All-island Animal Disease Surveillance Report 2011

A joint AFBI / DAFM Veterinary Laboratories publication

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**Agriculture,
Food and the Marine**
An Roinn
**Talmhaíochta,
Bia agus Mara**

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Introduction

This is the second 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, Food and the Marine (DAFM) in Ireland and is part of the actions agreed by both the Department of Agriculture and Rural Development and DAFM to help deliver the All-island Animal Health and Welfare Strategy.

New sections in this year's report include reports on equine disease surveillance by DAFM and AFBI, and a contribution from the Marine Institute on the surveillance work they carry out on diseases of fish. These sectors monitor a different range of disease syndromes, pathogens and production systems, but share our desire to communicate the results of passive surveillance of diagnostic submissions with the wider public through this second All-island Animal Disease Surveillance Report.

The development of this report required close co-operation between the respective staff of the two organisations. In addition to supporting the significant workload involved in drafting and editing this report, this project has developed and deepened relationships between individuals in the two jurisdictions with shared interests as they collaborated on jointly authored sections, and has reinforced the formal relationships between the organisations at the level of individual members of staff.

Virtually all of the data in this report was generated because of voluntary submission of material (carcases and clinical samples) to the laboratories by farmers through their private veterinary practitioner. This is known as scanning or passive surveillance and is but one element of this island's suite of measures to monitor and control animal disease on the island of Ireland. Other elements of surveillance include active screening for exotic disease and for statutorily controlled endemic diseases as well as inspections of food businesses.

However, scanning surveillance at regional diagnostic laboratories is unique in that no other form of surveillance has the ability to detect diseases that are not being actively monitored (e.g. new disease entities), while continuing to monitor for endemic and emerging diseases, and the incursion of exotic disease. For example the initial recognition of bluetongue in Northern Europe in 2006 and subsequent identification of Schmallenberg virus there in 2011 were attributable to scanning surveillance activity.

Surveillance underpins the assurances we give both our national and overseas customers regarding animal health and welfare and food safety standards in our food animal production systems. Such assurance will become increasingly important in order to achieve the objectives of Food Harvest 2020 (in Ireland) and the NI Food Strategy Board for the sustainable expansion of livestock production and the export trade in livestock produce.

The European Surveillance Network is a relatively new organisation established by the UK, Switzerland and The Netherlands, which aims to promote and develop passive surveillance networks across Europe, by providing a discussion forum for countries that have functional scanning surveillance programmes in place. At a meeting in Berne, Switzerland in October 2011, staff members from DAFM and AFBI diagnostic laboratories described the features of the surveillance system in place in both jurisdictions, presenting a summary of the 2010 All-island Animal Disease Surveillance Report and this island-wide programme was accepted for membership of the network.

This report will continue to evolve and develop just as the activities that it reports change in response to the requirements of the rapidly changing and dynamic indigenous agriculture and food sector.

Overview of submission rates, animal demographics and the weather

Submission rates to the AFBI and DAFM veterinary laboratories in 2011

The post-mortem rooms of the AFBI and DAFM veterinary laboratories have a daily throughput of diagnostic material which aids in animal disease investigations. A high volume of carcases and samples from cattle, sheep, pigs, poultry and fish is submitted to DAFM and AFBI laboratories annually for diagnostic investigation. This activity provides DAFM and the Department of Agriculture and Rural Development (DARD) with a programme of animal disease surveillance by monitoring for epizootic diseases, new or emerging diseases or changes in patterns of endemic diseases. The laboratories assist veterinary surgeons in facilitating the rapid diagnosis and investigation of disease outbreaks and the implementation of effective treatment, control and preventative measures. Although many diseases such as abortion, scour and pneumonia have similar symptoms, they may have multiple causes. Laboratory testing is therefore essential for the identification of the precise cause so that the most effective control measures may be implemented.
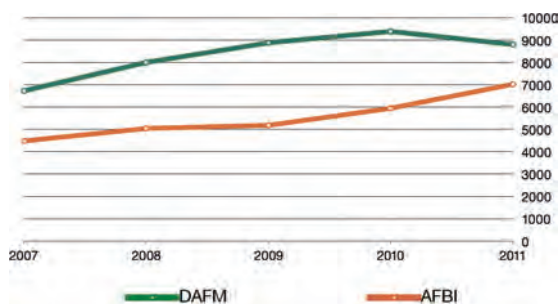
Figure 1: Trends in the submission of carcases for post-mortem examination to the AFBI veterinary laboratories and the DAFM Regional Veterinary Laboratories from 2007 to 2011.

Figure 1 shows the trends in the submissions of carcases to the AFBI and DAFM veterinary laboratories over the last five years. A total of 8,805 carcases were examined in the DAFM RVLs during 2011, which represented a 6.3 *per cent* reduction on the 2010 total. This marginal reduction was expected owing to the temporary closure of the post-mortem rooms in Cork, Sligo and Kilkenny Regional Veterinary Laboratories (RVLs) during the autumn of 2011 to facilitate the upgrading of the post-mortem facilities therein. In the AFBI veterinary laboratories a total of 7,014 carcases were examined during 2011, representing an increase of 18.1 *per cent* when compared to 2010.

The general increasing trend in the numbers of carcases submitted over the last number of years to both AFBI and DAFM laboratories reflects an increased awareness of the importance of achieving a conclusive diagnosis, following the loss of an animal, in order to help prevent further losses.

Figure 2: Well chosen clinical pathology samples can be very useful in achieving a diagnosis.

Well chosen clinical pathology samples from animals early in the clinical course of a disease can also be very informative in reaching a diagnosis. Following a massive increase in demand (77 *per cent*) in DAFM RVLs for clinical pathology laboratory analyses between 2008 and 2010, it was recognised by veterinary management that the growth in demand was unsustainable in the longer term. A subsequent reassessment of our sampling and testing protocols led to a prioritisation of those diagnostic tests which aided the goal of providing effective national animal disease surveillance. A decline in the numbers of samples submitted for clinical pathology analyses (Figure 3) to 102,058 in 2011 represents a return to levels previously processed in 2009.
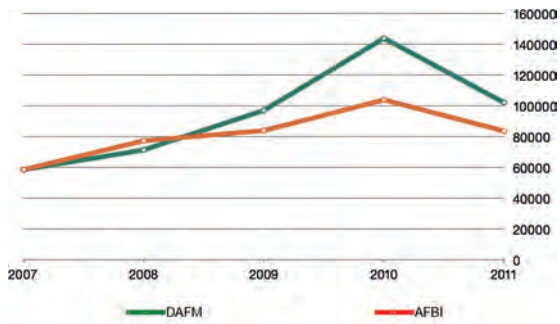
Figure 3: Trends in the submission of clinical pathology samples to the DAFM Regional Veterinary Laboratories and to the AFBI veterinary laboratories over the five years 2007 to 2011.

In 2011, the AFBI laboratories in Stormont and Omagh processed a total of 83,553 clinical diagnostic samples. Similar to the DAFM laboratories, this figure reflected a return to the volume of samples previously witnessed in 2009

The surveillance footprint of a veterinary laboratory

The veterinary laboratories of DAFM and AFBI are engaged in primarily scanning (passive) surveillance by gathering post-mortem data from animals that are presented to them on a daily basis. Analysis of this unique data provides an insight into the changing trends in disease incidence and the causes of mortality on Irish farms, thereby informing decision-making relevant to disease control at a national level in both jurisdictions. This scanning surveillance is also a vital aspect of our defence against the introduction and silent spread of exotic or novel diseases on the island.
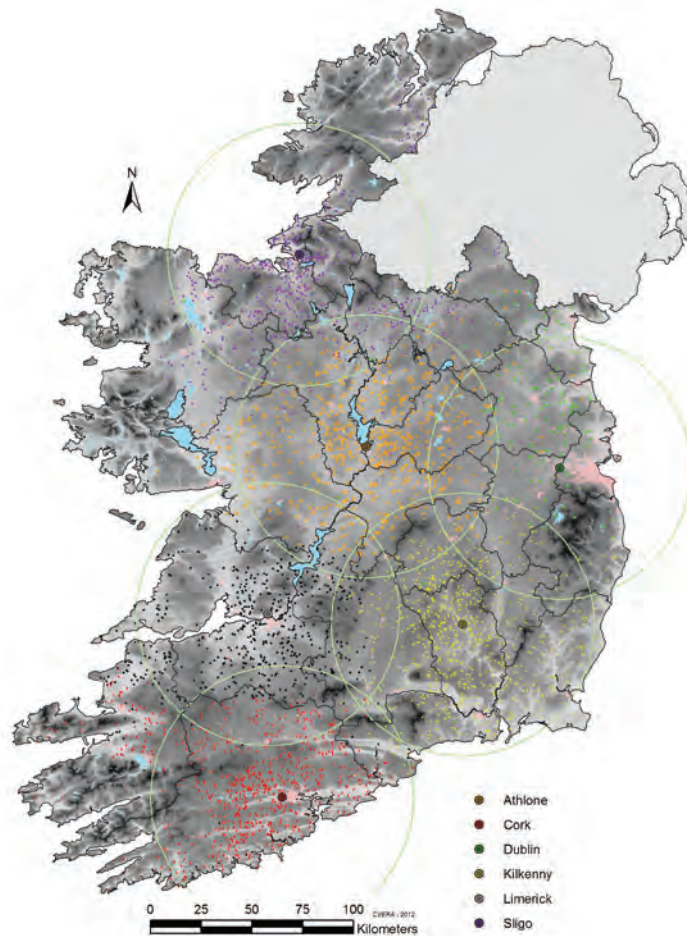
Figure 4: A map of Ireland showing the herds of origin (dots) of all bovine carcases submitted to the six regional veterinary laboratories (denoted by solid large dots) during 2011. The circles on the map represent a 65 kilometre radius from each laboratory (Map produced by Guy McGrath, UCD/CVERA).

In early 2012 DAFM engaged in a project with the assistance of the Centre for Veterinary Epidemiology and Risk Analysis (CVERA) to determine the surveillance footprint of a regional veterinary laboratory (RVL) by charting the herds of origin of all bovine carcases submitted to the six RVLs during 2011 (Figure 4). Greatest clustering of herds of origin was noted in the county in which the RVL is based and immediately adjacent counties with a gradual decrease in the submission frequency with increasing distance from the regional laboratories. This is a typical trend in all countries with a regional veterinary laboratory structure. Areas from which few, if any, submissions were made are primarily the upland areas where animal density would be very low. Of particular note, however, is the geographically dispersed location of herds which have contributed the carcases from which data has been generated in this report for Ireland. The coverage of the national herd provided by the strategic location of the RVLs is central to the operation of an effective animal disease surveillance network in Ireland.

The location of the AFBI laboratories in Omagh and Stormont are shown in Figure 5 as well as the distribution of herds from which a bovine carcase was submitted. Jointly they provide effective coverage of the national herd of Northern Ireland. The extent of the coverage of the national herds by the veterinary laboratory services in both jurisdictions highlights the importance of cross-border collaboration in the area of animal disease control for the protection of the disease status of all herds on the island of Ireland.

Cattle and Sheep Demographics

During 2011 an increase was observed in the size of the national sheep flocks, both in Ireland (2.9 *per cent*) and Northern Ireland (2.2 *per cent*) (Figure 6). Meanwhile the national cattle herd in Ireland decreased 1.7 *per cent* to 6.5 million cattle in 2011, due primarily to a drop in the numbers of male cattle, while in Northern Ireland the national herd showed a more modest contraction of 0.9 *per cent* to 1.6 million cattle.
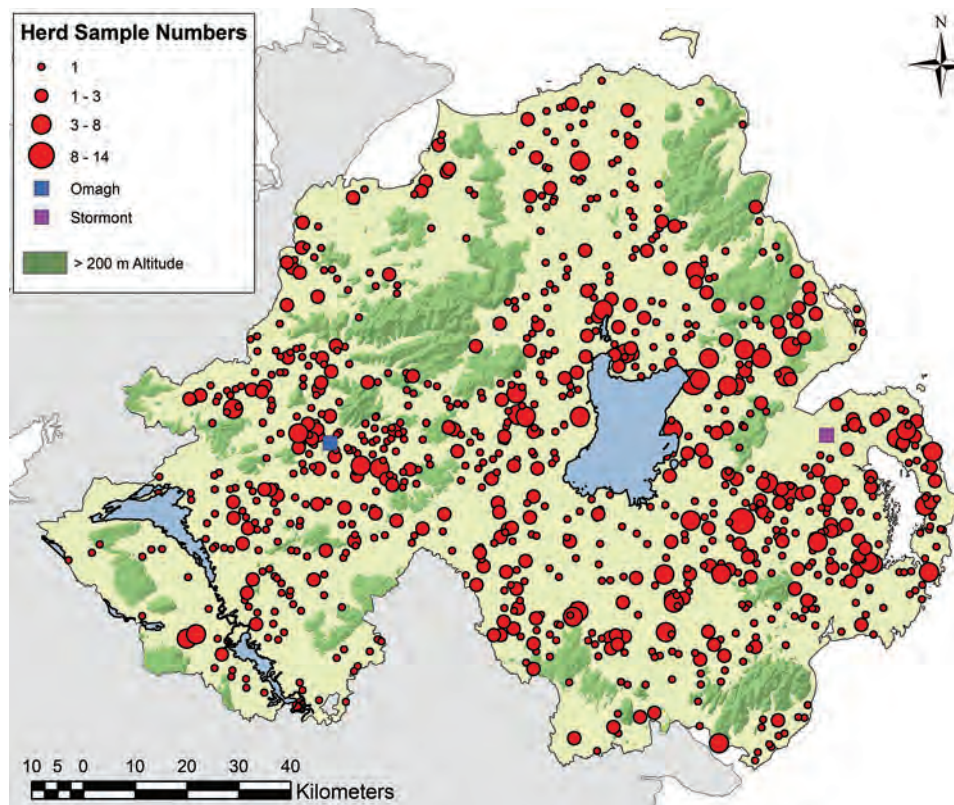

Figure 5: The location of herds (red dots) which submitted bovine carcases to the AFBI laboratories in Omagh (blue square) and Stormont (purple square) during 2011 (Map produced by Alex Higgins, AFBI).

Within these figures, the average dairy cow population in Ireland and Northern Ireland was broadly consistent at 1.028 million cows and 279,200 cows respectively. Milk production rose by 3.9 *per cent* in Ireland to 5.38 billion litres in 2011 and by 6 *per cent* in Northern Ireland to 1.97 billion litres. This was driven in part by a rise in the average price of milk to 34 cent *per* litre in Ireland and 27.6 pence *per* litre in Northern Ireland.

The increase in sheep numbers in Ireland in 2011 served to redress the decline in the national flock recorded from 2008 to 2010. This was forecast in *The All-island Animal Disease Surveillance Report 2010* as a likely response to the joint impetuses of improved farm gate prices and the longer term strategic goals outlined in *Food Harvest 2020*. The most significant increase in sheep numbers was recorded in ewes aged less than two years of age.
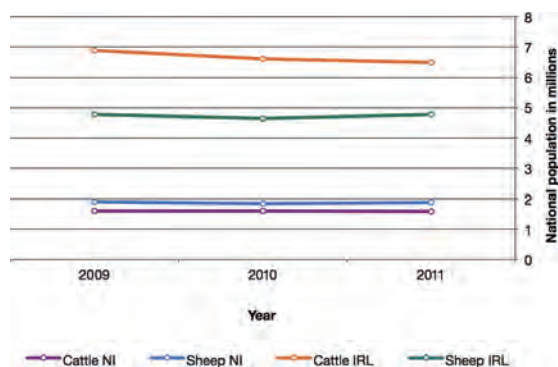
Figure 6: The national cattle and sheep populations of Northern Ireland and Ireland as measured in June each year for the years 2009 to 2011 (Source: NI data from The Agricultural Census in Northern Ireland – Results for June 2011; IRL data from the Central Statistics Office http://www.cso.ie)

In Northern Ireland, the increase in sheep numbers was a consequence of rising ewe numbers in the national flock. This marks the first year that a rise in ewe numbers has been recorded since the declining trend in Northern Ireland began in 1998. Some 8,439 farms were recorded as keeping breeding sheep in Northern Ireland in 2011, with an average flock size of 106 ewes. Only 26 farms were recorded as keeping a flock size of 1,000 ewes or more. The number of sheep flocks recorded by the Department of Agriculture, Food and the Marine (DAFM) in the 2011 Sheep and Goat Census was 33,766 which is an increase of approx 1,600 (5 *per*

cent) on the December 2010 figure of 32,176.

Significantly improved farm gate prices for lamb in Northern Ireland have certainly contributed to the increased numbers with an average price of 407 pence *per* kilogram paid in 2011, surpassing the previous high average price of 372 pence *per* kilogram recorded in 2010. In Ireland the average price *per* kilogram paid by processors for lamb in 2011 was 468 cents *per* kilogram, the highest average price recorded in over fifteen years.

Figure 7: The national flocks in Ireland and Northern Ireland grew by more than two *per cent* during 2011 (Photo: Jennifer Sheehan).

Against the backdrop of modest contractions in the national cattle herds of both jurisdictions, the rate of on-farm deaths has continued a significant downward trend. Figure 8 shows the monthly distribution of on-farm deaths of cattle in Ireland over the past three years. While the seasonal pattern of cattle deaths is evident each year, with highest mortality recorded during the peak calving period in the spring, the total figure for 2011 of 215,828 animals represents an 11.6 *per cent* decrease in on-farm mortality when compared to 2010. This is the fourth successive annual decrease in on-farm cattle mortality from the total of 300,779 recorded in 2008 and is a very welcome trend.
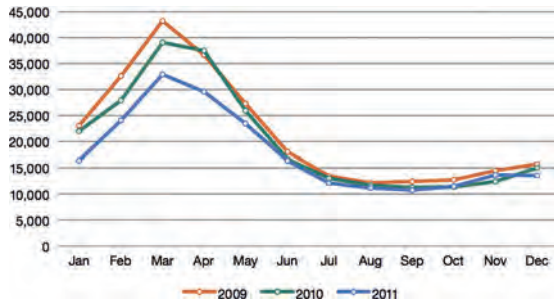
Figure 8: The total numbers of cattle deaths (cattle and aborted foetuses) recorded on the Animal Identification and Movement (AIM) system in Ireland by months for the years 2009, 2010 and 2011 (Source: DAFM AIM Bovine Statistics Report).

The reason for this trend is most probably due to a combination of more favourable summer weather conditions in 2011 when compared to both 2008 and 2009, as well as a milder winter in 2011 than those experienced in the previous two years.
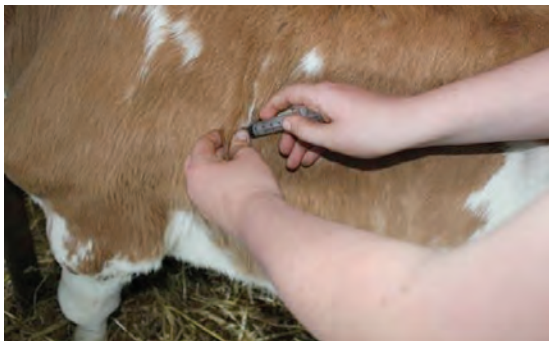
Figure 9: Changing farming practices in Ireland and Northern Ireland have seen the increased use of vaccines as a means of disease prevention in farm animal species (Photo: Michael McManus).

Changing practices on Irish farms have also played a role in reducing mortality, specifically the increased focus on preventive medicine (Figure 9). This has been reflected most dramatically in the growth (in excess of 80 *per cent*) in the sales of veterinary preventative vaccines for farm animal species over the last five years (Figure 10). Furthermore, the increased value of livestock has sharpened the sector's commitment to herd health and attention to other preventive measures such as pro-active culling.
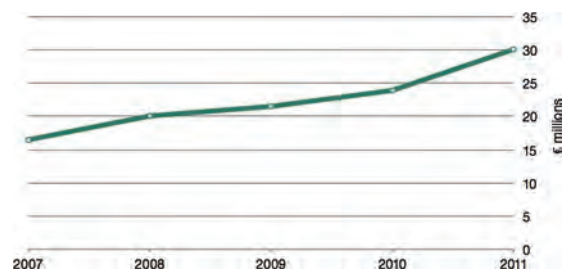
Figure 10: The expenditure in Ireland, in millions of Euros (€), on veterinary large animal preventative vaccines in the years 2007 to 2011 (Source: GfK Kynetec, Denise Roche, 2011 APHA presentation).
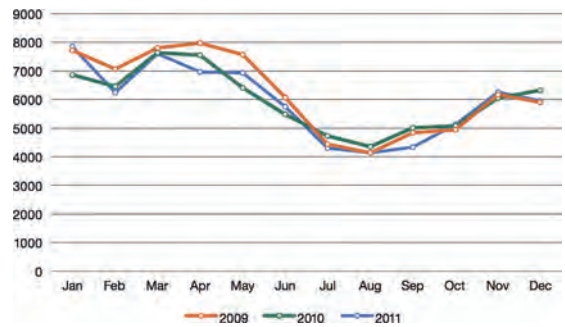
Figure 11: The total numbers of cattle deaths (cattle and aborted foetuses) recorded in Northern Ireland, by month, for the years 2009, 2010 and 2011 (Source: DARDNI).

The trend in cattle mortality in Northern Ireland during the same period has also been encouraging, with a total of 71,445 on-farm deaths recorded in 2011 (Figure 11). This represents only a marginal decrease of 0.7 *per cent* when compared to 2010; however this figure is significantly lower than the total of 83,816 recorded in 2008.

The seasonal pattern of mortality in Northern Ireland differs from that in Ireland with a less marked rise in mortality in the spring and a more pronounced rise in mortality in the autumn. This is assumed to result from differences in calving patterns between the national herds in both jurisdictions, with Ireland practicing a predominantly spring-calving system.

When on-farm mortality figures for both Ireland and Northern Ireland are expressed relative to the size of the respective national herds, a crude bovine mortality rate of 33.2 deaths *per* thousand cattle and 44.9 deaths *per* thousand cattle are recorded respectively.

Weather
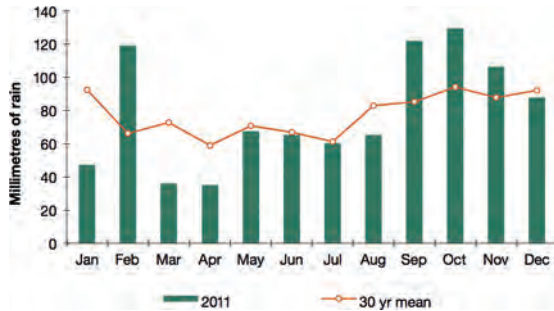
Figure 12: The average monthly rainfall in millimetres measured in Mullingar weather station, Co. Westmeath during 2011 compared to the thirty-year rainfall mean (Data courtesy of Met Éireann http://www.met.ie)

Heavy rainfall in early spring and autumn (Figure 12) coupled with a warmer spring and cooler than average summer (Figure 13) characterised the weather on the island of Ireland in 2011. The above average rainfall in September provided conditions suitable for the propagation of the snail *Galba truncatula* (formerly *Limnaea truncatula*), intermediate host of liver fluke (*Fasciola hepatica*) and the water snails that carry the rumen fluke (*Paramphistomum spp.*) facilitating the production of the infective stages of these parasites. This led to the DAFM warning of a high risk for liver fluke in the annual liver fluke forecast by the Liver Fluke Advisory Group in November 2011. Rainfall during the same period in Northern Ireland was lower than that in Ireland. As a result AFBI predicted lower fluke infection levels compared to previous years.
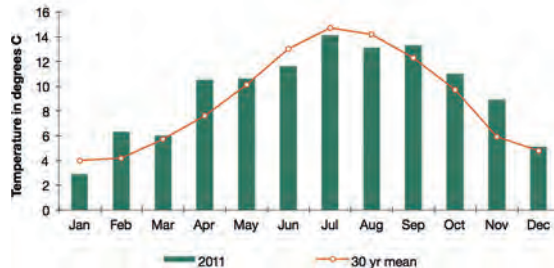
Figure 13: The average monthly temperature in degrees Celsius (C) measured in Mullingar weather station, Co. Westmeath during 2011 compared to the thirty-year temperature mean (Data courtesy of Met Éireann http://www.met.ie)

April was considerably warmer than normal (Figure 13) which led, in many areas, to the earlier than usual release of cattle onto pasture. This probably contributed to the lower bovine mortality recorded during spring in Figure 8. While the summer was cooler than average, it brought only average levels of rainfall. Consequentially, the mid-summer peaks of housing-related disease such as mastitis and calf enteritis which were recorded in 2009 and 2010, associated with the temporary housing of stock, were not witnessed in 2011.

Diseases of cattle

Mortality in cattle can be caused by a wide range of conditions, the frequency of which varies considerably with the age of the animal. For the purposes of clarity, we present the most frequently diagnosed causes of death, as diagnosed on post-mortem examination, by age category in this section. Many of the categories of diagnoses are combined into larger more general categorisations for ease of description, but more specific details on many of the conditions included in these general categorisations are available in other sections of this report. As the demarcation of ages for the classification of 'calves' and 'weanlings', as recorded on the respective information management systems of DAFM and AFBI laboratories differs somewhat the data from each laboratory service is presented separately in this section.

Neonatal calves (birth to one-month-old)

Enteritis is consistently recorded as the most common cause of mortality in neonatal calves in both Ireland (Figure 14) and Northern Ireland (Figure 15), accounting for approximately 25 *per cent* of mortality in this age group annually in Ireland. During 2011 the proportion of mortalities attributable to enteric infection in Northern Ireland was 36.6 *per cent*, compared to 31.6 *per cent* recorded during 2010. In Northern Ireland rotavirus (84 cases) and *Cryptosporidium spp.* (70 cases) were the pathogens most frequently associated with cases of neonatal enteric disease. Factors related to environmental hygiene, colostrum management and the ability of the causative pathogens to survive in the calves' environment are all central to enteritis being responsible for so many losses each year. A more thorough examination of the pathogens identified *post mortem* in enteritis cases is presented in the neonatal enteritis section on page 37 of this report.

Figure 14: The conditions most frequently diagnosed on post-mortem examination of neonatal (less than one-month-old) calves in Ireland in 2011 (n=1127).

Septicaemia, bacteraemia or toxaemia are often a sequel to bacterial infection of a given tissue where the bacterium, or its toxin, gains entry to the blood. The host defences are overwhelmed and high mortality can result. In many cases among neonates, septicaemia or bacteraemia can occur subsequent to an enteric infection, further highlighting the far reaching consequences of enteritis in this age group.
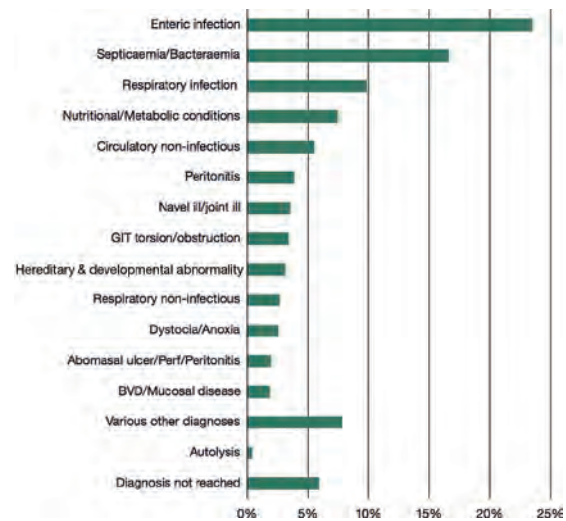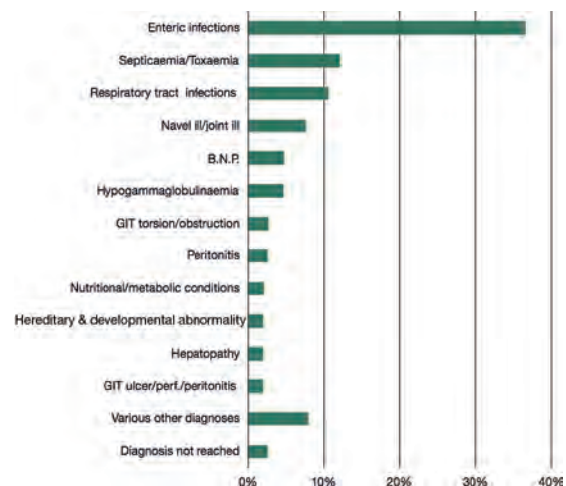

Figure 15: The conditions most frequently diagnosed on post-mortem examinations of neonatal (less than one-month-old) calves in Northern Ireland during 2011 (n=714)

Figure 16: Diffuse suppurative peritonitis associated with navel ill infection in a one-week-old calf (Photo: Dónal Toolan).

There were a total of forty nine cases of navel ill or joint ill diagnosed during 2011 in Ireland. Forty of these cases were diagnosed in neonates (Figure 16). There were six additional cases of hepatic abscessation in neonates which most probably originated from navel infections. It is also possible that the navel was the point of entry for some of the cases of septicaemia. *Trueperella pyogenes* (formerly *Arcanobacterium pyogenes*) was isolated from eleven navel ill cases by DAFM. *T. pyogenes* is an opportunist organism which is ubiquitous in the environment. During 2011 it was also isolated in 32 cases of pneumonia and 15 cases of abscessation. In Northern Ireland the category 'Navel ill/joint ill' was the fourth most frequent diagnosis during 2011 accounting for 55 deaths in neonates. The importance of navel hygiene at birth and the provision of a clean dry bed for newborns cannot be over emphasised.

Respiratory infections accounted for 9.9 *per cent* of diagnoses in this age group in Ireland. A small proportion of these are aspiration pneumonia cases (Figure 17) where foreign material (often milk) enters the lungs when a calf is being stomach-tubed. Weakness at birth in many of these calves is the reason for stomach-tubing, such that their ability to fight the infection is often already compromised and mortality is consequently very high. During 2011 in Northern Ireland, eight of the twelve cases of aspiration pneumonia recorded were diagnosed among neonates.
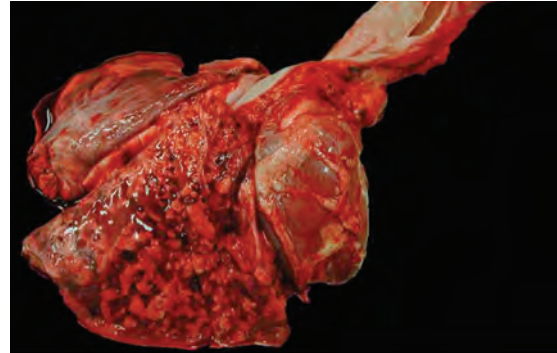
Figure 17: Patchwork lobular pattern of lung consolidation associated with foreign matter in the bronchioles in a calf less than one-day-of-age (Photo W. Byrne).

The category 'Circulatory non-infectious' includes bovine neonatal pancytopaenia (BNP) cases, of which there were 21 cases recorded in Ireland during 2011. The majority of these cases were recorded in Co. Cork. In Northern Ireland there were 42 calves recorded with BNP during 2011. Further information on BNP is available on page 24 of this report.
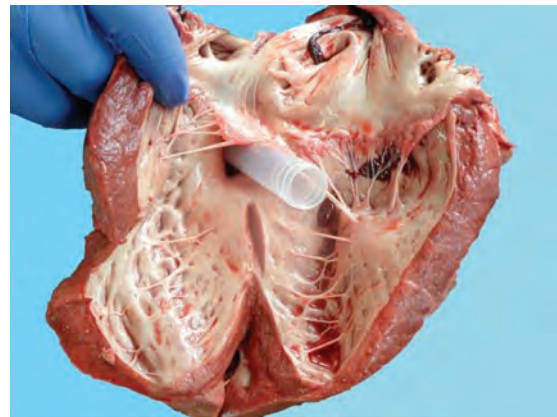
Figure 18: A ventricular septal defect in a two day old calf (Photo: Cosme Sanchez-Miguel).

In Ireland, 'Hereditary & developmental abnormality' (three *per cent*) includes a number of conditions among which atresia (four cases of anal atresia, ten cases of colon atresia and one case of jejunal atresia), ventricular septal defects (eight cases) (Figure 18) and dwarfism/chondrodysplasia (seven cases) predominate. In Northern Ireland, fourteen cases (1.9 *per cent*) were recorded in this category, comprising six cases of atresia ilei, five cases of patent ductus arteriosus, two cases of patent foramen ovale and one case of cerebellar hypoplasia.
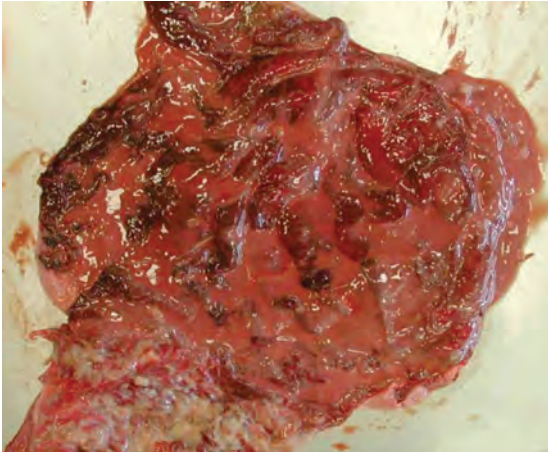
Figure 19: Acute diffuse inflammation of the abomasal mucosa from a three-week-old calf with *Salmonella* Typhimurium infection (Photo: William Byrne).

Salmonella Dublin was more frequently isolated in younger animals during 2011 than in 2010. In Ireland there were in total, 106 isolations of this organism, the majority of which (69 cases) were in neonates. The majority of the isolates, in all ages, were associated with septicaemia (76 cases) while there were 20 cases associated with enteritis and five with pneumonia. In Northern Ireland *Salmonella* Dublin was isolated from ten cases of septicaemia across all age-groups. *Salmonella* Typhimurium was much less frequently isolated than *Salmonella* Dublin in Ireland, with four isolates from adults and one from a neonate (Figure 19).

Included in the category 'Other diagnoses' in Ireland are diseases which account for three *per cent* or less of all diagnoses in this age group e.g. non-infectious respiratory diseases (30 cases), dystocia/anoxia (29 cases), abomasal ulceration (22 cases) and BVD/ Mucosal disease (21 cases). In Northern Ireland this category includes three cases of pericarditis and four cases in which haemorrhage was the cause of death.

Dystocia in beef calves
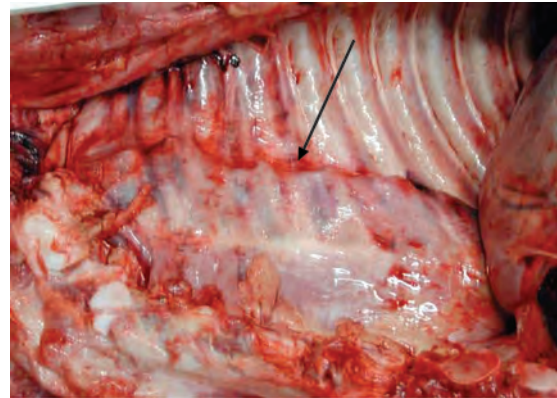
Figure 20: Multiple rib fractures (arrow) in a neonatal calf in which a diagnosis of dystocia was made (Photo: William Byrne).

Dystocia (Figure 20) accounts for a number of losses of calves annually on Irish farms. Occasionally these losses are precipitated by poor sire selection or alternatively by heifers going in-calf too young (often unbeknownst to herdowners). To examine these cases further, herd and calf details from the ICBF database relating to diagnoses of dystocia and anoxia in 86 beef calves (recorded as either foetuses or neonates) diagnosed by RVLs in 2011 were examined. Table 1 outlines some of the parameters of these beef herds.

	Mean	Median	National average
Total calvings	37.83	24.50	15
No. of heifers	7.51	5.00	
% of heifers	20.32	17.24	16
Heifer age at calving (months)	31.94	32.90	30

Table 1: Parameters of beef herds which had a diagnosis of dystocia / anoxia in a neonatal calf submitted for post-mortem examination to a RVL in 2011.

The average herd size among beef herds from which a dystocia case originated was 37.83 cows which was greater than the national average (15 cows) for suckler herds and the percentage of heifers in these herds (20.32 *per cent*) was also greater than the national average (16 *per cent*). The age at which these heifers calve down is marginally above the national average for beef heifers (32 months versus 30 months).

Sire Breed	% Breed in sample size	% in general population
A.Angus	5.4	7.9
B.Blue	14.0	7.9
Charolais	33.3	36.4
Hereford	5.4	3.6
Limousin	28.1	32.4
Simmental	5.4	5.4
Other	8.9	6.4

Table 2: The breed of sire of calves in which a diagnosis of dystocia/anoxia was made in 2011.

No of calvings *per* dam	Percentage
parity 1	30.6
parity 2	14.5
parity 3	16.1

Table 3: The parity of dams of beef calves in which a diagnosis of dystocia/anoxia was made in 2011.

Some of the findings were not unexpected – the proportion of Belgian blue sires in the study was almost twice that of the proportion of Belgian Blue bulls used in the general population (Table 2) and heifers accounted for 30 *per cent* of dams of calves with a diagnosis of dystocia in 2011 (Table 3). Dystocia cases were also most prevalent in December and January when many of the heifers would typically calve.

Calving ease score	Percentage
Calve ease score 1	33.3
Calve ease score 2	27.1
Calve ease score 3	14.5
Calve ease score 4	25

Table 4: The calving ease score of dams of beef calves in which a diagnosis of dystocia/anoxia was made in 2011

Other findings, such as the prevalence of dystocia/ anoxia cases among calves born to easy calving score

dams, were not expected. The majority of these dams had a score of 1 or 2 denoting that they should calve with no or minimal assistance. This finding may reflect a failure of adequate supervision of calving playing a role in the loss of some of these calves.

Calves

Owing to differences in the age categorisation of calves on the respective data management systems of the AFBI (one- to five-months-old) and DAFM laboratories (one- to three-months-old), the data from each laboratory service presented in this section is not directly comparable. However, despite these differences in the age categorisation of calves, the diagnosed causes of mortality of animals recorded as 'calves' on post-mortem examination in DAFM (Figure 21) and AFBI (Figure 22) laboratories continue to be quite similar.

Figure 21: The conditions most frequently diagnosed on post-mortem examination of calves (one to three-months-old) in Ireland in 2011 (n=514).

Respiratory infections were the most commonly diagnosed cause of mortality in calves on the island of Ireland during 2011. The recorded frequency of respiratory infections in calves in Ireland declined during 2011 (22.8 *per cent*) when compared to 2010 (29.6 *per cent*) while that in Northern Ireland remained stable at 34 *per cent* of deaths in calves aged between one and five months.

Figure 22: The conditions most frequently diagnosed on post-mortem examinations of juvenile calves (one to five-month-old) in Northern Ireland during 2011 (n=488).

Enteric infections were diagnosed on post-mortem examination in 15.0 *per cent* of calves in Ireland and 11.3 *per cent* of calves in Northern Ireland during 2011. The range of enteric pathogens afflicting calves in this age group differs from neonatal calves, with conditions such as coccidiosis and salmonellosis predominating.

Figure 23: A jejunal intussusception in a young calf (Photo: William Byrne).

GIT torsions or other gastrointestinal obstructions are a relatively common but sporadic finding in calves, accounting for 7.2 *per cent* of calf diagnoses in Ireland and 4.7 *per cent* in Northern Ireland during 2011. Torsion or obstructions such as intussusceptions (Figure 23) typically lead to occlusion of the lumen of the intestine and circulatory disturbance. In acute cases this disturbance can lead to shock and sudden death while in subacute cases metabolic alkalosis due to reflux of ingesta into the abomasum and rumen occurs. Toxins can also leak into the mesenteric blood vessels through

the intestinal wall if the blood supply is compromised leading to toxaemia and rapid deterioration.

Most intussusceptions are found near the the distal jejunum or proximal ileum, often in calves of two-months–of-age or less. Caecocolic and colonic intussusceptions are recorded less frequently in calves. Intestinal volvulus and volvulus around the mesenteric root are seen sporadically at all ages.
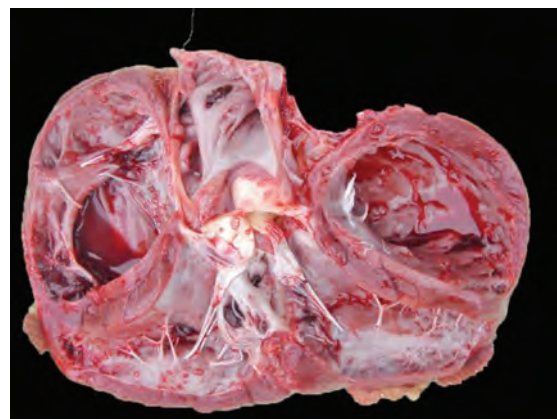
Figure 24: Dilated cardiomyopathy in the heart of a one-month-old calf (Photo: Mícheál Casey).

Among those conditions which were categorised as 'Other diagnoses' were BVD/Mucosal disease (13 cases in Ireland and seven cases in Northern Ireland), poisoning (12 cases in Ireland) and non-infectious circulatory conditions (e.g. heart failure) (Figure 24) (11 cases in Ireland, seven in Northern Ireland). Northern Ireland also recorded six cases of pericarditis and one case of aortic thrombosis in this age-group.

Weanlings

The age categorisation used for denoting weanlings differs between the data management systems used by AFBI and DAFM laboratories. DAFM categorises weanlings as cattle between three and twelve months of age while AFBI use this category for cattle between six and twelve months of age. The relative frequency of the most common diagnoses recorded in the respective age groups referred to as 'weanlings' are presented in Figure 25 for Ireland and in Figure 26 for Northern Ireland.
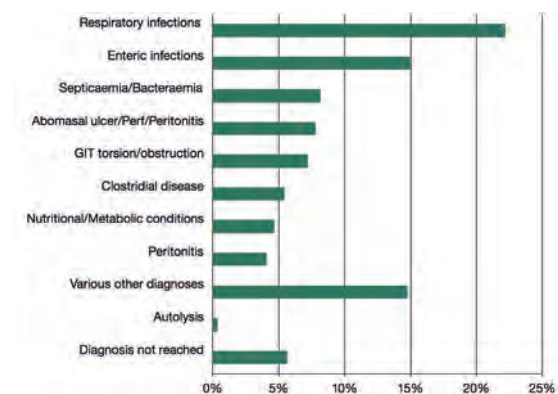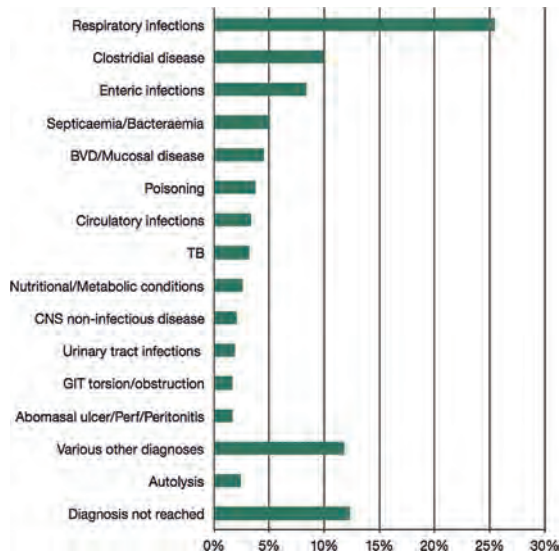
Figure 25: The conditions most frequently diagnosed on post-mortem examination of weanlings (three to twelve-months-old) in Ireland in 2011 (n=535).

Respiratory disease was responsible for one quarter of all deaths in weanlings examined *post mortem* in Ireland during 2011. This figure, while extremely high, actually represents a marginal improvement in comparison to 2010 when approximately 30 *per cent* of deaths were attributable to respiratory disease. In Northern Ireland a contrasting trend was observed, with pneumonia recorded in 40.9 *per cent* of weanlings during 2011, a notable increase on the 2010 figure of 31.0 *per cent*. This finding highlights the enormity of the problem of respiratory disease in this age group and the need for veterinary practitioners and their clients to adopt a multifaceted approach to tackling this disease through appropriate husbandry, vaccination and antimicrobial treatment (where warranted).
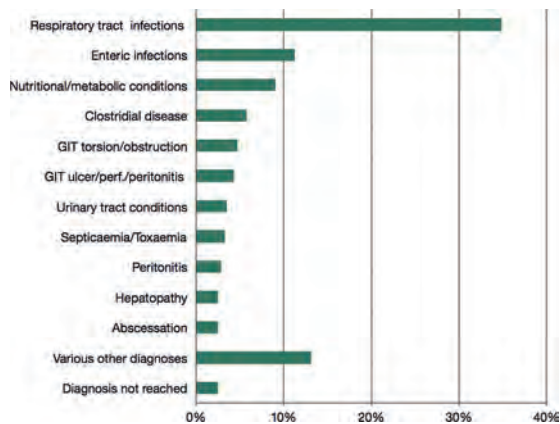

Figure 26: The conditions most frequently diagnosed on post-mortem examination of weanlings (six to twelve-months-old) in Northern Ireland during 2011 (n=159).

Many cases of respiratory disease in weanlings are classical enzootic pneumonia cases where co-infection of the lungs by two or more pathogens is implicated. The confluence of events such as weaning, transportation for sale and/or the introduction into a new herd can cause stress which allows such infections to flourish. This is discussed in more detail in the Bovine respiratory disease section on page 36.

Figure 27: The classical liver lesion associated with Black disease caused by *Clostridium novyi* infection (Photo: Colm Ó Muireagáin).

Clostridial disease (9.9 *per cent* in Ireland, 11.3 *per cent* in Northern Ireland) continues to claim significant numbers of weanlings each year and the relative frequency of diagnosis of these diseases increased

among weanlings in Ireland during 2011 when compared with 2010 (6.3 *per cent*). In Northern Ireland the relative frequency of diagnoses of clostridial disease has decreased from the level of 14.4 *per cent* recorded in 2010. Many of these losses are readily preventable as multivalent, clostridial vaccines are widely available and are quite effective in controlling these diseases.

In total, there were 21 post-mortem diagnoses of TB in DAFM laboratories during 2011, of which 17 were diagnosed in weanlings. The animals came from five herds.

Figure 28: Ulcerative enteritis in the intestine of a weanling infected with the BVD virus (Photo: Dónal Toolan).

BVD virus was detected in 24 weanling carcases by PCR methodology in Ireland during 2011 (Figure 28), which was the age group in which it was most frequently detected. Nevertheless, this figure represents a reduced frequency of detection when, compared to 2010, the virus was detected in 31 weanling carcases. BVD virus was detected in three carcases in this age-group in Northern Ireland.

In both jurisdictions, the category 'Other diagnoses' includes conditions such as intestinal torsion and obstruction (nine cases in Ireland, two cases in Northern Ireland), non-infectious central nervous system conditions (such as CCN) and urinary tract infections, which were diagnosed in less than three *per cent* of weanlings examined *post mortem*.

Adult cattle

Figure 29: The conditions most frequently diagnosed on post-mortem examination of adult (greater than twelve-months-old) cattle in Ireland in 2011 (n=543).

In both jurisdictions adult cattle are classified, for surveillance purposes, as those over twelve-months-of-age and it is among cattle in this age group that the most diverse range of diagnoses are recorded.

Respiratory disease was the most commonly diagnosed cause of death in adult cattle on the island of Ireland (15.5 *per cent* and 14.1 *per cent* of deaths in Ireland and Northern Ireland respectively) during 2011 (Figure 29 and Figure 30) which is consistent with the trend in all age groups of cattle with the exception of neonates. There were eleven cases of hoose recorded among adults in Northern Ireland and six cases in Ireland. An examination of the most frequently identified pathogens is available in the respiratory disease section of this report (see page 36).

Peritonitis is an occasional sequel to enteritis, uterine infections or abscessation in cattle and was diagnosed in 6.8 *per cent* and 3.7 *per cent* of adult carcases examined *post mortem*, in Ireland and Northern Ireland respectively, during 2011.
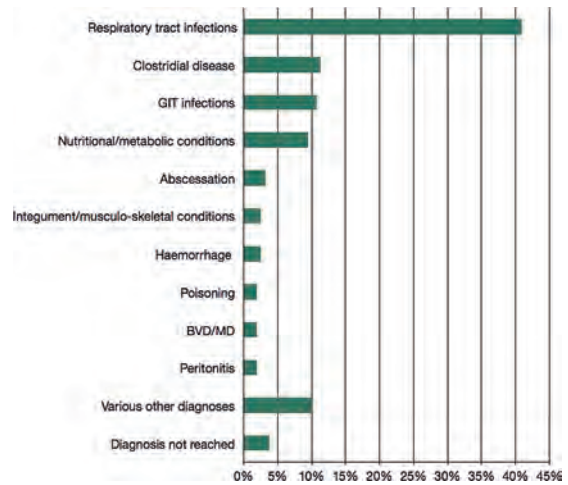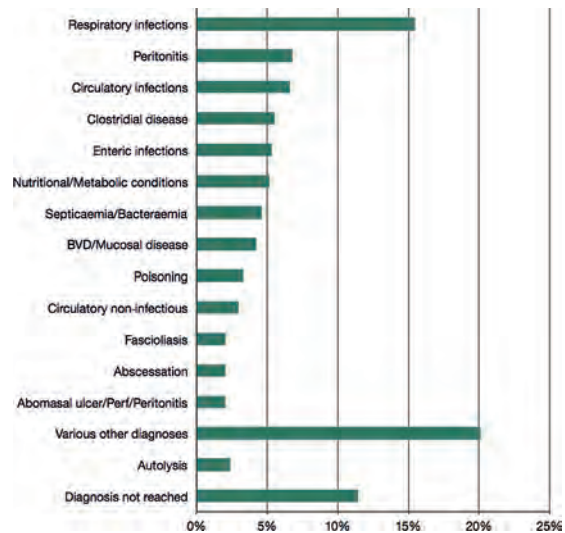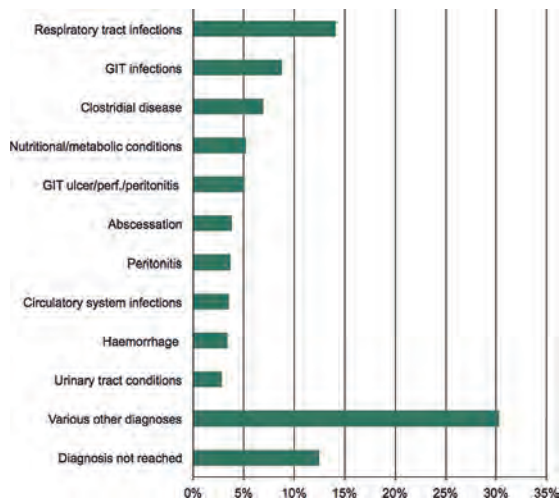
Figure 30: The conditions most frequently diagnosed on post-mortem examination of adult (greater than twelve-months-old) cattle in Northern Ireland during 2011 (n=595).

The category 'nutritional/metabolic' conditions accounted for 5.2 *per cent* of deaths among adults in both jurisdictions. The most common conditions recorded in this category were fatty liver, bloat, ruminal acidosis and metabolic acidosis. Fatty liver was recorded in 13 cases in Northern Ireland.
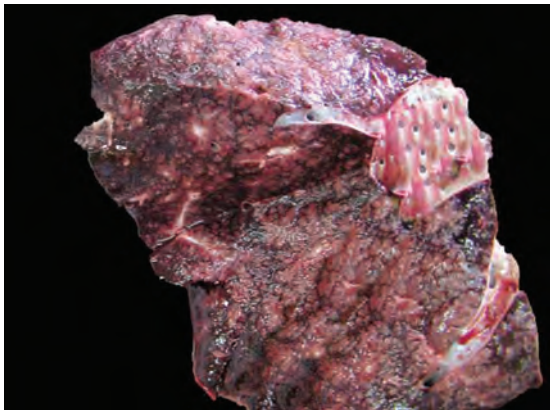
Figure 31: Chronic passive congestion of the liver associated with heart failure due to pericarditis in a cow. The cut surface has a 'nutmeg' pattern which is a characteristic finding (Photo: Dónal Toolan).

The category 'Circulatory infections' refers to a group of loosely associated conditions which, when combined, accounted for 6.6 *per cent* of adult deaths in Ireland and 3.5 *per cent* of adult deaths in Northern Ireland during 2011. Included in this category were cases of babesiosis (16 cases in Ireland, three in Northern

Ireland), endocarditis (17), pericarditis (16 cases in Ireland, eight in Northern Ireland), myocarditis (four cases in Ireland, two in Northern Ireland) and posterior vena caval thrombosis (three cases in Ireland, eight cases in Northern Ireland).

Enteric infections accounted for 5.3 *per cent* of diagnoses among adult cattle in Ireland during 2011. Included in this were eight cases of Johne's disease which was the same number as recorded *post mortem* during 2010.

In both jurisdictions, 'Other diagnoses' includes conditions which were recorded in less than three *per cent* of carcases examined *post mortem*; this category includes conditions such as abscessation, tumours and fascioliasis. Liver abscessation was recorded as the cause of death in 13 adult cattle in Northern Ireland. Abscesses associated with fatalities were also recorded by AFBI in the brain, spine, muscle, heart and feet.

A total of 15 tumours were diagnosed in cattle in Ireland during 2011. The majority of these (seven cases) were identified in adult animals while a further five cases were identified in weanlings. Among the tumours which were identified in all ages of cattle, lymphosarcoma was the most commonly identified tumour (eight cases) while haemangioma, glial cell tumour, lymphoma, metastatic adenocarcinoma, and a cholangiocarcinoma with peritoneal metastases (one case of each) were detected less frequently.

In Northern Ireland other diagnoses of interest among the 'Other diagnoses' category included nine cases of ruptured uterus and twelve cases of foreign body reticulitis.

Diagnoses of fascioliasis as a cause of death in adult cattle in Ireland decreased to two *per cent* of diagnoses during 2011 compared to the elevated levels witnessed during 2010 (6.6 *per cent*) and 2009 (9.0 *per cent*). This may reflect the joint effects of reduced precipitation during 2011 when compared to 2009, in particular, as well as the increased awareness by herdowners of the need to monitor the levels of fluke in their herds. In Northern Ireland the reduction in diagnoses of fascioliasis as the cause of death in adult cattle decreased from 3.0 *per cent* in 2010 to 1.7 *per cent* in 2011.

Figure 32: Sloughing of the mucosa of the dental pad of a sixteen-month-old heifer diagnosed with malignant catarrhal fever (Photo: Mícheál Casey).

Malignant Catarrhal Fever (MCF) was diagnosed in three adults in Ireland and three in Northern Ireland during 2011. MCF is typically caused by ovine herpesvirus 2 which is endemic in sheep and carried asymptomatically by them. The incubation period in cattle can be 70 days or longer after exposure. Sudden death can occur from the peracute disease while animals with acute disease (Figure 32) often show bilateral corneal opacity, mucopurulent oculonasal discharge, and an encrusted muzzle. Diarrhoea, haemorrhagic gastroenteritis or haematuria can also occur. Occasionally, animals display nervous signs including incoordination, or head pressing. The mortality rate is typically 90-100 *per cent* in symptomatic animals.
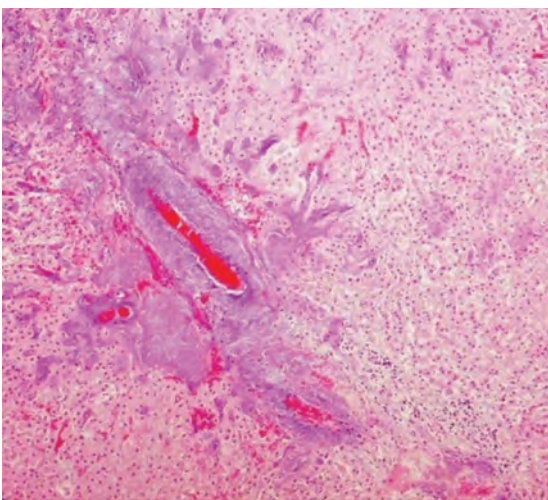
Figure 33: Acute necrotising bacterial hepatitis associated with *Bibersteinia trehalosi* infection in a two-year-old bullock (Photo: Cosme Sánchez-Miguel).

There was one diagnosis of *Bibersteinia trehalosi* infection in a two-year-old bullock in Ireland (Figure 33). Grossly, serosal surface petechiation of the gastrointestinal tract, spleen and myocardium were noted with a focal area of hard consistency within the hepatic parenchyma and necrosis/oedema of the gallbladder. *B. trehalosi* is an occasionally identified cause of acute systemic infection of growing lambs in the autumn but is less frequently recorded in cattle. Watson and Scholes, 2010, have identified *B. trehalosi* infection with marked hepatic involvement as having the potential for confusion with clostridial hepatitis.

References:
Watson, P.J., Scholes, S.F.E. (2010) *Bibersteinia trehalosi* necrotising hepatitis associated with sudden death in an adult cow. *Veterinary Record* (2010) 167, 100-102

Clostridial disease in cattle
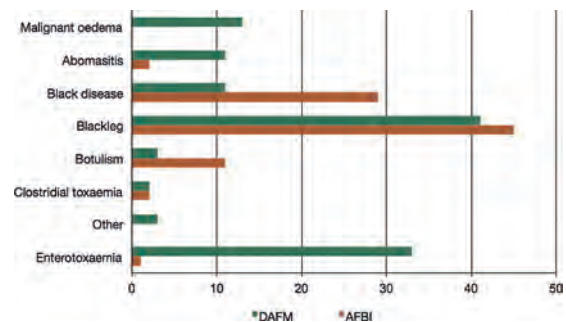
Figure 34: The number of cases of various clostridial diseases recorded in AFBI (n=88) and DAFM (n=117) laboratories during 2011.

As in 2010, blackleg was again the most commonly diagnosed clostridial disease of cattle on the island of Ireland during 2011. Forty five cases of blackleg were diagnosed in Northern Ireland while 41 cases were diagnosed in Ireland (Figure 34). Cases of blackleg were more commonly seen in younger animals with a total of just four cases recorded in animals over 24 months-of-age.
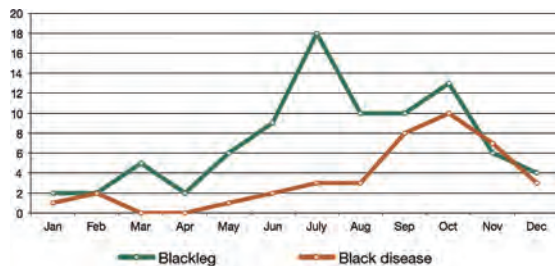
Figure 35: The distribution, by month, of the number of diagnoses of blackleg and black disease on the island of Ireland.

Figure 35 displays the number of blackleg and black disease cases diagnosed, by month, in both the AFBI and DAFM laboratories during 2011. Cases of blackleg were most frequently diagnosed during the summer and autumn months, in animals at pasture, reflecting the fact that *Clostridium chauveoi* is a soil-associated organism whose spores can remain viable in soil for many years. It is notable however that blackleg cases were also recorded in animals during the housing period.

Figure 36: Scleral oedema in an animal diagnosed with black disease (Photo: Colm Ó Muireagáin).

During 2011, black disease (Figure 36) was diagnosed on post-mortem examination in 40 cattle carcases (29 in Northern Ireland and 11 in Ireland) with a surge in cases witnessed in the autumn months. Black disease is caused by toxin production by *Clostridium novyi* bacteria in the liver. Liver damage caused by migrating immature fluke can create a suitable low oxygen environment which promotes the activation of *Clostridial novyii* spores and the production of toxins. The association with immature fluke migration can explain, in part, the seasonal occurrence. It is notable that 36 of the 40 cases recorded on the island of Ireland

were diagnosed in cattle older than 12 months of age.

Clostridial enterotoxaemia was the second most common clostridial disease diagnosis in Ireland (33 cases). A number of *Clostridium spp.* can cause clostridial enterotoxaemia and this is reflected in the variety of pathogens identified in these cases. Seventeen of these cases were associated with *C. sordellii*, three with *C. perfringens* and one case was associated with *C. novyi*.

Malignant oedema, an acute toxaemia of ruminants, horses, and pigs, is caused by *Clostridium septicum*, but other species, such as *C. chauvoei*, *C. novyi*, or *C. sordellii* may also be implicated. The causative pathogen can infect the animal through superficial wounds with the devitalised tissue providing the suitable anaerobic conditions for activation of the clostridial spores. Of the thirteen cases diagnosed in Ireland during 2011, seven were associated with *C. sordellii* infection.

Occasional cases of botulism continue to be recorded annually. Botulism is caused by *C. botulinum*. The 'Type D' toxin of *C. botulinum* is the most commonly identified botulinum toxin in cattle. Cattle and sheep of all ages are susceptible to botulism, which is characterised by progressive muscle weakness (paralysis). Cattle display a characteristic progressive flaccid paralysis. Tongue protrusion is considered pathognomic for the disease but is, in fact, a rarely reported clinical sign. Testing of all samples on the island of Ireland is carried out by the AFBI veterinary science division (VSD) in conjunction with the DAFM laboratories. During 2011, *C. botulinum* toxin was identified in three samples submitted *via* DAFM and in eleven cases in Northern Ireland.

Fatal poisonings in cattle

Poisoning continues to be a significant cause of death on Irish farms, often resulting in multiple loses in the course of an explosive outbreak. The most common toxicities identified on post-mortem examination of cattle during 2011 in the AFBI and DAFM laboratories are presented in Table 5.

Poisonous Agent	AFBI	DAFM
Carbofurans	0	1
Copper	2	6
Lead	4	27
Ragwort	0	1
Salicylanides	2	0
Selenium	0	2
Yew	0	2
Totals	**8**	**39**

Table 5: The frequency of detection of various toxic agents in bovine carcases where poisoning was diagnosed in 2011.

Lead

Each year, lead proves to be the most common cause of fatal poisoning in cattle on the island of Ireland. During 2011 a total of 31 cattle, of various ages, were identified, on post-mortem examination, as having succumbed to lead poisoning. This figure actually represented a decreased incidence when compared to 2010, when 46 such cattle were identified. Two notable features of lead poisoning of cattle in Ireland are the age profile of fatal lead poisoning cases – 15 of the 31 cases were less than six months of age – and the seasonal nature of the occurrence of cases – most cases occurred during the grazing period (Figure 37).
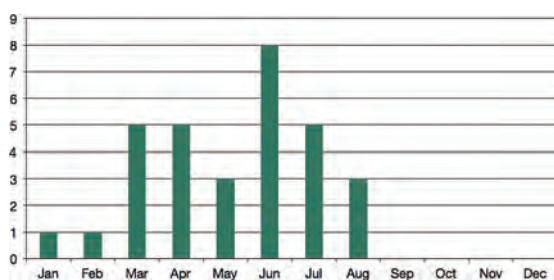
Figure 37: The monthly distribution of lead poisoning cases on the island of Ireland during 2011 (n=31).

Following a diagnosis of lead poisoning in the post-mortem room it is vital that the source of the lead is discovered without delay to prevent further losses. Many of the sources which are regularly identified as being

implicated in lead poisoning cases include old batteries, sump oil, flaking paint, paint cans and rubbish fire ash which contains lead. Herdowners are strongly advised to walk their land before the turnout of cattle onto pasture to identify if any items have been dumped on their land which could potentially poison their animals.

Figure 38: The characteristic finding of pale musculature ('fish flesh') in a weanling carcase in which lead toxicity was confirmed (Photo: Colm Ó Muireagáin).

Clinical signs of lead poisoning are attributable to

Figure 39: Petechial thymic haemorrhages which are a characteristic post-mortem finding in cases of lead toxicity (Photo: Colm Ó Muireagáin).

To prevent lead poisoning in livestock

- Dispose of used car batteries and motor oil through official local authority routes

- Keep rubbish out of pastures and areas used by animals

- Prevent access to rubbish sites

- Service farm machinery away from animals

- Remove all lead paint

- Check all areas carefully before introducing animals

- Do not overgraze areas that have potentially high soil lead

Cases of lead toxicity diagnosed at AFBI laboratories are notified to the Food Standards Agency (FSA). The FSA advised that farmers observe a meat withdrawal period of at least 16 weeks before animals which were potentially exposed to sources of lead are slaughtered for human consumption.

Copper

Copper is an important mineral required for the growth and development of animals and the provision of copper supplementation to animals is an important practice in copper deficient herds. Excess copper, however, is regularly fatal and, in many cases, is associated with over-zealous supplementation of animals by herdowners who fail to adhere to the dosing recommendations of manufacturers or fail to assess the copper status of their herd before engaging in supplementation.

DAFM laboratories investigated one case where a batch of 40 seven-week-old calves were orally administered copper sulphate. Within four hours some calves had already died and in spite of vigorous veterinary therapy, the deaths continued. Three calves were examined at a regional veterinary laboratory within 24 hours of receiving veterinary treatment. At post-mortem examination all of the calves appeared markedly dehydrated, the abomasal mucosa was blue-green in colour and intestinal contents were also blue-green. Kidney copper values were marginally elevated. An additional three calves from the same batch died three days after treatment and were examined *post mortem*. There was thickening and necrosis on the abomasal mucosa and haemoglobinuria. Kidney copper values were at the upper end of the normal range.

Clinical signs of acute copper poisoning in cattle are usually due to the development of an acute haemolytic crisis leading to haemolysis and haemoglobinuria. Affected animals exhibit depression, weakness, pale mucous membranes, haemoglobinuria and jaundice. Occasionally, when administered large amounts of solutions such as copper sulphate, the acidic nature of the fluid is responsible for severe enteritis and sloughing of the mucosa with consequent dehydration and shock before the copper is absorbed into the circulation.

Herdowners should only engage in copper supplementation when herd deficiency has been confirmed by the laboratory.

Yew tree poisoning

Figure 40: Yew leaves identified in the rumen contents of a heifer (Photo: Ian Hogan).

Yew tree (*Taxus spp.*) poisoning was diagnosed in two animals by DAFM laboratories during 2011. Yew species

are toxic all year round and contain a number of toxic alkaloids referred to as taxines. Taxines inhibit normal sodium and calcium exchange across myocardial cells, depressing electrical conduction which results in arrhythmias and rapid death. Death is sufficiently rapid that animals are often found adjacent to the yew tree or clippings. There are no specific post-mortem lesions associated with yew poisoning but, owing to the rapid clinical course, the discovery of partially digested twigs and needles in the mouth or stomach (Figure 40) is diagnostic. Neither is there a specific treatment or antidote for yew poisoning. Poisoning of livestock normally occurs when yew trimmings are thrown or left where they are easily accessible to ruminants or horses.

Selenium poisoning

Selenium is a component of the glutathione peroxidase enzyme that acts as an antioxidant during the release of energy. However, it has a narrow margin of safety and if supplemented without assessing the selenium status of the animal in advance, there is the potential for toxicity to occur. Selenium toxicity causes acute generalised cytotoxicity by inhibiting cellular oxidation/reduction reactions. Chronic selenium toxicity leads to the altered structure and function of cellular components due to the replacement of sulphur by selenium. This is seen clinically through changes in hooves and hair due to the effects of this on the structutre of keratinocytes.

Clinical signs of toxicity include abnormal posture, unsteady gait, abdominal pain and diarrhoea and increased heart rate. Post-mortem signs are non specific with acute congestion and haemorrhages in many organs but particularly in the endocardium noted. Selenium toxicity was recorded in two cows by DAFM during 2011.

Halogenated salicylanide toxicosis

Halogenated salicylanilides are anthelmintics used in the treatment of liver fluke infestations and include closantel and rafoxanide. Closantel is a broad-spectrum antiparasitic agent used against several species and developmental stages of trematodes, nematodes and arthropods. The anti-trematode activity of closantel is mainly used against liver fluke while the anti-nematode and anti-arthropod activity is especially used against those species which feed on blood or plasma. The drug is widely used in sheep and cattle and can be used either parenterally or orally for both prophylactic and therapeutic purposes. It is available in drench, bolus and injectable formulations. Closantel has also been combined with mebendazole and several other benzimidazoles in drench formulations for sheep and with levamisole in a bolus for cattle (Marsboom *et al.*, 1989).

In sheep and cattle, clinical signs of toxicity include anorexia, laboured breathing, recumbency, general weakness and decreased vision or blindness, appearing approximately one week after dosing.
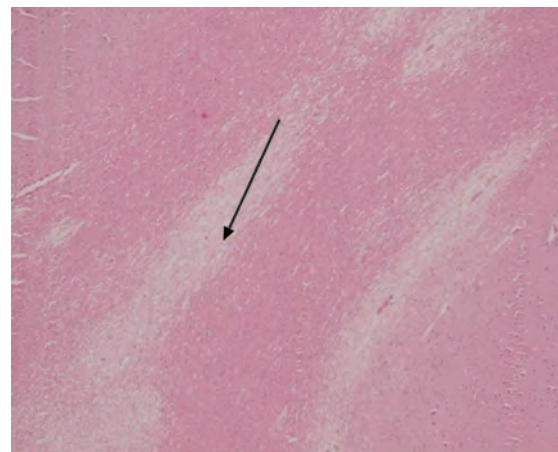
Figure 41: Angiocentric perivascular leucomalacia (arrow) affecting the white matter of the cerebrum of a four month old calf in which halogenated salicylanilides toxicity was diagnosed (Photo: Seán Fee).

Two cases of suspected toxicity with halogenated salicylanilides were diagnosed by AFBI based on histological findings (Figure 41) and clinical history. In one case a four-month-old calf developed blindness and died one week after being treated with a closantel containing product without adherence to the recommended dosage. Unfortunately the safety index for closantel is not as high as it is for other anthelmintics and overdosage can lead to blindness, general weakness, convulsions and death.

Novel diseases of cattle

Bovine Neonatal Pancytopaenia

During 2011 the incidence of cases of bovine neonatal pancytopaenia (BNP) was distributed throughout the year with small peaks in late spring/early summer and again in the autumn, corresponding with the busiest calving periods. Northern Ireland diagnosed BNP in 42 calves, from 37 different farms and Ireland diagnosed the condition in 21 calves from 19 different farms during the year. These numbers reflect a small increase in the number of cases identified when compared to 2010 (when Northern Ireland recorded 36 affected calves, and Ireland recorded 16).
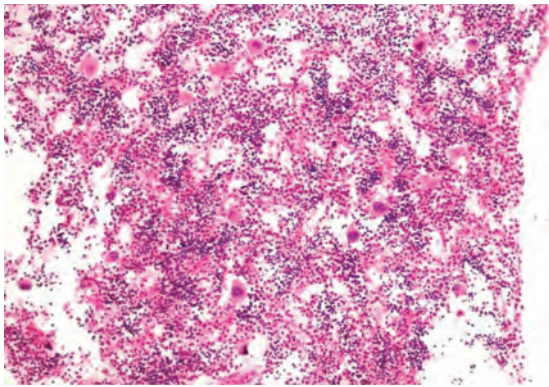
Figure 42: Sternal bone marrow from a normal calf (Photo: Pauline Baird)
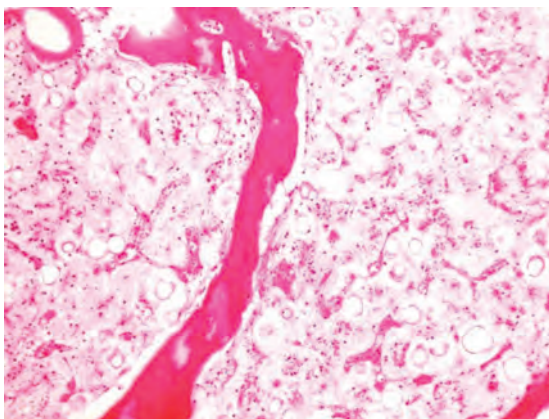
Figure 43: Sternal bone marrow from an affected calf. Note the lack of cellularity when compared to Figure 42 (Photo: Pauline Baird).

Clinical signs of BNP can vary, but typically, they include fever, pale mucous membranes with petechiae and melena. Research into the condition, which is ongoing in many European countries, continues to support the theory that a substance in the colostrum of particular cows is passed to calves fed that colostrum at birth and, in susceptible calves, causes the destruction of the calf's bone marrow cells. A particular bovine vaccine, which has been removed from the market, has been implicated as a possible cause of the condition. One research project (Bastian *et al.*, 2011) showed that sera of BNP dams (i.e. dams that gave birth to a BNP calf) harboured alloreactive antibodies which bound to surface antigens on bovine leukocytes. They also showed dependence between the number of booster immunisations with the suspected vaccine and the induction of alloreactive antibodies. Finally, they also demonstrated that BNP associated alloantibodies cross-react with the bovine kidney cell line used for vaccine production.

Other researchers (Deutskens *et al.*, 2011) determined that the antigens in bovine leukocytes reacting with these alloantibodies were major histocompatability complex 1 (MHC I) and a -2-microglobulin. They also demonstrated the presence of MHC-1 in the vaccine.

Not all calves fed the same colostrum are equally affected. This may be due to individual differences between calves (e.g. in terms of colostrum absorption or their immune systems) and partly explains why a cow may feed clinically normal calves in the years between producing affected calves.

Once a cow has had a calf which has been confirmed as a BNP case, her colostrum should not be used to feed calves, especially within the first days of life. Any calves born subsequently to affected dams will need to gain their vital colostral protection from an unaffected donor cow. While all farms should avoid the use of pooled colostrum due to the risk of spreading infectious diseases such as Johnes to a large number of vulnerable calves, farms with BNP cases are advised to store colostrum from healthy cows without a history of having affected calves to supply newborn calves of affected dams. It is good practice to record the identity of the donating cow against the calf receiving the colostrum.

No evidence has been found of an infectious or contagious cause of this disease and furthermore, there is no evidence to suggest that the milk or meat from affected cows or recovered calves is unsafe for human consumption.

References

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Fabian Deutskens, Benjamin Lamp, Christiane M Riedel, Eveline Wentz, Günter Lochnit, Klaus Doll, Heinz-Jürgen Thiel and Till Rümenapf (2011): Vaccine-induced antibodies linked to bovine neonatal pancytopenia (BNP) recognize cattle major histocompatibility complex class I (MHC I). *Veterinary Research* 2011, 42:97

Schmallenberg Virus

Schmallenberg virus (SBV) is a newly discovered virus from a family of viruses (Bunyaviridae) which are transmitted by biting insects, such as midges and mosquitoes. Although the source of SBV is unknown, the closest relatives of this virus seem to include a number of viruses (such as Akabane virus) that circulate in Asia and Africa.

Schmallenberg virus was first detected in Germany in 2011. It was subsequently identified in the Netherlands associated with disease outbreaks of diarrhoea, milk drop and mild fever in cattle which were recorded between August and October 2011. Signs in adult sheep are subtle and are often not detected. The clinical signs noted in cattle were transient and the cows made an apparent uneventful recovery. However, from early December, the Netherlands, Germany and Belgium detected increased numbers of stillbirths and congenital malformations, initially in sheep and later in cattle and other ruminants. SBV was detected in the tissues of affected lambs and calves.

Figure 44: Arthrogryposis and twisted spine © Crown Copyright 2012

The congenital malformations range from fused joints and distorted limbs or spines (arthrogryposis) (Figure 44), to shortened lower jaws or brain deformities. In some cases, the lamb or calf may appear clinically normal but may be blind, ataxic, unable to rise or suck, or prone to fitting. Deformities in the lambs and calves depend on the dams being pregnant when they are first infected, with the virus causing damage particularly to the nervous system of the foetus, and the stage of the pregnancy has an influence on the type of deformity.

Figure 45: *Culicoides spp.* are capable of transmitting SBV (Photo: Sam Clawson).

Figure 46: Blood fed *Culicoides obsoletus* (Photo: Sam Clawson).

It is thought that the disease is spread by biting flies such as midges and mosquitoes, and SBV has been detected in *Culicoides spp.* midges in Belgium, among species that are present in Ireland (Figure 45 and Figure 46).

No cases of SBV infection have been identified in Ireland; however cases were detected in England from early 2012. The English cases are thought to have been infected from biting insects blown across the English Channel from mainland Europe during the summer or autumn months.

Currently it is believed that SBV is more likely to arrive in Ireland *via* imported livestock from affected areas of Europe and GB rather than windborne spread of insects, but as more cases are detected across Europe and GB this situation may change and as potential insect vectors of SBV occur in Ireland the risk of SBV becoming established in the national herds or flocks of both jurisdictions remains.

Surveillance for SBV is ongoing, through post-mortem examinations of stillborn and aborted ruminants, virology analysis and through the trapping and testing of insects at various sites. A vaccine is not currently available to protect against SBV but it is hoped that current research in this regard will soon come to fruition. A serological test is now available to help identify previously infected animals. Previous tests relied on identification of the virus in the tissues of affected animals during the short viraemic phase.

There is no evidence that SBV or the closest related viruses are a risk to human health, but precautions at calving and lambing are advised, with pregnant women avoiding all contact with ruminants around the time they give birth or any of the birth products.

Salient Features

- thought to be spread *via* insects such as midges and mosquitoes
- affects ruminants including sheep, cattle and goats
- may cause mild, transient disease around the time of infection
- if ruminants (cattle, sheep or goats) are pregnant when first infected, offspring may be weak or stillborn or may have malformed brains, heads or joints
- currently no vaccine is available
- no known risk to human health

Bovine neonatal enteritis

Neonatal enteritis continues to be the most common cause of mortalities in calves less than one month of age on the island of Ireland (see Figure 14 and Figure 15). Neonatal enteritis is generally caused by the interaction of a number of infectious enteropathogens and predisposing factors.
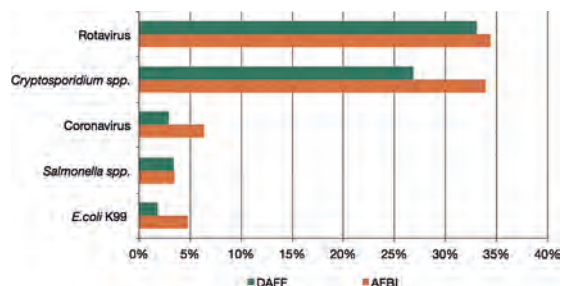

Figure 47: Relative frequency of enteropathogens identified in faeces from calves less than one month of age in 2011.

The most common infectious enteropathogens include *Escherichia coli*, *Salmonella spp.*, rotavirus, coronavirus and *Cryptosporidium*. While often present as a single

infection, any of these pathogens may be present as a co-infection with other pathogens. The relative frequency of detection of selected enteric pathogens in calf faecal samples in 2011 is shown in Figure 47. Rotavirus (33.5 *per cent* in Ireland and 34.4 *per cent* in Northern Ireland) and *Cryptosporidium* (28.1 *per cent* in Ireland and 33.9 *per cent* in Northern Ireland) were the enteropathogens most commonly detected in faecal samples from calves less than one month of age, while *E. coli* K99, *Salmonella spp.*, and coronavirus were less frequently detected.

Figure 48: Splenomegaly and icterus due to *Salmonella* Dublin infection in a young calf (Photo: William Byrne).

Salmonella Dublin is an invasive pathogen and can cause a number of other conditions (Figure 48; Figure 49) in young calves such as septicaemia and pneumonia. It was detected in 3.4 *per cent* of faecal samples tested in both jurisdictions.

Figure 49: Diffuse enteritis with a luminal fibrin cast present in the small intestine (dissected longitudinally), associated with *Salmonella* Dublin infection (Photo: Dónal Toolan).

Campylobacter jejuni was detected in 9.3 *per cent* of the samples tested. *Campylobacter jejuni* is not usually pathogenic in cattle; however, it is an important bacterial enteric pathogen in humans. *Eimeria spp.* were detected in 15.2 *per cent* of samples tested. *Eimeria spp.* are a significant cause of calf enteritis, typically in calves older than one month of age. Infection in younger calves is occasionally reported, usually when the young animals are placed on pasture or in housing contaminated by older infected cattle.

Pathogens such as *Cryptosporidium parvum*, *Campylobacter jejuni* and *Salmonella spp.* are all potentially zoonotic and the frequency with which they are detected in calf faeces highlights the importance of adherence to good hygiene practices by calf handlers.

During 2011, peak submissions of faecal samples from neonatal calves for enteropathogen detection occurred between January and March in the DAFM laboratories and between April and June in the AFBI laboratories, corresponding with the main calving seasons observed in the two jurisdictions. There was no obvious seasonal pattern with respect to the relative frequency of detection of each enteropathogen.

Failure of veterinary practitioners to include the age of the calf in addition to a history of treatment, when submitting samples continues to pose difficulties for laboratories. The significance of detection of some pathogens is dependent on the age of the calf. For example, *E. coli* K99 causes secretory diarrhoea in the first five days of life while the other common infectious agents cause damage to the intestinal mucosa resulting in mixed malabsorption and secretory diarrhoea, mainly in the first three weeks of life. Treatment history is also important as antimicrobial treatment can hinder the ability to culture a causative pathogen on bacteriological examination. For this reason we advise that to aid the achievement of a diagnosis, faecal samples from neonatal calves with enteric infections should be taken early in the course of clinical signs and prior to the administration of treatment.

On some farms, rotavirus, coronavirus and *Cryptosporidium* are associated with minimal clinical signs while on other farms the balance is shifted toward severe disease. The causes of calf enteritis

are multifactorial and include factors that affect the resistance of calves (such as adequate passive transfer of immunoglobulins) and those that affect the challenge dose of pathogens (such as the housing standards or the hygienic management of the calf's environment) playing a central role.

These factors can be addressed by appropriate management. The resistance of the calves to infection can be improved by feeding an adequate quantity and quality of colostrum at, or very soon after, birth (three litres within two hours of calf's birth). When colostrum management is optimised, vaccination of dams may also play a role in the control of some enteric pathogens. Resistance can also be positively affected by the appropriate nutrition of young calves.

Reduction of the extent of pathogen contamination in the calf's environment can be effected by the provision of clean dry housing, as well as clean feeding equipment. As the calving season progresses, there is potential for the build-up of infectious agents in the calves' environment; adequate calf house hygiene procedures should be maintained until the end of the calving season. Grouping calves according to their age and avoiding high stocking densities are two further measures which can also help to manage the infection pressure in the calves' environment.

The basic principles for the treatment of the neonatal diarrhoeic calf include:

- Rapid isolation and treatment of sick calves to prevent spread of infection.

- Using oral rehydration solutions to replace the lost salts and fluids.

- Feeding milk or milk replacer to provide the energy required for weight gain and the nutrients that are necessary for the recovery of the intestinal mucosa.

- The prudent use of antibiotics to avoid antimicrobial resistance building up among pathogens on the farm. Only the diarrhoeic animal presenting clinical signs of systemic illness should be treated.

- *Cryptosporidium* can be controlled by using a preventive treatment with halofuginone lactate in combination with good hygiene practice. The specific effect of that drug on *Cryptosporidium* can delay the onset of diarrhoea and reduce any environmental contamination.

- Ammonia-based disinfectants or steam cleaning are the most effective methods of cleaning contaminated pens or utensils.

Zinc sulphate turbidity test results

Due to the structure of the bovine placenta, the transfer of immunoglobulins from the dam to her offspring is minimal before birth and consequently, colostrum is vital for the successful passive transfer of maternal immunoglobulins to the calf. Colostrum also provides the calf with cytokines and growth factors as well as providing superior nutritional value, when compared with whole milk, to the neonatal calf.

The zinc sulphate turbidity (ZST) test is performed on calf serum to obtain an indirect measure of serum immunoglobulin concentrations. This test quantifies the turbidity produced by the selective precipitation of immunoglobulins in the serum with zinc sulphate. In calves less than ten days of age, 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 as indicative of the adequate transfer of passive immunity to the calf.
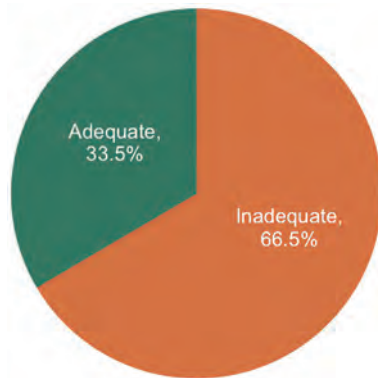
Figure 50: The results of zinc sulphate turbidity tests performed in 2011 on the island of Ireland, presented as reflecting adequate (≥20 units) or inadequate (<20 units) colostrum consumption (n=1876).

In 2011, a combined total of 1,876 ZST tests were performed by the AFBI and DAFM laboratories, on blood samples submitted by veterinary practitioners, as well as on samples taken from carcases examined *post mortem*. Of these, two thirds of the tests recorded results indicating inadequate transfer of passive immunity (less than twenty units) (Figure 50). Failure of the passive transfer of immunity increases the risk to calves from various diseases (Figure 51), particularly enteritis and septicaemia. These results show that inadequate colostrum intake remains 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.
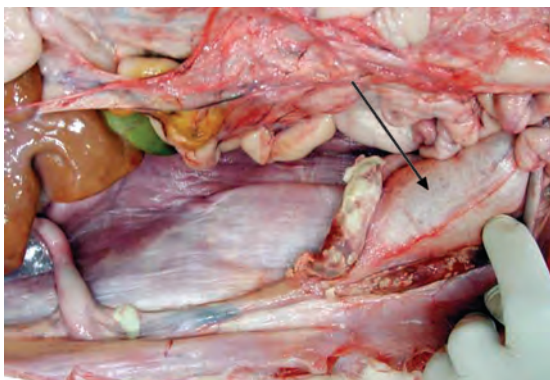
Figure 51: Thickened suppurative vestigial umbilical arteries (arrow) in a one-week-old hypogammaglobulinaemic calf (Photo William Byrne)

Ingestion of inadequate amounts of colostrum, poor quality colostrum production by the dam or delayed feeding of colostrum by the herdowner can all lead to failure of passive transfer of maternal immunity.

To ensure that the quality of colostrum produced by the dam is maximised, cows should be milked directly after calving as the quality of the colostrum decreases with every hour passing between calving and first milking. Assuring good nutrition of the dams and leaving at least three weeks of a dry period before calving can also ensure that colostrum quality is optimised.

Colostrum should be given in adequate quantities (i.e. three litres of colostrum for a 35 to 45 kg calves) to the calf within two hours of birth and certainly no later than 12 hours after birth. The ability of the neonate to absorb immunoglobulins declines progressively after four to six hours and virtually ceases 24 hours after birth.

Bovine abortion

Bovine abortion is a serious problem on cattle farms resulting in considerable economic losses to the cattle industry from reduced reproductive efficiency. In addition, some agents pose a potential risk of human infection (e.g. *Brucella abortus*, *Salmonella spp.* and *Listeria monocytogenes*). Both AFBI and DAFM laboratories play an important role in the investigation of bovine abortions both by providing diagnostic services to farmers through their private veterinary practitioners and by providing advice in terms of disease control.

Agent	No. positive	Percentage
Salmonella **Dublin**	258	7.7%
Trueperella pyogenes	218	6.5%
Bacillus licheniformis	138	4.1%
Listeria monocytogenes	68	2.0%
Aspergillus spp.	13	0.4%

Table 6: The combined frequency of detection of selected abortion agents isolated on routine foetal culture in the AFBI and DAFM laboratories in 2011 (n=3355).

During 2011, DAFM and AFBI laboratories carried out a combined total of 3,355 bovine foetal cultures on abomasal contents, organs and/or placenta to investigate abortion events. Table 6 shows the frequency of detection of selected abortifacient micro-organisms isolated from these analyses.
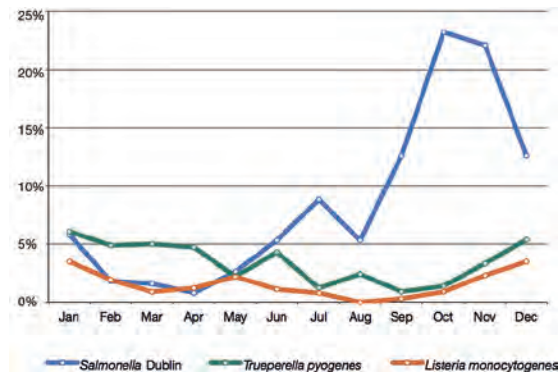
Figure 52: The monthly distribution of the isolation of selected bacterial abortionfacients at Cork RVL between 1989 and 2003 (n=13,865) (Source: http://www.teagasc.ie/research/reports/dairyproduction/4992/hyper18abortseatab.asp).

Salmonella Dublin is a significant abortifacient and was isolated in 7.7 *per cent* of cases. *S.* Dublin abortions have a well-documented seasonal distribution (Figure 52) with a peak of cases seen late in the year. The seasonal pattern of abortions caused by *Trueperella pyogenes* or *Listeria monocytogenes* is less pronounced, but peaks in winter. It has been suggested that the act of drying off cows may be an important predisposing factor in the activation of latent *S.* Dublin infection which precipitates an abortion.
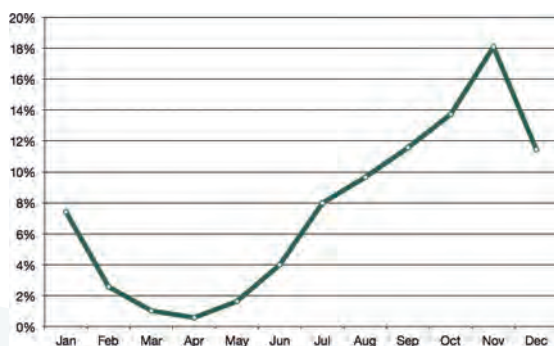
Figure 53: The seasonal distribution of *Salmonella* Dublin isolates from foetal bacterial culture in both AFBI and DAFM laboratories as a percentage of all bovine foetal submissions during 2011.

A similar seasonal trend in the frequency of isolation of *S.* Dublin from abortion material, characterised by a steady increase in the autumn relative to the monthly submissions, was seen in both DAFM and AFBI laboratories during 2011 (Figure 53). This pattern of distribution highlights the importance of timing *S.* Dublin vaccination to provide the optimal cover in a herd at the time of greatest risk.

Serotypes other than *S.* Dublin were also isolated; among them were *Salmonella* Typhimurium, *Salmonella* Newport and *Salmonella* Mbandaka.
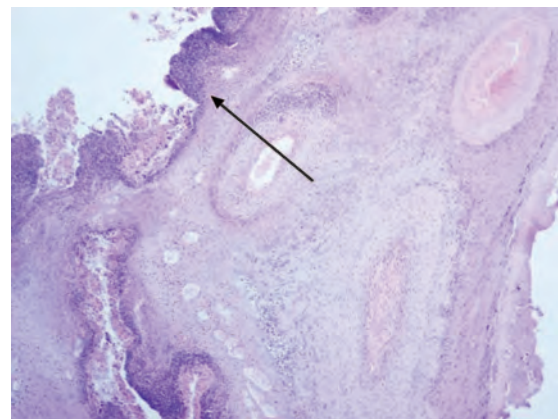
Figure 54: A section of thickened and oedematous chorioallantoic membrane showing a dense neutophil-rich infiltrate (arrow) at and beneath the ulcerated chorionic suface. *Listeria monocytogenes* was isolated from the chorioallantoic membrane and foetal stomach contents (Photo: Jim O' Donovan).

While *Trueperella pyogenes* (formerly named *Arcanobacterium pyogenes*), *B. licheniformis*, *L. monocytogenes* (Figure 54) and *Aspergillus.spp* are well-known abortifacient agents, based on the epidemiology of these infections in pregnant animals, they are considered as sporadic causes of bovine abortion. Compared to previous years, a similar proportion of cases were diagnosed in AFBI and DAFM laboratories during 2011.

Agent	Numbers of cases
E. coli	283
Proteus spp	120
Streptococcus spp	90
Bacillus spp	26
Staphylococcus spp	16
Fungal and Yeast organisms	13
Pseudomonas spp	12
Pasteurella multocida	11
Salmonella spp	10
Campylobacter spp	7
Haemolytic coliforms	3
Listeria spp	3
Mannheimia haemolytica	2
Nocardia spp	2
Yersinia pseudotuberculosis	2

Table 7: The combined frequency of cases of abortion associated with other bacterial and fungal agents in AFBI and DAFM laboratories in 2011.

Other pathogens were also isolated from foetal material, many of which are considered of lesser importance as causes of bovine abortion; nevertheless they have the potential to cause sporadic abortions (Table 7).

These organisms are also sometimes isolated from healthy animals, so their presence in the tissues of an aborted foetus should not be considered as definitive evidence that they caused the abortion. An absolute determination of their significance may be assisted by analysis of associated data such as growth in pure culture, frequency of occurrence and the herd history.

	Agent	No. tested	Percentage positive
DAFM	*L.* Hardjo *	1334	1.60%
	BVDV**	1451	4.90%
	*N. caninum***	1187	5.30%

* *L.* Hardjo serology with titre of >1/100 in foetal fluids or FAT positive
** BVD antigen serology with OD>0.3 or virus PCR positive
*** serology results only, histopathology results not included.

	Agent	No. tested	Percentage positive
AFBI	*L.* Hardjo[1]	535	4.50%
	BVDV[2]	535	5.40%
	N. caninum[3]	535	7.70%

[1] *L.* Hardjo serology with titre of >1/30 in foetal fluids or FAT positive
[2] BVDV antigen serology with OD>0.3 or immunofluoresence
[3] foetal serology or histopathology or immunocytochemistry

Table 8: Serology results from foetal fluids sampled from aborted foetuses in AFBI and DAFM laboratories in 2011.

Table 8 outlines the results of serological tests performed on foetal thoracic fluid (considered as an accessible analogue of foetal serum). Abortions due to *Leptospira interrogans* serovar Hardjo occur sporadically, and are generally observed when naïve pregnant cows are infected. Leptospirosis in cattle can present in a number of ways, including poor reproductive efficiency and decreased milk production, abortions, stillbirths, birth of weak calves and the retention of foetal membranes. The two main test methodologies currently available for the diagnosis of leptospirosis in foetuses involve either the detection of a significant antibody titre using the immunocomb test or the microscopic agglutination test (MAT) or alternatively the detection of leptospires in an impression smear of foetal tissues or placenta using the Fluorescent Antibody Test (FAT).

The interpretation of leptospiral serological results is complicated by a number of factors: cross-reactivity of antibodies, antibody titres induced by vaccination, and debates regarding the appropriate cut-off for the antibody titre which is indicative of infection. This debate regarding the appropriate cut-off can explain the apparent differences in the rate of detection of leptospirosis in foetuses by DAFM and AFBI laboratories.

AFBI use a lower threshold for identifying significant titres than that used in DAFM laboratories. The presence of antibodies in the foetus is indicative of leptospirosis; however a diagnosis of leptospirosis must be made with caution and with full consideration of the clinical and vaccinal history of the herd.

When bovine abortion cases are analysed by aetiological agent, bacterial causes predominate, followed by protozoal (*Neospora caninun*) and viral (BVDV and BHV-1) identification in descending order. *Neospora* infection does not always cause abortion. Many cows in a herd may be infected with *Neospora* and they may not abort, although they are more likely to do so than their uninfected herd mates. Furthermore, *Neospora*-positive animals may abort more than once or give birth to apparently normal full term progeny that are congenitally infected; while usually appearing to be normal calves, they are often infected with the protozoa for life. Therefore, the female progeny of a *Neospora*-positive cow should not be bred due to the potential for vertical transmission of the parasite. *Neospora* abortions are usually sporadic but abortion storms are also noted on occasion. Maternal and foetal serology, histological examination and immunohistochemistry are the tests that are used for the detection of *Neospora caninum*.

BVDV is a major cause of bovine reproductive failure. Mummified foetuses, gross foetal lesions (cerebellar hypoplasia, opacity of the lens, etc) or the birth of weak neonates are all potential outcomes of infection associated with BVDV, especially when the dam has been exposed to the virus in the second trimester of gestation. By affecting the host immune response, BVD virus may also be a predisposing factor to abortions by opportunistic microorganisms. It is not unusual to isolate a concurrent bacterial infection with the BVDV in an aborted foetus.

Infectious Bovine Rhinotracheitis virus (BHV-1) normally produces respiratory disease but occasionally can be involved in bovine abortion. This herpes virus is not routinely investigated in foetal submissions except when the clinical history and signs point to it as being potentially implicated in an abortion outbreak. DAFM laboratories carried out Polymerase Chain Reaction (PCR) in tissues of 105 foetus and stillbirths; three (2.9 *per cent*) of these specimens produced a positive result for BHV-1.

A thorough investigation of abortions is vital in preventing further losses. 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. Where the submission of a foetus carcase to the laboratory is not feasible, 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 (5ml 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.

Bovine mastitis

For clinical mastitis diagnosis, prompt bacterial culture results can inform treatment and save costs. Mastitis leads to costs which are often subdivided into direct costs (veterinarian's time, herdsman's time, the cost of drugs, discarded milk, and reduced yield) and indirect costs (higher culling rate, risk of fatality, extra services and extended calving intervals). The exact cost of a case of mastitis can be difficult to quantify but the literature estimates the cost of a typical mastitis case in a dairy herd to be €200/£150.

Mastitis control in cows is based on a number of fundamental principles which include teat hygiene, prompt treatment, segregation and recording of mastitis cases, appropriate dry cow therapy and culling of chronic cases. Proper milking machine maintenance is also central to mastitis control.
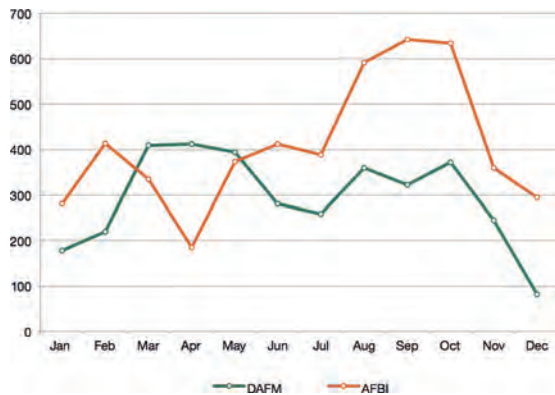
Figure 55: The frequency of submission of milk samples by month to AFBI (n=4907) and DAFM (n=3528) veterinary laboratories in 2011.

The frequency of submission of milk samples to the veterinary laboratories during 2011 is shown in Figure 55. There was a notable variation in the pattern of submission of samples to both AFBI and DAFM laboratories during 2011 when compared to that observed in 2010. The submission totals to both laboratories showed contrasting trends as the submissions to DAFM fell from 5466 to 3533 (35 *per cent* decline), while submissions to AFBI rose from 2787 to 4507, (a rise of 61 *per cent*). In addition to these changes, there was also a difference in the monthly trends, with DAFM laboratories experiencing two peaks in submissions – during the spring when large numbers of cows are coming into milk and to a lesser extent in the autumn when many cows are dried off. The autumn peak was less marked than in previous years and is perhaps an indication that the traditional seasonality of milk production in Ireland is beginning to change.

Submissions to AFBI did show a marked autumn rise in submission frequency which is the traditional pattern associated with spring calving herds. There was a sharp drop in the frequency of submissions experienced during the month of April, when submissions to DAFM were at their peak, the cause of which is not clear.
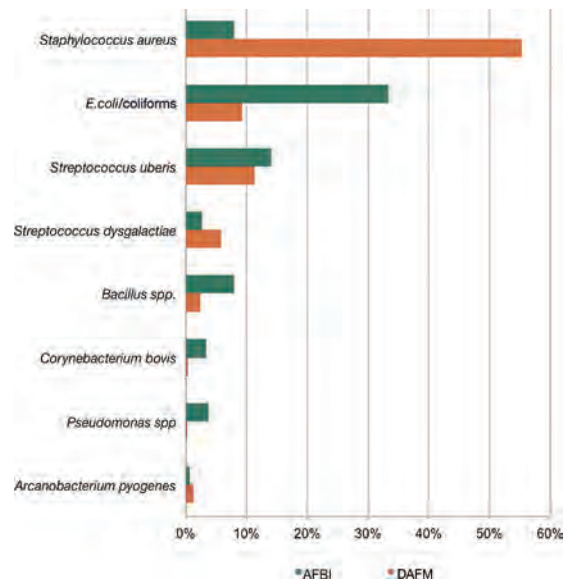
Figure 56: The relative frequency of detection of selected mastitis pathogens by AFBI (n=4907) and DAFM (n=3528) in 2011.

The relative frequency of detection of selected mastitis pathogens in milk samples submitted to AFBI and DAFM laboratories is illustrated in Figure 56. *Staphylococcus aureus* is a contagious mastitis pathogen commonly associated with chronic mastitis and raised somatic cell counts. Clinical mastitis also occurs following infection with this pathogen, which is known to infect cows particularly at milking time, due to both poor milking hygiene which facilitates direct transfer, and faults in milking machine function (damaged teat liners or fluctuations in vacuum). The isolation rates for *S. aureus* are significantly greater in herds where parlour hygiene is suboptimal (Barrett *et al.*, 2005). As witnessed in 2010, *S. aureus* was the most frequently isolated pathogen from milk submissions to the DAFM laboratories during 2011 (40.1 *per cent*). In contrast, *S. aureus* was isolated in less than eight *per cent* of milk samples in AFBI laboratories. The prevalence of *S. aureus* in samples submitted to DAFM laboratories is exceptionally high and the national incidence of *S. aureus* infection is likely to be much lower than 40 *per cent*. It is likely that many of the milk samples received by DAFM are composite samples which may lead to an increased estimation of the prevalence of common pathogens such as *S. aureus*. It is also possible that a high proportion of these samples have been selected from cows with a high SCC over a prolonged period, introducing a submission bias likely to favour *S. aureus* infections. In contrast, AFBI receives

a significant number of individual quarter samples from high cell count cows. This would naturally lower the detected incidence of common pathogens like *S. aureus*, since very few cows will be infected with *S. aureus* in all four quarters, but a composite milk sample will usually detect the pathogen, even if only one quarter is infected.

Figure 57: *Staphylococcus aureus* isolated on blood agar (Photo: Alan Johnson).

Herds with mastitis caused by *Staphylococcus aureus* (Figure 57) 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.

E.coli and other coliforms were isolated in 9.52 *per cent* of DAFM submissions and in 33.3 *per cent* of submissions to AFBI. *E.coli* is both an opportunistic mastitis pathogen and a very common isolate from milk samples which are contaminated with dust or faecal material. It is imperative that samples for mastitis culture are collected aseptically.

Sampling Technique

1. Take the samples before milking.

2. Soak a number of cotton wool balls in alcohol.

3. Label the tubes prior to sampling with the cow number and date and quarter (if collecting a separate sample from an individual quarter or from each quarter).

4. 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.

5. Dip all four teats with fresh, clean teat dip and leave for at least one minute.

6. 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.

7. Beginning with teats on the far side of the udder, scrub the ends thoroughly with the cotton wool and alcohol balls until the teats are very clean. Spend at least ten seconds on each teat. Do not use a cotton wool ball on more than one teat.

8. 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 45 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. Close the tube immediately after collection of each sample.

9. If it is felt that some contamination has occurred, discard the sample and use a new tube.

10. When all cows have been sampled, put the tubes in a fridge and chill to 4°C. This is very important.

The samples should be taken to the laboratory as quickly as possible.

Figure 58: Mammary tissue from a case of coliform mastitis. Note the sharp delineation between the inflamed mammary tissue on the left and the normal tissue on the right (Photo: Alan Johnson).

Coliform mastitis (Figure 58), sometimes termed acute mastitis or toxic mastitis, is a severe, acute mastitis with a well recognised clinical presentation. Hygienic teat preparation (clusters should only be applied to clean dry teats) prior to milking and improving environmental hygiene are the most important control measures. Teat injuries and faecal-contaminated bedding may be predisposing factors. Coliforms do not usually survive long in the mammary gland, but the release of endotoxin leads to the clinical signs.

Streptococcus uberis was a relatively common pathogen isolated in AFBI (14.0 *per cent*) and DAFM (8.2 *per cent*) laboratories during 2011. *S. uberis* is an environmental and opportunistic pathogen. The organism is found throughout the cow's built environment and on and within the animal's body. Isolation of *S. uberis* is significantly greater in herds with suboptimal housing (Barrett *et al.*, 2005).

Streptococcus dysgalactiae was identified in 2.7 *per cent* (AFBI) and 4.17 *per cent* (DAFM) of milk samples cultured in 2011. This pathogen resides mainly in the cow's udder and in teat wounds. Clinical symptoms may be more serious than infections caused by other *Streptococcus spp.*, and the disease can be quite acute in nature. This bacterium is also isolated occasionally from summer (or dry cow) mastitis, often in a pure culture. Some researchers are of the opinion that summer mastitis begins as a *S. dysgalactiae* infection (Sandohlm *et al.*, 1995).

Higher numbers of *Bacillus spp.* were isolated during 2011, being found in 7.9 *per cent* of AFBI submissions and 1.67 *per cent* of DAFM submissions. This was largely due to a high rate of *Bacillus licheniformis* isolation from samples submitted to AFBI (238 cases). *B. licheniformis* is an opportunistic pathogen which is ubiquitous in the environment.

Isolation of *Pseudomonas spp.* from submissions to AFBI occurred in 3.7 *per cent* of samples, but in only 0.11 *per cent* of submissions to DAFM. *Pseudomonas aeruginosa* and other species are common in the environment of cattle, and infection can originate from contaminated water used for washing udders, or water left in the hose of milking machines (Radostits et al 10th edition).

Corynebacterium bovis similarly was isolated with much greater frequency by AFBI, from 3.3 *per cent* of submissions compared to 0.2 *per cent* by DAFM. This contagious pathogen commonly causes subclinical mastitis and a raised somatic cell count, but infrequently leads to clinical disease. This bacterium spreads rapidly in the absence of proper teat dipping, and the incidence is markedly reduced by intensive programmes of teat-dipping and dry cow therapy (Radostits *et al.*, 10th edition).

Trueperella pyogenes, formerly known as *Arcanobacterium pyogenes*, was isolated from less than 1 *per cent* of milk submissions. This is the most commonly isolated pathogen from cases of summer mastitis, which occurs mainly in dry cows and heifers. Summer mastitis is associated with a suppurative and foul-smelling secretion from the quarter. Even with treatment, the quarter is usually lost. Insect vectors are central to the spread of disease, hence its association

with the summer months. A similar syndrome has been described however during the housing period associated with teat injuries. *T. pyogenes* is not the only pathogen involved in summer mastitis cases and a mixture of aerobes and anaerobes is typically isolated, including *Strep. dysgalactiae* (Sandohlm *et al.*, 1995).

Streptococcus agalactiae was isolated in eight cases in total during 2011. This is an obligate pathogen of the cow's udder leading to severe infections which are difficult to eradicate from the herd. "Blitz therapy", or treatment of all diseased animals simultaneously is recommended as a means of control of outbreaks (Sandholm *et al.*, 1995)

Other mastitis pathogens isolated less frequently included *Pasteurella multocida* (isolated in 35 cases in total) and *Listeria monocytogenes* (isolated in two cases).

Sampling of the bulk milk tank is occasionally used to investigate mastitis in herds.However the sensitivity of a single bulk milk bacterial culture is low. While contagious pathogens in bulk milk samples generally arise from intramammary infection, environmental mastitis pathogens isolated from bulk milk may originate from non-specific contamination of milk by the cow's skin, or environment. Collecting samples at quarter level is more informative and reliable in identifying the pathogens which are responsible for disease (Lam *et al.*, 2009).

Further Reading:
Animal Health Ireland CellCheck webpage at: http://www.animalhealthireland.ie/page.php?id=29

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Bovine respiratory disease

Bovine Respiratory Disease continues to be a major problem on Irish farms. The cattle industry incurs losses through cattle mortalities, immediate impacts of clinical disease and its treatment and also through the long-lasting impact that pneumonia can have on growth rates in young stock (Thompson *et al.*, 2006).

Post-mortem data
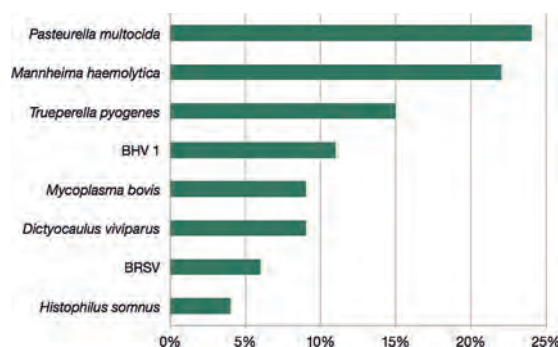
Figure 59: The relative frequency of post-mortem detection of primary respiratory pathogens associated with fatal respiratory disease, as a percentage of all cases in which a primary pathogen was identified in AFBI and DAFM veterinary laboratories during 2012 (n=491).

The laboratory investigation of bovine respiratory disease encompasses both analyses performed on samples taken during post-mortem examination of animals which have succumbed to disease, and analyses performed on clinical pathology submissions by veterinary practitioners treating clinical cases. Figure 59 presents data on the agents that were identified as the principal pathogen isolated from bovine lungs at post-mortem examination where respiratory disease was recorded as the cause of death.

Mannheimia/Pasteurella spp.
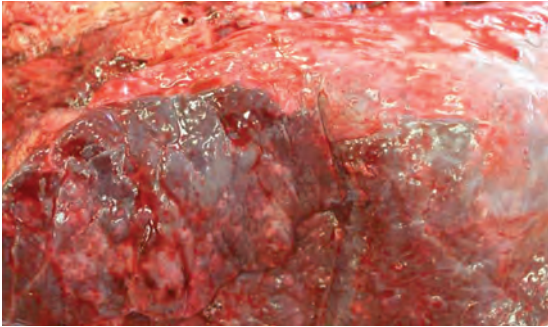
Figure 60: Cranioventral consolidation in the lungs of a two-week-old Charolais heifer calf. Note the contrast between the dark consolidation and the pale pink unaffected lung. Both *Mannheima haemolytica* and *Pasteurella multocida* were isolated from this lung. (Photo: Colm Brady).

Either *Mannheimia haemolytica* or *Pasteurella multocida* or both were isolated from approximately 50 *per cent* of necropsy submissions to DAFM and AFBI laboratories where respiratory disease was diagnosed. This indicates the importance of these bacteria in bovine respiratory disease. The pathogenesis of pneumonia due to *Mannheimia haemolytica* has been studied in more detail than in the case of *Pasteurella multocida*. While low numbers of *Mannheimia haemolytica* can colonise the nasopharynx of normal calves, stress or cold may result in proliferation of nasopharyngeal bacteria which may overwhelm the pulmonary defences leading to bronchopneumonia. Alternatively primary viral infection or *Mycoplasma spp.* infection may impair pulmonary defences leading to secondary *Mannheimia/Pasteurella spp.* infection and bronchopneumonia (Figure 60).

Trueperella pyogenes

Trueperella pyogenes infection was confirmed in 14 *per cent* of cases of pneumonia, which is consistent with the findings in previous years. This organism, which is often present on nasopharyngeal mucosa of cattle, is an opportunistic pathogen and in the context of bovine respiratory disease is a secondary invader of tissues. It is frequently isolated from cases of enzootic pneumonia where pathogenic respiratory viruses, or possibly *Mycoplasma bovis*, may cause primary pneumonia, and *Trueperella pyogenes* may subsequently invade, causing suppurative pneumonia.

Histophilus somni

*Histophilus somni* infection may cause multiple disease manifestations, of which respiratory disease is one. These disease manifestations include thrombo-embolic meningoencephalitis (TEME), myocarditis, arthritis and abortion. The respiratory form of *Histophilus sp.* infection induces fibrinosuppurative pneumonia which on pathological examination can be difficult to distinguish from mannheimosis. In a similar manner to Mannheimia spp. infection, factors predisposing to *Histophilus somni* infection include stress or a preceding viral infection. *Histophilus somni* is often isolated from lungs of calves with enzootic pneumonia which is pneumonia of intensively housed calves caused by a mixed variety of etiological agents that produces an assortment of lung lesions. Mixed pulmonary infections of *Histophilus somni*, *Mannheimia haemolytica*, *Pasteurella multocida*, *Trueperella pyogenes* and *Mycoplasma spp.* are sometimes encountered in such cases.

Mycoplasma bovis

Figure 61: A section of consolidated lung from a four-month-old calf with characteristic 'rice grain' multifocal abscessation associated with *Mycoplasma bovis* infection (Photo: William Byrne).

Bovine respiratory disease involving *Mycoplasma bovis* can take two forms, either enzootic pneumonia of calves (as discussed above) or chronic pneumonia and polyarthritis in feedlot cattle. Such cattle may have a history of prolonged antibiotic therapy for non-responsive or relapsing respiratory disease. Grossly, the lung lesions recorded are chronic necrotising bronchopneumonia with numerous well delineated caseous nodules, often referred to as 'rice grain' abscessation (Figure 61). The diagnosis of *Mycoplasma bovis* infection can be confirmed by either culture isolation, antigen-capture ELISA or immunohistochemistry (IHC) specific for *Mycoplasma bovis* antigen.

Dictyocaulus viviparus
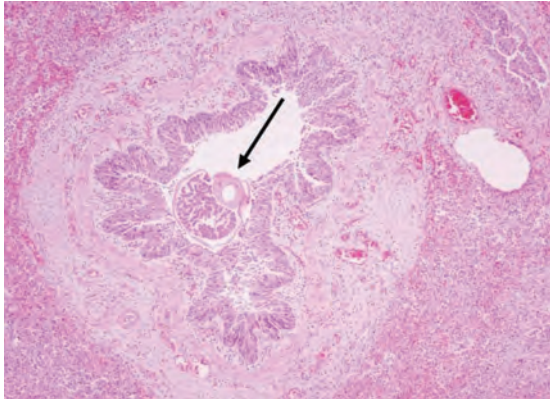
Figure 62: A cross section of a lungworm (*Dictyocaulus viviparus*) in a bronchiole of a bovine lung (Photo: Cosme Sanchez-Miguel).

Parasitic pneumonia (Figure 62), also called hoose pneumonia or verminous pneumonia is most commonly associated with young calves in their first grazing season. The number of clinical cases normally peaks in the early autumn. Hoose has, however, also been recorded by the laboratories in older cattle; such cases probably arise due to a lack of acquired immunity associated with insufficient exposure to larvae in an earlier grazing season.

Bovine herpesvirus 1 (BHV1)

Figure 63: Severe fibrinonecrotic tracheitis in a weanling associated with infectious bovine tracheitis (BHV-1 infection). (Photo: John Fagan).

Bovine herpesvirus 1 which causes Infectious Bovine Rhinotracheitis (IBR) was first recorded in the early

feedlot management systems in the 1950s. IBR can affect all age groups but typically causes disease in young feedlot cattle. The disease is manifested clinically as a transient acute febrile illness and pathologically as multifocal mucosal necrosis of the nasal, pharyngeal, laryngeal and tracheal mucosae. Secondary bacterial infection of these lesions is very common leading to a fibrinonecrotic tracheitis (Figure 63). A common sequel of BHV 1 infection is pneumonia due either to aspiration of necrotic material or impairment of the pulmonary defences.

Bovine Respiratory Syncytial Virus (BRSV)
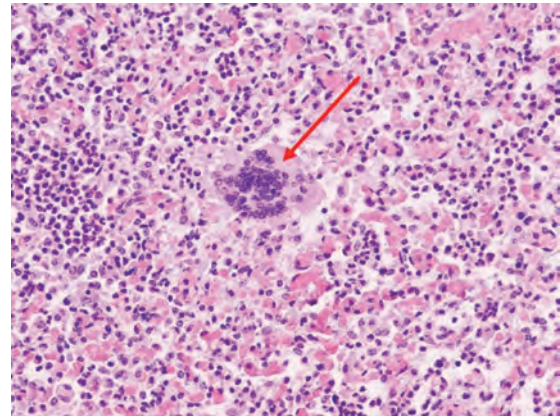
Figure 64: Bronchiolar epithelial syncytial cell (arrow) or 'signet ring' cell which is a characteristic histological finding in cases of BRSV (Photo: Cosme Sanchez-Miguel).

BRSV infection typically affects younger cattle, between six and eight months of age. It can be detected in the early stages of enzootic pneumonia but may also be similarly involved in some cases of shipping fever, an acute respiratory disease of cattle which occurs days or weeks after transport, where co-infection with *Mannheimia haemolytica* is commonly implicated. BRSV infects epithelial cells lining the mucosal surfaces of the lung and type 2 pneumocytes which line the alveolar walls. Infection gives rise to bronchointerstitial pneumonia with necrotising bronchiolitis, bronchiolar epithelial syncytial formation and proliferative alveolitis.

Clinical Pathology data
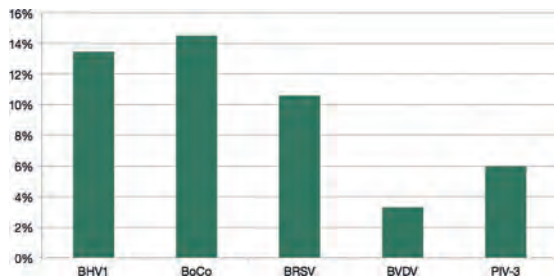
Figure 65: The frequency of detection of primary respiratory virus pathogens on nasal swabs from clinical cases of bovine respiratory disease in DAFM laboratories during 2011.

Bovine coronavirus was the most frequently detected virus from live clinical cases of pneumonia during 2011. Coronavirus has long been associated with diarrhoea in neonatal calves and winter dysentery in older cattle. More recently it has come to be regarded as an infective agent of the pulmonary system and a relatively recent observation suggests that it can cause bovine respiratory disease without the involvement of other pathogens (Decaro *et al.*, 2008).

Clinically significant disease with Parainfluenza 3 virus (PI3V) infection is rare; however this virus is sometimes referred to as a 'gateway' virus facilitating secondary bacterial infection in infected animals.

The main involvement of Bovine Virus Diarrhoea Virus (BVDV) infection in bovine pneumonia is the effect it has on the immune response, compromising the function of white blood cells, thereby making the lungs more susceptible to infection.
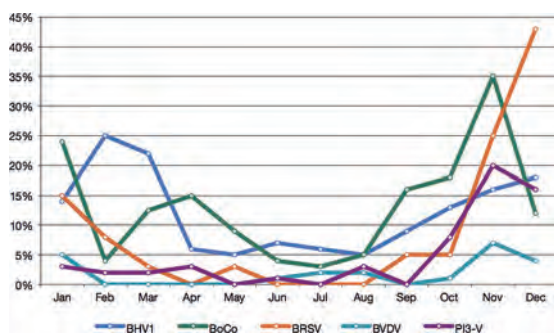
Figure 66: The relative frequency of detection of viruses implicated in bovine respiratory disease by month during 2011 as a percentage of all nasal swabs tested each month by polymerase chain reaction (PCR) at the CVRL Backweston (n=4617).

Figure 66 shows the seasonal patterns in the detection of viral agents associated with bovine respiratory disease. Unsurprisingly, there is a notable trend in the seasonal distribution with increased detection of viruses in the winter months which coincides with the housing of cattle. This seasonal distribution is more marked with some viruses (e.g. BRSV) than with others (e.g. BVDV).

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Decaro, N, Campolo M, Desario C, Cirone F, D'Abramo M, Lorusso E, Greco G, Mari V, Loredana M, Gabriella E, Martella V, Buonavolgia C. Respiratory disease associated with bovine coronavirus infection in cattle herds in Southern Italy. *Journal of Vet Diagnostic Investigation* 20;28-32 (2008)

Johne's disease

Johne's disease is caused by infection with *Mycobacterium avium* subsp. *paratuberculosis* (MAP) and is a class B notifiable disease. The clinical signs include chronic diarrhoea and weight loss.

Most cattle acquire infection early in life, through the ingestion of colostrum or milk containing MAP, or by exposure to feed, water or environments contaminated by MAP. *In utero* infection of the foetus can occur and older animals exposed to a large number of MAP organisms can also become infected. The disease is often introduced to a MAP-free herd through the purchase of an infected animal.

Figure 67: Granulomatous enteritis in a three-year-old heifer diagnosed with Johne's disease (Photo: Mícheál Casey).

Infected animals can test negative on all MAP tests, but as the disease progresses detectable MAP will be shed in the faeces and seroconversion will usually occur subsequently. Clinical signs often appear when the animal is between two and six-years of age and relate to the development of granulomatous enteritis (Figure 67). Clinically affected animals shed very large numbers of MAP bacteria in their fluid faeces resulting in heavy contamination of their environment with MAP.

Year	Total tested	Total positive	Percentage positive
2008	416	92	22.1%
2009	376	103	27.4%
2010	410	82	20%
2011	632	133	21%

Table 9: *Mycobacterium avium* subsp. *paratuberculosis* (MAP) culture results from cattle in Ireland for the years 2008 to 2011.

During 2011 in Ireland, there were 632 samples submitted from bovine animals for MAP culture and MAP was isolated from 133 (21 *per cent*) animals (Table 9). These animals came from 98 herds, with dairy and beef enterprises equally represented. The infected animals consisted of 18 bulls, 100 cows, 9 heifers and 6 steers. Sixty-one (46 *per cent*) of the cows were of a dairy breed and 12 of the bulls (67 *per cent*) were of the Limousin breed.

The age of the infected animals at the time of sample submission ranged from 14 months to 12-years-old with the greatest frequency of submissions recorded in animals between two- and four-years-old and between six- and seven-years-old. Seven of the 133 infected animals were imported. Of the 126 animals born in Ireland, 72 were located in their herd of birth. The 54 infected animals which had been purchased had moved on average 2.8 times to reach the herd in which a diagnosis of MAP infection was made.

Survival analysis was conducted on the infected animals. Fifty one *per cent* had died or were slaughtered within two months of sample submission and this increased to 66 *per cent* at four months and 82 *per cent* at six months post submission. Approximately 60 *per cent* of

these animals were submitted to a regional veterinary laboratory or a knackery.

In terms of the shedding of MAP in their faeces, 66 *per cent* of the animals were considered to be high shedders, 12 *per cent* were moderate shedders and 22 *per cent* were shedding low numbers of the bacterium. Animals that are high shedders are considered to be very important in the spread of MAP within a herd as they extensively contaminate the farm environment.

Year	Total tested	Total positive	Percentage positive
2008	64	4	6.3%
2009	50	2	4%
2010	190	12	6.3%
2011	148	19	13%

Table 10: *Mycobacterium avium* subsp. *paratuberculosis* (MAP) culture results from cattle in Northern Ireland for the years 2008 to 2011.

During 2011, AFBI performed MAP culture on 148 bovine faecal samples using the TREK automated liquid culture system, with 13 *per cent* of these proving positive (Table 10). A further 33 sheep faecal samples were submitted for MAP culture with four of these samples proving positive.

Year	Total tested	Total positive	Percentage positive
2008	3372	229	6.8%
2009	3981	251	6.3%
2010	5062	302	6%
2011	8010	475	5.9%

Table 11: The percentage of sera which tested positive in a *Mycobacterium avium* subsp. *paratuberculosis* ELISA in Ireland for the years 2008 to 2011.

There were 8,010 sera tested by a MAP ELISA in Ireland during 2011; 5.9 *per cent* of these were positive (Table 11). The positive results could be sub-divided into low positive (23.6 *per cent*), medium positive (21.5 *per cent*),

high positive (20.6 *per cent*) and very high positive (34.3 *per cent*). Animals displaying strong reactivity in the ELISA are probably infected with MAP, but culture should be performed if the disease has not previously been recorded on the farm. It was again noted in 2011 that some strongly seropositive animals were sold into a different herd, subsequent to their serologic status being established and reported by the laboratory.

Year	Total tested	Total positive	Percentage positive
2008	6834	738	10.8%
2009	7749	689	8.9%
2010	12229	978	8%
2011	18751	1224	6.52%

Table 12: The percentage of sera which tested positive in the *Mycobacterium avium* subsp. *paratuberculosis* ELISA in Northern Ireland for the years 2008 to 2011.

In Northern Ireland, during 2011, a total of 18,751 samples were tested for MAP using a MAP ELISA. Of these, over six *per cent* were positive (Table 12). A proportion of these tests were carried out for herds enrolled in the AFBI Cattle Health Scheme. This is in contrast to the DAFM results in Table 11 where the sample workload is largely derived from clinical suspects. The Cattle Health Scheme provides programmes to control, monitor and demonstrate freedom from BVDV, IBR, MAP and leptospirosis. Within the scheme, faecal culture can be used as a confirmatory test for seropositive animals in herds with no previous history of Johne's disease, or in animals with seropositive values near the test cut off value.

False-positive serological reactions cause difficulty with the interpretation of *paratuberculosis* serology results. Infection with non-pathogenic environmental mycobacteria and the intradermal administration of tuberculin can interfere with the sensitivity and specificity of the MAP ELISA. It is advised to wait until 90 days after the tuberculin skin test to sample for MAP serology. Faecal culture can be used to establish the true MAP status of a seropositive animal, where it is positive, but a negative culture result in a seropositive animal does not rule out a non-shedding infection. Both

the Central Veterinary Research Laboratory, Backweston (DAFM) and AFBI employ a liquid culture system with an incubation period of 42 days.

Because the disease can spread silently and diagnosis can be difficult, herd owners and their PVP should develop a plan to prevent MAP introduction and spread on the farm. Key points include regular herd screening to monitor herd status, maintaining a closed herd, maternity pen hygiene, colostrum management, feeding calves milk replacer or pasteurised milk, keeping younger stock away from adult faeces both in housing and at pasture. Herds which have MAP infection diagnosed face a very significant challenge to prevent its spread within their herd and into other herds. Once MAP is diagnosed the herdowner may be looking at a decade or more of running an effective control programme before being confident that the disease is no longer in the herd. Further information on the control of MAP and Johnes' Disease can be accessed at: http://www.agriculture.gov.ie/media/migration/animalhealthwelfare/diseasecontrols/johnes3.pdf and at 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.

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 onto or off a farm, biosecurity involves more than cleansing and disinfecting; it includes, for example the prudent sourcing of stock (both purchasing or borrowing), on-farm quarantine, and testing for specific diseases. 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 68: The use of (a&b) appropriate signage and (c) 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 68 (a) & (b)) 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 be achieved by maintaining adequate farm boundaries, operating a closed herd, and the quarantining and testing of purchased animals before their introduction to the herd. The importance of appropriate disinfection of protective footwear at the entry point to the farm (Figure 68(c)), as well as the disinfection of transport vehicles should not be overlooked.

The provision of isolation facilities plays an important part in controlling the entry of, and spread of disease on your 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. Further measures such as maintaining clean water and feed troughs, rodent control and preventing dog or cat access to feed stores are equally important.

Additional biosecurity measures which should be adhered to include:

- Try to purchase cattle from herds with a known herd disease status.

- Avoid purchasing cull cows.

- Do not share bulls between herds

- Quarantine animals returned unsold from the mart for 3 weeks before reintroducing them to the herd.

- Do not use calving pens for sick animals. Disinfect equipment 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.

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
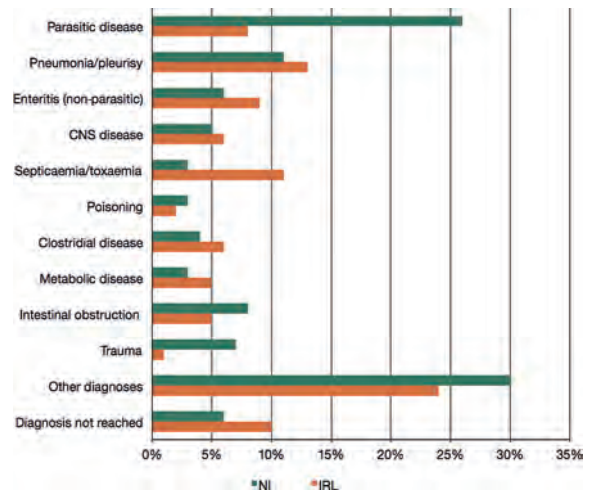
Figure 69: The relative frequency of the causes of mortality of sheep of all ages, submitted for post-mortem examination during 2011 in Ireland (n=832) and Northern Ireland (n=714).

The diagnostic analyses for the most frequent causes of sheep mortality in Northern Ireland and Ireland during 2011 are presented in Figure 69. The data are presented on a disease category basis and as a percentage of the total submissions in each catchment area, excluding abortions.
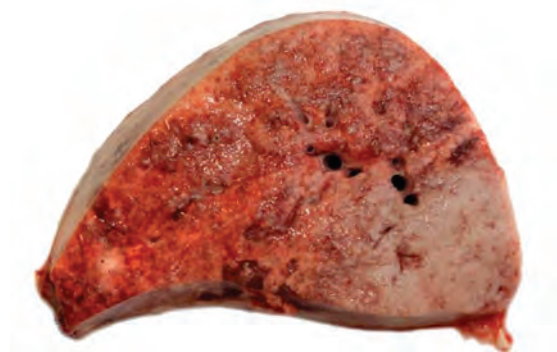
Figure 70: Lung from a sheep with Ovine Pulmonary Adenocarcinoma (Jaagsiekte) showing a localised pale firm nodule (Photo: Cliff Mason).

As in 2010, parasitic disease, respiratory disease and enteric diseases were the most commonly diagnosed causes of death in sheep of all ages in Ireland. *Mannheimia haemolytica* remains the most common cause of bacterial pneumonia in both Northern Ireland and Ireland.

Trueperella pyogenes is also a frequent isolate and is more commonly isolated than *Pasteurella multocida*. Jaagsiekte (ovine pulmonary adenocarcinoma) (Figure 70) and atypical (mycoplasmal) pneumonia are currently much more common in Northern Ireland than in Ireland with only a few cases of each of these diseases being reported in Ireland during 2010 and 2011.

Figure 71: Intestinal torsion in a lamb, showing the distended, twisted and congested bowel loops which give the condition the colloquial name 'red gut' (Photo: Colm Ó Muireagáin)

The category 'Enteritis (non-parasitic)' included abomasitis and intestinal torsion in growing lambs. Intestinal torsion is a significant cause of mortality in lambs on the island of Ireland, accounting for 5 *per cent* of mortalities in Ireland and 8 *per cent* in Northern Ireland during 2011. Intestinal displacement and torsion ('red gut') is commonly seen in fast growing lambs on a high plane of nutrition (Figure 71). The condition is thought to occur as a result of the presence in the large bowel of significant quantities of fermentable carbohydrate. Fermentation in the large intestine results in the production of volatile fatty acids leading to intestinal distension and reduced motility. The large increase in intestinal volume relative to rumino-reticular volume leads to instability, displacement and finally torsion. Adequate supply of roughage to balance concentrate or lush grass intake is advised as a means of control.

Colibacillosis, ovine neonatal enterotoxaemia ('watery mouth') and cryptosporidiosis are other common causes of enteric disease in young lambs. Enteric viral infections (rotavirus and coronavirus) remain uncommon diagnoses on post-mortem examination of sheep in both jurisdictions.

Pasteurellosis is a significant cause of mortality among sheep flocks on the island of Ireland, most of which could be prevented by flock vaccination. The disease manifests as neonatal septicaemia, pneumonia in sheep of all ages and septicaemia of growing lambs in their first autumn. Vaccination of the ewe will allow additional passive protection of neonatal lambs. Vaccination of lambs should be completed prior to the onset of the period of risk.

As in 2010, septicaemia and toxaemia were more commonly diagnosed in Ireland than Northern Ireland. The prevalence of clostridial disease was similar in both jurisdictions in 2011, repeating the pattern recorded during 2010. Clostridial disease remains a common diagnosis despite the availability of effective vaccines for ewes, rams and lambs. Many cases of clostridial disease are associated with incomplete or non–existent vaccination programmes in flocks.

In 2011 the differences in the levels of central nervous system disease (CNS) and poisoning seen between Northern Ireland and Ireland were not as marked as in 2010. Listeriosis remained the most frequently diagnosed CNS disease, and copper and *Pieris spp* (Forest Flame) were the most commonly diagnosed causes of poisoning.

Pieris spp. such as *Pieris japonica* and *Pieris formosa* are grown as ornamental shrubs. The clinical signs in poisoned animals are similar to those of rhododendron poisoning – abdominal pain, grinding of the teeth, blood-stained faeces and vomiting. The toxin responsible for clinical signs is grayanotoxin I.

The category 'Other diagnoses' includes conditions, such as laryngeal chondritis and ovine botulism, which were recorded less frequently during 2011.

Laryngeal chondritis is an important cause of upper respiratory tract disease in adult sheep, particularly those of the short necked breeds. Texel, Beltex and Southdown are considered prone to the condition and an inherited component cannot be ruled out.
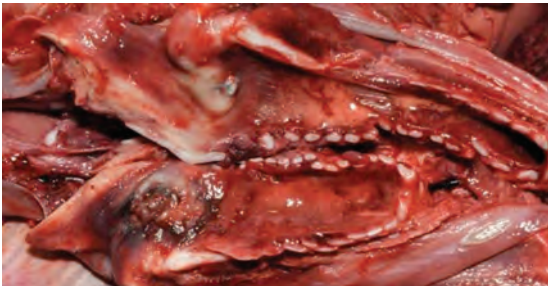

Figure 72: Larynx from a Texel sheep with laryngeal chondritis (Photo: Cliff Mason).

Deep abscessation and granulation of the arytenoid cartilages occurs (Figure 72) with colonisation by bacterial species including *Escherichia coli*, *Fusobacterium necrophorum* and *Trueperella pyogenes*.

Clinical signs include severe and progressive dyspnoea with cyanosis. Sheep which survive the acute disease may become chronic cases and re-crudesence of infection can occur under stress.

Botulism in sheep is uncommon and infrequently reported in the literature. In early spring 2011, botulism was diagnosed by AFBI in a four-year-old ewe submitted for post-mortem examination with a history of death following a short period of recumbency whilst at grass. The history also indicated that broiler litter had recently been spread on adjacent pasture and that other stock, both cattle and sheep had died recently on the farm, although the cause of these deaths had not been subjected to laboratory investigation. Gross findings and histology were unremarkable and there was no evidence of metabolic disease or heavy metal poisoning. The small intestinal contents and faeces were positive on bioassay for *Clostridium botulinum* type D toxin and a diagnosis of botulism was made.

Parasitic disease in sheep

Parasitic disease is consistently one of the most frequent causes of post-mortem diagnostic submissions to veterinary laboratories. The frequency of parasitic disease as a cause of diagnostic submissions fell to 8 *per cent* in Ireland during 2011, from a level of 20.9 *per cent* during 2010. A similar reduction was not seen in Northern Ireland.
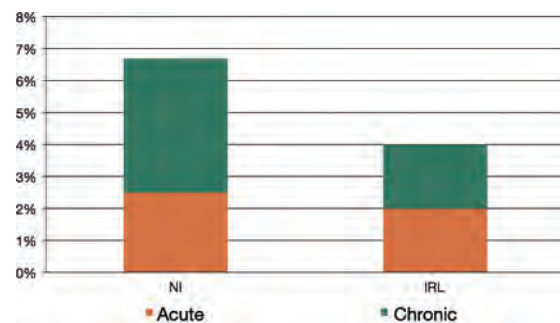
Figure 73: The percentage of all ovine mortality caused by acute fluke and chronic fluke infestation as diagnosed by AFBI and DAFM laboratories during 2011.

Figure 73 shows the diagnostic analyses for *Fasciola hepatica* (liver fluke) infestation in sheep carcases examined *post mortem* in Northern Ireland and Ireland during 2011.

Fascioliasis remains a commonly diagnosed parasitic disease throughout the island of Ireland (see Parasitic disease section on page 64); however the reduction in mortality attributable to fascioliasis, as diagnosed by the DAFM laboratories during 2011, is notable on comparison to 2010 when liver fluke was diagnosed as the cause of death in 16.8 *per cent* of sheep examined. The proportion of sheep deaths attributable to fluke infestation in Northern Ireland remained constant at 6.8 *per cent* through both 2010 and 2011. These results show that the downward trend in the fluke-related mortality recorded in Ireland, as recorded by the *All-island Animal Disease Surveillance Report 2010*, is continuing.
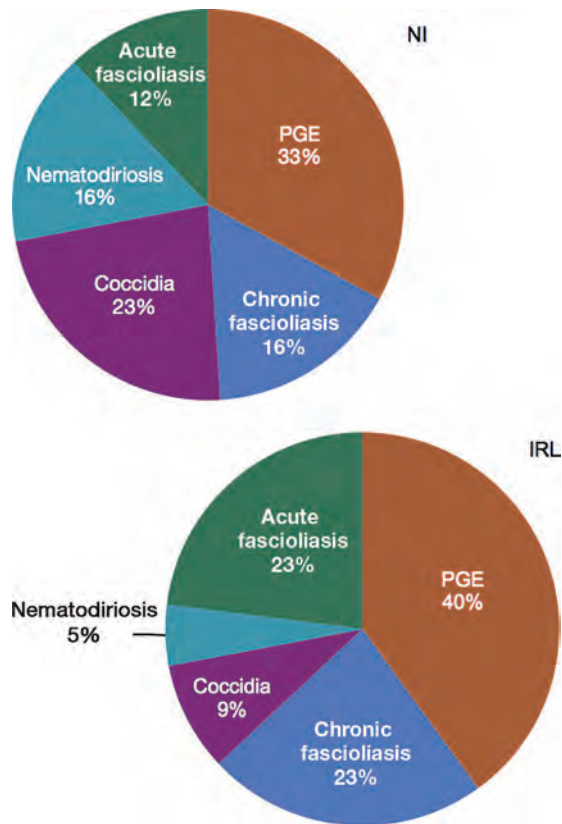
Figure 74: Specific endoparasitic conditions diagnosed in 2011 in sheep as a percentage of all ovine endoparasitic disease diagnosis made in NI (n=184 from 714 submissions) and IRL (n=66 from 832 submissions)

The relative importance of parasitic gastroenteritis (PGE) as a cause of death increased in both jurisdictions during 2011. Figure 74 shows the frequency of diagnosis of each disease as a percentage of the total number of post-mortem submissions in which parasitic disease was recorded as the cause of death.

Nematodirosis and coccidiosis were more frequently diagnosed at necropsy in Northern Ireland than in Ireland in 2011. Other less commonly diagnosed causes of endoparastism recorded on post-mortem examination included haemonchosis, sarcocystosis, cestode infection and cryptosporidiosis.

Clostridial disease in sheep

Clostridial organisms are naturally present in the soil, where the spores can survive for a long time but they can also live in the gut of healthy animals. Table 13

shows the prevalence of clostridial diseases diagnosed *post mortem* by AFBI in Northern Ireland and by DAFM in Ireland during 2011.

	Lambs	Adults (>12 months-of-age)
Blackleg	1	0
Black Disease	1	6
Clostridial abomasitis	1	4
Malignant oedema	0	1
Enterotoxaemia	10	6
Pulpy Kidney disease	30	1

Table 13: The frequency of diagnosis of clostridial disease in sheep on post-mortem examination in 2011.

Similar to 2010, pulpy kidney disease remains the most commonly diagnosed clostridial disease on the island of Ireland. Pulpy kidney disease is caused by infection with *Clostridium perfringens* type D. It is commonly identified in fast-growing lambs, typically over one month-of-age that are consuming high concentrate rations, or sucking ewes which are heavy in milk. Losses in a flock often coincide with a sudden change in the feed or with an increase in the plane of nutrition; this causes proliferation of the organism with consequent release of the toxin. Rapidly autolytic kidneys ('pulpy kidneys'), glucosuria and the presence of a serous clot in the pericardium, which when observed *post mortem*, are highly suggestive of pulpy kidney disease.
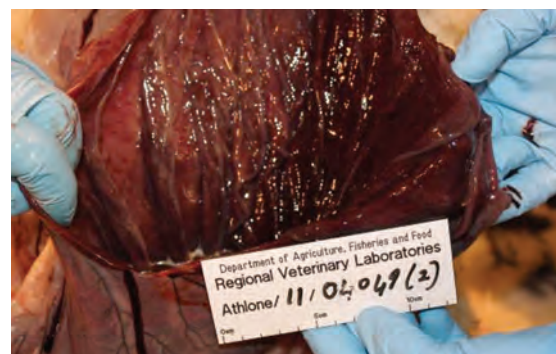

Figure 75: Clostridial abomasitis in a hogget (Photo: Ger Murray).

Clostridial abomasitis (Figure 75) is a relatively common disease of sheep. It can be caused by a number of

different *Clostridium* species. *C. sordellii* is commonly isolated from such cases while *C. perfringens* type B is associated with lamb dysentery which can lead to the post-mortem finding of abomasitis and enteritis, typically affecting neonates. Older lambs with this condition may develop a chronic condition called "pine," associated with chronic abdominal pain without diarrhoea. *C. septicum* is also associated with cases of braxy where abomasitis occurs due to the development of clostridial spores in the abomasal wall associated with the consumption of frozen forage.

Black disease is caused by the bacterium *Clostridium novyi* type B, which becomes active in liver tissue damaged by the liver fluke. As in cattle, the majority of cases are recorded in adult sheep rather than the young. Control relies on vaccination and elimination of liver flukes.

Ovine abortion

Although sporadic abortions are expected at a low level in all sheep flocks close to lambing, laboratory investigation is indicated when a cluster of cases occurs or the incidence of abortion exceeds five *per cent*.

Laboratory investigation can yield optimal results when appropriate samples are submitted for analyses. When available, the placenta should be submitted with the foetus. To increase the likelihood of identification of the cause of an abortion, more than one submission should be made where multiple losses have occurred. Occasionally maternal blood samples are of use to demonstrate recent acute infection (e.g. Chlamydiosis (enzootic abortion of ewes – EAE), toxoplasmosis, border disease, leptospirosis) but it is important that at east 10 *per cent* of ewes or at least 10 ewes (whichever is greater) are sampled. Where a full carcase submission is not possible the samples of choice are placenta (fixed and fresh), foetal stomach contents (collected aseptically), liver and foetal pleural fluid.

The purpose of laboratory investigation is to try to identify the cause of abortion, but even if no specific diagnosis is made the standard tests carried out can allow several common infectious causes to be ruled out. Where an infectious cause of abortion is identified, control measures can include treatment, management

of the lambing flock and, in the case of toxoplasmosis or EAE, vaccination.
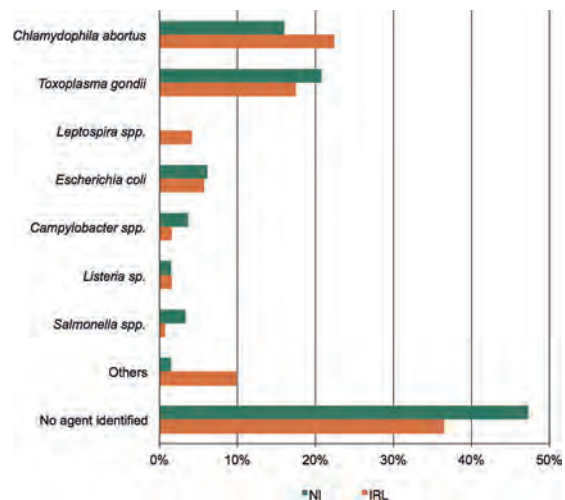
Figure 76: The diagnosed causes of ovine abortion in Northern Ireland (n=263) and Ireland (n=277) during 2011.

The number of aborted ovine foetuses submitted to both DAFM and AFBI was lower in 2011 than 2010. Submission numbers to DAFM fell from 402 in 2010 to 277 in 2011, while AFBI received 263 submissions in 2011 compared to 317 in 2010.

Figure 76 illustrates the relative frequency of diagnosed causes of abortion in sheep in Northern Ireland and Ireland during 2011. As in previous years, *Chlamydophila abortus* and *Toxoplasma gondii* were the two most commonly diagnosed causes of abortion in both jurisdictions. *C.abortus* (causing Enzootic Abortion of Ewes) was the most commonly diagnosed infectious cause of abortion in Northern Ireland, accounting for 22 *per cent* of diagnoses compared to 16 *per cent* in Ireland. *Toxoplasma gondii* was the most commonly diagnosed cause of abortion in Ireland (21 *per cent*) and the second most commonly diagnosed in Northern Ireland (17.5 *per cent*).

Salmonellosis was diagnosed more frequently in Ireland (4 *per cent*) than Northern Ireland (0.8 *per cent*). In Ireland, *Salmonella* Dublin was isolated in submissions from four farms, while *S. arizonae* and *S. mbandaka* were implicated in abortion outbreaks on one farm each.

The category "others" includes abortions attributed to *Trueperella pyogenes*, *Staphylococcus spp.*,

Streptococcus spp. and *Bacillus licheniformis.*

The zoonotic potential of infectious causes of abortion should be communicated to flockowners and other persons working with sheep. In particular, pregnant women should avoid contact with sheep, particularly around lambing time. *Toxoplasma gondii* or *Chlamydophila abortus* infections in pregnant women can have severe consequences for the health of the pregnant woman and her foetus.

Diseases of horses

Strangles

Strangles, caused by the bacterium, *Streptococcus equi* subspecies *equi*, is a highly contagious infection of horses characterised by severe inflammation of the mucosae and associated lymph nodes of the head and throat. The incubation period is typically three days to two weeks in length, after which time clinical signs of pyrexia, inappetance, coughing and a nasal discharge (mucoid, later becoming purulent) are noted. In some cases the clinical signs can be very mild which is thought to be the result of either partial immunity in the affected horse or alternatively from infection by *S. equi* of relatively low virulence.

In classical cases swelling of the submandibular lymph node with consequent pain leads to affected horses holding their heads extended and low to relieve the throat and lymph node pain. Swelling of the retropharyngeal lymph nodes may follow with obstruction of breathing from which the disease name "strangles" originates. If the affected lymph node is lanced or bursts the purulent material which emanates from the node is heavily contaminated with *S. equi* and is a source of infection for other horses. Once the lymph node is drained, recovery is normally uneventful.

Complications do arise occasionally, however, and include dissemination of infection to other organs ('bastard strangles'), purpura haemorrhagica, post-strangles myocarditis, purulent cellulitis or guttural pouch empyaema. Guttural pouch empyaema can lead to the development of long-term guttural pouch carriers. Shedding of *S. equi* from the nose and saliva of recovered horses may occur for up to six weeks following infection.

Diagnosis is often made based on clinical examination alone but can be confirmed by culturing pus from the nose, throat or abscessated lymph nodes of clinically affected horses. During 2011, AFBI and DAFM laboratories diagnosed two cases on post-mortem examination and a further seven cases from seven different premises based on bacteriological culture of submitted swabs.

Salmonellosis

Salmonellosis was diagnosed in two horses at post-mortem examination during 2011 by AFBI and DAFM laboratories. One of these cases was a one-month-old foal from which *S.* Typhimurium was isolated while the second was a two-year-old mare in which a diagnosis of salmonellosis was made based on clinical and histological findings. *Salmonella spp.* were also isolated from bacteriological culture of submitted tissues or swabs from four other cases. Two of these cases were associated with *S.* Typhimurium, one was associated with *S.* Dublin while the fourth was identified as a serogroup B *Salmonella*.

Acute gastrointestinal disease

Acute gastrointestinal disease typically affects foals less than ten days of age and is characterised by abdominal pain, bloody diarrhoea (occasionally) and sometimes by sudden death. The toxin of *Clostridium perfringens* has been implicated as a cause of the condition. Enterotoxin can be produced by all types of *C. perfringens* but this condition is most commonly associated with type A. In common with clostridial diseases in other species, the occurrence is often sporadic while the mortality rate, depending on the the type of *C. perfringins* implicated, may be high with many foals dying within 24 hours of the onset of clinical signs. Where type A toxin alone is implicated, while there may be significant morbidity, there may be a response to treatment and mortality may be lower.

C. perfringens is part of the normal flora of the intestine of horses and is also present in the environment. Development of the disease appears to result from an alteration of the normal intestinal flora allowing an overgrowth of the clostridial bacteria and toxin production. This may be due to changes in the diet, antibiotic therapy, stress, or concurrent infection. The enterotoxin of *C. perfringins* is broken down by intestinal trypsin. As trypsin is deficient in neonates, this explains the predisposition of young foals to the condition.

Gross post-mortem lesions include dehydration, congestion of the intestines and haemorrhagic intestinal contents. The diagnosis of *C. perfringens* enterocolitis is based on the gross findings and culturing *C. perfringens* from the intestine while definitive diagnosis of *C. perfringens* enterocolitis requires demonstration of toxins in the intestine or faeces of the affected foal. This is complicated by the rapid inactivation of toxin and overgrowth of other intestinal bacteria following the death of the animal.

During 2011, AFBI analysed 62 small intestinal contents from foals using the *C. perfringins* toxin ELISA. Six animals were positive for type A toxin.

Parasitology

Endoparasites	No. tested	No. positive	No. of premises affected
Cyathostomiasis	194	9	8
Strongyloides	358	100-500 epg = 12	11
		500-1000 epg = 1	
		>1000 epg = 2	
Large Strongyles	267	50-500 epg = 97	54
		500-1000 epg = 22	
		1000-1500 epg = 11	
		1500-2,000 epg = 3	
		>2,000 epg = 6	
Tapeworms (*Anaplocephala perfoliata*)	161	2	2
Dictyocaulus arnfieldi	147	6	4
Ascarids (*Parascaris equorum*) (Figure 77)	350	6	6

Table 14: The results of analyses for equine endoparasites performed by AFBI and DAFM laboratories during 2011. (epg = eggs *per* gram).

Figure 77: Masses of ascarid worms (*Parascaris equorum*) in the intestine of a horse (Photo: Cosme Sánchez-Miguel).

Requests for parasitological analysis of faecal or skin samples are regularly made to AFBI and DAFM laboratories. Table 14 displays the results of faecal analyses performed in both jurisdictions.

Figure 78: *Chorioptes equi* mite from an equine skin scraping (Photo: Cosme Sánchez-Miguel).

Microscopic examination is used to analyse hair samples and skin scrapings from horses suspected of ectoparasite infestation. This method of examination also facilitates examination for the presence or absence of fungal spores or hyphae. The results of these analyses are presented in Table 15.

Endoparasites	No. tested	No. positive	No. of premises affected
Lice	52	0	0
Sarcoptes scabeii	52	0	0
Chorioptes (Figure 78)	52	1	1
Ringworm	41	26	23

Table 15: The results of analyses for equine ectoparasites and ringworm performed by AFBI and DAFM laboratories during 2011.

Equine herpesvirus

Equine herpesvirus 1 (EHV-1) and EHV-4 are significant pathogens of horses and are widely distributed within horse populations worldwide. They can cause outbreaks of respiratory disease among younger horses or abortion in mares which can occur several weeks to months after clinical or subclinical infection. Transmission occurs by direct or indirect contact with infectious nasal secretions, aborted foetuses, placentas, or placental fluids. The outcome of exposure is determined by the strain of virus and the immune status and the pregnancy status of the host. EHV-1 for example is more commonly associated with abortion than EHV-4, which is often associated with outbreaks of respiratory disease in weanlings. In common with herpesvirus infections in other species, latent infections and carrier states also occur. On rare occasions infection with EHV-1 infection may lead to the development of neurological disease which is thought to occur more commonly but not exclusively in mares after abortion storms.

Clinical signs of respiratory disease in susceptible horses include pyrexia, leukopaenia, serous nasal discharge, cough, and possibly lymphadenopathy of the submandibular or retropharyngeal lymph nodes. Abortions typically occur between the seventh and eleventh month of gestation. The birth of live foals with viral pneumonitis may occur following infection in late gestation.
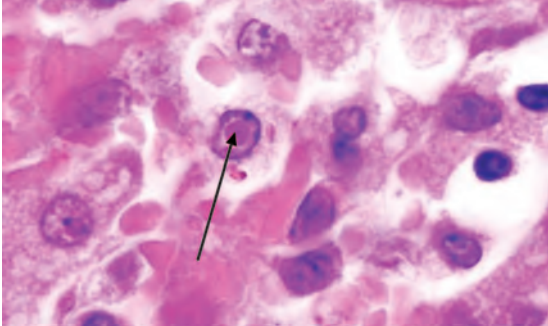
Figure 79: An intranuclear inclusion body (arrow) in the heptocyte of a horse with equine herpesvirus infection (Photo: Cosme Sánchez-Miguel).

A diagnosis of EHV infection can be established by demonstration of the virus in tissues or swabs, by serology or by histological analysis of tissues (Figure 79). During 2011, AFBI diagnosed four neurological cases and two respiratory cases using indirect fluorescent antibody testing (IFAT) on serum. A further 20 equine abortions were analysed for the presence of equine herpesvirus in foetal material using the IFAT, all of which were negative. In Ireland, DAFM identified two cases of EHV-4 infection from serology during 2011 and diagnosed one case of EHV-1 abortion using PCR.

Diseases of aquatic animals

Legislation

The Fish Health Unit (FHU) at the Marine Institute is the National Reference Laboratory in Ireland for diseases of finfish, molluscs and crustaceans and performs surveillance programmes for diseases listed under EU Directive 2006/88/EC. Under this Directive, routine surveillance is carried out for the following viral diseases of finfish: infectious salmon anaemia (ISA), viral haemorrhagic septicaemia (VHS), infectious haematopoietic necrosis (IHN) and koi herpesvirus (KHV). Routine surveillance is also carried out under this Directive for the two molluscan diseases caused by the parasites *Bonamia ostreae* and *Marteilia refringens*. Under Commission Decision 2010/171/EC Ireland is currently operating a KHV surveillance programme with the objective of achieving disease free status. Similarly under Commission Decision 2011/187/EC the FHU is undertaking a surveillance program for the early detection of Ostreid Herpes virus-1 µVar. Under Commission Decision 2010/221/EU, Ireland has been granted additional guarantees in relation to freedom from the finfish diseases bacterial kidney disease (BKD), spring viraemia of carp (SVC) and gyrodactylosis (infestation with *Gyrodactylus salaris*) and the FHU is obliged to test regularly for these diseases in order to confirm freedom. In addition to this, the FHU also provides a diagnostic service for the aquaculture industry, the wild fish sector, Inland Fisheries Ireland and veterinarians, for diseases currently not listed under EU Directives or by the OIE. The FHU laboratory is also accredited to ISO 17025 standards.

Testing

Figure 80: Fish Health Unit staff sampling a pike (*Esox lucius*) for a pre-movement health check (Photo: Marine Institiute).

In 2011, almost 4,000 finfish were tested for disease pathogens either as part of surveillance programmes, using diagnostic samples received into the laboratory or screening tests for the aquaculture industry. The majority of the finfish species tested were Atlantic salmon (86 *per cent*) and common carp, including koi carp (9 *per cent*), however a smaller number of rainbow trout, Atlantic cod, pike and coarse fish (roach, rudd and bream) were also tested. Ireland remains free of finfish diseases listed under Directive 2006/88/EC and also those included under Commission Decision 2010/221/EU.

Figure 81: Faecal casts in the gut of an Atlantic salmon (*Salmo salar*) with pancreas disease (Photo: Marine Institute).

The main diseases of finfish detected in 2011 were diseases which are not listed, either under EU Directives or by the OIE. These diseases were pancreas disease (PD) (Figure 81), caused by an alphavirus and infectious pancreatic necrosis (IPN), caused by an aquabirnavirus[1].

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[1] McLoughlin M.F. & Graham D.A. (2007) Alphavirus Infections in salmonids-a review. *Journal of Fish Diseases* 30, 511–531.

Both diseases are commonly diagnosed in Atlantic salmon reared in sea cages and are detected in the laboratory by virus isolation in cell culture followed by confirmation by ELISA, IFAT or PCR. Pancreas disease has been the most significant infectious disease in finfish aquaculture in Ireland over the past decade with the majority of marine salmon sites in the country becoming infected each year. Average yearly mortality rates have ranged between seven and eighteen *per cent* over the past six years. 2011 also saw the emergence of amoebic gill disease in marine finfish sites. The disease caused by *Neoparamoeba perurans* affects the gill tissue causing respiratory distress, anorexia and death. Although the disease has previously been reported in Ireland, it has become more prevalent and persistent on certain sites in 2011, resulting in higher mortalities than previously recorded.

Figure 82: The Pacific Oyster (*Crassostrea gigas*) (Photo: Marine Institute).
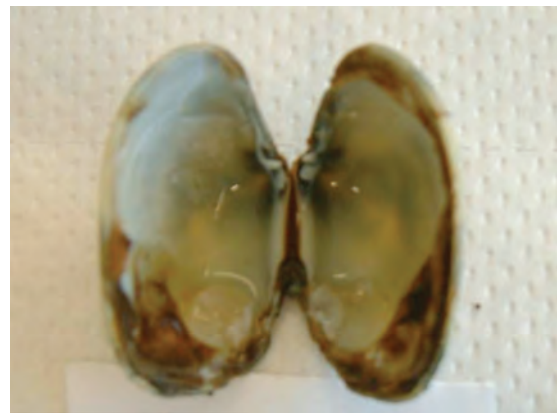

Figure 83: Brown ring disease in a clam (Photo: Marine Institute).

In the same period, 8,500 molluscs and crustaceans were tested by the FHU. The vast majority of the testing focused on Pacific oysters (Figure 82) in relation to Ostreid herpes virus-1 µVar. The testing carried out related to mortality events in areas where the virus has become established. There is also surveillance in those areas which remain free, and there are research programmes examining this emerging disease situation. Ninety native oysters were tested for the presence of the listed diseases *Bonamia ostreae* and *Marteilia refringens*. The entire coast of the Republic of Ireland is designated free from *Marteilia refringens* whilst the entire coast, with the exception of eight bays, is considered free from *Bonamia ostreae* (Commission Decision 2002/300). The remainder of the samples were Manila clams, submitted following reports of high mortality and brown ring disease (BRD) (Figure 83) was diagnosed in these clams following clinical examination and isolation of the causative bacterial agent, *Vibrio tapetis*.

Research

"Sea Change: A Marine Knowledge, Research & Innovation Strategy for Ireland 2007-2013" outlines the Marine Institute's research strategy for Ireland, including fish and shellfish health. The FHU is involved in two projects funded under this strategy. *AQUAPLAN: Health Management for Finfish Aquaculture* was developed to help provide Ireland with a strategic plan for the management of finfish health. *GILPAT: An Investigation into Gill Pathologies in Marine Reared Finfish* is investigating the interaction of jellyfish and aquaculture and aims to increase our understanding of this multifactorial disease. Under the EU FP7 program, the FHU is a partner in *BIVALIFE Management of Infectious Diseases in Oysters and Mussels in Europe* which aims to improve disease diagnostics and management for European molluscan aquaculture. The FHU is also collaborating with Dublin City University on a PhD project developing a diagnostic PCR for koi herpesvirus based on the expression of miRNAs during the latency stages of infection.

2011 Publications

Baxter EJ, Sturt MM, Ruane NM, Doyle TK, McAllen R, Harman L & Rodger HD. 2011. Gill damage to Atlantic salmon (*Salmo salar*) caused by the common jellyfish (*Aurelia aurita*) under experimental challenge. PLoS ONE 6(4): e18529.

McCleary S, Ruane NM, Cheslett D, Hickey C, Rodger HD, Geoghegan F & Henshilwood K. 2011. Detection of koi herpesvirus (KHV) in koi carp (*Cyprinus carpio* L.) imported into Ireland. Bulletin of the European Association of Fish Pathologists 31: 124-128.

Diseases of pigs

The pig production industry is an important sector in Irish agriculture to which both AFBI and DAFM laboratories provide diagnostic services as an aid to disease control. They also provide surveillance information on patterns of endemic diseases, prevalence of zoonotic diseases and evidence of emerging or exotic diseases if these occur. During 2011, 234 pig carcases were examined by AFBI and 121 were examined by DAFM.
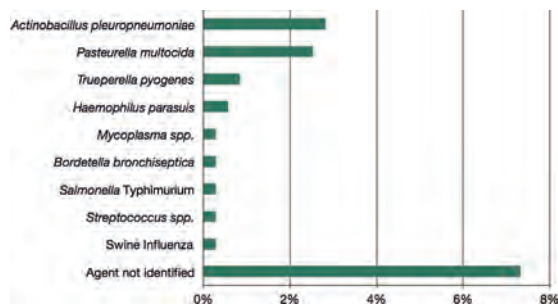
Respiratory disease

Figure 84: The distribution of aetiological agents identified in pigs diagnosed with pneumonia on post-mortem examination by AFBI and DAFM during 2011 (n=355).

Pneumonia was the single most commonly diagnosed cause of death and was diagnosed in 15.5 *per cent* of cases. A breakdown of the aetiological agents identified in cases of pneumonia is shown in Figure 84. *Actinobacillus pleuropneumoniae* (34.5 *per cent*) and *Pasteurella multocida* (31 *per cent*) were the most commonly identified agents in pneumonia cases on post-mortem examination. *A. pleuropneumoniae* is an important primary respiratory pathogen of fattening pigs in particular. *P. multocida* is the most common respiratory pathogen of pigs worldwide, but usually acts as a secondary agent in pneumonia cases.

Gastrointestinal disease
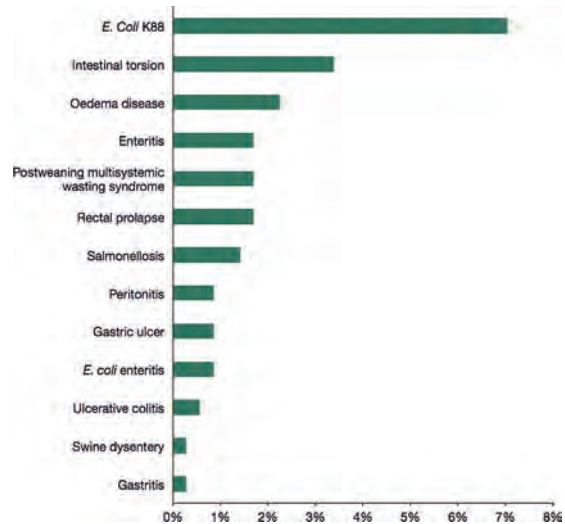
Figure 85: The distribution of aetiological agents identified in pigs diagnosed with gastrointestinal disease on post-mortem examination by AFBI and DAFM during 2011 (n=355).

Gastrointestinal diseases were diagnosed in 22.8 *per cent* of the pigs presented for post-mortem examination to AFBI and DAFM laboratories during 2011 (Figure 85). *Streptococcus suis* was detected in 18 (5 *per cent*) cases; seven cases had *S. suis* septicaemia or polyserositis and 11 had *S. suis* meningitis. *Streptococcus suis* is a common and important pathogen of young pigs. *S.suis* type 1 usually affects young piglets 2-3 weeks of age. Infection is normally acquired from the sow and typically it causes death through septicaemia or meningitis. *S. suis* type 2 is usually detected in weaned piglets 10-14 weeks of age and can cause sudden death. Occasionally polyserositis and meningitis can occur following infection and these syndromes are often observed following periods of stress.

Figure 86: Serous fluid present in the pleural cavity of a pig with Oedema disease (Photo: Colm Ó Muireagáin).

Oedema disease (Figure 86) was identified in 2.3 *per cent* of cases on post-mortem examination during 2011. Oedema disease is a peracute toxaemia, caused by haemolytic strains of *E. coli*, which often affects healthy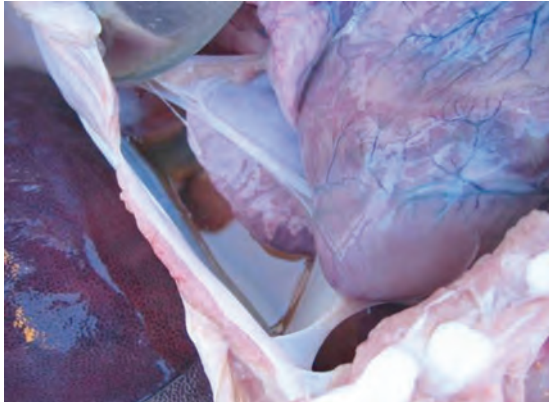, rapidly growing pigs between one and two weeks after weaning. Mortality can be very high in some cases. Clinical signs range from sudden death with no signs of illness to CNS involvement with ataxia, paralysis, and recumbency.

Postweaning multisystemic wasting syndrome (PMWS) was confirmed in six cases. PMWS is a complex disease syndrome caused by porcine circovirus 2 (PCV-2), which affects weaned piglets 8-12 weeks of age and results in a variety of clinical signs including reduced growth, wasting, anaemia, immunosuppression, lymphadenopathy, pneumonia and diarrhoea. Definitive diagnosis is difficult as the associated signs are non-specific. Furthermore, PCV-2 infection also causes both clinically silent infection and other disease syndromes. Diagnosis therefore requires identification of pathognomic lesions along with evidence of PCV-2 infection.

Thirteen cases of porcine abortion were investigated in 2011. Three cases of abortion due to *Escherichia coli* infection were identified. Two cases of abortion due to leptospiral infection and one case of abortion due to porcine parvovirus infection were also detected.

Diagnosis	Case numbers		Total
	DAFM	AFBI	
Colisepticaemia	2	18	20
Septicaemia	18	1	19
Meningitis	9	8	17
Erysipelothrix septicaemia	2	1	3
Arthritis	4		
Pericarditis	3		3
Polyserositis		2	2
Endocarditis		1	1
Splenic torsion		1	1
Pleurisy	1		1

Table 16: Other diagnoses in pig carcases during 2011.

Septicaemia was detected in a large number of cases from both jurisdictions, as detailed in Table 16. Twenty cases of colisepticaemia were detected, three cases of *Erysipelothrix rhusiopathiae* septicaemia and 19 cases of septicaemia where the agent was not identified.

Backyard Pigs

Pig-keeping in small outdoor production units or as pets is increasingly popular and tends to be associated with a different set of disease conditions when compared to commercial pig farming. Such holdings tend to have low stocking densities, outdoor keeping facilities, specialist breeds and limited use of vaccines and antibiotics. In such enterprises, when good husbandry conditions prevail, pig health is excellent with a low incidence of infectious diseases, particularly pneumonia. However, these animals have much longer lifespans, reduced reproductive efficiency, lower growth rates and, in the case of pets, tolerated obesity when compared to commercial pigs.

Lameness is common in outdoor pigs with foot problems such as hoof overgrowth and foot abscesses. Osteochondrosis and osteoarthritis are two conditions which are often seen. In both of these cases, clinical signs are exacerbated in obese animals. Infectious

causes of arthritis such as *Erysipelothrix rhusiopathiae* can lead to outbreaks of lameness in a herd.

Provision of shelter to pigs is important. Pigs are poorly able to regulate their body temperature and extremes of temperature causing heat stress or hypothermia in young animals can be fatal.

Figure 87: *Haematopinus suis* identified in a backyard pig (Photo: Cosme Sanchez-Miguel).

Skin problems can be caused by ectoparasites such as *Sarcoptes scabiei* causing mange, *Haematopinus suis* lice (Figure 87), or *Staphylococcus hyicus* causing greasy pig disease. Skin fold dermatitis is not uncommon in overweight animals. Sunburn can also be a problem among non-pigmented breeds.

Internal parasitism is common and related to poor rotation of holding areas. *Ascaris suum* infection results in heavy intestinal colonisation by adult ascarid worms which can lead to obstruction and migrating larvae cause white spot liver. In confirmed cases there is likely to be heavy contamination of the pens by *A. suum* eggs.

Enteritis in piglets, in common with most farmed animals, is associated with inadequate colostrum intake and poor hygiene of piglet housing. Causes of porcine neonatal enteritis include *E. coli*, *Clostridium perfringens* type A and *Isospora suis* (coccidiosis). Iron deficiency anaemia is common in piglets around three weeks of age, due to the combination of low iron in sows milk and rapid piglet growth.

Erysipelas caused by *Erysipelothrix rhusiopathiae* is sporadic but can spread through a herd leading

to a variety of clinical presentations such as acute septicaemia and sudden death or chronic illnesses such as endocarditis and arthritis.

Pyelonephritis caused by *Eubacterium suis* (formerly *Corynebacterium suis*) is common in all sows but, in outdoor facilities, where it may escape detection and prompt treatment, it may lead to death.

Seasonal infertility in late summer and early autumn is occasionally reported in outdoor sows. The cause is unknown and it does not appear to be associated with known pathological conditions. While *Leptospira* Bratislava seroprevalence is generally high in outdoor sows, there is little evidence of reduced reproductive performance directly attributable to this.

Diseases of poultry

The majority of poultry submissions to both AFBI and DAFM laboratories come from commercial poultry producers and often comprise multiple carcases per submission. Commercial poultry producers are principally concerned with large scale disease outbreaks or reduced flock performance. A growing number of poultry submissions have come from backyard flocks in recent years where the principal concern of owners is the cause of individual bird deaths.
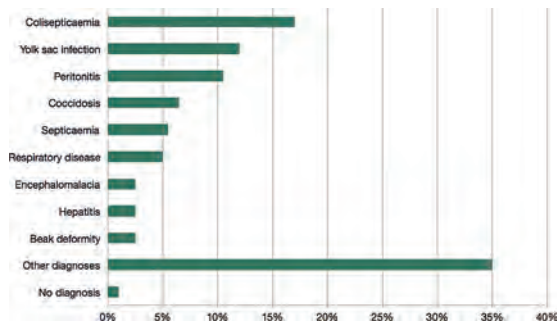

Figure 88: The relative frequency of the most commonly diagnosed cause of mortality in poultry in AFBI laboratories in 2011 (n=324).

During 2011, 324 poultry carcases were examined by AFBI and 236 were examined by the DAFM regional laboratories. Colisepticaemia (17 *per cent*) was the most common diagnosis among poultry carcases examined in AFBI laboratories, (Figure 88). Colisepticaemia, has a wide range of presenting lesions including; airsacculitis, hepatitis, cellulitis, peritonitis (Figure 89), osteomyelitis and swollen head syndrome. Colibacillosis, caused by secondary systemic or localised infection with avian pathogenic *Escherischia coli* is the most frequently reported disease of poultry worldwide and is often responsible for carcase condemnation at slaughter. AFBI diagnosed 17 cases of respiratory disease, representing 5 *per cent* of submissions, these included: 12 cases of pulmonary aspergillosis and two confirmed cases of infectious laryngotracheitis (gallid herpesvirus 1).

Figure 89: Perihepatitis associated with colisepticaemia in a 40-week-old layer hen (Photo: William Byrne).
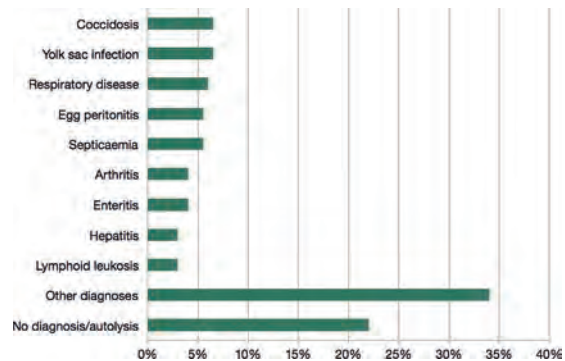
Figure 90: The relative frequency of the most commonly diagnosed cause of mortality in poultry in DAFM laboratories in 2011 (n=236).

Coccidosis was the disease most commonly diagnosed by DAFM, detected in 6.5 *per cent* of cases (Figure 90). Coccidiosis is a well recognised condition of poultry caused by numerous *Eimeria spp* of varying virulence, which can produce disease, usually in young chickens, which ranges from subclinical to fatal necrohaemorrhagic enteritis.

Diagnosis	Numbers of cases	
	AFBI	DAFM
Marek's disease	4	6
Parasitic gastroenteritis	5	2
Encephalomalacia	8	
Cellulitis		6
Histomoniasis	6	
Adenoviral crop ulceration	6	
Erysipelothrix septicaemia	6	
Avian pox virus		3
Avian tuberculosis		2
Broiler ascites syndrome		1
Fatty liver syndrome and haemorrhage		1

Table 17: The numbers of cases of less commonly diagnosed diseases from both laboratories during 2011.

Figure 91: Liver from a chicken with Marek's disease showing typical multifocal to coalescing pale areas of lymphoid proliferation (Photo: Cliff Mason).

The numbers of less commonly diagnosed conditions are given in Table 17. Marek's disease, caused by Marek's disease virus, a herpesvirus, is an important lymphoproliferative disease of poultry and was diagnosed by both AFBI and DAFM laboratories during 2011. Its presentation varies from acute paralysis with peripheral polyneuritis (infiltration of peripheral nerves by inflammatory cells) to chronic lymphoid tumors in solid organs (Figure 91). Diagnosis is based on

recognition of distinctive histological lesions in typically affected organs.

Figure 92: Liver from a chicken with Histomoniasis (Blackhead), showing the typical multifocal to coalescing target lesions of hepatic necrosis. (Photo: Cliff Mason).

Histomoniasis is caused by *Histomonas meleagridis*, a protozoan that infects the cecum, and later the liver, of turkeys in particular, but which can also infect chickens. In turkeys mortality can be very high, but in chickens the mortality rate is somewhat less. The parasites migrate into the submucosa and muscularis mucosa of the caecum causing extensive necrosis. The parasite reaches the liver either by the vascular system or *via* the peritoneal cavity. In the liver, rounded necrotic lesions are evident on post-mortem examination (Figure 92). AFBI recorded six cases of *Histomonas meleagridis* infection in poultry during 2011.
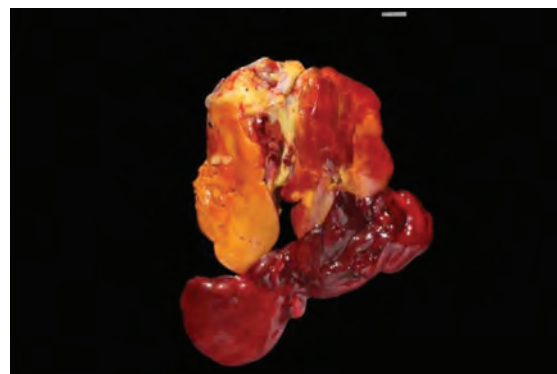

Figure 93: The liver and abdominal fat from a laying hen with fatty liver disease and rupture with haemorrhage (Photo: Colm Ó Muireagáin).

Fatty liver syndrome and haemorrhage is a disease of laying hens particularly those with large amounts of fat deposited in their liver and abdomen (Figure 93). This may result in an enlarged liver that is easily damaged and prone to bleeding often leading to death as a result of blood loss from an internal haemorrhage in the liver. Haemorrhage is thought to occur when a hen is straining to lay an egg. The disease may be hereditary but excessive dietary energy intake is central to most cases of the disease.

Infectious bursal disease (avibirnavirus) is a highly contagious infection of young birds that causes severe lymphoid necrosis and depletion, particularly in the Bursa of Fabricus resulting in death or immunosuppression in affected animals. Due to vaccination of commercial poultry, seroprevalence in birds is high, although disease is uncommon except where variant strains emerge in a flock.
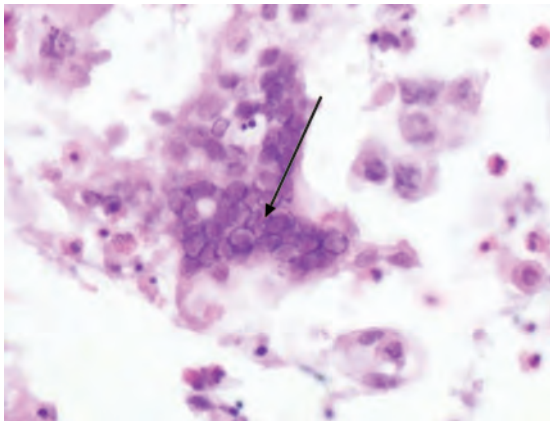

Figure 94: Clusters of eosinophilic intranuclear inclusion bodies (arrow) in the tracheal epithelial cells of a hen with infectious laryngotracheitis (H&E X400)(Photo: Ann Sharpe).

In addition to post-mortem examinations, 180 submissions of fixed poultry tissues were examined histologically by AFBI. On histological examination there were 12 cases of adenoviral crop ulceration, 11 cases of Marek's disease, three cases of infectious bursal disease, two cases of inclusion body hepatitis and one case of infectious laryngotracheitis (Figure 94).

Wildlife surveillance

Mute swan deaths

There were reports of many mute swan deaths at multiple sites in Northern Ireland during January and February 2011. This coincided with a prolonged period of cold weather when lakes and ponds were frozen but deaths appeared to be restricted to mute swans.

A total of 23 mute swans were examined from eight separate sites and there were a range of *post-mortem* findings. All swans tested negative for avian influenza by rtPCR and there was no evidence of botulism or of lead poisoning in any of the carcases.

While two birds showed evidence of starvation, generally the swans had been in good nutritional condition. The most common post-mortem findings included generalised bacterial infections of the liver, air sac or lungs. One swan showed changes suggestive of amyloidosis while two birds had necrotic enteritis.

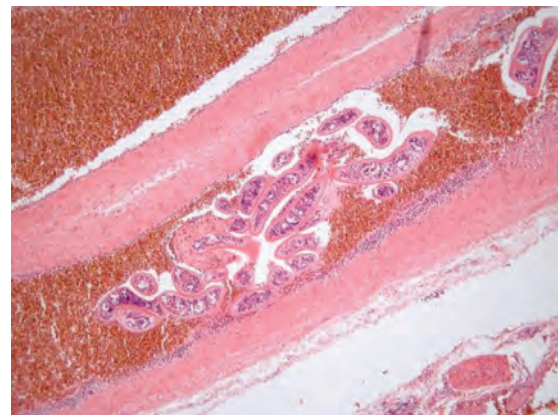Figure 95: Schistosomes in a mesenteric blood vessel of a mute swan (Haematoxylin and Eosin x 100) (Photo: Bob Hanna).

Intestinal parasites such as intestinal flukes, tapeworms and *Capillaria* nematodes were also recorded in many swans, though burdens were not high. Schistosome flukes within blood vessels of the liver and mesentery were noted in others (Figure 95), the significance of which was unclear.
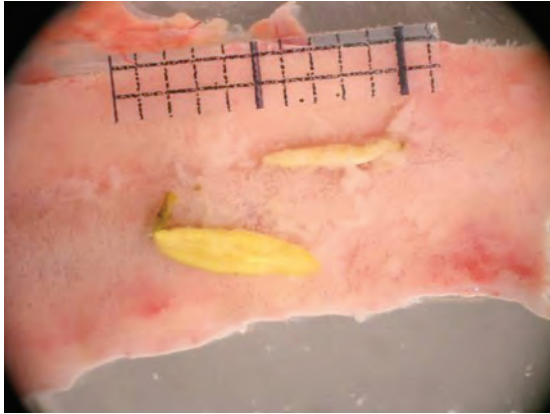
Figure 96: *Acanthocephalan sp.* in the intestines of a swan (Photo: Tony Patterson).

Swans from one site had significant burdens of *Acanthocephalan* (Figure 96) 'thorny-headed' worms within the intestines. In a number of cases, the proboscis of worms had penetrated through the intestinal walls which may have predisposed the swans to the generalised bacterial infections which were noted in those cases. Acanthocephalans appear to be particularly pathogenic in swans, but the significance of these infections is often unclear as clinical signs may be absent in conspecific birds with similar burdens. There is evidence however that even light burdens of acanthocephalans can be harmful, as the pathogenesis is highly influenced by the nutritional status of the host and by environmental stress. A study in starlings, for example, showed reductions in standard metabolic rates as a result of infection, indicating that their basal metabolism and thermoregulatory abilities were altered.

Bacterial culture isolated a range of bacterial pathogens, including strains of *E.coli* known to be pathogenic in birds, and a scanty growth of *Riemerella anatipestifer* was recovered from one bird.

Scotland and England also reported increased mortality of mute swans with very similar circumstances and post-mortem findings to the Northern Ireland cases. In the English and Scottish cases the main causes of death were identified as necrotic enteritis and hepatic amyloidosis.

Amyloidosis is often recorded in waterfowl as a secondary change to chronic inflammatory conditions such as avian tuberculosis. There was no evidence of a primary inflammatory focus in these birds. It was postulated however, that a high carbohydrate diet in swans may predispose to hepatic amyloidosis in the absence of chronic inflammation. It was noteworthy that all of these events occurred in waters where swans were fed.

A hypothesis was formulated to explain these events which presumed that the cause was multifactorial. The very cold period experienced over Christmas 2010 and New Year 2011 and the consequent freezing of lakes would have restricted the swans into smaller areas which would have had two main effects. Firstly freezing would have restricted the birds' natural feeding patterns and diet and thus made them more dependent on artificial feeding. Such feeding with constituents such as grain or bread would have resulted in a higher carbohydrate intake than in a natural diet. Secondly, the birds would have been forced closer together and this may have resulted in stress as well as increasing the risks of bacterial infections.

Necrotic enteritis is caused by *Clostridium perfringens*. This organism is part of the normal intestinal flora and causes disease when there are factors that allow bacterial overgrowth to occur. Parasitic damage and high carbohydrate intakes are possible predisposing factors. Swans also appear to be more at risk from necrotic enteritis than other species of wildfowl.

Suspected cases of wildlife poisoning

Both AFBI and DAFM laboratories are involved in the investigation of suspected cases of wildlife poisoning. AFBI process and analyse suspected cases as part of the Wildlife Incident Investigation Scheme (WIIS) which is overseen by the Chemical Regulations Directorate 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 is suspected. Samples are taken from carcasses during post-mortem examination and subjected to a range of toxicological analyses. The results of these investigations are used to monitor pesticide use and enforce legislation on the protection

of humans, animals, food and the environment from pesticides. During 2011 in Northern Ireland, eleven cases of suspected pesticide abuse were reported. Among avian species, suspected cases were recorded in barn owls (*Tyto alba*), buzzards (*Buteo buteo*), red kites (*Milvus milvus*), common magpies (*Pica pica*) and house sparrows (*Passer domesticus*) while a further four suspected cases were identified in mammals (a hedgehog (*Erinaceus europaeus*) and red foxes (*Vulpes vulpes*)).

A buzzard and a magpie showed evidence of alpha-chloralose poisoning while evidence of carbofuran poisoning was identified in a buzzard and a red kite. No evidence of pesticide abuse was found in the mammals submitted.

In Ireland, the DAFM laboratories provide post-mortem diagnostic services for suspected poisoning cases of wild birds of prey (both native and reintroduced species). The service is provided under an agreed protocol between DAFM and the National Parks and Wildlife Service. The Golden Eagle Trust, a private charity, has managed three state supported reintroduction projects – White-tailed eagles in Co. Kerry, Golden eagles in Co. Donegal and Red kites in Co. Dublin and Co. Wicklow.

Species	Submission numbers
Buzzards	10
Black-headed gull	5
Pigeons	5
Sparrowhawk	2
Starlings	2
Red Kites	2
Golden Eagle	1
Peregrine falcon	1
Rook	1
Carrion crow	1
Wood pigeon	1

Table 18: The numbers of different species of birds, suspected as having been poisoned, submitted to DAFM laboratories in 2011.

During 2011, DAFM received 17 separate submissions in which poisoning was suspected (Table 18) comprising 31 birds in total. Carbofurans were detected on analyses in five pigeons, two buzzards and one sparrowhawk (Figure 97).

Figure 97: A sparrowhawk with suspected poisoning which was submitted to DAFM laboratories (Photo: John Fagan).

The Golden Eagle Trust has produced a leaflet on the safe and legal control of foxes and crows at lambing time. This was produced as a means of avoiding the inadvertent poisoning of these birds of prey by people who are attempting to control a fox or crow problem on farm.

Bovine tuberculosis (bTB) surveillance in badgers

Screening of badgers for bovine TB is performed by the regional veterinary laboratories in Ireland. It should be noted that these badgers represent only a small proportion of those tested under the ERAD scheme (>6,000). The majority of those examined are snared under licence and submitted by district veterinary offices but there are a small proportion of badgers submitted which are found on the road (i.e. 'road kill). During 2011 a total of 205 badgers were examined *post mortem*, of which 13 were positive (6.3 *per cent*) for TB (*M. bovis* was isolated in all cases).

Trichinellosis

Figure 98: *Trichinella spiralis* larvae from the muscle of a fox (Photo: Cosme Sanchez-Miguel).

Trichinellosis is a zoonotic disease caused by *Trichinella* spiralis (Figure 98). Numerous mammalian species can harbour the parasite and humans can develop severe disease following infection. In Europe, horsemeat, wild boar and pork are the main sources for human infection.

Trichinella has a sylvatic cycle, which is maintained mainly by wild carnivores. The red fox (*Vulpes vulpes*) is the principal sylvatic reservoir in Europe. An annual *Trichinella* risk-based wildlife monitoring programme is in place in Ireland, a country where the risk of *Trichinella* in domestic pigs is officially recognised as negligible.

In 2011, 643 foxes were collected from across the island of Ireland (167 by AFBI and 476 by DAFM). Muscle samples were dissected from each fox and these were analysed microscopically for the presence of *Trichinella* spp. larvae following a pepsin digestion procedure. Four foxes (three from Co. Cork, and one from Co. Louth) were found to harbour *Trichinella spiralis* larvae and the results were confirmed following submission of the larvae for PCR testing to the EU Reference Laboratory for Parasites, in Rome. Figure 99 illustrates the location of the four positive foxes.

Figure 99: The capture location of the four *Trichinella*-positive foxes from the 643 tested in 2011.

The *Echinococcus multilocularis* survey in wildlife (foxes)

Tapeworms are highly relevant to public health. Depending on the species of tapeworm, humans can either be infected with adult worms from larvae harboured by food animals or with larvae from adult worms parasitising domestic pets, farm dogs and wild caniidae. The most important genera, worldwide, are *Taenia* and *Echinococcus*. The majority of the *Taenia* species are present in Ireland. However, there are a number of *Echinococcus* species and it is generally considered that the non-zoonotic horse strain, *Echinococcus granulosus equinus*, is the only species circulating in the country.

Echinococcus multilocularis is considered one of the most lethal parasitic zoonoses in temperate and artic regions of the Northern Hemisphere. The parasite in the wild has both a sylvatic and syanthropic life cycle involving foxes as the definitive host and arvicolid rodents as intermediate hosts. Although foxes are the maintenance host, dogs are highly susceptible and infected dogs appear to be the main source of infection for humans in endemic areas. Humans are aberrant hosts for the metacestode (larval) stage. Once an intermediate or aberrant host ingests the tapeworm eggs, they hatch, releasing an oncospheres that migrates *via* the circulatory system to the liver where they develop into multilocular or alveolar cysts. These cysts contain variable numbers of protoscoleces and appear like slow growing malignant neoplasms. The metacestode stage has the unusual capacity to proliferate by external budding and to spread into extrahepatic tissues and also metastasise to other organs including the lungs. Alveolar echinococcosis in humans is of considerable public importance because mortality can be up to 100 *per cent* in undiagnosed and untreated individuals. The infection has a long incubation period (*circa* 5-15 years) and clinical symptoms, which are invariably vague and not typically related to the disease, occur in the late phase when the parasite has already infiltrated a large part of the liver.

The main risk factor associated with human infection in endemic areas is a high prevalence of *E. multilocularis* in both wildlife and domestic pets. This has been attributed to both an increase in the fox population and the urbanisation of foxes throughout Europe.

It is estimated that there are at least 150,000 foxes in Ireland and each year the National Association of Regional Game Councils (NARGCs) cull about 25,000 to 30,000. A selection of these foxes is submitted annually to the regional veterinary laboratories as part of the *Trichinella* survey. During the period of October 2009 to February 2010, a total of 395 foxes were collected for a national survey of trichinellosis amongst wildlife. The number of foxes killed in each of the 26 counties in the Republic of Ireland varied from 3 to 21 and these were sent to the nearest Regional Veterinary Laboratory (RVL) for examination. Of the 395 foxes examined, only intestines from 303 foxes were suitable for the *E. multilocularis* survey.

The sedimentation and counting technique (SCT) was selected as the method of choice for this study. The sensitivity and specificity of this method is 100 *per cent* and it is considered the "gold standard" test. There was no evidence of *E. multilocularis* infection in any of the animals examined.

There are many ways *E. multilocularis* could be introduced into Ireland. The most obvious method, which poses the greatest risk, is the importation of infected domestic pets. The level of risk depends on the prevalence of infection amongst the wildlife and domestic pet populations in the area the imported animal comes from. Other routes of introduction pose a lesser but nevertheless real risk, such as illegal importation and unauthorized release into the rural environment of wild boar infected with metacestodes. This could eventually lead to scavenging of the dead pig carcasses by foxes or dogs. A similar transmission cycle could be initiated by the importation of wild boar meat and offal and its disposal in a manner that allows scavenging by foxes and domestic or feral dogs and cats.

Parasitic Diseases

The number of faecal samples submitted to the AFBI and DAFM veterinary laboratories for parasitological examinations declined in 2011 from the peak witnessed in 2010. As an example of this, Figure 100 illustrates the numbers of bovine and ovine faecal sample numbers submitted for liver fluke egg examination during the four years 2008 to 2011.
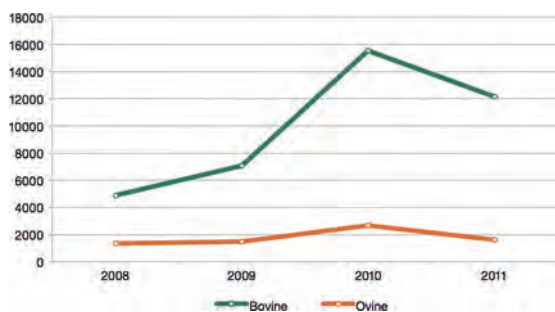

Figure 100: The combined number of faecal samples submitted for liver fluke egg detection to AFBI and DAFM laboratories in the years 2008 to 2011.
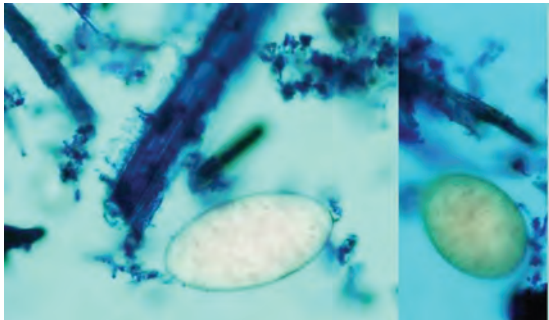
Liver and rumen fluke infections

Figure 101: A rumen fluke (*Paramphistomum spp.*) egg on the left which is paler in colour and larger in size than that of a liver fluke (*Fasciola hepatica*) egg on the right (Photo: Cosme Sanchez-Miguel).

During 2011, a combined total of 12,167 bovine faecal samples was analysed for the presence of liver fluke eggs (3,263 by AFBI and 8,904 by DAFM). Liver flukes (*Fasciola hepatica*) are associated with widespread morbidity and mortality in sheep and cattle across the entire island of Ireland, most particularly in areas prone to water logged pasture. In what represents a significant decline in the detection of positive samples, only 7.3 *per cent* of the 12,167 bovine samples analysed were

positive in 2011 compared to 17.4 *per cent* of samples in 2010. It is likely that this decline in positive samples is due to the joint effects of increased awareness of the danger of fluke infestation following from heavy infection pressure experienced in the last number of years as well as rainfall amounts which did not equal the high levels experienced in 2010.

Furthermore, the unusually severe and sustained period of frost and cold weather from early December 2010 to February 2011 is likely to have destroyed any infectious cysts (metacercariae) remaining on the pastures after the autumn of 2010, and also to have killed off many hibernating host snails, *Galba truncatula*, particularly those individuals bearing larval fluke infection. Thus the pastures in Spring and Summer of 2011 would have been relatively free of the stage of liver fluke infective for sheep and cattle.

A combined total of 12,176 samples were examined for rumen fluke eggs (*Paramphistomum spp.*) during 2011 of which 34.8 *per cent* were positive, representing a modest decline from the levels recorded in 2010. Figure 102 illustrates the trend in positive results for liver and rumen fluke egg detection in faeces by quarter.
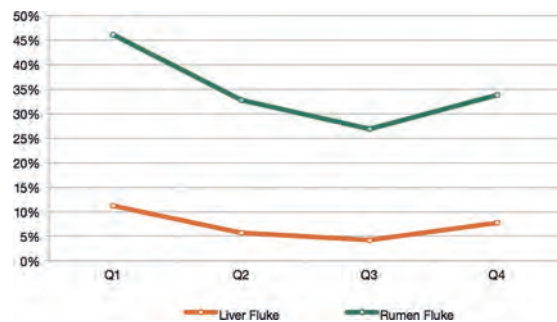

Figure 102: The percentage of bovine faecal samples positive for fluke eggs by quarter during 2011 in AFBI and DAFM laboratories.

Figure 103: A liver from a lamb which died from acute liver fluke (*Fasciola hepatica*) infection (Photo: Cosme Sanchez-Miguel).

A combined total of 1,634 ovine faecal samples was analysed for the presence of liver fluke eggs in 2011, a decline of approximately 38 *per cent* when compared to 2010. Of these, 6.1 *per cent* were positive which again, similar to the bovine results, represents a marked reduction from the level of 15.4 *per cent* recorded as positive in 2010. A further 1,645 ovine samples were examined for rumen fluke eggs, 17.9 *per cent* of which were positive. Figure 104 charts the trend in positive results in sheep for both liver and rumen flukes, by quarter, during 2011.
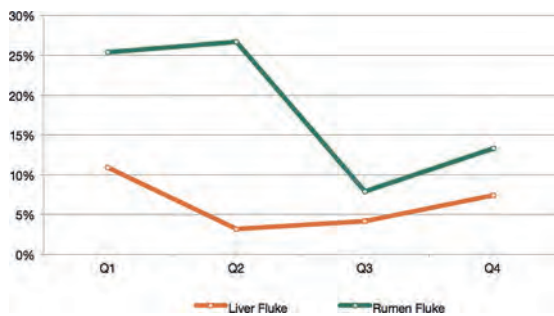

Figure 104: The percentage of ovine faecal samples positive for fluke eggs by quarter in 2011 in AFBI and DAFM laboratories.
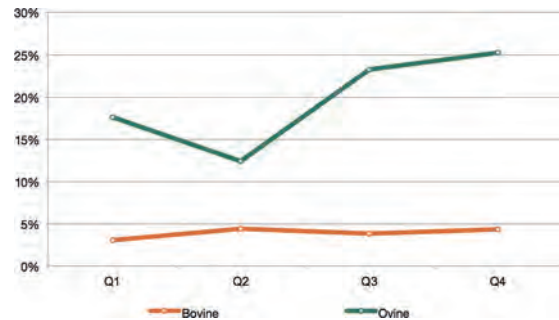
Gastrointestinal parasitic infections

Figure 105: The percentage of bovine and ovine faecal samples positive (≥500eggs per gram) for strongyle eggs in DAFM and AFBI laboratories during 2011.

Faecal worm egg counts are routinely performed in veterinary laboratories to aid in parasite control on farm, as a means of assessing potential anthelmintic resistance and as a diagnostic aid to farmers and their veterinary practitioners. In 2011, a combined total of 13,749 bovine and 2,107 ovine faecal samples were examined for the presence of strongyle eggs. Almost 4 *per cent* were found to have egg counts of 500 or greater per gram of faeces, a level considered to be clinically significant. Figure 105 illustrates the quarterly results for both bovine and ovine species.

The figures show that, as in previous years, the percentage of samples positive for strongyle eggs is much higher for ovine than bovine samples. There may be a number of reasons for this. Firstly, it is more common for sheep to be outwintered than cattle, leaving the sheep more exposed to parasitic infections. Secondly, the number of ovine samples tested by the laboratories is much smaller than the number of bovine samples. It is likely that farmers are more selective about the submission of samples and are more conscious of the costs involved, because the profitability of sheep farming in recent years has been lower than dairy and beef farming. Therefore it is reasonable to assume that ovine samples, when submitted, are more likely to be positive for parasitic eggs.
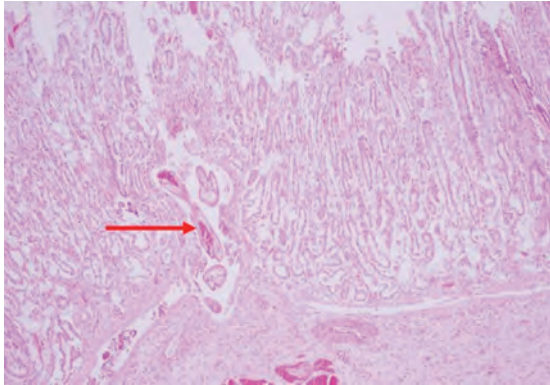
Figure 106: *Ostertagia spp.* (arrow) identified on H&E section of the ruminant abomasum (Photo: Cosme Sanchez-Miguel).

Nematodirus battus is the most important *Nematodirus* species in Ireland and heavy infections can cause diarrhoea, dehydration and ill thrift in young lambs. Hatching of the third stage larvae (L3) requires specific environmental conditions that usually prevail in May and June, so it is normal to see a spike in positive samples in the summer months. During 2011, 11.5 *per cent* of the 1,925 ovine faecal samples examined by the DAFM and AFBI laboratories were positive for the presence of *Nematodirus spp.* eggs. Figure 107 shows the quarterly distribution of positive results.
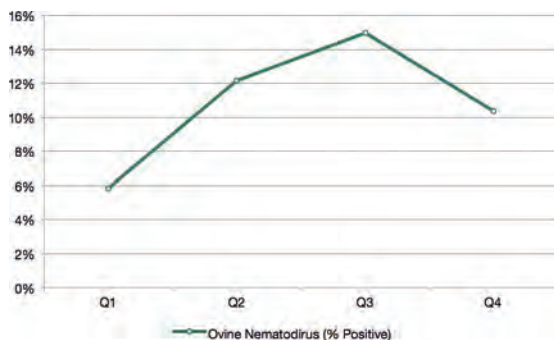
Figure 107: The trend, by quarter, in the detection of *Nematodirus spp.* larvae in ovine faecal samples submitted to DAFM and AFBI veterinary laboratories during 2011.

Lungworm infections

Bovine faecal samples are examined for lungworm larvae (primarily *Dictyocaulus viviparus*) using the Baermann technique. During 2011, 2,534 bovine faecal samples were examined for the presence of lungworm larvae. 4.0 *per cent* were positive which represented an increase from the level of 2.8 *per cent* recorded in

2010. Figure 108 illustrates the trend in positive results by quarter and is similar to that found in 2010, with the highest percentage of positive results found in Q3.
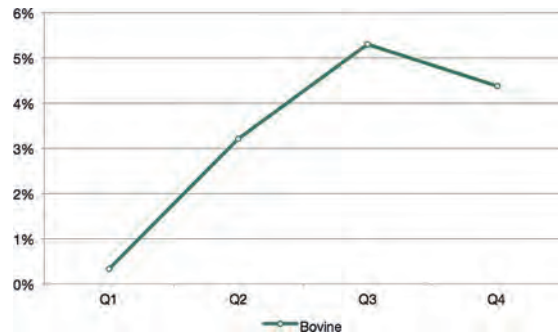
Figure 108: The percentage of bovine faecal samples positive for lungworm larvae by quarter in AFBI and DAFM laboratories during 2011.

Figure 109: A lungworm (*Dictyocaulus viviparus*) larva (Photo: Cosme Sanchez).

Coccidiosis

Coccidia (*Eimeria spp.*) are protozoan parasites that can cause significant disease in lambs and calves, particularly in the first six months of life. The disease is worst in those animals exposed to large numbers of oocysts that have built up in the environment, often as a result of poor management practices. Disease in older bovine animals is relatively uncommon.
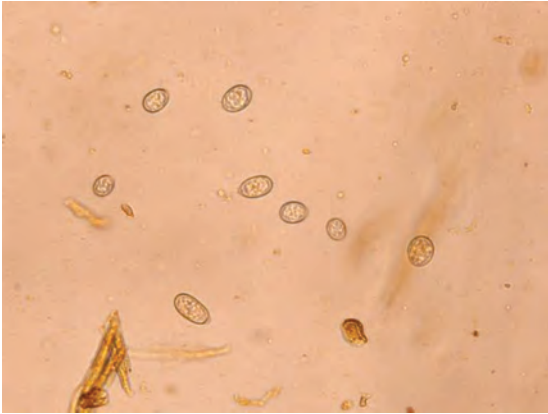
Figure 110: Coccidial oocysts as seen on McMasters examination of a ruminant faecal sample (X200) (Photo: Colm Ó Muireagáin).

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.

Of 11,041 bovine faecal samples and 1,826 ovine faecal samples which were tested for the presence of coccidial oocysts in 2011, 16.0 *per cent* and 47.5 *per cent* were positive respectively. The majority of the positive bovine samples contained low numbers of oocysts (Figure 111).

Figure 111: The percentage of bovine faecal samples positive for coccidial oocysts in AFBI and DAFM laboratories during 2011 (n=11,041).

There were a far higher proportion of positive ovine samples than bovine samples, a finding that has also been noted in previous years (Figure 112).
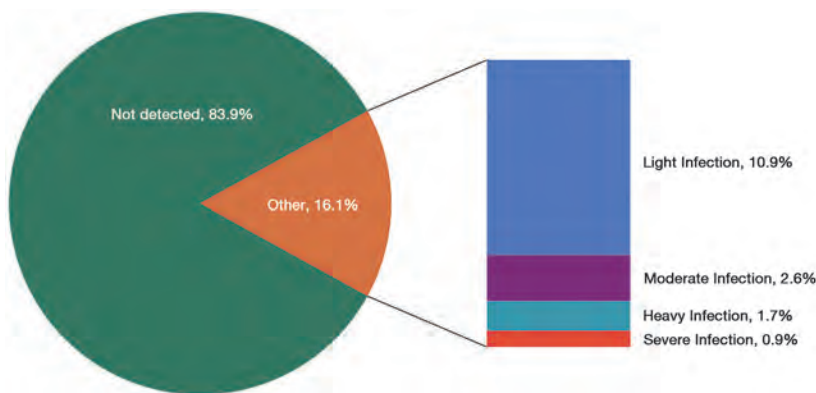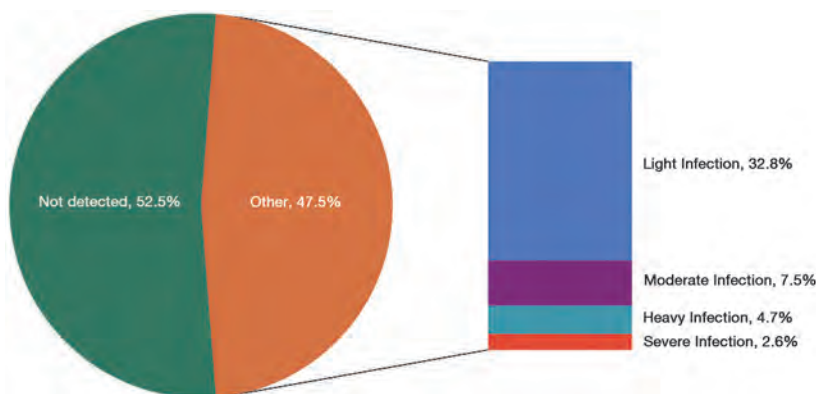

Figure 112: The breakdown of results of analyses of ovine faecal samples for coccidial oocysts in AFBI and DAFM laboratories during 2011 (n=1,826).

Other infections

One outbreak of sheep scab, caused by *Psoroptes ovis* (Figure 113), was confirmed in Ireland by laboratory testing in 2011. There were no laboratory confirmed outbreaks of sheep scab in Northern Ireland in 2011.

Figure 113: *Psoroptes spp.* mite. One outbreak of sheep scab was confirmed in Ireland by laboratory testing in 2011 (Photo: Cosme Sanchez-Miguel)

Anthelmintic resistance

Anthelmintic resistance poses a serious threat to the health of livestock on the island of Ireland. At present there are initiatives underway in both jurisdictions to assess the level of anthelmintic resistance among gut nematodes and liver fluke in cattle and sheep.

Ireland

In Ireland, DAFM and Teagasc are collaborating with a number of international partners from Denmark, Sweden, France, Greece, Canada and Guadaloupe as part of the Coordination of European Research on Emerging and Major Infectious Diseases of Livestock (EMIDA ERA-NET) project on Coping with Anthelmintic RESistance (CARES). This collaborative project directly addresses the topic of parasite control/anthelmintic resistance which was identified in the *Stimulating Sustainable Agricultural Production through Research and Innovation* document as a research priority area. This research is required to underpin the targets of the Food Harvest 2020 report in Ireland.

The CARES project aims to mitigate against the risks of anthelmintic resistance and of new and emerging parasitic diseases as well as providing for the sustainable use of anthelmintics and the development of alternative parasite control strategies, with particular emphasis on the sheep sector.

The main objectives of the work areas that DAFM and Teagasc are involved in are:

- To identify benzimidazole resistant species in Ireland along with the gene and specific mutation responsible for benzimidazole resistance and to examine the diversity of resistant haplotypes

- To identify candidate genes mediating ivermectin resistance

- To evaluate criteria for the targeted selection of animals for anthelmintic treatment.

- To evaluate the Sustainable Control of Parasites in Sheep (SCOPS) strategy of preserving susceptible worms on farm and reducing the number of treatments to lambs. This is a means of delaying the development of anthelmintic resistance, by increasing the *in refugia* parasite population.

The preliminary results will be available in next years *All-island Animal Disease Surveillance Report*.

Northern Ireland

Work undertaken in Northern Ireland during 2011 confirms the existence of serious problems of anthelmintic resistance in gut nematodes and liver fluke on sheep and cattle farms across the province. The profound economic and welfare issues implicit in these findings indicate the need for increased investment in field survey work and in the development of methods and schemes for the diagnosis of resistance status on individual premises. There is also a need for the evolution of pragmatic, locally-applicable guidelines to advise farmers on best management practices in their individual circumstances, and for improved dissemination of information on appropriate use of anthelmintics.
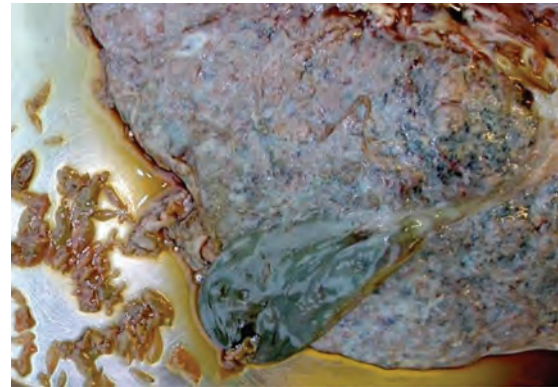
Figure 114: Chronic fascioliasis in a ewe – anthelmintic resistance among fluke is a growing problem on the island of Ireland (Photo: Colm Ó Muireagáin).

During 2011, the Parasitology section of DSIB (part of AFBI) was involved in a number of surveys and field investigations relating to the incidence of anthelmintic resistance in gut nematodes and liver fluke of sheep and cattle throughout Northern Ireland. This work was carried out in co-operation with two PhD students and two staff members from the School of Biological Sciences, Queen's University Belfast.

On each of 13 well-managed lowland and upland sheep farms approximately 60 grazing lambs were rectal-faecal sampled, then dosed with triclabendazole, closantel or nitroxynil, and resampled three weeks later. Faecal egg count reduction tests on the pre- and post-dose faecal samples revealed that in five flocks with high and moderate fluke burdens, triclabendazole resistance was well-established, although closantel and nitroxynil remained effective. On the remaining eight farms, pre-dose egg counts were too low to permit statistically valid conclusions to be drawn.

On four of the farms surveyed for fluke resistance, groups of animals were also tested by faecal egg count reduction for gut nematode resistance to albendazole, ivermectin and moxidectin. On three farms, well-established resistance to albendazole and ivermectin was recorded, with emerging resistance to both these anthelmintics present on the fourth farm. On one farm out of the four, established resistance to moxidectin was recorded.

Results of the field trial on gut nematode resistance were consistent with the findings of a wider survey that involved 93 farms across Northern Ireland. In this, individual farmers agreeing to take part were provided with sample pots and instructions to collect pre- and post-dose 'mob' faecal samples respectively before, and two-to-three weeks after, dosing with an anthelmintic product of their choice. The results of faecal egg count reduction testing revealed worryingly high levels of resistance to benzimidazole drugs (>90 *per cent*), ivermectin and moxidectin (approximately 50 *per cent* each).

A large questionnaire-based survey on sheep and cattle farm management, with particular reference to the use of anthelmintics drugs and perceived anthelmintic resistance, was also carried out during the period. Over 300 farmers returned completed survey forms, and the findings are at present being analysed. It appears that, while there is widespread concern regarding the rapid evolution of drug-resistant worms, there is confusion as to the management strategies that should be adopted to preserve drug efficacy on premises where existing anthelmintics still remain effective, and to prevent emergence of resistance to new drugs.

Zoonoses

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

In this section of the report, some of the most common zoonotic agents identified in the veterinary laboratories are discussed; other zoonoses, such as tuberculosis, trichinellosis or botulism, are discussed in other areas of the report.

Brucellosis

Brucellosis is a notifiable disease. On the island of Ireland, bovine brucellosis is the most common manifestation of this disease and *Brucella abortus* is the most commonly identified causative agent. Ireland holds an 'Officially Brucellosis Free' status since June 2009.

Figure 115: Serological screening is used by AFBI and DAFM as a surveillance tool to control the potential incursion and spread of brucellosis in the cattle population.

Brucellosis is a contagious bacterial cause of abortion in cattle and is usually asymptomatic in non-pregnant females. Adult male cattle may develop orchitis (inflammation of the testicle) and brucellosis may be a cause of infertility in both sexes. Bacteria may be found in the uterus during pregnancy, uterine involution, and less frequently, for a prolonged time in the non-pregnant uterus. *Brucella* bacteria are also present in large numbers in aborted foetuses, foetal membranes, uterine discharges and in milk. Shedding from the vagina largely disappears with the decrease of fluids following parturition.

Man may become infected by contact with infected materials, as *Brucella* bacteria can penetrate through skin. This remains an important reason for wearing gloves at all times when either handling cows whilst calving or any foetal membranes or materials left after calving. When it spreads to man it causes 'undulant fever' which is associated with clinical signs such as night sweats, muscular aches and pains and occasionally miscarriages in women.

It is imperative that stock handlers wear proper personal protective equipment such as gowns, gloves and goggles when handling calving cows and materials such as afterbirths or other potentially infected materials.

As part of the ongoing control programme and as recommended by the OIE, each aborted foetus and stillborn calf is tested for the presence of *Brucella abortus*. In 2011, 2730 foetuses were tested in Ireland, and in Northern Ireland 602 aborted bovine foetuses were tested for *Brucella abortus*. All of the samples tested proved negative for *B. abortus*. In addition, AFBI sampled 17 individual marine mammals *post mortem* for *Brucella spp.* and all were negative.

Salmonellosis

Salmonellosis is caused by many species of salmonellae and characterised clinically by one or more of three major syndromes—septicaemia, acute enteritis, and chronic enteritis. Pregnant animals may abort. Clinically normal carrier animals make control problematic in all host species.
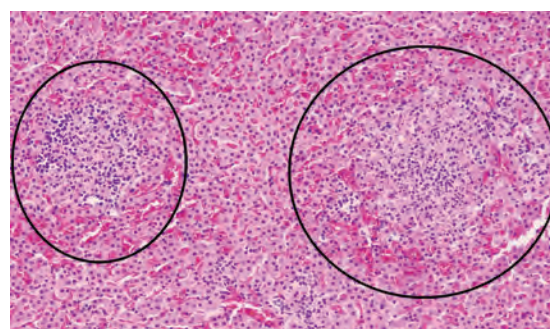
Figure 116: Focal hepatic necrosis (paratyphoid nodules) (circled) in the liver of a calf with salmonellosis (Photo: Cosme Sanchez-Miguel).

While there are many *Salmonella* species those which are detected with relative frequency include *Salmonella* Typhimurium, *Salmonella* Dublin in cattle and *S.* Typhimurium, *S.* Dublin and *S.* Montevideo in sheep and goats.

Salmonellosis in humans presents as a gastro-enteritis with symptoms such as vomiting, diarrhoea and fever. As in the case for many foodborne illnesses, symptoms tend to be most severe in the very young, elderly, immuno- compromised or those with underlying disease problems. Infection is generally contracted through the handling or consumption of contaminated foods of animal origin (such as poultry, eggs and pork), although other foods, including green vegetables have been implicated in transmission. Occupational

cases can also occur in those working with infected animals. The incidence of human salmonellosis has generally decreased across EU countries in recent years, associated with improved control on farms.

In 2011, there were 680 *Salmonella* isolates identified in the Regional Veterinary Laboratory service, taken from carcases and submitted material from cattle. Of these, 26 were *S.* Typhimurium isolates and 648 *S.* Dublin isolates (mainly from abortions and still births). Additionally, there were 24 isolates of *S.* identified in sheep samples. Of these, 13 were *S.* Dublin, 2 were *S.* Typhimurium and 3 were *S.* Mbandaka. The isolation of *S.* Mbandaka in sheep is unusual as it is more commonly found in poultry and broilers. AFBI identified *S.* Typhimurium in 15 pig submissions, four cattle submissions and isolated *S.* Dublin from 147 cattle submissions and three sheep submissions.

The notification rate of human salmonellosis cases continued to decrease at EU level, which is demonstrated by the statistically significant trend observed since 2006. The continuing decrease in the numbers of salmonellosis cases in humans is likely to be mainly related to the successful Salmonella control programmes in poultry populations, particularly in laying hens. (EFSA Journal 2012).

Campylobacteriosis

Campylobacter jejuni causes gastrointestinal campylobacteriosis. While many cases are asymptomatic in animals, camylobacteriosis is a significant cause of gastro-intestinal disease in humans.

As with most intestinal pathogens, faecal-oral spread and food- or waterborne transmission are the principal avenues of infection. Asymptomatic carriers can shed the organism in their faeces for prolonged periods and contaminate food and water.

Diarrhoea appears to be most severe in young animals and infection in adults is usually asymptomatic. Isolation of *Campylobacter jejuni* from diarrhoeic faeces is not, in itself, an indication for antibiotic therapy but an indication of a zoonotic risk to anyone regularly handling that animal.

Campylobacteriosis in humans is typically characterised by abdominal pain, fever and diarrhoea. It lasts between one and seven days and is usually self limiting.

The disease is found worldwide and is recognised as the most common cause of food-borne gastroenteritis. Data from 2010 showed 1660 confirmed human campylobacteriosis cases in Ireland, down slightl compared to previous years[1].

In 2011, the Regional Veterinary Laboratories of the Department of Agriculture identified *Campylobacter jejuni* in 263 post-mortem submissions, and a further 294 isolates from 3163 clinical submissions from calves less than one month of age. An additional 23 isolates were found in samples from diarrhoeic sheep. During 2011, AFBI confirmed two isolates of *C. jejuni* in cattle and two in sheep. It is to be recognised, therefore, that there is a risk of contracting this bacterium when handling calves and sheep and that appropriate hygienic precautions should be taken.

Toxoplasmosis

Toxoplasmosis is caused by *Toxoplasma gondii*, a protozoan parasite that infects humans and other warm-blooded animals. Felines are the only definitive hosts of *Toxoplasma*, therefore wild and domestic cats can serve as the main reservoir of infection. There are three infectious stages of toxoplasmosis; tachyzoites, which are a rapidly multiplying form, bradyzoites (found as tissue cysts) and sporozoites (found in oocysts).

Toxoplasmosis is transmitted by consumption of infectious oocysts in cat faeces, consumption of tissue cysts in infected meat, and by transplacental transfer of tachyzoites from mother to foetus.

Toxoplasma gondii is a significant cause of foetal death and resorption, abortion, or stillbirth in sheep and goats.

Toxoplasma gondii infection may be acquired by humans through the consumption of undercooked meat containing intermediate cysts or by food, water or litter trays contaminated with oocysts from cat faeces. In the case of stock handlers, contact with infected materials/ fluids produced in ovine abortion also poses a risk. Most human infections are asymptomatic or cause mild flu-like symptoms and it is estimated that approximately 50-80 *per cent* of the European population are infected.

[1] The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2010

Toxoplasmosis is a major concern for people with immune system dysfunction (e.g. HIV positive patients) or for pregnant women because tachyzoites can migrate across the placenta and cause abortion.

In 2011, the RVLs diagnosed 50 cases of toxoplasmosis following ovine abortion. In AFBI, 262 ovine abortion cases were tested for *Toxoplasma* and 46 were confirmed as positive.

Q fever

Q fever is a zoonotic disease caused by *Coxiella burnetii*, a bacteria whose main reservoirs are goats, sheep and cattle but which can also infect a wide range of mammals. Many infections in animals are subclinical but reports have implicated *C. burnetii* as a cause of infertility and sporadic abortion with a necrotizing placentitis in ruminants.

As recently as 2010, a human outbreak of Q fever in Holland was linked to *C. burnetii* associated abortions in dairy goats. In Ireland, a survey carried out in 2011 found a prevalence of 0.7 *per cent* in sheep and 0.3 *per cent* in goats[1], and preliminary results in Northern Ireland published in 2010 showed a prevalence of 12.3 *per cent* in sheep and 9.3 *per cent* in goats[2].

The greatest risk of transmission occurs at parturition by inhalation, ingestion, or direct contact with birth fluids or placenta. Thus, farmers and veterinarians are most at risk during calving or lambing. The organism is also shed in milk, urine, and faeces. The majority of outbreaks in people have been associated with wind dispersion of desiccated reproductive products, contaminated with *C. burnetii*, from sites where sheep, goats, or cattle are kept. Ticks may transmit the disease among domestic ruminants, but are not thought to play an epidemiologically important role in transmission of disease to humans. In humans, Q fever has a highly variable clinical presentation, ranging from a self-limiting influenza-like illness to pneumonia, hepatitis, and endocarditis.

In Ireland during 2011, almost 10 *per cent* (28 out of 272 bovine blood samples) submitted from veterinary

[1] Ryan *et al*, *Veterinary Record* 2011;169:280

[2] McCaughey et al, *Epidemiol Infect*. 2010 Jan;138:21-27

practitioners for Q fever testing were positive for *C. burnetii*.

Listeriosis

Listeriosis is a sporadic bacterial infection that affects humans and a wide range of animals. *Listeria monocytogenes* causes encephalitis or meningoencephalitis in adult ruminants and is the most frequently recognized form of the disease. The natural reservoirs of *L. monocytogenes* are the soil and mammalian intestinal tracts, both of which can contaminate vegetation.

Aborted foetuses and necropsy of septicaemic animals present the greatest infection hazard to handlers. Human infection can lead to fatal meningitis, septicaemia, or papular exanthema on the arms from handling post-abortion material. Pregnant women in particular, should be aware of the risk of infection because of danger to the foetus, with possible abortion, stillbirth, and infection of neonates among the possible outcomes. While human listeriosis is rare, mortality can reach 50 *per cent* among elderly patients, or immunocompromised people.

In 2011, there were 81 confirmed isolates of *Listeria spp.* species found in submissions to the Regional Veterinary Laboratories in Ireland. Of these, 72 were from cattle samples and 9 were from sheep samples. In Northern Ireland, AFBI recorded eight isolates of *Listeria monocytogenes* in sheep and nine isolates in cattle in 2011.

Cryptosporidiosis

Cryptosporidiosis, due to *Cryptosporidium parvum*, is a cause of diarrhoea in very young farm animals. *Cryptosporidiae* are protozoal organisms, found worldwide, that are parasitic in the intestine of mammals.

Infections in domestic animals may act as a reservoir for infection of susceptible humans. *Cryptosporidium parvum* is a relatively common non-viral cause of self-limiting diarrhoea in immunocompetent persons, particularly children. In humans, cryptosporidiosis infection can be asymptomatic, or may cause watery diarrhoea, stomach cramps and stomach upset and a mild fever. Symptoms of cryptosporidiosis can appear two to ten days after infection and usually lasts about two weeks.

The infection is transmitted predominantly person to person, but direct infection from animals and waterborne infection from contamination of surface water and drinking water by domestic or wild animal faeces can also be important.

In Ireland, *Cryptosporidiae* found in farm animals are predominately *C. parvum*, which accounts for about 50 *per cent* of the human cases of cryptosporidiosis, while the other 50 *per cent* of human cases is caused by *C. homini*.
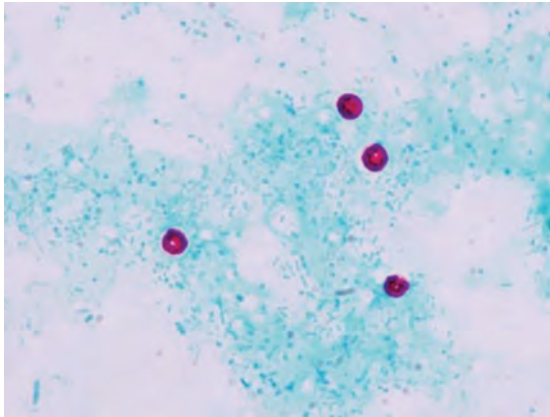

Figure 117: *Cryptosporidium* spp. (red staining) identified on modified Ziehl-Neilson (MZN) staining of calf faeces (Photo: Cosme Sanchez-Miguel).

In 2011, there were 54 cases of cryptosporidiosis detected in calves (Figure 117) submitted to the Regional Veterinary Laboratory service for post-mortem examination. In addition, there were 985 positive results from 3670 tests in faecal samples from diarrhoeic calves, submitted by veterinary practitioners to the RVL service. In Northern Ireland, AFBI tested 767 samples for cryptosporidiosis from both post-mortem and clinical cases, of which 260 were positive.

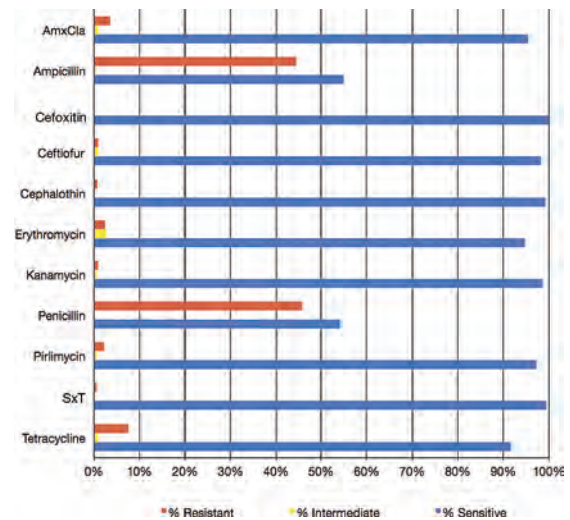# Antimicrobial sensitivity profiles

Staphylococcus aureus

Figure 118: Antimicrobial susceptibility in *S. aureus* isolates from bovine milk submissions to DAFM laboratories in Ireland during 2011 (n=553) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

During 2011, DAFM laboratories isolated *S. aureus* from milk with antimicrobial sensitivity profiles which were broadly similar to 2010 (Figure 118). Cefoxitin (a second generation cephalosporin antibiotic) discs are included in Gram-positive bacterial antimicrobial sensitivity panels as a screen for MRSA (Meticillin Resistant *Staphylococcus aureus*). DAFM laboratories did not identify meticillin resistance in any *S. aureus* cultured during 2011.

Meticillin resistant *Staphylococcus* spp. (i.e. non-*aureus*) were cultured from two samples cultured during 2011 and confirmed by PCR. The first was a blood sample from a cow which was submitted for culture; the *Staphylococcus* spp. in this instance may have been a contaminant from the skin. The second was pus collected from a one-month-old calf that had been repeatedly treated for joint and navel ill with antibiotics. The *Staphylococcus spp.* in this case has been presumptively identified as *Staphylococcus cohnii*, a bacterium that has been described as part of the bovine skin flora. It can act as a donor of the meticillin resistance (mec-A) gene to *Staphylococcus aureus*.
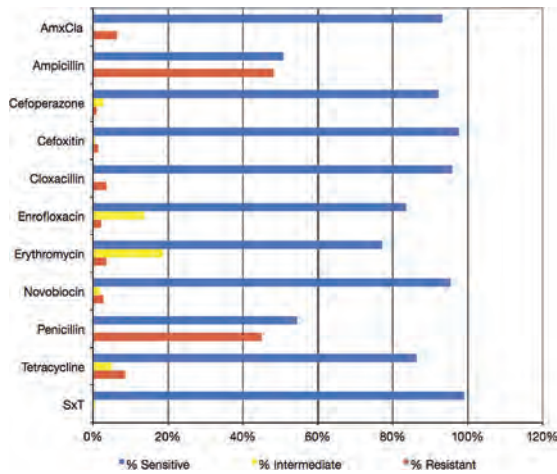
Figure 119: Antimicrobial susceptibility in *S. aureus* isolates from bovine milk submissions to AFBI laboratories in Northern Ireland during 2011 (n=220) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

In AFBI laboratories, *S. aureus* isolates were detected in less than fourteen *per cent* of milk submissions during 2011. The susceptibility profiles for *S. aureus* isolates from these submissions showed broad susceptibility to most antibiotics on test – with the exception of ampicillin and penicillin (Figure 119). As would be expected, a high level of susceptibility was recorded for amoxicillin clavulanate – a combination which enhances the efficacy of amoxicillin (a ß-lactam antibiotic) against bacteria that produce the enzyme ß-lactamase. There were three suspect MRSA isolates identified by AFBI during 2011. All three of these isolates were molecularly typed for MRSA markers and all proved negative. Intermediate resistance to enrofloxacin, erythromycin, cefoperazone, novobiocin and tetracycline was shown in a proportion of the isolates. This indicates a level of antimicrobial sensitivity in the isolate that corresponds to an uncertain clinical outcome, but where the isolate does not show a distinctly resistant profile.

Streptococcus uberis

Figure 120: Antimicrobial susceptibility in *S. uberis* isolates from bovine milk submissions to DAFM laboratories in Ireland during 2011 (n=153) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

DAFM laboratories recorded *Streptococcus uberis* as being susceptible to most antimicrobials tested during 2011 with the exception of kanamycin (Figure 120).

Figure 121: Antimicrobial susceptibility in *S. uberis* isolates from bovine milk submissions to AFBI laboratories in Northern Ireland during 2011 (n=349) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

In AFBI laboratories, as in 2010 there was broad sensitivity to the ß-lactam antimicrobial tested (penicillin and cephalosporin antimicrobials) and some resistance seen in the macrolide, aminoglycoside and tetracycline classes of antimicrobials. However, *in vitro* sensitivity profiles do not always correlate with clinical outcome. The pharmacokinetics and pharmacodynamics of

the drugs chosen should be taken into account in conjunction with the site of infection etc. *S. uberis* can prove to be a difficult pathogen to treat and eliminate from the udder. When prescribing antimicrobials, it is important to ensure that therapy is of sufficient duration in chronic cases of streptococcal mastitis to achieve a bacteriological cure.

Escherichia coli

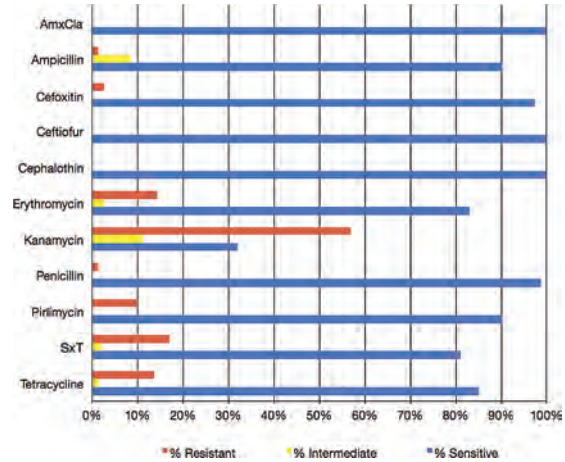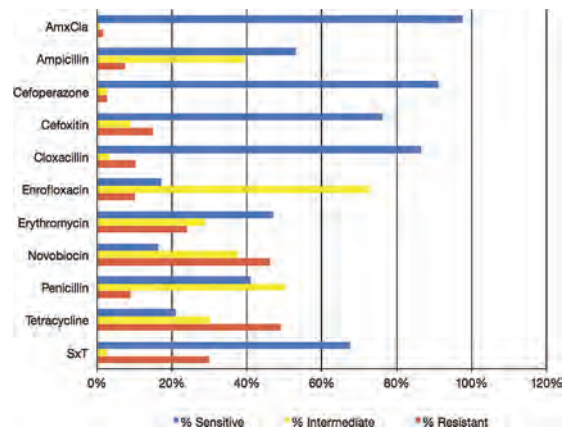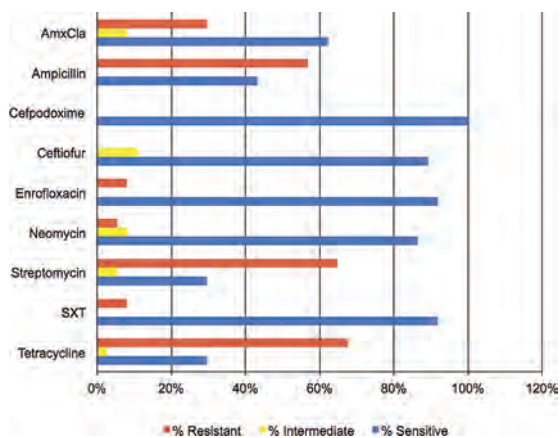Figure 122: Antimicrobial susceptibility profiles of *E. coli* isolates from bovine milk submissions to DAFM laboratories in Ireland during 2011 (n=204) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

During 2011, DAFM laboratories isolated *E.coli* from milk with antimicrobial sensitivity profiles which were broadly similar to 2010 (Figure 122). Moderate levels of ampicillin and cephalothin resistance due to ß-lactamase production were recorded. Cefpodoxime (a third generation cephalosporin) discs are included by DAFM and AFBI in antimicrobial sensitivity panels as a method of screening for Extended Spectrum Beta Lactamase production (ESBLs) among coliforms. These are then confirmed by MIC (minimum inhibitory concentration) testing and PCR. ESBL production among *E. coli* isolates is of interest as ESBL producing *E. coli* may be associated with multiple drug resistance and resultant antimicrobial treatment failure in humans and animals. There was not any ESBL-producing *E. coli* identified by DAFM from milk samples in 2011. However, one ESBL strain was isolated from a bovine umbilical abscess.
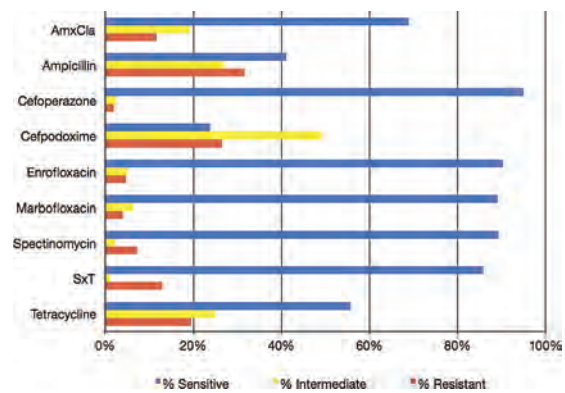
Figure 123: Antimicrobial susceptibility profiles of *E. coli* isolates from bovine milk submissions to AFBI laboratories in Northern Ireland during 2011 (n=318) (AmxCla = amoxicillin clavulanate; SxT = sulphamethoxazole trimethoprim).

In AFBI laboratories, significant levels of resistance were seen among *E.coli* isolates from bovine milk to the ß-lactam antimicrobials tested (amoxycillin plus clavulanic acid, ampicillin, and the third generation cephalosporin, cefoperazone) (Figure 120). In Northern Ireland ESBL resistance was confirmed in six *E. coli* isolates in 2011. Only one of these isolates was from a milk sample.

Clinical Chemistry

The identification of mineral deficient animals and their supplementation to prevent or treat the clinical signs of mineral deficiency are common practices among both veterinary practitioners and their farming clients. Both AFBI and DAFM laboratories provide analyses for a number of minerals which play a role in maintaining good health and thrive in farm animals. Here we present the results of some of the more commonly requested mineral analyses.

Cobalt analyses

Cobalt deficiency is a disease of ruminants which occurs primarily in areas in which the soils are deficient in cobalt. In ruminants, approximately 3 *per cent* to 13 *per cent* of ingested cobalt is used by rumen microflora in the synthesis of vitamin B_{12}. Therefore, cobalt deficiency is really a relative vitamin B_{12} deficiency and many of the clinical signs attributed to cobalt deficiency are associated with the animal's inability, in the absence of vitamin B_{12}, to metabolise propionate through the gluconeogenesis pathway – an important source of energy for ruminants. Cattle and sheep are similarly affected and the signs are similar in both species. Clinically, the disease is characterised by non-specific signs such as inappetance, weight loss, pica and pallor of mucous membranes. In sheep, lacrimation is also an important sign in advanced cases. The main differential diagnoses for cobalt deficiency in ruminants include those for illthrift, namely: copper deficiency, general nutritional deficiency (energy and/or protein deficiency), Johne's disease and intestinal helminthiasis.

Ovine white liver disease is a specific disease of sheep associated with cobalt deficiency. Histologically, this disease produces liver lesions in cobalt deficient sheep in which the dissociation and necrosis of hepatocytes and sparse infiltration by neutrophils, macrophages and lymphocytes is seen (Figure 124).
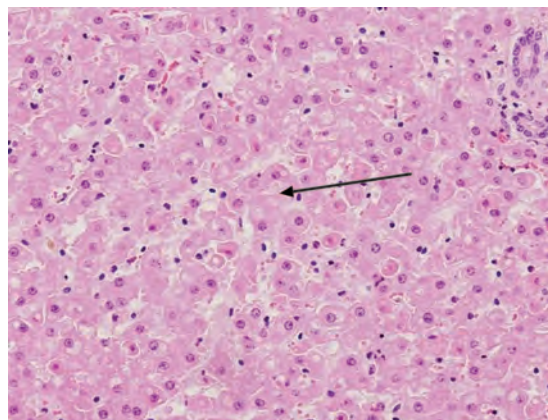
Figure 124: Liver from an ill-thriven 4-month-old lamb, with a liver cobalt concentration of 0.01 micromoles *per* kilogram, showing random hepatocyte necrosis (arrow) and a mild background inflammatory cell infiltrate in the sinusoids (Photo: Ann Sharpe).

Liver cobalt concentrations of less than 0.7 micromoles *per* kilogram wet matter are considered to be deficient. During 2011, 41 *per cent* of ovine liver samples analysed by DAFM were determined to be cobalt deficient while in cattle, 37 *per cent* of the total number of liver samples analysed were recorded as deficient (Figure 125).
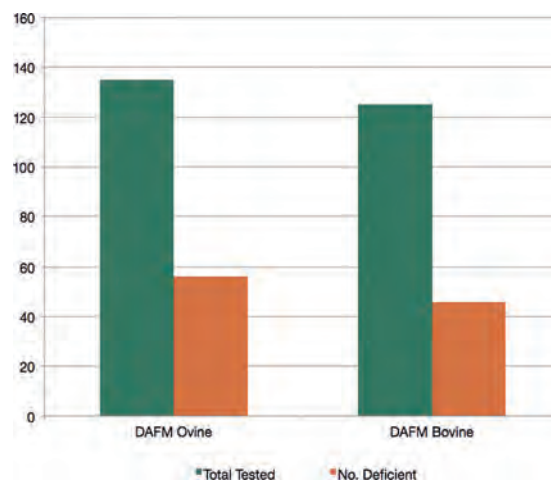
Figure 125: The numbers of ovine and bovine liver samples analysed for cobalt and the numbers of those samples identified as deficient in DAFM laboratories in 2011.

Copper analyses

Copper deficiency is described as primary deficiency, due to inadequate levels in forage grown on deficient soils, or secondary deficiency, due to impediments to

copper absorption such as excess molybdenum, iron salts and sulphur in the diet. Clinical signs of copper deficiency (both primary and secondary) are usually seen in young growing ruminants on pasture and include ill-thrift, changes in hair colour (Figure 126), chronic diarrhoea, lameness and anaemia. Swayback and enzootic ataxia are specific conditions associated with copper deficiency in lambs.

Figure 126: Characteristic browning of the coat which is associated with copper deficiency in cattle (Photo: Pat Sheehan).

A diagnosis of copper deficiency in a herd or flock relies on an interpretation of the history, clinical examination of the affected animals, laboratory analyses on serum and liver samples, and an assessment of the environment including analyses of feed and water supplies. While the concentration of copper in liver is the best marker of the copper status of the animal, the determination of copper in serum is a more practical approximation.

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

Eighteen *per cent* of blood samples tested by DAFM and 4 *per cent* of blood samples tested by AFBI for copper were classified as copper deficient. The variation in results for copper analysis between laboratories (Figure 127) is most probably due to regional differences in the soil composition coupled with variations in animal management practices.
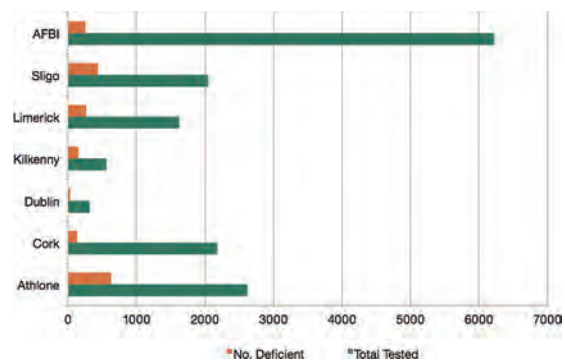
Figure 127: The number of bovine blood samples analysed for copper and the number of those samples identified as deficient in AFBI and DAFM laboratories in 2011.

Selenium analyses

Selenium is a mineral which forms part of the enzyme glutathione peroxidase (GSH-Px), which catalyses the reduction of hydrogen peroxide and lipid hydroperoxides and prevents the potential for oxidative damage to body tissues. White muscle disease in calves, a disease associated with selenium deficiency, is characterised by the degeneration and necrosis of skeletal and heart muscles. Vitamin E also plays a role in preventing this condition. Other clinical signs associated with selenium deficiency include ill-thrift, lowered milk production, retained foetal membranes, infertility and impaired immunity.

Figure 128: The number of bovine blood samples analysed for selenium status (either by blood selenium analysis or measurement o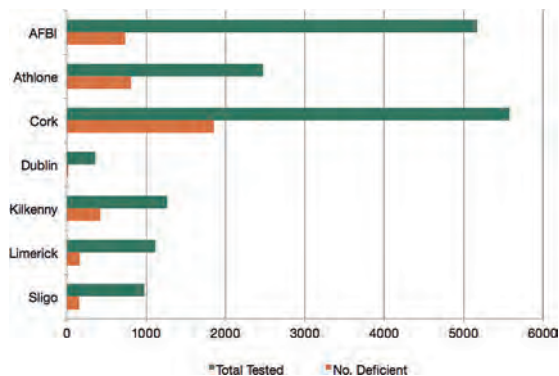f glutathione peroxidase activity) and the number of those samples identified as deficient in AFBI and DAFM laboratories in 2011.

The selenium status of an animal can be determined by measuring the activity of GSH-Px in red blood cells or by directly measuring blood selenium levels. Figure 128 shows the results of blood selenium and GSH-Px analyses, categorised by laboratory, during 2011. Twenty nine *per cent* and 14 *per cent* of all blood samples tested for selenium status by DAFM and AFBI respectively were classified as selenium deficient. The regional variation in recorded selenium levels between laboratories is likely to be due to regional differences in pastures, soils, mineral supplementation practices and management factors. Low soil pH, high soil sulphur content and heavy rainfall all may play a role in reducing selenium availability.

Blood samples for selenium or glutathione peroxidase analysis must be submitted in Lithium Heparin bottles (green topped).

Iodine analyses

DAFM regional veterinary laboratories do not carry out iodine analysis. Plasma inorganic iodine is used by the AFBI laboratories to assess iodine status and gives an indication of current (previous 2-3 days) iodine intake. Iodine deficiency may contribute to decreased fertility, embryonic loss, uterine infection, abortion, stillbirth,

weak calves and increased incidence of retained placenta. Plasma inorganic iodine results of less than 30 micrograms *per* litre indicate very low recent iodine intake.

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.

During 2011, AFBI tested 3,306 cattle in Northern Ireland for plasma inorganic iodine levels, of which 1,157 (35 *per cent*) were found to be below the accepted normal level.

Haematology

Full haematological examination of blood samples from farm animal species is provided by all laboratories of AFBI and DAFM. Haematological examination may be performed to assess general health, to aid in a diagnosis (e.g. babesiosis, tick borne fever or Bovine Neonatal Pancytopaenia), to assess the animal's 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. For haematologic examination, blood is collected into a vial containing the anticoagulant EDTA (ethylenediaminetetra-acetic acid). Sodium citrate is recommended for blood platelet studies.

Haematological examination is often useful in the identification of Bovine Neonatal Pancytopaenia (BNP) suspects. BNP, a disease of calves usually less than one

month old, is characterised by trilineage bone marrow hypoplasia i.e. hypoplasia of red and white blood cell precursors and megakaryocytes. The case definition of BNP requires that BVD virus infection and septicaemia must be ruled out as possible causes in suspect cases. The following table gives some haematological results which are typical of animals suffering the disease, taken from three cases of BNP diagnosed by DAFM during 2011. All three calves were anaemic, leukopenic and thrombocytopenic.

	HCT l/l	WBC 109/l	Platelets 109/l
Normal range	30-40	3.5-10	200-300
Calf 1	20	1	16
Calf 2	29	0.6	33
Calf 3	24	0.9	74

Table 19: Haematological results from three calves aged two weeks in which BNP was diagnosed during 2011.

The severe bone marrow damage which is recognised histologically is believed to be caused by specific antibodies the calf receives from colostrum which target the bone marrow cells. Clinical signs include fever, pale mucous membranes with petechiae and melena. Further information on BNP is available on page 24 of this report.

Proficiency testing in AFBI and DAFM veterinary laboratories

In Northern Ireland, AFBI participates in a number of proficiency testing (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.

In Ireland, DAFM's five Regional Veterinary Laboratories and Clinical Pathology Section, Backweston (for Dublin RVL), subscribe to four 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.

Participation in these schemes by both AFBI and DAFM 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 129: 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 129).

Figure 130: Place the leak-proof plastic container in an outer padded envelope.

This is then placed in an outer padded envelope and sealed (Figure 130)

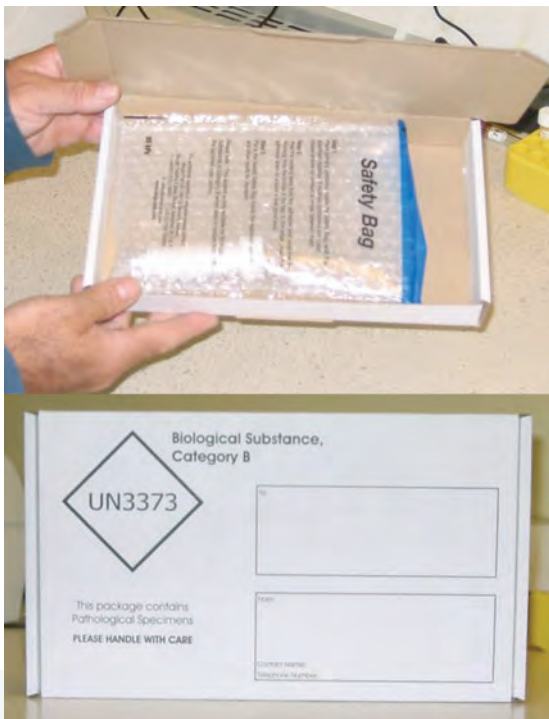Figure 131: The words 'BIOLOGICAL SUBSTANCE, CATEGORY B' and a 'UN 3373' diamond must be on the outside of the package.

The words 'BIOLOGICAL SUBSTANCE, CATEGORY B' and a 'UN 3373' diamond must be on the outside of the package (Figure 131).

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 of epizootic diseases

It is a legal requirement for the presence or suspected presence of avian influenza, foot-and-mouth disease, bluetongue and Newcastle disease to be notified to the competent authority under national and European legislation. The island of Ireland is currently free of these epizootic diseases. In addition to their cost in terms of animal health and welfare, these diseases bring an associated financial burden because of trade restrictions.

Foot-and-Mouth disease (FMD)

Figure 132: Multiple round ulcers on the dorsal aspect of the tongue of a FMD suspect investigated during 2011 (Photo: Cosme Sánchez-Miguel).

The island of Ireland continues to be free of foot-and-mouth disease but constant surveillance to prevent incursion of the virus is vital.

Cork RVL examined a case which was reported to DAFM as a FMD suspect during 2011. A five-year-old cow was slaughtered in a meat factory and was deemed to be a FMD suspect by the veterinary inspector in the plant when multiple round ulcers were observed on the dorsal and ventral aspect of the tongue (Figure 132). Following isolation of the carcase, detailed examination of the lesions (chronicity and appearance) and a prompt visit to the farm of origin by veterinary inspectors, FMD was ruled out. Histological examination of the tongue showed large sheets of neopastic lymphocytes in the epithelium and between the muscular fibres of the tongue (Figure 133); glossal lymphoma was diagnosed. No other lesions were noted in the carcase.
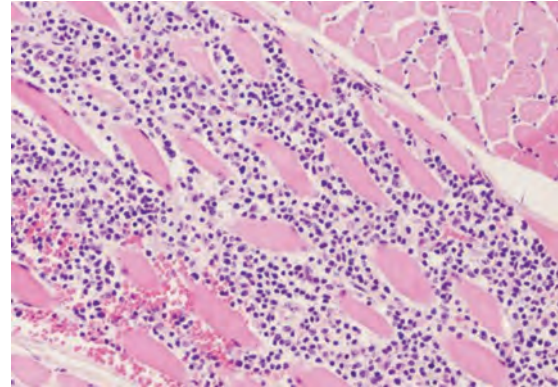

Figure 133: Neopastic lymphocytes between the muscular fibres of the tongue (Photo: Cosme Sánchez-Miguel).

Bluetongue (BT)

In Ireland, DAFM virology division based in CVRL tested 1,970 cattle for BT antibody following importation with 934 (47 *per cent*) proving antibody positive. In addition 1,793 cattle were tested for the presence of BT virus, all of which were negative. Of 281 sheep tested following importation for BT antibodies, 162 (58 *per cent*) were positive while none of the 198 sheep tested for BT virus following importation were positive.

During 2011, there were ten live bovine clinical investigations of the BT suspects conducted by DAFM with 17 animals sampled by the RVLs. There were also four bovine and four ovine post-mortem investigations by the RVLs. All tests proved negative for BT virus.

Random surveys continue to form part of the DAFM surveillance response to BT and during 2011 a total of 1,335 animals (780 cattle and 555 sheep) were tested for BT antibodies. Seven animals were found to have inconclusive results using the primary screening ELISA and were repeated using that assay and a different BT antibody ELISA. All animals proved to be negative for BT antibodies.

In Northern Ireland during 2011, the Immunodiagnostics Branch of AFBI tested 3,366 cattle for BT antibodies following importation, with 1,470 (44 *per cent*) proving positive. Surveillance samples of 2,498 indigenous cattle were tested for BT antibodies, none of which were positive. The Virology Branch of AFBI tested 3,138 cattle and 4,131 sheep following importation, all of

which proved negative for BT virus. In addition, a total of six cattle and one sheep were submitted as diagnostic cases with a request for BT virus detection. All proved negative.

Avian Influenza

During 2011 in Ireland, a total of 1,100 analyses for avian influenza virus (AIV) were performed by real time RT-PCR, and /or virus isolation. A further 21,085 samples from commercial poultry flocks were serologically examined for AI antibodies as part of two major national surveys and to satisfy requirements for movement and trade. All of the samples tested proved negative.

In Northern Ireland, AFBI tested 68 tissue samples for avian influenza by RT-PCR and a further 14 tissue samples using the avian influenza fluorescent antibody test (FAT). All samples proved negative for avian influenza virus. In addition, 443 samples were serologically examined for H5 and H7 antibodies by haemaglutination inhibition, all of which were negative.

Newcastle disease

In Ireland, a total of 1,094 tests were carried out on poultry samples during 2011 by RT-PCR and /or virus isolation for Newcastle disease. In addition, serology for antibodies to Newcastle Disease was performed on 1,997 poultry sera samples. All the samples tested were negative.

Twelve pigeon samples from five different premises, which were submitted to DAFM RVLs under scanning surveillance, were positive for the presence of pigeon paramyxovirus-1 (PPMV-1). This is the same causative agent of Newcastle Disease in poultry, and the finding emphasises the need for a high standard of biosecurity and continuous surveillance in commercial poultry flocks.

In Northern Ireland, a total of 7,427 sera were tested serologically for Newcastle Disease during 2011, all of which proved negative.

Porcine Influenza

In Ireland a total of 96 animals were tested by the haemaglutination inhibition test (HAI) for porcine (swine)

influenza during 2011. The HAI tests are performed for two strains – H1N1 and H3N2. Of the 96 animals tested, 16 were positive for H1N1 and 37 were positive for H3N2. Twelve animals were positive for both strains. In addition, 53 samples were tested by RT-PCR for swine influenza of which seven were positive for H1N1. These seven animals had come from three farms. The swine influenza PCR is specific for H1N1. All positive samples were also sequenced for confirmation.

A total of 76 tissue samples (75 lung cryostats and one tonsil) from porcine animals which had undergone a post-mortem examination in Northern Ireland were tested for porcine influenza by AFBI during 2011. Using the fluorescent antibody test (FAT), all samples proved negative.

Classical swine fever

AFBI examined a total of 149 samples for classical swine fever (CSF) during 2011. The majority (137 samples) were tested by fluorescent antibody test (FAT) while 12 were tested using RT-PCR. All samples proved negative. In Ireland, DAFM tested a total of 4073 sera CSF antibodies during 2011. All results were negative.

Bovine Spongiform Encephalopathy

In 2011 in Ireland, confirmatory diagnosis for BSE was carried out on samples from a total of 25 suspect bovine animals. Of the 25 samples, three were detected in the Rapid Testing Laboratories (active surveillance) and forwarded to the NRL for confirmatory diagnosis. BSE was confirmed in the three animals. The other 22 samples were from clinical suspect cases (passive surveillance). None of these were confirmed as positive for BSE.

Table 20 shows a breakdown of the histopathological diagnoses reached for the 22 negative cases that were submitted through the passive surveillance programme.

H&E Result	Number of Cases
Listerial encephalitis	4
CNS abscessation	1
Non-suppurative encepahilitis	1
Cerebrocortical necrosis	1
No specific findings	15

Table 20: Histopathological diagnoses for BSE clinical suspects in Ireland's NRL during 2011.

During 2011 in Northern Ireland, AFBI confirmed BSE in two fallen cattle which had been identified by the active surveillance programme. There was one clinical suspect submission which was confirmed as negative by the laboratory.

Scrapie

During 2011 a total of 40 cases of scrapie were confirmed by the NRL. Of these 40, 39 were classified as classical scrapie and one was classified as atypical scrapie.

The 39 confirmed cases of classical scrapie came from nine flocks; 34 were identified through active surveillance while the remaining five were identified as clinical suspects (passive surveillance).

Tissues from the single atypical case were sent to the NRL from a Rapid Testing Laboratory, i.e. they were detected through the active surveillance programme.

Co-existence of classical and atypical scrapie was not detected in any flock during this year.

All samples tested during 2011 by Discriminatory Western Blotting (to differentiate between scrapie and BSE in sheep) were reported as "scrapie-like".

One case of scrapie was confirmed in Northern Ireland during 2011. This had been identified through the abattoir human consumption sheep survey, a form of active surveillance. Tissue was submitted to the National Reference Laboratory (AHVLA) and was confirmed as atypical scrapie. There were two goat scrapie suspects in Northern Ireland during 2011, both of which were confirmed as negative by the laboratory.

A selection of diagnostic investigations

Q fever in a dairy herd

Sligo diagnosed Q fever as the cause of abortion in a 200-cow dairy herd. In the autumn of 2011, ten foetuses were submitted from bovine abortions in the herd. The herd had vaccination programmes in place for IBR, BVD, leptosporosis, and salmonellosis. The diagnosis was made using histopathology. Subsequent blood testing identified 13 of 40 animals sampled as seropositive for Q fever.

Endometritis in a dairy herd

Athlone investigated the retention of foetal membranes in approximately a third of cows calved in a 200-cow dairy herd. Affected cows developed endometritis and subsequently suffered dramatic body condition loss. There was a history of iodine deficiency in the herd. There was also evidence of raised ketones in the affected group. Following the on-farm investigation, the dietary magnesium inclusion rates were considered low (18g/cow/day versus the recommended 30g/cow/day) and this suggested a problem with the dietary cation/anion balance (DCAB). DCAB involves balancing cations in the diet such as Na+ and K+ which increase blood pH with anions such as Cl- and S- which decrease the pH of the blood. If the balance is kept negative in the dry cow the blood pH is lowered and the cow mobilises Ca+ from bone to counteract it which helps to prevent hypocalcaemia. High levels of potassium in feed such as on pasture or silage can elevate the blood pH. Cattle slurry is another rich source of potassium and pastures fertilised with it can interfere with calcium and magnesium metabolism. Potassium also reduces magnesium absorption in the rumen. In this case it was advised to increase magnesium in the diet of the dry cow to a level of 30g/day *per* animal. Once magnesium intake was increased the situation improved.

An investigation of elevated somatic cell count (SCC)

Sligo investigated elevated SCC in a 60-cow dairy herd. Average SCC at the most recent milk recording prior to the visit was 513,000 cells/ml, while the median was recorded as 134,000 cells/ml, which suggested that the high cell count was caused by a small number of troublesome cows. The herd was a spring and autumn calving herd and all cows were dried off abruptly and were dry for between six and eight weeks before calving. Cows with high somatic cell counts did not receive any additional treatment at drying off. Enquiries revealed that post-milking teat disinfection was applied as a spray, with between four and five millilitres of teat spray applied *per* cow after milking. Examination of the cows revealed some evidence of hyperkeratosis on some teats and several teats were inflamed and painful after cluster removal. This raised concerns regarding the milking machine vacuum levels. *Staphylococcus aureus* and *Streptococcus dysgalactiae* were the most significant isolates on bacteriology. The following conclusions were drawn based on the available evidence.

1. There was a core of infected cows in the herd which acted as the source of infection for non-infected cows.

2. The isolation of *Streptococcus dysgalactiae* was associated with teat end damage, and likely to have been caused by the milking machine.

3. The volume of teat spray used (5ml) was insufficient to achieve proper teat disinfection.

4. The inflamed and painful teats, together with the hyperkeratosis, raised concerns that there was excessive vacuum at the teat end during milking. Therefore the milking machine technician was asked to examine the vacuum levels.

The following recommendations were made:

1. A minimum dry period of three months should be implemented for high SCC cows.

2. The dry-cow therapy was altered to a longer acting formulation which had broader effectiveness against gram positive bacteria.

3. The worst offending cows were to be culled promptly.

4. Every cow was to receive 15 ml of teat spray *per* milking.

5. The chronically infected cows were to be segregated from the non-infected cows and milked last.

An investigation of respiratory disease in calves

Sligo investigated an outbreak of respiratory disease among calves in a large dairy herd. There had been ongoing problems with numerous cases of pneumonia over a number of years. The problem usually peaked in March, coinciding with the onset of milder weather and the peak of the calving season. Bovine respiratory syncytial virus (BRSV) and *Mannhaemia haemolytica* were isolated from the lungs of two calves which had been presented for post-mortem examination. During the farm investigation, an assessment of the calf accommodation identified a number of issues. These were particularly notable in a shed which had individual pens and it was here that calves regularly initially developed pneumonia. The ceiling of this shed was particularly dirty, indicating poor air movement. Further examination revealed a total absence of inlets or outlets in the shed and it was concluded that the shed was beyond redemption and no longer suitable to house calves.

In the 'second stage' shed, the calves were bedded toward the lower end of a slope in the floor. As a result, it appeared that the straw bed was wet most of the time. This was significant in the pathogenesis of this respiratory problem as wet straw releases ammonia which interferes with the mucociliary apparatus in the upper respiratory tract. It was recommended that the bedding arrangement should be altered to avoid this and that drainage should be improved. In addition to these findings, two yearlings were also proved seropositive to BVD virus and this raised concerns regarding the role that BVD may have played in immunosupression in the herd. The farmer was advised to test all calves for BVD virus, either by ear notch or blood testing. Given that RSV was detected, RSV vaccination was also recommended.

Mortality due to IBR in a spring calving herd

Athlone investigated an outbreak of mortality, weight loss and reduced milk yield in an 83-cow spring-calving herd. The farmer had recently changed from all-year round calving to spring calving. No animals had been purchased during the previous two years and the cows had been dosed for rumen and liver fluke. Precalving minerals were administered *via* the water. The dry cow diet consisted of grass silage and two kilograms of rolled oats while thin cows were fed two kilograms of beef nuts. After calving, dairy concentrates were introduced to the diet.

The problem presented as cows that had calved uneventfully becoming anorexic and losing weight within a few days of calving. It was reported that there was a ketotic smell from their breath and some had slightly elevated temperatures. During the farm investigation there was no evidence of significant ketosis found. However it was noted that cows were dosed with a high energy product to combat the development of ketosis after calving. The vast majority of the herd were affected. Young cows and heifers appeared to have been worst affected and a total of 13 cows died.

There were no problems with the calves which were born strong and healthy. Some abortions had occurred during the winter but a causative agent had not been determined. Bloods from 12 cows were examined for the ketone beta-hydroxy butyrate (BHB) and magnesium but apart from slight increases in a few of the BHB values and a few marginally low magnesium values there were no significant findings.

Bovine herpesvirus 1 (BHV-1 / IBR) was detected in nasal swabs from some affected animals and from carcases at post-mortem examination. High ELISA antibody titres to BHV-1 were noted in ten cows which had been sampled on the farm.

Chronic liver fluke damage was also noted in a cow on post-mortem examination and faecal samples confirmed a high incidence of fluke infestation. It was considered likely that heavy fluke burdens had predisposed to the spread of IBR as well as increasing the severity of the condition. This was supported by evidence of anaemia in some cows, low serum albumen values, raised liver enzymes in serum (one cow) and the finding of chronic liver fluke damage during post-mortem examinations.

The following recommendations were made:

1. Live intranasal vaccination for IBR was carried out on all the cows.

2. The establishment of a liver fluke control plan was recommended for the herd. Among the recommendations issued were monitoring of faecal samples for eggs in summer, autumn, winter and spring to establish infection patterns and the examination of the livers of cull cows for evidence of liver damage.

Following vaccination for IBR, the number of cows affected and the severity of their condition decreased to a degree that the owner was able to manage the disease and no further deaths were reported.

A selection of abstracts from published scientific papers

Novel findings in the veterinary laboratories can be shared with the wider scientific, veterinary and farming (local and international) communities through their publication in specialist journals.

The laboratory staff of AFBI and DAFM are actively involved in research projects aimed at studying livestock diseases prevalent on the island of Ireland. Research in these areas covers risk factors predisposing the animals to disease, outbreaks and progression of the disease, biology of the causative agent and the development of new, more efficient tests capable of detecting affected animals. Again, relevant findings in the research projects are shared through scientific publications.

Presented below is a selection of scientific publications by AFBI and DAFM, in some cases jointly, during 2011.

Disruption of egg formation by *Fasciola hepatica* following treatment *in vivo* with triclabendazole in the sheep host.

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Eight indoor-reared cross-bred sheep with no prior exposure to *Fasciola hepatica* were infected by oral gavage with 200 metacercarial cysts of the triclabendazole (TCBZ)-susceptible Cullompton isolate of F. hepatica. Twelve weeks after infection, sheep were treated with 10 mg/kg triclabendazole. Two sheep were euthanised *per* time period; at 48 hours, 72 hours and 96 hours post-treatment (hpt). Two untreated control sheep were euthanised at 96 hpt. Flukes were recovered from the liver and, if present, from the gall bladder of the sheep. They were processed for whole mount analysis, histology and transmission electron microscopy of the female reproductive system; specifically, the uterus, vitelline follicles, Mehlis' gland and ovary.

Over the four-day post-treatment period, there was a progressive reduction in the number of oogonia and oocytes in the ovary and evidence of apoptosis. Vacuolation and a decrease in the number of Mehlis' gland cells were observed from 48 hpt onwards and disruption of the normal role of the gland in egg formation was evident. The vitelline follicles showed a gradual decrease in size and became vacuolated; the population structure in each follicle changed to be one consisting mainly of mature cells and the production of shell protein material declined. The follicle became disorganised as the cells broke down and released their contents into the lumen of the follicle. While the uterus appeared to contain eggs at 48 hpt in whole-mount specimens, no properly-formed eggs were observed in histological sections. By 96 hpt, the uterus was completely devoid of eggs. Overall, egg production was seen to be severely affected by TCBZ treatment and flukes were incapable of producing normal eggs within two days of treatment. The implications of this in terms of the epidemiology of the disease are discussed.

Tuberculosis in cattle herds are sentinels for *Mycobacterium bovis* infection in European badgers *(Meles meles)*: The Irish Greenfield Study

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In Ireland badgers are removed in response to tuberculosis (TB) breakdowns in cattle herds (focal culling). Prevalence studies, conducted using a detailed post-mortem examination and bacteriological examination, showed that 36–50 *per cent* of badgers were infected with *Mycobacterium bovis*. Focal culling forms part of the medium term national strategy for the control of bovine TB in cattle and is based on the premise that badgers in areas with herd breakdowns have a higher prevalence of infection than the badger population at large. However, the hypothesis that cattle can be used as sentinels for infection in the badger population has never been formally tested. In this study we tested the hypothesis by determining the infection prevalence in badgers in areas where there had been historically a consistently low prevalence of infection in cattle. Low cattle TB prevalence areas were defined as those herds with ≤2 standard reactors in the annual round of skin testing over the preceding 5 years (Greenfield sites). Using GIS, and adjusting for variation in land use, previous culling and cattle density, 198 Greenfield sites were identified and surveyed, and 138 areas with badger setts or signs of badger activity were identified. A single badger was removed from 87 sites and all were examined using detailed post-mortem and bacteriological procedures. A prevalence of *M. bovis* infection of 14.9 *per cent* was found in the Greenfield site badgers. This prevalence was significantly lower (P < 0.001) than in badgers removed during focal culling (36.6 *per cent*). The results validate the use of cattle as sentinels for TB in badgers and support the medium term national strategy for the control of bovine TB. The geographic variation in *M. bovis* infection prevalence in the Irish badger populations will be used when devising strategies for the incorporation of badger vaccination into the long term bovine TB control programme.

Enteritis *cystica profunda* in a bullock

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Figure 134: Gross necropsy view of nodules on the serosal surface of the intestine (Photo: Jason Barley).

A 16-month-old beef bullock was submitted for necropsy with a history of long-standing ill-thrift, diarrhoea and weight loss. At necropsy there were significant lesions in the gastro-intestinal tract. Creamy-white nodules (Figure 134) were visible beneath the congested serosal surfaces of the intestinal mucosa, which was pale in colour with raised pseudo-diphtheritic plaques.
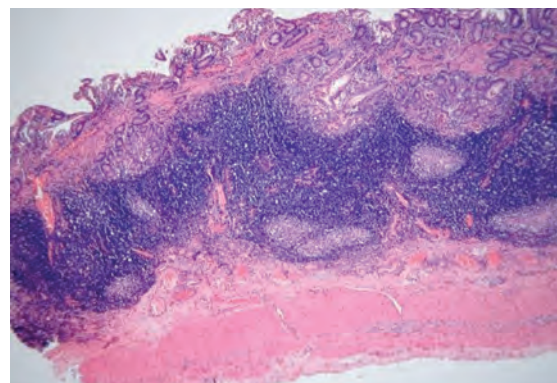

Figure 135: Lymphocyic infiltration of the small intestinal sub mucosa (H&E) (Photo: Jason Barley).

Histologically, ectopic glandular mucosal elements and cysts filled with mucin were present in the sub mucosa (Figure 135). A diagnosis of enteritis cystica profunda

was made. Differential diagnoses such as lymphocytic-plamacytic enteritis (inflammatory bowel disease) and diffuse alimentary lymphoma were ruled out on the basis of lesion morphology. This case is notable for the rareness of the condition in cattle and the extensive nature of the lesions throughout the small and large intestine. Enteritis cystica profunda should be added to the list of differential diagnoses of chronic diarrhoea and weight loss in cattle.

Temporal trends in dioxin, furan and polychlorinated biphenyl concentrations in bovine milk from farms adjacent to industrial and chemical installations over a 15 year period

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The concentrations of polychlorinated dibenzo-p-dioxins, furans and polychlorinated biphenyls (PCBs) were measured in pooled bovine milk samples collected between 1991 and 2005 in County Cork, Ireland. The pooled samples were of bulk-tank milk collected from farms adjacent to industrial, chemical and pharmaceutical installations (target milk) or from rural farms distant from industrial activity (control milk).

Comparing data between the first and last 3-year periods of the study revealed a 62 *per cent* decrease in the mean total dioxin concentration in target milk from 1.58 to 0.60 pg toxic equivalents (TEQ)/g fat. On the same basis the dioxin-like PCB concentration in target milk decreased by 80 *per cent* over the study period (from 0.95 pg to 0.19 pg TEQ/g fat). The mean 'marker' PCB concentration in target milk from 1991 to 1993 inclusive was 3359 pg/g fat. This value decreased

by 75 *per cent* to a mean of 849 pg/g fat for the years 2003–2005 inclusive.

The results of this study are consistent with low background dietary/environmental PCB contamination in both target and control herds. The total dioxin concentrations in all samples were well below the maximum tolerable limits permitted for marketable milk. The decrease in the total dioxin concentration in target and control milk samples over the study period was chiefly due to decreases in the concentration of dioxin-like PCBs, consistent with significant reductions in the concentration of PCBs in the dairy cow diet over the 15 year study period.

An Outbreak of Type C Botulism in Laying Hens

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Figure 136: Hen affected with botulism, in sternal recumbency with closed eyes and flaccid neck paralysis resulting in the head and beak resting on the ground (Photo: Ann Sharpe).

Botulism, otherwise known as "limberneck" in poultry, is an intoxication caused by the exotoxin of *Clostridium*

botulinum. There are seven antigenically distinct toxin types A, B, C, D, E, F and G. Types A, B, E and F are most toxic to humans while types C and D are most toxic to animals. The majority of avian cases are due to type C toxin. Worldwide, reports of botulism in laying hens are very rare with only a few outbreaks reported in the literature. The outbreak occurred in a group of 7500 Lohmann layer hens housed in a slatted barn. The birds had been vaccinated at their rearing site against Gumboro disease, Newcastle disease, infectious bronchitis, avian encephalomyelitis and egg drop syndrome. Clinical signs, first noticed by the farmer when the birds were 29 weeks old, included sternal recumbency, reluctance to move, flaccid paralysis of the neck with the head and beak resting on the ground in front of them (Figure 133). The farmer described the head and neck of some birds hanging down between the slats. Other clinical signs included wings drooping to the sides, closed eyes and diarrhoea-stained vent feathers. Egg production remained at a constant level and egg quality was normal. Twenty three birds underwent *post mortem* examination which included testing for botulinum toxin in 12 birds. No macroscopic or microscopic lesions were detected in brain, sciatic nerves, muscle or viscera. There were no significant bacteriological or parasitological findings. Botulinum toxin was detected in 1 out of 8 heart blood samples using a monoclonal antibody based enzyme linked immunosorbent assay (ELISA). The positive heart blood sample was confirmed positive for toxin using mouse bioassay but there was insufficient sample to identify the toxin type. Ten out of 12 crop samples and 1 out of 4 caecal samples from morbid birds were positive for botulinum toxin using mouse bioassay. The toxin was identified as type C by mouse neutralization testing (Centres for Disease Control 1998). This is the first report of botulism in laying hens in the British Isles. The diagnosis was based on the clinical signs, the elimination of other potential causes of paralysis and the demonstration of botulinum toxin in morbid birds. Feed and water were ruled out as possible sources of toxin. The ingestion of preformed toxin from carcasses may have been the source of toxin in this outbreak similar to some reports of broiler botulism. It was noted at an unannounced visit that the farmer was slow to remove carcasses from the barn and carcasses at varying stages of decomposition were left on the slatted and concrete floor areas.

A selection of other peer-reviewed scientific publications by AFBI and DAFM laboratory staff in scientific journals published during 2011

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Backweston, Dublin

Stormont, Belfast

Kilkenny

Omagh

Athlone

Sligo

Cork

Limerick