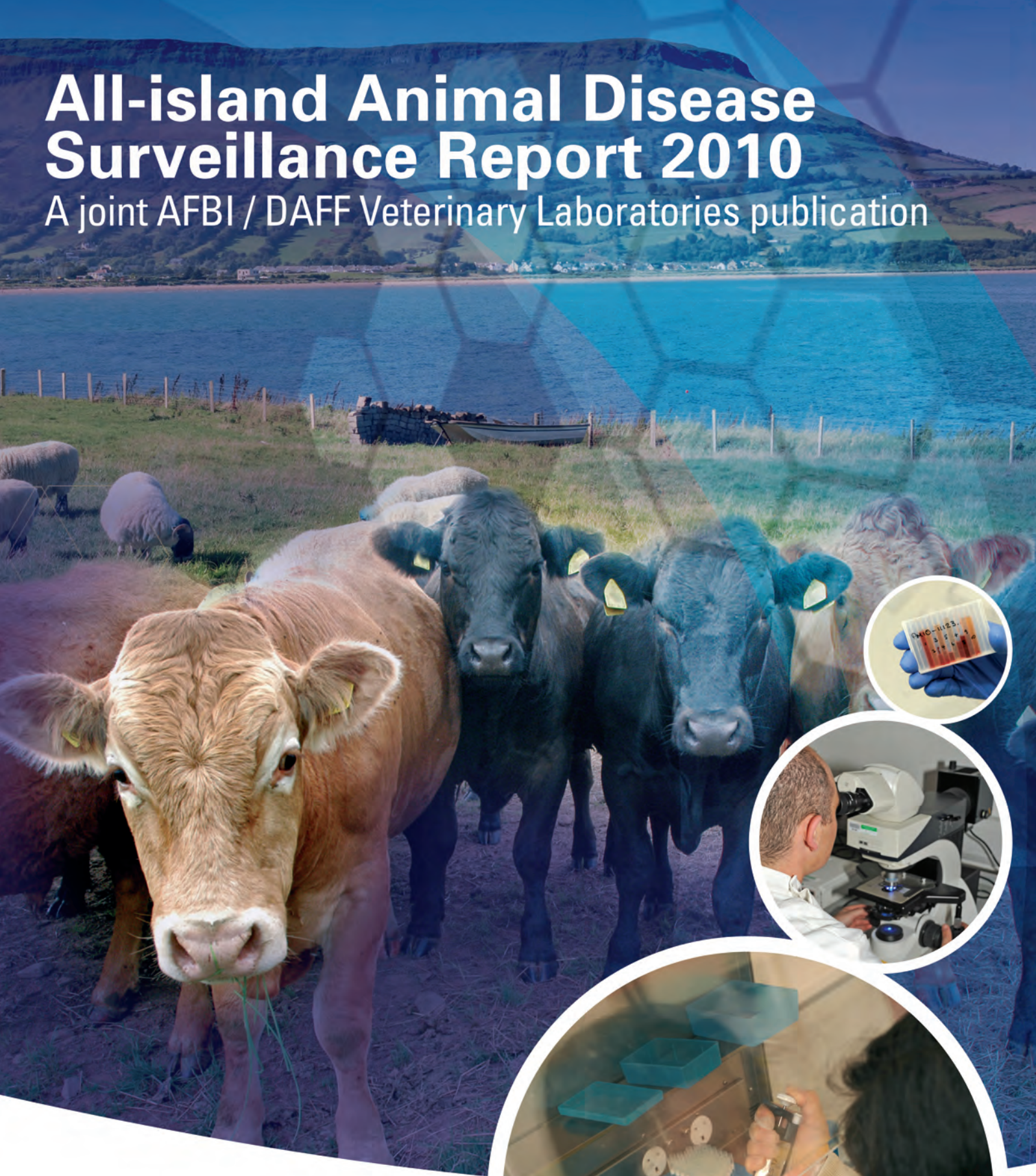
All-island Animal Disease Surveillance Report 2010

A joint AFBI / DAFF Veterinary Laboratories publication



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Introduction

The need for a high level animal health and welfare status throughout the island led the North South Ministerial Council (NSMC) to commission in late 2001 a programme of work to develop closer co-operation and joint strategies for the improvement of animal health on both sides of the border.

This led to the development of the All-Island Animal Health and Welfare Strategy, which was agreed by NSMC Ministers in March 2010. The ultimate objective of the strategy is the development of policies which facilitate the free movement of animals on the island.

This is the first All-island Animal Disease Surveillance Report, prepared by the veterinary diagnostic laboratories operated by the Agri-Food and Biosciences Institute (AFBI) in Northern Ireland, and by the Department of Agriculture, Fisheries and Food (DAFF) in Ireland and is part of the actions agreed by the Department of Agriculture and Rural Development and DAFF to help deliver the All-Island Animal Health and Welfare Strategy.

The island of Ireland trades in livestock produce on the basis of environmentally sustainable grass-based production systems. Livestock health is a difficult concept to encapsulate and quantify over a sizeable animal population in diverse management systems. In this report we seek to do this by quantifying these diseases and monitoring the trends of their occurrence in Irish livestock.

Food security is now a pressing global concern and the increasing requirement for animal protein affords the agri-food industry on this island with an opportunity to expand production and trade in livestock produce. This opportunity is encapsulated in DAFF's "Food Harvest 2020" report which envisages sectoral expansion, especially in dairying as quota restrictions are relaxed post-2013. Likewise, work is ongoing in Northern Ireland to develop the current Focus on Food Strategy into a longer term strategic vision for the sector. Sustainable expansion of the livestock sector and export trade will require greater attention to the provision of credible data on the frequency and patterns of disease in farmed animals, as achieved by surveillance.

If a farmer anywhere on the island has unexplained illness or deaths in farmed stock, their veterinary practitioner can refer them to avail of the services of the state supported veterinary diagnostic laboratories of AFBI or DAFF. These centres accept carcases of dead animals and samples from live animals, and offer a wide range of diagnostic test methods. The results of the tests and post-mortem examinations performed at these regional centres are reported to the farmer through his/her veterinary practitioner, who is in a position to complement these findings with appropriate advice. Laboratory-based veterinary staff may also undertake follow-up field investigations in certain cases as outlined in page 56 of this report. Both agencies enter all of the results from these investigations into their respective computerised databases, from which data can be extracted to provide detail on various aspects of food animal morbidity and mortality.

Jointly reporting the data generated by these activities in both jurisdictions during 2010 is a natural progression in the development of the island-wide animal health strategy. It is an essential step in signalling the commitment of parent Government Departments, DAFF and DARD (NI) to reducing restrictions on trade and movement of livestock across the border and ensuring that this is reflected in the revision of EU legislation on animal health currently underway in Europe which in turn may help deliver the aims envisaged in the All-Island Animal Health and Welfare Strategy.

The sea that surrounds the island of Ireland provides a natural defence to the introduction of many diseases of livestock. However as both jurisdictions operate open trading economies within the EU-wide single market; we need to remain vigilant, to the threats of the introduction of novel or exotic diseases.

Our ability to detect and identify such threats depends on a steady throughput of diagnostic material ensuring both services have a well-trained and practiced staff of veterinary diagnosticians, laboratory scientists and support staff. Closer alignment of surveillance activities and collaboration between the staff in both agencies has the potential to increase the efficiency and credibility with which we substantiate freedom from specific diseases on this island. It also allows us to identify knowledge deficits that might be addressed through collaborative research initiatives.

This report assembled by frontline staff of both agencies, is the first of what is hoped will be a series of Annual All-island Animal Disease Surveillance Reports into the future, and it is intended that the scope and reach of these reports will expand as this initiative develops.

Overview of submission rates, animal demographics and weather

Submission rates to the AFBI and DAFF veterinary laboratories in 2010

In a continuation of the trends identified in recent years, the number of carcases submitted to the DAFF Regional Veterinary Laboratories (RVLs) and to the AFBI Veterinary Laboratories has continued to increase annually. While well chosen clinical pathology samples from animals early in the clinical course of a disease can help to reach a diagnosis, if an animal dies, then the submission of entire carcases offers the best opportunity for the achievement of a conclusive diagnosis in the investigation of a fatal disease outbreak on farm.

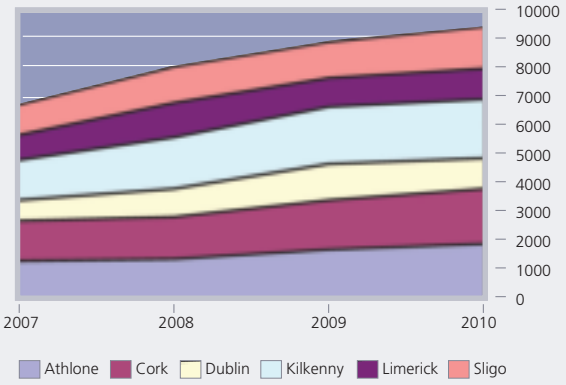


Figure 1: Trends in the submission of carcases for post-mortem examination to the DAFF Regional Veterinary Laboratories over the four years 2007 to 2010.

In 2010 DAFF RVLs processed a total of 9,396 carcases (Figure 1) which represented an increase of 39.7 *per cent* in submission numbers since 2007 while the AFBI veterinary laboratories processed a further 5,937 carcases in 2010 (Figure 2) reflecting an increase of 32.5 *per cent* in submission numbers during the same period.

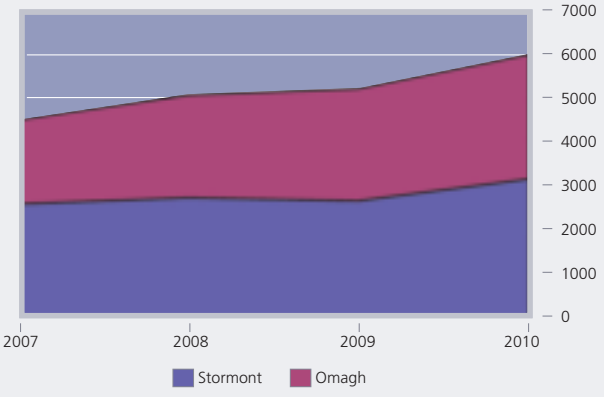


Figure 2: Trends in the submission of carcases for post-mortem examination to the AFBI Veterinary Laboratories over the four years 2007 to 2010.

The increase in the submission of clinical diagnostic samples over the last four years in both the AFBI and DAFF veterinary laboratories has been remarkable. In 2010 AFBI veterinary laboratories processed a total of 103,811 clinical diagnostic samples, an increase of 77.6 *per cent* on the submission numbers in 2007 (Figure 3).

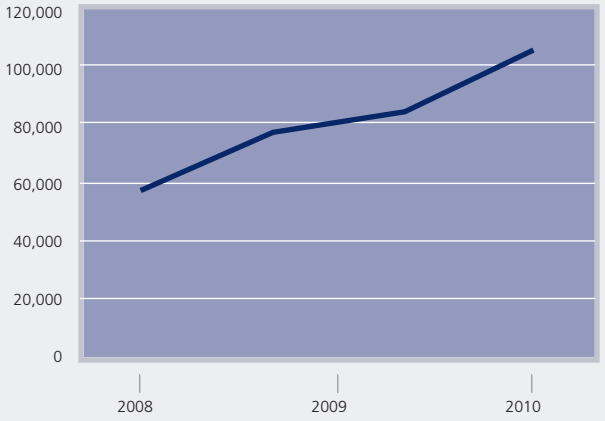


Figure 3: Trends in the submission of clinical pathology samples to the AFBI Veterinary Laboratories over the four years 2007 to 2010[1].

Since 2007, the DAFF regional veterinary laboratories (RVLs) have recorded a two and a half fold increase in clinical diagnostic samples submitted with an increase of 48.3 *per cent* (to 143,947 samples) in the year 2010 alone (Figure 4). This was a staggering increase in the demand for laboratory analyses and led to a reassessment by DAFF RVLs of our sampling and testing protocols in early 2011. The changes which were made at this time, of which veterinary practitioners were advised, sought to find the most appropriate way for DAFF RVLs to deliver quality animal disease surveillance, and to provide quality diagnostic services to Irish livestock farmers through their veterinary practitioners in the face of an inordinate increase in demand coupled with finite resources.

The significant increase in the demand for the diagnostic services of both AFBI and DAFF laboratories reflects an increasing awareness on the part of veterinary practitioners and their farming clients of the invaluable role which laboratory examination can play in the diagnosis, prevention and treatment of animal disease.

[1] Figures presented are the combined totals for AFBI Stormont and AFBI Omagh laboratories
[2] Dublin RVL numbers exclude parasitological and clinical chemistry submissions.

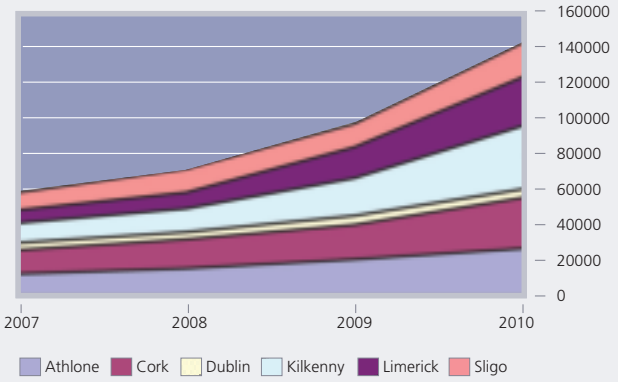


Figure 4: Trends in the submission of clinical pathology samples to the DAFF Regional Veterinary Laboratories over the four years 2007 to 2010 [2].

Irish animal demographics

The national populations of cattle and sheep for both Northern Ireland and Ireland are shown in Figure 5. While the cattle population has shown little change in both jurisdictions (1.6 million cattle in Northern Ireland and 6.6 million cattle in Ireland) during the last four years, the sheep population has suffered a decline, particularly so south of the border. In 2010 the DAFF sheep census recorded 4.6 million sheep in Ireland which represents a decline of 15.9 *per cent* since 2007. This was mainly due to reductions in ewes aged two years and over.

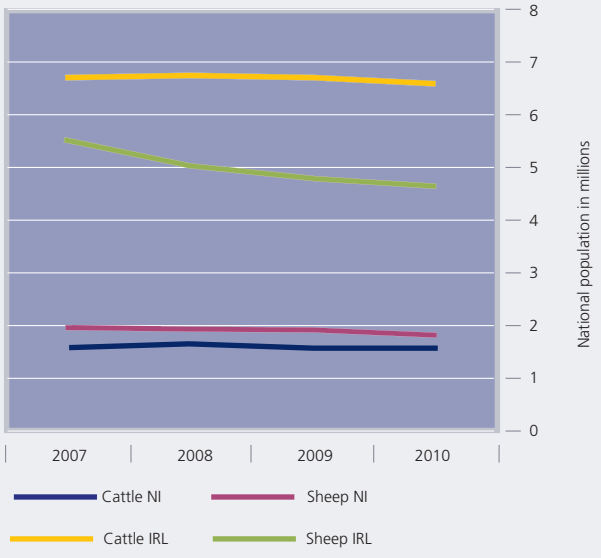


Figure 5: The national cattle and sheep populations of Northern Ireland and Ireland as measured in June each year for the years 2007 to 2010 (Source: NI data from The Agricultural Census in Northern Ireland - Results for June 2010; IRL data from the Central Statistics Office http://www.cso.ie)

Figure 6: The national herds of both jurisdictions have shown little change in size during the last four years.

In Northern Ireland the decline during the same period was less marked (8.7 *per cent*) with a population of 1.8 million sheep recorded in 2010. While this decline reflected reduced numbers of ewes (now at their lowest level since 1984) and lambs in the Northern Ireland flock, the numbers of fattening sheep aged over one year of age increased by 50.8 *per cent* during the same period.

Figure 7: Lamb prices remained buoyant in both Northern Ireland and Ireland in 2010 (Photo: Declan Murray).

This shrinkage in the national breeding flocks of both jurisdictions was a significant contributor to improved farm gate prices in 2010. The overall average price paid by processors for lambs in Ireland in 2010 was 460 cents per kilogram, an increase of 17 *per cent* on 2009 and the second highest average price paid for the last fifteen years. In Northern Ireland the average price paid by processors was 375 pence per kilogram which was the highest average price paid over the last fifteen years. A reversal in the reduction of sheep numbers on the island of Ireland is expected in 2011.

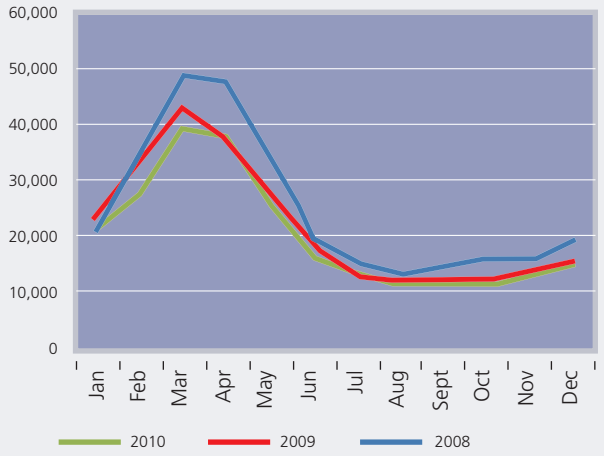


Figure 8: The total numbers of cattle deaths (cattle and aborted foetuses) recorded on the Animal Identification and Movement (AIM) system in Ireland by month for the years 2008, 2009 and 2010 (Source: DAFF AIM Bovine Statistics Reports).

The monthly totals of on-farm cattle deaths in Ireland, as recorded by DAFF, for the years 2008 to 2010 are shown in Figure 8. On-farm deaths follow a typically seasonal pattern, as would be expected, with the highest mortality in the spring months when most calving occurs (with associated complications) and the young calf population is exposed to neonatal disease. The 2010 figures mirrored closely the mortality figures for 2009 with marginally lower bovine mortality recorded in February and March. The annual bovine mortality total for 2010 was 244,132 animals compared to 261,974 in 2009 which is a reduction of 6.8 *per cent*. In the context of a national herd which contracted by only 1.6 *per cent* during the same period, this reduction represents a real and welcome reduction in bovine mortality in 2010.

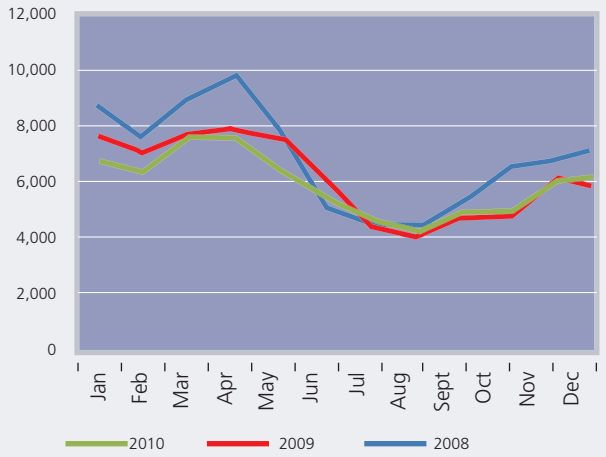


Figure 9: The total numbers of cattle deaths (cattle and aborted foetuses) recorded in Northern Ireland by month for the years 2008, 2009 and 2010 (Source: DARDNI).

The equivalent mortality figures for Northern Ireland are shown in Figure 9. On-farm mortality shows a seasonal rise in October and November in Northern Ireland which is not seen to the same extent in Figure 8. This may be due to a larger proportion of farmers engaged in autumn calving cows in Northern Ireland when compared to Ireland. Against the background of a static national herd (see Figure 5) the total on-farm losses of 71,916 represented a welcome reduction of 3.6 *per cent* in on-farm mortality in Northern Ireland during 2010 when compared to 2009. When the on-farm mortality figures for both Northern Ireland and Ireland are expressed relative to the size of the national herds in both jurisdictions a crude mortality rate of 44.9 deaths per thousand cattle and 37.0 deaths per thousand cattle were recorded in Northern Ireland and Ireland respectively.

Weather

The weather on the island of Ireland in 2010 was characterised by rainfall amounts below the thirty year average for many months of the year, with heavy falls of rain recorded in July, September and November. Indeed, in July and September the rainfall amount recorded was in excess of twice the average for those months (Figure 10).

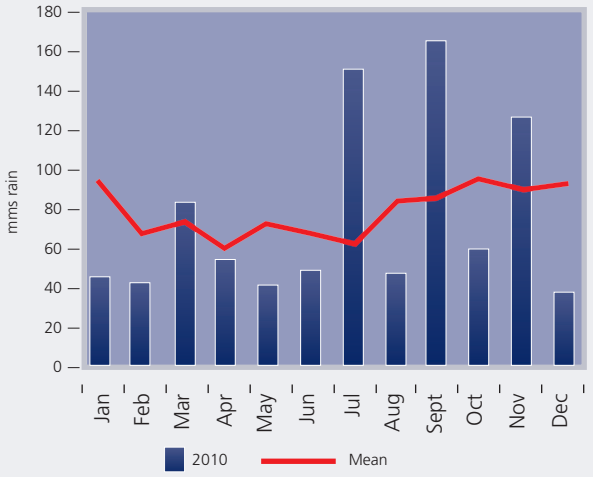


Figure 10: The average monthly rainfall in millimetres (mms), measured in Ballyhaise weather station, Co. Cavan during 2010 compared to the mean monthly rainfall for the years 1961-1990 (Data courtesy of Met Eireann http://www.met.ie)

Average daily temperatures were below the thirty year average in early spring and again in November and December with an average daily temperature of minus one degree Celsius recorded for December 2010 (Figure 11).

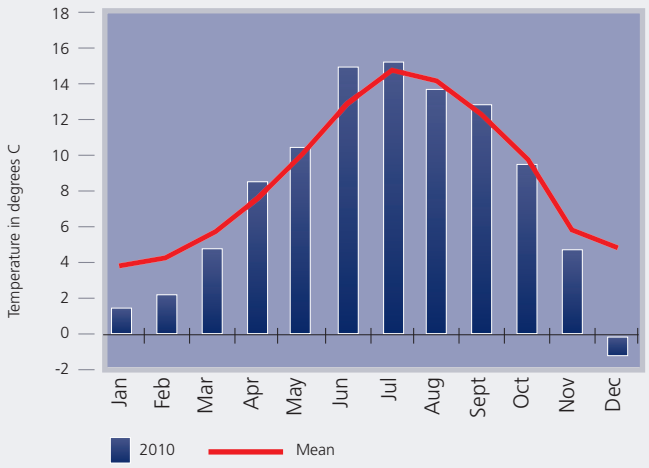


Figure 11: The average monthly temperature in degrees Celsius (C) measured in Ballyhaise weather station, Co. Cavan during 2010 compared to the mean monthly temperature for the years 1961-1990 (Data courtesy of Met Eireann http://www.met.ie)

Wet summers provide the optimal conditions for the survival of the mud snail, the intermediate host for liver fluke (*Fasciola hepatica*) (Figure 12) and the aquatic snail that is the intermediate host for rumen fluke (*Paramphistomum cervi*). This may explain the rise in rumen fluke detection in the third quarter of the year in both cattle and sheep (see Figure 91 and Figure 93).

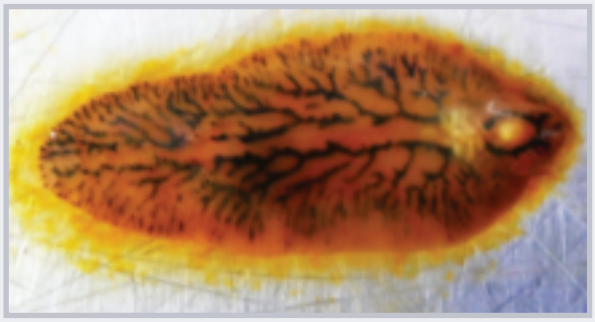


Figure 12: A liver fluke *(Fasciola hepatica)* (Photo: Cosme Sánchez-Miguel).

In spite of the low temperatures experienced in the winter of 2009/10, the reduction in liver fluke cercariae on pasture was not as significant as might have been expected, and liver fluke caused significant losses again in 2010. This finding seems to contradict previously held beliefs that very low temperatures in winter reduce liver fluke levels in the spring and may warrant further investigation. Certainly, the number of liver fluke deaths was reduced in 2010 when compared to 2009 (see Figure 24), but much of this reduction could be attributed to increased awareness on the part of herdowners and their consequent adherence to preventative measures.

Diseases of cattle

In spite of the wide spectrum of possible causes of mortality in cattle the most common causes of death remain remarkably consistent from year to year and from each jurisdiction. The causes of mortality in cattle diagnosed in both the AFBI and DAFF veterinary laboratory post-mortem rooms are presented in this section. Owing to minor differences in the age categories used for classifying calves and weanlings in the AFBI and DAFF data management systems, the data for each jurisdiction is displayed in separate graphs. In interpreting the diagnoses presented it is important to acknowledge that many of those diagnoses listed represent a number of similar or related entities. For ease of presentation, many similar conditions are subsumed into a more general categorisation. More specific data on many of these conditions can be obtained in the other sections of this report.

Neonatal calves (birth to one-month-old)

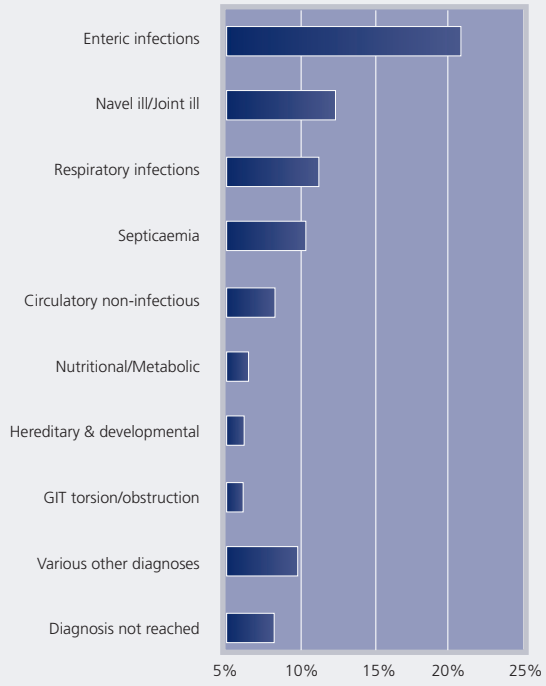


Figure 13: The conditions most frequently diagnosed on post-mortem examinations of neonatal (birth to one-month-old) calves in Northern Ireland in 2010 (n= 478).

Enteritis continues to be the most commonly identified cause of mortality in neonatal calves on the island of Ireland (Figure 13 and Figure 14). In Northern Ireland, among carcases in which enteritis was diagnosed as the cause of death, *Cryptosporidium parvum* was the enteric pathogen identified with greatest frequency (18.4 *per cent*) while rotavirus was identified in 17.1 *per cent* of cases.

In Ireland the situation was remarkably similar with rotavirus identified in 18.6 *per cent* of neonatal carcases and *Cryptosporidium parvum* from a further 17.5 *per cent* of carcases. Further analysis of findings among clinical cases of enteritis is presented in the Neonatal enteritis section on page 18.

Hypogammaglobulinaemia (low blood immunoglobulins) was recorded as being the predisposing cause of death in twenty nine neonatal calves in Northern Ireland and in thirty four calves in Ireland. This occurs when calves fail to receive adequate amounts of protective antibodies from their mothers in colostrum. These results underline the role played by appropriate colostrum management in the prevention of neonatal disease.

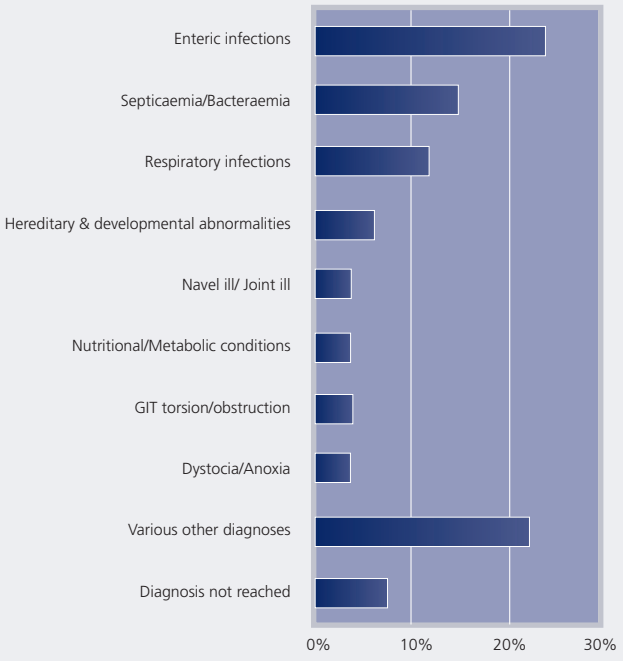


Figure 14: The conditions most frequently diagnosed on post-mortem examinations of neonatal (birth to one-month-old) calves in Ireland in 2010 (n= 1214).

The majority of the circulatory non-infectious conditions in neonatal calves were due to bovine neonatal pancytopaenia (BNP) (thirty six in Northern Ireland and sixteen in Ireland). An update on BNP in calves is presented on page 17 of this report.

Bacteraemia and septicaemia were relatively common findings among neonatal calves in 2010. Bacteraemia and septicaemia often represent the end-stage of a disease process when pathogenic organisms and their toxins enter the bloodstream, ultimately leading to shock. In many cases, owing to unsuccessful antimicrobial treatment before death, routine culture of the organ tissues may fail to isolate the causal pathogen.

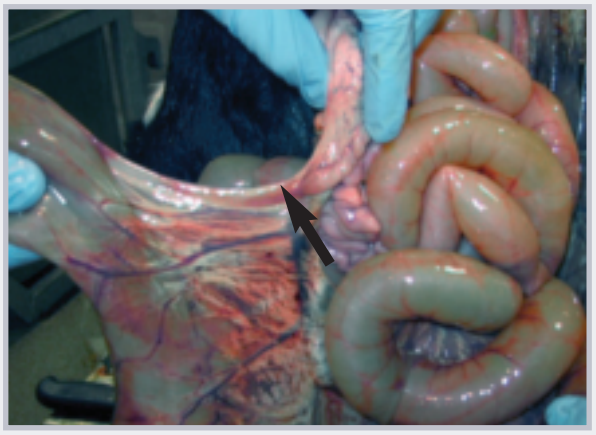


Figure 15: Atresia of a section of jejunum (arrow) in a newborn calf (Photo: Ger Murray).

In Ireland there were seventy one cases of hereditary and developmental abnormalities recorded, representing 5.8 *per cent* of neonatal mortality in 2010. Intestinal atresia (Figure 15) was the most frequently recorded (twenty six carcases) congenital abnormality while there were also twenty three cases of disproportionate dwarfism. Skeletal deformities were recorded in five carcases - three affecting the hind limbs and one each affecting the vertebral column and the mandible. There were also five cases of cardiac defects recorded on post-mortem examination – two carcases with an atrial septal defect, an interventricular septal defect in two animals and patent ductus arteriosus in one animal. In addition there were two cases of hydrocephalus (Figure 16) and two of renal deformities. Arthrogryposis and palatoschisis (SAP) of Charolais cattle were diagnosed in two calves from the same herd. Hereditary abnormalities accounted for 2.5 *per cent* of mortality (twelve cases) in Northern Ireland in this age category.

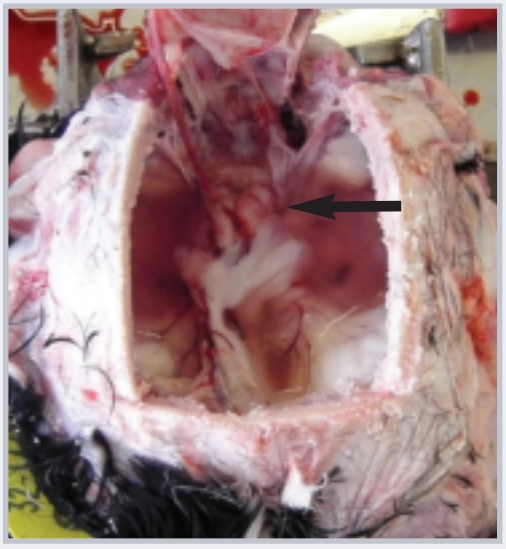


Figure 16: A case of hydranencephaly in a neonatal calf. The cranial cavity is filled with fluid and very little recognisable brain tissue is evident (arrow) (Photo: Mícheál Casey).

Navel ill and joint ill continue to be a significant cause of death in this age group. In Northern Ireland it was the second most frequent diagnosis (14.6 *per cent*) in neonatal calves in 2010, while in Ireland it accounted for 3.5 *per cent* of deaths. The agents isolated on bacteriological culture from such cases vary widely but *Arcanobacterium pyogenes* is common.

Figure 17 : Terminal dry gangrene in the hind limbs of a 6-week-old calf following *Salmonella* Dublin infection (Photo: Dónal Toolan).

Salmonella Dublin is commonly associated with enteric infections and septicaemia in calves (Figure 17), but it was also occasionally associated with gross lesions of nephritis, pericarditis and peritonitis. In Ireland, *Salmonella* Dublin was isolated from 5.9 *per cent* of neonatal carcases in 2010 and from 5.0 per cent of neonatal carcases in Northern Ireland.

Calves

The age categorisation of calves on the data management systems of AFBI and DAFF differ somewhat, with AFBI recording diagnoses for calves in the one to five-month-old bracket while DAFF records diagnoses for calves in the one to three-month-old bracket. The data from the respective age groups therefore are not exactly comparable. Nevertheless, allowing for this difference in how ages are categorised there is considerable similarity in the most frequently diagnosed causes of mortality in calves in Northern Ireland (Figure 18) and Ireland (Figure 20).

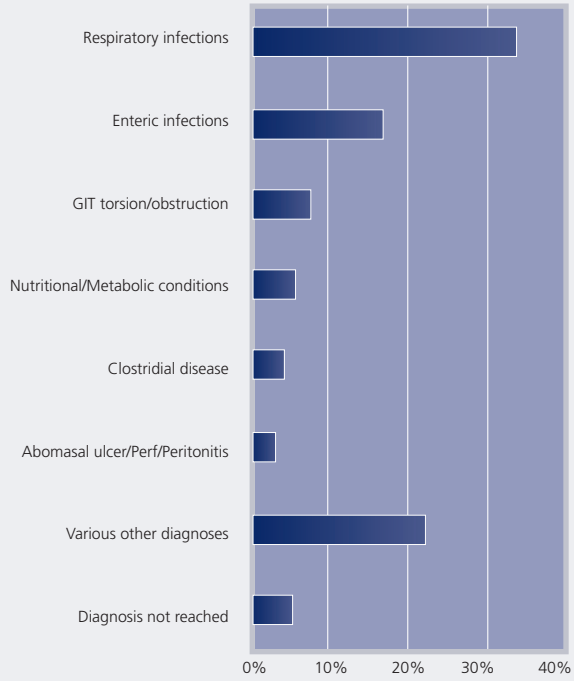


Figure 18: The conditions most frequently diagnosed on post-mortem examinations in juvenile (one to five-months-old) calves in Northern Ireland in 2010 (n= 336).

As with all age categories of cattle other than neonatal animals, respiratory disease was the most frequently diagnosed cause of mortality in calves in Northern Ireland (34.2 *per cent*) and Ireland (29.6 *per cent*) in 2010. Further details of respiratory diagnoses in cattle are available on page 25 of this report.

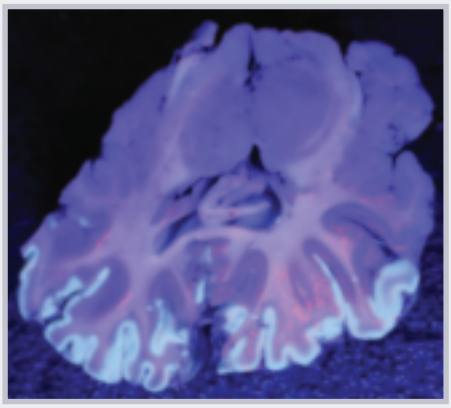


Figure 19: Fluorescence of the cerebrum under the Woods lamp (UV) in a three-month-old calf diagnosed with cerebrocortical necrosis (CCN) (Photo: Jim O' Donovan).

The category 'nutritional/metabolic conditions' in calves includes diseases such as cerebrocortical necrosis (Figure 19), bloat, ruminal acidosis and mineral deficiencies. In 2010 this grouping of diagnoses accounted for 5.7 *per cent* of diagnoses among one to five-months-old calves in Northern Ireland and 2.4 *per cent* of one to three-month-old calves in Ireland. This category of diagnoses was relatively more common in Ireland among neonatal calves (3.5 *per cent*).

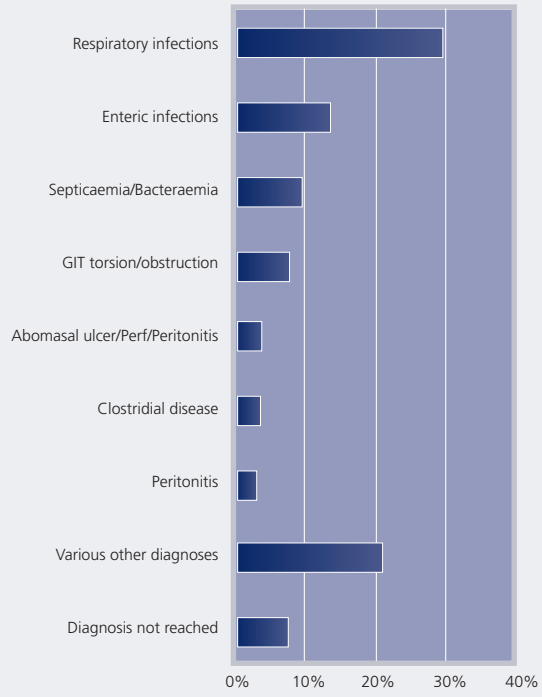


Figure 20: The conditions most frequently diagnosed on post-mortem examinations in calves (one to three-months-old) in Ireland in 2010 (n=510).

Among calves in Northern Ireland, enteric infections accounted for fifty six (16.7 *per cent*) deaths in this age category with coccidiosis accounting for twenty one (37.5 *per cent*) of these diagnoses. *Salmonella* Dublin was isolated from fifteen of these fifty six (26.8 *per cent*) cases. Pathological signs of septicaemia were also described in some of these carcases in addition to enteric infections. In Ireland, enteric infections were diagnosed in seventy (13.7 *per cent*) calves in the one to three-months-old category. *Salmonella* Dublin was isolated from thirty of these calf carcases; however septicaemia, rather than enteritis, was the cause of death in some of these cases.

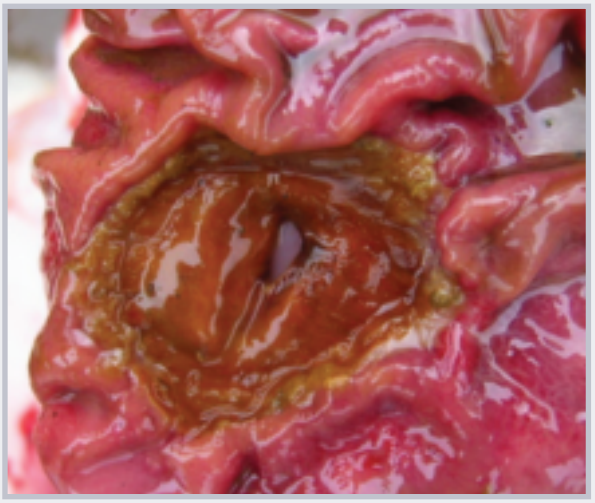


Figure 21: Abomasal ulceration and perforation in a young calf (Photo: Colm Ó Muireagáin).

Abomasal Ulcer/Perforation/Peritonitis' is a category which includes abomasal ulcers, some of which may have perforated through the abomasal wall causing peritonitis (Figure 21), accounting for approximately 3 to 4 *per cent* of mortality in young calves. The causes of these abomasal ulcers are often not immediately apparent in young calves but occasionally, their occurrence may be associated with BVD virus infection, dietary mismanagement or, in some cases, due to animals being dosed with acidic solutions (such as copper sulphate or cobalt sulphate). Peritonitis, due to causes other than abomasal perforation, was diagnosed in a further sixteen calves (3.1 *per cent)* in Ireland.

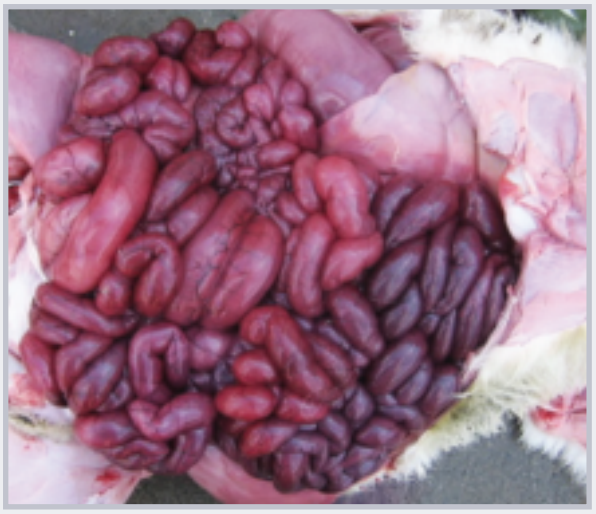


Figure 22: The characteristic finding of diffuse congestion of the intestines associated with mesenteric torsion in a three-month-old calf (Photo: Colm Ó Muireagáin).

The disease category "GIT torsion/obstruction" includes intestinal torsion, mesenteric torsion (Figure 22), and intestinal obstruction. Intestinal torsion is a relatively common diagnosis in calves accounting for 7.7 *per cent* and 6.1 *per cent* of deaths in calves in Northern Ireland and Ireland respectively in 2010.

Weanlings

In spite of the differences in the age categorisation used for weanlings in both jurisdictions (six to twelve-months-old in Northern Ireland and three to twelve-months-old in Ireland), the relative frequency of the most common diagnoses are quite similar.

Respiratory infections continue to be the most significant cause of death among weanlings on the island of Ireland, accounting for 31.0 *per cent* of deaths in this age category in Northern Ireland (Figure 23) and 31.3 *per cent* in Ireland (Figure 24).

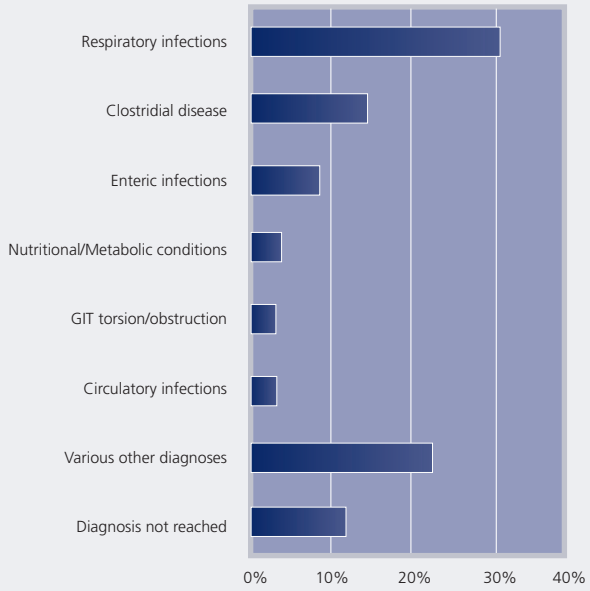


Figure 23: The most frequently diagnosed conditions following post-mortem examinations of weanlings (six- to twelve-months-old) in Northern Ireland in 2010 (n= 174).

Clostridial disease (14.3 *per cent*) was the second most common cause of death recorded in this age category in Northern Ireland while in Ireland it accounted for 6.3 *per cent* of deaths. Losses due to diseases caused by clostridial infections continue to occur despite being preventable by the use of a multivalent clostridial vaccine in the herd. This is an area where much improvement in survival rates of cattle should be achievable.

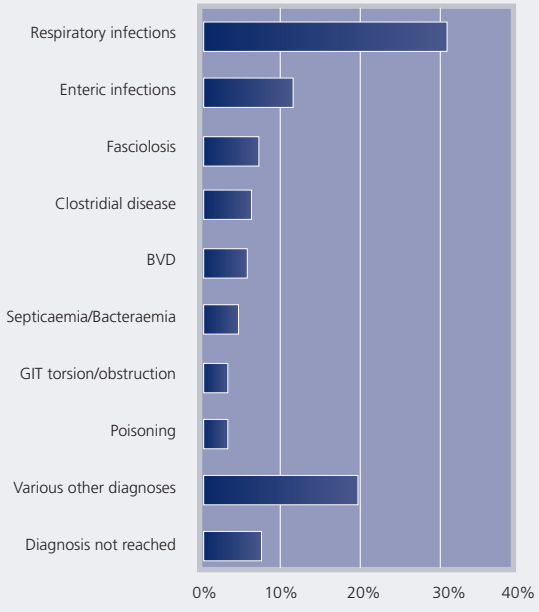


Figure 24: The most frequently diagnosed conditions following post-mortem examinations of weanlings (three- to twelve-months-old) in Ireland in 2010 (n= 568).

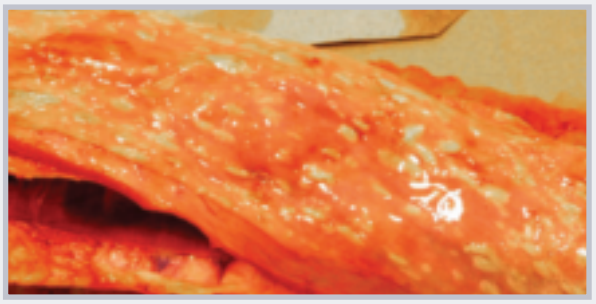


Figure 25: Ulceration of the oesophagus associated with BVD virus infection in a ten-month-old heifer (Photo: Ger Murray).

BVD virus was detected in thirty one weanling carcases in Ireland by PCR methodology in 2010. This was the age category in which it was most frequently detected on post-mortem examination. It was also detected in twenty three adults. In Northern Ireland, it was detected most frequently in adult carcases (fourteen cases), and considerably less frequently in weanling carcases (4 cases). In addition to the classical lesions of mucosal disease (Figure 25) it was also associated with lesions of pneumonia in a number of these carcases, suggesting its probable role as a risk factor in the development of respiratory disease.

Adult cattle

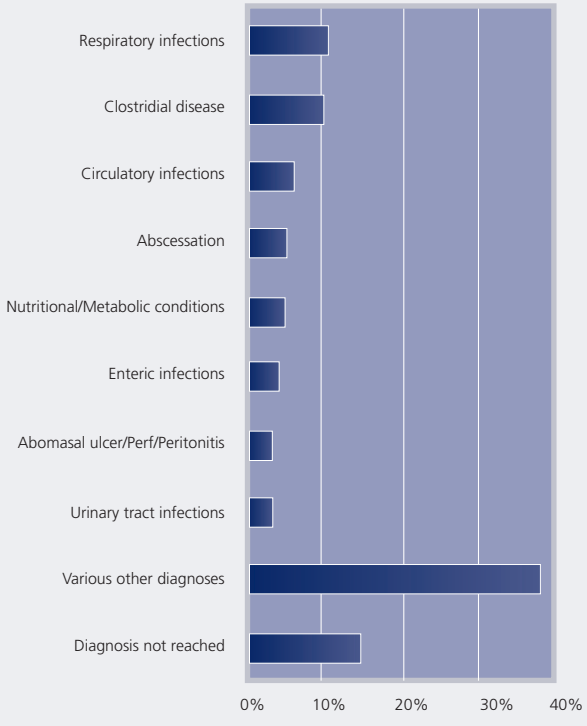


Figure 26: The most frequently diagnosed conditions following post-mortem examinations of adult (greater than twelve-months-old) cattle in Northern Ireland in 2010 (n= 610).

In both jurisdictions, bovine animals over twelve months of age are classified as adults. In this age group, the variety of diagnosed causes of death tends to be greater and while respiratory infections are still the most common cause of mortality, the relative frequency of this diagnosis is less than in other age categories (Figure 26 and Figure 28). Further analysis of respiratory infections in cattle is presented on page 25.

Again, as in weanlings, clostridial disease featured prominently as a cause of death in adult cattle. Northern Ireland recorded clostridial involvement in 10.0 *per cent* of adult deaths while 5.7 *per cent* of deaths in Ireland among adults were due to these pathogens. Further analysis of clostridial infections in cattle on the island of Ireland is presented on page 13.

Figure 27: 'Bread and butter' pericarditis caused by the puncturing of the pericardial sac by a piece of metal wire (arrow) which was found *in situ* (Photo: Jim O Donovan).

The category 'Circulatory Infections' includes conditions such as vegetative endocarditis, pericarditis (Figure 27), vena cava thrombosis, babesiosis, and myocarditis. This group of broadly similar infections was much more common in adult cattle than in the other age categories and accounted for 6.1 *per cent* and 3.3 *per cent* of adult bovine mortality in Northern Ireland and Ireland respectively in 2010.

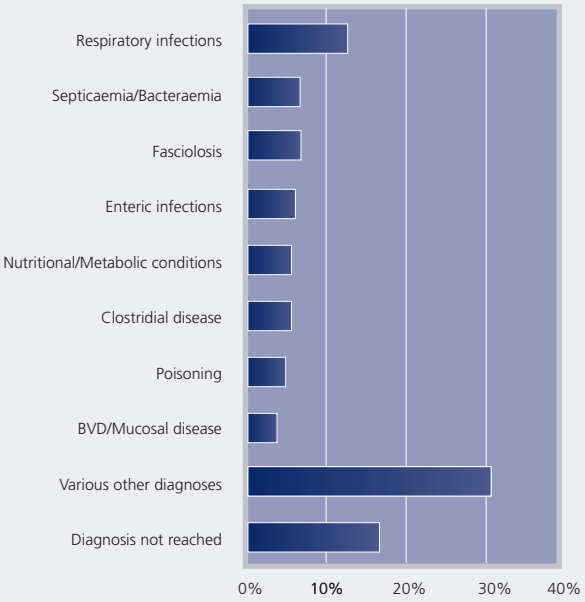


Figure 28: The most frequently diagnosed conditions following post-mortem examinations of adult (greater than twelve-months-old) cattle in Ireland in 2010 (n= 564).

Each year there are a significant number of carcases in which abscessation is considered a very significant finding. The category of 'abscessation' included all abscesses recorded from multiple sites on post-mortem examination where the finding was considered to be the cause of death. Among adult cattle, there were twenty eight cases of abscessation recorded in Northern Ireland in 2010 and thirteen cases in Ireland.

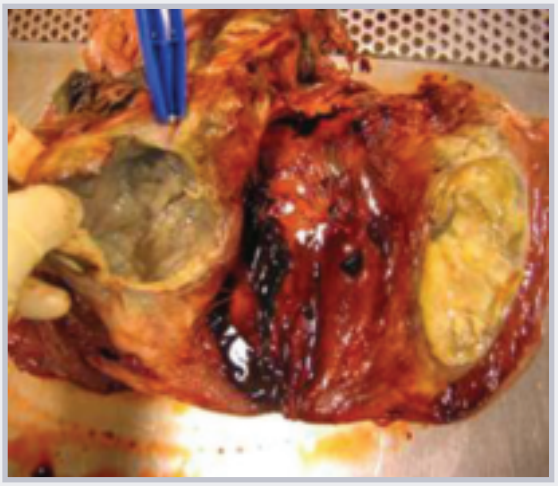


Figure 29: Abscessation of the interventricular septum of a two-year-old heifer (Photo: Ger Murray).

Arcanobacterium pyogenes was the pathogen most commonly isolated from these abscesses on bacteriological culture. Cardiac abscesses (Figure 29) were the most common in Ireland and accounted for five of the thirteen cases in adult bovines while brain abscessation (nine cases) and cardiac abscessation (eight cases) were most frequently recorded in Northern Ireland.

Hepatic abscessation (five cases and three cases in Northern Ireland and Ireland respectively) is commonly associated with ruminal acidosis. It is important that good hygienic practice is adhered to when injecting cattle, as the use of non-sterile needles may be a significant contributing factor to the development of all types of abscessation, in particular intra-muscular abscessation.

The category 'nutritional/metabolic conditions' accounted for approximately 5 *per cent* of diagnoses among adult cattle in both Northern Ireland and Ireland. This category includes a number of conditions, of which the most frequently diagnosed were ruminal/metabolic acidosis, bloat, fatty liver and hypocalcaemia.

Fasciolosis was diagnosed in thirty seven adult cattle in Ireland, representing 6.5 *per cent* of adult mortality in 2010. In Northern Ireland, fasciolosis was recorded as the cause of death of eighteen adults (3.0 *per cent*), although it was recorded as a secondary finding in a further seventeen carcases. These results probably reflect the high rainfall recorded in some months in 2010 (see Figure 10) and also suggest that some liver fluke control regimens that were employed were insufficient to adequately control the parasite. Further details on the frequency of detection of fasciolosis are available on page 42 of this report.

Clostridial diseases in cattle

Figure 30: A classical blackleg lesion of haemorrhagic myositis in the musculature from the hind leg of a bovine animal (Photo: Cosme Sánchez-Miguel).

Blackleg (Figure 30) was the most frequently diagnosed clostridial disease in cattle in 2010 - accounting for fifty two deaths in cattle in Northern Ireland (almost half of them in weanlings) and twenty five deaths in Ireland, seven of which were in calves aged one to three-months-old (Figure 32 and Figure 33).

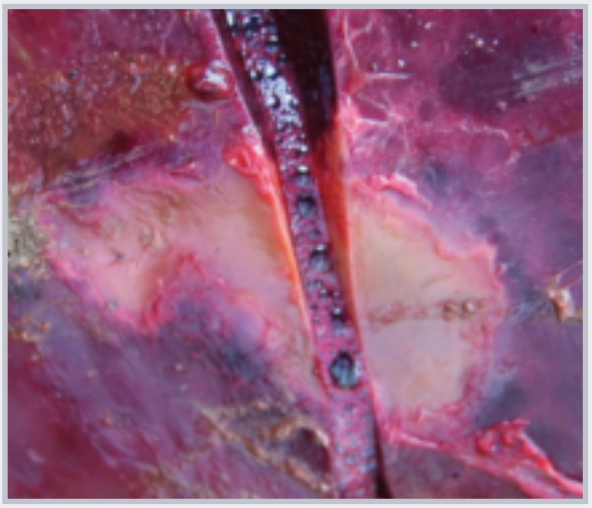


Figure 31: The classical necrotic focal lesion in the liver associated with Black disease (Photo: Colm Ó Muireagáin).

Clostridial enterotoxaemia was the second most common diagnosis (fourteen cases) in Ireland. Black disease accounted for thirty three deaths in Northern Ireland in 2010. The majority of these (twenty seven cases) occurred in adults, with two thirds of the cases being recorded in the second half of the year, reflecting the higher prevalence of fasciolosis then.

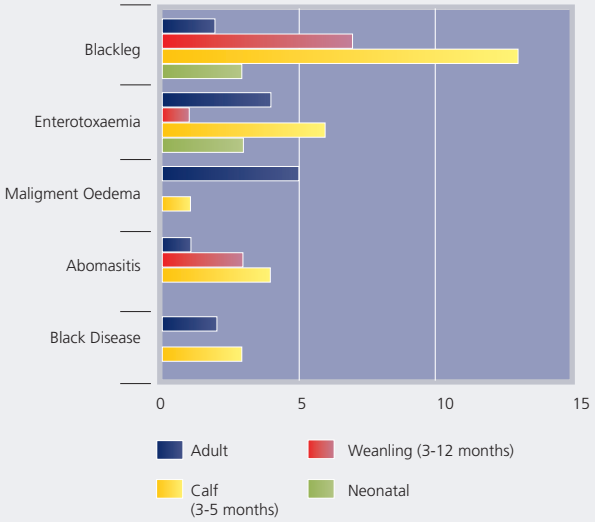


Figure 32: The frequency of detection of clostridial disease (number of cases) in cattle in Ireland in 2010 categorised by age group.

Malignant oedema was a relatively uncommon diagnosis in cattle in 2010. This disease is an acute toxaemia of cattle which is usually caused by *Clostridium septicum,* although other species such as as *C. chauvoei, C. perfringens, C. novyi,* and *C. sordellii* may be implicated. These organisms may be found in soil and the intestinal tracts of animals. Contamination of wounds allows entry of the organism into the body where devitalised tissue can provide the optimal anaerobic conditions for replication of the bacterium and toxin production.

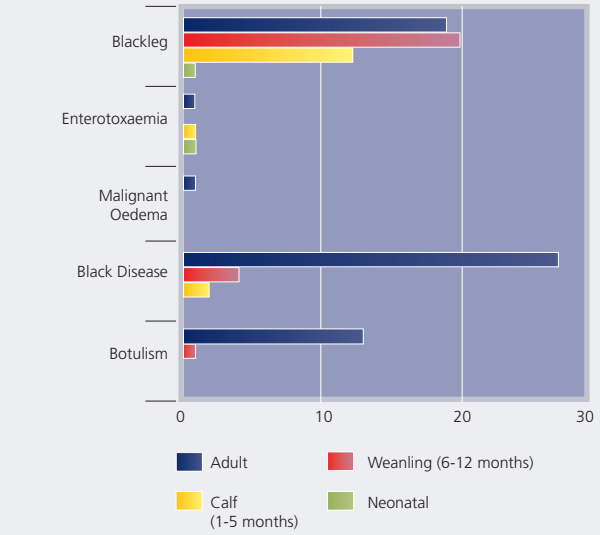


Figure 33: The frequency of detection of clostridial disease (number of cases) in cattle in Northern Ireland in 2010 categorised by age group.

Botulism in cattle

Botulism is caused by *Clostridium botulinum*, a bacterium that produces toxins under certain environmental conditions. Botulism remains an occasionally diagnosed disease on the island of Ireland and is normally associated with areas where spreading of broiler litter on farm land occurs. Testing of all samples on the island is carried out by the AFBI Veterinary Sciences Division (VSD) in conjunction with the DAFF laboratories. The 'Type D' toxin of *C. botulinum* is the most commonly identified botulinum toxin in cattle. In 2010 the toxin was not identified in any samples submitted *via* the DAFF laboratories and was identified in fourteen suspect botulism cases by AFBI, almost entirely in adult cattle.

C. *botulinum* bacteria are commonly found in the environment and will grow rapidly in decaying organic matter, including animal and bird carcases. The spreading on pasture of broiler litter which has been contaminated with the carcases of chickens that have died from various causes during production is a common risk factor in Irish botulism outbreaks in cattle. Transfer of even small fragments of carcases onto adjoining or nearby pasture by scavenger animals, such as foxes, dogs or crows can potentially lead to exposure of cattle to the toxin.

It is important to note that the spreading of poultry litter sourced from egg laying hen units is not usually associated with outbreaks of botulism in cattle. A possible reason for this is that husbandry arrangements for layers reduce the likelihood of contamination of litter with carcases, except on rare occasions.

A joint investigation by veterinarians from DAFF and AFBI into a botulism outbreak in a poultry flock in 2010 was the first reported case of botulism in laying hens in the British Isles. (Sharpe *et al.*,2011)

Cattle and sheep of all ages are susceptible to botulism, which is characterised by a progressive muscle weakness (paralysis). Cattle characteristically display flaccid paralysis, and become recumbent. Occasionally flaccid protrusion of the tongue caused by a reduction of muscle tone (Figure 34) is seen, and while this is almost pathognomonic of the disease, it is only seen in approximately five *per cent* of cases clinically examined. Signs in sheep and goats are similar to those seen in cattle, but protrusion of the tongue, if it occurs, may not be as obvious. In most cases the disease is fatal, although some animals may recover. In many cases of botulism, euthanasia is necessary on welfare grounds. Cattle are extremely sensitive to the effects of the toxin, such that ingestion of very small amounts can result in clinical disease. The progression and severity of the disease depend on the amount of toxin ingested – the ingestion of a large quantity may lead to apparent sudden death.

Figure 34: Tongue protrusion and recumbency in a cow with botulism (Photo: AFBI).

The diagnosis of botulism is based primarily on the clinical signs and a history of known exposure to contaminated broiler litter or carcase material. Laboratory confirmation is frequently difficult and relies on detection of the toxin in samples harvested from suspect cases, and the elimination of other possible causes of disease. Practitioners and herdowners are urged to submit the carcase for post-mortem examination so that other differential diagnoses can be ruled out. In suspected botulism cases where the submission of a carcase is not possible, samples of rectal, small intestinal, and abomasal contents should be submitted, together with a comprehensive history of the clinical signs and any other relevant information.

Careful disposal of all animal or bird carcases and poultry litter is essential to minimise the risk of botulism to livestock. Poultry carcases should be promptly removed and disposed of by incineration, or by rendering as required by EU Regulations No. 1069/2009 and 142/2011. At no time should broiler litter be accessible to dogs, foxes, crows or other scavengers that may carry carcases onto adjacent pasture or into livestock housing. Washings from poultry houses and yards should be collected in tanks rather than be allowed to flow onto adjacent land.

C. botulinum toxin may persist on pasture for a considerable time if there is ongoing production of new toxin within the anaerobic environment of a contaminated carcase. Poultry litter should not be spread on agricultural land that is to be grazed, or from which silage or hay is to be harvested, in the same year. If litter must be spread, it should be deep-ploughed into arable ground. Spreading litter on a windy day may also pose a risk of contaminating adjacent fields.

No vaccine is available under general licence for the protection of cattle against botulism. However, veterinary surgeons in Northern Ireland may apply to the Veterinary Medicines Directorate (VMD) to obtain and use vaccines under "special treatment certification", to protect animals at risk of botulism. In Ireland, botulism vaccine is not available for cattle. Vaccination should not be used as a substitute for the hygiene and biosecurity measures described above.

The UK Food Standards Agency's Advisory Committee on the Microbiological Safety of Food has concluded that the risks posed to the human food chain by outbreaks of botulism in cattle, sheep or goats, associated with broiler litter, are very low as the toxin types involved in such outbreaks have only rarely been associated with human disease.

Further information and advice may be obtained from http://www.afbini.gov.uk or http://www.agriculture.gov.ie/animalhealthwelfare/diseasecontrol/botulism/

Reference:
A. E. Sharpe, E. J. Sharpe, E. D. Ryan, H. J. Clarke and S. A. McGettrick (2011) An outbreak of type C botulism in laying hens. ***Veterinary Record*** 168, 669

Fatal poisonings in cattle

Introduction

The common toxicities in cattle carcases identified on post-mortem examination by the AFBI and DAFF laboratories in 2010 are presented in Table 1.

Poisonous Agent	Ireland	Northern Ireland
Yew	0	2
Oak/acorn	1	0
Ragwort	8	1
Lead	31	15
Copper	3	2
Cobalt	1	0
Other plants	0	1
Totals	**44**	**21**

Table 1: The frequency of detection of various toxic agents in bovine carcases where poisoning was diagnosed in 2010.

Lead

Lead poisoning is the most common cause of fatal poisoning of cattle submitted for post-mortem examination in farm animals and was identified in a combined total of forty six animals in 2010. Lead poisoning occurs most commonly during the spring and early summer when cattle are turned out to pasture (Figure 35).

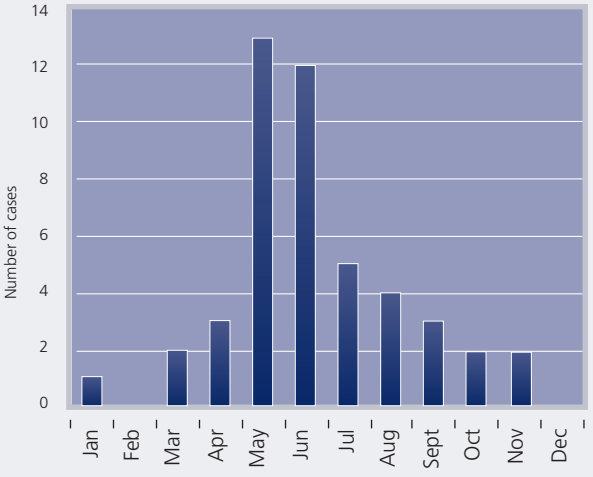


Figure 35: Combined data from AFBI and DAFF showing the seasonality of lead poisoning in cattle in 2010 (n=46).

Owing to their curious nature and tendency to nuzzle and lick at what they find on grazing pasture, cattle often ingest lead from old batteries, sump oil, flaking paint, paint cans and rubbish fire ash that contains lead. It is highly advisable that herdowners walk their fields before turnout of animals to identify if any items have been dumped on their land that could potentially poison their animals. Feed can also be contaminated although this is a less frequent finding. Approximately fifty deaths occurred on one farm in Ireland in 2008 when animals were exposed to silage that was contaminated when a car battery was inadvertently chopped by a feed mixer.

To prevent lead poisoning in livestock

- Dispose of used car batteries and motor oil through official local authority collection/recycling facilities
- Keep rubbish out of pastures and areas used by animals
- Prevent access to refuse, landfill sites (even if disused), old machinery, vehicles
- Service farm machinery away from animals
- Remove all lead paint and treat all painted objects, especially pallets, as potential sources of lead.
- Check carefully before introducing animals to pasture, yards or housing
- Do not overgraze areas that have potentially high soil lead

Ragwort

Ragwort *(Senecio spp.)* poisoning was diagnosed as the cause of death in one animal in Northern Ireland and eight animals in Ireland in 2010. Ragwort is a highly poisonous plant and cattle in particular are highly sensitive to its active compounds, pyrrolizidine alkaloids. These are cumulative toxins, which damage the liver leading to a variety of clinical signs which may include jaundice, diarrhoea, generalised oedema or photosensitisation. On *post mortem* examination the liver tissue may be hard due to fibrosis and, histologically, the characteristic changes of bile duct proliferation, portal fibrosis and megalocytosis (Figure 36) may be seen. In animals which display clinical signs the disease is almost always fatal. Sheep tend to be more tolerant but losses will still occur. Ragwort is a biennial plant in which the typical yellow flowers occur during the second year of growth. The plant is poisonous through both years of growth. While the growing plant tends to be unpalatable to cattle, they will ingest the plant when pastures are bare. Dead or dying ragwort is considerably more palatable to cattle and poses a greater risk. If the plant is conserved as hay or ensiled the risk of poisoning remains. In the case of silage the whole silage pit may be contaminated. Control requires the pulling rather than cutting of plants or alternatively spraying with herbicide.

The risk that ragwort poisoning poses to livestock was highlighted by a field investigation conducted by Athlone RVL presented below.

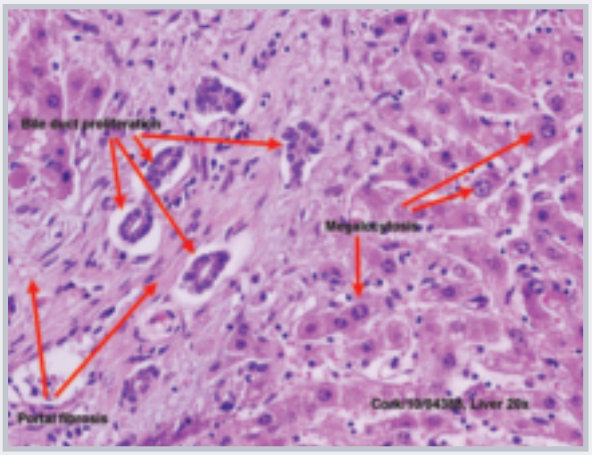


Figure 36: A photomicrograph showing the histological findings of megalocytosis, portal fibrosis and bile duct proliferation which are consistent with a diagnosis of ragwort poisoning (Photo: Cosme Sánchez-Miguel).

Athlone RVL investigated a number of cattle deaths on a holding in the summer of 2010. Deaths, predominantly among yearlings, were first recorded in June, and by mid-August, twelve animals had died. The clinical signs recorded in these animals included fluid green diarrhoea, trembling of the limbs, stiffness, stupor, photosensitisation on the muzzle (Figure 37) and rectal prolapse in some animals due to tenesmus (intense and repetitive straining to pass faeces, often seen in ragwort poisoning). Three carcases were examined at Athlone RVL and a diagnosis of ragwort toxicity was made following gross and histopathological examinations. On post-mortem examination the gross lesions noted were diffuse enteritis, the liver tissue consistency was firm, and oedema of the abomasal folds, mesentery and intestinal wall. There was also spongy change (status spongiosus) of the brain of one of the animals. Spongy change occurs when the liver function is reduced to the extent that toxins are not filtered from the blood stream resulting in damage to brain tissue.

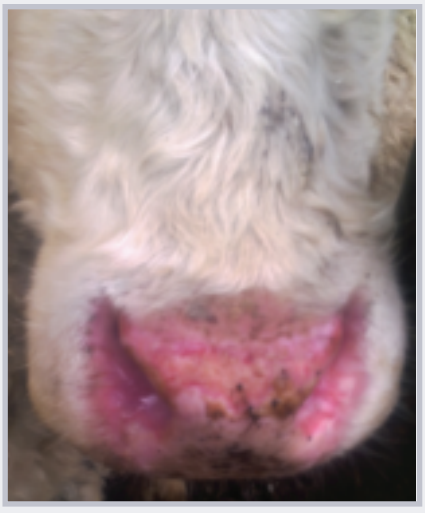


Figure 37: Erythema of the muzzle caused by photosensitisation in a yearling with ragwort poisoning (Photo: John Fagan).

Other apparently normal cattle in the herd were blood sampled and showed hypoalbuminaemia which was a consistent finding (arising from liver malfunction) and raised liver enzymes (indicating hepatocyte damage) in some samples. The Woolfe test (Iodine flocculation test for liver function) was used in this case and proved useful as a predictor of liver damage among clinically normal animals many of which subsequently developed clinical signs of ragwort toxicity. On further investigation, it was discovered that there had been ragwort ensiled in the silage eaten during the previous winter/spring. The slow but progressive nature of the disease was demonstrated by the fact that the first clinical signs didn't develop until June, four weeks after the animals were let out onto grass. Failure to control ragwort on land can have serious economic consequences for a farmer.

Copper

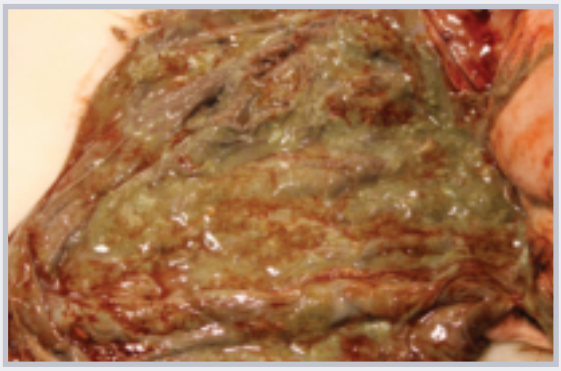


Figure 38: Blue- green staining material on the abomasal mucosa of a calf in which copper sulphate poisoning was diagnosed (Photo: Ger Murray).

Copper toxicity was responsible for five deaths in cattle in 2010. While sheep are particularly prone to copper poisoning, it is a relatively uncommon finding in cattle and is normally associated with over-zealous supplementation of animals which are assumed to be deficient. Copper sulphate is sometimes administered by herdowners to animals with diarrhoea, as a traditional remedy, occasionally with fatal consequences (Figure 38).

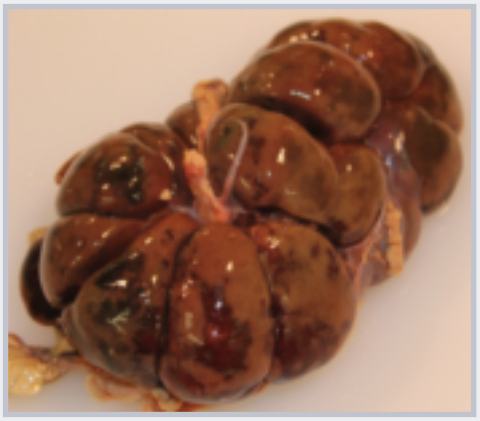


Figure 39: Diffuse cortical haemorrhages in the kidney of a calf diagnosed with copper sulphate poisoning (Photo: Ger Murray).

With cases of acute copper sulphate intoxication there can be irritation of the lining of the abomasum and duodenum due to the corrosive nature of the copper sulphate solution, while the subsequent loss of fluid into the intestinal lumen can lead to hypovolaemic shock. Animals which survive this initial phase may progress to develop haemolysis, haemoglobinuria and diffuse haemorrhages (Figure 39).

Haphazard supplementation of animals with minerals should be avoided and supplementation should be undertaken only where a deficiency has been definitively identified.

Bovine neonatal pancytopaenia – an update

Bovine neonatal pancytopaenia (BNP) is a disease of calves characterised by bleeding in young calves following minor injuries, causing haemorrhages in the body or from the skin. The condition is associated with severe bone marrow damage, which is believed to be caused by antibodies the calf receives from the colostrum consumed during the first twenty four hours of life. Normally the antibodies absorbed from colostrum by the calf provide it with protection from disease; however in a few rare diseases antibodies can attach to cells and tissues in the body, leading to cell damage.

It should be noted that BNP is a rare condition. The feeding of colostrum to a newborn calf is a vital step in the prevention of neonatal disease and the survival of calves and should not, under any circumstances, be discontinued in a healthy herd. Herdowners with confirmed cases of BNP in their herd should seek veterinary advice on colostrum management.

The first cases of BNP on the island of Ireland were diagnosed in October 2009 in Northern Ireland, while the first three cases of BNP in Ireland were diagnosed in May 2010. Since the initial cases, the condition has been diagnosed in sixty two calves from forty nine farms in Northern Ireland (thirty six calves in 2010), and in sixteen calves from fourteen farms in Ireland. These calves, of both sexes and various breed types, were apparently normal at birth. Typically calves became ill at around sixteen days of age with recognisable signs of BNP: fever, anaemia, bleeding and shock. In some cases the calves were found dead.

Agreeing a case definition for a novel disease can be difficult. For BNP the case definition which has been used to identify suspect cases is as follows:

- calves with widespread haemorrhages
- less than one month of age
- thrombocytopaenia (platelet count less than $100X10^9$)
- leukopaenia (white blood cell count less than $3 X 10^9$)
- BVD virus negative
- calf is not septicaemic

As the disease progresses, reduction in the white cell counts can leave a calf susceptible to septicaemia such that fulfilling the final criterion of the case definition can be difficult.

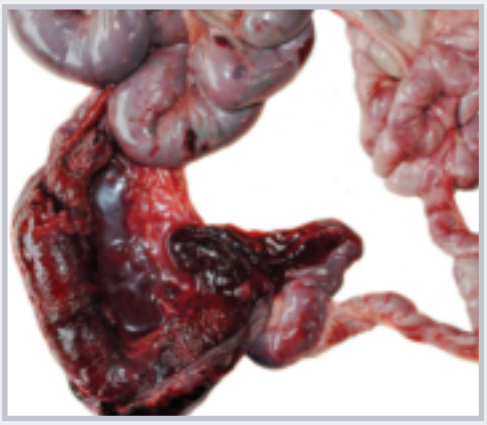


Figure 40: An intestinal blood cast in the lumen of the jejunum of a calf diagnosed with bovine neonatal pancytopaenia (BNP) (Photo: Pauline Baird).

At post-mortem examination, there were numerous haemorrhages observed on the surface of various organs, in muscles, or in the lumen of the intestines, where a firm cast may form (Figure 40). The bone marrow was grossly pale in many cases and histologically the (normally highly cellular) marrow of a young calf had severely reduced numbers of cells or was replaced by fatty tissue. Bacteriology, virology including culture, immunofluorescence, PCR and serology failed to identify an alternative infectious cause in these animals, although secondary bacterial infections were detected.

In some countries it has been reported in occasional cases that cows have had more than one affected calf but not in consecutive years (i.e. affected calves were born to the cow in year one and year three with a 'normal' calf being born to the cow in year two). In view of this finding, farms with confirmed cases of BNP should not use the colostrum from cows which have had previous calves with the condition.

Farms with BNP cases are advised to store colostrum from healthy cows without a history of having affected calves to supply the newborn calves of affected dams. It is good practice to record the identity of the donating cow against the calf receiving the colostrum in case the calf unexpectedly develops signs of BNP. All farms should avoid the use of pooled colostrum due to the risk of spreading infectious diseases such as Johne's disease.

As a precaution farms with affected calves should not supply colostrum or blood for commercial use such as for the production of 'artificial colostrum', but there is no evidence to suggest that milk or meat from the affected cows or recovered calves is unsafe for human consumption.

Bovine neonatal enteritis

Neonatal enteritis is responsible for a high proportion of mortalities in calves less than one month of age throughout the island of Ireland (*see* Figure 13 and Figure 14). In order to identify the enteric pathogens involved in cases of neonatal calf diarrhoea a series of tests are performed on faecal samples from these calves.

To aid the achievement of a diagnosis, faecal samples from neonatal calves with enteric infections should be taken prior to the administration of treatment.

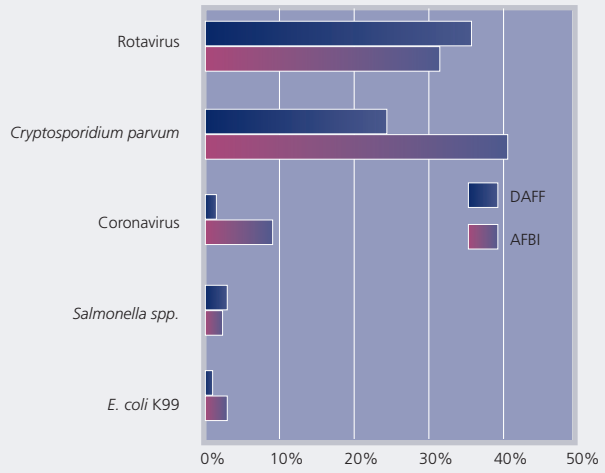


Figure 41: The relative frequency of calf faecal pathogens detected in faecal samples from calves less than one-month-old in Ireland (DAFF: n=3157) and Northern Ireland (AFBI: n=1863) in 2010·

The relative frequency of identification of enteric pathogens in calf faecal samples in 2010 is shown in Figure 41. *Cryptosporidium parvum* and rotavirus were the most common enteropathogens identified. *Cryptosporidium parvum* (40.5 *per cent*) was the most frequently identified pathogen in Northern Ireland in this age group and the diagnostic frequency was similar to recent years. Rotavirus (36.2 *per cent*) was the most frequently identified pathogen in Ireland, a consistent finding in recent years, with the frequency of identification ranging from 26 – 36 *per cent* between 2005 and 2010. Results between laboratories may not be directly comparable due to differences in test selection protocols and methodologies.

Calves are most susceptible to rotavirus enteritis between one and three-weeks-old. Adult animals are the primary source of rotavirus infection for neonatal calves. Rotavirus targets the upper small intestine causing shortening and fusion of the intestinal villi causing malabsorption and leading to diarrhoea. Death may ensue due to acidosis, dehydration (Figure 42) and starvation.

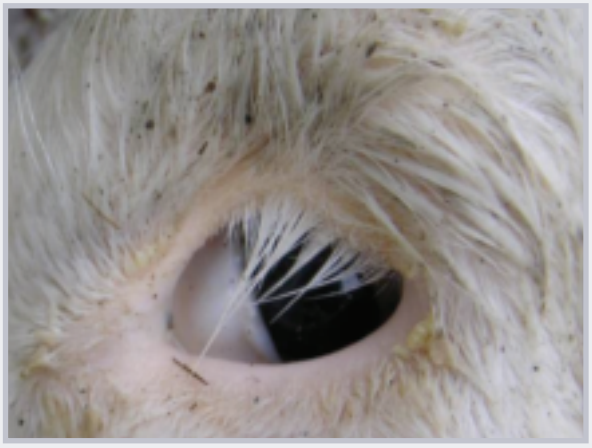


Figure 42: Enopthalmus (sunken eye) and anaemia in a calf. Enopthalmus is a typical clinical and/or post-mortem finding in dehydrated calves (Photo: Dónal Toolan).

Cryptosporidiosis is a common cause of enteritis in calves between one and three-weeks-old. Affected calves excrete large numbers of oocysts that are resistant to many disinfectants. Control of the parasite is best achieved by strict maintenance of good calf housing hygiene practices and avoidance of mixing animals of different ages. The prophylactic use of drugs such as halofuginone lactate may also be useful where a disease risk has been identified. In addition to causing disease in animals, *Cryptosporidium parvum* has the potential to cause zoonotic disease especially in immunocompromised humans; therefore farm workers should take appropriate hygiene precautions when handling calves.

As with disease associated with rotavirus and *Cryptosporidium parvum*, calves are most susceptible to coronavirus enteritis between one and three-weeks-old. Coronavirus preferentially infects enterocytes in the lower small intestine and colon typically resulting in blunting and fusion of villi and mild colitis.

E. coli K99 is an enterotoxigenic *E. coli* (ETEC) and is an important cause of neonatal enteritis in young calves, typically less than three-days-old. These strains of *E. coli* preferentially colonise the lower small intestine and produce toxins that cause hypersecretion of water and electrolytes from the intestinal mucosa, resulting in rapid dehydration. The percentage prevalence of *E. coli* K99 would likely be higher if testing for this enteric pathogen was restricted to animals less than one-week-old but as the data presented includes calves up to one-month-old the proportion of calves from which *E. coli* K99 is identified is somewhat diluted.

Salmonella Dublin accounted for 2.6 *per cent* and 2.9 *per cent* of enteritis cases in neonatal calves in Northern Ireland and Ireland respectively in 2010. As well as enteritis (Figure 43), *Salmonella* Dublin is invasive and can cause a number of other conditions in young calves such as septicaemia and pneumonia.

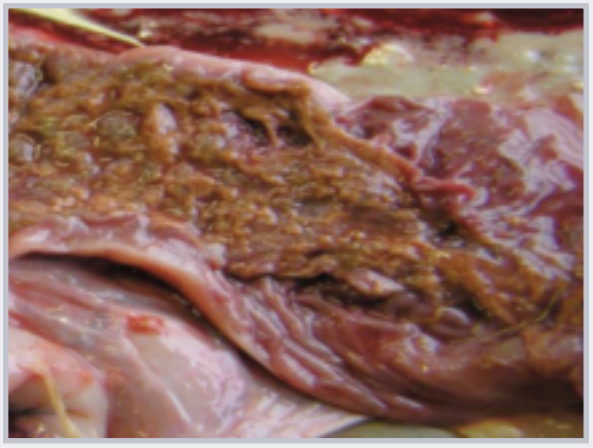


Figure 43: Fibrino-necrotising enteritis associated with *Salmonella* Dublin infection in a two-month-old calf (Photo: Dónal Toolan).

Campylobacter jejuni is an important bacterial enteric pathogen in humans although it is not generally pathogenic in cattle. It was identified in 10.4 *per cent* of faecal samples from calves less than one-month-of-age in Ireland in 2010, an increase from 7.9 *per cent* in 2009. This highlights again the importance of adherence to good hygiene practices by calf handlers.

The risk of neonatal enteritis in housed calves increases as the calving season progresses primarily due to inadequate calf house hygiene procedures leading to the build up of infectious agents in the calves' environment.

The basic principles for the prevention and control of neonatal enteritis include:

- Feeding an adequate quantity and quality of colostrum at, or very soon after, birth (3 litres within 2 hours of birth).
- Grouping calves according to their age and avoiding high stocking densities.
- Provision of dry, clean bedding for calves.
- Good hygienic practices including appropriate disinfection of housing between batches of calves.
- Rapid isolation and treatment of sick calves.
- Appropriate nutrition of young calves including diarrhoeic calves.
- Vaccination of dams may also play a role in the control of some enteric pathogens.

The age of the calf must be included on all laboratory submission forms accompanying faecal samples for neonatal enteritis testing, to allow meaningful interpretation of the laboratory findings. The significance of the results of faecal analyses is dependent on the age of the calf.

Zinc sulphate turbidity test results

The zinc sulphate turbidity (ZST) test can be performed on calf serum to give an indirect measure of immunoglobulin concentrations which are essential to prevent establishment of infectious disease in calves during early life. In calves less than two-weeks-old this concentration can be used to evaluate the adequacy of the passive transfer of maternal immunity to the calf *via* the colostrum. The ZST test is reported in units of turbidity with a result of twenty units or greater considered indicative of the adequate transfer of immunity.

In 2010, a combined total of 1,746 ZST tests was performed by the DAFF and AFBI laboratories, on blood samples submitted by veterinary practitioners, as well as on samples taken from carcases examined *post mortem*. Of these, 1,040 samples (almost 60 *per cent*) recorded results of less than twenty units (Figure 44).

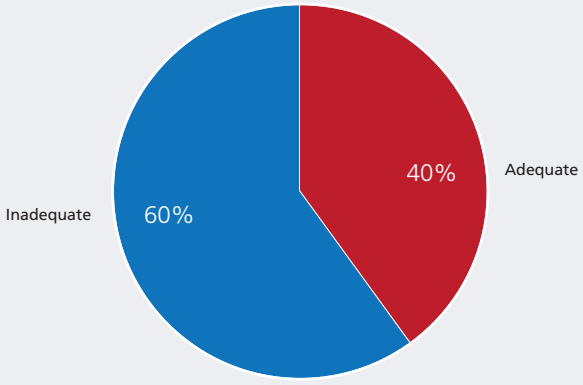


Figure 44: The results of ZST tests performed in 2010, presented as reflecting adequate (≥20 units) or inadequate (<20 units) colostrum consumption (n=1746).

When the results of samples taken post mortem alone in the DAFF Regional Veterinary Laboratories were examined, the proportion of inadequate results increased to 71 *per cent* (Figure 45). This underlines the link between the inadequate transfer of maternal immunity to the neonatal calf through colostrum consumption and neonatal mortality.

Farms should have measures in place to ensure that all calves receive adequate colostrum early enough for absorption to take place (*i.e.* ideally in the first six to twelve hours). Inadequate amounts of colostrum ingested, poor quality colostrum and delayed colostrum feeding can all lead to failure of passive transfer.

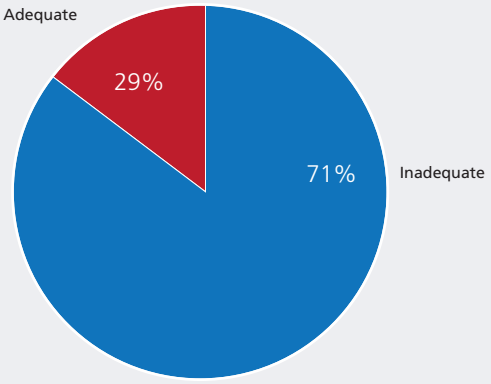


Figure 45: The results of ZST tests performed on samples taken from neonatal calves at post-mortem examination in DAFF RVLs in 2010, presented as reflecting adequate (≥twenty units) or inadequate (< twenty units) colostrum consumption (n=642).

Failure of passive transfer of immunity, *via* colostrum, increases the risk to calves from diseases, particularly enteritis and septicaemia. The high incidence of failure of passive transfer reflected by the results of samples tested by the laboratory services suggests that inadequate colostrum is a common factor in the disease processes which bring these animals to veterinary attention. Many of these disease processes could be readily prevented by adherence to good colostrum management.

Bovine abortion

Bovine abortion is a significant cause of loss of productivity and profitability on farms. The cost of a single bovine abortion can be difficult to quantify but in a dairy herd it is estimated to cost approximately £630 (€700) (Cabell, 2007). Occasional abortion is a normal occurrence in any herd; however when the abortion rate exceeds 3 *per cent* or a number of abortions occur over a short period of time, they should be a cause for concern. All bovine abortions should be notified to the veterinary services and aborted foetuses and placentas may be submitted to the veterinary laboratory for a diagnostic workup; where available, maternal serology may also be informative.

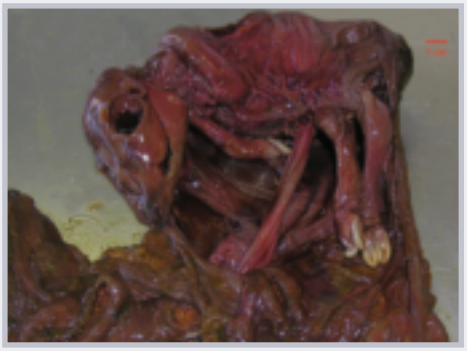


Figure 46: A mummified foetus and autolysed placenta (Photo: Dónal Toolan)

The diagnostic rate achieved for abortions in cattle can vary depending on the preservation of the carcase. Often in cattle there may be a delay between foetal death and expulsion, resulting in advanced autolysis (Figure 46), with a significant deleterious effect on the sensitivity of the diagnostic tests employed.

Abortions in cattle may result from a broad range of causes – both infectious and non-infectious. Non-infectious causes include trauma, nutritional deficiency and genetic defects while infectious causes include bacterial, viral, fungal and parasitic agents. Among bovine abortions in which an aetiological diagnosis is achieved, bacterial agents represent the most frequently identified group. Many of the bacterial abortions are sporadic in nature and are caused by organisms that are ubiquitous in the environment of the cow. These agents may gain access to the bloodstream and consequently the placenta of the cow eventually reaching the immature foetus which may lack the immunological capability to eliminate them.

Figure 47: A second trimester foetus submitted for post-mortem examination, from which *Salmonella* Dublin was isolated. (Photo: Dónal Toolan).

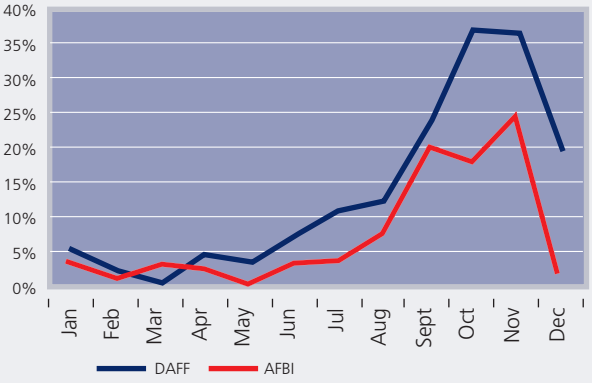


Figure 48 *Salmonella* Dublin abortions as a percentage of all bovine foetal submissions during 2010 in Northern Ireland (AFBI: n=571) and Ireland (DAFF: n=2608).

Contagious bacterial abortion agents, such as *Brucella abortus* and *Salmonella* Dublin (Figure 47), have the potential to cause abortion storms. While brucellosis-free status has been achieved in Ireland, *Brucella abortus* was identified in one foetus in Northern Ireland in 2010. Brucellosis poses a serious zoonotic risk to animal handlers and may be transmitted by contact with foetal tissues. *Salmonella spp.* are also zoonotic although *Salmonella* Dublin is rarely so. Cows suffering *Salmonella spp.* induced abortion may also show signs of enteritis and septicaemia, although the abortion is often the only clinical sign observed. The monthly distribution of *Salmonella* Dublin associated abortion, for both AFBI and DAFF laboratories, follows the characteristic seasonal distribution, increasing steadily in frequency towards October and November (Figure 48).

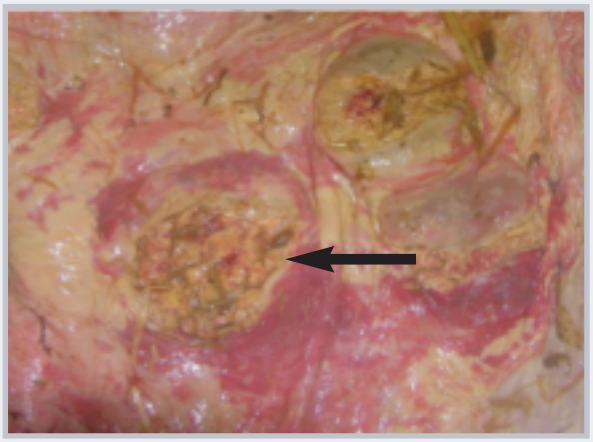


Figure 49: A bovine placenta showing cotyledonary necrosis (arrow) with extension to the intercotyledonary areas, caused by *Aspergillus spp.* (Photo: Dónal Toolan).

Mycotic (fungal) abortion is relatively uncommon and is a result of fungal invasion of the placenta and foetus. The characteristic gross lesions on the placenta or foetus are generally evident (Figure 49) although on occasion live infected calves are born. As the infection is of haematogenous origin, it typically infects placentomes (cotyledonary areas) initially and then proceeds to the intercotyledonary areas. Fungal abortion tends to be more prevalent in the winter months when animals are housed and exposed to preserved fodder – particularly mouldy hay or silage. The fungi most frequently isolated are *Aspergillus spp*. In 2010 *Aspergillus spp.* were isolated by AFBI and DAFF laboratories in 1.4 *per cent* and 1.0 *per cent* of cases respectively.

Arcanobacterium pyogenes is a common cause of sporadic abortion in cattle. *A. pyogenes* is a ubiquitous organism and normally reaches the placenta following bacteraemia in the cow, resulting in placentitis and subsequent abortion. *Bacillus licheniformis* similarly is a cause of sporadic abortion in herds. Spoiled forage and feed often acts as a vehicle for the introduction of this organism to the herd.

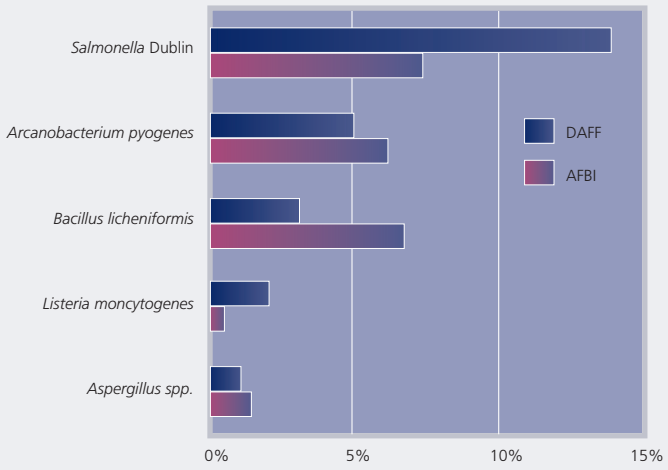


Figure 50: A comparison of selected bovine foetal culture results in the AFBI (n=571) and DAFF (n=2608) laboratories in 2010.

Infections with bovine abortion agents during early pregnancy may result in early embryonic death and return to service without other visible signs. Infections at a later stage may lead to abortion, stillbirths or the birth of live but weak calves. In both jurisdictions a combined total of three thousand one hundred and seventy nine (two thousand six hundred and eight by DAFF and five hundred and seventy one by AFBI) foetal cultures was undertaken in 2010. The results of these bacteriological cultures are shown in Figure 50. The prevalence of *Salmonella* Dublin in Ireland (14.0 *per cent*) was significantly higher than in Northern Ireland (7.4 *per cent*) and doubled in 2010 when compared to 2009 (6.0 *per cent*).

Other microorganisms isolated from foetal cultures conducted by both DAFF and AFBI were *Escherichia coli* and other coliforms (three hundred and thirteen isolates), *Streptococcus spp*. (sixty two), *Bacillus spp*. (nineteen), *Staphylococcus spp*. (twelve), *Pasteurella spp*. (eleven), Fungal species (nine), *Campylobacter spp*. (seven), S. Typhimurium (two). *Yersinia pseudotuberculosis* (one) and *Pseudomonas aeruginosa* (one).

Neospora caninum is a protozoan parasite first identified in 1989. Dogs are the definitive host and excrete oocysts in their faeces, normally only for a short period of time. When ingested by the intermediate hosts, such as cattle, tachyzoites may develop in the placenta while tissue cysts (containing bradyzoites) may develop within the central nervous system of the calf. Infected foetuses may be aborted (typically at six to seven months of gestation), may be born with neurological deficits or may be clinically normal at birth. While dogs may be responsible for the introduction of the parasite into cattle herds, the vertical route of transmission appears to be the most significant mode of transmission in cattle. Cows which abort may do so again and the retention of the female offspring of infected cows for replacement purposes is not recommended.

The finding of *Neospora caninum* antibodies in a blood sample from a cow which has aborted or in the foetal pleural fluid is not sufficient to confirm *Neospora*-induced abortion. Confirmation requires the supporting evidence of protozoal encephalitis or myocarditis on histopathology of foetal tissues.

	Agent	Test	Positive	Total Tested	% Positive
DAFF	BVD Ag	PCR + ELISA	81	1241	6.5%
	Neospora Ab	Comb+ELISA	119	1751	6.8%
	Leptospira Ab	Comb	60*	1157	5.2%
AFBI	BVD Ag	ELISA + Immunofluorescence	31	637	4.9%
	Neospora Ab	ELISA	14	439	3.2%
	Leptospira Ag	FAT**	8	161	5.0%
	Leptospira Ab	MAT	4***	441	0.9%

Table 2: The frequency of detection of *Leptospira* Hardjo antibodies, *Neospora caninum* antibodies and BVD virus in foetal carcases in AFBI and DAFF veterinary laboratories in 2010 (*Comb titre of >1/100; ** placenta samples; * MAT titre of >1/30)**

Serological results in addition to the results of specific tissue analyses from foetal carcases for *Leptospira* Hardjo, *Neospora caninum* and BVD virus are shown in Table 2. Foetal serological and maternal serological results need to be interpreted with caution in the investigation of bovine abortion. Rising maternal titres to BVD virus or BHV-1 may be difficult to demonstrate due to the time delay between infection and abortion in some cases and maternal titres may remain high for an extended period after the initial infection. Maternal vaccination and its timing can also complicate the interpretation of results. *Leptospira spp.* titres can be equally difficult to interpret for these reasons. Serology therefore should be used as supporting evidence in the investigation of bovine abortion but the submission of a foetal carcase (preferably accompanied by the foetal membranes) to the veterinary laboratory is central to identifying the causal agent and is the submission of choice.

Comparison of the frequency of detection of *Leptospira* Hardjo, *Neospora caninum* and BVD virus in AFBI and DAFF laboratories (Table 2) shows that the incidence of detection of these pathogens in foetal carcases is broadly similar in both Northern Ireland and Ireland. The 2010 figures for Ireland show a marginal increase in the detection of all three pathogens relative to 2009 and a return to levels of detection witnessed in 2008. Differences in detection frequency between Northern Ireland and Ireland may be due to differences in the sample sizes tested in each jurisdiction or possibly due to differences in the tests employed.

Where the submission of a foetus carcase to the laboratory is not possible, the veterinary practitioner should submit as many of the following tissues as possible:

- Stomach fluid collected and submitted in a sterile manner for culture
- Pleural fluid (5mls where possible) for serology
- Brain – a section fixed in 10 *per cent* formalin
- Placenta – a section including a cotyledon both fresh and fixed
- Thyroid gland - a section fixed in 10 *per cent* formalin
- A fresh section of thymus or spleen – for BVD virus PCR
- A maternal blood sample, from the dam of the aborted foetus, as well as from any other cows that aborted or have proven to be non-pregnant.

Details of maternal vaccination and the timing of vaccination should also be provided.

See Packaging Requirements for the submission of samples outlined on page 52.

References:

Cabell, E (2007) *In Practice* 29, 455-463

Bovine mastitis

The submission of milk samples for bacteriological culture is an important step in the diagnosis, treatment and control of both clinical and subclinical bovine mastitis. Mastitis is the second most common cause, after infertility, of culling of cows from dairy herds and leads to both direct costs (discarded milk, veterinary treatment, processor penalties etc.) and indirect costs (increased mortality and extended calving intervals) which have been estimated at approximately €125 to €400 per case depending on the severity (Esslemont and Kossaibati, 2002).

The control of mastitis in cows is based on six fundamental principles:

1) Hygienic teat management (and housing management)
2) Prompt treatment of mastitis cases
3) Appropriate dry cow therapy
4) Culling of chronic cases
5) Proper milking machine maintenance
6) Proper record keeping

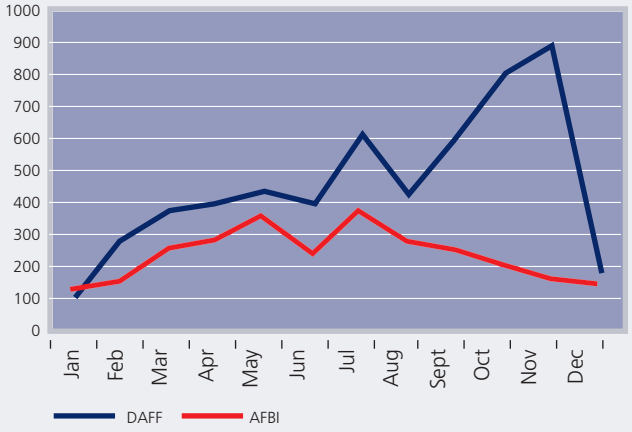


Figure 51: The frequency of submission of milk samples by month to AFBI and DAFF veterinary laboratories in 2010.

The submission of milk samples to the veterinary laboratories follows a predictably seasonal pattern from year to year in Ireland (DAFF) with an increase in sample submissions in the autumn months when most cows are 'dried off'. The seasonal distribution of milk sample submission to the AFBI laboratories in Northern Ireland differs with the autumn rise in sample submission not being observed, and the overall distribution shows a more consistent pattern of submission throughout the year (Figure 51). Examination of the pattern of milk sample submissions to both AFBI and DAFF RVLs in 2010 shows a rise in the numbers submitted in July. In 2009, a marked increase in sample submissions to the Regional Veterinary Laboratories was also noted in July of that year which was attributed to the heavy rainfall experienced. The heavy rainfall experienced in July 2010 (see Figure 10) which was more than double the July average probably resulted in the re-housing of stock in some parts of the island, creating the necessary conditions in which mastitis pathogens can flourish.

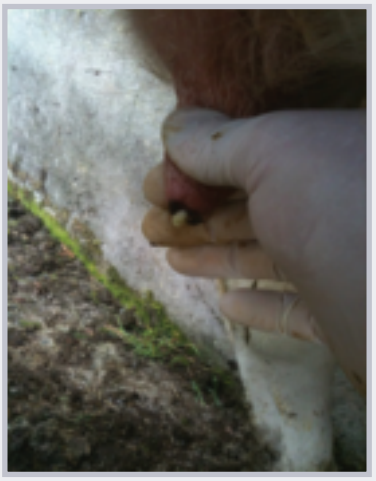


Figure 52: A case of `summer mastitis' in a cow (Photo: Brian Flynn)

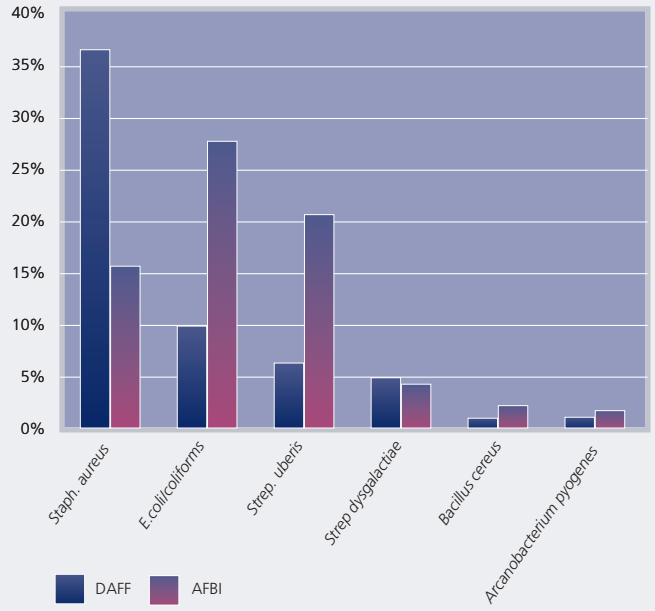


Figure 53: The relative frequency of detection of selected mastitis pathogens by AFBI (n=2787) and DAFF (n=5466) in 2010.

The relative frequency of detection of selected mastitis pathogens in milk samples submitted to AFBI and DAFF laboratories in 2010 is shown in Figure 53. In Northern Ireland *Staph. aureus* accounted for only 15.7 *per cent* of isolates compared to 36.3 *per cent* of isolates in Ireland where it remains the pathogen most commonly isolated from milk sample submissions. While the prevalence of this pathogen is high, this figure represents a decrease when compared to the 2009 prevalence (43.6 *per cent*). *Strep. uberis* (21.0 *per cent*) was the most frequently isolated bovine mastitis pathogen in Northern Ireland in 2010 (when the caveat regarding *E.coli* isolation, discussed below, is considered). This is consistent with findings in England, Wales and New Zealand.

Mastitis pathogens are often classed as either environmental or contagious pathogens although some pathogens display characteristics of both groupings. *Streptococcus uberis* has been traditionally considered to be an environmental pathogen and rates of infection tend to be highest in split-calving herds on straw bedding and where housing hygiene requires improvement (Barrett *et al.,* 2005). The inflammatory response to infection can result in occlusion of the ducts and entrapment of bacteria thereby reducing the ability of antimicrobials to contact the pathogen. Binding of lactoferrin in the host also facilitates the survival of *Streptococcus uberis* in the udder. Lactoferrin tends to be found in higher concentrations in the non-lactating udder, which may explain why susceptibility to infection increases through the dry period.

Staphylococcus aureus is a contagious mastitis pathogen commonly associated with chronic mastitis and raised somatic cell counts, although clinical mastitis is often recorded especially around calving time. Spread of infection may occur through poor milking hygiene – transfer of infection by the milker's hands, the use of wash cloths and through teat cup liners. Irregular vacuum fluctuations can also promote the spread of the pathogen by facilitating its entry into the teat canal. Control of *Staph. aureus* can be difficult and involves the prevention of new infections coupled with the culling of chronic cases and the astute employment of antimicrobial therapy where warranted. Additional information on the control of *Staph. aureus* and other mastits pathogens is available on the Animal Health Ireland CellCheck webpage.

Herds with mastitis caused by *Staph. aureus* infection should reassess their milking hygiene and segregate infected cows for milking last or in a separate unit where this is possible, to prevent spread of infection.

Milk samples submitted to AFBI and DAFF from which *E.coli* was isolated represented 27.5 *per cent* and 9.4 *per cent* respectively of all milk samples cultured in 2010. Coliform mastitis is a severe clinical condition which normally affects cows in the peri-partum period and is associated with poor housing hygiene, certain bedding materials or poor preparation of the udder for milking. In such animals, isolation of the causative pathogen can be difficult due to their short duration in the udder. While the isolation of *E.coli* from a milk sample in the immediate peripartum period would be considered to be possibly associated with the well recognised severe clinical condition, the majority of those isolated are due to environmental contamination of milk samples during collection. This emphasises the importance of adhering to aseptic techniques when collecting samples.

Streptococcus dysgalactiae was identified in 4.1 *per cent* (AFBI) and 4.7 *per cent* (DAFF) of milk samples cultured in 2010. *Streptococcus dysgalactiae* is generally characterised as an environmental pathogen, but also may have characteristics of a contagious organism and can spread from cow to cow. Infections are also related to milking equipment function, damage to teat ends and chopped straw bedding, while control relies on adequate teat dipping, machine maintenance and appropriate dry cow therapy.

Other mastitis pathogens isolated with less frequency included *Pasteurella multocida* (DAFF: twenty isolates) and *Streptococcus agalactiae* (AFBI: one isolate, DAFF: ten isolates).

Cows infected with *Streptococcus agalactiae* often show no signs of clinical mastitis, though some will show intermittent clots in the milk. Many cases eventually become chronic, necessitating culling from the herd.

Aseptic technique for milk sample collection

1. Take the samples before milking.
2. Soak a number of cotton wool balls in alcohol.
3. Using a hand or paper towel, brush any loose dirt, straw or hair from the underside of the udder and teats. Washing should be avoided if possible, but if teats are very dirty they should be washed and carefully dried with paper towels.
4. Dip all four teats with teat dip and leave for at least one minute.
5. Wear gloves if available. If not, then wash and dry the hands thoroughly and use some of the cotton wool balls to wipe them with alcohol.
6. Beginning with teats on the far side of the udder, scrub the ends thoroughly with the cotton wool and alcohol until the teats are very clean. Spend at least ten seconds on each teat. Do not use the same cottonwool ball on more than one teat.
7. Begin sampling with the teats on the near side of the udder. Remove the cap of the sampling tube and keep the top face down in the palm. Hold the open tube (in the same hand as the top) at an angle of forty five degrees (holding it straight up will allow dust etc. to fall inside). Using the free hand, discard a few streams of milk on to the ground before collecting three or four streams in the tube. Do not allow the teat ends to make contact with the tube. Move quickly onto the next teat. When the four teats have been sampled close the tube.
8. Put the tubes in a fridge and cool to 4°C. This is very important.
9. The samples should be taken to the laboratory as soon as possible.

Further Reading:

Animal Health Ireland CellCheck webpage at: http://www.animalhealthireland.ie/scc.php

Barrett, D.J., Healy, A.M., Leonard, F.C. Doherty, M.L. (2005) Prevalence of pathogens causing subclinical mastitis in 15 dairy herds in the Republic of Ireland Irish *Veterinary Journal*, 58:333-337

Esslemont R.J. and Kossaibati M.A. (2002). Mastitis: How do we get out of the dark ages? *The Veterinary Journal* 164, 85-86

Bovine respiratory disease

Respiratory disease is a major problem in all bovine husbandry systems, is associated with production losses and mortalities and can have a long-lasting impact on growth in young stock

In this section, two main types of data are presented:
- Post-mortem examinations: agents that were identified as the principal pathogen isolated from bovine lungs at post-mortem examination, where the diagnosis was respiratory disease.
- Clinical pathology: viral agents demonstrated in samples submitted for PCR examination to the DAFF Veterinary Laboratory Service.

Figure 54: Fibrinous (yellow deposit) pleuropneumonia in a yearling with *Mannheimia haemolytica* infection (Photo: Colm Ó Muireagáin).

Pasteurella multocida and *Mannheimia haemolytica* (Figure 54) continue to be the major pathogens associated with fatal respiratory disease in Irish cattle (Figure 55). Although both of these agents are capable of precipitating fatal disease, parainfluenza 3 (PI3) virus is believed to play an important role in facilitating the rapid invasion of the lungs by these agents. The very low number of fatal respiratory disease cases in 2010 where PI3 virus was the only pathogen identified (1.8 *per cent*) supports the view that it is a minor pathogen in its own right on Irish farms.

Arcanobacterium pyogenes is not considered a primary pathogen in bovine pneumonia, but is a common secondary invader, when tissues have already been damaged by an acute episode caused by any one of a range of infectious agents. It is particularly common in cases of chronic suppurative pneumonia, often a chronic sequel to incompletely resolved pneumonia in young calves. It was isolated from 14.0 *per cent* of carcases with a diagnosis of respiratory disease in 2010.

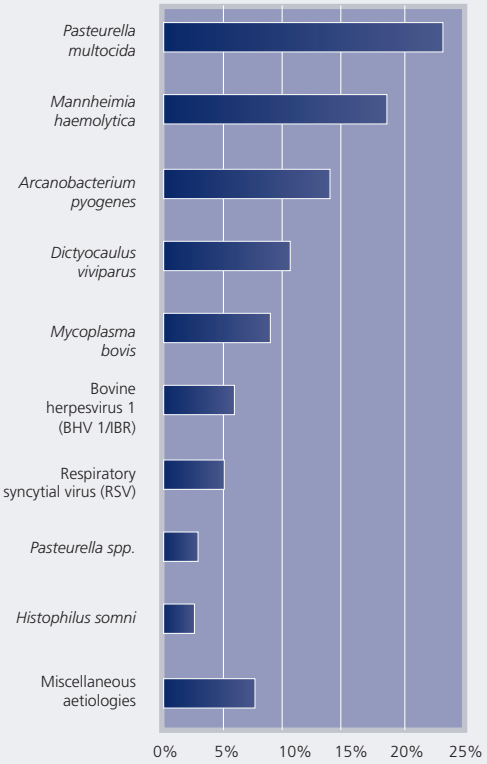


Figure 55: The relative frequency of post-mortem detection of primary respiratory pathogens associated with fatal respiratory disease in AFBI and DAFF veterinary laboratories in 2010 (n=602).

Mycoplasma bovis can play a primary role in the development of respiratory disease and was identified in 9.0 *per cent* of necropsy cases of respiratory disease in 2010. It can also be implicated in mastitis, meningitis, otitis and arthritis in cattle. *Mycoplasma bovis* can be introduced into a herd by subclinical carriers which may shed the organism through nasal discharges. The impairment of the mucocillary clearance in the airways or the immune defence can lead to the introduction of the organism into the lower respiratory tract of an animal. At necropsy, the cranioventral areas of lungs are red-blue in colour, consolidated and occasionally exhibit the characteristic 'rice grain' multifocal abscessation. The treatment of *Mycoplasma bovis* is difficult as *Mycoplasma spp.* lack a cell wall, and are thus resistant to some commonly used antibiotics.

Histophilus somni is a commensal of the mucous membranes of cattle which is occasionally associated with pneumonia, particularly in feedlot cattle. It is also associated with other conditions of cattle such as reproductive disorders, neurological signs and septicaemia. It is a primary respiratory pathogen although co-infection by opportunist pathogens such as *Pasteurella multocida* and *Mannheimia haemolytica* is often recorded. Occasionally rapid death of the animal can occur before clinical signs have been detected.

Parasitic pneumonia – hoose - caused by *Dictyocaulus viviparus* has a highly seasonal pattern and is also much more common in young stock. However the frequency and severity of disease varies from year to year, often occurring as explosive outbreaks associated with extended periods of moist mild weather.

Figure 56: Severe tracheitis associated with Bovine herpesvirus – 1 infection in a two-year-old bull (Photo: John Fagan).

Deaths due to bovine herpesvirus 1 (BHV-1, causing infectious bovine rhinotracheitis - IBR) (Figure 56) and respiratory syncytial virus (RSV) (Figure 57) are more usually seen in younger stock, with RSV usually being more important than IBR in the youngest groups of calves. Many RSV-related deaths in calves occur before they are let out to grass. Post-mortem findings typically include diffuse pneumonia, consolidation, oedema and emphysema, the severity of which will vary depending on the clinical course of the disease. BHV-1 and RSV were identified in 6.0 *per cent* and 5.0 *per cent* of cases of respiratory disease diagnosed on post-mortem examination in 2010.

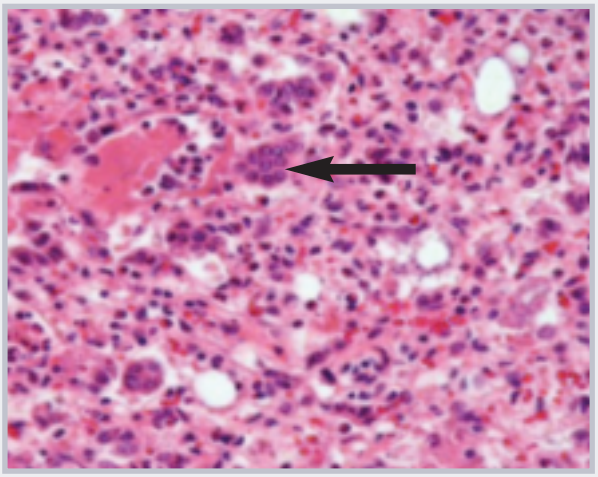


Figure 57: A photomicrograph of a bovine lung showing syncytial cells (arrow) which are a characteristic finding in RSV pneumonia (Photo: John Fagan).

The category 'miscellaneous aetiologies' encompasses a range of minor infectious agents associated with respiratory disease including *Pseudomonas spp., Staphylococcus spp., Streptococcus spp.* and *Salmonella* Dublin.

An analysis of the relative frequency of the infectious agents associated with fatal respiratory disease in any particular year tells only part of a complex story. All infectious diseases occur as a result of the complex interplay of the animal, the agent and the environment, and few conditions illustrate the interplay of these factors more than respiratory disease. Stress, transport, stocking densities, and air quality are among the main environmental factors, while animal age, nutrition and immune status also determine the incidence and final outcome of respiratory disease in any management group when any particular infectious agent enters the herd.

	Number positive	Number tested	Percentage positive
Bovine coronavirus	55	291	18.9
PI3	89	360	10.1
BHV1	176	2017	8.7
BVD	82	1192	6.9
BRSV	92	1551	5.9

Table 3: The relative frequency of detection of primary respiratory virus pathogens on PCR tests in DAFF laboratories in necropsy cases and clinical cases of respiratory disease in 2010.

Table 3 shows the relative frequency of the detection of primary respiratory virus pathogens in all samples tested from cases of respiratory disease in 2010. This includes samples from post-mortem examinations in the Regional Veterinary Laboratories in Ireland, as well as clinical samples (swabs) submitted by private veterinary practitioners from clinical cases of respiratory disease. The results are from animals spanning a wide range of age groups. These figures provide a snapshot of the range of bovine respiratory viruses confirmed in affected cattle on farms in Ireland in 2010. The relatively high detection rate for PI3 virus and bovine coronavirus, when compared to the other viral pathogens, should be considered against the comparatively small sample size tested for these two agents.

	Number positive	Number tested	Percentage positive
PI3	7	352	2.0%
BHV1	21	404	5.2%
BVD	9	444	2.0%
BRSV	7	352	2.0%

Table 4: The relative frequency of detection of primary respiratory virus pathogens on fluorescent antibody tests (FAT) among necropsy cases in AFBI laboratories in 2010.

Table 4 outlines the results of fluorescent antibody tests (FAT) for respiratory pathogens conducted on tissue from necropsy cases by AFBI in 2010. The differences in the relative frequency of detection of the various pathogens when compared to Table 3 is possibly due to differences in methodologies but is more likely to be accounted for by the fact that these tests were performed entirely on necropsy cases, which often represent the end-stage of respiratory disease when the availability of virus for detection can be considerably less than in acute clinical cases.

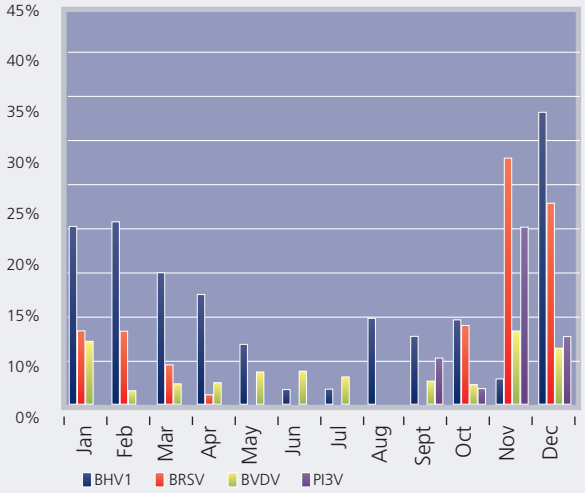


Figure 58: The relative frequency of detection of viruses implicated in bovine respiratory disease by month during 2010 as a percentage of all nasal swabs tested by polymerase chain reaction (PCR) at the CVRL, Backweston.

Figure 58 shows the seasonal patterns observed in the detection of these agents. As well as the expected winter peak associated with housing, it is clear that BHV1 (IBR) is detected with increasing frequency from late summer onwards. Presented below is a farm investigation into an outbreak of IBR conducted by Dublin RVL in December 2010.

An investigation into an infectious bovine rhinotracheitis (IBR) outbreak in a beef unit

Dublin RVL diagnosed IBR as the cause of pneumonia in a large feedlot in December 2010. At the time of the outbreak there were nine hundred and fifty animals in the herd. Fourteen animals had died, but over eight hundred animals had shown signs of respiratory disease (84 *per cent* morbidity).

Cattle were bought in September and October at about fourteen months of age, and fattened over the following one hundred and fifty days or so. Animals were housed on arrival and vaccinated with an IBR intra-nasal vaccine within twenty four hours. The farmer made an effort not to mix groups, but given that they were bought at marts they would have been mixing with cattle from a diverse range of sources anyway. There were five separate cattle sheds in the feedlot and animals were not mixed between these sheds. Cattle were fed on maize silage.

Following the very cold weather in early December, cattle in two of the five sheds showed clinical signs of IBR. This was subsequently confirmed by the detection of bovine herpes virus (BHV-1) by PCR on nasal swabs.

All affected cattle in both sheds were administered antimicrobial therapy, with more severely affected animals receiving non-steroidal anti-inflammatory drugs. Animals in the remaining three sheds were given a second dose of IBR intranasal vaccine. Animals in these three sheds developed clinical signs of IBR, but not as severely as the animals in the first two sheds. During the course of the outbreak average feed intake fell by over 80 *per cent*.

The investigation concluded that extreme weather at the start of December caused physiological stress to some of the stock. A proportion of these was BHV-1-infected, and started re-shedding virus due to this stress. It is more likely that virus was re-activated in several animals in each shed than the alternative theory that one shedder caused the outbreak which then spread from shed to shed. The fact that animals in sheds at opposite ends of the feedlot got sick first corroborates this theory. Extremely cold air can create a "ceiling" in very still conditions (a phenomenon known as inversion), trapping warmer air underneath it. While this normally does not occur in sheds, it may have occurred in the open-faced straw-bedded bull sheds, thus creating a lack of ventilation as the humid hot air breathed by the bulls was trapped under a colder layer. This would have exacerbated the situation further.

Johne's disease

Johne's disease is a chronic disease of cattle caused by infection with *Mycobacterium avium* subspecies *paratuberculosis* (MAP) and is an OIE-listed disease. The clinical signs can vary but chronic diarrhoea and weight loss are consistently recorded.

Most cattle acquire infection early in life, through ingestion of colostrum or milk containing MAP, or by exposure to feed, water or environments contaminated by MAP. It is also possible for older animals exposed to a large number of MAP organisms to become infected. *In-utero* infection of the foetus can also occur and has been typically recorded in herds where the prevalence exceeds 5 *per cent*. Most commonly, however, the disease is introduced to a MAP free herd through the purchase of an infected animal.

It is possible for infected animals to be negative on both serology and faecal culture, but as the disease progresses MAP will be shed in the faeces and subsequently seroconversion will usually occur.

Owing to the nature of MAP infection and the blood testing kits presently available, establishing the exact correlation between MAP serological results and infection can be difficult. The correlation between serological results and faecal culture tends to be highest in animals showing clinical signs. Samples tested in the MAP ELISA generate an S/P (sample divided by the positive control) value. The higher the ELISA S/P value is, the more likely the animal is to be infected. MAP serology is useful therefore when employed as an annual screening test on adult animals in herds which have a MAP control programme in place. As animals progress to being high shedders, they are more likely to be seropositive in the ELISA test. DAFF operates a policy of recommending to veterinary practitioners that all seropositive animals are subsequently sampled for confirmatory MAP faecal culture tests as animals may display false-positive serology results. It is important to remember that animals can shed MAP for long periods prior to seroconverting.

Clinical signs are most frequently observed when the animal is between two and six-years-old and relate to the development of a granulomatous enteritis with the consequent development of protein losing enteropathy and malabsorption. At this stage in the disease, clinically affected animals will shed very large numbers of MAP in their diarrhoeic faeces. Approximately two thirds of MAP culture positive animals identified by DAFF were high shedders.

	Ireland		Northern Ireland	
Year	No. cultured	Percentage positive	No. cultured	Percentage positive
2008	416	22.1%	64	6.3%
2009	376	27.4%	50	4.0%
2010	410	20.0%	190	6.3%

Table 5: *Mycobacterium avium* subsp. *paratuberculosis* (MAP) culture results from cattle for the years 2008 to 2010

In 2010, of four hundred and ten bovine samples submitted for culture to DAFF in Ireland, MAP was isolated from eighty two (20 *per cent*) animals, representing fifty five herds (Table 5). A proportion of these samples was submitted in response to positive serological results on the MAP ELISA, which may account for the relatively high rate of detection of MAP on culture which is not a reflection of the prevalence in the national herd. Good *et al*. (2009) estimated the true prevalence in Ireland of herds infected and shedding *Mycobacterium avium* subspecies *paratuberculosis* to be 9.5 *per cent* for all herd types. Around 85 *per cent* of infected cattle in Ireland were female and 46 *per cent* of infected animals had been bought in. The majority (>92 *per cent*) of infected animals were born in Ireland.

In Northern Ireland, AFBI cultured one hundred and ninety samples using the Treks automated liquid culture system; 6.3 *per cent* of samples tested were positive.

Culture is used as a confirmatory step as part of the AFBI Cattle Health Scheme and is typically used where animals show unexpected seropositivity (e.g. in herds with no history of Johne's disease) or in animals with seropositivity values near the test cut-off value.

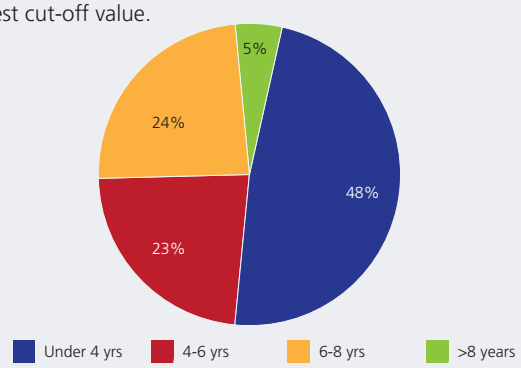


Figure 59: The age profile of MAP culture positive animals identified by DAFF in Ireland in 2010 (n=410).

The age profile of cattle in Ireland in which DAFF cultured MAP from their faeces is shown in Figure 59. Forty eight *per cent* were aged less than four-years-old.

A survival analysis of culture-positive animals indicated that 56 *per cent* were dead within three months and 75 *per cent* were dead within six months of the date the sample was received at the Regional Veterinary Laboratory.

	Ireland		Northern Ireland	
Year	No. tested	Percentage positive	No. tested	Percentage positive
2008	3372	6.8%	6834	10.8%
2009	3981	6.3%	7749	8.9%
2010	5062	6.0%	12229	8.0%

Table 6: The percentage of sera which tested positive in the *Mycobacterium avium* subsp. *paratuberculosis* ELISA in Ireland[3] and Northern Ireland[4] for the years 2008 to 2010.

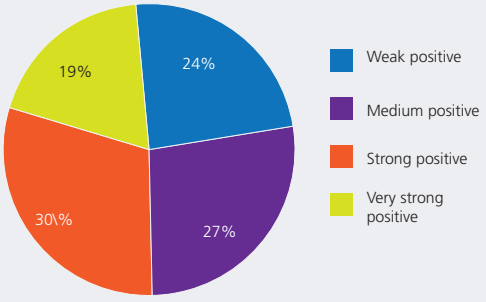


Figure 60 A breakdown of MAP ELISA positive results identified by DAFF in Ireland in 2010 (n=302)

[3] Data is from clinical submissions only. Herd health screening is also performed which is not included in these figures.
[4] Data includes clinical submissions and commercial health screening samples

A total of 5,062 sera was tested by DAFF using a MAP ELISA in 2010; six *per cent* of these were positive (Table 6). The analysis of the positive results is shown in Figure 60. Animals displaying strong reactivity in the ELISA are probably infected with MAP, but culture should be performed for confirmation if the disease has not previously been diagnosed on the farm. Survival analysis shows that ninety *per cent* of strongly seropositive animals in Ireland were dead within one year of sample submission to a DAFF laboratory. It is very unsatisfactory that some strongly seropositive animals were sold into other herds in Ireland, subsequent to their serologic status being established. Such irresponsible activities will present a serious challenge to the implementation of any effective or credible control programme for the prevention of between-herd transmission of the disease.

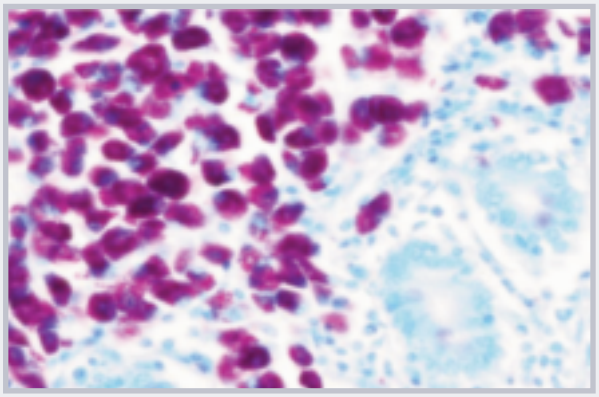


Figure 61: Positive Ziehl-Nielson (ZN) staining (red) of the macrophages in the lamina propria in a MAP-positive animal (Photo: Cosme Sánchez-Miguel).

AFBI tested a total of twelve thousand two hundred and twenty nine samples using a MAP ELISA in 2010 and 8.0 *per cent* of these were positive. A proportion of these samples were tested as part of the cattle health scheme operated by AFBI in Northern Ireland. This scheme allows herdowners to demonstrate freedom of their herds from four of the most economically important infectious disease agents present in herds in Ireland, or to monitor and eradicate these infections as appropriate.

False-positive serological reactions can arise due to infection with non-pathogenic environmental mycobacteria. Equally, intradermal administration of tuberculin can cause certain animals to display false-positive reactions in the MAP ELISA for up to ninety days after exposure. It is recommended that faecal culture is used to establish the true status of a seropositive animal. The Central Veterinary Research Laboratory in Backweston employs a liquid culture system where samples are incubated for forty two days and this has led to the availability of results in a shorter time frame than occurred previously.

Because the disease can spread silently and diagnosis can be difficult, herd owners and their private veterinary practitioners should develop a plan to prevent MAP introduction and spread on the farm. Barrett *et al*.,(2011), identified importation of animals, pooling of colostrum and the lack of individual calving pens as risk factors for the spread of disease. Other key points include maintaining a closed herd, feeding calves milk replacer or pasteurised milk and keeping younger stock away from adult faeces both at housing and at pasture. Further details on control are available on the DAFF website at: http://www.agriculture.gov.ie/media/migration/animalhealthwelfare/diseasecontrols/johnes3.pdf and the AFBI website at: http://www.afbini.gov.uk/index/services/services-diagnostic-and-analytical/cattlehealthscheme/animal-cattle-health-diseases/animal-cattle-health-johnes-disease.htm

References:

Barrett, D., Mee, J., Mullowney, P., Good, M., McGrath, G., Clegg, T., More, S. (2011). Risk factors associated with Johne's disease test status in dairy herds in Ireland. *Veterinary Record* 168:410

Good, M., Clegg T., Sheridan H., Yearsely D., O'Brien T., Egan J. and Mullowney P. (2009). Prevalence and distribution of paratuberculosis (Johne's disease) in cattle herds in Ireland. *Irish Veterinary Journal* Vol. 62 No. 9: 597-606.

Biosecurity

Biosecurity is defined as the prevention of disease causing agents entering or leaving any place where they can pose a risk to farm animals, other animals, humans, or the safety and quality of a food product. In any discussion of disease prevention, farm biosecurity plays a vital role. As the single most effective way of spreading animal disease is the movement of infected livestock on to or off a farm, biosecurity involves more than cleansing and disinfecting; it includes, for example the prudent sourcing of stock, on-farm quarantine, and testing for specific diseases/agents. Biosecurity should be part of the general farm management to limit incursion of infectious disease or the spread of endemic disease on the farm.

Figure 62: The use of (a) appropriate signage and (b) footbaths at the entry points to farms are simple and effective biosecurity measures to prevent the transmission of disease (Photos: Michael Gormley).

The herd veterinarian has a critical role in advising on biosecurity. Specifically, such advice refers to controlling the movement of people (Figure 62(a)) and animals onto and within the farm, grouping of animals according to their age, and adherence to effective vaccination protocols.

Protection of the herd or flock begins by preventing the introduction of infectious disease. This can best be achieved by operating a closed herd, i.e. by not buying-in animals and preventing contact between animals in the herd and animals kept elsewhere. The importance of appropriate disinfection of protective footwear at the entry point to the farm (Figure 62 (b)), as well as the disinfection of transport vehicles should not be overlooked.

Where animals must be purchased, the provision of isolation facilities (for quarantine and testing before introduction to the herd) plays an important part in controlling the entry of, and spread of disease on the farm, and is part of the process in planning to avoid disease.

The control of endemic disease on farm requires measures such as batch rearing animals with appropriate disinfection between batches, isolation and prompt treatment of sick animals, and the separation of age-groups while housed.

Additional biosecurity measures which should be adhered to are listed below:

- Maintain clean feed and water troughs
- Try to purchase cattle from herds with a known herd status and test purchased animals for BVD, IBR, Johne's disease and *L. Hardjo* before mixing with the herd.
- Avoid purchasing cull cows.
- Do not share bulls between herds
- Quarantine any animals returned unsold from the mart for three weeks before reintroducing them to the herd.
- Do not use calving pens for sick animals. Disinfect equipment (e.g. cattle tongs) before use - this is especially important with stomach tubes. Never use a stomach tube for colostrum feeding where it has been used on sick calves.
- Adopt a routine of wearing clean protective clothing and footwear for use solely on your premises. Wash and disinfect regularly.
- Discourage vermin by disposing of waste feed, and operating vermin control; prevent dog or cat access to feed stores.

The implementation of effective biosecurity measures promotes animal health and welfare and consequentially farm productivity.

Additional useful information can be accessed at either of the following websites:
http://www.agriculture.gov.ie/animalhealthwelfare/diseasecontrol/ or
http://www.dardni.gov.uk/biosecurity_code_booklet_for_northern_ireland_farms.pdf.

Diseases of sheep

Figure 63 shows the diagnostic analysis for the most frequent causes of sheep mortality in Northern Ireland and Ireland during 2010. The data are presented on a disease category basis and as a percentage of the total submissions in each catchment area, excluding abortions.

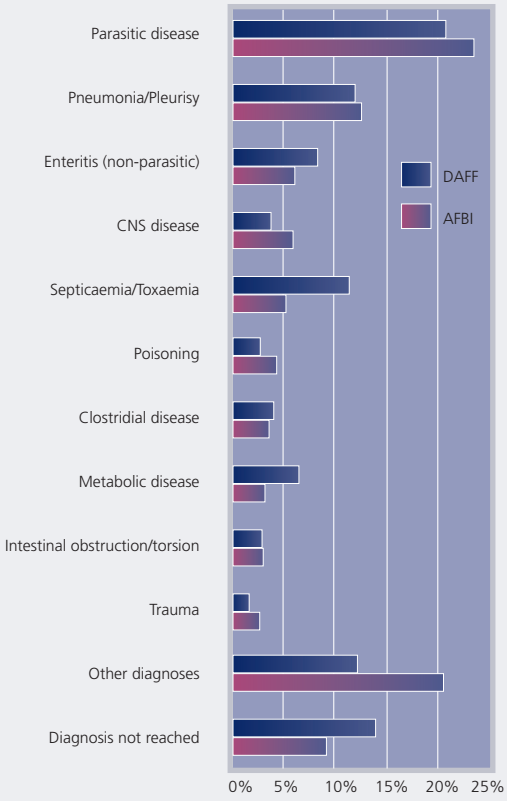


Figure 63: The relative frequency of the causes of mortality of sheep of all ages submitted for post-mortem examination in Northern Ireland (AFBI: n=849) and in Ireland (DAFF: n=737) in 2010.

Parasitic disease, respiratory and enteric diseases were the most commonly diagnosed causes of death in sheep of all ages in Ireland. *Mannheimia haemolytica* was the most common cause of bacterial pneumonia. Jaagsiekte, also known as ovine pulmonary adenocarcinoma (Figure 64) was much more commonly diagnosed in Northern Ireland (sixteen cases) than in Ireland (one case). Enteric diseases included abomasitis and intestinal torsion in growing lambs and enteric colibacillosis and ovine neonatal enterotoxaemia ('watery mouth') in young lambs.

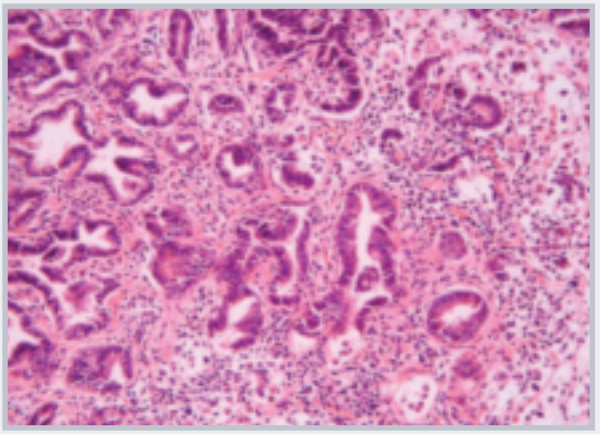


Figure 64: Lesions of Jaagsiekte (OPA) in the lungs of an adult ewe (Photo: Bob Hanna).

Septicaemia / toxaemia was more commonly diagnosed in Ireland than in Northern Ireland while the prevalence of clostridial disease was similar in both jurisdictions. *Clostridium perfringens* Type D (pulpy kidney disease in lambs, enterotoxaemia in adult sheep) and *Clostridium novyi* Type B infection (Black disease) were the most common clostridial diseases diagnosed. Black disease is very often associated with fasciolosis.

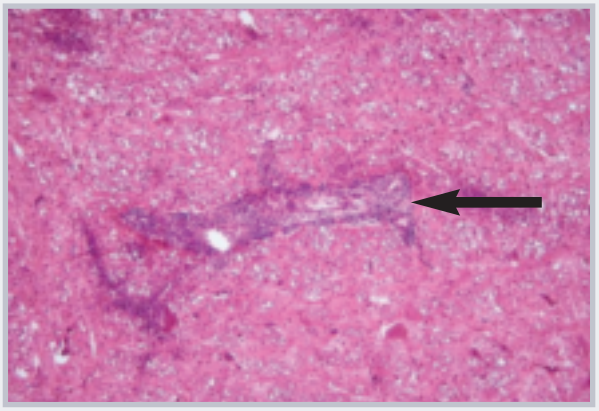


Figure 65: Perivascular cuffing and microabscess formation (arrow) in the midbrain of a ewe with listerial encephalitis (Photo: Bob Hanna).

Central nervous system (CNS) disease and poisoning were more commonly diagnosed in Northern Ireland in 2010. Listerial encephalitis (Figure 65), usually associated with the feeding of silage to pregnant ewes, was the most common CNS disease recorded. Copper and *Pieris spp* (Forest Flame) were the most commonly diagnosed causes of poisoning.

Parasitic disease in sheep

Parasitic disease remains a frequent cause of post-mortem diagnostic submissions accounting for 23.6 *per cent* and 20.9 *per cent* of diagnoses in Northern Ireland and Ireland respectively. Fasciolosis was the most commonly diagnosed endoparasitic disease throughout the island of Ireland. Nematodirosis was diagnosed at a similar level in both jurisdictions but coccidiosis (as diagnosed at necropsy) was more prevalent in Northern Ireland.

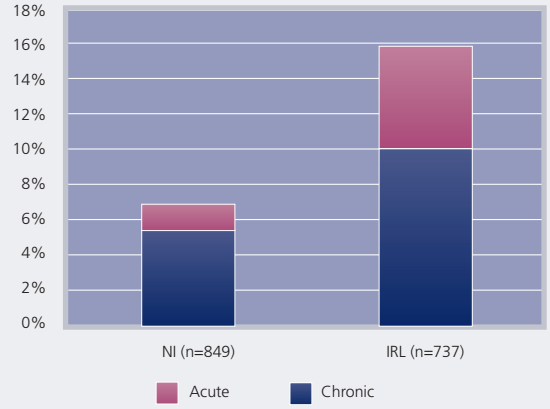


Figure 66: The percentage of all ovine mortality caused by acute and chronic fluke infestation diagnosed by AFBI (NI) and DAFF (IRL) in 2010.

Figure 66 shows the diagnostic analysis for *Fasciola hepatica* (liver fluke) infestation in sheep carcases examined *post mortem* in Northern Ireland and Ireland in 2010. Ireland recorded a significantly higher proportion of liver fluke related deaths in 2010 (16.8 *per cent*) compared to Northern Ireland (6.8 *per cent*) and a larger proportion of the liver fluke related deaths were classed as due to acute infestation. In spite of the high numbers of liver fluke related deaths recorded in 2010, these figures actually represent a significant reduction in fluke-related mortality recorded by DAFF in Ireland when compared to 2009 (37.4 *per cent*). There is evidently a considerable need for flock owners to reassess their dosing strategy with a view to reducing the proportion of deaths caused by fasciolosis even further. Veterinary practitioners and farm advisers have an advisory role to play in this.

Figure 67 shows the diagnostic analysis for all endoparasitic disease in Northern Ireland and Ireland during the reporting period. 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.

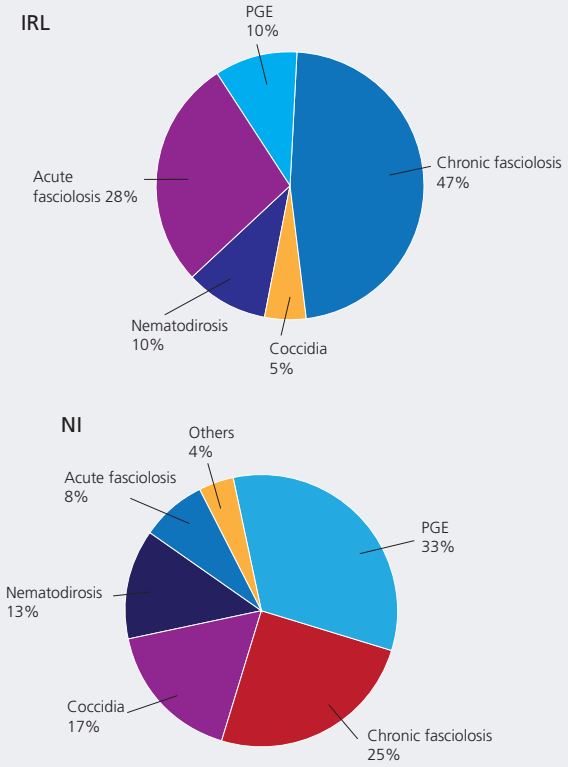


Figure 67: Specific endoparasitic conditions diagnosed in 2010 in sheep as a percentage of all ovine endoparasitic disease diagnoses made in Northern Ireland (n=200 from 849 submissions) and Ireland (n=154 from 737 submissions).

Other causes of endoparasitism diagnosed in Northern Ireland but not individually specified include: haemonchosis, sarcocystosis, cestode infestation and cryptosporidiosis.

Clostridial disease in sheep

Clostridial organisms are naturally present in the soil, where their spores can survive for a long time but they can also live in the gut of healthy animals. Pulpy kidney disease was the most common clostridial disease diagnosed in lambs on the island of Ireland in 2010 (Table 7).

Figure 68 The typical finding of soft autolytic (`pulpy') kidneys in a lamb diagnosed with Pulpy kidney disease (Photo: Colm Ó Muireagáin)

Pulpy Kidney Disease is caused by infection with *Clostridium perfringins* type D. It is commonly identified in fast growing lambs, typically over one month of age that are consuming high concentrate rations, or sucking from ewes which are heavy in milk. Losses in a flock often coincide with a sudden change in feed which causes the organism, which is already present in the lamb's gut, to proliferate causing release of its toxin. The finding of rapidly autolytic kidneys ('pulpy kidneys'), glucosuria and the presence of a serous clot in the pericardium are all highly suggestive of *Clostridium perfringins* type D infection.

	Lambs (DAFF)	Lambs (AFBI)	Adults (DAFF)	Adults (AFBI)	Totals
Blackleg	5	0	1	1	7
Black Disease	1	0	2	9	12
Abomasitis	3	0	2	0	5
Malignant oedema	0	0	2	1	3
Enterotoxaemia - clostridial	15	4	1	1	21
Pulpy Kidney Disease	11	16	0	0	27

Table 7: The frequency of diagnosis of clostridial disease in sheep on post-mortem examination in AFBI and DAFF veterinary laboratories in 2010.

Black disease (Figure 69), caused by the bacterium *Clostridium novyi*, becomes active in liver tissue damaged by the liver fluke. Its prevalence is highest in areas prone to liver fluke infection. Control relies on vaccination and effective control of liver flukes.

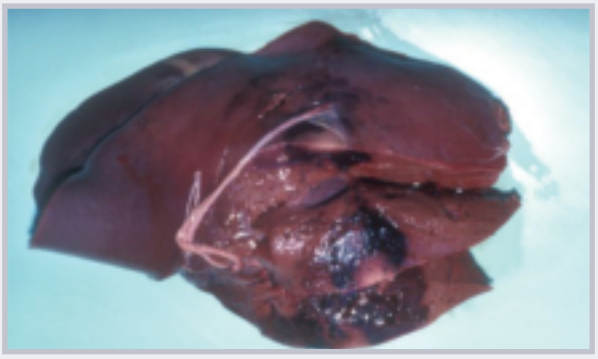


Figure 69: Black disease, showing the classical darkened tissue, in the liver of a sheep (Photo: AFBI).

Malignant Oedema is an acute, rapidly fatal wound infection of grazing animals caused by several different types and combinations of clostridial organisms such as *C.septicum, C.chauvoei, C.perfringens, C.novyi* and *C.sordellii*. Infection leads to swelling and inflammation at the wound site, gas production and the characteristic bubbly feel to the skin. The skin may subsequently darken and become gangrenous as the infection spreads locally.

Clostridial diseases are a significant cause of mortality among sheep flocks on the island of Ireland, much of which can be readily prevented by flock vaccination with a multivalent clostridial vaccine. Diagnostic laboratories in both jurisdictions regularly diagnose clostridial disease in sheep that have been partly or inadequately vaccinated. Clostridial vaccines are among the cheapest livestock vaccines in use, and among the most effective if used properly.

Other findings of interest in sheep

Table 8 shows a number of conditions of interest diagnosed over the reporting period.

	DAFF	AFBI	Total
Abomasal emptying defect	3	1	4
Caseous lymphadenitis (CLA)	1	1	2
Johne's disease	2	1	3
Escherichia fergusonii infection	2	0	2
Ruptured aorta	1	0	1

Table 8: Other noteworthy cases recorded in 2010

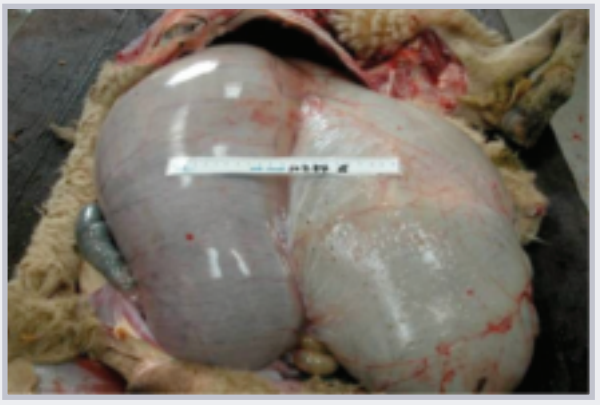


Figure 70: Abomasal distension due to emptying disorder (Photo: Norman Beggs).

Abomasal emptying disorder is an uncommon condition and is seen mainly in the Suffolk breed. The cause is unknown but a hereditary component has been suggested (Scott, 2007). A clinical presentation of gradual weight loss with developing cranial right- sided abdominal distension (Figure 70) and the passing of firm mucus coated faeces are suggestive of the condition. Similar signs have been reported in scrapie (Sargison, 2008) and all cases of this condition should be routinely investigated for TSE.

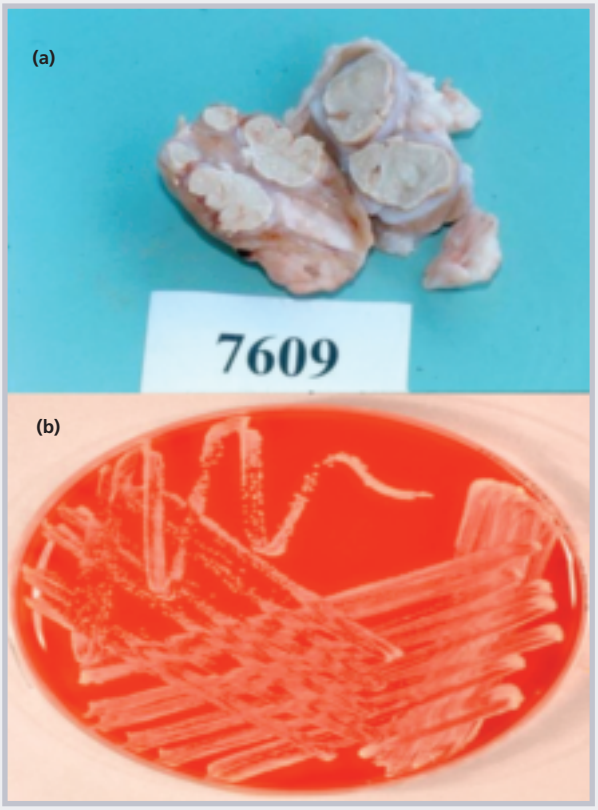


Figure 71: (a) A lymph node granuloma in a case of CLA; (b) A culture of *Corynebacterium pseudotuberculosis* on blood agar from the same lesion(Photos: Frank Malone).

Caseous lymphadenitis (CLA) is due to infection with *Corynebacterium pseudotuberculosis* and presents as an enlargement of the superficial lymph nodes (Figure 71) with internal abscessation being recorded in some cases. The disease has become important in the pedigree sector but has little impact in commercial flocks in the Northern hemisphere. Serological tests exist but are unreliable in individual animals while their use for control of the disease on a group or flock basis is somewhat more promising. Diagnosis continues to rely primarily on clinical examination, culture of suspect lesions and necropsy. Affected animals should be culled and control can be achieved by:

1. Adherence to strict biosecurity measures
2. Scrupulous hygiene in routine operations which involve injections or may cause wounds (like shearing, tagging)
3. Possibly the use of vaccines under Special Treatment Authorisation from the Regulatory Authorities

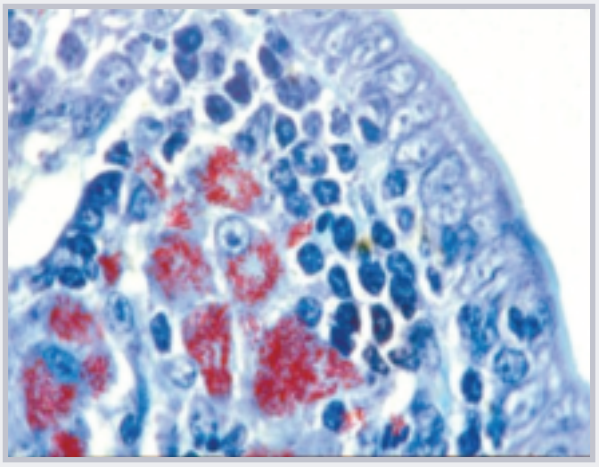


Figure 72: Acid fast MAP organisms within macrophages in the lamina propria of the terminal ileum, in a case of Johne's disease in sheep (Photo: Frank Malone).

Johne's disease due to *Mycobacterium avium* subspecies *paratuberculosis* (MAP) is an important cause of slow progressive weight loss in adult sheep. The condition should be considered in any cases of weight loss in adequately fed adult sheep which are not affected by poor dentition, chronic parasitism or lameness (Scott, 2007). Full necropsy, histopathology (Figure 72) or culture of the organism is required for diagnosis.

Escherichia fergusonii has been isolated from sheep with clinical signs including abortion, diarrhoea, septicaemia and sudden death (Voigt *et al*, 2009). In a number of cases where this organism has been isolated, the significance of the isolate is not clear. A primary or secondary pathogenic role is likely especially in association with chronic parasitic disease. Healthy carrier sheep have also been shown to exist (Voigt *et al*, 2009)

The cause of aortic rupture in sheep is unknown and the condition is not reported in the literature.

References:

Sargison, N., 2008: Sheep Flock Health Blackwell Publishing, Oxford, UK

Scott, P. R., 2007: Sheep Medicine, Manson Publishing, London, UK

Voigt, K., Evans, J., MacArthur, I., Foster, G., 2009: *Escherichia fergusonii* in the Scottish Highlands: Prevalence and Potential Pathogenicity factors: *Proceedings of the Sheep Veterinary Society,* 33 p 81 – 82.

Ovine abortion

Sporadic abortions around the beginning of the lambing period are expected by most shepherds and their incidence can increase with flock size. Some of these abortions can readily be attributed to external events such as rough handling or fighting between ewes. However, a few isolated abortions can sometimes precipitate quickly into an outbreak or 'abortion storm'. Where the incidence rapidly surpasses 5 *per cent* of the ewe flock or where there are a number of abortions in a short time period, then a laboratory determination of the cause should be attempted.

There was an increase in the number of laboratory submissions to the DAFF laboratories, in 2010 compared to 2009, with a 33 *per cent* increase in the numbers of individual foetuses examined. Attributing a reason for this significant increase is difficult but it is likely that the high average lamb price in 2010 (as discussed on page 5) possibly played a role. Submissions for ovine abortion frequently include multiple lamb carcases and placental material when available.

Veterinary surgeons and shepherds are strongly urged to submit diagnostic material from flocks experiencing abortion. Not least because the two most common causes of abortion (enzootic abortion and toxoplasmosis), if diagnosed, are largely preventable by vaccination. Outlined below are the guidelines for sampling during an abortion investigation.

Guidelines for sampling for an abortion investigation are as follows:

1) The foetus and placenta should be submitted when both are available
2) More than one submission is normally required to investigate an outbreak of abortion.
3) Maternal blood samples may be useful (EAE, Toxoplasmosis, Border Disease, *Leptospira Hardjo*), to demonstrate recent acute infection. Ideally a minimum of at least 10 *per cent* of the ewe flock or 10 ewes (whichever is the greater) should be blood sampled
4) If a full carcase submission is not possible the samples of choice are placenta (fixed and fresh), foetal stomach contents (collected in an aseptic manner), liver and foetal pleural fluid.

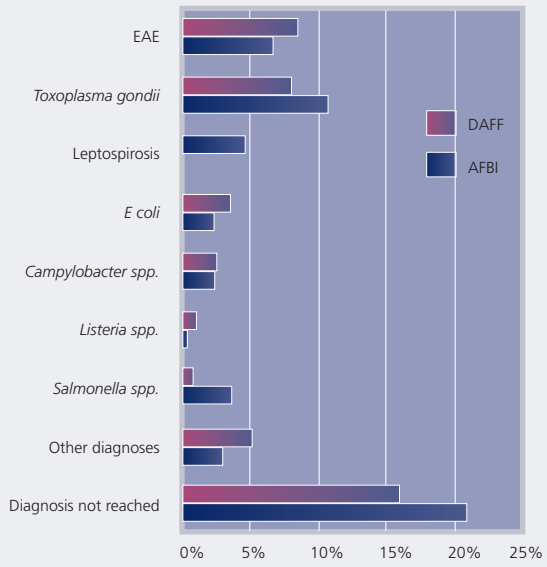


Figure 73: The relative frequency of detection of the agents which cause ovine abortions in foetal carcase submissions in Northern Ireland (n=317) and Ireland (n=402) in 2010.

Figure 73 shows the relative frequency of detection of ovine infectious abortifacients in foetal carcases on post-mortem examination in Northern Ireland and Ireland in 2010. Enzootic abortion of ewes (EAE) was the most frequently diagnosed cause of ovine abortion in Northern Ireland, accounting for 17 *per cent* of diagnoses while Toxoplasmosis was the most frequently diagnosed cause of ovine abortion in Ireland (21.4 *per cent*). Toxoplasmosis was a relatively frequent diagnosis in Northern Ireland too accounting for a further 16 *per cent* of diagnoses while leptospirosis (9 *per cent*) was also a relatively common diagnosis in aborted ewes.

Salmonella spp. were isolated relatively frequently from ovine foetal carcases (7.5 *per cent*), in the DAFF laboratories, with *Salmonella* Dublin being identified in twenty nine foetal carcases while *Salmonella* Typhimurium was identified in one carcase. In Northern Ireland, the *Salmonella spp.* identified included *Salmonella* Dublin (three cases), *Salmonella* Typhimurium (one case) and *Salmonella* Arizonae (one case).

The category 'other diseases' include sporadic bacterial abortion due to *Arcanobacterium pyogenes, Bacillus licheniformis, Mannheimia haemolytica, Staph. aureus, Streptococcal spp.* and *Yersinia pseudotuberculosis.*

Chlamydophila abortus infection is transmitted to uninfected female sheep by contact with contaminated foetal membranes, foetal fluids, discharges or bedding material. Infection in these animals usually becomes latent but may reactivate during the subsequent pregnancy.

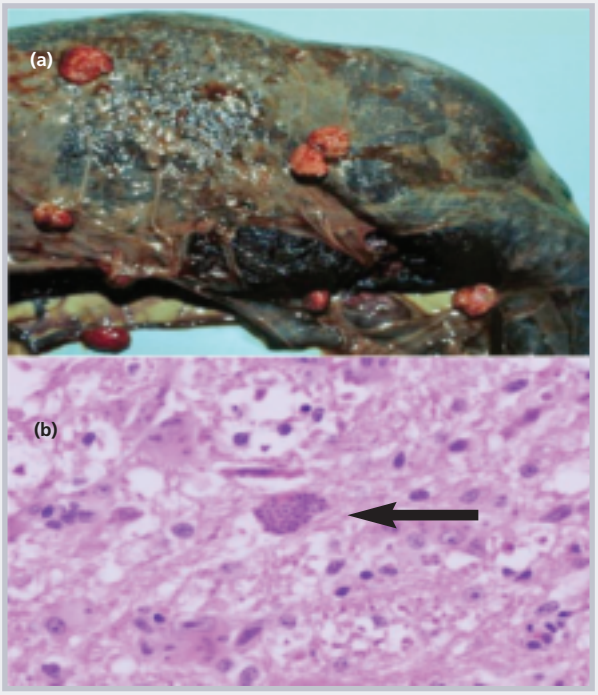


Figure 74: (a) Foetus and placenta from a case of *Toxoplasma* abortion showing pinpoint necrotic foci on the placental cotyledons (Photo: AFBI). (b) A photomicrograph showing a *Toxoplasma gondii* organism (arrow) in the placental cotyledon (Photo: Cosme Sánchez-Miguel).

Both *Toxoplasma gondii* and *Chlamydophila abortus* are zoonotic pathogens which can pose a risk to the unborn child. Pregnant women should avoid all contact with sheep, especially at lambing time.

Toxoplasmosis, caused by infection with *Toxoplasma gondii* is a commonly diagnosed cause of abortion especially in ewe lambs and hoggets/shearlings (Figure 74). Sheep are infected by ingestion of oocysts present in cat faeces, usually contaminating concentrate feed. Infection outside pregnancy usually causes no more than a subclinical febrile condition which often escapes detection. The consequence of infection during pregnancy depends on the stage of gestation at which exposure occurs.

The likely consequences of *T. gondii* infection in sheep

Non pregnant: Acute, subclinical febrile condition

Early-mid pregnancy (<110 days): Foetal death and abortion.

Late pregnancy: Birth of a live but weak lamb.

A solid, probably life-long, immunity is established after natural infection; hence the higher level of disease in young breeding sheep, as older sheep tend to become exposed and resistant. Good control can be achieved by the use of a live tachyzoite vaccine.

Diseases of pigs

The pig sector is an important part of Irish agriculture, and the laboratory services throughout the island provide diagnostic support to pig producers to assist disease control, fulfil export requirements, and improve productivity. The DAFF laboratories are currently undertaking a programme, with expert assistance from AFBI colleagues, of increasing and developing our existing capacity to provide diagnostic support to pig practitioners in Ireland. In 2010 AFBI received four hundred and twenty nine pig carcases for examination, while the DAFF received ninety, totalling five hundred and nineteen carcases for the island.

The most common diagnoses were pneumonia (19.7 per cent) and gastrointestinal disease (9.2 *per cent*). Figure 75 and Figure 76 show the aetiological agents implicated for each, respectively.

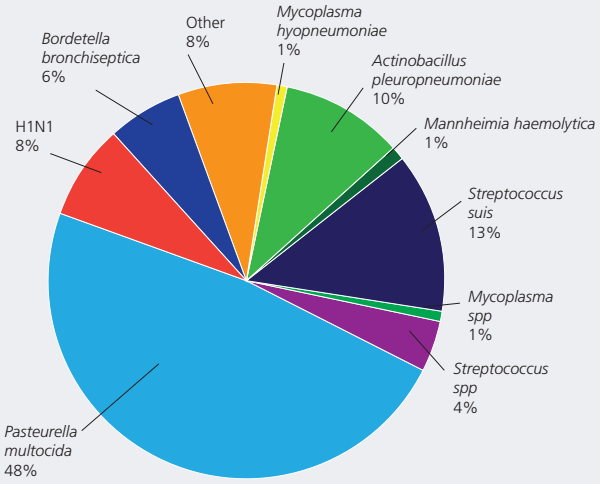


Figure 75: Causes of pneumonia in pigs diagnosed in 2010 (n=102).

As detailed in Figure 75 and in line with current worldwide trends the most common respiratory pathogen isolated from pigs was *Pasteurella multocida. P. multocida* is considered an opportunistic respiratory pathogen in pigs, as pathological infection has only been reproduced experimentally using very high inoculations. It is hypothesised that clinical pneumonic pasteurellosis arises where pre-existing lung lesions are colonised by *P. multocida.* This secondary infection increases the severity of pneumonia and worsens the clinical signs. This is particularly common in cases of *Mycoplasma hyopneumoniae* infection. Other primary respiratory pathogens of pigs that can be complicated by secondary *P. multocida* infection include; Swine influenza virus, porcine reproductive and respiratory syndrome (PRRS) virus and *Bordetella bronchiseptica.* Therefore, a diagnosis of *P. multocida* pneumonia should be considered as an indicator of the presence of other respiratory pathogens within the herd.

Actinobacillus pleuropneumoniae was the third most common respiratory pathogen isolated from porcine lungs and is a primary respiratory pathogen of major importance in porcine pneumonia worldwide. It most commonly affects growing pigs up to six-months-old and is spread by direct contact between infected pigs. Although the pathognomic lesions of pleuropneumonia allow rapid diagnosis, even with treatment *A. pleuropneumoniae* infection within a herd will adversely affect growth rates as there is often incomplete resolution of the associated pathology. In addition, treated and recovered animals can maintain subclinical infection in the tonsils for up to six months, acting as a continuing source of infection within the herd. A diagnosis of *A. pleuropneumoniae* disease should be complemented by serotyping of the agent, as immunity to one serotype is only partially protective against other serotypes. This is particularly relevant in vaccinated herds as vaccines are only protective against homologous serotypes.

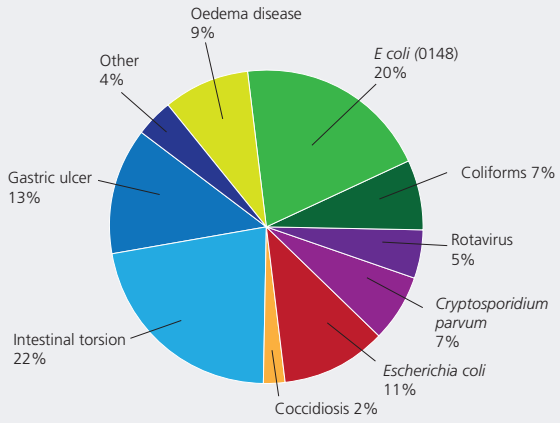


Figure 76: Causes of enteric disease in pigs diagnosed in 2010 (n=48).

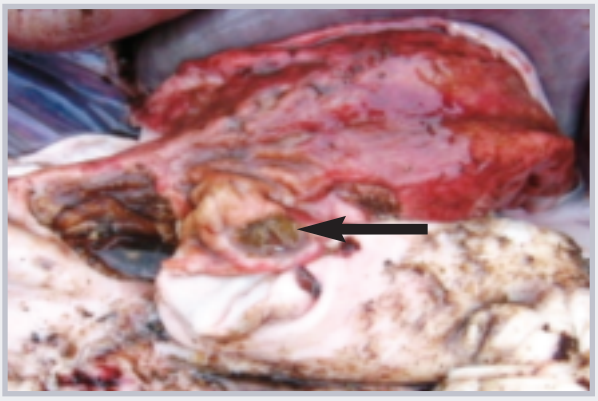


Figure 77: An ulcer (arrow) in the stomach of a 22-month-old pig (Photo: Colm Ó Muireagáin).

Porcine circovirus 2 (PCV2), the aetiologic agent of postweaning multisystemic wasting syndrome (PMWS), was detected in thirty two cases by AFBI, while one PMWS case was diagnosed at post-mortem examination by DAFF. PCV2 infection alone is not confirmatory of PMWS; clinical and histopathological findings are also required to confirm a diagnosis.

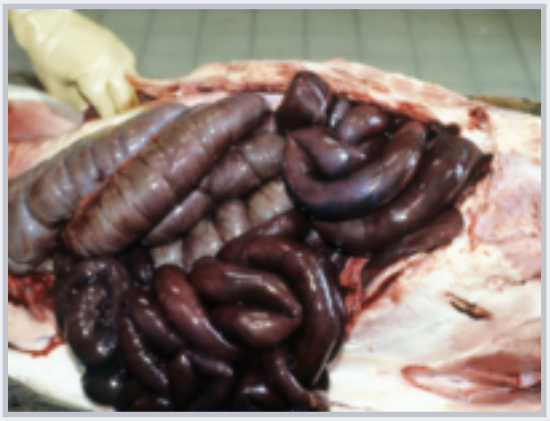


Figure 78: Severe congestion of the intestines in a pig due to intestinal torsion (Photo: AFBI)

Diagnosis	DAFF	AFBI	Total
Endocarditis	1	1	2
Meningitis	4	13	17
Nephritis	1	2	3
Pericarditis	1	0	1
Polyserositis	2	8	10
Septicaemia	9	4	13
Exudative dermatitis	1	0	1
PDNS	1	2	3
Streptococcus suis	6	21	27
Mulberry heart disease	0	3	3
Liver Lobe Torsion	0	2	2

Table 9: Other pig diagnoses made in 2010.

Streptococcus suis is a common but serious infection of pigs; serotypes two and nine are particularly severe and can be zoonotic. Twenty seven cases of *Streptococcus suis* infection (5.2 *per cent* of cases) were detected in 2010 (Table 9).

Twenty cases of abortion were submitted to AFBI; two were caused by parvovirus, two by *Leptospira*, while no significant pathogen was identified in the remainder. The DAFF laboratories identified *Leptospira canicola* as the cause of abortion in one case.

Diseases of poultry

The majority of poultry submissions to the laboratories come from commercial poultry enterprises and usually consist of multiple carcases. For this reason the diagnoses and numbers given here relate to the numbers of submissions with a particular diagnosis and not to individual carcase diagnoses.

In 2010 there were one thousand and eighty five chicken submissions to the AFBI laboratories; five hundred and three were examined for intestinal parasites, three hundred and seventeen underwent statutory *Salmonella spp*. sampling and two hundred and sixty five had post-mortem examinations performed. There were one hundred and sixty two submissions representing two hundred and ninety chicken carcases to the DAFF laboratories in 2010.

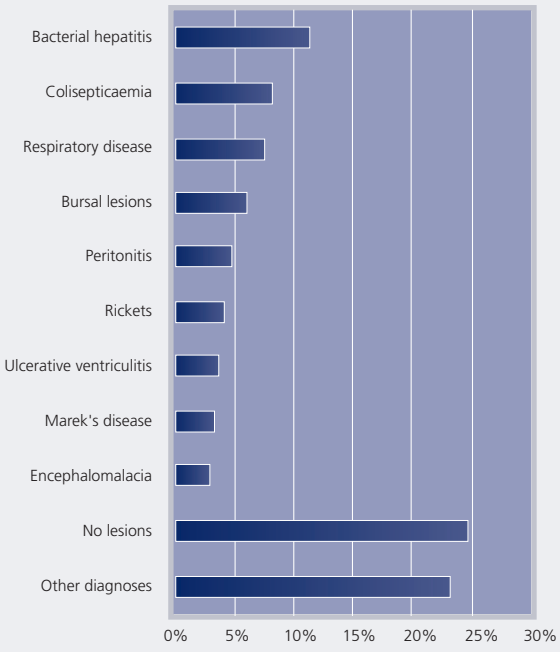


Figure 79: The most frequently diagnosed conditions on post-mortem examination in poultry in AFBI laboratories in 2010 (n=265).

Figure 79 presents the most common post-mortem diagnoses in poultry submissions from the AFBI laboratories in 2010. Bacterial hepatitis was the most frequently diagnosed condition (11.3 *per cent*) while colisepticaemia was diagnosed in a further 8.3 *per cent* of carcases examined. Respiratory disease (7.5 *per cent*) encompasses a number of conditions which included infectious laryngotracheitis (Gallid Herpesvirus 1) which was identified in five submissions. Various bursal lesions were also detected, which included submissions confirmed with infectious bursal disease (Gumboro disease, Avian birnavirus).

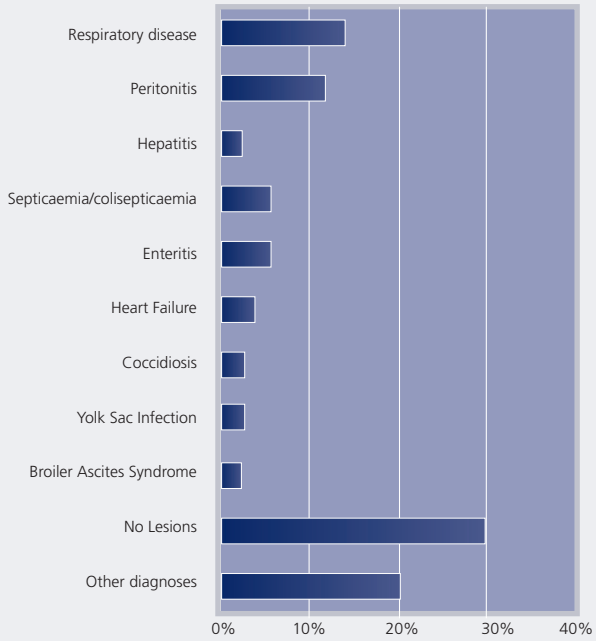


Figure 80: The most frequently diagnosed conditions on post-mortem examination in poultry in DAFF laboratories in 2010 (n=162).

The most common diagnoses in DAFF poultry submissions are presented in Figure 80. Respiratory disease (14.2 *per cent*) and peritonitis (11.7 *per cent*) were the most common findings. One respiratory submission was confirmed as infectious laryngotracheitis and two submissions had infectious bronchitis virus confirmed. Infectious bronchitis is contracted by the inhalation or conjunctival route and is highly contagious. Typically the disease is accompanied by mild respiratory signs such as sneezing and a watery discharge from the eyes and nostrils. Co-infection with *Mycoplasma gallisepticum* or *Mycoplasma synoviae* can cause more severe clinical signs.

Less frequent diagnoses were coccidiosis (2.5 *per cent*) and broiler ascites syndrome (2.5 *per cent*). Broiler ascites syndrome is a condition commonly referred to as 'waterbelly'. There are many possible causes but fibrosis of the liver, heart failure, sodium toxicity or respiratory disease may all contribute to the occurrence of the condition. Broilers can die suddenly, often without the ascites being clinically apparent. On post-mortem examination the heart may be enlarged and the right ventricle may be thickened. Control requires examination of underlying disease or stress factors in the birds' environment.

AFBI offers screening for parasites in commercial poultry. A total of five hundred and three submissions was examined in 2010 and clinically significant levels of parasites were detected in just fifty submissions; thirty one had *Heterakis spp.*, twelve had *Ascarid spp.* and seven had *Capillaria spp*. infections. These results reflect the high levels of parasite control in commercial poultry.

The frequency of some of the other common poultry diagnoses made by AFBI and DAFF laboratories in 2010 are presented in Table 10.

Diagnosis	AFBI submissions	DAFF submissions
Ascites	2	4
Coccidiosis	6	4
Hepatic lipidosis	5	0
Tendon rupture	4	0
Inclusion body hepatitis	4	0
Tenosynovitis	3	0
Gout	3	1
Haemorrhage	1	3
Pericarditis	0	3
Gastrointestinal impaction	0	3

Table 10: The frequency of some of the other common poultry diagnoses to AFBI and DAFF laboratories.

Enterococcus encephalomalacia caused by *Enterococcus hirae* was diagnosed in five submissions. *Enterococcus spp.* are present worldwide and ubiquitous in poultry environments. Typically encephalomalacia is seen in very young chicks presenting with neurological signs. There are no gross lesions. Histologically there is bilateral symmetrical encephalomalacia of the cerebrum and pons with microthrombi within the blood vessels. Culture of *Enterococcus hirae* from the brain aids diagnosis.

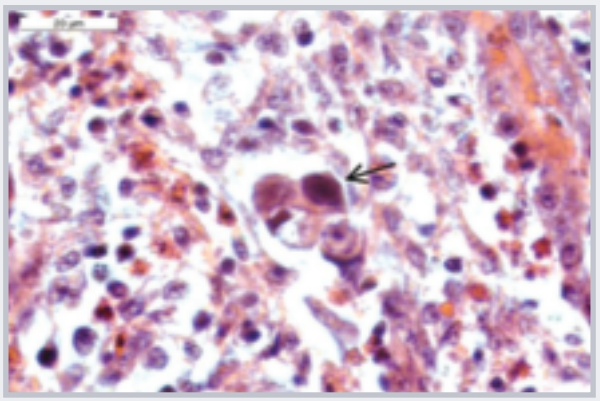


Figure 81: Pathognomic intranuclear inclusion bodies in the gizzard epithelium (arrow) of a hen with adenoviral ventricular ulceration (Photo: Margaret Wilson).

Adenoviral ventricular ulceration was first described in commercial poultry in the early part of this century by Japanese researchers. AFBI have seen a low but increasing number of submissions for the past five years. There were ten submissions to AFBI in 2010 in which this condition was suspected and three of these had confirmed adenoviral aetiology. Typically, the disease presents as reduced growth rates with gizzard erosions and ulcerations in young broilers. Histologically there is erosion and ulceration of the koilin layer with transmural inflammation. Definitive diagnosis requires recognition of pathognomic intranuclear inclusion bodies in the gizzard epithelium (Figure 81).

Backyard poultry

The husbandry of small, usually free range backyard, poultry flocks is less intensive and fundamentally different from commercial poultry production. In general, backyard poultry live and lay eggs for longer; they often have access to wild birds and are rarely vaccinated. The types of diseases and their implications for flock health in backyard poultry are quite different to those of commercial poultry. An outline of some common conditions in backyard flocks follows.

Respiratory disease can present as nasal discharge, sneezing, listlessness and reduced egg production. There are many causes of respiratory disease in poultry. Infectious Laryngotracheitis (Gallid Herpesvirus 1) causes acute disease with secondary bacterial complication. Pasteurellosis *(Pasteurella multocida)* is usually subacute and can be accompanied by swollen sinuses. Gapes , where a nematode worm *(Syngamus trachea)* resides in the trachea is associated with open mouth breathing, while *Aspergillus spp*. pneumonia and airsacculitis tend to have a chronic course and are associated with dusty environments.

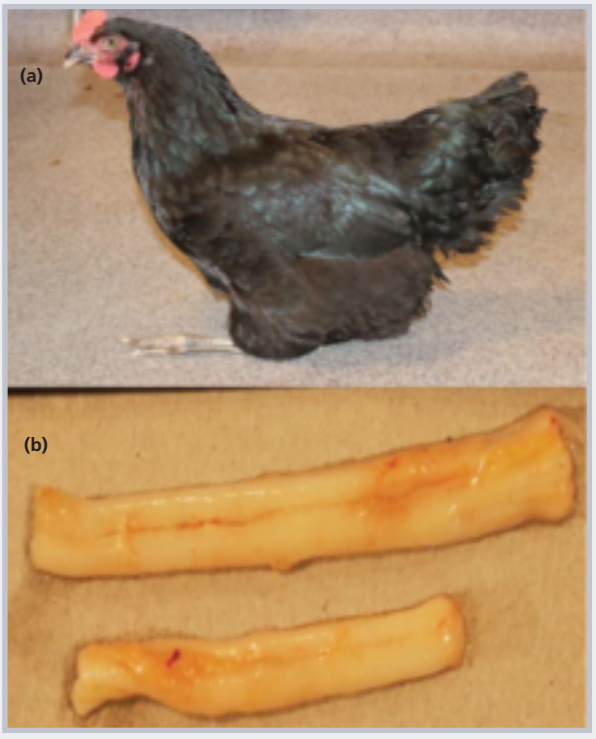


Figure 82: (a) The classical clinical sign of unilateral leg paralysis in a hen with Marek's disease. (b) An enlarged sciatic nerve (top) and a normal sciatic nerve (bottom) from a hen with Marek's Disease (Photo: Jim O Donovan).

Marek's disease is one of the common avian viral diseases seen in backyard flocks. Typically it affects younger birds and presents as paralysis (Figure 82) with perineuritis or as lymphoid tumours in organs such as liver or kidney.

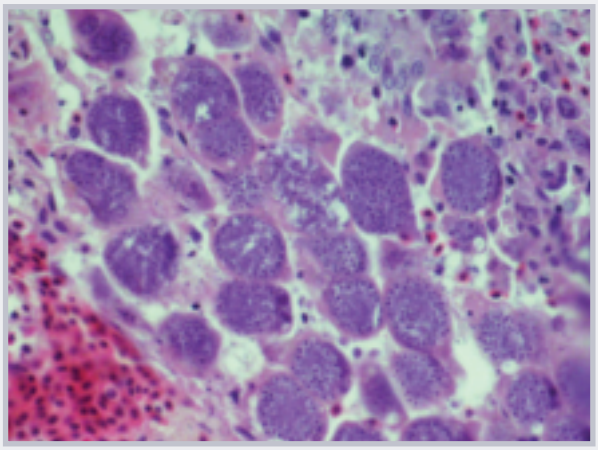


Figure 83: Photomicrograph of *Eimeria spp.* schizonts present in the intestine of a hen from a backyard flock (Photo: Ger Murray).

Internal and external parasites are common, though clinical disease is not always present. Infestations can cause ill-thrift, reduced laying and listlessness. Lice and red mites cause feather damage and anaemia. Ectoparasites can usually be detected by close examination of the skin. Common internal parasites include Ascarids (roundworms), *Capillaria spp.* and *Eimeria spp*. (Figure 83).

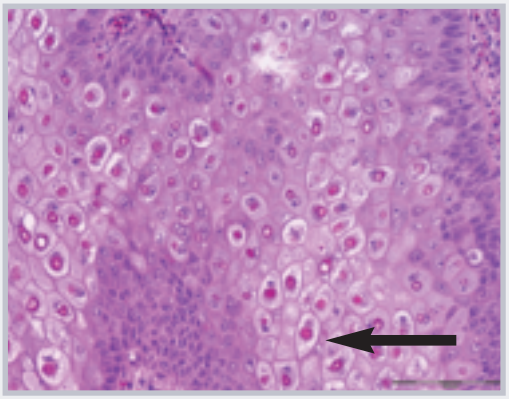


Figure 84: A section of eyelid showing marked hyperplasia of the epithelium with ballooning degeneration of the epithelial cells containing Bollinger bodies (arrow) consistent with Avipoxvirus infection (Photo: Jim O Donovan).

Figure 85: Fowl pox lesions in the oral cavity of a chicken identified during post-mortem examination (Photo: Jim O Donovan).

Fowl pox virus infection causes wart-like pock lesions on the featherless skin of the head of chickens and other poultry, but a "wet" form of the disease causing diptheritic lesions in the upper respiratory and alimentary tracts can also occur (Figure 84 and Figure 85). Clinically birds are often very thin and present with severe bilateral conjunctivitis, swollen eyelids and conjunctival sacs distended with inspissated pus. Mortality tends to be low with the dry form and greater with the wet form of the disease. Sick birds become depressed and egg production may be reduced. Culling sick birds with typical lesions may help limit the spread of fowl pox but all-in/all-out rearing practices, with disinfection between batches, is required to eradicate the disease.

Egg peritonitis is a problem in aged layers. Typically an egg is retained within the oviduct (egg bound) and fibrinosuppurative peritonitis ensues. Oviduct adenocarcinoma can occasionally be seen in aged layers, in which there is often serosal implantation of the tumour on the intestines and other organs.

Avian tuberculosis in backyard flocks is thought to originate from contact with wild birds. Usually, a chronic disease of older birds, the typical granulomatous lesions, with acid fast bacteria, are most commonly found in the intestines and liver; pulmonary lesions are less common.

Wildlife surveillance

Corkscrew injuries in harbour seals

During 2010, AFBI examined several sub-adult harbour seals which had dead stranded in the Strangford Lough area. All the seals had a characteristic single smooth edged cut starting at the head and spiralling around the body to the lower thorax ('corkscrew injuries'). In all cases the resulting strip of skin and blubber had become detached from the underlying tissue (Figure 86).

Figure 86: A sub adult harbour seal showing a characteristic spiral cut or 'corkscrew injury' (Photo: Cliff Mason)

These injuries were considered to be similar to those described in seals found on the beaches of eastern Scotland and along the Norfolk coast in England. The injuries are considered consistent with seals being drawn through a ducted propeller such as a Kort nozzle or some types of Azimuth thrusters, which are common means of propulsion and manoeuvre in a variety of coastal and sea-going vessels.

Suspected cases of wildlife poisoning in Ireland

Figure 87: Various baits used in the poisoning of wildlife which were recovered in the course of AFBI investigations of suspected wildlife poisoning. The black substance was analysed and found to contain carbofuran (Photo: AFBI).

Suspected cases of wildlife poisoning in Northern Ireland are processed and analysed by AFBI as part of the Wildlife Incident Investigation Scheme (WIIS). The scheme is overseen and run by the Chemical Regulations Directorate (CRD) of the United Kingdom Health and Safety Executive. The purpose of this scheme is to investigate deaths of wildlife and occasionally pets where there is evidence that pesticide poisoning may have occurred. AFBI regularly performs post-mortem examinations on wildlife where poisoning is suspected and samples taken from carcases are subjected to a range of toxicological analyses (Figure 87). The results of these investigations are used to monitor pesticide use and to enforce legislation on the protection of humans, animals, food and the environment from pesticides.

Figure 88: A buzzard found poisoned and submitted to Sligo RVL. Subsequent toxicological examination of tissue samples confirmed death was due to carbofuran poisoning (Photo: Mícheál Casey).

DAFF RVLs have provided a post-mortem diagnostic service on wild birds of prey (both native and re-introduced) on a case-by-case basis and hope to agree a protocol with the State Laboratory and the National Parks and Wildlife Service in 2011 which will put this work on a more formal footing. Three state-supported reintroduction projects have been managed by The Golden Eagle Trust, a private charity (Red Kites in Wicklow and Dublin, Golden Eagles in Donegal, and White-tailed Eagles in Co. Kerry). All three projects have experienced poisoning incidents, and DAFF RVLs have assisted by performing post-mortem examinations and the submission of samples for toxicology in 2010 (Figure 88). This work has highlighted the range of poisons being used in Ireland. In all cases it was believed that the raptors were accidentally poisoned by people targeting other species (mainly foxes, crows), and the Golden Eagle Trust has undertaken an education programme, including a leaflet on the safe and legal control of foxes and crows at lambing time. The work of the DAFF RVLs has informed this educational work, as well as some recent changes in the legislation to prevent the use of some of the poisons detected.

Trichinella surveillance in wildlife (foxes)

A Trichinella risk-based wildlife monitoring programme is in place in both Northern Ireland and Ireland, both being classed as jurisdictions in which the risk of *Trichinella* infestation in domestic pigs is officially recognised as negligible.

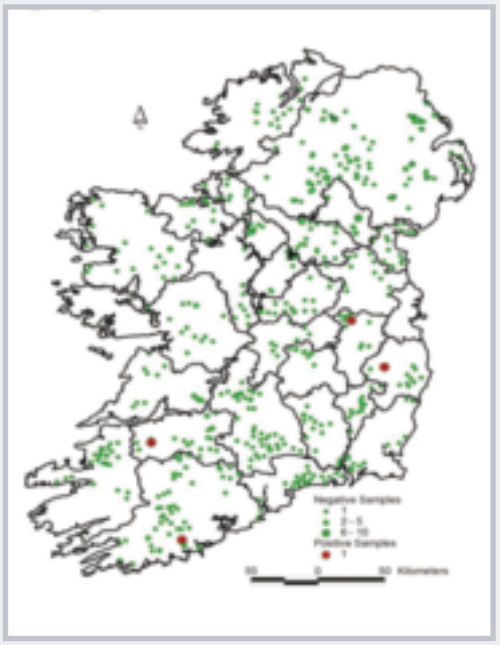


Figure 89: A map of the island of Ireland showing the locations where foxes were collected for the *Trichinella* surveys in 2010 (n=653). Larger dots represent locations where more than one fox was collected. The sites where the positive foxes were located are marked in red (n=4) (Map: Guy McGrath, CVERA and UCD)

In 2010, six hundred and fifty three foxes were collected from multiple locations across the island of Ireland and submitted to contributing laboratories (one hundred and sixty seven by two AFBI laboratories and four hundred and eighty six by six DAFF laboratories).

Figure 89 shows the origin of the foxes collected. Muscle samples from specific locations in the body (cheek, forelimb, tongue and diaphragm) were collected from each fox and these were analysed microscopically for the presence of *Trichinella spiralis* larvae following a pepsin digestion procedure. Four foxes (one each from counties Kildare, Cork, Limerick and Wicklow) were found to be positive for *Trichinella spiralis* larvae.

Bovine tuberculosis (bTB) surveillance in badgers

In Ireland, the regional veterinary laboratories participate in the screening of badgers for bovine TB. This includes the examination of badgers found on the road (i.e. `road-kill') as well as a proportion of those snared under licence and submitted by district veterinary offices. In 2010 a total of two hundred and twenty six badgers was examined *post mortem* by the regional veterinary laboratories and bovine TB was diagnosed in twenty two of these (9.7 *per cent*). It should be noted that this represents only a small proportion of those tested under the ERAD scheme.

Parasitic diseases

The number of faecal samples submitted to DAFF veterinary laboratories for parasitological examinations increased dramatically in 2010. As an example of this, Figure 90 shows the rise in bovine faecal sample numbers submitted for liver fluke egg examination in the years 2006 to 2010.

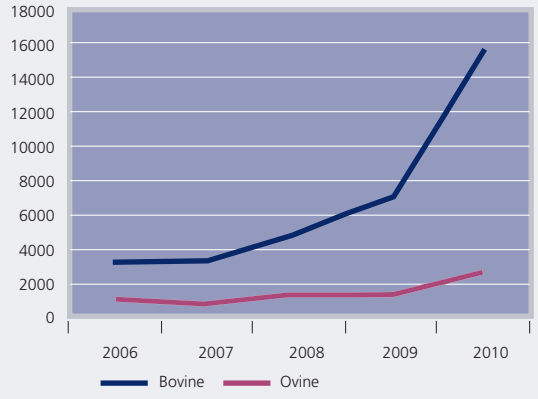


Figure 90: The number of faecal samples submitted for liver fluke egg detection to DAFF Regional Veterinary Laboratories in the years 2006 to 2010.

Liver and rumen fluke infections

In 2010 a combined total of fifteen thousand five hundred and forty eight bovine faecal samples was analysed by AFBI and DAFF laboratories for the presence of liver fluke eggs. Of these, two thousand seven hundred and eleven (17.4 *per cent)* were positive. A further fifteen thousand one hundred and ninety five samples were examined for rumen fluke eggs and five thousand six hundred and seventy nine (37.4 *per cent*) were positive. The frequency of detection was remarkably similar for both liver fluke and rumen fluke eggs in both the DAFF and AFBI laboratories. Figure 91 illustrates the change in the proportion of positive results by quarter during 2010.

Figure 91: The percentage of bovine faecal samples positive for fluke eggs by quarter during 2010 (AFBI: n=3,494; DAFF: n = 12,054).

The highest incidence of rumen fluke detection coincided with the periods of highest rainfall (see Figure 10). Liver fluke detection in cattle decreased progressively from the first to the fourth quarter. This trend differs considerably from that witnessed in sheep (Figure 93) and may suggest an increasing awareness on the part of cattle herdowners of the importance of efficient liver fluke management.

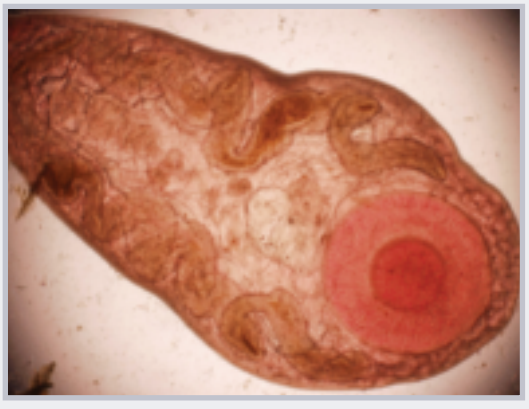


Figure 92: A rumen fluke (*Paramphistomum spp.*) (Photo: Cosme Sánchez-Miguel)

It should be stressed that the finding (or failure to find) fluke eggs in a faecal sample needs careful examination. Both liver fluke and rumen fluke (Figure 92) 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 positive rumen fluke results show few if any clinical signs of disease.

In terms of mortality, liver fluke infestation is a much more serious threat to livestock (see Diseases of cattle on page7) than rumen fluke infestation. The flukicides used for the treatment of paramphistomes are not effective against immature *Fasciola hepatica.* If a herd or flock owner focuses on paramphistome control to the neglect of *Fasciola hepatica* control serious losses may occur.

The clinical significance of paramphistomosis (rumen fluke infestation) has only become apparent in recent years and accurate data on its true prevalence and economic impact is lacking. Heavy infestation can lead to illthrift but mortality attributable to paramphistomosis is uncommon - in 2010 in Northern Ireland one bovine post-mortem examination recorded paramphistomosis as the cause of death while in Ireland it was not recorded as the cause of death in any bovine post-mortem examination performed. Collaborative studies may be undertaken by AFBI and DAFF aimed at a better understanding of the prevalence, risk factors for, and economic impact of rumen fluke infestation in Ireland.

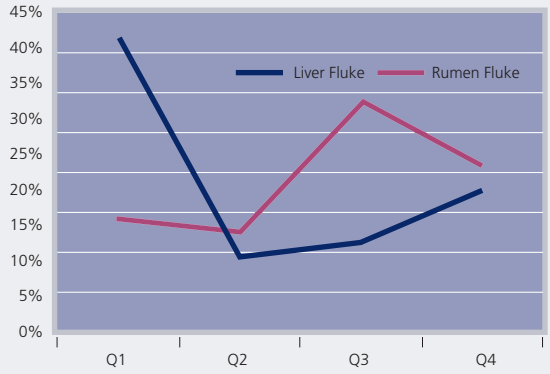


Figure 93: The percentage of ovine faecal samples positive for fluke eggs by quarter in 2010 (AFBI: n=1,715; DAFF: n= 965)

A combined total of two thousand six hundred and eighty ovine faecal samples were analysed for the presence of liver fluke eggs in 2010. Fluke eggs were detected in three hundred and three (15.4 *per cent* - 14.1 *per cent* in AFBI labs and 23.7 *per cent* in DAFF labs). A further one thousand seven hundred and seven samples (1,450 by AFBI and 257 by DAFF) were examined for rumen fluke eggs and four hundred and nine (24.0 *per cent*) were positive (25.9 *per cent* in AFBI labs and 12.8 *per cent* in DAFF labs). The differences in detection frequency of liver fluke and rumen fluke eggs between the laboratories may be due, in part, to the fact that the number of samples analysed in the DAFF laboratories was low in comparison to the AFBI laboratories. Figure 93 illustrates the change in the proportion of positive results by quarter.

Gastro-intestinal parasitic infections

In 2010, a combined total of fourteen thousand nine hundred and fifteen bovine and three thousand one hundred and twenty four ovine faecal samples were examined by AFBI and DAFF laboratories for strongyle eggs. A strongyle burden of greater than five hundred eggs per gram of faeces is considered clinically significant. Based on this, 5.1 *per cent* of bovine (8.2 *per cent* in AFBI and 4.1 *per cent* in DAFF laboratories) and 20.8 *per cent* of ovine samples (20.4 *per cent* in AFBI labs and 21.6 *per cent* in DAFF labs) were recorded as having a significant strongyle worm burden. Figure 94 illustrates the combined quarterly results of both DAFF and AFBI for both bovine and ovine species.

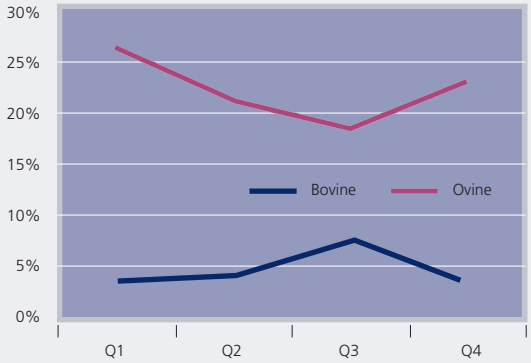


Figure 94: The percentage of bovine (AFBI: n=3,593; DAFF: n=11,322) and ovine (AFBI: n=2,003; DAFF: n=1,121) faecal samples which were positive (>=500 eggs per gram) for strongyle eggs in 2010.

The detection of strongyle eggs is consistently higher in sheep when compared to cattle. There may be a number of reasons for this, such as inherent resistance, age profile of the animals sampled, type of pasture grazed etc. but it may also point towards a greater focus on parasite control in cattle herds and suggests that this is an area which requires further attention among sheep producers.

Lungworm infections

The Baermann technique was used to examine a combined total of three thousand and ninety nine bovine faecal samples (408 by AFBI and 2,683 by DAFF) for the presence of lungworm larvae (primarily *Dictyocaulus viviparus)* (Figure 95). Eighty seven (2.8 *per cent*) were positive (13.7 *per cent* in AFBI and 1.4 *per cent* in DAFF laboratories). The difference in detection rates, while large, is most probably due to the more stringent selection of animals to be tested by practitioners in Northern Ireland. Often requests for this test come from practitioners treating animals displaying clinical signs of respiratory distress such that the proportion of positive results may be distorted due to the type of animal sampled. Figure 96 illustrates the trend by quarter.

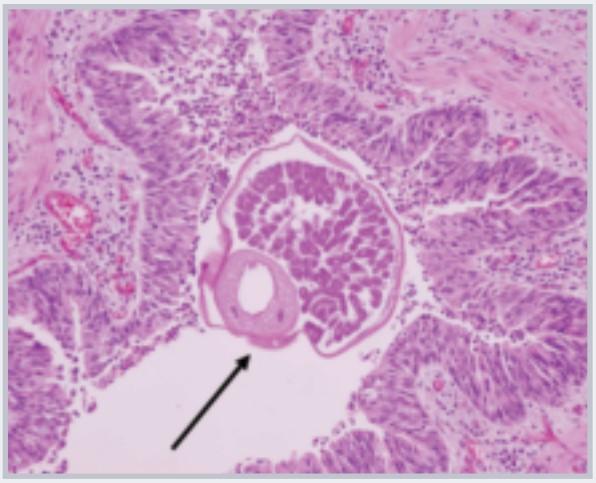


Figure 95: A photomicrograph of a bovine bronchus showing a cross-section of a lungworm larva (arrow) (Photo: Cosme Sánchez Miguel).

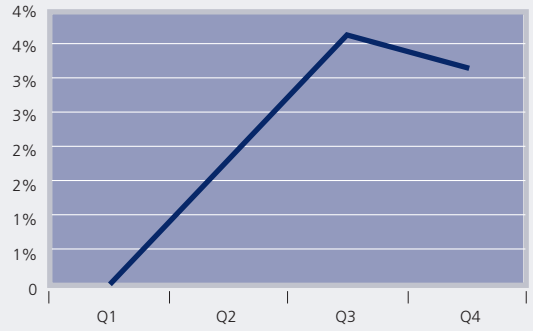


Figure 96: The percentage of bovine faecal samples positive for lungworm larvae by quarter in 2010.

Coccidiosis

Eimeria spp. are protozoan parasites that can cause significant disease (coccidiosis) in young animals. While disease in older bovine animals is relatively uncommon, diarrhoea caused by *Eimeria spp.* is common in calves between one and six months of age that are exposed to large numbers of oocysts. This may occur due to poor hygiene or management practices such as the failure to provide clean dry bedding, failure to disinfect between batches or the mixing of different age groups during housing.

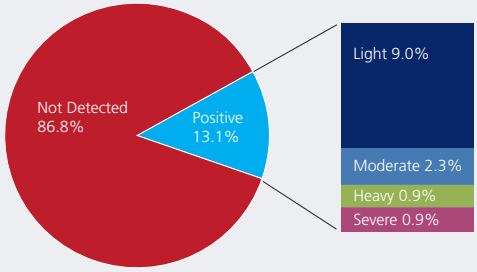


Figure 97: The percentage of bovine faecal samples positive for coccidial oocysts (n=12,750).

In 2010, twelve thousand seven hundred and fifty faecal samples were tested for the presence of coccidia (three thousand three hundred and thirteen by AFBI and nine thousand four hundred and thirty seven by DAFF). Of these, one thousand six hundred and seventy six samples (13.1 *per cent*) were positive (20.9 *per cent* in AFBI and 10.4 *per cent* in DAFF laboratories). However the majority of these positive samples (66 *per cent*) contained very small numbers of coccidial oocysts and are unlikely to have been solely responsible for significant disease. Figure 97 illustrates the results.

The results of faecal coccidial oocyst counts in cattle and sheep should be interpreted with caution. Only two (*Eimeria bovis* and *Eimeria zuernii*) out of twelve species of bovine coocidia and three (*Eimeria crandallis, Eimeria ovinoidalis* and *Eimeria ahsata*) out of twelve ovine coccidia species are pathogenic. Some of the non-pathogenic or weakly pathogenic species (e.g. *E ovina*) are capable of producing massive numbers of oocysts. These species can also produce dense focal lesions containing large numbers of oocysts in the small intestine which are visible on post-mortem examination. Large numbers of oocysts can be produced daily from these focal lesions without any clinical effect on the host. As oocysts are prevalent in faeces of sheep of all ages, coccidiosis cannot be diagnosed based solely on the finding of oocysts and the clinical presentation and history should also be considered.

Other parasitic diseases

Only two outbreaks of sheep scab (psoroptic mange in sheep, caused by *Psoroptes ovis*) were confirmed by laboratory testing in 2010, both of these by DAFF laboratories in Ireland. Four outbreaks of psoroptic mange in cattle were detected (one in Northern Ireland and three in Ireland). Presented below is an investigation conducted by Limerick Regional Veterinary Laboratory (RVL) into one of these outbreaks.

Psoroptic mange in a beef herd

Limerick RVL visited a beef unit in January 2010 to investigate a problem of severe pruritis in a group of housed bullocks. The farmer normally purchased weanlings and store cattle in the spring each year, grazed them and then finished the cattle over the winter period.

In the spring of 2009 he purchased a group of cattle from a mart. One of the animals (animal A) began to lose its hair over the following summer and the autumn period and was housed with other cattle in a slatted unit in early winter. Some weeks later the owner noticed that a number of the housed cattle were licking and scratching excessively. An ivermectin pour-on product was administered to the group but did not appear to remedy the situation.

Animal A was clinically depressed and drooling from the mouth on the day of the farm investigation (Figure 98).

Figure 98: Extensive hair loss in a bullock (Animal A) with psoroptic mange (Photo: Alan Johnson).

Other animals affected had localised lesions of moist dermatitis and hair loss (Figure 99), mostly on the dorsal parts of the trunk.

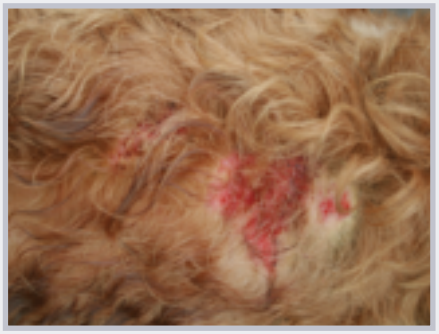


Figure 99: Moist dermatitis and hair loss in a bullock with psoroptic mange (Photo: Alan Johnson).

Skin scrapings were taken from animal A and a small number of the other affected cattle. A diagnosis of psoroptic mange was made following microscopic examination of the scrapings and identification of *Psoroptes ovis* mites (Figure100).

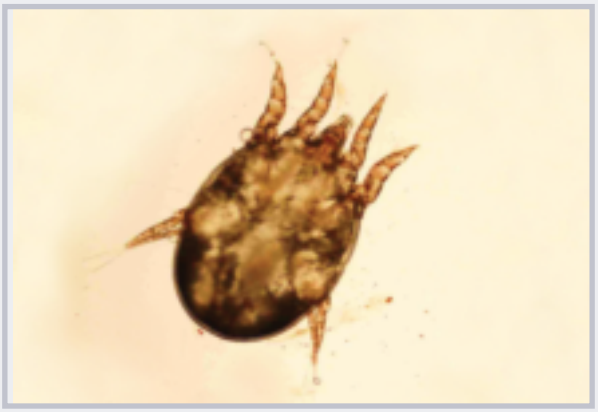


Figure 100: *Psoroptes ovis* mite seen in a skin scraping taken from Animal A (Photo: Brendan Crowe).

Treatment with two injections of 1 *per cent* w/v doramectin, with a fourteen-day interval between injections, was recommended. Animal A did not recover however, and died one week after the farm visit. The other animals did respond well and the scratching and licking reduced dramatically over the following weeks. The source of the outbreak was not determined. However an assumption was made that animal A was the original source of the infestation. This animal had been purchased at the mart from a farmer who was involved in the business of purchasing, storing and selling sheep wool each year. One theory considered during this investigation was that the animal had come into contact with some stored wool from a sheep infected with sheep scab. However the *P. ovis* mite associated with bovine psoroptic mange is a different (cattle-adapted) strain to that which causes sheep scab, so it was considered unlikely that cross-infection occurred.

Anthelmintic resistance in Ireland

Anthelmintic resistance in Ireland is a growing problem. Limited evidence derived from an AFBI questionnaire circulated in 2005, and a field survey on eight farms conducted in 2006 suggested that significant levels of resistance to the benzimidazoles, levamisole and macrocyclic lactones were already established at that time. Currently the returns from a new and extensive Northern Ireland wide questionnaire are being analysed, and studies on the efficacy of anthelmintic regimes used by farmers to control gastrointestinal nematode infestations and liver fluke on over one hundred sheep and cattle farms throughout the province are being carried out. A detailed comparative field study on anthelmintic efficacy against nematodes and fluke is also in progress on a limited number of selected sheep farms covering most of the important production systems and areas in Northern Ireland. Our present aim is to establish a data base of anthelmintic resistance, to develop effective protocols for rapid diagnosis in nematode and fluke infestations and to provide timely and up-to-date advice on effective control strategies on a farm-to-farm basis.

Antimicrobial susceptibility profiles

Resistance to antimicrobials is a serious concern in human and veterinary medicine. Increasing resistance within microbial populations to commonly used antibiotics is a global problem. Some resistant bacteria have zoonotic potential, and furthermore, as similar bacteria are found in humans and animals, resistance mechanisms developed by bacterial populations in animals may be transmitted to their counterparts in humans.

The ability of micro-organisms to adapt to their environment, together with the widespread usage of antibiotics has meant that some bacteria have developed resistance to certain commonly used antimicrobial drugs thereby limiting their efficacy.

Prudent use of antibiotics in veterinary medicine is essential to ensure that any risk of increasing antimicrobial resistance among animal bacterial populations and possible transfer to humans is minimised. Availability of effective antibiotic treatments for animals in the future depends on the appropriate responsible use and monitoring of the currently available antibiotics. Consequentially DAFF and AFBI carry out a comprehensive surveillance programme on samples received for disease investigation, which includes routine testing to monitor the incidence of antibiotic resistance in certain veterinary pathogens. Information is provided to veterinary practitioners in the form of *in vitro* resistance profiles for particular bacterial isolates on a case by case basis to allow effective therapeutic decisions to be made.

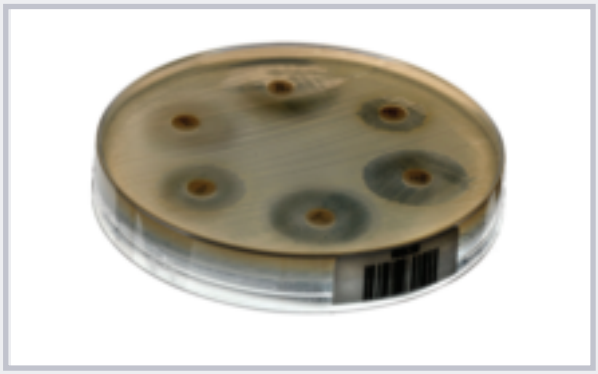


Figure 101: Antimicrobial susceptibility testing showing zones of clearance (Photo: AFBI).

In addition to its immediate clinical value, antimicrobial susceptibility testing by the DAFF and AFBI laboratories also allows the resistance profiles of pathogens of potential public health interest to be monitored on a large scale. The occurrence of methicillin-resistance in *Staph. aureus* isolates (MRSA), for example, and ESBL (extended-spectrum beta-lactamase) activity in *E. coli* isolates, are issues of concern in human healthcare.

The antibiotic susceptibility results presented are for the three most common bacterial isolates from cases of bovine mastitis – *Staph. aureus, Strep. uberis,* and *E. coli*. The results indicate the *in vitro* susceptibility of specific isolates in laboratory conditions, and it is important to note that these *in vitro* results may not directly correlate with clinical efficacy in field situations. The results from DAFF and AFBI are also presented separately below due to differences in the antibiotic makeup of the various panels and breakpoints used. They are, however, indicative of the work done on monitoring the problem of antibiotic resistance in bacterial isolates from farm animals on the island of Ireland.

Staphylococcus aureus

Staph. aureus is a common cause of bovine mastitis. It was the most frequent isolate from DAFF milk submissions at 46 *per cent* – followed by *Strep. uberis* and *Strep. dysgalactiae* combined at 28 *per cent*, and *E. coli* at about 25 *per cent*. In AFBI, *Staph. aureus* accounted for 16 *per cent* of mastitis cases from bovine milk submissions

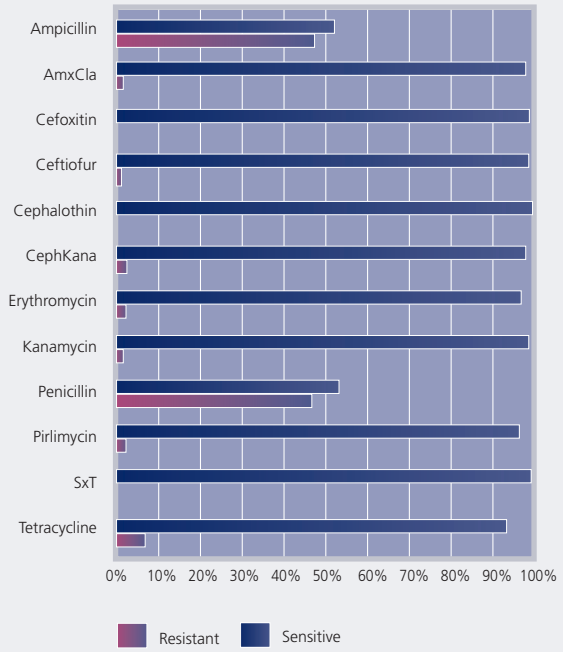


Figure 102: Antimicrobial susceptibility in *Staph. aureus* isolates from bovine milk submissions to DAFF in 2010 (n = 880) (AmxCla = amoxicillin clavulanate; CephKana = cephalexin + kanamycin; SxT = sulphamethoxazole trimethoprim).

The results of antibiotic susceptibility testing on *Staph. aureus* isolates from bovine milk samples submitted to the DAFF and AFBI are presented in Figure 102 and Figure 104.

Figure 103: Antimicrobial susceptibility profiles are an important aid to the veterinary practitioner in the treatment of clinical and subclinical mastitis (Photo: Brian Flynn).

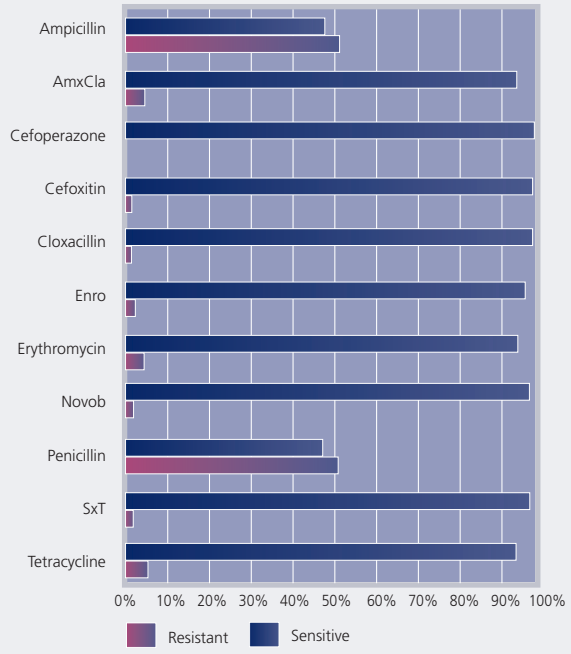


Figure 104: Antimicrobial susceptibility in *Staph. aureus* isolates from bovine milk submissions to AFBI laboratories in 2010 (n = 208[5]) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim; Enro = Enrofloxacin; Novob = novobiocin).

Susceptibility patterns for DAFF and AFBI *Staph. aureus* isolates were very similar where data was available for the same antibiotics, i.e. ampicillin, penicillin, amoxicillin clavulanate, sulphamethoxazole trimethoprim and tetracycline. Isolates showed broad susceptibility to most antibiotics on test – with the exception of ampicillin and penicillin. As would be expected, a high level of susceptibility was recorded for amoxicillin clavulanate – a combination which enhances the efficacy of amoxicillin (a β-lactam antibiotic) against bacteria that produce the enzyme β-lactamase. Cefoxitin, a second generation cephalosporin antibiotic, is included in the milk antibiotic susceptibility profiles in DAFF and AFBI as a screening test for MRSA isolates. There were three suspect MRSA isolates in each of the DAFF and AFBI datasets. All three of the AFBI isolates, and one of the DAFF isolates, were molecularly typed for MRSA markers. None were positive[6].

From a therapeutic standpoint,the duration of *Staph. aureus* infection should be borne in mind when considering treatment options; the more chronic cases are less likely to respond to antibiotic therapy.

[5] Samples tested as intermediate sensitivity have been excluded from analysis
[6] Two of the VLS isolates were not available for molecular typing.
[7] Samples tested as intermediate sensitivity have been excluded from analysis

Streptococcus spp.

The two streptococcal species most frequently implicated in bovine mastitis in Ireland are *Strep. uberis* and *Strep. dysgalactiae.* A small number of *Strep. agalactiae* isolates are recorded each year. In 2010, the susceptibility patterns for *Strep. uberis* and *Strep. dysgalactiae* isolates were very similar so only *Strep. uberis* results are shown here – see Figure 105 and Figure 106.

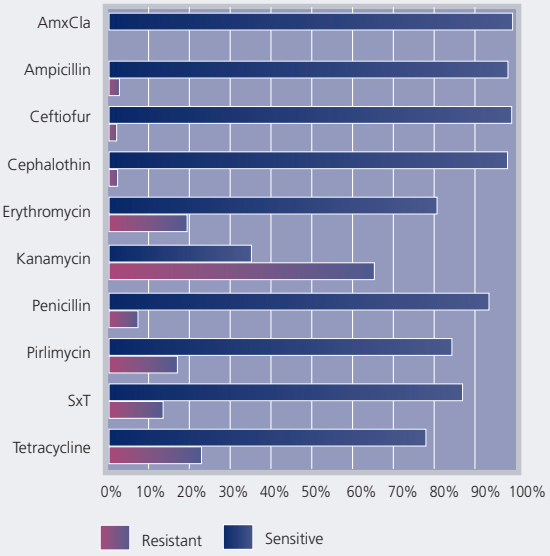


Figure 105: Antimicrobial susceptibility of *Strep. uberis* isolates from bovine milk submissions to DAFF in 2010 (n = 228) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

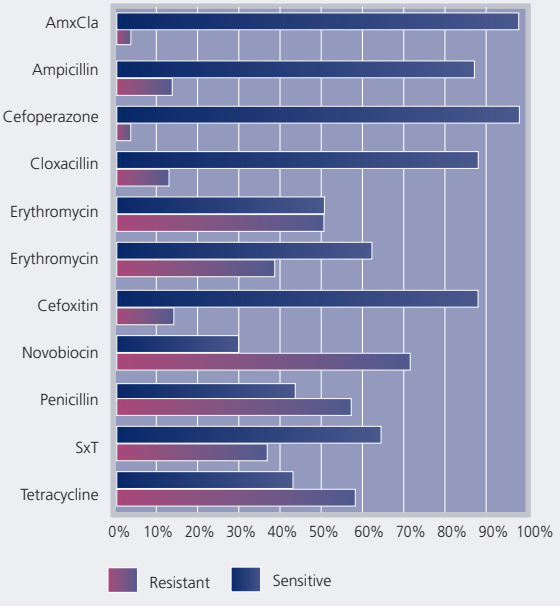


Figure 106: Antimicrobial susceptibility in *Strep. uberis* isolates from bovine milk submissions to AFBI in 2010 (n = 342[7]) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

Most *Streptococcus uberis* isolates (DAFF and AFBI) were sensitive to the penicillin and cephalosporin classes of antimicrobials but there was some resistance to macrolide, aminoglycoside and tetracycline compounds.

Escherichia coli

E. coli is an environmental bacterium and an opportunistic pathogen of the mammary gland. Laboratory antimicrobial susceptibility testing results are only of value in cases where it is the sole pathogen isolated. In mixed cultures and after the first weeks of lactation, it may only be a contaminant hence the importance of ensuring hygienic sample collection procedures on farm. The results of *in vitro* antimicrobial susceptibility testing for *E. coli* isolates from bovine milk samples submitted to the DAFF and AFBI laboratories are shown in Figure 107 and Figure 108.

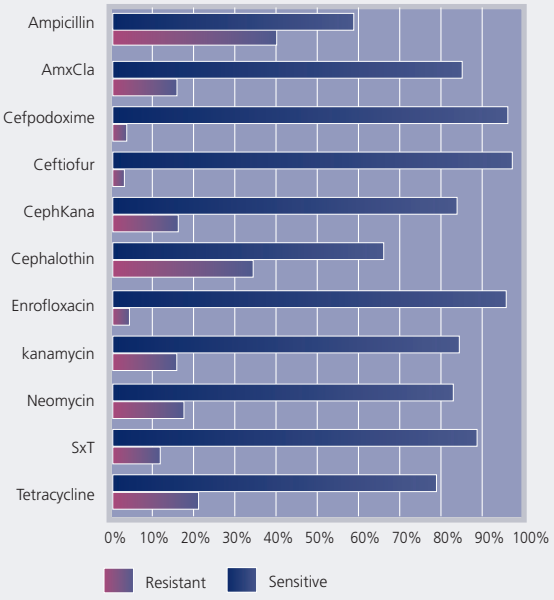


Figure 107: Antimicrobial susceptibility in *E. coli* isolates from bovine milk submissions to DAFF in 2010 (n = 370) (AmxCla = amoxicillin clavulanate; CephKana = cephalexin + kanamycin; SxT = sulphamethoxazole trimethoprim).

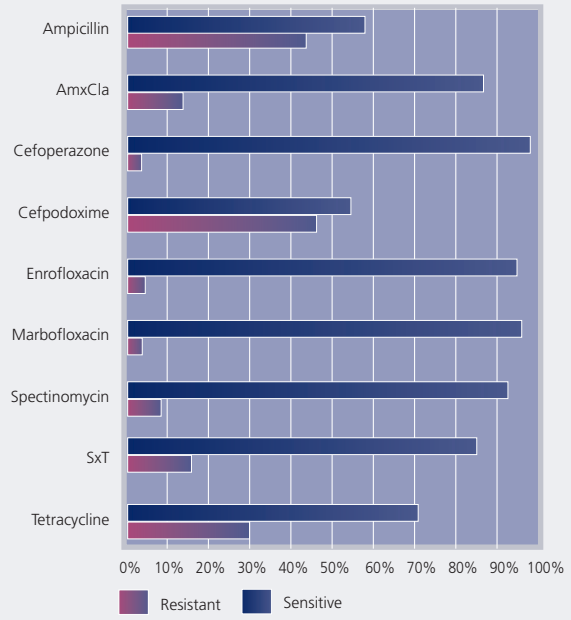


Figure 108: Antimicrobial susceptibility in E. coli isolates from bovine milk submissions to the AFBI laboratories in 2010 (n = 355[8]) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

DAFF isolates showed significant resistance to extended spectrum beta-lactam (ampicillin) and first generation cephalosporin (Cephalothin) drugs. A similar pattern of resistance was observed in AFBI to ampicillin and other antibiotics common to both panels. Cefpodoxime resistance was higher in AFBI *E.coli* mastitis isolates. Cefpodoxime is used as a marker antibiotic for detecting extended spectrum beta lactamase (ESBL) resistance in *E.coli* (Figure 109). However further screening and molecular based tests are required on individual samples to confirm ESBL status. *In vitro* susceptibility results for kanamycin and the combination cephalexin plus kanamycin in the DAFF laboratories were similar at about 85 *per cent*.

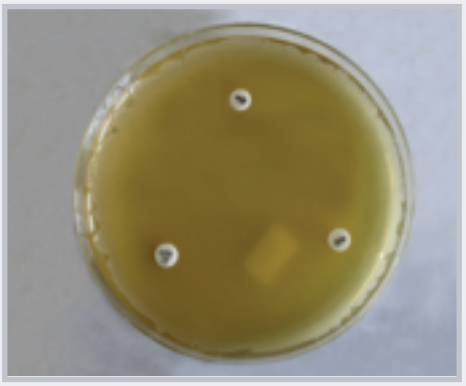


Figure 109: ESBL *E. coli* isolate without a zone of clearance around a cefpodoxine (cpd10) impregnated disk (Photo: Jim O' Donovan).

[8] Samples tested as intermediate sensitivity have been excluded from analysis

Clinical chemistry

Copper analyses

Copper (Cu) is an essential trace element and a cofactor of several enzymes and proteins. Typical clinical signs of copper deficiency include growth retardation, increased susceptibility to infections (due to a depressed humoral and cell mediated immune response), anaemia, abnormal bone growth, diarrhoea, reproductive failure, vascular abnormalities, and at extremely low concentrations, recumbency and death may occur. Growing cattle are particularly susceptible to copper deficiency but older ruminants may also be affected. Secondary deficiency may occur in the face of high molybdenum and/or iron intakes. While the concentration of copper in liver tissue is the best marker of the copper status of the animal, the determination of copper in plasma or serum is a useful practical approximation. A bovine serum copper level of nine micromoles per litre or less is suggestive of copper deficiency.

When assessing the copper status of a herd it is important to take samples from a number of animals in each age group. Individual healthy rapidly growing animals may occasionally have low blood copper levels in spite of sufficient copper intakes. This can occur as the liberation of copper stores from the liver may not be sufficient to maintain blood levels within the normal range but yet is unlikely to cause disease.

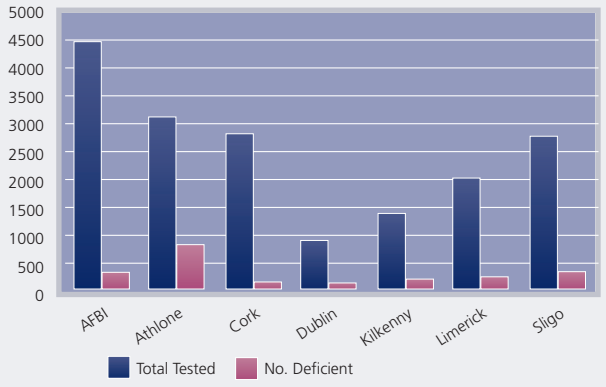


Figure 110: The number of bovine samples analysed for determination of copper status and the numbers of those samples identified as deficient in AFBI (n=4,441) and VLS (n=12,912) laboratories in 2010.

The results displayed in Figure 110 show that copper deficiency remains a problem throughout the island of Ireland. There is some variation in results for copper analysis among laboratories which is likely to be explained by regional differences in soil composition and animal management practices. It is possible that the results may indicate an increased awareness among veterinarians and farmers of the importance of testing for copper levels in areas where it is perceived as an issue affecting animal performance.

Presented below is an investigation where copper deficiency proved central to the problems experienced.

Mineral deficiency-related neonatal mortality in a suckler herd

Athlone RVL investigated high levels of mortality in a thirty five cow spring calving suckler herd. The problem was confined to the two to ten-day-old age group, and was associated with neonatal scour. Previous laboratory submissions identified *Cryptosporidium parvum,* rotavirus and variable ZST results. Low cobalt, marginal copper and low ZST were found in a three-day-old calf which died of septicaemia.

The farmer fed minerals for a few weeks before calving, and all cows received copper and selenium boluses. Cows were vaccinated against leptospirosis, BVD and neonatal enteritis. All calves normally ingest colostrum themselves, but colostrum is administered if they do not.

Visually the stock appeared to be in good condition, apart from calves which had been sick earlier in the spring. Those calves failed to thrive and had dry coats. Land was considered 'heavy' and prone to flooding. Much of the land has been reseeded over the last four to five years. Housing has been from early September over the previous winters owing to the adverse weather.

Clinical pathology revealed that serum samples were low in magnesium and copper (serum copper mean 6.0 µmols/litre, range 1.9-13.3 µmols/litre). Previous submissions had raised concerns in relation to poor transfer of colostral immunity. However some of the previous necropsy submissions had been diagnosed with septicaemic conditions despite adequate ZST results which suggested poor colostral immunity was unlikely to be a factor. The low serum copper concentrations encountered in spite of supplementation were considered highly significant. Molybedenum and sulphur were suspected as significant antagonists to copper uptake, based on the heavy nature of the soil. Reduced immune function is a well-recognised impact of copper deficiency. Considering the history and poor response to various treatments, the extremely low copper values recorded were considered as having a major contribution to the problems encountered. Copper oxide needles were recommended on the basis of their relatively high bioavailability.

The low magnesium levels were considered significant and the farmer was advised to supplement magnesium urgently. A further concern was that concurrent copper deficiency and hypomagnaesemia could lead to grass tetany in calves, as well as grass tetany in cows. This case clearly shows that copper can lead to impaired immunity. Until such impaired immunity is addressed health problems will continue. Symptomatic treatment will struggle to control such problems.

Selenium analyses

Selenium (Se) is an essential trace element for mammals and plays an important role in the cellular antioxidant defence mechanism through selenium-dependent enzyme systems and selenium-binding proteins. Selenium is an integral part of the structure of the enzyme glutathione peroxidase (GSH-Px) which plays a major role in inhibiting peroxidative cellular damage from free radicals and maintaining the integrity of cellular membranes. GSH-Px activity is under nutritional control through the intake of selenium and is used as an indication of selenium status.

Selenium deficiency in cattle can result in nutritional myodegeneration (white muscle disease); retained placenta, infertility, and can indirectly interfere with the normal functioning of the immune system. Determination of blood selenium concentrations allows identification of potential selenium deficiencies and evaluates the adequacy of supplementation protocols. Nutritional selenium status in cattle can be determined by either measuring selenium concentration in whole blood or plasma or GSH-Px activity in whole blood. Plasma selenium indicates current dietary intake and is likely to rise quickly following supplementation. GSH-Px activity reflects incorporation of selenium into erythrocytes during erythropoiesis and therefore is an indicator of selenium status sometime earlier than that at the time of sampling.

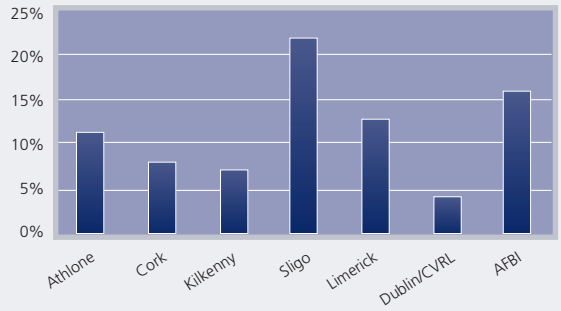


Figure 111: The proportion of bovine blood samples recorded as selenium deficient in AFBI (n=4165) and DAFF (n=7190) laboratories in 2010.

Approximately 98 *per cent* of the GSH-Px activity in peripheral blood is associated with the erythrocytes, and approximately 73 *per cen*t of the blood selenium is contained in the cellular component of blood. GSH-Px activity in red blood cells is wholly selenium dependent and is therefore a good estimation of selenium status. However, since the GSH-Px level takes weeks to rise or fall following a dietary change, current dietary deficiencies or excesses may be missed.

Selenium levels in Irish soils can be quite variable depending on the geographic area area, resulting in animals eating grass based diets being susceptible to selenium deficiency in some areas. The proportion of blood samples recorded as being indicative of deficient selenium status is displayed for each laboratory in Figure 111. The comparison of the results of selenium analyses needs to be interpreted with caution due to differences in the methodologies and tests employed in each of the laboratories; however the comparison here is of the proportion of samples deemed deficient in each catchment area irrespective of the methodology used (e.g. GSH-Px or whole blood selenium analyses) and is therefore comparable on that basis. The laboratories in Northern Ireland (AFBI) and Sligo RVL show the highest proportion of selenium deficient samples tested. It is probable that the marked variation in pastures, soils, supplementation, management factors, different production operations, etc may account for the variability in the results obtained in different parts of the island of Ireland.

Iodine analyses

The DAFF Regional Veterinary laboratories in Ireland have discontinued iodine analysis. Plasma inorganic Iodine is used to assess iodine status in AFBI. It reflects current iodine intake.

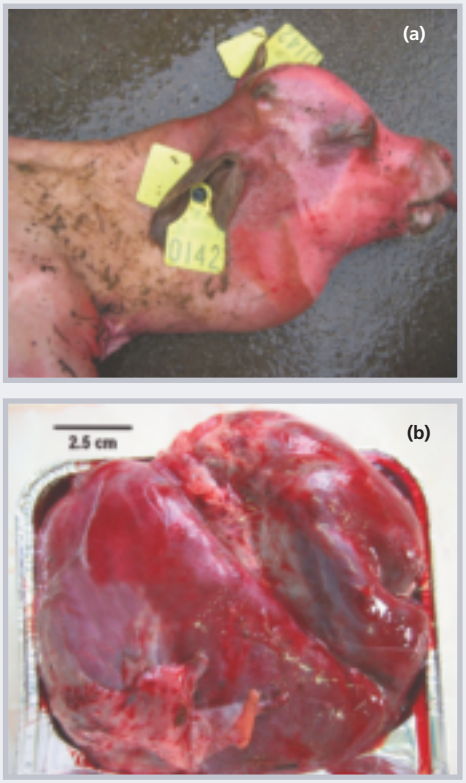


Figure 112: (a) Goitre in a newborn calf (b) the enlarged thyroid gland following dissection from the same calf (Photos: Colm Ó Muireagáin).

Deficiency of iodine in livestock leads to decreased production of the hormone thyroxine which plays a central role in metabolism. Iodine deficiency in Irish cattle herds is associated primarily with reproductive disorders and impaired viability in young calves (Figure 112). Deficient cows suffer decreased fertility, uterine infections, embryonic loss, stillbirths and an increased incidence of retained placenta. Calves born to deficient cows suffer an increased incidence of neonatal disease due to neonatal weakness, inability to suck, and decreased immunity which often leads to a higher prevalence of other infectious diseases such as diarrhoea or pneumonia.

It is important that animals chosen within a herd for sampling are currently receiving a diet which is representative of the diet of the herd. In selecting animals for sampling, animals which have a low dry matter intake or which have received recent supplementation should be avoided. Results should be interpreted on a herd basis as an individual low result does not necessarily mean 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 intake on the day of sampling was low and prolonged intakes of this level are likely to result in deficiency, if they have not already done so.

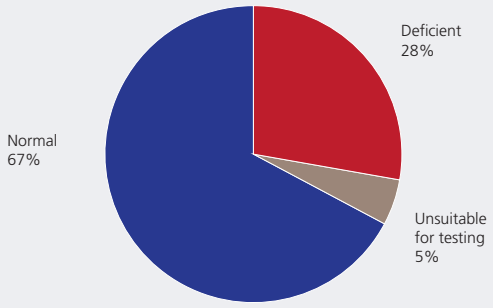


Figure 113: Iodine status of bovine samples tested in 2010. Samples with values below 60 g/l are deemed to be deficient (n=3148).

Figure 113 demonstrates that plasma inorganic iodine levels were below the reference range in 28 *per cen*t of samples tested in 2010. While these results do not prove that iodine deficiency was contributing to disease in these animals, they indicate that the diets of a high proportion of animals tested did not contain sufficient iodine to meet their requirements on a long term basis and would put them at higher risk of developing signs of deficiency in the future. Supplementation in these cases should be considered.

Haematology testing in the veterinary laboratories

Full haematological examination of blood samples from farm animal species is provided by all the laboratories of AFBI and DAFF. Haematological examination may be performed to assess general health, to aid in a diagnosis (e.g. tick borne fever, babesiosis or BNP), to assess the animals' ability to fight infection or to assess the progress of a disease. As abnormal findings on a haemogram are often non-specific it is important that findings are interpreted in conjunction with a thorough history and consideration of the clinical signs. Blood should be drawn from the animal at rest with the minimal degree of stress, to minimise physiological variations in cell counts, and should be submitted as soon as possible to the laboratory.

Babesiosis, also called redwater, is a tick-borne disease caused by *Babesia divergens* which infects red blood cells. Ticks acquire *Babesia* infections from feeding on infected animals and then pass the parasite on to other healthy animals at a subsequent blood meal. The infection in ticks can be also passed onto the next generation through the eggs.

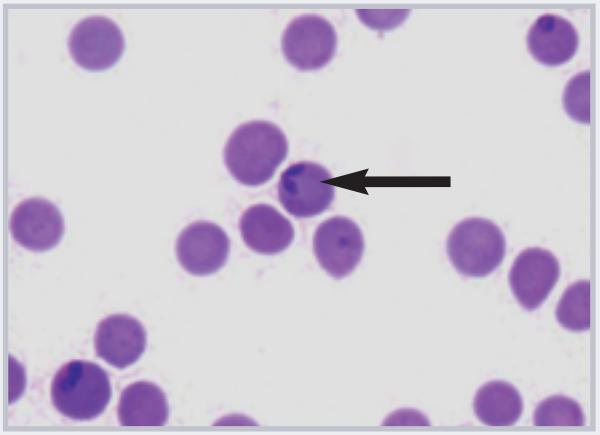


Figure 114: A blood film showing *Babesia spp.* merozoites (arrow) in the red blood cells (Photo: Jim O Donovan).

Clinical signs of babesiosis include fever, anaemia, loss of appetite, constipation and the charasteristic haemoglobinuria from which the name 'red water' comes. In severe cases, animals may die within one or two days of the appearance of clinical signs. However, in less severe cases, animals may recover with, or sometimes without, treatment. Clinical diagnosis is based on a history of grazing on pasture known to harbour ticks and the recognition of clinical signs. Diagnosis can be confirmed by haematological examination of a blood smear where the haemoparasites can be seen in the red blood cells (Figure 114).

To control babesiosis the introduction of naïve cattle into endemic areas should be avoided. It is also important that herdowners implement a tick control programme or combine tick control with chemoprophylaxis.

Proficiency testing in AFBI and DAFF veterinary laboratories

In Ireland, DAFF's five Regional Veterinary Laboratories and Clinical Pathology Section, Backweston (for Dublin RVL), subscribe to four Proficiency Testing (PT) Schemes. Three schemes are operated by the Animal Health and Veterinary Laboratories Agency (AHVLA) (haematology, microbiology and tissue lead and copper). The Randox International Quality Assessment Scheme (RIQAS) offers proficiency testing of proteins, metabolites, liver enzymes, major and trace element tests. All of the Regional Veterinary Laboratories also follow an internal quality control programme using standard solutions and controls.

In Northern Ireland, AFBI participates in a number of PT schemes which include microbiology culture and isolation as well as specific PT schemes for *Bacillus anthracis, Taylorella equigenitalis, Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and antibiotic sensitivity testing. Other PT schemes include *Mycobacterium paratuberculosis* serology, *Trichinella spiralis* detection, BVD virus antigen (milk and serum), *Chlamydophila abortus,* Infectious Bovine Rhinotracheitis (milk and serum), Bovine Parainfluenza type 3 (PI3) and Bovine Respiratory Syncytial Virus (RSV) (serology and IFAT), rotavirus and coronavirus detection, Porcine Parvovirus (PPV) serology and *Neospora* serology. Clinical chemistry PT schemes include tissue copper and tissue lead analysis while parasitological PT schemes include worm and fluke egg detection. AFBI also participates in a haematology PT scheme.

Participation in these schemes by both AFBI and DAFF laboratories shows a commitment to improving performance and maintaining a good reputation for delivering high quality, reliable and accurate results. It is an independent verification of testing practices.

Proficiency testing for bacteriology involves the dispatch of freeze-dried material containing a known pathogen (and possibly also containing contaminants) being sent to all participating laboratories accompanied by a limited case history. These are circulated to participating laboratories at agreed intervals during the year. Using normal routine procedures the participants will make their choice of tests to try to determine the organisms present. Each laboratory, following an attempt to identify the pathogen, is then scored on the basis of its results.

Proficiency testing for the haematology and biochemistry components involves each laboratory testing sample materials for certain specified constituents (e.g. copper, calcium). The returned results for all of the laboratories in the scheme are assessed by the external proficiency supplier (i.e. AHVLA or RIQAS) and, after obvious 'outlier' values have been discarded, a consensus mean is arrived at. Each laboratory then receives its own individual results - together with a statistical analysis showing how its performance compares to the mean for the peer group. This process allows any laboratory with a result of two or more standard deviations from the consensus mean for any one component to investigate its analytical procedures. Participation in PT schemes is beneficial in excluding the possibility that laboratory results could be biased in a particular direction - and is one of the requisites for accreditation.

Procedures for the submission of samples for laboratory investigation

Compliance with correct procedures for the packaging of samples being submitted to the Laboratory Service is key to protecting the health and safety of laboratory staff and postal workers. The responsibilities of the consignor are laid down in the European Agreement for Transportation of Dangerous Goods Regulations (ADR). The current version can be viewed at:
http://live.unece.org/trans/danger/publi/adr/adr_e.html

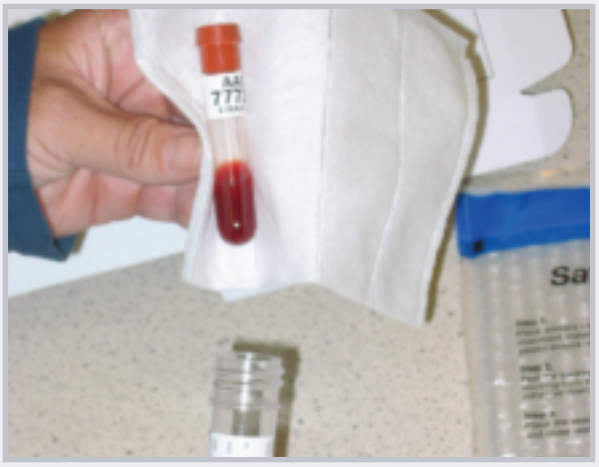


Figure 115: Wrap the sample in absorbent material and place in a leak proof plastic container.

Samples should be packaged in three layers. The primary container, which holds the specimen, should be wrapped in absorbent material and placed in a leak proof plastic container (Figure 115).

Figure 116: Place the leak proof plastic container in an outer padded envelope.

This is then placed in the outer padded envelope and sealed (Figure 116).

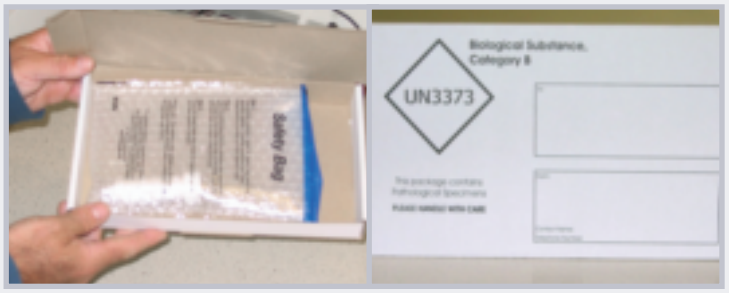


Figure 117: The words "BIOLOGICAL SUBSTANCE, CATEGORY B" and a "UN 3373" diamond must be on the outside of the package.

The words "BIOLOGICAL SUBSTANCE, CATEGORY B" and a "UN 3373" diamond must be on the outside of the package (Figure 117).

Contact details for suppliers of appropriate packaging materials may be obtained from the Institute of Packaging Ireland (also known as the Irish Packaging Society).

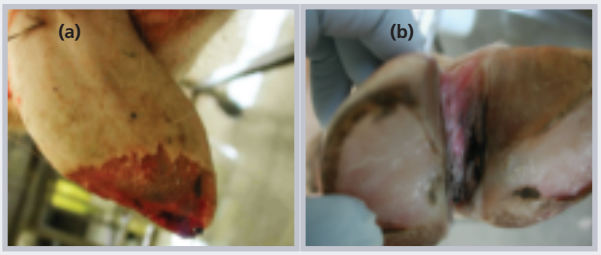
Surveillance for Office International des Epizooties (OIE) listed disease

The AFBI and DAFF laboratories are centrally involved in the surveillance for exotic or novel animal diseases in Northern Ireland and Ireland respectively. The island of Ireland has intrinsic advantages in the prevention of the incursion of exotic diseases onto her shores. However, the vigilance of the surveillance networks which operate in both Northern Ireland and Ireland are vital in providing mutual benefit to the national herd and flock of both jurisdictions.

Foot-and-Mouth disease

Figure 118: A photograph illustrating multiple ulcers on the dental pad of the oral cavity, a predilection site of ulceration in sheep infected with FMD (courtesy of Keith Dalzell, DARDNI).

There have been no cases of foot-and-mouth disease on the island of Ireland since 2001. However, surveillance is on-going in both Northern Ireland and Ireland to prevent the introduction of this highly contagious disease of cloven hooved animals. The incubation period of the disease is between one and twelve days, after which the classical clinical findings of high fever and vesicle formation in the mouth (Figure 118) and on the feet can occur. The disease has very high morbidity but mortality is low.



Figures 119 (a) Loss of epithelium on the tongue (b) interdigital lesion in the foot of a six-month-old calf which was suspected of being infected with FMD (Photos: Eoin Ryan)

Dublin RVL dealt with a suspect case of FMD in a six-month-old calf during 2010. The calf was one of a number on the farm frothing at the mouth and stamping their feet. The findings on examination included loss of epithelium at the tip of the tongue, extending 3-4cm caudally with firmly attached bordering epithelium (unlike in classical FMD lesions) (Figure 119 (a)) and interdigital ulceration (Figure 119 (b)). Following a full investigation FMD was ruled out.

The island of Ireland continues to be free of foot-and-mouth disease.

Bluetongue

Surveillance for Bluetongue in Northern Ireland and Ireland is ongoing and is conducted on all susceptible animals (cattle and sheep) imported from countries that have not been declared disease-free by the EU. A random sample of susceptible cattle from Northern Ireland and Ireland is also tested.

In Northern Ireland during 2010, a total of three thousand nine hundred and sixty eight serological tests (three thousand and one NI random sample surveillance and nine hundred and sixty seven post-importation samples) and seven thousand one hundred and two PCR tests following importation was performed by the Immunodiagnostic and Virology Branches of Veterinary Sciences Division, AFBI. All were negative for BT virus.

In Ireland DAFF Virology Division in CVRL tested eight hundred and thirty five cattle following importation for BTV antibody with five hundred and fifty seven (67 *per cent*) proving antibody positive while a further seven hundred and six cattle were tested for BT virus, all of which were negative. A further four hundred and eighty five sheep were tested for BT antibody following importation with three hundred and seventy five (77 *per cent*) proving antibody positive. Four hundred and forty one sheep were tested for BT virus, all of which were negative. Eighteen cattle and six sheep which were live clinical suspects and five cattle and three sheep which were suspected on post-mortem examination were identified by the Regional Veterinary Laboratories, all of which were negative. Random surveys were also conducted by DAFF, testing one thousand seven hundred and eighty cattle sera from three hundred and fifty six herds and seven hundred and six sheep sera from one hundred and thirteen flocks with all proving negative for BTV antibody. There were thirty seven sheep samples with inconclusive results on the ELISA in 2010 which required a second confirmatory ELISA test. All proved negative on this second BT ELISA.

The island of Ireland continues to be Bluetongue-free.

Avian influenza

As part of the annual avian influenza (AI) survey of poultry premises across the UK, AFBI performs a serological survey of poultry flocks in Northern Ireland for antibodies against AI H5 and H7 viruses. The survey includes fowl, turkeys, ducks and geese. During 2010, nine hundred samples were tested under this surveillance programme. All samples proved negative for AIV antibodies. In addition, thirty seven samples from poultry flocks and forty seven from pigeons and other birds were also tested by real time RT-PCR for avian influenza virus. All samples tested negative for the presence of AI virus.

An active programme of surveillance of wild birds for avian influenza was suspended in Northern Ireland for 2010 but wild bird 'die-offs' continued to be investigated. Carcases from wild birds found dead and reported to DARD in Northern Ireland were examined by AFBI pathologists and tested for AIV by real time RT-PCR testing. Forty samples in total were tested, all of which were negative.

In Ireland, a total of two hundred and eighty five specimens from wild birds and three hundred and eighty four specimens from commercial flocks were tested by DAFF using real time RT-PCR, and / or virus isolation, for avian influenza virus and reported "online" as required by the EU Commission. In addition, twenty two thousand three hundred and sixty four samples from commercial poultry flocks were serologically examined for AI as part of two major national surveys and to satisfy requirements for movement and trade. All tests were negative.

Porcine influenza

In Northern Ireland, one hundred and fifty nine samples were tested by the Indirect Flourescent Antibody Test (IFAT), of which four were positive. The IFAT test is an pan-influenza test and all samples that are positive for influenza by IFAT are subsequently tested for the influenza pandemic strain by PCR tests. Fifty eight samples were tested by RT-PCR, of which fifteen were positive for the pandemic strain H1N1 2009.

In Ireland twenty eight carcases were tested by DAFF for porcine influenza pandemic H1N1 2009 strain by PCR and five of these were positive. All five animals were from the same farm. An additional forty seven sera were examined by the haemaglutination inhibition test (HAI). Of these eleven were positive, one for H3N2 and ten for H1N1. Serology does not differentiate the pandemic strain from the classical swine H1N1 strain.

Newcastle disease

In Ireland a total of two hundred and forty seven samples were tested by DAFF using PCR and three hundred and eighty four were tested using virus isolation for Newcastle disease. All results were negative. In addition, serology for antibodies to Newcastle disease virus was performed on one thousand two hundred and ninety seven sera.

In 2010 in Northern Ireland a total of ninety two tissue samples were tested by PCR for Newcastle disease virus. All test results were negative.

In addition a total of eighteen thousand, three hundred and thirty-two samples from commercial flocks were tested serologically for Newcastle disease by AFBI.

Classical swine fever

Classical swine fever is caused by infection with classical swine fever virus (CSFV) (previously called hog cholera virus). The effect of different CSFV strains varies widely, leading to a wide range of clinical signs. Clinical signs include fever, immunosuppression, chronic diarrhoea, skin lesions, convulsions, and in young animals, death may occur. The clinical signs are indistinguishable from those of African swine fever. Infected piglets born to subclinically infected sows help maintain the disease within a population. There have been no cases of classical swine fever in Ireland since 1958. AFBI maintains a level of surveillance by testing tissues from pigs submitted for post-mortem examination by immuno-fluorescence test (IFAT). During 2010, two hundred and thirty six samples were tested by IFAT in Northern Ireland and found to be negative. In Ireland seven thousand nine hundred and sixty five CSF ELISA tests and eight CSF PCR tests were performed in 2010. All were negative.

Bovine Spongiform Encephalopathy (BSE)

Surveillance for BSE is both active and passive. Active surveillance involves the routine sampling of fallen animals in knackeries and the sampling of animals over a given age in meat factories, while passive surveillance refers to the notification of suspect clinical cases of BSE by veterinary practitioners to the veterinary service.

In 2010 in Ireland, DAFF confirmed BSE in two animals, both of which were identified by active surveillance and were confirmed by the National Reference Laboratory (NRL). In Ireland the age limit for the compulsory rapid test sampling of animals in meat factories for BSE was increased to six years of age on the 1st July 2011, while the age limit for BSE rapid testing remains at four years of age for all fallen animals.

Thirty five clinically suspect cases were also examined at regional veterinary laboratories and samples were sent to the NRL in Backweston for confirmatory diagnosis. None of these were confirmed as positive for BSE. Table 11 shows a breakdown of the histopathological diagnoses reached for each of these cases:

H&E Result	Number of Cases
Listerial Encephalitis	5
Hepatic Encephalopathy	3
Neoplasia	2
Viral Encephalitis	1
Cerebrocortical Necrosis	1
No Specific Findings	23

Table 11: Histopathological Diagnoses for BSE Clinical Suspects in Ireland's National Reference Laboratory (DAFF) in 2010.

AFBI conduct both rapid test surveillance and confirmatory diagnosis (Histopathology, Immunohistochemistry, and Western Blot) of BSE and Scrapie in Northern Ireland on behalf of DARD in accordance with EU Regulation (EC) 999/2001 and the Transmissible Spongiform Encephalopathies Regulations (Northern Ireland) 2008.

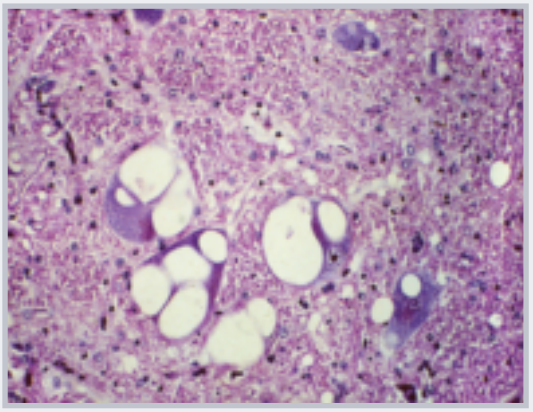


Figure 120: A photomicrograph of BSE in a H&E section of a bovine brain showing the typical vacuolation associated with BSE infection (Photo: AFBI).

In 2010 there were no BSE positives detected by AFBI as part of the active surveillance programme. There were a total of six clinical suspect submissions, all of which were confirmed as negative for BSE.

Scrapie

In 2010 twenty four cases of scrapie were confirmed by the NRL in Ireland. Of these twenty four, twenty two were classified as classical scrapie, with the remaining two being classified as atypical scrapie.

The twenty two confirmed cases of classical scrapie came from nine separate flocks; seventeen were identified through active surveillance and the remaining five were identified as clinical suspects (passive surveillance).

Tissues from both atypical cases were sent to the NRL from rapid testing laboratories i.e. they were detected through active surveillance programmes.

DAFF identified seven new flocks with scrapie in Ireland in 2010; five with classical scrapie and two with atypical scrapie. Co-existence of classical and atypical scrapie was not detected in any flock during 2010.

All samples tested by discriminatory western blotting (to differentiate between scrapie and BSE in sheep) were reported as "scrapie-like" in 2010.

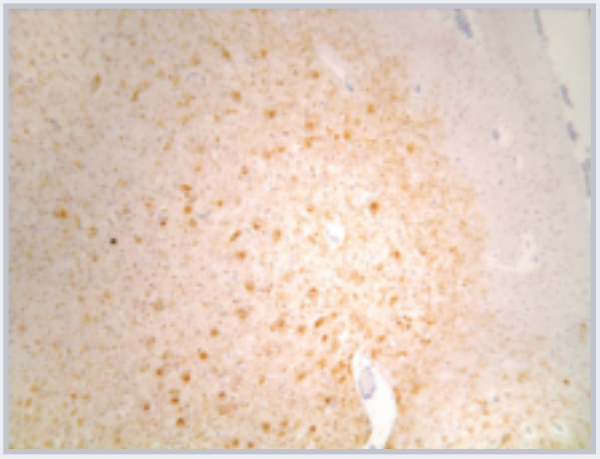


Figure 121: Positive (brown) immunohistochemistry staining for scrapie in an ovine brain (photo: AFBI).

In Northern Ireland the annual Scrapie Active Surveillance programme of the Department of Agriculture and Rural Development for Northern Ireland (DARDNI) encompasses the following :

- a pro rata (UK) human consumption sheep survey (minimum of six hundred slaughtered animals over eighteen-months-old)
- a pro rata (UK) sheep fallen stock survey (random sample of approximately seven hundred sheep over eighteen-months-old)
- a fallen goat survey (all animals over eighteen-months-old)
- a fallen sheep survey from Scrapie Monitored Flocks and flocks restricted under the Compulsory Scrapie Flocks Scheme (all animals over eighteen-months-old)
- an annual sample of cull sheep (end of productive life) submitted for human consumption from Compulsory Scrapie Flocks.

In 2010 there were no submissions in Northern Ireland for confirmatory diagnosis for scrapie in either clinical suspects or active surveillance samples.

A selection of farm investigations

The investigatory and advisory role of the veterinary laboratories in cases of novel, exotic or unresolved disease syndromes is an important part of their surveillance function, as well as providing a valuable support to food animal production. Veterinary pathologists of AFBI and DAFF are available to advise on animal disease and production problems. On occasion, laboratory pathologists may conduct on-farm visits to investigate cases where exotic, zoonotic or novel diseases are suspected. Presented below is a selection of summaries of farm investigations conducted by AFBI and DAFF pathologists during 2010.

Dwarfism outbreaks in calves

In 2010, all the veterinary laboratories on the island of Ireland reported an increased prevalence of calves born with congenital chondrystrophy (disproportionate dwarfism) in recent years.

Kilkenny RVL investigated eight herd outbreaks involving fifty dwarf calves. The mean prevalence of dwarfism was 13 *per cent* of calvings in the affected herds, with a range 2.4 *per cent* to 20 *per cent*. One farm had seen cases in two previous years and two other farms had recorded cases in only one other year. Forty five *per cent* of dwarf calves were born to first calvers and 30 *per cent* to second calvers.

Figure 122: Shortened fore limbs on an affected Charolais calf (Photo: Dónal Toolan).

Cases were defined as disproportionate shortening of the limbs (chondrodystrophy) with or without joint laxity (hocks that appear sickle shaped in lateral view or hyper-extended fetlocks) (Figure 122). However on visiting farms, it was found that all eight farms had chondrodystrophic dwarf calves. Some herds reported that some calves were born with severe joint laxity but normal bone length.

Such calves were often unable to stand unaided but, if assisted to suckle for up to two or three weeks, they tended to strengthen and their locomotion became normal. This suggests a wide spectrum of clinical signs with this condition, making it difficult to define the syndrome or to recognise all affected animals by inspection. The following clinical signs were reported on the eight farms visited (not necessarily in all affected animals); hyperextension of fetlocks on seven farms; carpus or hock almost on ground on five farms; sickle hocks on three; bowing of forelimbs on three; rotation of limbs on three; and undershot jaw on two.

Most herds were fed on grass silage only during the winter, with one herd feeding 4 kg sugar beet plus correct balancing minerals for the month of December; one farm fed hay in March after silage ran out and another used some hay (no details); at least one thin cow that had been fed 2-3 kg concentrate from November 1st until February 1st went on to deliver a dwarf calf. Two herds used baled silage only; two used pit silage and four used a mixture. No herds analysed their silage but none thought that quality was poorer than in other years. The conventional advice given to control the disease is to replace 30 *per cent* of the silage dry matter by concentrates or hay. However despite this, some affected herds were feeding cows solely on silage during the winter.

A similar syndrome has been reported worldwide over many decades. Like previous reports, in this study males and females were equally affected; suckler herds were more frequently affected than dairy herds; affected calves tended to be born towards the end of the spring calving period and often in a cluster over a short period. Affected calves were not born prematurely. Cases occurred with both natural service and artificial insemination. A wide variety of beef breeds was affected involved, with Charolais well represented, but affected calves were also born to dairy breeds.

Mortality after acute disease in lambs

Sligo RVL investigated an outbreak of mortality in lambs following acute illness. Acute Louping ill and pasteurellosis (*Mannhaemia haemolytica*) (Figure 123), were diagnosed in four lambs presented for post-mortem examination. The lambs were deficient in cobalt and there were fulminant orf lesions on the mouths, ears and limbs; some with secondary bacterial infections. There were significant heavy infestations with nematodes. There was evidence of tick infestation. All the lambs had focal abscesses in the axillae where they were said to have been injected with a clostridial vaccine. It was immediately advised that cobalt be repeatedly given orally to all the affected lambs. Systemic antimicrobial therapy was recommended for lambs diagnosed with pneumonia, while topical treatment was recommended for lambs with orf lesions.

During the course of the field investigation, it transpired the affected lambs had been moved to a lush pasture on the mountain before the disease outbreak. The group were blood sampled on two occasions and faecal samples were analysed for parasites.

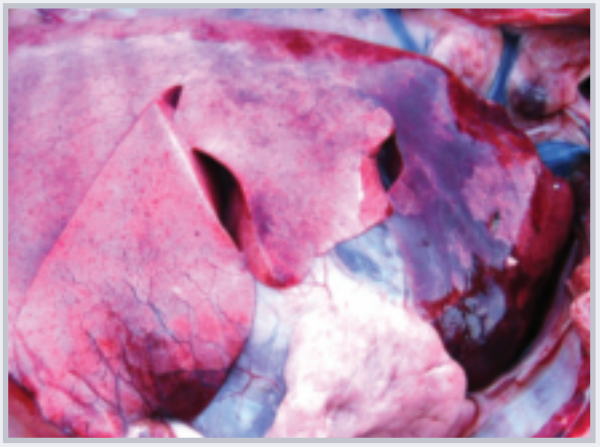


Figure 123: Pneumonia lesion in a lamb from which *Mannhaemia haemolytica* was cultured (Photo: Colm O'Muireagáin).

Two home-reared lambs that had never been on the mountain pasture had no detectable antibodies to louping ill virus, which led to the conclusion that this virus was present in the tick population on the mountain pasture. In Ireland, it is thought that there are two periods of major tick activity; spring and autumn. Lambs being pastured on high risk ground should ideally be vaccinated against louping ill virus. Another option would be to treat the lambs with an acaricide to prevent tick infestation before introducing them to the area. This would also protect against other tick-related conditions and therefore was recommended in addition to vaccination. Cobalt supplementation was advised for all lambs, especially when moved to mountain pasture. The cobalt deficiency was suspected of adding to the severity of the infectious and parasitic conditions identified. Preventative measures to address the worm and potential fluke burdens were advised through strategic dosing. Increased hygiene at clostridial vaccination was advised to avoid the abscesses in the axilla (which is not a recommended injection site in any event).

An investigation of milk drop in a dairy herd.

In October 2010 AFBI Stormont was asked to investigate a case of milk drop in a spring calving dairy herd of sixty milking cows. Cows presented with decreased milk yield, lethargy and pyrexia.

Udders of affected animals appeared normal, were not swollen or painful but there were occasional clots present in the milk. Individual cases responded to broad spectrum antibiotics and milk yield returned to normal ten to fourteen days after the initial milk drop. Microbiological culture of milk samples and leptospirosis serology on blood samples performed in another laboratory had yielded negative results.

Initial investigations by AFBI involved testing of a small number of blood samples from animals that had presented with clinical signs in the previous three weeks for a variety of differential diagnoses. One sample tested positive by *Leptospira* ELISA while all others tested negative. Since there was no history of vaccination for leptospirosis in the herd and in light of the specific clinical signs observed, a microscopic agglutination test (MAT) for *Leptospira Hardjo* was performed on these samples at the OIE *Leptospira* reference laboratory in AFBI Stormont, in which all samples tested positive. A positive MAT and negative ELISA indicated that the animals tested were likely to be in the acute stages of a leptospirosis infection. Results of further blood samples indicated animals throughout the herd were at various stages of the seroconversion process. Animals that had been kept on an outfarm for the preceding three months tested negative for leptospirosis antibodies indicating that the source of the infection was likely to have been introduced in the intervening period.

A recently purchased stock bull used to 'mop up' repeat breeders in the main dairy herd had tested positive for leptospirosis antibodies both by ELISA and MAT but could not be definitively determined as the source of the infection, as his vaccination status was unclear. However as no other animals had been introduced to the herd in the recent past, and seronegative animals on the outfarm had not had any access to the bull following separation from the main herd, it was determined that the bull was a potential source of infection.

Advice given by the laboratory was to immediately vaccinate all cattle on the farm for leptospirosis. The vaccination strategy was intended to reduce cow to cow transmission of the disease by reducing the numbers of leptospires being shed by infected animals and increasing overall herd immunity. The farmer was advised that pregnant cows in the most at risk group i.e. greater than 6 months pregnant could be treated with streptomycin to minimise abortion risk. The abortion rate in this herd was mitigated by the fact that it was a spring calving herd so that at the time of initial outbreak most cows were in early-to-mid gestation and that the referring vet and farmer were willing to take immediate action to diagnose and treat the problem. The farmer was made aware of the serious zoonotic risk posed by such an outbreak and was advised that strenuous efforts should be made to reduce risk of exposure to himself and farm staff.

This case and subsequent investigation highlights the important co-operative roles played by farmer, submitting veterinary practitioner and laboratory in diagnosing and controlling a disease outbreak.

An investigation of recurring milk drop in a dairy herd

Kilkenny RVL investigated a herd with a two year problem of milk drop and respiratory signs in cows, with many individual animals being affected more than once. Milk yield in some cows recovered in a week or so, others took three weeks, while others never recovered and went dry early. Many cows had respiratory signs, with cough, nasal discharge and rapid breathing. A diagnosis of IBR had been made clinically but twice-yearly IBR vaccination did not control the problem.

Sero-conversion to IBR gE was demonstrated in paired sera from a cow presented for examination at a farm visit. The cow had an elevated temperature of 104ºF a few days earlier. This raised suspicions of the involvement of wild IBR virus. Some animals affected on earlier occasions had milk drop without obvious respiratory signs, raising suspicions of the involvement of other pathogens. As well as that, half of the blood samples taken in spring of the previous year were hypocalcaemic and one third were hypomagnesaemic. *Salmonella* Dublin was isolated a couple of months before the laboratory visit from a maiden heifer. A month after the visit, S. Dublin abortion was confirmed in a number of cows. Many faecal samples contained rumen fluke eggs. No evidence of ketosis or recent exposure to leptospirosis was detected and body condition scores and grass quantity and quality seemed adequate.

It was considered likely that the milk drop problem had more than one cause and that this could explain why certain cows had recurring problems. This emphasised the need for accurate diagnosis to determine the cause of the milk drop in each case. Careful clinical examination along with the following sampling protocol was suggested for early cases: nasal swabs for respiratory viruses PCR, *Mycoplasma bovis* and routine culture; blood samples for IBR gE serology, calcium and magnesium and faecal samples for *Salmonella* culture. The importance of choosing animals in the earliest stage of disease for sampling for PCR for respiratory viruses was stressed. Demonstration of sero-conversion to IBR gE in paired blood samples is a useful means of confirming IBR infection if virus isolation is negative and can be used even in animals that have received IBR marker vaccine. Nutritional advice to ensure that correct calcium/magnesium status was maintained was recommended.

The importance of biosecurity measures in reducing spread of infection between animals was stressed. Clinically affected animals were to be isolated (including those with milk drop, even if respiratory signs were not obvious). It is important to provide sufficient designated calving and isolation boxes.

This case study clearly showed that milk drop syndrome can have a multi-factorial aetiology. It emphasises the need for a holistic approach in dealing with the problem. The value of good biosecurity, good husbandry and preventative medicine are also highlighted.

Neonatal calf diarrhoea and forelimb paresis

Kilkenny RVL investigated an outbreak of neonatal diarrhoea (and associated mortality) and forelimb paresis in the dairy calves on an eighty five cow spring calving dairy farm. Twenty five calves (29 *per cent* of calves born) died in the affected herd between January and June 2010. All calves born developed diarrhoea at seven to ten-days-old and approximately thirteen of these calves died as a result of the diarrhoea. A further twelve calves recovered from the diarrhoea and subsequently developed forelimb paresis (Figure 125) and ataxia with knuckling of the fetlocks at four to six-weeks-old. There was 100 *per cent* mortality in the calves that developed forelimb paresis. The remaining calves recovered. In 2009 thirty to forty calves developed neonatal diarrhoea at seven to ten-days-old and approximately half the affected calves died.

Low ZST levels (Figure 124) were identified in number of calves in spring 2010 submitted for post-mortem examination to Kilkenny. In spring 2009 *Salmonella* Dublin was isolated from cow faeces and rotavirus detected in samples of calf faeces. Marginal/subnormal copper levels had been identified in this herd in previous carcase and clinical sample submissions to the RVL in 2009 and in 2010.

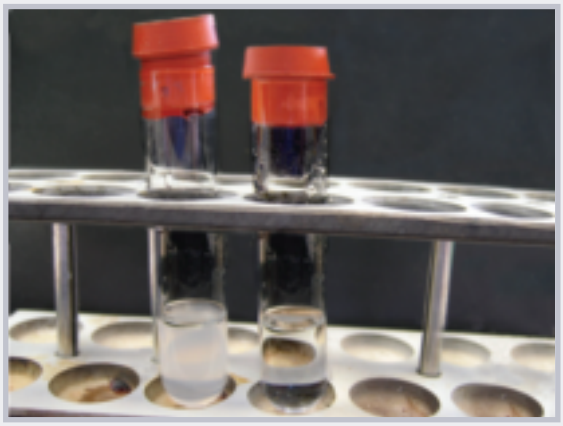


Figure 124: The zinc sulphate turbidity test (ZST) is used to determine immunoglobulin levels in calves up to about ten days of age.

Figure 125: A recumbent calf with paresis on the affected farm (Photo: Denise Murphy).

The farm investigation revealed an inadequate number of calving pens (one for eighty five cows) and poor bedding hygiene. Calves were housed in a makeshift calf house. The farmer was vaccinating for salmonellosis and neonatal enteritis. Cows had access to mineral licks in the dry period and received a selenium injection pre-calving. Young stock did not receive mineral supplementation. The calves of all first calved heifers (n = 15) died from diarrhoea/paresis.

Blood samples were collected from three calves, which were all that were available as it was the end of the calving period, and one cow. Significant *Salmonella* titres and low and marginal blood copper levels were identified. As it was nearing the end of calving period and there were no untreated diarrhoeic calves available, a faecal sample was taken from a healthy three-day-old calf; no enteric pathogens were detected. ZST levels were adequate in the blood samples. A five-week-old calf with a history of enteritis, and presenting with paresis, had a significant Salmonella titre and was submitted for post-mortem examination. A diagnosis of cervical vertebral osteomyelitis caused by *Salmonella* Dublin was made.

It was concluded that *Salmonella* Dublin infection was active in the herd and that there was inadequate colostral immunity, as evidenced by low ZST levels and marginal serum copper levels. The herdowner was advised to minimise the infection pressure by improving hygiene (clean bedding etc); to ensure the isolation and prompt treatment of sick animals; to avoid mixing age groups; to ensure vaccinations are used correctly and boosted at an appropriate interval pre-calving and that mineral nutrition was addressed in a proactive way.

The farm veterinary practitioner has reported the neonatal enteritis/paresis problems resolved in spring 2011.

Pathological fractures in calves

A five-month-old Friesian-type calf was submitted to Kilkenny RVL with a history of recumbency. Another four calves on the same premises were recumbent and there was a history of a calf with a similar history being euthanised and sent to a knackery two weeks previously. At post-mortem examination the calf was found to have bilateral distal comminuted femoral fractures. Because the bone was relatively easy to cut with a knife it was considered that the fractures were most likely to be pathological in nature (due to an inherent weakness in the bone) and it was decided to visit the farm of origin to investigate further.

The calves were in a group of forty five being reared by a tillage farmer. In addition to the four recumbent animals there was another lame calf with a large swelling over the femur which was judged clinically to be a healing fracture. Blood samples were taken from the five affected calves and five randomly selected unaffected animals. A detailed nutritional history was also taken from the farmer. The four recumbent animals were euthanised and brought to Kilkenny RVL for post-mortem examination where each was found to have multiple fractures.

Multiple fractures in a group of animals without a history of trauma are highly suggestive of an underlying metabolic bone disease. There are various metabolic bone diseases which can predispose to pathological fracture, but diagnosis of the specific problem can be challenging. No biochemical abnormalities were detected in the sampled animals (parathyroid hormone levels were not tested). Bones from the animals were radiographed and no abnormalities were detected in bone density or in the growth plates. Histopathologically there were lesions resembling fibrous osteodystrophy (replacement of bone with fibrous tissue). Due to the limitations of standard histopathological techniques it was not possible to determine if there were lesions of osteoporosis. The most common causes of metabolic bone disease in a group of farm animals are an underlying nutritional or toxic problems. These calves had been fed milk replacer up to eight-weeks of age. They were then fed exclusively on a home-mixed ration of cereal and beans, plus barley straw. No mineral supplements were being given. Cereals and field beans are very low in calcium. The overall calcium level in the diet was estimated by a nutritionist as being approximately 0.12 *per cent* (should be 0.55 *per cent* or it will predispose to osteoporosis). In addition the calcium:phosphorosis ratio was estimated at 1:3.3 (which should never be <1:1 or it will predispose to fibrous osteodystrophy). Following mineral supplementation of the calves' rations, no further cases of fracture were reported.

Copper deficiency leading to scour and stunting in dairy calves

Sligo RVL investigated an outbreak of scour and stunting in a fifty cow dairy herd. The herd was predominately spring calving. Calves were retained and reared either as dairy replacement heifers or for beef. There had been a history of scour and consequential stunting in calves as they have gone to grass over the previous two to three years in the herd. Morbidity was high among both home-reared and purchased calves.

Young calves were fed milk, hay and approximately one kilogram of concentrates while housed. These calves were thriving well, with no evidence of scour. Calves were weaned off milk before they went to grass, where they continued to be fed conentrates. Within a few weeks of going to grass they developed diarrhoea. Calves received various types of wormers, with an initial apparent improvement following treatment on a number of occasions, but within a week or two they were scouring again.

Figure 126: Calves with the characteristic discolouration of the coat associated with copper deficiency (Photo: John Moriarty).

At the farm visit, six calves which had recovered were in a stunted state (Figure 126). Faecal samples were taken from eight calves, all of which had loose faeces. *Cryptosporidium* oocysts were detected in four of these. This was not considered likely to be significant in the age group (three to six-month-old calves). Five calves had temperatures of 103°-104°F. Some calves were coughing. The major finding on clinical pathology was low serum copper concentration in the calves (range 5.2 to 12.1 micromoles per litre). The farmer reported an improvement following supplementation with copper by injection.

A nutritionist was consulted, and a forage analysis was requested. Analysis of forage revealed very high levels of molybdenum, sulphur, iron, and aluminium. All of these antagonise copper. Forage levels of copper were regarded as normal, but the antagonists would have reduced its availability. The nutritionist recommended supplementation of copper to calves through feed.

Increased cell count and increased clinical mastitis incidence

A laboratory-based investigation of mastitis pathogens causing increased cell counts and an increased incidence of clinical mastitis was performed on milk samples submitted to AFBI Omagh from six herds in 2010. In one herd seventy two quarter samples were submitted to investigate an increasing bulk milk somatic cell count (SCC) which had reached 520,000 cells per millilitre prior to investigation. *Staph. aureus* was isolated from eleven individual quarter samples, coagulase-negative staphylococci were isolated from eighteen individual quarter samples and *Corynebacterium bovis* was isolated from sixteen individual quarter samples. Advice was given on control measures appropriate to contagious mastitis pathogens, including culling chronic *Staph. aureus*-infected cows, the treatment of new infections, and a review of the quantity, quality and method of post-milking teat disinfection. *Streptococcus uberis* was isolated from eight individual quarter samples and *Escherichia coli* from seven individual quarter samples. Advice was also given on control measures appropriate to environmental pathogens including hygienic teat preparation prior to milking and detailed improvements in environmental hygiene in dry cow cubicles and calving boxes. The prescribing veterinary surgeon advised on the appropriate duration and type of antibiotic to use in the treatment of clinical mastitis cases. An initial improvement in bulk milk SCC to 285,000 cells per ml was associated with the culling of chronically-infected cows and drying-off some late lactation high cell count cows. Improvements in parlour routine, parlour maintenance and environmental hygiene over the next twelve months resulted in a further decrease in bulk milk SCC to 178,000 cells/ml.

Periparturient neonatal mortality in a dairy herd

Sligo RVL investigated perinatal mortality in a hundred cow dairy herd. The problem was confined to heifers. Affected heifers were reported to be "slow about calving" with the calf appearing to "just sit there" (uterine inertia). Any calf whose delivery was assisted by traction survived. The afterbirth was expelled immediately after calving (abnormally quickly). The predominant breed of the calves which died was Aberdeen Angus (AA), but this was coincidental with the breeding policy of putting heifers in calf to AA bulls. The heifers went to an outfarm as yearlings, where their diet before calving consisted of baled silage; a 16 *per cent* protein concentrate ration was fed up to one month pre-calving and pre-calving minerals were given.

There was no evidence of a mineral deficiency or an active infectious agent on clinical pathology testing. Mineral analysis of second cut silage revealed high level of calcium, sodium, iron and iodine. This was the silage the heifers were fed when the problem was at its peak. Consultation with a nutritionist indicated these were not likely to be of significance, especially in the absence of such problems in mature cows. Laboratory investigation did not reveal any infectious or mineral-related cause for the problem.

The placenta was expelled almost immediately after the calf, which is similar to a premature placental separation and expulsion syndrome described by Mee (1991). The premature separation leads to anoxia and foetal death. The only association Mee found between the syndromes was with foetal malposition. However, he could not determine if this was a cause or consequential to the syndrome. Mee noted that the prevalence of the condition was higher among AA calves than Friesian Holsteins, which appears to be the experience in the case herd, although it probably relates to the fact that more heifers are in calf to AA bulls than to Holstein or other breeds. Mee found no association with maternal parity, although other authors he cites have found a greater prevalence among heifers. The association between first parity and the condition in the case herd did not appear to be documented in the literature, although infections, hormonal and mineral imbalances have been implicated as possible causes of similar syndromes. While we have ruled out infectious and mineral issues in this case we are not in a position to rule out hormonal imbalances.

The standard of calving supervision was already quite good. It was suspected that any malposition was likely to be rather mild. It was therefore recommended that calving heifers be handled early in the course of labour to identify any malpositions and correct them, without necessarily delivering the calf. This is normally contraindicated and is not recommended as a general practice.

Mee noted that a significant proportion of cases had sanguineous (bloody) uterine fluid, so this should be looked out for when heifers are calving.

Reference:

Mee J.F. (1991) Premature expulsion of the placenta and bovine perinatal mortality. *Veterinary Record* 128:521-523.

An outbreak of ill-thrift in a dairy herd

Sligo RVL investigated a chronic wasting syndrome, progressing in some cases to downer cows, in an eighty cow spring calving dairy herd. Rumen fluke eggs had been identified in faecal samples, but despite treatment the cows were continuing to waste. Eight cows had been affected, many of which were among the oldest in the herd. Milk protein concentrations dropped to 1.12 *per cent* at that stage. Quite a few cows were also regurgitating the cud.

The body condition scores of the cows were considered quite poor at the farm visit. The heifers had received a fluke dose while still at pasture on September 25th, while the majority of cows were dosed with a fluke dose on December 2nd. They were again dosed with oxyclozanide on March 31st for rumen fluke and adult liver fluke.

High creatine kinase (CK) levels were found in three cows, which is indicative of muscle damage and / or muscle wastage. Liver fluke eggs were detected in a faecal sample from one heifer. BVD virus was detected in one purchased heifer, and unsurprisingly all cohort heifers associated with this animal had antibodies to BVD virus. The herd had been vaccinating against BVD for some time. The herd had been fed poor quality hay for the first six weeks of the dry period. During this time they lost a considerable amount of body condition. The cows never regained the condition lost during this period and were considered to be too thin at the time of calving.

It became clear that the problem was due to poor nutrition exacerbated by a burden of liver and rumen fluke. Therefore a two-pronged approach was recommended to avoid a recurrence. Firstly the farmer was told that such losses in body condition were to be avoided at all costs. The value of monitoring condition score at the time of drying-off was emphasised. Cows that are particularly thin at that stage need additional feeding.

The BVD virus detected in a heifer was not thought to be of significance to the wasting syndrome observed in the cows, but it was considered that it may have been of significance in some of the heifers. A comrade of the BVDV PI animal had died exhibiting clinical signs consistent with mucosal disease. A BVD screen was recommended.

This case clearly showed the importance of dry cow nutrition and the challenge that internal parasites can present to dairy cows.

A selection of abstracts from published scientific papers

Occasionally the findings in the veterinary laboratories lead to publications in the scientific literature. Equally, veterinary laboratory staff may participate in research projects which further our understanding of the risk factors which predispose animals to disease, the progression of the disease process or the diagnosis and control of specific animal diseases. Presented below is a selection of scientific publications by AFBI and DAFF laboratory staff during 2010.

Control of caseous lymphadenitis in six sheep flocks using clinical examination and regular ELISA testing

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In an effort to control the spread of caseous lymphadenitis (CLA) infection, flocks of affected sheep on six holdings were tested serologically at regular intervals using an antibody ELISA with a mean (sd) specificity of 99 (1) *per cent* and a sensitivity of 79 (5) *per cent*. Western blot assays to detect antibodies to the phospholipase D (PLD) exotoxin of *Corynebacterium pseudotuberculosis* were used as a further test when ELISA results were inconclusive. Owners were advised to remove from the flock any sheep that demonstrated clinical signs of CLA or tested positive for PLD by ELISA or western blot. Of the six trial flocks, one was dispersed after only two blood tests, and in another the recommendations for CLA control were not followed and infected animals were retained within the flock. In the remaining four flocks, the testing regimen and other advice enabled the disease to be controlled to such an extent that the appearance of new clinical cases of CLA was effectively halted. This remained the case for up to five years after the end of the trial. In two of these flocks, a small number of seropositive animals were detected at the last flock test. However, on the other two holdings all sheep were seronegative in the final two flock tests, consistent with the complete eradication of infection.

Fasciola hepatica: Histological changes in the reproductive structures of triclabendazole (TCBZ)-sensitive and TCBZ-resistant flukes after treatment in vivo with TCBZ and the related benzimidazole derivative, Compound Alpha

Reprinted from *Veterinary Parasitology,* 168 (2010) 240–254 with permission from Elsevier

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Twenty-four shed-reared lambs were each infected orally with 250 metacercariae of *Fasciola hepatica*, using either the triclabendazole (TCBZ)-sensitive Cullompton isolate or the TCBZ-resistant Sligo isolate. Twelve weeks after infection the lambs were treated with TCBZ (10mg/kg) or with the experimental fasciolicide, Compound Alpha (Cpd a), a benzimidazole derivative of TCBZ (15 mg/kg). The lambs were euthanised 48, 72 and 96 h after TCBZ treatment, or 24, 48 and 72 h after Cpd a treatment, and flukes were collected from the liver and/or gall bladder of each animal. Untreated animals harbouring 12-week infections were euthanised 24 h after administration of anthelmintic to the treatment groups, and the untreated flukes provided control material. A semi-quantitative assessment of the degree of histological change induced by the two drugs after different times of exposure was achieved by scoring the intensity of three well-defined lesions that developed in the testes and uteri of a representative sample of flukes from each lamb. In general, it was found that in those tissues where active meiosis and/or mitosis occurred (testis, ovary, and vitelline follicles), there was progressive loss of cell content due to apparent failure of cell division to keep pace with expulsion of the mature or effete products. Further, actively dividing cell types tended to become individualised, rounded and condensed, characteristic of apoptotic cell death. Protein synthetic activity was apparently inhibited in the Mehlis' secretory cells. In the uterus, where successful formation of shelled eggs represents the culmination of a complex sequence of cytokinetic, cytological and synthetic activity involving the vitelline follicles, the ovary and the Mehlis' gland, histological evidence indicating failure of ovigenesis was evident from 24 h posttreatment onwards. The development of these lesions may be related to the known antitubulin activity of the benzimidazole class of anthelmintics, to the induction of apoptosis in cells where mitosis or meiosis has aborted due to failure of spindle formation, and to drug-induced inhibition of protein synthesis. The semi-quantitative findings indicated that Cpd a is slightly less efficacious than TCBZ itself in causing histological damage to the reproductive structures of TCBZ-sensitive flukes, and that, like TCBZ, it caused no histological damage in flukes of the TCBZ-resistant isolate. This study illustrates the potential utility of histological techniques for conveniently screening representative samples of flukes in field trials designed to validate instances of drug resistance or to test the efficacy of new products against known drug-resistant and drug-susceptible fluke isolates. It also provides reference criteria for drug-induced histopathological changes in fluke reproductive structures which may aid interpretation of TEM findings.

Detection and quantification of *Toxoplasma gondii* in ovine maternal and foetal tissues from experimentally infected pregnant ewes using real-time PCR.

Reprinted from *Veterinary Parasitology* 2010 Aug 27; 172(1-2): 8-15 with permission from Elsevier

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A real-time PCR (rt-PCR) targeting the 529-bp repeat element (RE) of *Toxoplasma gondii* was used to detect and quantify the parasite burden in maternal and foetal tissues in 18 seronegative ewes infected with 3000 *Toxoplasma oocysts* on day 90 of pregnancy. The infected ewes were sacrificed in groups of 4-6 at 21, 25, 33 and 35 days post-challenge. Ten sham inoculated pregnant ewes were used as controls. *T. gondii* was not detected in the control ewes or their foeti. The parasite was only detected in the maternal tissues in a few of the challenged ewes on a small number of occasions where it was identified in spleen and uterine lymph nodes. *T. gondii* was detected in the foetal spleen and liver at the early sacrifice times but only sporadically thereafter. In the case of amniotic, allantoic and foetal aqueous humor samples *T. gondii* was only detected on a small number of occasions. However, it was found in the majority of the foetal lung and placentome samples throughout the study period, while placentomes and foetal brains contained high levels of the parasite during the later stages. Histopathological examination of placentome and brain tissue from the foeti in the present study revealed a strong correlation between histopathological lesions and quantities of the parasite DNA detected. These results indicate that the cotyledonary component of the foetal membranes is the sample of choice for the diagnosis of *T. gondii* by rt-PCR, followed by foetal lung and brain.

Identification of immunologically relevant proteins of *Chlamydophila abortus* using sera from experimentally infected pregnant ewes.

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Chlamydophila abortus is an intracellular pathogen and the etiological agent of enzootic abortion of ewes (EAE). *C. abortus* has a biphasic development cycle; extracellular infectious elementary bodies (EB) attach and penetrate host cells, where they give rise to intracellular, metabolically active reticulate bodies (RB). RB divide by binary fission and subsequently mature to EB, which, on rupture of infected cells, are released to infect new host cells. Pregnant ewes were challenged with 2 x 10(6) inclusion forming units (IFU) of *C. abortus* cultured in yolk sac (comprising both EB and RB). Serum samples were collected at 0, 7, 14, 21, 27, 30, 35, 40, and 43 days postinfection (dpi) and used to identify antigens of *C. abortus* expressed during disease. Additionally, sera from fetal lambs were collected at 30, 35, 40, and 43 dpi. All serum samples collected from experimentally infected pregnant ewes reacted specifically with several antigens of EB as determined by one-dimensional (1-D) and 2-D gel electrophoresis; reactive antigens identified by mass spectrometry included the major outer membrane protein (MOMP), polymorphic outer membrane protein (POMP), and macrophage infectivity potentiator (MIP) lipoprotein.

Dublin

Stormont (Belfast)

Kilkenny

Athlone

Omagh

Sligo

Cork

Limerick