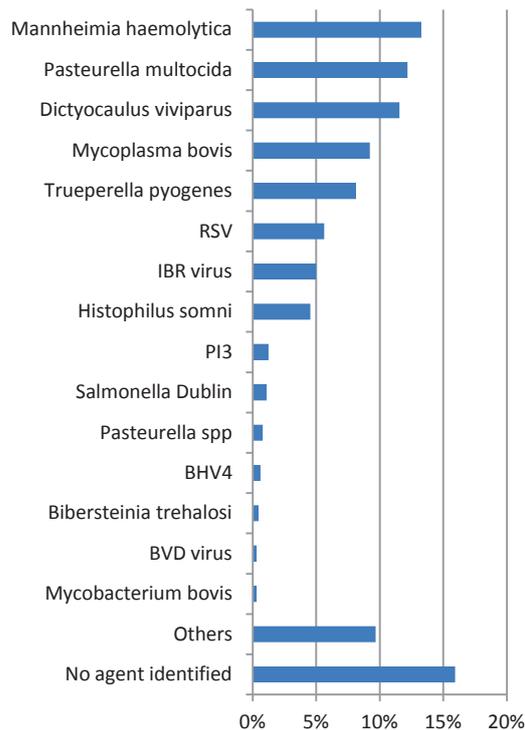


Figure 27: Relative frequency of pathogenic agents detected in bovine respiratory disease cases diagnosed on post-mortem examination by DAFM during 2016 (n=640)

Mycoplasma bovis was the respiratory pathogen identified with the greatest frequency on post-mortem examination of cattle diagnosed with BRD during 2016 in Northern Ireland. 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. *M. bovis* is present in the airways of a significant proportion of healthy animals such that positive detections of the pathogen by PCR need to be interpreted in conjunction with pathological findings.

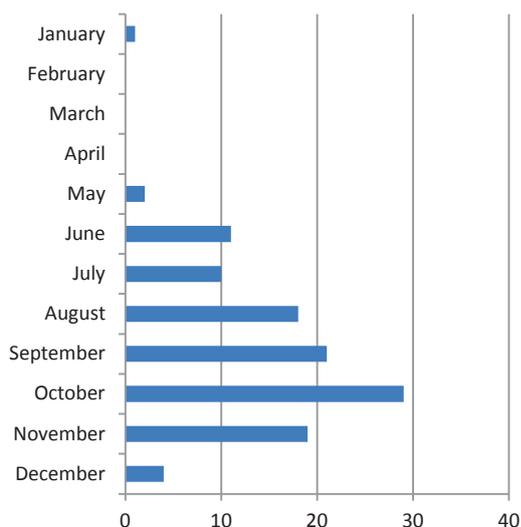


Figure 28: Number of diagnoses of hoose/husk (parasitic bronchopneumonia) in AFBI and DAFM laboratories by month of diagnosis during 2016 (n=115)

Parasitic bronchitis (hoose/husk) caused by the lungworm, *Dictyocaulus viviparus* is regularly diagnosed over the summer and autumn months, normally peaking in late August and early September (Figure 28). Occasional cases with adult lungworms in the airways were detected in November and December. Adults of *D. viviparus* inhabit the large mainstem bronchi and trachea, 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 airways, emphysema is a common lesion in lungworm infection. Immunity to lungworm is relatively short lived and a constant low level exposure is most effective in order to maintain high levels of immunity. Re-infection 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 (i.e. without adult worms laying eggs in the airways). Patent lungworm infection 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.

Bovine Tuberculosis Eradication Programme in Ireland

PHILIP BRESLIN, TB ERADICATION PROGRAMME POLICY, BACKWESTON

A bovine tuberculosis (bTB) eradication scheme has been in place in the Republic of Ireland since the 1950s. Rapid progress was achieved in the initial period of the scheme reducing animal incidence from 17 per cent in 1950 to 0.44 per cent in 1965. However, progress stalled between the mid sixties and 2000, with numbers ranging between 20,000 and 40,000 reactors per year. At that stage, a new strategic framework was put in place. This involved, on an incremental basis, investment in enhanced IT systems (Animal Identification and Movement and Animal Health Computer System), wildlife management, research, quality control and policy development. This has resulted in a surveillance system that incorporates the use of the single intradermal comparative tuberculin test (SICTT) on all herds on an annual basis as well as specific protocols for low and high risk herds. In addition an interferon gamma (IFN- γ) release assay is used in a targeted manner in herds where there is evidence of *M. bovis* infection. Routine post-mortem examination is carried out on all cattle slaughtered, with enhanced protocols in place for reactor animals. This is supported by the Central Veterinary Research Laboratory (CVRL) in Backweston, providing diagnosis of suspected tuberculous lesions. Considerable progress has been made in reducing the incidence of bTB. The number of new herd restrictions has been reduced from almost 11,000 in 2000 to 3,682 in 2016. The number of reactors has reduced to 16,914 from 33,702 in the same period (Figure 29). Similar trends have been observed for herd

incidence and APT (reactor animals per 1,000 tests) (Figure 30).

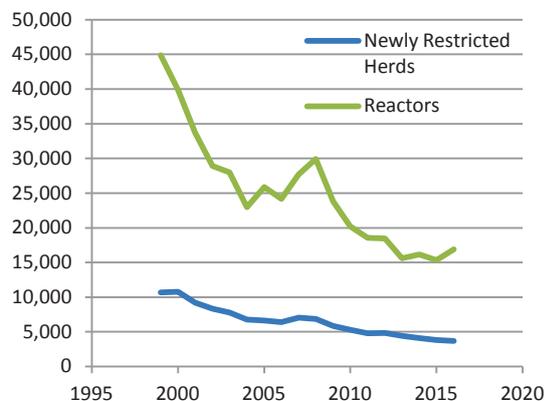


Figure 29: Number of newly restricted herds for bovine tuberculosis and the number of reactor cattle between 1995 and 2006

The herd incidence reduced from 3.4 *per cent* in 2015 to 3.3 *per cent* in 2016, whereas the APT increased from 1.82 *per cent* to 1.96 *per cent* for the same period. The APT includes all animals removed as reactors, including those positive to both the SICTT and IFN- γ tests. Over the last 3 years the use of the IFN- γ test in targeted cohort animals has increased from 9,586 in 2014 to 34,341 in 2016 as the policy has changed from a voluntary targeting of infected animal groups to one where all herds with four or more reactors are assessed for testing. This has resulted in the number of reactors disclosed from IFN- γ testing to increase from 2,742 to 4,792, which comprise 9.7 *per cent* and 24.5 *per cent* of total reactors respectively for those years. The increased use of the IFN- γ test in targeted animals is intended to reduce the overall duration of TB breakdowns, the number of subsequent breakdowns and the number of reactors in subsequent breakdowns over time as the policy is designed to identify an increased proportion of animals that have early-stage infection and those infected animals that fail to react to the SICTT. For 2016, the latter group of animals, when compared to animals that are SICTT positive but IFN- γ negative have abattoir post-mortem lesion rates of 15 *per cent* versus 16 *per cent*.

Bovine TB in Ireland continues to be located in geographical hotspots but the TB reactor density maps shown in Figure 31 (courtesy of Guy McGrath, CVERA, UCD) demonstrate the

effectiveness of focused testing of high risk herds, their contiguous herds, badger removal where implicated and the targeted application of supplementary blood testing.

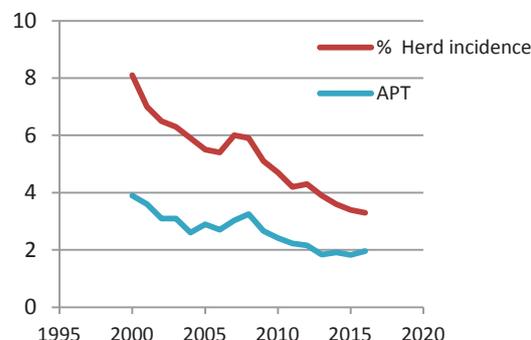


Figure 30: Herd incidence of bovine tuberculosis and the APT rate in cattle herds between 2000 and 2016

The TB statistics for 2016 (Table 4) also demonstrate the geographical variability by county in the key parameters. Renewed policy initiatives to be delivered in 2017 will enhance disease reduction in those areas. Routine abattoir post-mortem examination of all cattle slaughtered in Ireland leads to the submission of suspected tuberculous lesions, primarily in the lymph nodes of the head and the mediastinum, to the CVRL in Backweston for histological, microbiological culture and PCR testing. Over the period of 2006 to 2016 this has resulted in the overall sample submission and the submission of confirmed TB lesions falling whilst the confidence in the surveillance remains strong with non-TB sample submission rates remaining constant over the period (Figure 32).

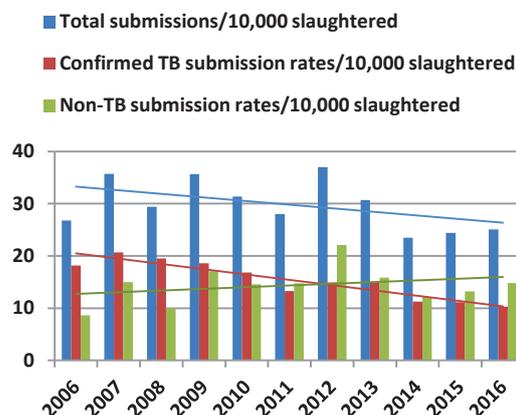


Figure 31: Slaughterhouse Sample Submission Monitor in Ireland between 2006 and 2016

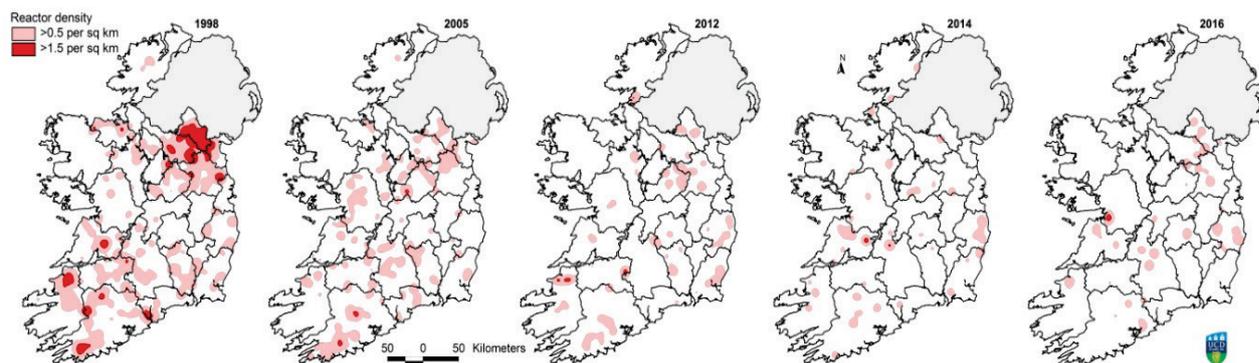


Figure 32: Bovine tuberculosis reactor density at > 1.5 reactors/Km² between 1998 and 2016 (CVERA, UCD)

RVO	Herds Restricted Since 01/01/16	Herd Incidence	Herds Restricted at 31/12/2016	Number of Animals in RVO	Number of Tests on Animals	No. of Reactors 31/12/2016	Reactors per 1000 Tests A.P.T.
CARLOW	33	2.52%	21	98,905	119,607	126	1.05
CAVAN	157	3.27%	79	222,871	302,990	812	2.68
CLARE	235	3.84%	135	257,768	378,083	1,335	3.53
CORK North	246	4.36%	130	530,542	713,432	1,534	2.15
CORK South	212	3.56%	106	458,753	615,751	884	1.44
DONEGAL	117	2.21%	56	170,385	217,131	249	1.15
DUBLIN	26	7.05%	19	21,363	31,404	53	1.69
GALWAY	289	2.60%	147	398,962	516,534	1,078	2.09
KERRY	164	2.48%	98	311,312	429,956	1,109	2.58
KILDARE	67	3.56%	63	122,601	150,313	261	1.74
KILKENNY	113	3.65%	63	328,034	416,548	405	0.97
LAOIS	120	4.20%	84	236,636	286,424	523	1.83
LEITRIM	46	1.56%	25	68,782	89,142	110	1.23
LIMERICK	131	2.43%	71	372,799	493,179	594	1.2
LONGFORD	56	2.35%	33	107,843	134,998	120	0.89
LOUTH	46	3.90%	25	87,879	103,720	193	1.86
MAYO	143	1.57%	77	247,705	319,189	275	0.86
MEATH	201	5.60%	127	274,358	401,834	1,029	2.56
MONAGHAN	168	4.01%	92	202,605	287,636	1,013	3.52
OFFALY	149	4.79%	72	220,693	292,814	492	1.68
ROSCOMMON	140	2.58%	69	184,407	253,866	376	1.48
SLIGO	92	2.62%	36	101,430	142,348	218	1.53
TIPP NORTH	148	4.33%	88	301,269	427,999	968	2.26
TIPP SOUTH	102	2.99%	56	300,134	386,177	489	1.27
WATERFORD	59	2.69%	36	238,378	300,636	567	1.89
WESTMEATH	136	4.51%	74	194,099	271,309	484	1.78
WEXFORD	139	4.54%	71	277,638	368,231	507	1.38
WICKLOW E	78	7.26%	48	75,768	114,671	640	5.58
WICKLOW W	69	12.52%	34	42,015	69,902	470	6.72
TOTAL	3,682	3.27%	2,035	6,455,934	8,635,824	16,914	1.96

Table 4: TB statistics for 2016 by county in Ireland

Bovine Tuberculosis Eradication Programme in Northern Ireland

ENZO ASCENZI, DAERA, STORMONT

Key disease control components of the Northern Ireland bovine tuberculosis (bTB) eradication programme, namely:

- 1. Disease surveillance** - passive surveillance based on post-mortem examination (PME) of all slaughtered cattle and active surveillance using the single intradermal comparative tuberculin test (SICTT) and the interferon gamma (IFN-γ) release assay in selected herds.
- 2. Removal of reactor animals** – the disclosure of diseased animals (reactors) leads to their compulsory slaughter.
- 3. Veterinary risk assessment and the application of appropriate disease controls**, which are applied as soon as disease is suspected to prevent further spread and also following investigations to indicate where disease may have come from, or spread to. Herds or animals that are considered to be at increased risk are subject to additional testing and movement controls, if applicable.

Disease summary

1. In 2016 the annual herd incidence increased to 7.45 *per cent*. The annual animal incidence also increased (0.70 *per cent*) (Figure 33).

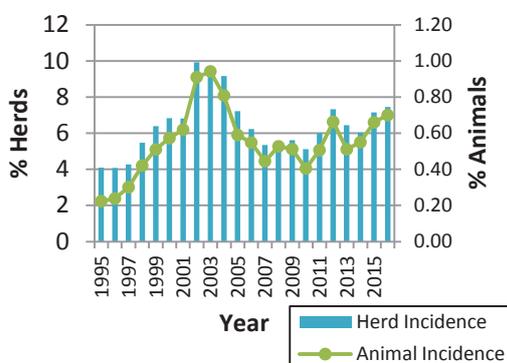


Figure 33: Annual animal and herd incidences of bovine tuberculosis in Northern Ireland 1995-2016

2. The number of SICTT reactor animals identified in 2016 was 11,923.
3. The number of new bTB herd breakdowns disclosed in 2016 (herds having a TB reactor in the year which did not have a reactor in the

previous 12 months) was 1,739.

4. The number of bTB-confirmed Lesion at Routine Slaughter animals (LRS) disclosed in 2016 was 1,007. This figure does not include animals imported directly for slaughter.

Surveillance summary

Herd Tests

During 2016 approximately 1.8 million cattle (+3.1 *per cent* compared to 2015) in NI were bTB tested from 23,344 herds. There were 34,350 herd tests completed (Table 5). The number and category of herd tests are shown in Table 6.

Herd Test Reason	Herd tests completed in 2016
Restricted	6,843
Risk	12,092
Routine	15,415
Total herd tests	34,350

Table 5: Number of bovine tuberculosis herd tests completed in 2016 (by test reason)

Herd test category	Count
(Annual Herd Test) AHT	1,104
(Backward Trace Check Test) BCT	531
(Check Herd Test) CHT	501
(Forward Trace Check Test) FCT	18
(High Risk Test) HRT	28
(Lateral Check Test) LCT	2,140
(Overdue Herd Test) OHT	9
(1 st Restricted Herd Test) RH1	5,233
(2 nd Restricted Herd Test) RH2	548
(Restricted Herd Test) RHT	1,112
(Restocking Test) RST	12
Total	11,236

Table 6: Number of bovine tuberculosis reactors by herd test category in 2016

Individual Animal Tests

The number of SICTTs completed in 2016 was 9,187 (Table 7).

Test Reason	Tests completed during 2016
Inconclusive retest (RI)	1,573
Check Test Trace (CTT)	6,250
Check Test Query (CTQ)	1,024
Check Test Status (CTS)	340
Total	9,187

Table 7: Individual animal level risk bovine single intradermal comparative tuberculin tests completed in 2016 (excluding private individual tests)

Individual test category	Count
Check Test Query	5
Check Test Status	6
Check Test Trace	139
(Private Check Test) PCT	4
(Private Test- Move not allowed) PNA	12
(1 st Inconclusive retest) RI1	522
Total	688

Table 8: Number of bovine tuberculosis reactors by individual test category in 2016

Total Animals Tested

The total number of animal tests in 2016 was 2,401,447 (Table 9). The number of animals tested was 1,767,922 (some animals were tested more than once). Overall, the number of bTB-confirmed skin reactors in 2016 was 5,339.

Test category	2016
Total animal tests	2,401,447
Total animals tested	1,767,922
Total animals with a restricted herd test	563,476
Total animals with a risk herd test	765,139
Total animals with a routine herd test	741,101

Table 9: Total animals tested for bovine tuberculosis and total animal tests in herd tests, excluding private individual tests

Lesions at Routine Slaughter (LRS)

In 2016, 1,635 animals were found with TB-like lesions at routine slaughter (this figure does not include animals imported for direct slaughter). Of these, 1,007 (61.6 per cent) were confirmed as bTB positive by histology and/or bacteriology (Table 10). 297 bTB breakdowns initiated by an LRS had reactors at the next skin test, and 194 bTB breakdowns initiated by a confirmed LRS had reactors at the next skin test.

Year	Number of LRS excluding direct imports	Number of confirmed LRS excluding direct imports (%)	bTB confirmed LRS per 1000 animals slaughtered excluding direct imports (%)
2016	1,635	1,007 (61.6)	2.4

Table 10: Number of LRS animals and confirmed LRS* animals in 2015 and 2016

*Histology and/or bacteriology positive

Interferon Gamma Blood Testing

Since July 2004, the interferon gamma (IFN-γ) release assay has been used in parallel with

the SICTT in bTB breakdowns, where certain criteria for selection are met, with the purpose of identifying, and thereby providing the opportunity to remove, infected animals that have not been identified by the skin test. The number of IFN-γ samples taken during the year is dependent on the disease levels, the number and the size of eligible herds and resource availability.

In February 2016 significant changes were implemented to maximise the overall disease control benefit IFN-γ contributes to the TB programme. IFN-γ is now targeted at the cohort groups of previous skin reactors or animals with confirmed TB lesions at routine slaughter and IFN-γ testing is no longer offered at consecutive breakdown skin tests to give more herds the opportunity to use the test. Following analysis of previous results by AFBI the test positive cut-off has been increased from $(B - A) \geq 0.05$ to $(B - A) \geq 0.1$, the test is now run on single wells rather than duplicate wells, and the routine use of the ESAT6 antigen has been discontinued.

These changes, and an increase in laboratory capacity, enabled an 11 per cent increase in the number of animals IFN-γ tested in 2016 (17,611) compared to 2015 (15,871), and a 5 per cent increase in the number of IFN-γ herd tests (208) compared to 2015 (198). 185 different herds were IFN-γ tested (177 in 2015).

1,041 animals were IFN-γ positive (6.0 per cent of the animals with valid skin and IFN-γ results), compared to 1,222 animals IFN-γ positive in 2015 (8.2 per cent).

DAERA offered voluntary valuation and removal of the 821 IFN-γ positive animals which were not removed as skin test positive or negative in-contacts in 2016. This was an 8.7 per cent decrease from the 899 animals offered valuation and removal in 2015. Of these, 719 animals were voluntarily slaughtered, a 19 per cent increase compared to 2015 (604 animals). Of the IFN-γ positive animals offered removal, 87.6 per cent were slaughtered in 2016, a significant increase from the 67.2 per cent slaughtered in 2015. (The increased voluntary slaughter rate is a direct result of the switch from whole herd testing to cohort testing, and the increased

test positive cut-off since February 2016.) TB was confirmed at post-mortem in 9.5 per cent of these animals (9.1 per cent in 2015).

Badger Road Traffic Accident Survey

The Badger Road traffic Accident (RTA) Survey, a province-wide survey, has been ongoing since the mid-1998. In 2016, 337 badgers were submitted, of which 53 (15.7 per cent) were confirmed bTB positive following histology and/or bacteriology (Figure 34).

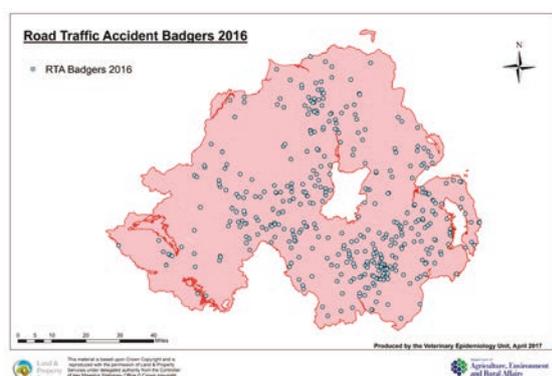


Figure 34: Geographical distribution of the 337 badgers submitted as part of the badger road traffic accident survey in 2016 (Data source: DAERA)

Bovine viral diarrhoea (BVD) Eradication Programmes

DAVID GRAHAM, ANIMAL HEALTH IRELAND
 SAM STRAIN, ANIMAL HEALTH AND WELFARE NORTHERN IRELAND
 MARIA GUEL BENZU, AFBI, STORMONT

Introduction

Eradication programmes for bovine viral diarrhoea (BVD) are overseen by Animal Health Ireland (AHI) in Ireland, and Animal Health and Welfare Northern Ireland (AHWNI) in Northern Ireland. Compulsory programmes are in place since 2013 in Ireland, and 2016 in Northern Ireland.

Ireland

Just over 2.3 million calves were born in 2016. Consistent with previous years, there was a very high level of compliance with the requirement to tissue tag test these calves, with results received by the programme

database for 99.6 per cent of these. The overall prevalence of persistently infected (PI) calves born in 2016 was 0.16 per cent (3,798), representing a reduction of approximately 50 per cent compared to 2015, when 0.33 per cent (7,424) were identified as PI. The prevalence of herds in which one or more calves had a positive or inconclusive result also decreased markedly from 5.9 per cent (4,759) to 3.2 per cent (2,534). These figures indicate an overall decrease in the prevalence of PI calves born during the compulsory phase of the programme by some 75 per cent, from 0.66 per cent in 2013 (Figures 35 and 36).

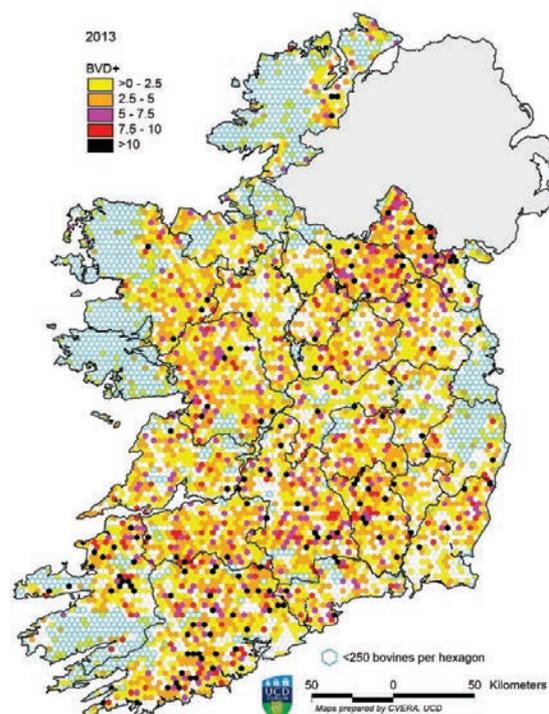


Figure 35: Map showing distribution of PI births in Ireland during 2013. Each hexagon represents an area of approximately 10km²

During 2016, the BVD Implementation Group (BVDIG) of Animal Health Ireland continued to emphasise the importance of prompt removal of all PI animals once identified, with strict isolation where the option to conduct a confirmatory re-test was applied. At the end of 2016 only 282 PI calves born in 2016 were still alive, compared to a figure of 891 2015-born PIs still alive at the end of 2015.

This increased rate of removal was assisted by the introduction by DAFM of restrictions (on both movements in and out) for herds retaining PI animals for more than seven weeks after the date of their first test, and

continues the year-on-year reduction in the level of retention of PI calves, as demonstrated in a study carried out by the Centre for Veterinary Epidemiology and Risk Assessment (CVERA) at University College Dublin (Clegg *et al.*, 2016).

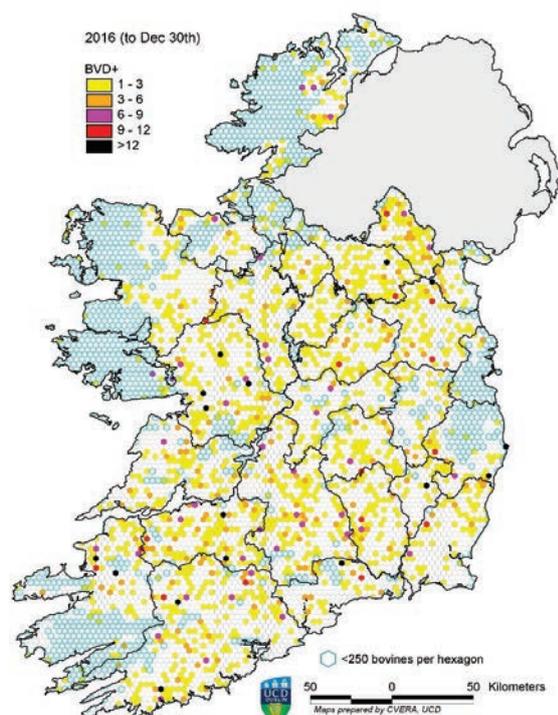


Figure 36: Map showing distribution of PI births in Ireland during 2016. Each hexagon represents an area of approximately 10km²

Negative herd status

A herd may qualify for negative herd status (NHS) by meeting the following requirements:

1. Existence of a negative BVD status for every animal currently in the herd (on the basis of either 'direct' or 'indirect' results).
2. Absence of any animal(s) deemed to be persistently infected with BVD virus from the herd in the 12 months preceding the acquisition of NHS.

At the end of 2015 49,087 of approximately 83,000 breeding herds had achieved NHS. By the end of 2016, this had risen to almost 65,000 (78 *per cent*), with the programme database holding a status on 99.2 *per cent* of the 5.7 million cattle in these herds. The status of the remaining 0.8 *per cent* (44,000) is unknown, with the majority (31,000) of these animals having been born prior to the start of the programme in 2013. The presence of small numbers of these untested animals is the reason that the majority of non-NHS herds

have not yet acquired a negative status. 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, and therefore the testing of these remaining unknown animals is an important goal for 2017. In December 2016, ICBC began issuing SMS messages or letters to these herds, listing the identity of these animals and encouraging their testing.

Targeted Advisory Service on Animal Health (TASAH)

The Targeted Advisory Service on Animal Health (TASAH) was introduced in late 2015 and provided an investigation by a trained veterinary practitioner for herds with one or more positive results in 2016. These investigations were funded through the Rural Development Plan (2014-2020) and sought to review herd biosecurity, identify a plausible source or sources of infection, ensure that the herd was left free from BVDV and agree farm-specific biosecurity measures to prevent its re-introduction. Animal Health Ireland (AHI) trained almost 400 private veterinary practitioners in the performance of herd investigations, with participating farmers typically able to select a practitioner from their own veterinary practice to conduct their investigation. (see

http://animalhealthireland.ie/?page_id=5009 for a full listing). By the end of 2016, 1,430 investigations had been requested, of which almost three quarters had been completed, biosecurity recommendations provided to herd owners, and the results reported to AHI. Preliminary analysis of these results indicated that the majority (82 *per cent*) of herd owners were provided with three biosecurity recommendations, with these most commonly relating to the risks of introduction of virus associated with personnel (including the farmer), the purchase of cattle, contact with neighbouring cattle at pasture and the role of vaccination. One or more plausible sources of infection were identified in 84 *per cent* of herds, with a single plausible source identified in 47 *per cent* of herds. In approximately one third of cases the source

was considered to be within the herd, while in two thirds of cases it was outside the herd. This latter proportion is anticipated to increase further as the number of herds with NHS increases, requiring a greater emphasis on bioexclusion measures to prevent accidental introduction of BVD virus.

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 the Department of Agriculture, Environment and Rural Affairs of Northern Ireland (DAERA)-approved identity tags which take a small section of ear tissue that 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. The success of the voluntary programme led to the commencement of the compulsory BVD eradication programme on 1st March 2016. The compulsory programme is carried out under the Bovine Viral Diarrhoea Eradication Scheme Order (2016) and requires all animals born on or after 1st March 2016 to be tested for BVD virus. Only animals with a negative test result are permitted to move to another herd.

Up to the end of December 2016, 18,581 herds had joined the programme. During the year a total of 731,709 animals were ascribed either a direct or an indirect disease status. Of the 465,188 animals with a direct test result, 2,933 (0.63 *per cent*) were identified as infected. 266,513 dams were ascribed an

indirect BVD status. Eight additional offspring from persistently infected dams were identified.

Approximately nine *per cent* of those herds that were tested during the nine months of the compulsory programme had test-positive animals. Of these herds, the great majority had four or fewer. Most herds with direct evidence of infection had only one test-positive calf (Figure 37). A clear correlation was observed between the size of the herd and the likelihood of infection being present. For example, less than five *per cent* of herds smaller than 11 animals had test-positive calves compared to approximately one third of herds larger than 250 animals (Figure 38).

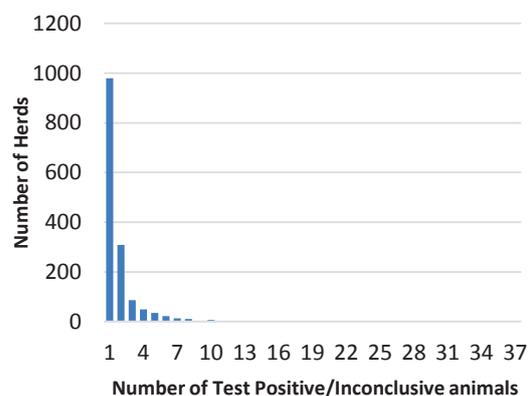


Figure 37: Distribution of test positive/inconclusive animals by herd since the introduction of the compulsory phase in Northern Ireland in 2016

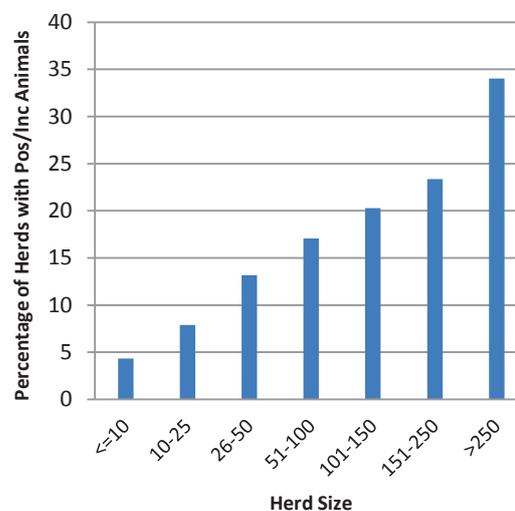


Figure 38: Relationship of herd size and likelihood of testing positive or inconclusive for BVD virus since the introduction of the compulsory phase in Northern Ireland in 2016

Reference:

Temporal trends in the retention of BVD+ calves and associated animal and herd-level risk factors during the compulsory eradication programme in Ireland. Clegg TA, Graham DA, O’Sullivan P, McGrath G, More SJ. Preventive Veterinary Medicine (2016) 134: 128–38

Fatal Poisonings

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Cases of poisoning were recorded in cattle, sheep, dogs and wild birds in 2016. Poisonings were most frequently recorded in cattle (93 cases) followed by sheep (67 cases). The wild bird poisoning cases are described in the “Wildlife Surveillance” section.

Cattle

Ninety-three cases of fatal toxicity in cattle were recorded in 2016, a significant rise on the number of cases detected in previous years (Table 11).

Year	Number of cases
2012	61
2013	75
2014	64
2015	63
2016	93

Table 11: Number of cattle poisoning cases by year in AFBI and DAFM laboratories

The toxicants recorded in cattle in 2016 are presented in Table 12.

Toxicant	DAFM	AFBI
Lead	43	2
Ragwort (<i>Senecio</i> spp.)	25	4
Copper	4	3
Yew (<i>Taxus baccata</i>)	5	0
Cobalt	3	0
Mycotoxin	1	0
Closantel	0	1
<i>Pieris</i> spp.	0	1
Fuel oil	1	0

Table 12: Poisonous agents responsible for fatalities in cattle by DAFM (n=82) and AFBI (n=11) in 2016

Lead

As in previous years, lead was the most common cause of fatal toxicity in cattle in 2016, with 45 cases recorded. This represents an increase compared to the previous three years, where between 28 and 35 cases were recorded annually. Most cases occurred during spring and summer months when animals were at pasture (Figure 39). Discarded batteries, lead-based paints and crankcase oil are the most common sources implicated in cases of lead poisoning. Unlike recent years where most cases were reported in young cattle less than one year of age, in 2016 most cases occurred in cattle older than one year (28 cases, or 62 per cent, occurred in cattle older than one-year-old).

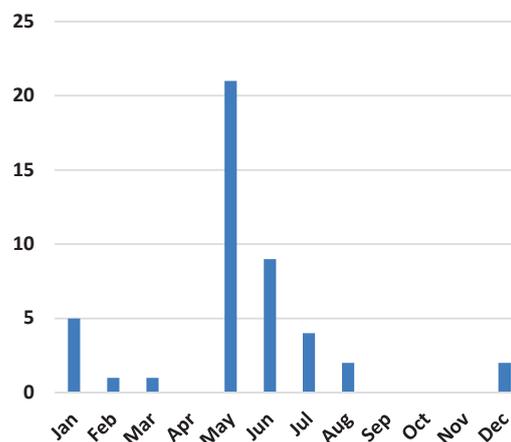


Figure 39: Number of fatal lead toxicity cases in cattle by month in 2016 (n=45)

Copper

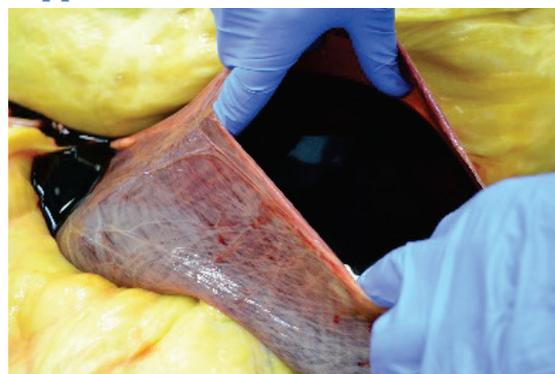


Figure 40: Haemoglobinuria and yellow colouration of carcass fat (jaundice) in a case of copper toxicity in a heifer (Photo: Seán Fee)

Seven cases of copper toxicity were recorded in cattle in 2016, three by AFBI and four by DAFM (Table 13). Six cases (86 per cent) were

diagnosed in animals less than six-months-old and one (14 *per cent*) was recorded in an adult. While copper is an essential element required for growth and production, many cases of copper toxicity are caused by over-supplementation. The supplementation of copper in Ireland is only warranted where there is a confirmed deficiency (Figure 40).

Year	Number of cases
2012	9
2013	3
2014	11
2015	13
2016	7

Table 13: Number of cases of fatal copper toxicity recorded in cattle by year

Ragwort

Twenty-nine cases of ragwort (*Senecio* spp.) toxicity were diagnosed in 2016 making ragwort the most frequently diagnosed cause of fatal plant intoxication (Figure 41). Ragwort (also known as benweed or buachalán buí) is a common plant found throughout Ireland. All stages of growth contain the toxic principle, pyrrolizidine alkaloids. Ragwort is unpalatable to cattle and is generally left uneaten where sufficient grass is available. However wilted plants after mowing or dying plants in the weeks after spraying are more likely to be eaten. Ragwort incorporated in hay or silage is generally the most likely source of intoxication, when animals are unable to selectively avoid ingesting the plant (Figure 42).

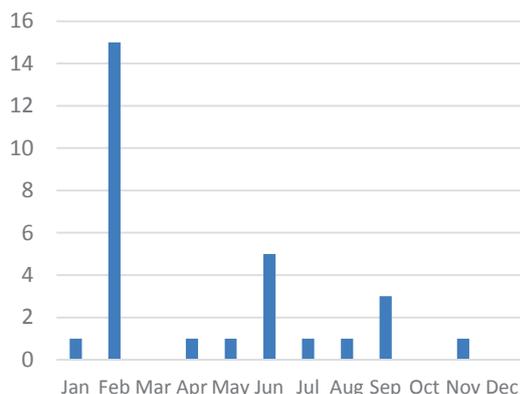


Figure 41: Cases of ragwort toxicity recorded by month on the island of Ireland in 2016 (n=29)

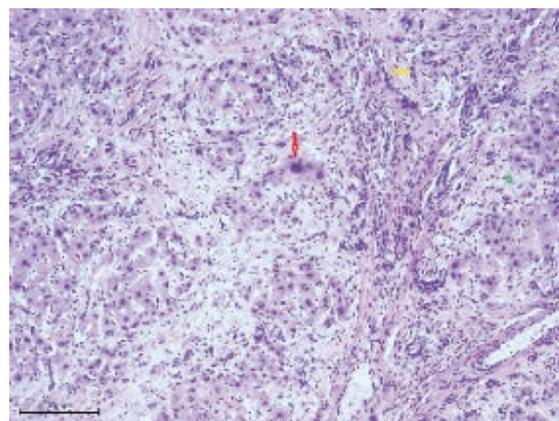


Figure 42: Bovine liver with histological features of ragwort toxicity; megalocytosis (red arrow), fibrosis (green star) and biliary hyperplasia (yellow arrow). (Photo: Seán Fee)

Yew

Five cases of yew (*Taxus baccata*) toxicity were recorded in 2016. Yew is an evergreen tree found throughout Ireland, often associated with churchyards and graveyards.

Closantel

One case of closantel toxicity was recorded in 2016. Closantel is an anthelmintic used to treat liver fluke infestations. It has a relatively narrow safety margin, so careful calibration of dose-to-weight as per the data sheet, is critical.

Sheep

Sixty-seven cases of fatal toxicoses were recorded in sheep in 2016 (Table 14). Ingestion of poisonous plants accounted for the majority of fatal toxicoses in sheep (39 of a total of 67 cases) while accidental access or over-supplementation with essential metallic trace elements accounted for 42 *per cent* of sheep poisonings (28 cases).

Poisonous agent	DAFM	AFBI
<i>Pieris</i> spp.	14	18
Copper	16	7
Cobalt	5	0
<i>Rhododendron</i> spp.	0	2
Ivy (<i>Hedera helix</i>)	0	2
Unidentified plant	2	0
Yew (<i>Taxus baccata</i>)	1	0
Total	38	29

Table 14: Poisonous agents responsible for sheep deaths in sheep in 2016

Copper

Copper was the second most frequently recorded cause of fatal poisoning in sheep, with 23 cases recorded in 2016 (Figure 43). Copper is an essential trace element in the diet of sheep; however, sheep are particularly susceptible to the toxic effects. All breeds of sheep are susceptible, but Texel, Charollais and Suffolk are amongst the breeds most susceptible. There were two distinct peak periods for cases of ovine copper toxicity in 2016. An initial peak period occurred from January to April, with a second peak period occurring from September to November. Cases of copper toxicity are most frequently associated with feeding concentrates supplemented with copper. In the initial peak period from January to April all the sheep affected were ewes (16 cases), presumably being fed concentrates to meet the demands of pregnancy and lambing. Only rams and ram lambs (seven cases) were affected in the second peak period of September to November and they were generally receiving concentrate associated with preparation for the autumn ram sales. Grazing pasture top-dressed with pig slurry or excessive administration of copper may also result in cases of copper toxicity.

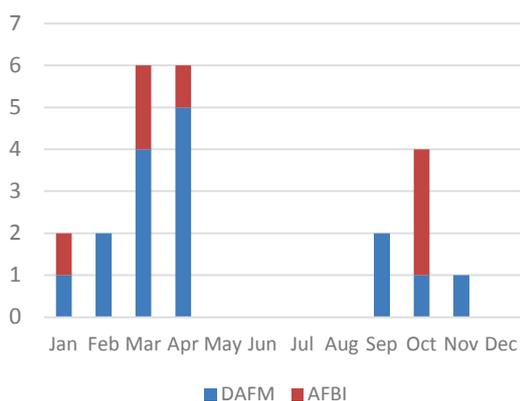


Figure 43: Number of cases of fatal copper poisoning in sheep by month in 2016

Cobalt

Five cases of cobalt toxicity were recorded by DAFM in 2016, but none were recorded by AFBI. Cobalt is an essential trace element for ruminants but over-supplementation can cause toxicity. Signs of toxicity include weight loss, lethargy, rough hair coat and anorexia.

Acute cobalt toxicity may present as severe, often fatal, diarrhoea.

Poisonous plants

Ingestion of plant poisons accounted for 39 (58 per cent) of the fatal ovine toxicoses recorded in 2016. *Pieris spp.* was the most frequent plant cause of fatal poisoning, accounting for 32 (82 per cent) of the 39 cases. *Rhododendron spp.* and ivy (*Hedera helix*) were the next most frequently recorded causes of plant toxicity. *Pieris spp.* and *Rhododendron spp.* are closely related plants, containing the toxic principle andromedatoxin. Although ivy may be given to livestock as a traditional folk tonic, the ingestion of large quantities may cause death in sheep.

As in previous years most cases of fatal plant toxicity in sheep occurred during the winter months, probably related to the weather and the possibility of other sources of food being scarce (Figure 44).

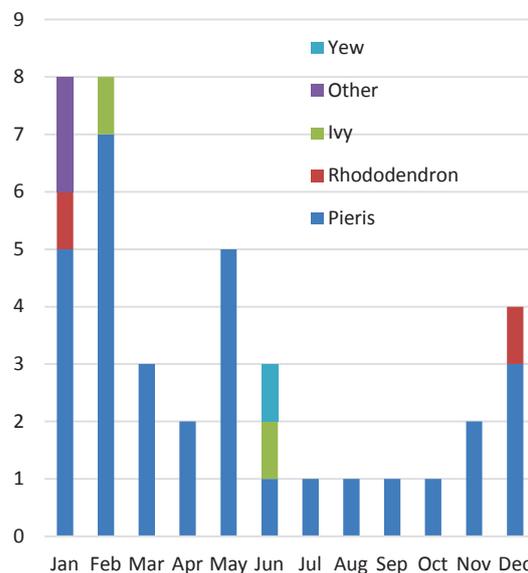


Figure 44: Number of cases of fatal poisoning in sheep by ingestion of poisonous plants by month in 2016

Dogs

Three cases of fatal poisoning in dogs were detected by AFBI in 2016. One case was associated with the ingestion of ethylene glycol (antifreeze), one was due to anticoagulant rodenticide toxicity and one was due to nitroxylin toxicity. Nitroxylin is widely used as a flukicide in cattle and sheep.

Five cases of fatal poisoning in dogs were detected by DAFM in 2016; three associated with anticoagulant rodenticide and two associated with strychnine, which has been banned for decades.

Diseases of Sheep

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COLM O’MUIREAGÁIN, DAFM, RVL SLIGO

Figure 45 summarises the findings for the most frequent causes of sheep mortality in AFBI and DAFM laboratories during 2016. The data are presented on a disease category basis and as a percentage of the total submissions, excluding abortions.

The number of sheep submissions to AFBI and DAFM increased in 2016 compared to 2015, perhaps reflecting the economic situation of the sheep sector during the year, but maybe also due to the higher levels of parasitic disease seen in the autumn and early winter. In addition, Ireland conducted a sheep mortality study on a number of flocks in which all deaths from those flocks were submitted for post-mortem.

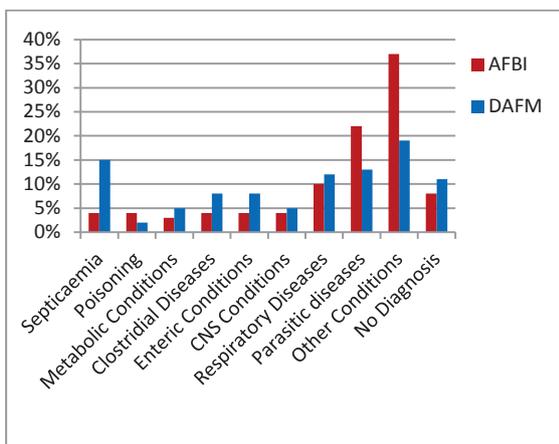


Figure 45: Relative frequency of causes of mortality in sheep of all ages submitted for post-mortem examination to AFBI (n=772) and DAFM (n=1,844) laboratories

As in 2015, parasitic disease and respiratory disease were the most commonly diagnosed causes of death in sheep of all ages in Northern Ireland and Ireland, with septicaemic disease being the commonest in younger lambs in Ireland. The relative importance of clostridial diseases decreased slightly in 2016 compared to 2015.

Enteric diseases

Colibacillosis, ovine neonatal enterotoxaemia ('watery mouth') and cryptosporidiosis were common causes of enteric disease diagnosed in young lambs. Enteric viral infections (rotavirus and coronavirus) remained uncommon diagnoses in AFBI and DAFM. Mesenteric volvulus was relatively common in young growing lambs in both jurisdictions.

Nervous system diseases

Listeriosis remained the most frequently diagnosed central nervous system (CNS) disease in AFBI and DAFM. It accounted for 60 per cent of CNS diagnoses in DAFM compared to 12 per cent for cerebrocortical necrosis (CCN) and 11 per cent for louping ill, the next two commonest. Copper and *Pieris* spp. (including varieties such as Forest Flame, Little Heath Green & Variegated) were the most commonly diagnosed causes of poisoning in 2016 in AFBI and DAFM laboratories.

Parasitic diseases

Laboratory submissions highlighted ongoing problems with acute and chronic fasciolosis (Figure 46) due to weather conditions which once again became better suited to the molluscan intermediate host during the year.



Figure 46: Acute fasciolosis with sub-capsular haemorrhage in a sheep's liver (Photo: Seán Fee)

Fasciolosis increased in importance as a cause of death in sheep in Northern Ireland and Ireland in 2016, accounting for eight per cent of all diagnoses of causes of death compared to five per cent in 2015 in Northern Ireland and rising from 3.5 per cent to four per cent in Ireland.

Figure 47 shows the diagnostic analyses for all endoparasitic diseases in Northern Ireland and Ireland during 2016. 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.

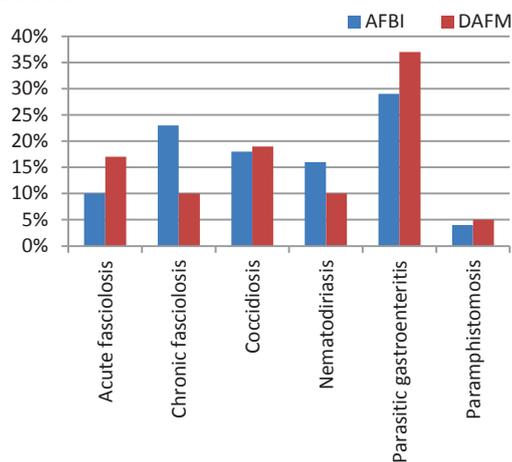


Figure 47: Specific endoparasitic conditions diagnosed in 2016 in sheep as a percentage of all ovine endoparasitic disease diagnoses made by AFBI and DAFM

Larval paramphistomosis was diagnosed in sheep by AFBI and DAFM during the year. Affected sheep ranged from one to two years of age and presented either with profuse watery diarrhoea or sudden death. It was noted that very high numbers of immature stages (60,000) were frequently present in the intestine, without the presence of adults in the rumen and, correspondingly, without the presence of eggs in the faeces.

Clostridial disease

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. Table 15 shows the prevalence of clostridial diseases diagnosed by AFBI and DAFM during 2016.

The overall pattern remained similar to 2015 with pulpy kidney disease the most commonly diagnosed clostridial disease within a group 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 diets, or suckling ewes which are heavy in milk. Losses in a flock often coincide

with a sudden change in feed or increase in 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 are highly suggestive of pulpy kidney disease.

	Lambs DAFM	Lambs AFBI	Adults DAFM	Adults AFBI	Totals
Blackleg	0	0	2	0	2
Black disease	2	2	5	1	10
Abomasitis	7	3	1	0	11
Malignant oedema	4	0	8	0	12
Enterotoxaemia	40	0	12	7	59
Pulpy kidney disease	39	10	1	0	50

Table 15: Number of clostridial disease-associated deaths recorded in sheep by AFBI and DAFM laboratories in 2016

Respiratory diseases

Mannheimia haemolytica remained the most common cause of bacterial pneumonia in AFBI and DAFM in 2016, accounting for 37 per cent and 24 per cent respectively of all diagnoses of respiratory disease in sheep. Other bacterial causes of pneumonia including *Pasteurella multocida*, *Trueperella pyogenes*, *Bibersteinia trehalosi* and *Mycoplasma ovipneumoniae* were much less commonly diagnosed. Jaagsiekte (ovine pulmonary adenocarcinoma) remained relatively commonly diagnosed by AFBI compared to DAFM. In 2016, jaagsiekte represented 35 per cent of all respiratory disease diagnoses in AFBI, an increase over the 2015 figure of 29 per cent. The total number of diagnoses of Jaagsiekte was 3.8 per cent of all diagnoses excluding abortions, a very similar figure to 2015. In DAFM, jaagsiekte accounted for less than one per cent of respiratory deaths.

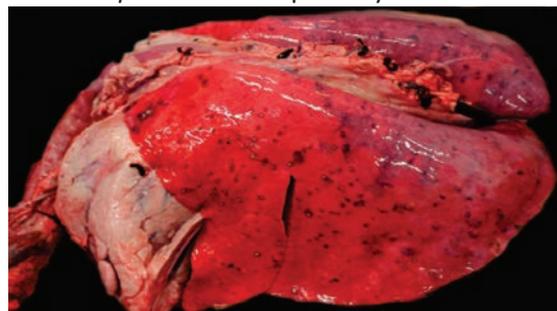


Figure 48: Lungs from an adult ewe with tick-borne fever (*Anaplasma phagocytophilum*) and secondary bacteraemia associated with *Staphylococcus aureus* (Photo: Colm Ó Muireagáin)

Ovine abortion

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

Investigation of ovine abortion cases is carried out by both AFBI and DAFM. An abortion case is defined as a submission consisting of one or more ovine foetus(es) and/or foetal membranes submitted on the same date. Individual farms may have submitted more than one case during 2016. In Ireland, 464 ovine abortion cases were concluded during 2016 whereas in Northern Ireland 264 cases were closed. The diagnosed causes of abortion in sheep during 2016 were broadly similar in Ireland and Northern Ireland.

The percentage of cases in which the cause of abortion or stillbirth was identified (i.e. the diagnostic rate) was 76.7 per cent for AFBI and 53.6 per cent for DAFM (Table 16). The diagnostic rate for Ireland has decreased from 74.1 per cent in 2015. This change appears to be mainly due to an increase in both the total number of cases and the number of repeat submissions from farms included in an enhanced surveillance of selected sheep farms; participating farms were required to submit every loss for investigation.

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

	AFBI	%	DAFM	%
Toxoplasmosis	67	35.1	100	40.2
<i>Chlamydomydia abortus</i>	51	26.7	65	26.1
<i>E. coli</i>	16	8.4	41	16.5
<i>Salmonella</i> Dublin	7	3.7	2	0.8
<i>Trueperella pyogenes</i>	7	3.7	11	4.4
Leptospirosis	6	3.1	0	0.0
<i>Listeria</i> spp.	6	3.1	10	4.0
<i>Streptococcus</i> spp	5	2.6	5	2.0
Others	26	13.6	15	6.0
Total Diagnosed	191	76.7	249	53.6
Total Cases	249	100	464	100

Table 16: Summary of the causes of ovine abortion diagnosed by AFBI and DAFM in 2016

During 2016, leptospirosis was diagnosed as the cause of abortion in three per cent of cases of ovine abortion by AFBI, with no cases diagnosed by DAFM. Testing of ovine abortion material for leptospirosis is not routinely carried out by DAFM, but a number of analyses are carried out annually. Abortion due to salmonellosis was diagnosed in a small number of sheep flocks by DAFM (n=2) and AFBI (n=9); all the DAFM cases and the majority of AFBI cases (n=7) were due to *Salmonella* Dublin.

It is worth noting that many of the agents associated with abortion in sheep are zoonotic agents i.e. these agents may also infect people. The most important of these are *Chlamydomydia abortus* (the cause of EAE), *Toxoplasma gondii*, *Listeria* spp. and *Salmonella* spp. Together these agents accounted for 71.1 per cent of DAFM diagnosed cases of ovine abortion, and 68.6 per cent of AFBI cases. These data further support the advice that pregnant women and the immunocompromised 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 to other sheep in the flock, and take appropriate precautions (e.g. use protective clothing, attend to handwashing before eating, drinking or smoking, and safely disposing of aborted foetuses, dead lambs and afterbirths).

Diseases of Pigs

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SIOBHÁN CORRY, AFBI, BELFAST

A total of 131 pig carcasses were submitted to AFBI laboratories and 622 pigs to DAFM laboratories during 2016.

Pneumonia

The most frequent diagnosis in pigs submitted to DAFM laboratories was pneumonia (Figure 49), accounting for 29 per cent of total diagnoses. AFBI diagnosed pneumonia in 20 per cent of submissions. In many instances the cause of pneumonia was multifactorial.

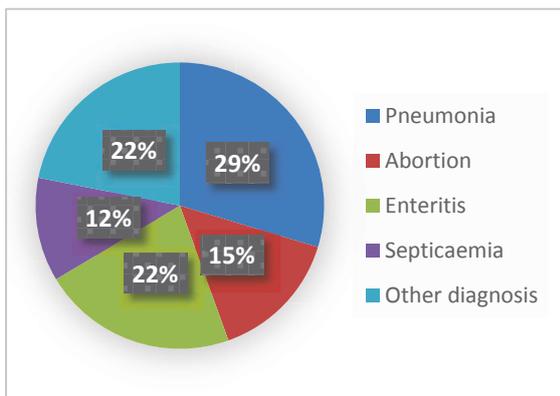


Figure 49: Relative frequency of diseases diagnosed in pigs submitted to DAFM laboratories in 2016

Porcine pneumonia is a complex disease and severity of lesions and effects on production are greatly influenced by management practices such as vaccination, antibiotic usage, stocking density and biosecurity. The relative importance of bacterial pathogens is likely to be over represented in figure 50 as these are often secondary invaders that are present at the time of post-mortem in chronic cases, while viral agents may have had a role in initiating the disease outbreak.

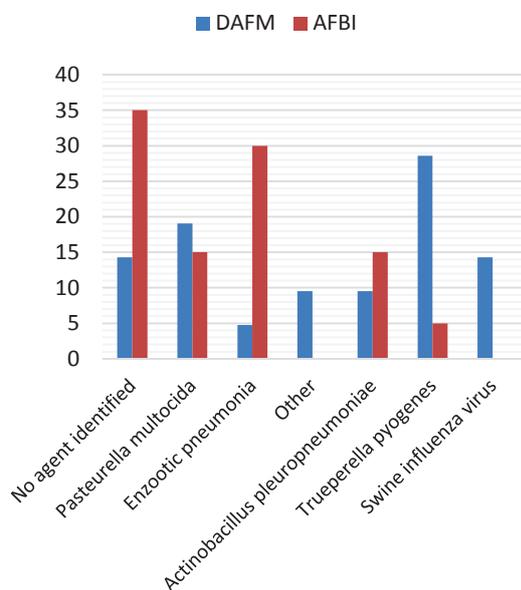


Figure 50: Relative frequency of agents identified by AFBI and DAFM in cases of pneumonia in pigs during 2016

Enteritis

Colibacillosis, including enteric infection and septicaemia (24 cases, 30 per cent) was the most frequently diagnosed condition in young piglets submitted to AFBI in 2016. DAFM identified rotavirus infection in 48 per cent of

cases diagnosed with enteritis (Figure 51). *E. coli* was considered the aetiological agent in only seven per cent of enteritis cases in DAFM. Salmonellosis (Figure 52) was diagnosed in 8 per cent of enteritis cases in young piglets in AFBI and in 11 per cent of cases submitted to DAFM.

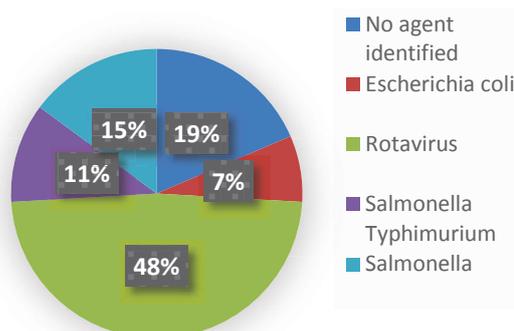


Figure 51: Relative frequency of agents identified by DAFM in cases of porcine enteritis in 2016



Figure 52: Thickened and oedematous colon from a six-week old pig with salmonellosis. (Photo: Shane McGettrick)

Multiple outbreaks of high morbidity and low mortality diarrhoea in piglets in the first few days of life were investigated by DAFM. Gross findings were frequently non-specific; soft yellowish intestinal contents and flaccid intestines. On histopathological examination of some of these cases, acute superficial fibrinosuppurative enteritis, microthrombosis or acute superficial erosive suppurative colitis was observed. *Clostridium perfringens* was isolated and alpha toxin was detected by ELISA, indicating *Clostridium perfringens* type A (CPA) in many of these pigs. In addition *Clostridium difficile* toxin was detected by ELISA in some neonatal pigs. A diagnosis of

colitis associated with *C. difficile* was reached in some of the pigs with suppurative colitis and mesocolitis.

Nervous disease

AFBI diagnosed meningitis in nine pigs during 2016. In three pigs, no organism was specified and, in six cases, streptococcal meningitis was identified. One pig was diagnosed with a spinal abscess. Streptococcal infection including *Streptococcus suis* meningitis (33 cases, 22 per cent) was the most common condition diagnosed in pigs of between one and five months of age in AFBI laboratories in 2016. DAFM reported *Streptococcus suis* infection in five per cent of all pigs submitted during 2016. Many cases of *Streptococcus suis* deaths occur shortly after weaning and are thought to be associated with environmental stressors at that time. The organism is often carried asymptotically in the tonsils of normal pigs and can be endemic in herds without necessarily causing recognisable clinical disease. The severity of disease observed in an outbreak depends on the *Streptococcus suis* serotype and strain, presence of concurrent disease such as porcine reproductive and respiratory syndrome (PRRS), environmental stressors such as insufficient ventilation and elevated population density, as well as management factors such as mixing of different age groups. Oedema disease is a relatively frequent cause of sudden death and nervous signs in recently weaned pigs, peaking at 10 - 14 days post-weaning. The number of cases has been noted to be increasing in European countries in recent years. DAFM and AFBI diagnosed oedema disease causing increased mortality in recently weaned pigs in various commercial pig units during 2016. Affected pigs were either found dead or were described as displaying nervous signs (Figure 53). Clinical signs were typically confined to recently weaned batches with signs commencing one to two weeks following weaning. The course of the illness was short and affected pigs died rapidly. The presence of haemolytic *E. coli* in small intestine is not sufficient for diagnosis although a pure growth of *E. coli* serotypes O138, O139 or O141 from cultured contents

together with presence of verotoxin-coding gene VTX2 and a suitable history is highly suggestive. Confirmatory histopathological lesions (vasculopathy) are not always present especially in peracute cases.



Figure 53: Recently weaned pig displaying ataxia associated with oedema disease. The pig had a high pitched vocalisation and was agitated prior to euthanasia (Photo: Shane McGettrick)

Other Diagnoses

AFBI diagnosed vegetative endocarditis in three pigs, pericarditis in four pigs and mulberry heart disease (Figure 54) in a further two pigs during 2016. DAFM diagnosed porcine dermatitis and nephropathy syndrome (PDNS) in one pig. Many pathogens have been implicated in the development of PDNS but it has been shown that porcine circovirus 2 (PCV2) is most likely to be the primary agent involved resulting in the vasculitis and glomerulonephritis that characterises the skin and renal lesions.



Figure 54: Mulberry heart disease in a pig submitted to AFBI. Note the multifocal ecchymotic haemorrhages on the epicardial surface (Photo: Seán Fee)

DAFM diagnosed rectal stenosis in a group of fatter pigs submitted to the laboratory

following increased condemnations of pigs with similar presenting signs at slaughter. The pigs presented with abdominal distention, and decreased weight gain. Onset of abdominal distention was described by the owner as occurring gradually. At post-mortem, there was megacolon in all pigs examined, secondary to rectal stenosis. No other significant lesions were observed. Rectal stenosis occurs most frequently following salmonella enteritis, rectal prolapse or trauma due to “boar riding”. The porcine rectum has a poor collateral blood supply. Infection or trauma which results in decreased blood supply to the rectal tissue will result in scar formation and stenosis. Rectal stenosis, subsequent megacolon and abdominal distention may be an indicator that welfare of affected individual pigs or batches may have been compromised. Carcasses with abdominal distention are frequently condemned by processing plants as there is a risk that distention may be due to peritonitis or that further manipulation of the carcass may impact on strict hygiene controls in place in these plants.

A 14-week-old free-range pig that had gradually been losing condition was submitted to DAFM. A partial blockage of the intestines had occurred as a result of the parasitic burden. Similar parasites were present in the liver and there was evidence of multifocal fibrosis (‘milk spot liver’) due to migration of larval stages of the parasite (Figure 55).



Figure 55: Milk spot liver in a pig due to infection with *Ascaris suum*. (Photo: Shane McGettrick)

Poultry Diseases

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ANN SHARPE, DAFM, BACKWESTON

During 2016, 298 poultry carcass submissions were examined by AFBI and 172 poultry carcasses were examined by DAFM. These were from commercial and backyard flocks, zoological collections and wild birds. Often, submissions to AFBI and DAFM from commercial flocks were comprised of multiple carcasses.

In DAFM, septicaemia (26 per cent) was the most common diagnosis (Figure 56); the most frequent cause was *Escherichia coli*, followed by *Erysipelothrix rhusiopathiae*. Erysipel was diagnosed in 76-week-old free range table egg layers with a history of severe mortality. Avian influenza was ruled out following laboratory testing. The house where the birds were kept was divided in two, both sides sharing the same air space and the problem was present only on one side of the house. On clinical examination, the sick birds were sitting, reluctant to move, and were listless. The head was retracted into the body. The eyes were open and the head was bright and alert. There was no evidence of diarrhoea. Post-mortem findings included dehydration, severe feather loss, multifocal necrotising hepatitis and splenitis. Bacteria were seen in the blood vessels of muscle, heart and lung on histopathology. *Erysipelothrix rhusiopathiae* was cultured from the liver. Red mites were found by the private veterinary practitioner (PVP) in the environment and these most likely accounted for the feather loss. The source of *Erysipelothrix rhusiopathiae* was uncertain. One possible source was the biofilm which was possibly loosened by the farmer when he manipulated the water line on the affected side of the house in the days prior to the outbreak, and did not flush properly. Biofilm is a thin, usually resistant, layer of microorganisms that can form on, and coat, various surfaces such as water pipes. The slime that these microorganisms produce can protect them from many disinfectants. Other possible environmental sources of *Erysipelothrix rhusiopathiae* included

droppings from infected hens, contaminated soil, dust and infected carcasses. Erysipelas is increasingly seen in free range chickens and may be transmitted by faecal carriers, in soil, water, fishmeal and by cannibalism. The bacterium is fairly resistant to environmental effects and may persist in alkaline soil for years. There is likely to be an increased risk if housing or land has been previously used by sheep or pigs. There was no history of indirect contact with sheep or pigs in this case. The source and portal of entry of the organism can be obscure in outbreaks of erysipelas. Recovered birds may be carriers for several weeks and shed the organism in their droppings. It is considered that some birds may be unaffected carriers. Carcasses of infected birds can be a source of infection. Eriksson (2013) reported that manure and dust samples collected in affected flocks were shown to contain *Erysipelothrix rhusiopathiae* and may therefore represent sources of transmission. Breaks in the mucous membranes or skin have been suggested as a portal of entry. The red mite infestation in this outbreak may have predisposed to the infection. Eriksson (2013) found that *Dermanyssus gallinae* collected from affected flocks was shown to carry *Erysipelothrix rhusiopathiae* externally and internally, but the reservoir potential of the mite could not be proven. Intercurrent infections or management failures may precipitate an outbreak. Therefore, it cannot be ruled out that poor quality or insufficient water may have precipitated this outbreak.

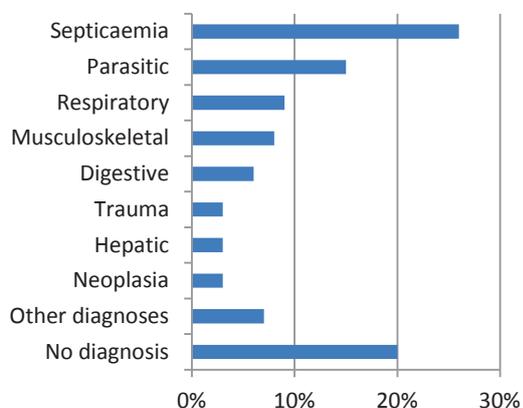


Figure 56: Relative frequency of the most commonly diagnosed causes of mortality in poultry in DAFM laboratories in 2016 (n=172)

Another disease that is becoming common on free-range poultry farms, avian intestinal spirochaetosis (AIS) caused by *Brachyspira* sp. infection, was diagnosed in 41-week-old table-egg layers with pasting of vents. The bacteria were seen on histology to be forming a false brush border attached to the surface of caecal epithelial cells, making it likely that *Brachyspira pilosicoli* was involved. In contrast, *Brachyspira intermedia* does not specifically attach to enterocytes but may be found in large numbers in the mucus layer in an apparently loose association with the underlying enterocytes. AIS is a disease complex reported mainly in laying hens and broiler breeder hens and is associated with chronic diarrhoea and/or reduced egg production. Other signs include increased numbers of dirty eggs, decreased feed consumption and occasional slight increases in mortality. Infection is more common in older flocks, multi-age sites and outdoor flocks. *Brachyspira* species determination is required to distinguish non-pathogenic species, i.e. *Brachyspira innocens*, from pathogenic species such as *Brachyspira pilosicoli* and *Brachyspira intermedia*. Efforts to prevent spirochaetosis focus on optimising site biosecurity and hygiene.

'Clubbed down' was a syndrome seen by DAFM in hatched Ross broilers from different farms supplied by one feed mill in particular. Poor hatchability was reported also. Chicks were weak and lame resulting in heavy culling. Clubbed down in broilers is purportedly due to riboflavin, zinc or possibly manganese deficiency. It is characterised by shortened and abnormal natal down feathers with a specific bilaterally symmetrical feather tract distribution. Synthetic riboflavin (vitamin B2) supplementation is required in poultry feeds and is essential for growth and health as part of co-enzymes. The vitamin is synthesised in the caecum and large intestine of adult birds (at sites of microbial activity). Since these sites are beyond small intestinal absorption, coprophagy appears to be a beneficial behaviour and daily provision is required. The vitamin is stored in the yolk of eggs. Aflatoxin is an antagonist that interferes with absorption of vitamin B2. The specific

cause in this case was not clear but low blood zinc concentrations were seen in some affected birds (less than 5µmol/litre).

Oregon disease or deep pectoral myopathy was seen by DAFM in a 56-day-old free range broiler. The affected muscle was green in colour and multifocal ischaemic necrosis surrounded by evidence of muscle repair and fibrosis was seen on histopathological examination. Oregon disease does not usually cause any mortality or obvious clinical signs and, therefore, is usually identified at slaughter. It is caused by a reduction in the blood supply to the deep pectoral muscles. Genetics in some heavy meat-type birds may play a role. Excessive flapping in association with management activities (e.g. thinning operations in meat-type birds, artificial insemination in breeding turkeys, weighing birds etc.) can predispose to disease. Because it is enclosed in a relatively unyielding membrane, any swelling of the muscle tends to cut off the blood supply. If the condition is of over seven days duration the muscle is dry and often shows greenish tinges.

Of the cases submitted to AFBI in 2016 conditions associated with the liver were most commonly diagnosed, as has been the case in previous years (Figure 57). Most consistently reported conditions were again bacterial hepatitis in a range of birds, inclusion body hepatitis in young broiler chickens, metabolic disease such as hepatic lipidosis affecting breeding and laying birds, and histomonosis in both free range layers and broiler breeders. Diseases associated with the digestive system were diagnosed in 44 cases (15 *per cent* of submissions), and within this category the largest volume of submissions were found to have gizzard erosion and ulceration. On gross examination the gizzards contained dark, haemorrhagic fluid and have multiple focal erosions within the koilin layer. The condition is characterised by disruption and necrosis of the solid carbohydrate-protein rich koilin layer that overlies the gizzard mucosa. The majority of the submissions were young broilers, as has been traditionally the case with this disease. However a number of cases in free-range layer flocks were also investigated; The Animal and Plant Agency (APHA) have also

reported cases in free-range layer flocks so this is a condition which is likely to become important among these flocks also. Transmission is both horizontal from infected birds, and vertically via the egg from infected parent flocks.

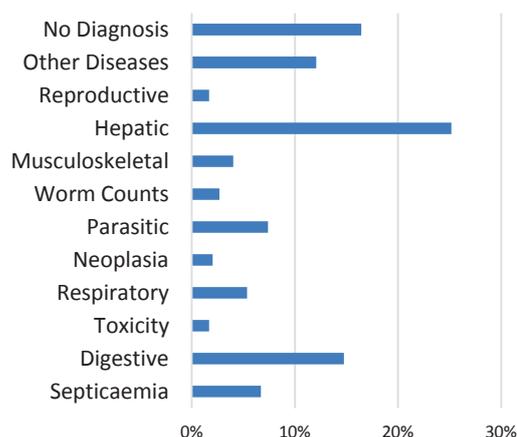


Figure 57: Relative frequency of the most commonly diagnosed causes of mortality in poultry in AFBI laboratories in 2016 (n=298)

A number of aetiologies and predisposing factors can be involved in the development of gizzard erosion and ulceration. In AFBI the condition was frequently due to infection with fowl adenovirus-1 strain (FAdV-1) which is diagnosed on histopathological identification of koilin layer degeneration, mucosal necrosis, intranuclear inclusion bodies in the glandular epithelial cells, and inflammatory cell infiltrations in the lamina propria, submucosa, and muscle layer. Fowl adenovirus strains are also associated with inclusion body hepatitis and hydropericardium in chickens, and in one case of 25-day-old broilers there was evidence of inclusion body hepatitis along with adenoviral ventriculitis.

Non-infectious causes of gizzard erosion and ulceration include feed and water deprivation in very young chicks, trauma from ingestion of sharp material, vitamin B6 deficiency, certain mycotoxins and biogenic amines (e.g. gizzerosine found in fishmeal).

AFBI investigated death and lameness with limb deformities in a group of 6-week-old turkeys from a small backyard flock, which also kept a small flock of hens and six ducks, although only the turkeys were affected, and these were kept in a separate shed. Gross examination findings were of soft, flexible

beaks, splayed twisted legs with enlarged hocks and phalangeal joints, and enlarged costochondral junctions. There was non-mineralised cartilage extending from the tibial heads into the shafts of the bones. Histological lesions present in all tibial heads included markedly elongated zones of hypertrophy and foci of unmineralised chondrocytes extending into the metaphysis, but with normal vascularisation. The gross and histological findings were consistent with a diagnosis of hypophosphataemic rickets. Rickets can be caused by deficiencies of calcium, vitamin D3 or phosphorus, calcium-phosphorus imbalance, amino acid deficiency, hypervitaminosis A, copper deficiency and enteric disease which leads to maldigestion or malabsorption. In this case, dietary deficiency was thought to be the cause.

A 23-year-old Violet Turaco was presented for post-mortem examination in AFBI from a zoological collection, with a history of several days of ataxia following trauma. There was some muscle haemorrhage and myonecrosis in the thigh muscles, however on histologic examination of the liver there were multifocal to confluent areas of brown granular pigmentation both within hepatocytes and in sinusoids. Staining with Perl's Prussian Blue for ferric iron was strongly positive, with marked granular blue staining of hepatocytes and iron storage disorder was diagnosed. An incidental finding of iron accumulation within hepatocytes and sinusoidal macrophages was recorded in a four-year-old Chilean Flamingo which was euthanised following an acute, severe limb injury.

Iron is stored in cells as ferritin, which aggregates to form haemosiderin. An excessive amount of iron is toxic to cells and can cause hepatic necrosis with fibrosis. Toucans, birds of paradise, mynahs and starlings have been shown to be susceptible to iron uptake and storage (Figure 58), and in flamingos, hepatocellular and Kupffer cell haemosiderosis increases with age and can be associated with hepatitis, cirrhosis and hepatocellular carcinoma in older birds.

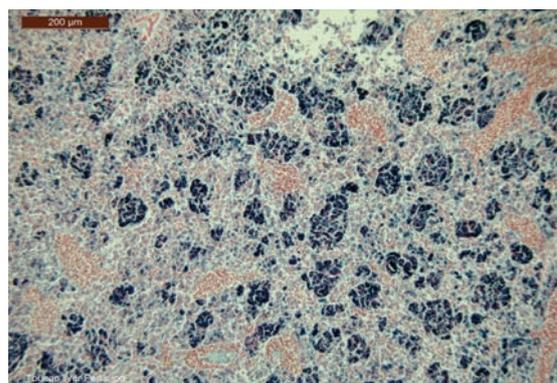


Figure 58: Histological section of a Toucan liver stained with Perl's Prussian Blue for ferric iron (Photo: Catherine Forsythe)

Reference:

Erysipelothrix rhusiopathiae in laying hens. Eriksson H. Thesis (2013). Swedish University of Agricultural Sciences

Diseases of Equines

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MARGARET WILSON, DAFM, KILKENNY RVL
MARIA GUEL BENZU, AFBI, STORMONT

The majority of equine diagnostic pathology across the island of Ireland is carried out by the Irish Equine Centre. AFBI and DAFM carry out a small number of equine post-mortem examinations and diagnostic tests on behalf of the relevant competent authorities and as part of animal welfare investigations.

Irish Equine Centre Surveillance

There were 482 equine post-mortem examinations performed by the Irish Equine Centre (IEC) during 2016, and in addition to this figure, 71 placental membranes were examined.

Adult Horses

90 adult horses were examined during 2016, with an average age of seven years (range 1-26 years). Forty-eight of these had been reported as dying suddenly. All horses were screened for equine dysautonomia (grass sickness) and all were negative. Those cases diagnosed with enteritis and/or colitis were also screened for *Campylobacter* spp., *Cryptosporidium* spp, *Listeria* spp, *Salmonella* spp., *Clostridium difficile* and other *Clostridium* spp. All animals except foetuses

were screened for the presence of parasitic larvae/eggs in their faeces.

Common findings among the adult horses submitted for post-mortem examination, included colitis/typhlitis (n=11), hepatic fibrosis (n=15) and traumatic injuries (n=10). In addition, cases of uterine related haemorrhage, gastric rupture/distension, ruptured colon, skeletal fractures and coagulopathy were seen. Tumours detected were lymphoma (one case), adrenal carcinoma (one case) and sarcoma in the cervical musculature (one case). Forty-eight out of the 90 had no parasitic eggs detected in their faeces. In the remainder of the adults, parasitic eggs detected were strongyles, *Fasciola hepatica*, *Ascaris perfoliata* and *Parascaris equorum*. Three adults had a >2000 eggs/gram of faeces (two with strongyles and one with *Parascaris equorum*). There was also one case of cyathostomosis. Six horses had parasitic endarteritis of the cranial mesenteric artery and 25 horses had other evidence of migrating strongyles; sixteen of these 31 horses had a negative faecal egg count.

Weanling Horses 6-12 months

Twelve equine weanlings were examined in 2016 at the Irish Equine Centre. The average age was eight months (range 6-10 months). All weanlings diagnosed with enteritis and colitis were also screened for *Campylobacter* spp., *Cryptosporidium* spp., *Listeria* spp., *Salmonella* spp., *Clostridium difficile* and *Clostridia* spp. Traumatic injuries were the most common cause of sudden death. Parasites detected on post-mortem examination were strongyles (three cases) and *Anoplocephala perfoliata* (one case), all of which had a negative faecal egg count. *Clostridium* spp. were detected in 11 weanlings and *Clostridium difficile* was detected in one case of colitis.

Foals 1-6 months old

There were 32 foals aged between 1 and 6 months old examined at the Irish Equine Centre, with an average age of 2.5 months (range 1-6 months), of which 14 were submitted with a history of sudden death. Traumatic injuries and gastric rupture were

the most common causes of sudden deaths. There appeared to be an increase in the incidence of the respiratory and abdominal forms of *Rhodococcus equi* infection. Fourteen out of the 32 foals examined showed the presence of parasitic eggs in their faeces – strongyles, *Strongyloides westerii* and ascarids. Fifteen foals had evidence of parasitic larval migration, ten of which had a negative faecal egg count. Foals with enteritis/colitis were screened for *Campylobacter*, *Cryptosporidium*, *Lawsonia*, *Listeria*, *Salmonella*, *Clostridium* spp., *Clostridium difficile* and Rotavirus. *Clostridium* spp. were detected in four foals; rotavirus in five and one case each of *Cryptosporidium* spp., *Lawsonia* and *Salmonella* spp.

Newborn – 1 month old

A total of 81 post-mortem examinations were carried out on newborn foals up to one month of age. All had survived for 11 months *in-utero*, except four which were born prematurely at 10.5 months. The average age was seven days (range 1-26 days). All were screened for equine herpesvirus 1 (EHV-1), equine herpesvirus 4 (EHV-4) and equine viral arteritis (EVA). Five were positive for EHV-1 and one was positive for EHV-4. The most frequent causes of mortality were asphyxiation during the birth process with foreign body pneumonia, septicaemia with multi-organ failure and dystocia. There were six cases of meningitis/encephalitis, five cases of sleepy foal disease and one case of Tyzzer's disease diagnosed. *Clostridium difficile* and *Clostridium* spp. were isolated from two and ten foals respectively. One case each of rotavirus and *Cryptosporidium* spp. was detected.

Congenital abnormalities present were glomerulocystic lesions (n=17), flexion/extension/contraction of the limbs (n=6) and brachygnathia inferior (n=2). There was one case each of diaphragmatic hernia, microphthalmia, interventricular septal defect and dextroposition of the aorta.

Stillborn Foals

A total of 65 post-mortem examinations were carried out on newborn foals that were dead

at birth or died during the birth process, with an average age of 11 months *in utero*. They were all screened for EHV-1, EHV-4 and EVA. Two were positive for EHV-1. The main findings recorded were asphyxiation during the birth process (n=29), dystocia (n=17), cervical placentitis/pathology (n=21), chronic placental pathology (n=10), bruising/fractured ribs (n=10) and perivascular brain haemorrhage (n=10).

The most common congenital abnormalities found in these foals were contracted limbs (n=13) and glomerulocystic lesions (n=11). Five foals were euthanized because of limb/skeletal abnormalities. Other issues encountered included deviation of the nasal septum, enlarged thyroid and scoliosis of the cervical/thoracic vertebrae.

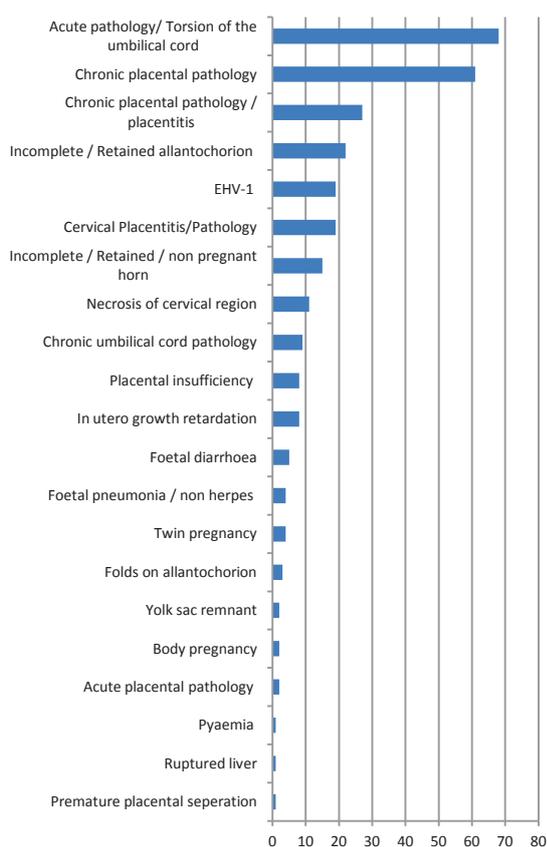


Figure 59 Findings of post-mortem examinations carried out on equine foetuses at the Irish Equine Centre

Foetal Abortions

One-hundred-and-fifty-seven equine abortions were examined during 2016. Examined material comprised of foetuses and placental membranes. The age at the time of aborted foetuses ranged from three to 10.5

months *in-utero*, with an average age of eight months. All cases are screened for EHV-1, EHV-4 and EVA. 19 cases of EHV-1 were diagnosed. No EHV-4 or EVA cases were detected. Acute pathology/torsion of the umbilical cord and chronic placental issues were the most common causes of abortion (Figure 59). Nineteen foetuses were diagnosed with congenital abnormalities, the most common ones being contracted limbs, cleft soft or hard palates, and glomerulocystic lesions.

A total of 71 placental membranes were examined during 2016, separate and additional to abortion/newborn foal submissions. Examined material comprised of complete and incomplete placental membranes from newborn foals. All placental membranes are screened for EHV-1, EHV-4 and EVA, and no positive results were obtained.

Donkeys

Forty-five post-mortem examinations were carried out on donkeys. The donkeys ranged from one day to 49 years of age, with an average of 25 years. All donkeys submitted for post-mortem examination were screened for AHV (Asinine Herpes virus) and Equine dysautonomia (grass sickness), all of which were negative. The more common findings included dentition issues (n=20), hepatic fibrosis (n=24), evidence of haemochromatosis (n=22), chronic laminitis (n=26) and enteritis/typhlitis/colitis (n=25). There was evidence of pyrrolizidine exposure in one donkey. Idiopathic pulmonary fibrosis was diagnosed in eight donkeys. There were also 21 donkeys in which *Clostridium* spp. were isolated from their intestinal contents. *Listeria* spp. were isolated from two donkeys. There were four cases of neoplasia diagnosed - leiomyoma, pyloric carcinoid, hepatocellular carcinoma and cholangiocarcinoma. Twenty-four out of the 45 donkeys had a negative faecal egg count. On gross and histopathological examination, 15 donkeys had evidence of large strongyle infestation, eight of which had negative faecal egg counts. There were five with evidence of cyathostome infestation, one of which had a negative

faecal egg count. There were three with hydatid cysts and one with evidence of *Fasciola hepatica* infestation, which had no faecal eggs detected.

AFBI and DAFM Surveillance

DAFM carried out 22 post-mortem examinations on equine carcasses in 2016 (Table 17); three foetuses, 10 foals (of which six were less than one-month-old neonates), five horses and four ponies. The majority of cases were received during the months of April, May and June, coinciding with late gestation and neonatal period for foals. All three aborted foetuses submitted tested negative for EHV1.

Diagnosis	Number of Cases
Bacteraemia/septicaemia	6
Parasitic gastroenteritis	2
Fatal haemorrhage	2
Hepatopathy	1
Haemochromatosis	1
Congenital heart defect	1
Peritonitis	1
Enteritis	1
No diagnosis	4

Table 17: Findings of equine (excluding foetus) post-mortems (n=19) carried out in DAFM laboratories during 2016

AFBI carried out 16 post-mortem examinations on equine carcasses in 2016 (Table 18); four foetuses, four foals (two of which were neonates), five adults, one pony and two donkeys. The same submission pattern was observed, with the majority of cases (six) submitted during the second quarter of the year.

Diagnosis	Number of Cases
Intestinal torsion	2
Typhocolitis due to <i>Salmonella</i> Typhimurium	2
Bacteraemia/septicaemia	1
Pericarditis	1
Hepatopathy	1
Congenital ectopic ureters	1
Sarcoma	1
Squamous cell carcinoma	1
Abdominal haemorrhage	1
Dermatophilosis	1
Abortion due to EHV-1	1
No diagnosis	3

Table 18: Findings of equine (including foetus) post-mortems (n=16) carried out in AFBI laboratories during 2016

Diseases of Aquatic Animals

Northern Ireland

LOUISE COSBY, AFBI, STORMONT

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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 herpes virus-1 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.

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 2016 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 (51 *per cent*), atlantic salmon (26 *per cent*), brown trout (16 *per cent*), and common carp including koi carp (7 *per cent*). 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 2016 are not listed under EU directives, or by the OIE. These diseases were 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 2016, 641 molluscs and crustaceans were tested for disease pathogens by the FDU. 60 pacific oysters (*Crassostrea gigas*) from Larne lough were screened for ostreid herpes virus-1 μ var (OSHV-1 μ var) for the statutory surveillance programme. These tested negative for OSHV-1 μ var by real time PCR. One-hundred-and-sixty-one (161) native oysters (*Ostrea edulis*) and 120 mussels (*Mytilus edulis*) were screened for *Bonamia ostreae* and *Marteilia refringens*; both these diseases are listed by the OIE. The entire coastline of Northern Ireland is designated free from *Bonamia ostreae* (with the exception of Strangford Lough and Lough Foyle, where *Bonamia ostreae* has been found previously). In October 2016 *Marteilia refringens* type M was identified in wild mussels in Dundrum bay during routine surveillance. Four out of 30 mussels tested positive by real time PCR and the positive

samples were sent for confirmation to IFREMER (French Institute for Exploitation of the Sea) the EURL (European Reference Laboratory) for molluscan diseases (Figure 60). *Marteilia refringens* type M was confirmed by the EURL early in 2017 and the confirmed designation notice (CDN) issued. The OIE were notified and the appropriate restrictions and movement controls put in place. More follow up surveillance for *Marteilia refringens* is planned for 2017. Three hundred (300) green crabs were screened for white spot syndrome virus (WSSV) and they all tested negative by real-time PCR.

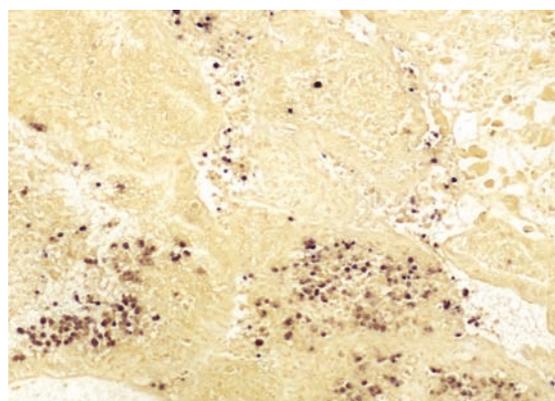


Figure 60: *In-situ* hybridisation used to detect parasites of the genus *Marteilia* in mussels from Dundrum Bay (Photo: IFREMER)

Research

AFBI worked alongside Vet-Aqua International, Galway-Mayo Institute of Technology, Carna Research Station and Queens University Belfast to identify a microsporidian species infecting wild caught lumpfish (*Cyclopterus lumpus*, L.) held at a breeding and rearing facility in the west of Ireland. The microsporidian species was identified as *Tetramicra brevifilum* by molecular analysis and transmission electron microscopy. This is the first record of *T. brevifilum* infecting lumpfish (Figures 61 and 62), and the disease is considered to be of potential significance to the rising aquaculture industry of this species (Scholz et al 2017).



Figure 61: Lumpfish (*Cyclopterus lumpus*) infected with *Tetramicra brevifilum*. (a) Dissection showing nodules in skeletal muscle and on visceral organs. Note external cysts, material in eye and remnants of ascitic fluid. (b) Exophthalmus and external parasitic cysts. (c) Liver with high numbers of cysts. (d) Large composite cyst on peduncle (Scholz et al 2017)

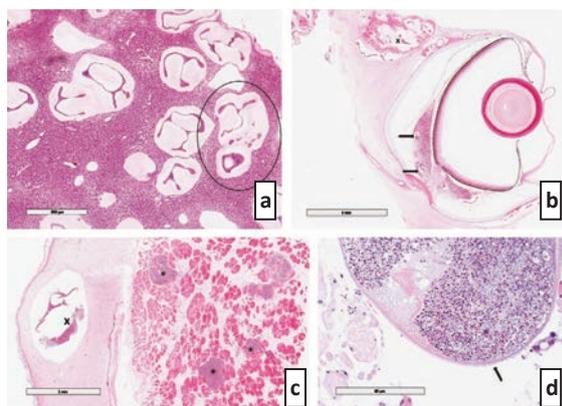


Figure 62: Histology of *Cyclopterus lumpus* infected with *Tetramicra brevifilum* (Haematoxylin & Eosin). (a) Multiple and partly confluent (circle) cysts containing xenomas in the liver. (b) Xenomas in the choroid of the eye (arrow). Note multiple space occupying xenomas in the retrobulbar muscle. (x) (c) Large xenoma within cyst in dermis (x) and multiple xenomas in the skeletal muscle. Note the absence of inflammatory host response in all cases. (d) Microvillous xenoma surface (arrow) in muscle tissue (Scholz et al 2017)

Publication:

First record of *Tetramicra brevifilum* in lumpfish (*Cyclopterus lumpus*, L.). Scholz F, Fringuelli E, Bolton-Warberg M, Marcos-Lopez M, Mitchell S, Prodhol P, Moffet D, Savage P, Murphy O'Sullivan S, O'Connor I, McCarthy E and Rodger HD. *Journal of Fish Diseases* (2017) 40: 757–771

Ireland

NEIL RUANE, MARINE INSTITUTE, GALWAY
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Statutory Testing

The Fish Health Unit (FHU) at the Marine Institute is the National Reference Laboratory in Ireland for diseases of finfish, molluscs and crustaceans, and implements 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 Ireland and Northern Ireland in relation to koi herpesvirus disease. Commission Decision 2011/187/EC, which came into effect on 1st May 2011, as amended by Commission Implementing Decision 2014/12/EU introduced national measures to prevent the introduction of ostreid herpesvirus 1 μ var (OsHV-1 μ var) into certain areas of Ireland and the United Kingdom. In addition to the statutory requirements, 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.

Diagnostic summary 2016

In 2016 over 4,400 finfish were tested for disease pathogens either as part of surveillance programmes, diagnostic samples received into the laboratory, or screening tests, including research, for the aquaculture industry. The majority of the finfish species tested were Atlantic salmon (*Salmo salar*, 63 per cent), wrasse species (14 per cent), lumpfish (*Cyclopterus lumpus*, 5 per cent) and rainbow trout (*Oncorhynchus mykiss*, 5 per

cent) along with a smaller number of brown trout (*Salmo trutta*) and koi carp (*Cyprinus carpio*). The most significant diseases affecting marine farmed Atlantic salmon in 2016 were amoebic gill disease (AGD) caused by the amoeba *Neoparamoeba perurans*, and pancreas disease (PD), caused by the salmonid alphavirus. As these diseases often co-occur on the same site it is difficult to ascertain the mortality levels to each disease, however management practices including freshwater treatments (AGD) and vaccination (PD) have kept mortality levels low. Four cases of cardiomyopathy syndrome (CMS) caused by the piscine myocarditis virus were recorded in Atlantic salmon in 2016. At present, there is no treatment for this disease and efforts are underway to determine the prevalence of the virus in Ireland. The use of wrasse and lumpfish (Figure 64) as a biological control of sea lice on marine Atlantic salmon farms has increased over the last three years. This has resulted in an increase in the screening of these fish for potential pathogens, both of the cleanerfish themselves and those which may pose a threat to the salmon. In 2016, a new ranavirus was isolated from lumpfish juveniles which were undergoing a mortality event at that time. A similar ranavirus has been isolated from adult lumpfish in the UK and Iceland and is not believed to be virulent. Studies are currently ongoing to determine whether this virus is virulent to lumpfish and salmon. 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 Atlantic salmon marine sites. In freshwater, an outbreak of koi herpesvirus disease, which is listed under current legislation, occurred in a large garden pond. The most likely cause of the outbreak was transmission of the virus through latent-infected fish introduced into the pond. All stock were culled and the pond drained and disinfected. The rainbow trout industry continues to be challenged by rainbow trout fry syndrome, caused by *Flavobacterium psychrophilum*.

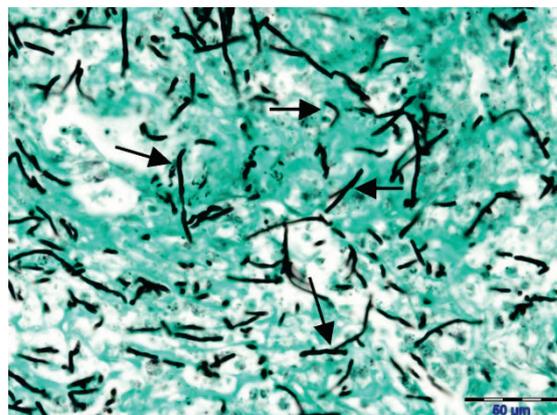


Figure 63: Fungal hyphae in the liver of lumpfish *Cyclopterus lumpus* during an infection of *Exophiala* sp. (Grocott's stain) (Photo: Evelyn Collins)

In the same period, approximately 2,300 molluscs, primarily Pacific oysters (*Crassostrea gigas*), were tested by the FHU under surveillance and research programs, as well as in response to reports of abnormal mortality. In 2016, *Bonamia ostreae*, a disease listed under EU legislation, was detected for the first time in Kilkieran Bay, Co. Galway in flat oysters (*Ostrea edulis*). Movement restrictions were put in place in December and an epizootic investigation was instigated to determine the possible source of infection. Both the levels and the number of incidences of mortality in Pacific oysters associated with either OsHV-1 or *Vibrio aestuarianus* were low compared with previous years. In contrast to 2015, the summer of 2016 was much drier and this is suspected to have been a contributing factor in the patterns of mortality.



Figure 64: The lumpfish *Cyclopterus lumpus* used as a biological control for sea lice infestations in marine Atlantic salmon sites. Photo: Cathy Hickey

In the spring of 2016, a report of a decline in the velvet crab (*Necora puber*) fishery in Galway Bay was investigated. Histopathological analysis of a number of crabs showed a high prevalence of a paramyxid species (protozoan parasites), later confirmed as a *Paramarteilia* spp. Sequences obtained from the 18srRNA gene and a second more variable region of the genome point to *Paramarteilia orchestiae*, or a closely related species (Figure 65). The parasite was observed in multiple tissues, including the gills, muscle, gonads, heart, hepatopancreas, cuticular epithelium, nerve tissue and antennal gland. The prevalence of infection and severity of disease associated with the infestation are significantly higher than that observed with similar infestations e.g. *P. canceri* in brown crab (*Cancer pagurus*) or *P. orchestiae* in the amphipod, *Orchestoidea gammarellus*. A link between infestation with the parasite and a decline in the fishery in Galway Bay seems likely.

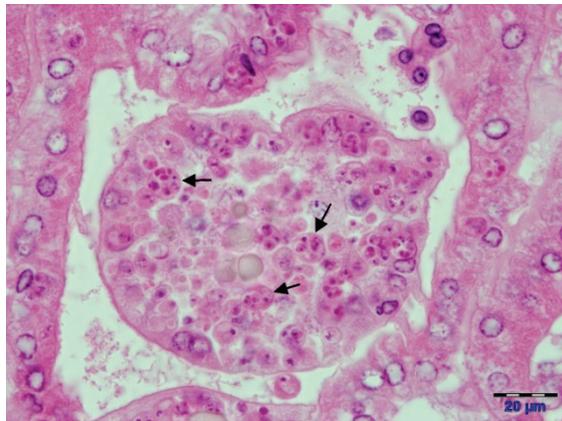


Figure 65: *Paramarteilia* sp. in the antennal gland of a velvet crab *Necora puber* (H&E stain) (Photo: Evelyn Collins)

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 in the final stages and has provided the industry with a non-lethal screening service for early detection of the amoeba using a real-time assay developed in the early stages of the project. The study has also provided the industry with information on the prevalence of other

pathogens which have been associated with gill diseases in Atlantic salmon.

In 2016 the Vivaldi project (preventing and mitigating farmed bivalve diseases), funded under Horizon 2020 began. The project will run for four years and is coordinated by the French Institute for Exploitation of the Sea (IFREMER). It will focus on a number of farmed molluscan species such as oysters, mussels, clams, cockles and scallops. The FHU is involved in a number of work packages with particular focus on Pacific oysters and *V. aestuarianus* infection in particular.

Publication:

***Oceanivirga salmonicida* gen. nov., sp., a member of the *Leptotrichiaceae* isolated from Atlantic salmon (*Salmo salar*).** Eisenberg T, Kämpfer P, Ewers C, Semmler T, Glaeser SP, Collins E, Ruttledge M and Palmer R. International Journal of Systematic and Evolutionary Microbiology (2016) 66: 2429-2437

Parasitic Diseases

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Liver and Rumen Fluke

Recent analysis of rumen flukes collected in Ireland has shown that *Calicophoron daubneyi* is 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*). The risk of liver fluke infection varies from year to year, dependant on the climatic conditions, in particular rainfall and surface moisture. Wet ground conditions in the spring and summer favour the reproduction and spread of the snail intermediate host as well as development of fluke infection in the snails and shedding of the infective metacercarial stages onto pastures. Analysis of meteorological data for the preceding 6 months forms the basis for the annual fluke forecast issued by AFBI and DAFM each autumn. Since liver fluke and rumen fluke use the same molluscan intermediate host, there

is a possibility that interspecific competition between the larval stages of the two species of fluke might have an additional impact on relative abundance of infection, a topic that might merit epidemiological investigation in Ireland.

Cattle

Rumen fluke eggs are detected more often in bovine faecal samples than liver fluke eggs (Figure 66, Figure 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 2016 (Figure 68).

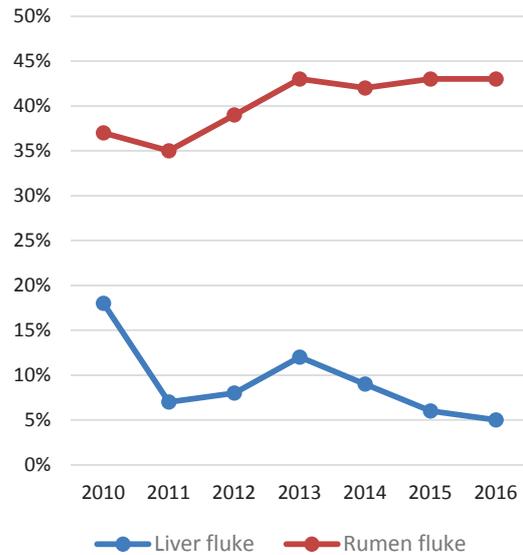


Figure 68: Percentage of bovine faecal samples containing liver and rumen fluke eggs on the island of Ireland 2010-2016

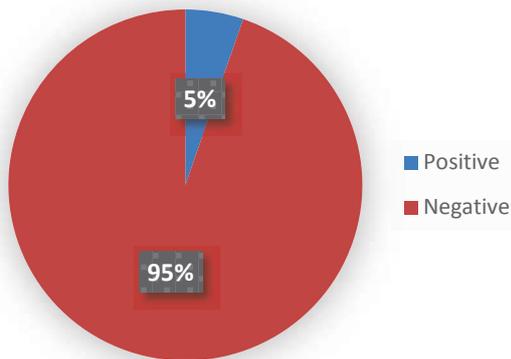


Figure 66: Relative frequency of detection of liver fluke eggs in bovine faecal samples examined on the island of Ireland during 2016 (n=6,855)

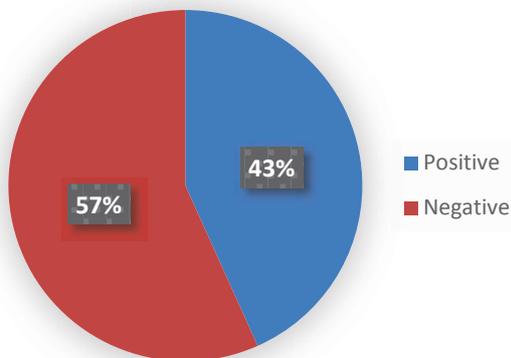


Figure 67: Relative frequency of detection of rumen fluke eggs in bovine faecal samples examined on the island of Ireland during 2016 (n=6,855)

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 showed an increase from 10 per cent to 14 per cent in 2016 from 2015 while rumen fluke egg detections remained static at 23 per cent (Figure 71).

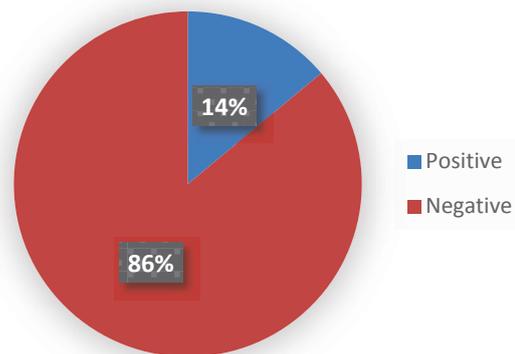


Figure 69: Relative frequency of detection of liver fluke eggs in ovine faecal samples examined by AFBI and DAFM during 2016 (n=2,485)

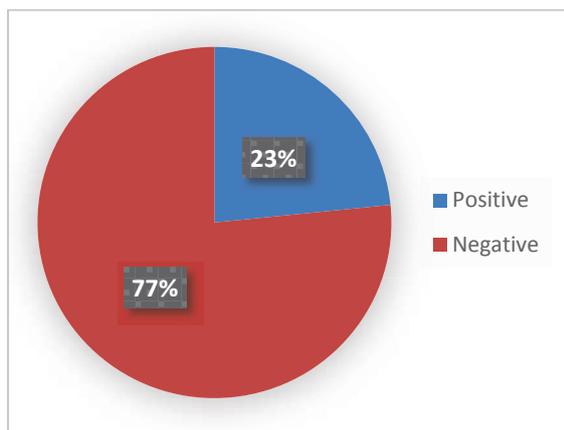


Figure 70: Relative frequency of detection of rumen fluke eggs in ovine faecal samples examined by AFBI and DAFM during 2016 (n=2,481)

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.

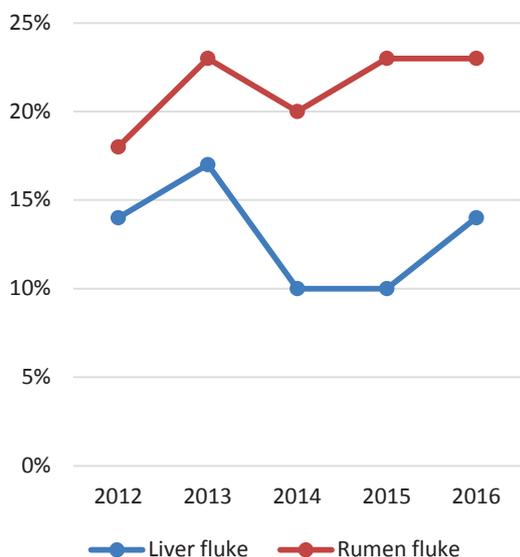


Figure 71: Percentage of ovine faecal samples containing liver and rumen fluke eggs on the island of Ireland 2012-2016

Larval paraphistomosis was diagnosed in sheep at AFBI Omagh during the last quarter of 2016. Affected sheep ranged from one to two years of age and presented either with profuse watery diarrhoea or sudden death. It was noted that in one case, very high numbers of immature stages (60,000) were

present in the intestine (Figure 72) without the presence of any adults in the rumen, and correspondingly without the presence of eggs in the faeces.

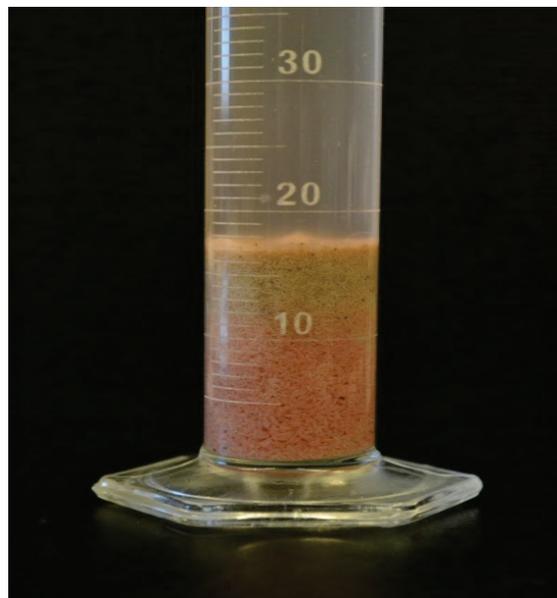


Figure 72: Immature stages of rumen fluke recovered from the intestine of a shearling (Photo: Seán Fee)

Regional Veterinary Laboratories (RVLs) Liver Fluke Abattoir ELISA Survey

As an additional aid to the national liver fluke forecast, blood samples were collected by DAFM from lambs (n=928) born in 2016 across 24 counties, and these were tested for the presence of liver fluke antibodies. In contrast to 2015, the number of blood samples indicating a moderate to heavy liver fluke challenge, had increased significantly. These samples had originated from lambs from the midlands and west of the country.

Roundworms and Coccidia

Faecal samples are examined for trichostrongyle eggs¹, *Nematodirus* eggs, lungworm larvae and coccidial oocysts. The number of trichostrongyle eggs detected is consistently higher in sheep when compared to cattle (Figures 73 and 74). There may be a number of reasons for this, such as inherent resistance, age profile of the animals sampled, type of pasture grazed and the fact 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, which therefore are more likely to contain worm eggs. However, the data 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. Whilst the percentage of bovine samples with significant trichostrongyle egg counts decreased slightly from 6 per cent to 5 per cent between 2015 and 2016, the percentage of ovine samples containing ≥ 500 eggs per gram rose from 25 per cent to 27 per cent in the same period (Figure 75).

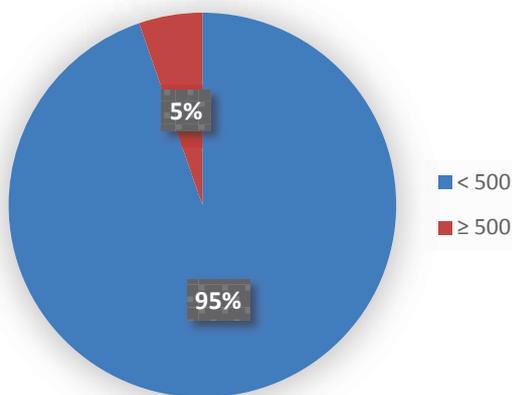


Figure 73: Relative frequency of detection of trichostrongyle eggs in bovine faecal samples examined on the island of Ireland during 2016 in relation to a commonly used threshold of significance - 500 eggs per gram (n=8,539)

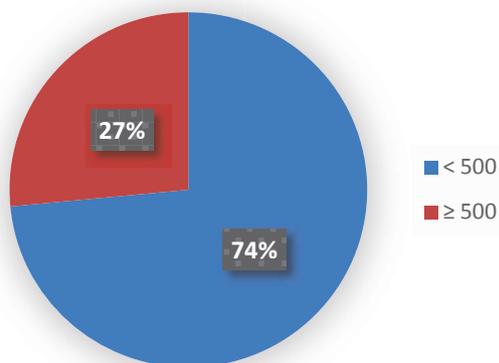


Figure 74: Relative frequency of detection of trichostrongyle eggs in ovine faecal samples examined on the island of Ireland during 2016 in relation to a commonly used threshold of significance - 500 eggs per gram (n=2,898)

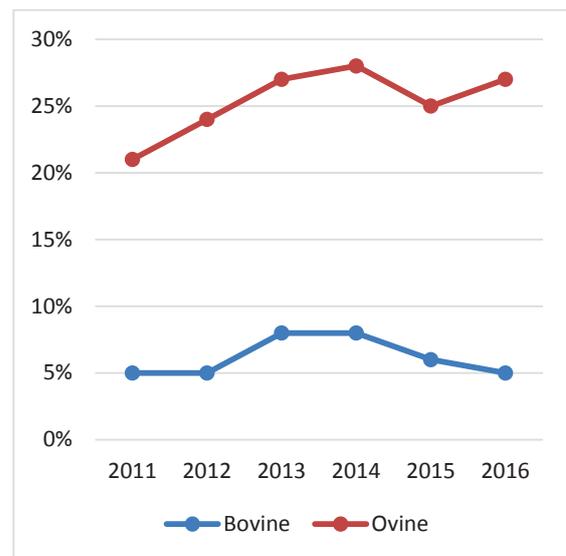


Figure 75: Percentage of bovine and ovine faecal samples with a trichostrongyle egg count in excess of 500 eggs per gram 2011-2016

¹ In this report the term “trichostrongyle eggs” is 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.

Nematodirus

Nematodiosis can be a significant cause of diarrhoea in sheep, particularly in young lambs (Figure 76). 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 usually 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. In recent years, a trend seems to be emerging for a second autumnal peak in *Nematodirus battus* infection in sheep, and the reason for this is the subject of on-going investigation.

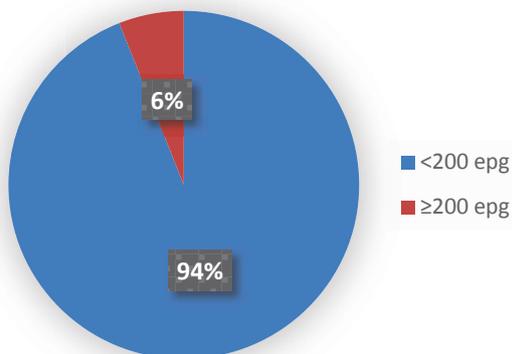


Figure 76: Relative frequency of detection of *Nematodirus* eggs in ovine faecal samples during 2016, in relation to the commonly used threshold of significance of 200 eggs per gram (n=3631)

Coccidiosis

Coccidial oocysts were detected more frequently in ovines than in bovines in 2016 (Figures 77 and 78). It is an insidious disease and is frequently associated with poor thrive in lambs and calves as well as more serious clinical disease. Figure 79 shows that it has been detected in sheep more frequently than in cattle since 2011.

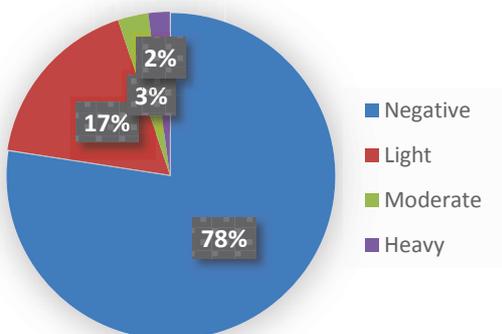


Figure 77: Results for bovine faecal samples tested for coccidial oocysts during 2016 (n=8,512) in AFBI and DAFM laboratories

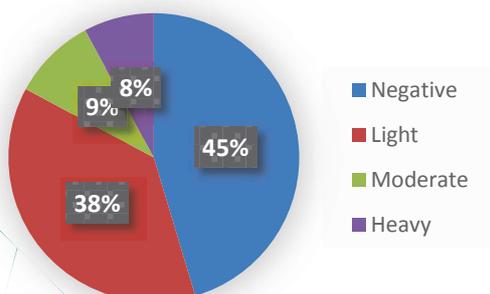


Figure 78: Results for ovine faecal samples tested for coccidial oocysts during 2016 (n=2,848) in AFBI and DAFM laboratories

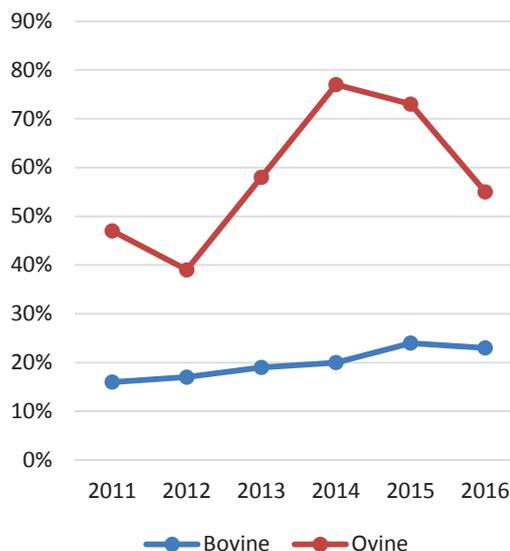


Figure 79: Percentage of bovine and ovine faecal samples containing detectable coccidial oocysts in AFBI and DAFM laboratories for the years 2011-2016

Bovine lungworm

Dictyocaulus viviparus is the cause of parasitic bronchitis (husk/hoose) in cattle. The disease is characterised by coughing and respiratory distress, and typically affects young cattle during their first grazing season, following which the surviving animals usually develop a strong immunity. Occasionally, if an older animal with acquired immunity is suddenly exposed to a massive larval challenge from a heavily contaminated field, severe clinical signs may result.

In 2016, AFBI and DAFM tested 525 bovine faecal samples for the presence of lungworm larvae (n=525), and of these, 10.3 per cent were positive (Figure 80). In recent years there has been a tendency for lungworm infection to occur in older cattle because treatment with long-acting anthelmintics during the first grazing season has prevented calves from being sufficiently exposed to lungworm infection to develop immunity.

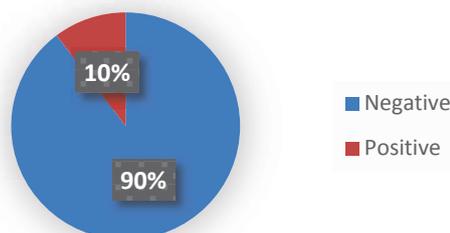


Figure 80: Relative frequency of detection of lungworm larvae in bovine faecal samples examined by AFBI and DAFM during 2016 (n=525)

Clinical Chemistry

SEAMUS FAGAN, DAFM, RVL ATHLONE

JASON BARLEY, AFBI, STORMONT

Trace elements play an important role in the health and thrive of production animals. Trace elements are subject to the “Goldilocks Principle” – too little or too much can be harmful to immune function, thrive and health. The trace element status of an animal at the time of testing is a reflection of their diet and supplementation over the previous months. Monitoring trace elements in blood and tissues is a valuable tool in a herd/flock health programme. Proactive identification and correction of a trace element problem can prevent more serious problems developing later and optimise health and thrive. 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. Here we present the results of some of the more commonly requested trace element analyses.

Cobalt

Cobalt deficiency is a disease of ruminants which occurs primarily in areas in which the soils are deficient in cobalt. In ruminants, approximately three to 13 *per cent* of ingested cobalt is used by ruminal microflora in the synthesis of vitamin B12. Therefore, cobalt deficiency is really a relative vitamin B12 deficiency and many of the clinical signs attributed to cobalt deficiency are associated with the animal’s inability, in the absence of vitamin B12, to metabolise propionate through the gluconeogenesis pathway – an important source of energy for ruminants. Cattle and sheep are similarly affected and the signs are similar in both species. Clinically, the disease is characterised by non-specific signs such as inappetance, weight loss, pica and pallor of mucous membranes. In sheep, lacrimation is also an important sign in advanced cases. Differential diagnoses for cobalt deficiency in ruminants include those for illthrift e.g. copper deficiency, general nutritional deficiency (energy and/or protein deficiency), Johne’s disease and intestinal helminthiasis. Ovine white liver disease is a

specific disease of sheep associated with cobalt deficiency. Histologically, this disease results in lesions of hepatic lipidosis. Liver cobalt concentrations of less than 0.7 micromoles per kilogram wet matter are considered to be deficient. During 2016, 40.7 *per cent* of ovine liver samples analysed by DAFM were determined to be cobalt deficient while in cattle, 38 *per cent* of the total number of liver samples analysed were recorded as deficient (Figure 81).

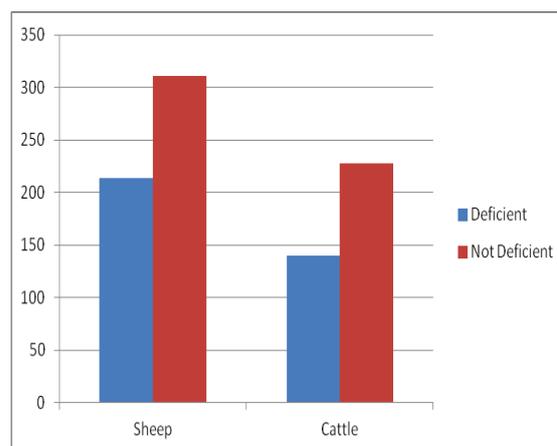


Figure 81: Number of ovine and bovine liver samples analysed for cobalt and the number of those samples identified as deficient or not deficient in DAFM laboratories in 2016

Copper

Copper deficiency is described as primary deficiency, due to inadequate concentrations in forage grown on deficient soils, or secondary deficiency, due to impediments to copper absorption such as excess molybdenum, iron salts and sulphur in the diet. Clinical signs of copper deficiency (both primary and secondary) are usually seen in young growing ruminants on pasture, and include ill-thrift, changes in hair colour (Figure 82), chronic diarrhoea, lameness and anaemia. Swayback and Enzootic ataxia (swayback) is a specific condition associated with copper deficiency in lambs. A diagnosis of copper deficiency in a herd or flock relies on an interpretation of the history, clinical examination of the affected animals, laboratory analyses on serum and liver samples, and an assessment of the environment including analyses of feed and water supplies.



Figure 82: Characteristic browning of the coat which is associated with copper deficiency in cattle (Photo: Pat Sheehan)

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. It is possible for clinical signs of copper deficiency to appear before there are significant changes in the levels of copper in the blood and liver. Conversely, blood levels of copper may be low (i.e. less than 9.0 micromoles per litre) in animals that are otherwise normal and performing well. Anaemia may occur in advanced cases of copper deficiency, haemoglobin levels being depressed to 50-80 grams per litre. It is also important to consider the possibility of an interaction between copper and selenium as there have been reports of animals failing to respond to copper supplementation when selenium deficiency is also present. Eighteen *per cent* of blood samples tested by DAFM and four *per cent* of blood samples tested by AFBI for copper were classified as copper deficient (Figure 83).

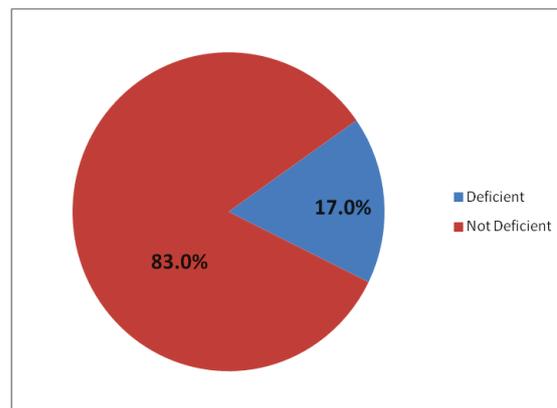


Figure 83: Number of blood samples submitted to AFBI and DAFM laboratories during 2016 which were analysed for copper status and identified as deficient or not deficient (n=14,406)

Selenium

Selenium is an element forming 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 directly, by measuring blood selenium levels, or indirectly, by measuring GSH-Px levels 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 84)

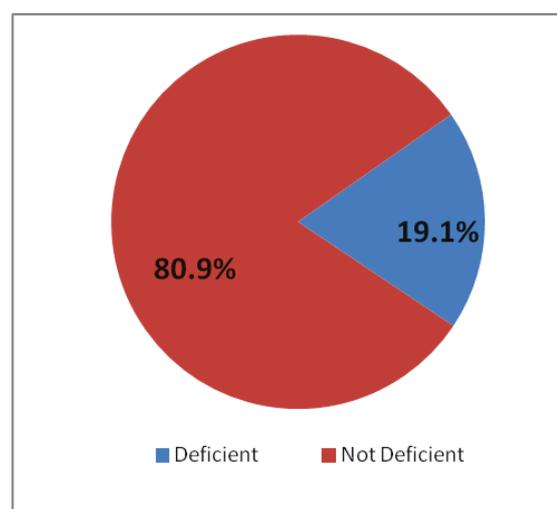


Figure 84: Number of bovine blood samples submitted to AFBI and DAFM laboratories during 2016 which were analysed for selenium status (either by blood selenium analysis or measurement of glutathione peroxidase activity) and were identified as deficient or not deficient (n=11,788)

Iodine

Plasma inorganic iodine is used by AFBI laboratories to assess iodine status, and gives an indication of current iodine intake (Table 19). 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 intake of this low level is likely to result in deficiency. Iodine deficiency may contribute to decreased fertility, embryonic loss, uterine infection, abortion, stillbirth, weak calves and increased incidence of retained placenta. DAFM laboratories do not currently carry out iodine analysis.

Result	No. of Tests	Percentage
Deficient <60µmol/litre	1,522	38%
Marginal 60 - 150µmol/litre	1,192	30%
Adequate >150µmol/litre	1,332	32%
Total	4,046	100%

Table 19: Number of bovine blood samples submitted to AFBI in 2016 for inorganic iodine status and identified as deficient, marginal or adequate

Wildlife Surveillance

REBECCA FROELICH-KELLY, DAFM, RVL SLIGO

PAULINE SHERIDAN, AFBI, STORMONT

Disease surveillance carried out by DAFM and AFBI includes surveillance of a wide range of wildlife species. This surveillance is in place in order to aid in the early detection of potential emerging diseases. Moreover, both institutions assist in the investigation of wildlife crimes in association with the Partnership for Action against Wildlife Crime in Northern Ireland (PAW) and the National Parks and Wildlife Service (NPWS).

During 2016 the species submitted to both laboratories included a wide array of wild bird species (including a yellowhammer (*Emberiza citronella*), rooks (*Corvus fragilegus*), a mute swan (*Cygnus olor*), magpies (*Pica pica*), gulls and several birds of prey), rabbits, hares, and otters, but also deer and badgers which are specifically tested as part of TB surveillance.

All submitted wild avian species are tested for avian influenza for surveillance purposes due to the potentially severe impact of this virus on commercial poultry and possible zoonotic potential of this disease.



Figure 85: Newly fledged juvenile peregrine falcon in the Partry Mountains, Co. Mayo (Photo: Mícheál Casey)

Wildlife crime

There were 52 submissions of raptors to DAFM and AFBI in 2016 for post-mortem examination. The submitted birds of prey in Northern Ireland are usually part of an investigation into wildlife crimes which are commonly illegal shootings or poisonings, while in Ireland the NPWS investigates all wild raptor deaths where a carcass in suitable condition is recovered. The submitted species consisted of buzzards (*Buteo buteo*), peregrine falcons (*Falco peregrinus*), barn owls (*Tyto alba*), red kites (*Milvus milvus*), sparrowhawks (*Accipiter nisus*), hen harriers (*Circus cyaneus*), and one kestrel (*Falco tinnunculus*).

In addition to the post-mortem examination, radiology (X-ray) and toxicology testing play pivotal roles in the investigation. X-ray examination of the carcass is especially important in suspected shootings, to detect shotgun pellets and potential shotgun injuries such as broken bones. Gunshot-inflicted trauma was established as the cause of death

by X-ray examination of a peregrine falcon and a buzzard during 2016. For all raptor submissions samples are collected at post-mortem to be submitted to the State Laboratory for toxicology tests (liquid chromatography tandem mass spectrometry) under the terms of a joint DAFM-NPWS-State Laboratory protocol in Ireland. In Northern Ireland, samples are submitted for toxicological testing to the Science and Advice for Scottish Agriculture (SASA) laboratory. There were 24 cases in which rodenticides or pesticides were detected in raptor samples in 2016.



Figure 86: Submitted raptor showing macroscopic evidence of carbofuran consumption (blue granules) (Photo: Pauline Sheridan)

There were two raptor submissions in which significant levels of carbamates (one with aldicarb and one with carbofuran) (Figure 86) were detected. Three cases of carbofuran toxicity were recorded by AFBI in 2016; in two cases buzzards were affected and there was one case recorded in a peregrine falcon. Carbofuran has a rapid mode of action (acetylcholinesterase inhibitor) in raptors and dead birds are often found with undigested baited meat in their mouth and upper digestive tract, and occasionally lying beside or near the poisoned bait. The formulation is usually presented as blue granules which can often be seen mixed through the baited meat the bird has eaten. These findings are significant as both carbamates are banned from the EU since 2008.

Rodenticide residues are a common finding in the tissues of wild birds of prey. In one case a buzzard, found in the mid-west region of Co. Limerick, presented with contusion of the

liver with an adherent blood clot and haemorrhage in the left leg. Toxicological investigation of a sample of liver tissue revealed positive levels of bromadiolone, difenacoum and flocoumafen (Figure 87).



Figure 87: Kestrel (*Falco tinnunculus*) found in Co. Cavan. The liver and kidney were positive for bromadiolone (Photo: Colm Ó Muireagáin)

These substances act as anti-coagulants and are commonly used alone or in combination as rodenticides. In conjunction with the gross findings at the post-mortem poisoning was determined to be the most likely cause of death. Rodenticide and pesticide results are qualitative rather than quantitative in many cases which renders it in most cases impossible to conclusively determine whether these toxicants have contributed to the death of the birds. Moreover, it is not possible to establish the source of the poison in most cases conclusively as raptors can suffer from secondary poisoning by consuming poisoned rodents. However, there were 4 cases in which poisoned meat was submitted which had been most likely intended as bait. In one of these cases six perinatal lamb carcasses were found laid out in a field and submitted with the suspicion of deliberate placement as bait. Two of the lamb carcasses showed incisions inflicted after death containing a crystalline substance. Toxicology revealed this contained paraquat, a highly toxic herbicide. These findings suggest a deliberate spiking and placement of the carcasses, most likely to be used as bait. AFBI recorded two fatal cases of alphachloralose toxicity in buzzards in 2016. Alphachloralose is an anaesthetic compound used as a rodenticide.

Wildlife TB surveillance

As part of the bovine tuberculosis (bTB) eradication scheme outbreak investigations, surveillance may be carried out on trapped badgers by DAFM. Other badgers that have been found dead (road traffic survey, AFBI) as well as deer are submitted for enhanced TB post-mortem and sampling for TB investigations (Figure 88).



Figure 88: Badger found dead in a TB outbreak area: preparation for enhanced post-mortem and TB sampling (Photo: Rebecca Froehlich-Kelly)

During 2016, 562 badgers were submitted (219 to DAFM and 343 to AFBI), sampled and tested for TB. Infection with *Mycobacterium bovis* was confirmed in 18 per cent of the carcasses examined.

In some bTB outbreaks, deer are included as part of the investigation. Samples from some fallen or hunted deer were submitted in 2016, and were examined and cultured for *M. bovis*. Moreover, some captive deer from farms or ornamental herds were submitted for post-mortem and tested for *M. bovis*. In total, there were 46 cervine submissions in 2016, consisting of red, sika, fallow deer and reindeer during 2016; of these, *M. bovis* was detected in two animals (Figure 89).

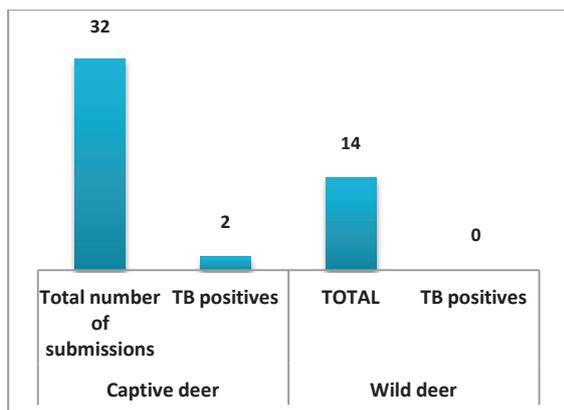


Figure 89: Number of deer submissions to DAFM and AFBI in 2016 and number of TB positive deer in the total

Echinococcus surveillance of wild foxes (*Vulpes vulpes*)

Echinococcus spp. are tapeworms (cestodes), which exploit the predator-prey relationship between canids and their prey to complete their life cycle. *Echinococcus multilocularis*, also known as alveolar hydatid tapeworm or small fox tapeworm, maintains a life cycle mainly in wildlife (sylvatic) between canids (foxes, wolves, coyotes etc.) as their final host, within which the tapeworm is sexually mature and produces eggs, and rodents (mice, rats, voles, shrews, etc.) as intermediate hosts. However the parasite can also maintain its life cycle using domestic dogs as the final host.

In the final host, *E. multilocularis* can be found in the small intestines but usually cause no clinical signs, with eggs being shed into the environment to be consumed by potential intermediate hosts. In the intermediate or dead-end host the hatched oncospheres migrate via the circulation to the liver, where, throughout the organ they develop alveolar cysts containing larval stages of the tapeworm. The cycle is completed when the final host consumes an infected intermediate host or infected tissue. Humans can be infected as accidental intermediate hosts by consumption of parasite eggs in contaminated food, water or soil or by direct contact with animal hosts. The concern with this particular parasite relates to the difficulty in treating the infection in the intermediate host, as the larval cysts are capable of growing and invading local tissue as well as spread to other organs, behaving like a metastatic tumour. In man, the cysts have often grown and spread for a considerable period of time before being diagnosed, necessitating prolonged and challenging treatment.

To date the whole island of Ireland is considered free of *E. multilocularis*; therefore to ensure that *E. multilocularis* is prevented from becoming established on the island, all dogs entering either jurisdiction have to receive certified anti-cestode anthelmintic treatment under the pet travel scheme (PETS) within a limited period before entry to the country. Moreover, in order to provide adequate scientific evidence for the island of

Ireland's "free" status, an annual surveillance of wild foxes is carried out in accordance with EU commission regulation 1152/2011.

In 2016, samples of intestinal contents from 696 wild foxes were received (405 by DAFM and 291 by AFBI) and examined using a standardised cestode egg flotation test (AFBI and DAFM) and multiplex PCR (DAFM). The samples are sourced across the island of Ireland in close approximation to the distribution of the fox population, to ensure a representative sample. All samples were negative for *E. multilocularis* in 2016.

Rabbit haemorrhagic disease type 2 (RHD2)

A high number of casualties among wild rabbits (*Oryctolagus cuniculus*) in Cork led to the submission of a two-year-old rabbit which had died suddenly. On post-mortem the animal showed non-specific pulmonary congestion and no visible lesions in the other organ systems. Histopathological examination revealed hepatic lesions consisting of loss of cord architecture, diffuse cytoplasmic vacuolation and degeneration of hepatocytes (apoptosis) characterised by hepatocellular hypereosinophilia with fading or loss of nuclei (karyopyknosis/karyolysis) and multifocal infiltration of lymphocytes (Figure 90). These findings were highly suggestive of RHD. RHD was confirmed by PCR and genotyped by sequencing as type 2 (RHDV2), in contrast to the most prevalent classic variant (RHD).

RHDV2 is generally less pathogenic, can affect young animals and hares and potentially cause devastating effects on the wild rabbit population. Rabbits under four weeks of age have no natural immunity to RHDV2. Prevention of RHDV2 infection is difficult: currently the vaccination of captive or pet rabbits only offers partial protection; some rabbits remain susceptible to the infection.

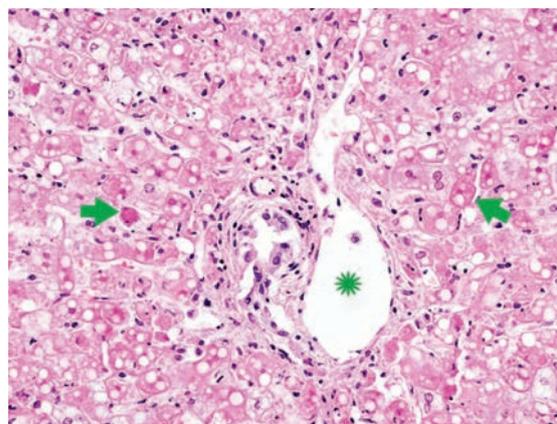


Figure 90: Photomicrograph demonstrating diffuse cytoplasmic vacuolation and degeneration of hepatocytes (apoptosis) characterised by hepatocellular hypereosinophilia (green arrows), karyopyknosis and karyolysis in the liver of a rabbit with RHD. (Star: portal vein) (Photo Cosme Sánchez-Miguel)

Antimicrobial Resistance Surveillance (AMR)

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WILLIAM FITZGERALD DAFM, RVL LIMERICK

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.

AMR 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 standpoint. 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' such as VRSA (vancomycin resistant *Staphylococcus aureus*) or KPC (*Klebsiella pneumoniae* carbapenemase) has sharpened the public focus on the use of antibiotics in the fields of medicine and veterinary medicine.

AFBI and DAFM carry out antimicrobial sensitivity testing (AST) according to the

relevant OIE laboratory methodologies. Particular attention is paid to a number of bacterial species and their resistance patterns. These bacteria include *Staphylococcus aureus*, *Streptococcus uberis*, *Pasteurella multocida*, *Mannheimia haemolytica*, *Salmonella* Typhimurium, *Salmonella* Dublin and enterobacteria showing evidence of extended spectrum *beta*-lactamase (ESBL). In 2016, as in previous years, the vast majority of bacteria on which antimicrobial sensitivity testing was performed came from samples of bovine origin (Figures 91 and 92).

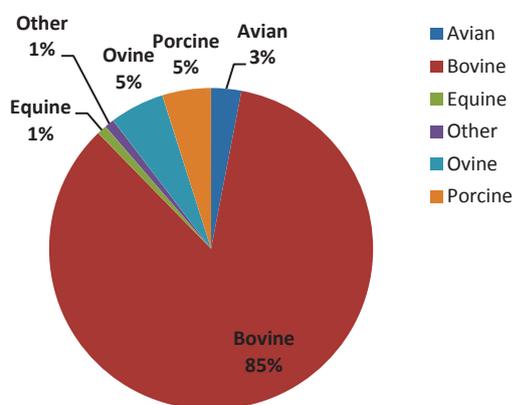


Figure 91: Proportions of antimicrobial testing performed on DAFM isolates originating from domestic animal species (n=1,763)

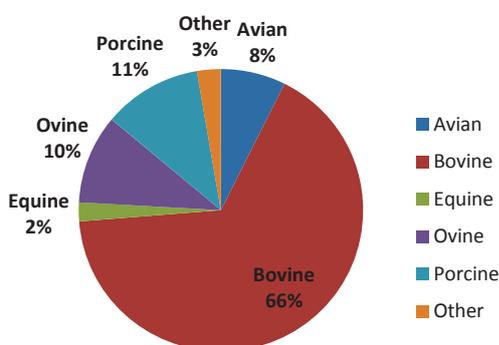


Figure 92: Proportions of antimicrobial testing performed on AFBI isolates originating from domestic animal species (n=1,949)

Staphylococcus aureus

One DAFM isolate, from a bovine milk sample, was identified as resistant to

amoxicillin/clavulanate. It was not resistant to cefoxitin.

A total of 132 isolates of *Staphylococcus aureus* from different animal species had AST performed by AFBI in 2016. Resistance to ampicillin and tetracycline was commonly detected. Levels of resistance to erythromycin and trimethoprim/sulphonamides were low. Livestock-associated methicillin resistant *Staphylococcus aureus* (LA-MRSA) was isolated and confirmed from two post-mortem submissions of pigs to AFBI. The two pigs originated from different farms. Further molecular characterisation of LA-MRSA strains identified both isolates as LA-MRSA CC398 spa type 034, the most commonly detected LA-MRSA since first detected in 2014. No epidemiological link between the farms was detected.

Streptococcus uberis

A total of 123 *Strep. uberis* isolates from bovine milk samples had AST performed by AFBI in 2016. Tetracycline, ampicillin and erythromycin were the antimicrobials where the higher levels of resistance were detected. Almost 30% of the isolates showed resistance to trimethoprim/sulphonamide and a 3rd generation of cephalosporin, cefoxitin.

Seven *Strep. uberis* isolates were highlighted, all of which were resistant to penicillin and all of which were isolated from bovine milk samples. Four of these samples were resistant to multiple drugs, including cefoxitin. An unusual and perhaps worrying trend amongst *Streptococcus uberis* isolates detected in DAFM RVLs, during 2016 was that 17 (5.6%) demonstrated resistance to cefoxitin, from a total of 299 isolates with sensitivity data.

Pasteurella multocida/ *Mannheimia haemolytica*

Two DAFM *P. multocida* isolates were flagged during 2016. One porcine isolate was resistant to tilmicosin. The second, isolated from a pneumonic bovine lung, was resistant to enrofloxacin.

There were four *M. haemolytica* isolates highlighted by DAFM, two ovine isolates resistant to enrofloxacin and two bovine isolates resistant to tilmicosin. One of the

ovine isolates was from the lung of an eight-month-old lamb that had presented with respiratory signs. Ovine pulmonary adenomatosis (Jaagsiekte) was also diagnosed in this lamb. The incubation period of Jaagsiekte in naturally infected sheep is long, with clinical disease typically taking two to four years to develop. Exceptionally, disease is seen in lambs 8 to 12-month-olds which are generally the progeny of infected ewes. Of the calves from which the isolates resistant to tilmicosin were taken, one of them had severe, diphtheritic pharyngitis.

Salmonella Typhimurium

Nine resistant *Salmonella* Typhimurium isolates were identified by DAFM, five of bovine, two of ovine and two of porcine origin. The two porcine isolates were from the separate farms, the isolates confirmed as DT18 and DT120. One of the bovine isolates was confirmed as DT104 and was isolated from the faeces of a one-week-old calf.

AFBI detected and confirmed 14 isolates of multiresistant *Salmonella* Typhimurium from clinical submissions in 2016. By livestock species, ten isolates were detected in pigs and two in sheep and cattle. Phage types 193 (n=7) and 104 (n=4) were the most common types detected.

Enterobacteria

Six *Escherichia coli* isolates resistant to cefpodoxime were identified by DAFM. One was from a six-day-old calf. Another was from the faeces of a four-year-old cow within a herd with a history of multi-drug resistant *E. coli*, leading to fatalities on this farm. Two resistant isolates were of avian origin, one in a commercial flock and one was from a wild peregrine falcon.

A total of 1,099 *E. coli* isolates had AST performed by AFBI in 2016. All isolates were resistant to erythromycin and streptomycin. A high proportion of those showed resistance to ampicillin and tetracycline. Although more than half of the *E. coli* isolates presented resistance to trimethoprim/sulphonamides, there were large differences, depending of the sample origin. *E. coli* isolates from bovine milk samples generally showed a lower level

of resistance compared with isolates from bovine enteric tissues.

Zoonoses

MERCEDES GOMEZ PARADA, DAFM, RVL CORK

TONY PATTERSON, AFBI, STORMONT

The World Health Organisation (WHO) defines zoonosis as “any disease or infection that is naturally transmissible from vertebrate animals to humans”. Infection occurs when humans are directly or indirectly exposed to infected animals, their products and/or their environment.

During 2016, DAFM and AFBI laboratories isolated and identified a number of zoonotic agents, some of which are discussed below.

Campylobacteriosis

During 2016, DAFM isolated *Campylobacter jejuni* in 210 bovine herds (including one isolate from foetal stomach contents), 26 ovine flocks (including one pregnant ewe with twin lamb disease), one goat flock, three pig herds, one poultry flock and one equine holding. On one holding *C. jejuni* was isolated in both cattle and sheep.

In relation to ovine abortions, *Campylobacter fetus* subsp *fetus* was isolated in one flock and *Campylobacter fetus* subsp. *venerealis* (identified using PCR) in another flock.

In AFBI laboratories, *C. jejuni* was isolated in one bovine case; *Campylobacter lari* was isolated in one bovine case and two ovine cases, and other *Campylobacter* spp. were isolated in two bovine, six ovine, two porcine and one cervine case.

Campylobacteriosis is the commonest cause of food-borne gastroenteritis worldwide. Campylobacteriosis due to *C. jejuni* is mostly asymptomatic in animals but it can cause gastrointestinal symptoms in humans. Asymptomatic carriers can shed the organism in their faeces for prolonged periods of time, contaminating food and water.

The main routes of infection are faecal-oral through ingestion of contaminated food and water. Campylobacteriosis in humans is typically characterised by abdominal pain,

fever and diarrhoea. Symptoms last between 24 hours and one week. Disease is usually self-limiting.

Cryptosporidiosis

During 2016, DAFM detected *Cryptosporidium parvum* in 490 bovine herds, 38 ovine flocks and two equine holdings. On one holding *Cryptosporidium* was detected in both bovine and ovine cases. In AFBI laboratories, *Cryptosporidium* was detected in 385 bovine cases, 25 ovine cases, one equine and four other cases where the species was not specified.

Cryptosporidium parvum is a parasitic protozoal organism found in the intestine of mammals worldwide. It is found primarily in neonatal calves but may also present in lambs, kids, foals and piglets. Many reports associate infection in calves with diarrhoea occurring between five and 15 days of age. Cryptosporidiosis is a common enteric pathogen in young lambs and kids. In humans, cryptosporidiosis 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 may 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 the faeces of domestic and wild animals, can also be important.

Erysipelas

During 2016, DAFM isolated *Erysipelothrix rhusiopathiae* from one pig herd, three hen flocks, one duck flock and one wild duck. AFBI identified *E. rhusiopathiae* from four bovine and six avian cases.

Erysipelas is a mostly sporadic bacterial infection caused by *E. rhusiopathiae* that affects a wide range of avian and mammalian hosts. From an economic point of view, pigs and poultry are the most important species affected.

Septicaemia is the commonest form of erysipelas. The disease also presents in

cutaneous, endocardial, and in lambs, polyarthritic forms. Animals may be asymptomatic carriers and shed the organism in faeces, urine, saliva and oronasal secretions. Direct infection is through breaks in the skin and through mucous membranes (e.g. during artificial insemination). Indirect infection is by ingestion of contaminated foodstuffs and, possibly, via biting insects (e.g. red mite *Dermanyssus gallinae*).

In poultry, erysipelas is primarily an acute infection that results in sudden death (~24h) and mortality is high. Just before death, some birds may be droopy with an unsteady gait. Chronic clinical disease is uncommon; birds may have cutaneous lesions and swollen hocks. Turkeys with vegetative endocarditis usually do not have clinical signs and may die suddenly. Clinical signs in chickens include general weakness, depression, diarrhoea, and sudden death. In laying hens, egg production may drop markedly. Decreased egg production and conjunctival oedema can be seen in organic, cage-free flocks.

Up to 50 *per cent* of intensively farmed pigs are considered to be carriers and, in asymptomatic carriers, the bacteria commonly reside in the tonsils. Clinical disease can be acute (septicaemia) and/or chronic (arthritis and/or endocarditis). Acute signs are depression, fever, reluctance to stand, stiff gait and excessive squealing when handled. Anorexia and thirst are common. Skin discoloration may vary from widespread erythema and purplish discoloration of the ears, snout and abdomen, to diamond-shaped skin lesions, particularly on the lateral and dorsal regions. Skin lesions may be discrete, pink or purple and of varying size. These become raised and firm to touch within 2–3 days. They may disappear over a week or progress to a more chronic type, commonly referred to as diamond skin disease. If untreated, necrosis and separation of large areas of skin can occur and the tips of ears and tail may become necrotic and slough. Abortion and agalactia have been reported, and mortality is variable.

In humans, *E. rhusiopathiae* causes three different syndromes: erysipeloid, a cutaneous form and a septicaemic form with

endocarditis. Bacteria usually enter through cuts in the skin. There are no reports of people becoming infected orally.

Giardiasis

In 2016 DAFM found positive *Giardia* faecal samples in 70 bovine herds, 15 ovine flocks and one kennel.

Giardiasis is an intestinal infection caused by protozoa that affects mammals and birds worldwide. *Giardia duodenalis* (also known as *G. intestinalis* and *G. lamblia*) is the species most often associated with domestic animals and humans. *Giardia* spp. have 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. *Giardia* cysts are infectious immediately after excretion, are resistant to the environment and their persistence is helped by high humidity. Infection is facilitated by the large numbers of cysts excreted and the low dose needed for infection. The pre-patent period is 3-10 days. It should be noted that excretion is often intermittent and that the faecal-oral route is the most frequent infection route - this can be direct (contact with infected faeces) or indirect (contact with infected environment). *Giardia* causes malabsorptive diarrhoea that is non-responsive to antibiotics or coccidiostats. Faeces can be pasty to fluid in consistency, with a mucoid appearance.

Leptospirosis

AFBI uses the Fluorescent Antibody Test (FAT) to detect *Leptospira* Hardjo (the serovar endemic in Irish cattle) in foetal material. In 2016, three *per cent* of both bovine (514 cases) and ovine (261 cases) samples submitted were positive. The prevalence of leptospiral disease in sheep appears similar to that in cattle, suggesting that sheep may co-maintain infection and act as a reservoir. *Leptospira* FATs are not carried out in DAFM laboratories.

AFBI offers serological testing of a variety of species to the eight serovars which are known to occur in NI.

In cattle, the *L. Hardjo* MAT (Microscopic Agglutination Test) is used to detect antibodies in serum and it is useful in the acute stage of infection. *L. Hardjo* ELISA is used to detect antibodies in serum and milk and it is useful to diagnose chronic infection and establish herd status. Serological diagnosis in sheep is hampered by short-lived ovine MAT titres and the lack of a suitable ELISA test.

Leptospirosis is caused by pathogenic serovars of the genus *Leptospira* that affects all mammals. The disease has a broad range of clinical manifestations, from sub-clinical to death, depending on the pathogenicity of the serovar, the host species, and the age and physiological status of the infected individual.

Listeriosis

During 2016, DAFM isolated *Listeria monocytogenes* mainly from foetuses (66 herds and 7 flocks). It was also isolated from a cow, a bullock and four young calves from five different herds. AFBI and DAFM *Listeria* spp. isolates for 2016 are summarised in Table 20. Listeriosis is a sporadic bacterial infection that affects humans and a wide range of animals. *L. monocytogenes* is one of the most pathogenic species. The natural reservoirs of *L. monocytogenes* are soil and the mammalian intestinal tract, which contaminates the environment.

Type	Bovine Herds		Ovine Flocks	
	DAFM	AFBI	DAFM	AFBI
<i>L. monocytogenes</i>	71	13	7	24
<i>L. ivanovii</i>	1	0	0	2
<i>Listeria</i> spp,	1	3	5	10

Table 20: Number of *Listeria* spp. isolates in AFBI and DAFM laboratories during 2016

In adult ruminants, encephalitis and meningoencephalitis are the most common forms of listeriosis. Aborted foetuses and post-mortem 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 danger to the foetus, with

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 2016, DAFM tested 458 bovine sera for antibodies for *Coxiella burnetii*, the causative agent of Q fever; 37 sera from nine different herds were positive. Of the 482 ovine sera tested; five samples from four flocks were positive. Three goat sera and one deer serum were also tested; they were all negative. AFBI tests for Q fever by examining modified Ziehl-Neelsen stained smears from abortion material. There were no positive samples identified in the 168 submitted.

C. burnetii 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. *C. burnetii* is also shed in milk, urine and faeces.

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

Ticks may also transmit the disease among ruminants. There is no evidence that ticks can transmit the disease to humans.

Salmonellosis

The isolation of *Salmonella* from aborted bovine and ovine foetuses is discussed in separate sections of this report. A breakdown of *Salmonella* serotypes isolated from samples other than foetuses by DAFM during 2016 can be seen in Table 21.

The breakdown of *Salmonella* serotypes isolated by AFBI from samples including foetuses can be seen in table 22. There were a number of significant abortion outbreaks in cattle due to *S. Dublin*. Cattle may also have

been the source of ovine and cervine infections. *S. Typhimurium* remains common in pigs. A specific monophasic Group B *Salmonella* was isolated in about a third of porpoises examined, most commonly in the lung; however, associated disease was rare.

Type	Bovine	Ovine	Caprine	Porcine	Avian
<i>S. Anatum</i>	1	0	0	0	0
<i>S. Dublin</i>	48	6	2	0	0
<i>S. Arizonae</i>	0	1	0	0	0
<i>S. Infantis</i>	0	0	0	1	0
<i>S. Montevideo</i>	1	0	0	0	0
<i>S. Typhimurium</i>	6	2	0	15	2
<i>Salmonella</i> spp.	0	2	0	1	0

Table 21: 2016 DAFM *Salmonella* spp. isolates (excluding foetal isolates)

In addition to Table 22, there was one case of *S. Dublin* in deer, three cases of *S. Kingston* and five cases of *Salmonella* spp. in porpoises. Salmonellosis is caused by many serotypes of *Salmonella enterica*. 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 and adult animals commonly develop acute enteritis. 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.

Type	Bovine	Ovine	Porcine	Equine	Avian
<i>S. Brandenburg</i>	1	3	0	0	0
<i>S. Choleraesuis</i>	0	0	0	16	0
<i>S. Derby</i>	0	0	2	0	0
<i>S. Diarizonae</i>	0	6	0	0	0
<i>S. Dublin</i>	187	24	0	0	0
<i>S. Kottbus</i>	5	0	0	0	0
<i>S. London</i>	0	0	1	0	0
<i>S. Mbandaka</i>	5	0	0	0	0
<i>S. Typhimurium</i>	5	6	13	9	6
<i>S. Typhimurium</i> monophasic	2	7	44	0	0
<i>S. Muenster</i>	0	0	0	0	1
Other <i>Salmonella</i> spp.	5	3	2	0	0

Table 22: 2016 AFBI *Salmonella* spp. isolates (including foetal isolates)

The most common pathogenic serotypes of *S. enterica* are *S. Dublin* and *S. Typhimurium*. In humans, incidence of Salmonellosis has increased in recent years. Transmission occurs via contaminated water and foodstuffs; poultry and eggs are a significant source of infection. Symptoms tend to be more severe in the very young, the elderly and those who are immunocompromised for any reason.

Toxoplasmosis

During 2016, DAFM diagnosed toxoplasmosis in 66 flocks (in 36 flocks using PCR, in 24 flocks using serology and/or histopathology and in 6 using PCR plus serology and/or HP).

AFBI identified 67 ovine abortion cases due to *Toxoplasma gondii*. In relation to serology, significant *T. gondii* antibodies were found in two bovine sera, 529 ovine sera, three caprine sera, two porcine sera and in two other samples where the species was not specified.

T. 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 definite hosts of *T. 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 the transplacental transfer of tachyzoites from the mother to her foetus. *T. 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 pregnant women (tachyzoites can migrate across the placenta and cause birth defects) and people with immunosuppression. Infection of women with toxoplasmosis may occur by the methods outlined above or through contact with infected materials/fluids produced in ovine/caprine abortion.

OIE-listed Disease Surveillance

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JASON BARLEY, AFBI, STORMONT

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 (DAFM) and Northern Ireland (AFBI) 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 fulfil 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

One case of H5N8 avian influenza was detected by DAFM in 2016; the affected bird was a wigeon (*Anas penelope*), a wild duck found in Wexford on December 28th. This was part of the H5N8 epidemic which swept across Europe from October 2016. Separately, a brent goose (*Branta bernicla*) infected with H3N8 influenza virus was detected in October. No avian influenza cases were detected in poultry by DAFM in 2016. 6,725 poultry sera were screened for H5 and H7 antibodies using haemagglutination inhibition in 2016; a further 16,418 poultry sera were tested for antibodies using the AGID test. 933 samples were tested for avian influenza by PCR.

In Northern Ireland 302 tests were carried out by AFBI on 163 samples submitted for avian influenza testing by rRT-PCR. No positives were detected.

Newcastle Disease

No cases of Newcastle disease were detected by AFBI or DAFM in 2016. 173 and 614 samples were tested by PCR by AFBI and DAFM respectively.

Foot and Mouth Disease (FMD)

DAFM had one suspected FMD investigation in 2016. A private veterinary practitioner reported that two farms in the same area had cattle exhibiting drooling and depression. DAFM veterinary staff from CVRL, Kilkenny RVL, and Tullamore RVO carried out on-farm investigations that evening and ruled out foot-and-mouth disease on clinical grounds. Other potential infectious causes such as BVD and bluetongue were also tested for, with negative results. No final diagnosis was reached.

AFBI had no FMD suspects in 2016.

Bluetongue Disease (BT)

2,464 bluetongue antibody and 733 bluetongue PCR tests were performed by DAFM in 2016. There were 164 (7 per cent) bluetongue antibody positive cattle samples and zero bluetongue PCR tests recorded as positive. Countries of origin include Austria, Denmark, France, Germany, the Netherlands and the UK.

2,724 indigenous cattle were tested by AFBI for the presence of bluetongue virus antibody under the BT surveillance programme. One animal from one herd tested as antibody positive by the ELISA. This animal and associated herds underwent extensive investigation by both serology and PCR; from this investigation there was no evidence of active infection detected. There were 789 samples from imported cattle and 151 samples from imported sheep tested for the presence of BT virus antibody. In total, 1364 tests were carried out by AFBI on 1,139 samples submitted for BT virus testing by rRT-PCR. All samples tested negative.

Enzootic Bovine Leukosis (EBL)

3,279 serum samples were tested for antibodies to EBL by DAFM in 2016; no cases were detected. 70 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)

2,519 porcine serum samples were tested by DAFM for CSF antibodies by ELISA, and 33 samples were tested by PCR for viral genome. No cases of CSF were detected. AFBI had no CSF suspects in 2016.

African Swine Fever (ASF)

DAFM tested 42 samples for ASF virus by PCR and 2,518 serum samples for ASF antibodies by ELISA. No cases of ASF were detected. AFBI had no ASF suspects in 2016.

Transmissible Spongiform Encephalopathies

17 clinical bovine spongiform encephalopathy (BSE) suspects were investigated by DAFM in 2016; all tested negative. There were also three scrapie clinical suspect submissions in 2016: one was confirmed as atypical scrapie, one as classical scrapie and one was unconfirmed.

One clinical BSE suspect was investigated by AFBI in 2016. Laboratory tests were negative. There were three scrapie clinical suspect cases investigated, all of which were confirmed as negative.

DAFM Farm Investigations 2016

IAN HOGAN, DAFM, LIMERICK RVL

Lead Poisoning

DAFM RVLs investigated a number of outbreaks of lead poisoning in cattle during the year. In all investigations into suspected lead poisoning the priority is to first ensure that lead contaminated food does not enter the human food chain and to identify the source of lead exposure to the animals and remove it.

In one outbreak investigated by Limerick RVL, a seven-week-old calf with a history of sudden death was necropsied and found to have elevated kidney lead levels. Elevated blood lead was then found in some of the live cohorts. The outbreak was limited to a group

of ten calves occupying four individual pens in a single shed. These calves ranged in age from six to seven weeks. From this group, two calves died and one exhibited clinical signs which subsequently resolved. The farm investigation and laboratory testing of risk material confirmed that exposure was most likely to be associated with lead paint in a single shed to which these animals had access. The private veterinary practitioner recalled that there had been a case of lead poisoning in the herd some years before involving the same sheds. Since then the herd was under new management (a son has taken over the farm) and some changes had been made to the layout of the sheds. Following the diagnosis all animals were removed from the pens, and restrictions were put in place to prevent these animals from being slaughtered and entering the food chain.

The calves had been kept in old (c. 1890) converted stables which had been unoccupied for two to three years due to severe storm damage to the roof. A painted wooden fodder 'holder' or chimney (Figure 93) was identified as a likely source of lead. The herdowner was advised to remove these structures, or where this was not possible, to board up the back wall of the pens.



Figure 93: Photograph showing the food hopper/chimney that was present in each of the calf pens. The areas indicated by the arrows were covered in dark grey/black paint which was flaking and showed signs of being chewed. The percentages reflect the amounts of lead in the paint samples taken from these structures during the farm visit (Photo: William Fitzgerald)

Paint samples taken from the suspected sources shown in (Figure 94) revealed lead levels ranging from 12.1 per cent to 40.7 per

cent. Arrangements were made to re-bleed the restricted calves approximately six months later, at which stage the blood lead levels had dropped to normal levels, and the movement restrictions were lifted by the Regional Veterinary Office.



Figure 94: Wider angle photograph of one of the pens within which the calves were kept (Photo: William Fitzgerald)

Bovine Botulism

In this outbreak, investigated by Limerick RVL, a herdowner initially reported one cow death and one recumbent animal in a group of sixteen heifers. The animals had been moved into a new field a few days previously. The PVP carried out a field post-mortem and a number of samples were submitted to the RVL for analysis. Kidney lead and vitreous humor magnesium levels were within the normal ranges. A cause of death was not established. The next day the animal that had been recumbent had died and there were several more recumbent. One animal was euthanased and submitted to Limerick RVL. Rumen, abomasal and small-intestinal contents were harvested and forwarded to AFBI, Stormont for *Clostridium botulinum* type C and D toxin testing. The result was positive. During the follow-up farm investigation the source of the *C. botulinum* toxin was not identified but the field did have a number of features which might have been potential sources.

- There were three water sources; one drinking trough and two separate streams flowing into different corners of the field.
- The field was bounded by a school and a number of private dwelling houses. Grass clippings had been thrown into the field from some of the houses, and there was a variety of other waste thrown in from the houses and the school.

- The boundary ditches were overgrown, as were several internal ditches and trenches.
- A large pile of builders waste was in the field.
- A disused round feeder containing a large quantity of old, rotten fodder was present.
- An unused yard and cattle house was accessible from the field.

No animal carcasses were found in any of these places. The field the animals had been in previously was inspected and no likely source of the problem was seen. An examination was carried out of the animals that were still alive and had been moved to another field. Two recumbent animals were euthanased and sampled for botulism; the rumen and small intestinal contents from one animal again tested positive for *Clostridium botulinum* toxin at the AFBI laboratory in Stormont. Two other animals were having difficulty in rising and had a slow, stiff gait. One of these animals also had difficulty in urinating. Both of these animals deteriorated and died within days. By the end of the outbreak, ten out of the sixteen animals in the group had died. Future prevention of this condition would involve preventing access of animals to the source of the toxin in the suspect field; this will be more difficult since the source was not identified.

Precautions were recommended but not limited to:

- Cutting back or spraying to remove overgrowth in the hedges and ditches.
- Removal of the round feeder and contents.
- Changing the drinking trough and fencing off the streams
- Preventing access to the yard and house
- Removing the builders waste
- Preventing dumping from adjoining premises
- Deep ploughing and reseeded of the suspect field in case toxin was present on grass.

Acute Larval Paramphistomosis

Athlone RVL investigated the deaths over a two-week period, in late September/early October, of twenty two from a group of 31 seven-month-old calves. The herdowner found 11 calves dead in one field, having seen them two days previously, when they appeared to be normal and healthy.

All of the surviving calves had clinical signs of dullness, inappetance and diarrhoea, and two were recumbent. The buccal mucosa and nares of some animals were hyperaemic.

Seven calves were submitted to Athlone RVL for post-mortem examinations over five days. Gross, histopathological, bacteriological, biochemical and parasitological examinations were carried out. Some of the first cases examined were partly autolysed and the gross findings were not remarkable. They included liquid green/brown intestinal contents, diffuse ecchymoses and pinpoint multifocal necrotic lesions on the liver surface. Rumen fluke eggs were identified in one calf's faeces. However, the histopathology findings were quite remarkable. They included interstitial lymphocytic enteritis with intralesional trematodes (presumptive larval paramphistomes) and multifocal acute, hepatic necrosis and haemorrhage with mild eosinophilic and histiocytic inflammatory response (presumptive migrating parasites) i.e. the lesions were consistent with a diagnosis of larval paramphistomosis and acute fasciolosis. Subsequent examinations of two freshly-dead calves revealed lesions of haemorrhagic jejunal mucosa and contents, with large numbers of paramphistome larvae visible in both duodenal and jejunal contents. Histopathologically, trematodes were found in abundance in the small intestine with associated lesions (Figure 95). *Salmonella* cultures were negative. Biochemical tests indicated a hypoalbuminaemia which is consistent with larval paramphistomosis.

An epidemiological investigation revealed that 31 calves had grazed a 20-acre field which had very wet spots and surface water visible. The animals had been in this field for three to four weeks and had been drenched with albendazole prior to being moved onto it. Mains water was supplied to the animals in

two tubs. Animals in a contiguous field drinking the same water were unaffected. Other animal groups seen on the farm were healthy. There was no association with dumps or poultry litter (as initially botulism or poisoning was considered). Three mineral lick buckets had been left available to the calves four days prior to the first deaths. These mineral buckets and water were screened for a range of potential toxins, with no significant findings.

Three subsequent visits were undertaken to this farm by DAFM and UCD staff in order to estimate the level of pasture infectivity with metacercariae and also to collect specimens (metacercariae and mud snails) for DNA extraction, PCR and sequencing. On the first of these visits, herbage was collected from 800 locations within the field along two 'W' shaped routes and the metacercarial pasture burden was estimated to be 1,270 (sum total of liver and rumen fluke metacercariae) per kilogram dry matter. While there is no reference in the literature as to what level of pasture infectivity is considered dangerous, parasitology experts at UCD indicated that they generally use an infective dose of 250 metacercariae per calf in their liver fluke infection trials. Work on the snail metacercariae is ongoing.

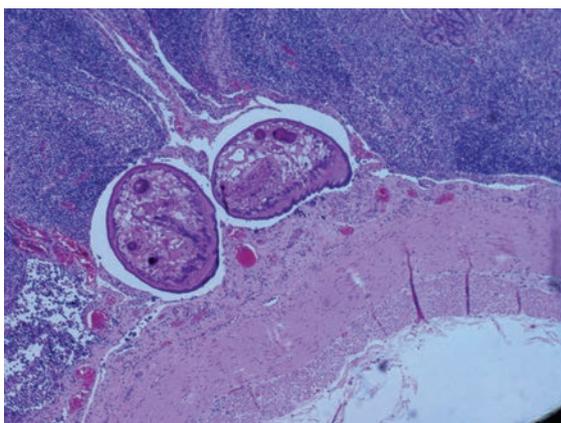


Figure 95: Histopathological (H&E) view of larval paramphistomes (Photo: Máire McElroy)

Based on all the evidence gathered and test results to date, it was concluded that acute larval paramphistomiasis (*Calicophoron daubneyi*) was the cause of the mortality and morbidity in this case. In addition there was also significant liver damage due to *Fasciola hepatica* infection which is likely to have

contributed to the severity of the outbreak. The clinical pathology features observed in this case was consistent with findings in other cases of larval paramphistomiasis.

The affected animals continued to deteriorate, despite veterinary treatment, with the loss of eleven more animals over the subsequent week resulting in a final death tally of 22.

AFBI Sheep Health and Performance Planning Study

JASON BARLEY, AFBI, STORMONT

Objectives

The overall objectives of the project were to 1) develop a robust, yet flexible flock health and production plan (FHPP) for sheep producers in Northern Ireland, 2) implement the plan on commercial farms, 3) monitor its effect on performance, welfare and financial indicators.

Materials and Methods

A detailed sheep FHPP was defined in consultation with scientists, farmers, their private veterinary practitioners (PVP) and farm advisors to agree on all the relevant issues to include in the FHPP. Ten farms were then recruited from lowland and upland environments across Northern Ireland. Farm visits were carried out pre-tupping with each farmer and his vet to collate initial baseline data, define farm specific targets and monitoring requirements for the following 12 months.

Results

The FHPP was first produced as a 20-page booklet with four main sections. Firstly, an audit establishes the current health and performance of the flock, and includes production parameters such as barren and lambing rates, and information on health and disease status. Secondly, the FHPP lists routine treatments and health monitoring carried out at the farm. Quarantine procedures are set out in a third section. Finally, three areas of intervention are

defined, with a list of associated actions to meet specific objectives.

Ten farms are now implementing the FHPP, following an initial two hour set up visit involving AFBI scientists, the farmer and PVP. This exercise indicated that most flocks needed to record more data especially on the number and causes of losses and culls. All ten flocks successfully identified three main areas of intervention, each falling into one of three main categories: reducing reproductive wastage, reducing growing lamb losses and improving gut worm and fluke control. The most common actions currently being carried out at each participating farm are 1) trace element profiling of breeding ewes, 2) more regular faecal egg counts to inform parasite treatments, 3) adjustments of vaccination and parasite control programmes and 4) lab investigations of abortions and other lamb losses.

Conclusion

A comprehensive, robust, yet flexible FHPP was successfully developed in collaboration with scientists, farmers, veterinary practices and farm advisors. The involvement of all stakeholders at the onset of this health planning process is crucial to maximise the future uptake and efficient use of this new management tool.

The AFBI Cattle Health Scheme

HELEN GIBNEY, AFBI, STORMONT

MARIA GUELBENZU, AFBI, STORMONT

AFBI offers a Cattle Health Scheme to provide programmes for the monitoring, control and eradication of diseases, working closely with herd owners and their Veterinary Surgeons. The Scheme is licensed by, and operates to the standards of Cattle Health Certification Standards (CHeCS). This is a self-regulatory body established by the cattle industry for the control and eradication of non-statutory diseases.

In addition to testing requirements, herd biosecurity is a very important component of the disease control programmes. The programmes may be used for routine

monitoring, for disease reduction, disease eradication and for disease free accreditation or risk level certification.

The scheme includes programmes for the five most important non-statutory diseases that are prevalent in both beef and dairy herds in the UK and Ireland.

Bovine Viral Diarrhoea (BVD)

BVD virus causes a complex of diseases in cattle, the most important of which interfere with reproduction, affect the foetus and can lead to persistent infection and mucosal disease.

AFBI Cattle Health Scheme members are now availing of the compulsory BVD eradication Programme in NI as a means of monitoring BVD in their herds, and ultimately gaining or maintaining accredited free status within the Cattle Health Scheme BVD programmes, in combination with biosecurity measures (see BVD Eradication Scheme section).

Infectious Bovine Rhinotracheitis (IBR)

IBR, caused by bovine herpesvirus 1 (BHV-1), causes acute upper respiratory tract disease, milk drop, reduced fertility and abortion.

In participating herds, all animals over twelve months of age, plus any non-homebred animals are tested annually. Figure 96 shows the relative percentages of animals testing positive, negative and inconclusive for IBR serology in 2016.

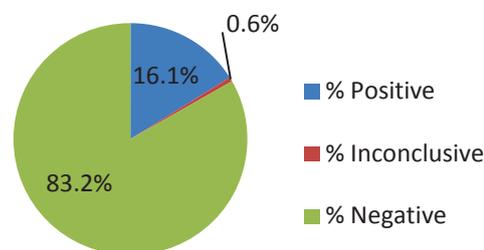


Figure 96: Relative percentage of animals testing positive, negative and inconclusive for IBR serology in 2016 (n=1330)

For herds participating in the IBR vaccinated monitored free scheme, the IBR gE serology test is used, which can distinguish between field virus and vaccination with a gE deleted (marker) vaccine. Figure 97 shows the relative

percentages of animals testing positive, negative and inconclusive for IBR gE serology in 2016.

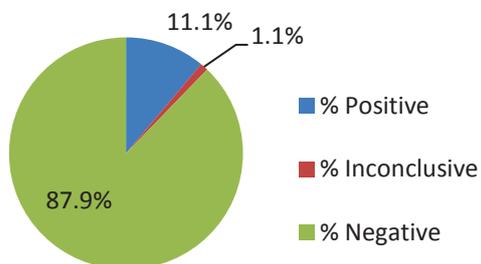


Figure 97: Relative percentage of animals testing positive, negative and inconclusive for IBR gE serology in 2016 (n=614)

Leptospirosis

In cattle, leptospirosis is caused by two organisms collectively referred to as *Leptospira* Hardjo. Infection can result in milk drop, infertility, abortion and the birth of weak calves.

In participating herds, all animals over two years of age, any animals between one and two years of age destined for breeding, and any non-homebred animals are tested annually. Figure 98 shows the relative percentages of animals testing positive, negative and inconclusive for *L. Hardjo* serology in 2016.

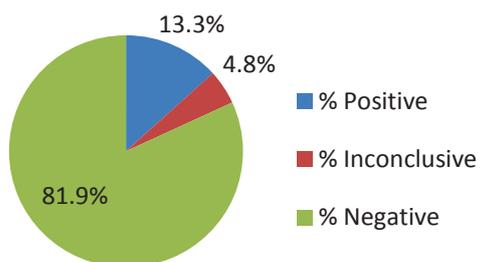


Figure 98: Relative percentage of animals testing positive, negative and inconclusive for *L. Hardjo* serology in 2016 (n=1066)

Johne's Disease

This disease, caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP), is a chronic, progressive, wasting condition that affects ruminants.

Herds participating in the scheme must carry out an annual herd test and adhere to other mandatory requirements of the scheme, designed to support the control and prevention of Johne's disease. They are then

allocated a risk level between 1 and 5, with level 1 being associated with the lowest risk of Johne's disease in relation to buying breeding stock from participating herds. In 2016, 75 AFBI Cattle Heath Scheme members gained or maintained the lowest risk (level 1) in 2016. The testing regime involves an annual serology test on all animals over two years of age. Any animal testing serology positive must then be tested for the presence of MAP in the faeces by culture or PCR.

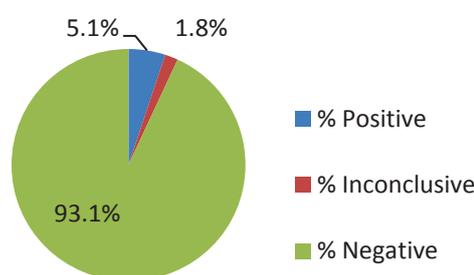


Figure 99: Relative percentage of animals testing positive, negative and inconclusive for Johne's disease serology in 2016 (n=11388)

Neosporosis

Neosporosis, caused by the protozoan parasite *Neospora caninum*, is a major cause of abortion in cattle on the island of Ireland.

In participating herds, breeding females over the age of two are tested annually. Figure 100 shows the relative percentages of animals testing positive, negative and inconclusive for *N.caninum* serology in 2016.

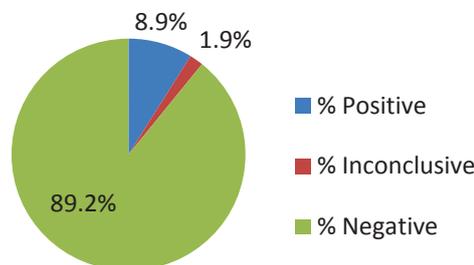


Figure 100: Relative percentage of animals testing positive, negative and inconclusive for *N.caninum* serology in 2016 (n=850)

AFBI Cattle Health Scheme members who progress towards accreditation and risk level certification enjoy a number of benefits including protecting the health, welfare and profitability of the herd.

Peer reviewed publications

A retrospective epidemiological analysis of risk factors for a primary necropsy diagnosis of bovine respiratory disease. Murray GM, Cassidy JP, Clegg TA, Tratalos JA, McClure J, O'Neill RG, Sammin DJ, Casey MJ, McElroy M, Earley B, Bourke N, More SJ. *Preventive Veterinary Medicine* (2016) 132: 49-56

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Evolving views on bovine respiratory disease: An appraisal of selected key pathogens - Part 1. Murray GM, O'Neill RG, More SJ, McElroy MC, Earley B, Cassidy JP. *Veterinary Journal* (2016) 217: 95-102

Evolving views on bovine respiratory disease: An appraisal of selected control measures - Part 2. Murray GM, O'Neill RG, More SJ, McElroy MC, Earley B, Cassidy JP. *Veterinary Journal* (2016) 217: 78-82

Genetic diversity of ruminant Pestivirus strains collected in Northern Ireland between 1999 and 2011 and the role of live ruminant imports. Guelbenzu, M.D.P., Cooper, L., Brown, C.W., Leinster, S., O'Neill, R., Doyle, L., Graham, D.A. *Irish Veterinary Journal* (2016) 69: (7)

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Infectious disease implications of invasive species: the greater white-toothed shrew and pathogenic *Leptospira*. Gilmore CM, Arent Z, Nally J, O'Bayles D, Regan S, McDevitt A, Yearsley J, Fanning S, McMahon BJ. *Plos Neglected Tropical Diseases* (2016)

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Optimisation of the zinc sulphate turbidity test for the determination of immune status. Hogan I, Doherty M, Fagan J, Kennedy E, Conneely M, Crowe B, Lorenz I. *Veterinary Record* (2016) 178(7): 169

Risk factors for failure to detect bovine tuberculosis in cattle from chronic herds across Northern Ireland (2004-2010). Lahuerta Marin A, McNair J, Skuce RA, McBride SH, Allen MM, Strain S, Menzies F, McDowell SWJ, Byrne A. *Research in Veterinary Science* (2016) 107: 233-239

Typhlocolitis associated with *Clostridium difficile* ribotypes 078 and 110 in neonatal piglets from a commercial Irish pig herd. McElroy MC, Hill M, Moloney G, MacAogáin M, McGettrick S, O'Doherty Á, Rogers TR. *Irish Veterinary Journal* (2016) 69: (10)

