

All-^visland Animal Disease Surveillance Report 2014

A joint AFBI / DAFM Veterinary Laboratories publication



Department of
**Agriculture,
Food and the Marine**

An Roinn
**Talmhaíochta,
Bia agus Mara**



Agri-Food and
Biosciences Institute®

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Introduction

This year marks the fifth edition of the All-island Animal Disease Surveillance Report, a significant milestone for any publication. We wish to thank all of the contributors and editors who have built and developed the report, as well as the farmers and veterinary practitioners who provide the caseload on which our animal disease surveillance systems north and south are built.

It is fair to say that over that time animal disease surveillance has gained an enhanced status in the eyes of stakeholders and policy makers, and that enhancement is due in no small part to the profile and accessibility to surveillance data provided by this publication.

While the principal driver for our surveillance efforts is the early detection and communication of exotic and emerging disease threats, animal disease surveillance as performed on this island also allows us to monitor the health, welfare and productivity of food-producing animals. As well as structured programmes that actively target specific diseases and zoonotic pathogens, the ability to rapidly detect the emergence of unexpected or entirely novel disease entities and changing patterns of endemic diseases is a key function of the surveillance systems in both jurisdictions. We also need to retain the ability to go beyond what is presented to our laboratories and carry out field investigations and other follow-up work in order to protect animal and public health and the agri-food industry. This is the other key value of our surveillance programmes – the development and maintenance of specialist investigatory disciplines

and the attraction and retention of expertise and talent in these fields.

It is worth noting a number of significant developments that are taking place as we write these introductory words in early October 2015. The dairy sector is in expansionary mode following the removal of dairy quota restrictions on milk production earlier this year. The timely provision of robust animal disease surveillance data is therefore increasingly important both to inform husbandry practices and disease control measures at home, and to substantiate marketing claims about our favourable animal health and welfare status in export markets. Both parts of the island have successfully eradicated brucellosis, achieved disease free (“OBF”) status and have recently discontinued mandatory pre-movement testing of cattle. However, continued vigilance will be necessary to ensure early detection if this disease were ever to recur on the island and to ensure a rapid and appropriate response to other disease threats – the first ever case of bovine besnoitosis in Ireland was diagnosed in 2015 and bluetongue virus is once again circulating in Northern Europe. AFBI has recently published its 2020 Strategy and DAFM is completing a Strategic Review of its laboratories; this may therefore be an opportune time to consider laboratory capability and capacity across the island of Ireland and opportunities for further collaboration to underpin our surveillance systems.

As the science that underpins our animal disease surveillance service becomes more sophisticated,

our ability to detect and define pathogens grows in parallel, but this will create its own challenges in terms of data-sharing and the volume of data to be filtered and evaluated in order to extract the key facts and messages. This report is an example of what can be derived by sharing and extracting from a large volume of data assembled over the course of a calendar year by multiple players. There is little doubt that the next five years will see new data streams mined to augment what we are currently doing to monitor disease patterns and trends and to detect the incursion of exotic disease.

These and many other challenges lie ahead, but whilst we expect to be reviewing an enhanced dataset in five years time, we also confidently expect that publication of robust surveillance data will still be a cornerstone of improving animal health and welfare for all stakeholders in the food chain.

SÉAMUS KENNEDY, CEO, AFBI
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Animal demographics and the weather

GERARD MURRAY

Cattle and sheep demographics

The national cattle and sheep populations in Ireland and Northern Ireland showed minimal change from the population numbers recorded in 2013. Cattle numbers decreased by approximately one *per cent* in both jurisdictions while sheep numbers remained unchanged in Ireland but increased by approximately one *per cent* in Northern Ireland (Figure 1). The modest increase in the size of the Northern Ireland flock was primarily accounted for by an increase in lambs aged under one year relative to the numbers recorded in 2013.

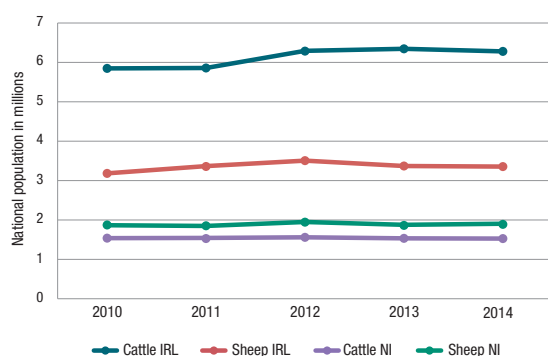


Figure 1: Trends in the national cattle and sheep populations in Ireland and Northern Ireland from 2010 to 2014. (Source: www.cso.ie for Ireland; www.dardni.gov.uk/index/statistics.htm for Northern Ireland)

Weather

Following the at times harsh weather conditions experienced in 2013, the weather in 2014 proved to be generally favourable for livestock. Nevertheless rainfall amounts deviated considerably from the 30-year average. January, February, August and November were all considerably wetter than normal while April, June, July and September

recorded considerably reduced rainfall compared to the 30-year average (Figure 2).

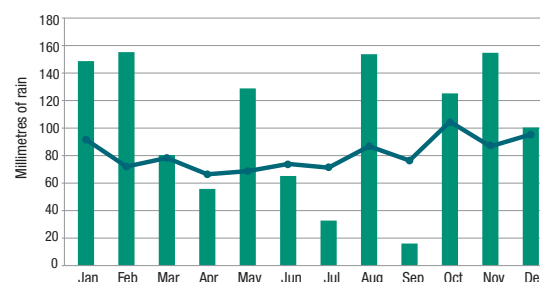


Figure 2: The monthly average rainfall (in millimetres) during 2014 as recorded in Mullingar compared to the 30-year average monthly rainfall (blue line). (Source: Met Éireann)

The monthly average temperature during 2014 was close to the 30-year average with the exception of a marginally warmer April and a cooler than average August (Figure 3).

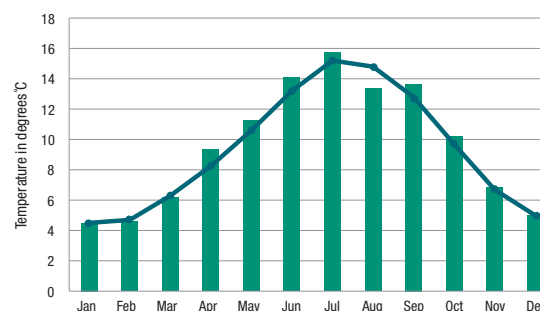


Figure 3: The monthly average temperature during 2014 compared to the 30-year average monthly temperature (blue line) as recorded in Mullingar. (Source: Met Éireann)

The mild but wet autumn period provided conditions conducive to increasing populations of liver fluke eggs and lungworm larvae present on pasture.

Diseases of cattle

SEÁN FEE
DENISE MURPHY

This section presents the most commonly diagnosed causes of death in cattle referred for *post mortem* examination at the Agri-Food and Biosciences Institute (AFBI) in Northern Ireland and the Department of Agriculture, Food and the Marine (DAFM) laboratories in Ireland. As the causes of mortality in cattle vary significantly by age, the data in this section is presented by age category. For comparative purposes, the age categories used are standardised for both laboratory services and consist of neonatal calves (less than one month of age), calves (one to five months of age), weanlings (six to twelve months of age) and adults (greater than twelve months of age).

While the possible causes of death in cattle are wide-ranging, the common causes of death remain remarkably consistent from year to year and from each jurisdiction. To facilitate the presentation of results, conditions are grouped into general categories. More specific details on the categories of neonatal enteritis, clostridial diseases, mastitis, respiratory diseases, abortion, congenital abnormalities, poisoning and parasitic diseases can be obtained in other sections of the report.

Neonatal calves

Animals less than one month old are included in the category of neonatal calves.

As in previous years, gastrointestinal infections were the most frequently identified cause of mortality among neonatal calves on the island of Ireland, accounting for 36 *per cent* of neonatal deaths in Ireland (Figure 4) and 38 *per cent* in Northern Ireland (Figure 6). Further details can be found in the bovine neonatal enteritis section.

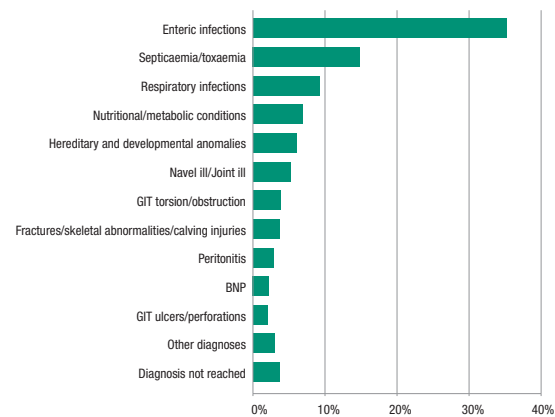


Figure 4: The conditions most frequently diagnosed on *post mortem* examination of neonatal calves (less than one month old) in Ireland during 2014 (n=835). GIT=Gastrointestinal tract; BNP=Bovine neonatal pancytopenia.

Septicaemia was the second most commonly diagnosed cause of neonatal mortality in Ireland (15 *per cent*; Figure 4), while this condition was the third most frequently diagnosed cause of neonatal mortality in Northern Ireland (11 *per cent*; Figure 6). In both jurisdictions, the most frequently recorded cause of septicaemia was colisepticaemia (Figure 5) representing 50 and 45 *per cent* of septicaemia cases in Northern Ireland and Ireland respectively.



Figure 5: Joint ill (septic polyarthritis) developed in a 7-day-old calf as a result of septicaemia. *E. coli* was recovered from liver, lung, spleen, small intestine and caecum. (Photo: Seán Fee)

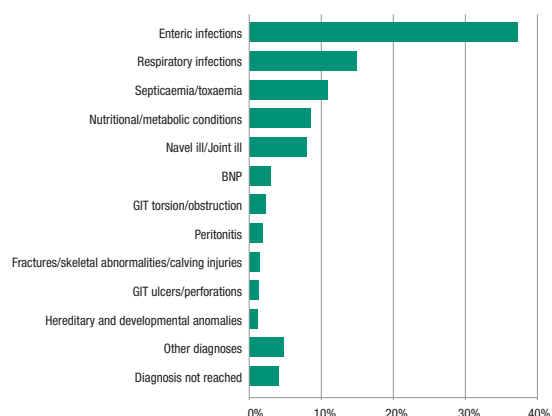


Figure 6: The conditions most frequently diagnosed on *post mortem* examination of neonatal calves (less than one month old) in Northern Ireland in 2014 (n=610). GIT=Gastrointestinal tract; BNP=Bovine neonatal pancytopenia.

Respiratory tract infection was the second most commonly diagnosed cause of neonatal mortality in Northern Ireland (n=87, 14 *per cent*; Figure 6) and the third most commonly diagnosed cause of neonatal mortality in Ireland (n=77, 9 *per cent*; Figure 4). *Mycoplasma bovis* was the most frequently recovered respiratory pathogen in this age cohort in Northern Ireland (19.5 *per cent*) while this pathogen was identified in 5 *per cent* of respiratory tract infections in Ireland. *Mannheimia haemolytica* was the most frequently diagnosed respiratory pathogen in Ireland at 22 *per cent* of all diagnoses, while it was identified in 17 *per cent* of respiratory tract infections in Northern Ireland. Bovine herpesvirus 1 (BHV-1), the causative agent of infectious bovine rhinotracheitis (IBR) was diagnosed in eight and one cases of respiratory tract infections in Ireland and Northern Ireland respectively.

Salmonella spp. were associated with cases of septicaemia and enteric infections in neonatal calves accounting for 3 *per cent* mortality in Northern Ireland and 3.5 *per cent* of cases in Ireland. *Salmonella* Dublin was the most frequent *Salmonella* isolate identified. In addition, *Salmonella* Goldcoast was isolated from two cases

of enteritis in Ireland. *S. Goldcoast* is an unusual isolate in cattle which does occur in livestock but more frequently in humans. A warning about the zoonotic implications was given to the owner.

Hypogammaglobulinaemia was the most frequently recorded nutritional/metabolic condition in neonatal calves in Northern Ireland accounting for 60 *per cent* of cases, while it accounted for 17 *per cent* of the nutritional/metabolic conditions recorded in Ireland. Other significant causes of nutritional/metabolic disease in neonatal calves in 2014 included three cases of white muscle disease (Figure 7), two of which were diagnosed histologically. Damage due to ruminal feeding was also a significant cause of mortality within the nutritional/metabolic conditions in Northern Ireland (19 *per cent*) and Ireland (15 *per cent*). Metabolic acidosis (22 *per cent*) and starvation/malnutrition (20 *per cent*) were the most frequently diagnosed nutritional/metabolic conditions in neonatal calves in Ireland.



Figure 7: White muscle disease in a 7-10 day-old Friesian calf. (Photo: Seán Fee)

During 2014, hereditary and developmental abnormalities were diagnosed in 6.2 *per cent* of the cases of neonatal mortality in Ireland and just one *per cent* in Northern Ireland. The higher rate of diagnoses in Ireland may be related to the promotion of the recording of bovine birth defects by the Irish Cattle Breeding Federation (ICBF) which has increased awareness of these conditions. See http://www.icbf.com/?page_id=2409. In Ireland,

congenital heart defects including ventricular and atrial septal defects and persistent ductus arteriosus, were the most frequently diagnosed congenital abnormalities accounting for 35 *per cent* of cases, while intestinal atresias accounted for 31 *per cent* of cases.

Calves

This age category includes cattle of one to five months of age.

During 2014, as in the 2012 and 2013 AIADSR reports, respiratory infections were the most frequent cause of death in any cattle age group with the exception of neonatal calves. In calves aged one to five months old, respiratory infections were diagnosed in 38 *per cent* of the *post mortem* cases in Northern Ireland (Figure 8) and 25 *per cent* in Ireland (Figure 9). The pathogens most frequently identified were *Mycoplasma bovis* in Northern Ireland and *Pasteurella multocida* in Ireland (Table 1).

Pathogen	AFBI	DAFM
<i>Mycoplasma bovis</i>	25	10
<i>Mannheimia haemolytica</i>	16	15
<i>Pasteurella multocida</i>	11	16
<i>Trueperella pyogenes</i>	7	8
<i>Haemophilus somni</i>	3	2
<i>Dictyocaulus viviparus</i>	5	10

Table 1: The relative frequency of detection of pathogens in *post mortem* cases diagnosed as respiratory infections of calves of 1 to 5 months of age during 2014 in Northern Ireland (AFBI) and Ireland (DAFM).

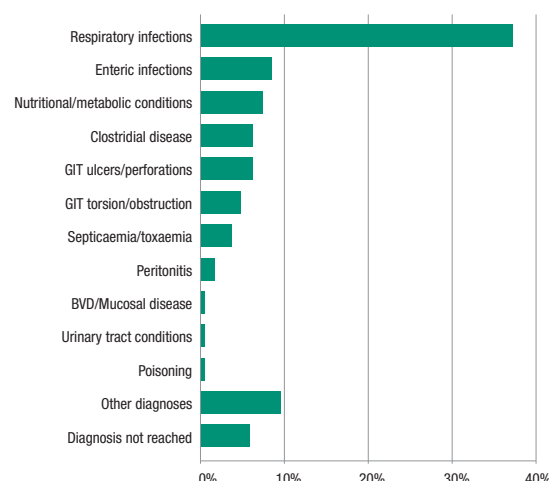


Figure 8: The conditions most frequently diagnosed on *post mortem* examination of calves aged one to five months in Northern Ireland during 2014 (n=381). GIT=Gastrointestinal tract.

Enteric infections were diagnosed in 15.6 *per cent* of calves in this age category examined at *post mortem* in Ireland (Figure 9). Coccidiosis was recorded in 21 *per cent* of these cases, salmonellosis in 5.5 *per cent* and parasitic gastroenteritis in 3 *per cent*. In Northern Ireland, enteric infections were diagnosed in 9 *per cent* (n=33) of calves in this age group (Figure 8). Coccidiosis was recorded in 30 *per cent* of cases, parasitic gastroenteritis in 18 *per cent* and cryptosporidiosis in 9 *per cent*.

Gastrointestinal ulceration/perforation leading to peritonitis was a relatively common diagnosis in this age cohort with 39 cases recorded in Ireland (Figure 9) and 26 cases in Northern Ireland (Figure 8). The category gastrointestinal torsion/obstruction includes mesenteric and intestinal torsions, intussusceptions and other intestinal obstructions. There were 55 cases diagnosed in Ireland and 21 cases in Northern Ireland in 2014.

Nutritional and metabolic conditions were diagnosed in 8 and 4 *per cent* of calves in Northern Ireland (Figure 8) and Ireland (Figure 9) respectively during 2014. The Northern Ireland figure represents a reduction from 2012 and 2013

when 57 and 52 cases respectively of nutritional and metabolic conditions were diagnosed by AFBI. Ruminal acidosis was the most frequent diagnosis in this category in Northern Ireland with 10 cases diagnosed and there were 6 cases in Ireland. Starvation/malnutrition was recorded as the cause of death in 11 cases in Ireland and in 6 cases in Northern Ireland.

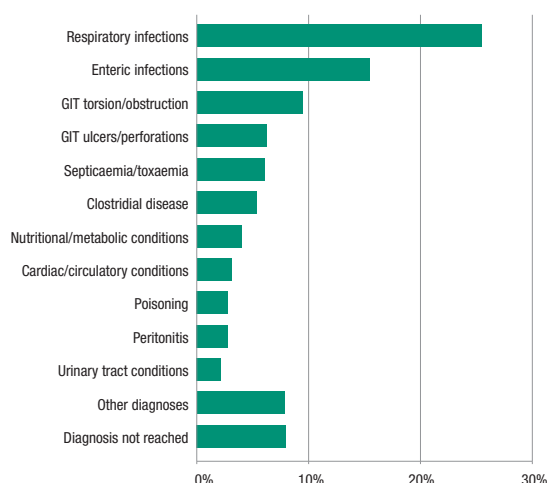


Figure 9: The conditions most frequently diagnosed on *post mortem* examination of calves one to five months old in Ireland in 2014 (n=588). GIT=Gastrointestinal tract.

Weanlings

Cattle between six and twelve months of age are categorised as weanlings.

As in previous years, respiratory tract infections were identified as the most significant cause of mortality in weanlings on the island of Ireland accounting for 34 and 30 *per cent* of deaths in this age category in Northern Ireland (Figure 10) and in Ireland (Figure 12) respectively. This represents a slight continuing decline in the relative frequency of mortality attributed to respiratory tract infections in weanlings in Northern Ireland over the past four years from 40 *per cent* in both 2011 and 2012 to 37 *per cent* last year. The figures for Ireland have risen from 25 *per cent* in 2012 to 31.5 *per cent* last year. Bacterial infections continue to

be the most frequent cause of respiratory tract infections. In Northern Ireland, *Mycoplasma bovis* and *Mannheimia haemolytica* (Figure 11) each represented 19 *per cent* of diagnosed respiratory tract infections followed by *Pasteurella multocida* (12.5 *per cent*), *Trueperella pyogenes* (6 *per cent*) and *Haemophilus somni* (4 *per cent*). In Ireland, *Mannheimia haemolytica* was also the most frequently detected pathogen (19 *per cent* of respiratory tract infections) followed by *Pasteurella multocida* (10 *per cent*) and *Mycoplasma bovis* (7 *per cent*), while *Haemophilus somni* was isolated in just one case. Among the viral pathogens identified, there were two cases of bovine respiratory syncytial virus (BRSV) and one case of parainfluenza 3 virus (PI3V) recorded in Northern Ireland, while BRSV was detected in 8 cases in Ireland. Parasitic pneumonia (hoose) was detected in 8 cases (17 *per cent*) and 13 cases (14 *per cent*) of respiratory infections in weanlings in Northern Ireland and Ireland respectively. Parasitic pneumonia prevalence is highly seasonal, with all cases in Northern Ireland observed between May and October with the peak number of cases in October, and between June and October in Ireland with the greatest number of cases diagnosed in September.

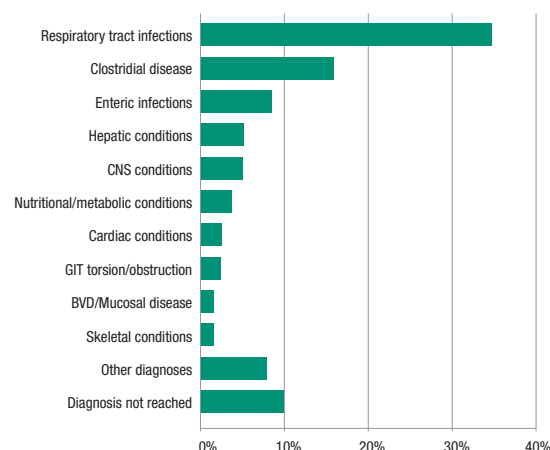


Figure 10: Conditions most frequently diagnosed on *post mortem* examination of weanlings in Northern Ireland during 2014 (n=140). GIT=Gastrointestinal tract; CNS=Central nervous system; BVD=Bovine viral diarrhoea.

Clostridial diseases were another important cause of death in weanlings, despite being preventable by the use of a multivalent clostridial vaccine, and during 2014 were responsible for 16 and 12 *per cent* of deaths in Northern Ireland (Figure 10) and Ireland (Figure 12) respectively in this age cohort. Blackleg (clostridial myositis) was the most common clostridial disease diagnosed in weanlings, with 16 and 30 cases in Northern Ireland and Ireland respectively, while there were 2 and 3 cases of botulism in weanlings diagnosed in Northern Ireland and Ireland respectively. Further information on bovine clostridial disease can be found in a dedicated chapter.

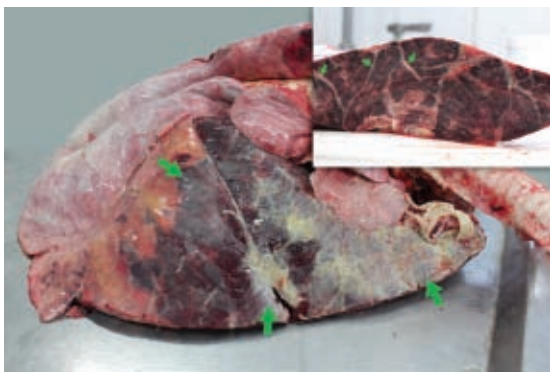


Figure 11: Fibrinous bronchopneumonia with a cranioventral distribution typical of *Mannheimia haemolytica* infection in the lungs of a weanling. The affected parenchyma appears dark and hyperaemic and there is deposition of fibrin (arrows) over the pleura and within interlobular septa (inset). (Photo: Cosme Sánchez-Miguel)

Enteric infections were the third most commonly diagnosed cause of death in weanlings in Ireland (Figure 12) and Northern Ireland (Figure 10). Parasitic gastroenteritis accounted for 75 *per cent* (9 cases) and 37.5 *per cent* (12 cases) of enteric infections in weanlings in Northern Ireland and Ireland respectively. There were 2 cases of coccidiosis diagnosed in weanlings in Northern Ireland and 4 cases in Ireland.

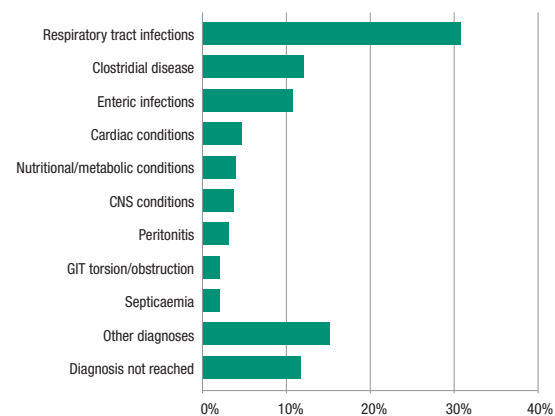


Figure 12: The conditions most frequently diagnosed on *post mortem* examination of weanlings in Ireland in 2014 (n=298). GIT=Gastrointestinal tract; CNS=Central nervous system.

Nutritional and metabolic conditions represented 4 *per cent* of weanling mortality on the island of Ireland with six and 12 cases in Northern Ireland (Figure 10) and Ireland (Figure 12). There were five cases of ruminal acidosis and two cases each of starvation and cerebrocortical necrosis (CCN) diagnosed in Ireland. Two cases of ruminal acidosis and two cases of malnutrition were recorded in Northern Ireland.

Adult cattle

This category includes cattle older than 12 months of age.

The range of causes of mortality in this age group tends to be broader than in the other age groups, and while respiratory tract infections are still the most frequent cause of death, the relative frequency of this diagnosis is lower than in other age categories. AFBI attributed respiratory tract infections to 14 *per cent* (n=89) of adult deaths examined at *post mortem* (Figure 13) and a similar percentage was found in Ireland at 17.4 *per cent* (n=71) (Figure 14). As in other age categories, bacterial pneumonia was the most frequent etiological diagnosis with *Mannheimia haemolytica* most frequently detected in Northern Ireland (21 cases) and Ireland (13

cases), followed by *Trueperella pyogenes* (10 and 6 cases in Northern Ireland and Ireland respectively), *Mycoplasma bovis* (9 and 4 cases in Northern Ireland and Ireland respectively) and *Pasteurella multocida* (5 and 3 cases in Northern Ireland and Ireland respectively). In Northern Ireland, nineteen cases of parasitic pneumonia were recorded in adult cattle and significantly 13 of these cases were recorded in cattle more than two years old of which seven were observed in cattle four years old or more highlighting the increasing trend toward clinical outbreaks of parasitic pneumonia in older cattle. Parasitic pneumonia cases were more frequent in 2014 than in 2013 (when 13 cases were diagnosed by AFBI). In Ireland, eight cases of parasitic pneumonia were diagnosed in adult cattle with four cases in cows between two and three-and-a-half years old.

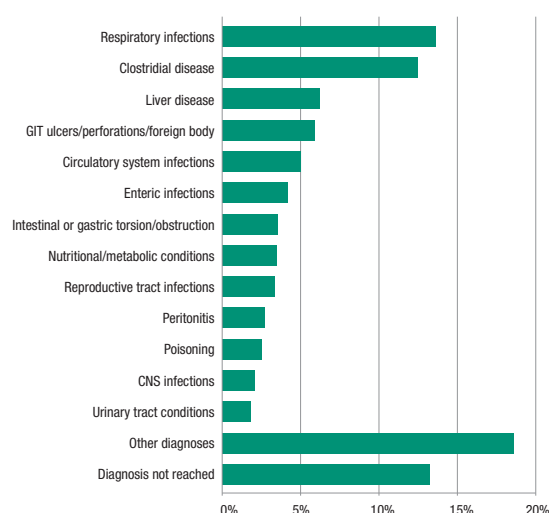


Figure 13: The conditions most frequently diagnosed on *post mortem* examination of adult cattle in Northern Ireland during 2014 (n=642). GIT=Gastrointestinal tract; CNS=Central nervous system.

Clostridial disease was responsible for 12 *per cent* of deaths (n=80) in adult cattle in Northern Ireland during 2014 (Figure 13) compared to 12 *per cent* in 2013 and 8.9 *per cent* in 2012 and six *per cent* (n=24) of adult cattle deaths in Ireland during 2014 were due to clostridial diseases (Figure 14)

compared to 5.5 *per cent* in 2013. Botulism was the most commonly diagnosed clostridial disease in adult cattle in Northern Ireland (34 cases), while black disease (infectious necrotic hepatitis) and blackleg (clostridial myositis) accounted for 32 cases and 13 cases respectively. In Ireland, 7, 5 and 3 cases of black disease, blackleg and botulism respectively were diagnosed in adult cattle during 2014.

Gastrointestinal ulceration/perforation or foreign bodies were a relatively significant cause of adult cattle mortality in both jurisdictions accounting for seven *per cent* and six *per cent* of mortality in this age group in Ireland (Figure 14) and Northern Ireland (Figure 13) respectively. Abomasal ulceration and/or perforation accounted for 21 cases in Ireland and 16 cases in Northern Ireland and there were eight cases of reticulitis/foreign body reticulitis in Ireland and 16 cases in Northern Ireland.

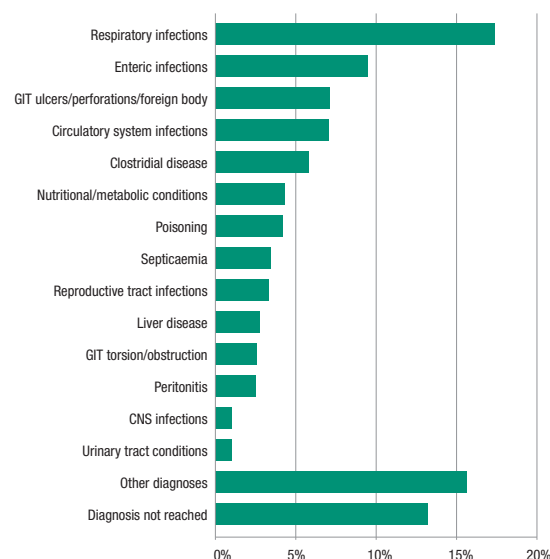


Figure 14: The conditions most frequently diagnosed on *post mortem* examination of adult cattle in Ireland during 2014 (n=408). GIT=Gastrointestinal tract; CNS=Central nervous system.

The most commonly diagnosed nutritional/metabolic conditions diagnosed in Northern Ireland were ruminal acidosis (11 cases), ketosis/fatty liver (5 cases), hypomagnesaemia (4 cases)

and hypocalcaemia (4 cases). In Ireland, the most common causes of death of adult cattle as a result of nutritional/metabolic conditions were hypomagnesaemia (11 cases) and ruminal acidosis (5 cases).

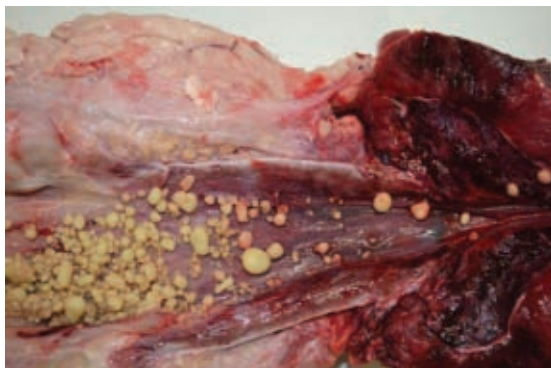


Figure 15: Urinary calculi in the neck of the bladder in a case of sudden death in a yearling bull diagnosed with urolithiasis. (Photo: Seán Fee)

Hepatic disease was diagnosed in 6 *per cent* of adult cattle in Northern Ireland (Figure 13), and in this category liver fluke infestation was the most common diagnosis (11 cases) followed by hepatic abscessation (9 cases). In adult cattle in Ireland there were five cases of hepatic abscessation and there were no cases of fascioliasis recorded as a cause of death. This continues the trend of decreasing adult cattle mortality in Ireland due to liver fluke from nine *per cent* in 2009, two *per cent* in 2011, and 1.9 *per cent* in 2013.

Circulatory system infections include conditions such as vegetative endocarditis, pericarditis, vena caval thrombosis, babesiosis and myocarditis and these conditions are much more common in the adult age group than any other age cohort. They accounted for 7 *per cent* (n=29) of adult mortality in Ireland (Figure 14) and 5 *per cent* (n=32) in Northern Ireland (Figure 13).

Clostridial diseases

JOHN FAGAN
SEÁN FEE

Clostridial bacteria continued to be important causes of bovine mortality during 2014, with 233 cases of clostridial disease diagnosed by AFBI and DAFM laboratories. The soil-associated bacteria which cause clostridial disease are widely distributed in the environment. Clostridial bacteria are anaerobic and under favourable conditions (low oxygen tension) latent spores can germinate, leading to rapid multiplication of the bacteria and production of deleterious toxins. Various husbandry factors including changes in management, trauma or parasite-associated damage frequently precipitate the onset of disease. Clostridial diseases are usually very acute and in many cases affected animals are found dead or severely ill, although in the case of tetanus and botulism the course of disease is longer and animals may survive for several days.

Similar to previous years, blackleg (clostridial myositis), black disease (infectious necrotic hepatitis) and botulism were the most frequently recorded clostridial diseases detected on the island of Ireland during 2014 (Figure 16).

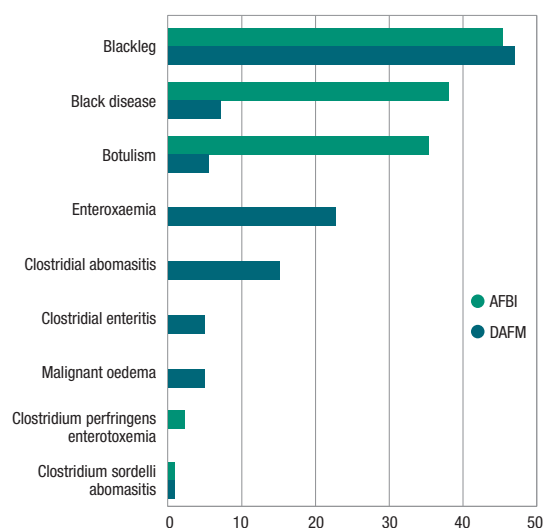


Figure 16: The number of clostridial disease diagnoses by AFBI (n=123) and DAFM (n=110) veterinary laboratories during 2014.

BLACKLEG

Blackleg is caused by the bacterium *Clostridium chauvoei*. Rapidly growing animals in good condition are frequently affected and the disease is produced when the spores of ingested bacteria, located in muscle, germinate in conditions of lowered oxygen tension and produce toxin. The favourable conditions of lowered oxygen are typically produced by traumatic damage and bruising.

Ninety-four cases of blackleg were diagnosed on the island of Ireland during 2014 (Figure 16). Cattle less than one-year old were most frequently affected with 75 cases recorded and accounting for 80 per cent of all cases of blackleg diagnosed (Figure 17).

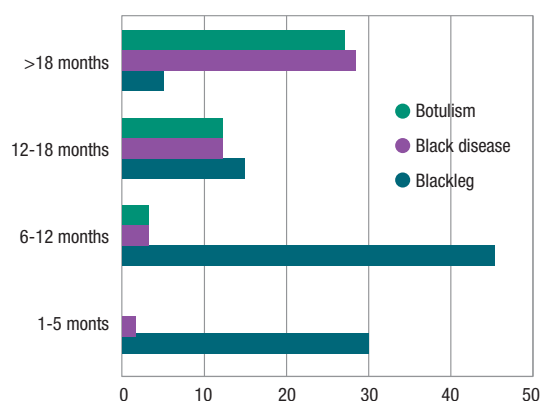


Figure 17: Number of cases by age of the three most commonly diagnosed clostridial diseases on the island of Ireland during 2014.

Most cases of blackleg were diagnosed in grazing animals from May to November with a significant peak in cases in September and October (Figure 19).



Figure 18: Typical blackleg lesion in shoulder muscle (above) of a calf and showing unaffected hindquarter muscle from the same calf (below). (Photo: Seán Fee)

BLACK DISEASE

Black disease is caused by *Clostridium novyi* bacteria. Ingested spores localise in the liver and germinate in conditions of lowered oxygen tension, as are typically produced by migrating immature liver fluke. Rapid multiplication of the bacteria occurs with production of toxin and the onset of disease (Figure 20). Forty five cases of black disease were recorded in 2014 (Figure 16). Most cases were seen during the grazing season between July and November (Figure 19). Forty of the forty-five cases (89 per cent) were recorded in cattle older than twelve months of age (Figure 17).

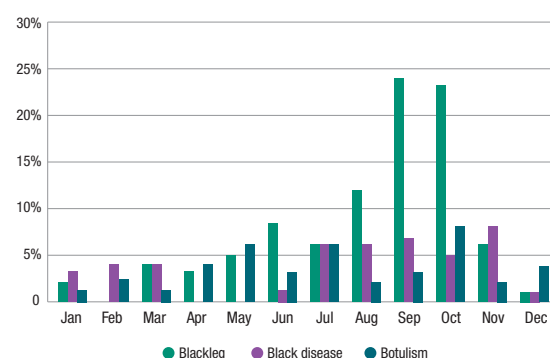


Figure 19: Number of cases by month of the three most commonly diagnosed clostridial diseases on the island of Ireland during 2014.

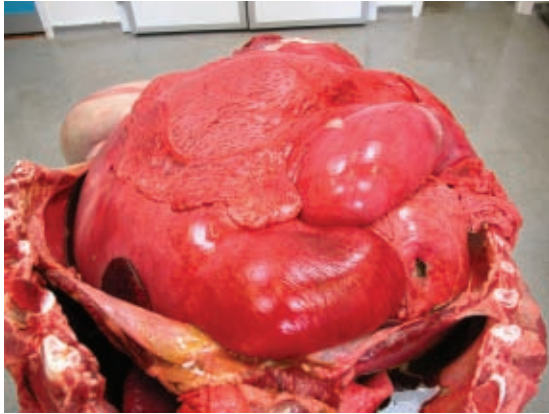


Figure 20: Intense congestion of the carcass due to the vascular effects of toxin in a two-year-old heifer, characteristic of black disease. (Photo: Seán Fee)

BOTULISM

Forty-two cases of botulism were diagnosed during 2014, maintaining the upward trend in diagnosis in recent years (Figure 21). Most cases of botulism were diagnosed in adult cattle (Figure 17).

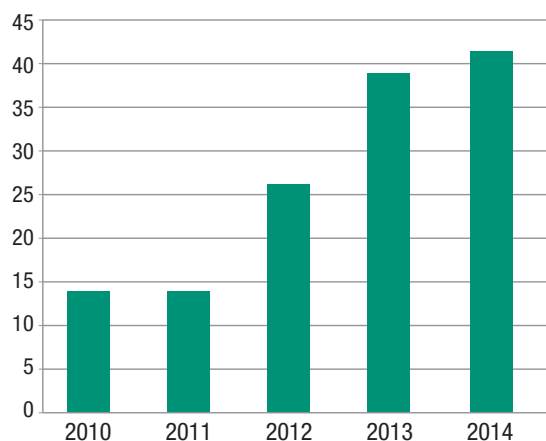


Figure 21: Number of cases of botulism by year from 2010 to 2014.

Botulism is caused by the ingestion of preformed toxin which has been produced by the growth of *Clostridium botulinum* bacteria in decaying vegetation or animal carcasses, particularly birds. If consumed by animals or birds, the toxin blocks transmission of nerve impulses to muscles and consequently leads to flaccid paralysis. The clinical signs usually become more severe over several

days leading to recumbency and death. In the island of Ireland carrion and broiler litter are the most frequently associated sources of botulism in cattle. Direct access to broiler litter or grazing on fields near locations where broiler litter has been spread are associated risk factors.

ENTEROTOXAEMIA

Clostridial enterotoxaemia was the fourth most frequently diagnosed clostridial disease on the island of Ireland and the second most frequently recorded clostridial disease of cattle by DAFM laboratories (Figure 16). Enterotoxaemia is caused by *Clostridium perfringens*, with different types depending on the toxin produced.

Bovine Neonatal Enteritis

MARESA SHEEHAN
SIOBHAN CORRY

Infectious neonatal enteritis in calves develops when there is an imbalance between the calf's immune system and the pathogen load of the calf.

It is best practice to feed calves colostrum from their own dams to reduce the risk of transmitting *Mycobacterium avium* subsp. *paratuberculosis* (Johne's disease). A store of good quality colostrum can be kept frozen for those cases where the dam fails to produce adequate colostrum. Colostrum for storage should be from cows with good milk yield and if Johne's disease is a potential risk in the herd, it should be taken from low risk animals i.e. older cows with a number of negative Johne's ELISA/culture results.

Colostrum replacement products are available but their efficacy and quality can be variable. The calf's own dam is the best source of colostrum. Furthermore these products usually contain good levels of readily absorbed calorific energy and can actually suppress the neonate's appetite and interfere with normal colostrum intake.

Enteric pathogen	Total samples tested		Positives		Positives per cent	
	PM	Total	PM	Total	PM	Total
<i>Cryptosporidium</i>	806	2658	171	693	21.2	26.1
<i>Rotavirus</i>	807	2649	155	882	19.2	33.3
<i>Coronavirus</i>	807	2641	5	21	0.6	0.8
<i>E.coli</i> K99	642	1815	16	32	2.5	1.8
<i>Salmonella</i>	805	2645	25	44	3.1	1.7
<i>Coccidiosis</i>	262	1019	71	282	27.1	28.3

Table 2: The absolute and relative frequency of pathogens identified in *post mortem* submissions alone (PM) and combined with faecal clinical samples (Total) submitted to DAFM veterinary laboratories during 2014.

Coccidiosis can be caused by several species of protozoa, *Eimeria* being the most prevalent in cattle (Figure 22). As coccidial oocysts detected on faecal parasitological examination may have been produced by highly pathogenic or much less pathogenic coccidia, the presence of oocysts in faeces should be interpreted in conjunction with clinical signs.

Enteric pathogen	Total samples		Positives		Positives per cent	
	PM	Total	PM	Total	PM	Total
<i>Cryptosporidium</i>	179	1313	45	404	25	30.8
<i>Rotavirus</i>	179	1330	42	387	23	29
<i>Coronavirus</i>	179	1319	17	90	9	6.8
<i>E.coli</i> K99	179	462	7	9	4	1.9
<i>Salmonella</i>	179	1330	15	185	8	14
<i>Coccidiosis</i>	179	219	17	41	9	18.7

Table 3: The absolute and relative frequency of pathogens identified in *post mortem* submissions alone (PM) and combined with faecal clinical samples (Total) submitted to AFBI veterinary laboratories during 2014.

The severity of enteritis in the neonatal calf will be determined among other factors by the strength and competence of immunity in the calf and the virulence of the pathogen challenge the calf is exposed to.

FACTORS THAT IMPROVE IMMUNITY IN THE CALF

- Feeding of colostrum ("biestings") is the greatest single contribution to the competence of the newborn calf immune system
- Appropriate and correctly administered vaccination of the dam will boost the effect of colostrum in the calf, but calves may still succumb to enteritis and diarrhoea if there is a heavy load of pathogens in the environment. This is why vaccination alone cannot prevent neonatal enteritis. The severity of environmental challenge should also be reduced by attention to hygiene, stocking rates and rapid identification and isolation of sick animals.

HUSBANDRY PRACTICES TO REDUCE THE AMOUNT OF PATHOGEN THE CALF IS EXPOSED TO INCLUDE:

- Clean environment: Calf houses and calving pens should be cleaned and disinfected as soon as possible after calves have been turned out in the early summer. The longer that calf houses can be left clean and dry, the better. Dessication is an important control method for *Eimeria* and *Cryptosporidium*. Use an appropriate disinfectant. If coccidiosis or cryptosporidiosis has been diagnosed then an appropriate disinfectant effective against the oocysts of the infectious agent responsible should be used.
- Dairy calves should be separated from their dams as soon as they are licked dry. The cow is an important source of bacteria and viruses that can cause enteritis leading to diarrhoea. Since beef calves will stay with the dam, an extra effort should be made to keep the

environment clean to reduce contamination of the cow's udder and skin.

- Never mix newborn calves with older calves (i.e. calves greater than 3-4 days old).
- Strict hygiene with feeding equipment.
- Replenish bedding (straw etc.) every 2 days.
- Keep troughs raised off the ground.
- Isolate animals affected by diarrhoea promptly.
- Feed younger calves before older calves. Always disinfect boots and wash hands between pens of calves. Work with sick calves last.

Other factors include:

- The dam's health status at calving
- Adequate nutrition before calving ensuring optimal magnesium and calcium levels in the diet to ensure hypocalcaemia and "slow" calvings are prevented.

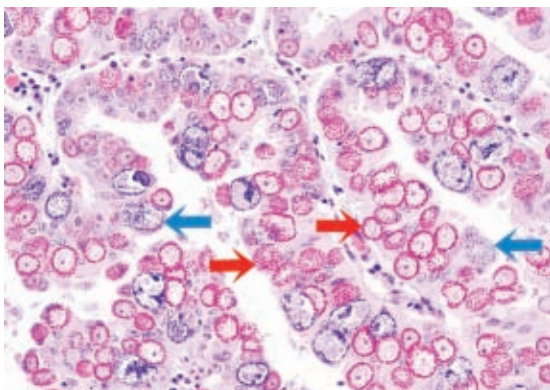


Figure 22: Photomicrograph demonstrating various stages of the life cycle of *Eimeria* sp. in the intestinal epithelium. Note merozoites differentiated into macrogametes (red arrows) and microgametes (blue arrows) as part of the sexual cycle of coccidian. (Photo: Cosme Sánchez-Miguel)

Zinc sulphate turbidity test

IAN HOGAN
SIOBHAN CORRY

Passive immunity refers to the transfer of antibodies from an actively immune animal to a susceptible animal, usually from the dam to the neonate. In the horse, pig and ruminant this is entirely carried out via colostrum. There is no *in-utero* transfer of passive immunity as the placenta of these domestic animals is not permeable to immunoglobulins. Without passive immunity, newborn piglets, calves, lambs and foals are susceptible to a wide range of pathogens. Inadequate amounts of colostrum ingested, poor quality colostrum and delayed colostrum feeding can all lead to failure of passive transfer.

The zinc sulphate turbidity test (ZST) can be performed on serum to get an indirect measurement of the level of immunoglobulin concentration in the blood (McEwan *et al*, 1970). Samples from healthy or diseased animals up to two weeks of age may be tested. This test may be used for the investigation of herd colostrum management and in this case samples from healthy calves between 24 hours and seven days of age are preferred. For such investigations samples from multiple calves should be taken; some authors suggest a minimum of twelve.

Laboratories at DAFM and AFBI conduct a large number of ZST samples on blood from calves and occasionally on samples from lambs to evaluate the adequacy of passive transfer of maternal immunity via colostrum. A value of less than 20 units is indicative of a failure of passive transfer of immunoglobulins.

To ensure an adequate amount of colostrum is ingested you should:

- Observe parturient animals carefully and intervene promptly where necessary.
- Colostrum feeding should take place as soon as possible after birth; the absorption of immu-

noglobulin declines rapidly once the calf is six hours old and has almost ceased at 24 hours.

- Remember an average calf weighing 40kg would need at least 3L of colostrum to gain adequate maternal immunoglobulins; this may not be achieved even if the calf is allowed to nurse to satiety.
- Supplementary feeding using a stomach tube or oesophageal feeder may be necessary.

BOVINE

During 2014 a combined total of 2482 ZST tests were performed on the island of Ireland on bovine samples submitted by private veterinary practitioners (1767 samples) and on bovine carcasses examined *post mortem* (715 samples). Around fifty *per cent* of these samples (1235 samples) had values less than 20 units indicating a failure of passive transfer (Figure 23).

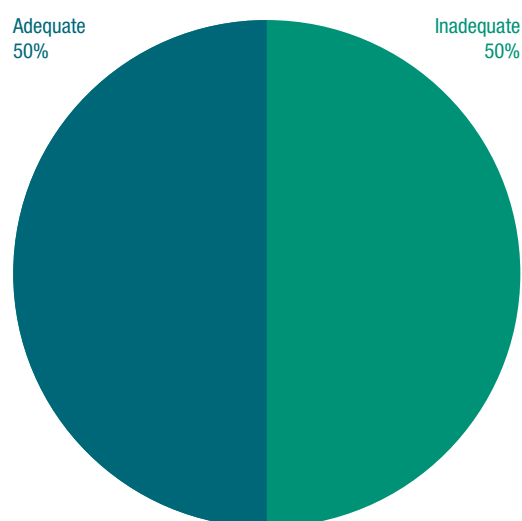


Figure 23: The results of zinc sulphate turbidity tests on bovine calf serum samples performed on the island of Ireland in 2014. Adequate colostral immunity is defined as greater than or equal to 20 units and inadequate as less than 20 units (n=2482).

Of the 715 samples tested from carcasses at *post mortem* examination, 424 (59 *per cent*) had values of less than 20 units. (Figure 24).

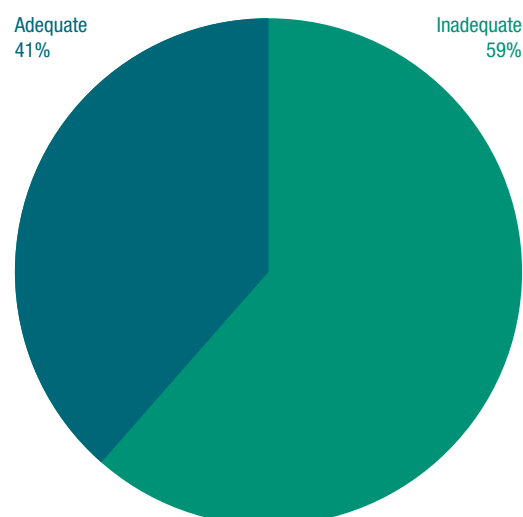


Figure 24: The results of zinc sulphate turbidity tests on bovine calf serum taken from calves submitted for *post mortem* examination on the island of Ireland in 2014. Adequate colostral immunity is defined as greater than or equal to 20 units and inadequate as less than 20 units (n=715).

Although fewer samples were taken for ZST testing from calves submitted for *post mortem*, overall more tests were performed in 2014 than in 2013 due to an increase in clinical samples submitted by veterinary practices. As expected, ZST results for calves submitted for *post mortem* are more often than not inadequate. However there has been a continued increase in the percentage of ZST samples showing adequate immunity in samples submitted by veterinary practitioners. This may be that practitioners are testing calves to check herd colostrum management before the calves get sick and thus using the ZST as a preventative tool for herd health. Use of the ZST test in this fashion provides better information to improve herd health than testing individual or sick calves. Testing a minimum of 12 clinically normal calves less than one week old is recommended (Godden S.*et al*,2008).

OVINE

The ZST test was performed on 143 serum samples from lambs under two weeks of age on the island of Ireland during 2014. Nearly all of these samples came from carcasses submitted for *post mortem*

examination. Fifty-eight of the samples (40 *per cent*) had a ZST value of less than 20 units (Figure 25).

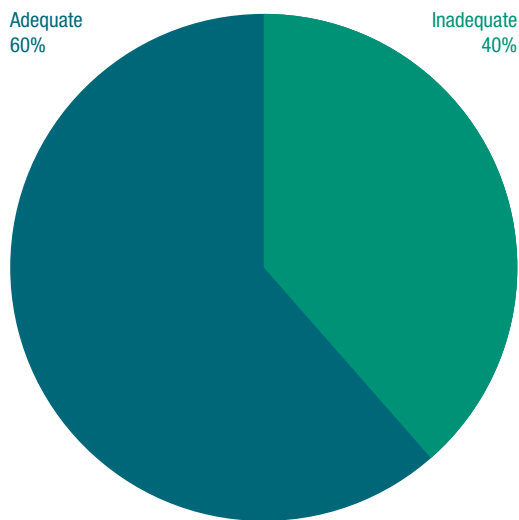


Figure 25: The results of zinc sulphate turbidity tests performed on ovine serum samples from the island of Ireland in 2014. Adequate colostral immunity is defined as greater than or equal to 20 units and inadequate as less than 20 units (n=143).

Bovine Abortion

COSME SÁNCHEZ-MIGUEL
NORMAN BEGGS

Most fetuses submitted for diagnosis to the AFB and DAFM veterinary laboratories are in the second or third trimester of pregnancy. Pathognomonic gross lesions in bovine abortions are uncommon and may be obscured by autolysis. Most foetal submissions follow a standardized diagnostic protocol based on bacterial cultures, including *Brucella* culture, foetal serology, and maternal serology if blood from the dam is provided. Ancillary tests are undertaken depending on the herd history and the lesions observed on gross examination. For an accurate aetiological diagnosis, submission of samples from several abortions is desirable. Placenta is a critical component in the diagnosis of mycotic and some bacterial abortions, thus it is important to include placenta in any foetal submission. In addition, potential zoonotic bacterial infections associated with

bovine abortion such as brucellosis, leptospirosis, listeriosis, and salmonellosis, are an important consideration when handling fetuses. Appropriate precautions should be employed when examining, sampling and shipping specimens to the regional laboratories.

Salmonella abortion is an important cause of enzootic and epizootic abortion. *Salmonella* Dublin was the serotype most commonly isolated, with 172 cases during 2014 representing 6.5 *per cent* of the fetuses submitted for examination in the island of Ireland during 2014 (Table 4). Sporadically, other serotypes can also be isolated; *Salmonella* spp other than *S. Dublin* were isolated in five cases, two of which were identified as *S. Typhimurium*.

Independently of the general pattern of foetal submission distribution, the annual distribution of *Salmonella* abortions in DAFM laboratories consistently produces a marked peak between November and February (Figure 26). Stress factors such as drying off and indoor housing may play an important role in this peak.

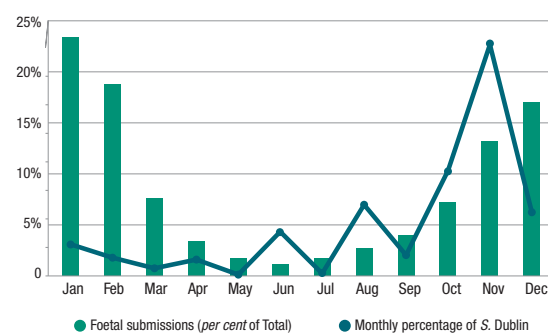


Figure 26: Monthly relative frequency of *Salmonella* Dublin isolated from foetal bacterial cultures in the DAFM laboratories (line graph), compared to the monthly relative frequency of foetal submissions (bar graph) during 2014. *Salmonella* Dublin isolates peak in November; while the higher frequency of foetal submission occurs in January-February.

Listeria monocytogenes, and sporadically other species of *Listeria*, are another important cause of

abortions generally associated with the ingestion of poorly fermented silage. The proportion of abortions where *L. monocytogenes* was diagnosed as the causative agent is low (63 cases during 2014 in the island of Ireland), but the organism is a well-recognised abortifacient and also poses a zoonotic risk, causing abortions in the second half of pregnancy in women.

Abortifacients	Positive samples		Percentage of total samples
Agent/Year	2014	2014	2013
<i>Salmonella</i> Dublin	172	6.5	5.8
<i>Trueperella pyogenes</i>	180	6.8	5.9
<i>Bacillus licheniformis</i>	117	4.4	4.7
<i>Listeria monocytogenes</i>	63	2.4	1.7
<i>Aspergillus</i> spp	23	0.9	0.8

Table 4: Frequency of detection of selected abortion agents identified by routine foetal culture in the AFBI and DAFM laboratories during 2014 (n=2633) compared to 2013 (n=3517).

A diverse group of bacterial and fungal species (Table 4) are associated with opportunistic infections of the placenta and foetus, resulting in sporadic abortions. Though these organisms are commonly found in the environment or on mucosal surfaces, they can sporadically cause maternal bacteremia, reach the gravid uterus and infect the placenta and foetus. *Trueperella pyogenes* was one the most commonly identified species, followed by *Bacillus licheniformis* and *Aspergillus* spp (Table 4). There are also other opportunistic microorganisms of minor importance occasionally isolated in abortion material, with inconsistent capacity in instigating a sporadic abortion (Table 5).

Organism	Total
<i>E. coli</i> and coliforms	287
<i>Streptococcus</i> spp	67
<i>Bacillus</i> spp	20
<i>Staphylococcus</i> spp	17
<i>Pasteurella</i> spp	10
Fungal spp.	10
<i>Salmonella</i> spp (other than <i>S. Dublin</i> or <i>Typhimurium</i>)	3
<i>Yersinia</i> spp	3
<i>Campylobacter</i> spp	2
<i>Salmonella</i> Typhimurium	2

Table 5: Number of diagnosed abortion associated with other bacterial and fungal agents in AFBI and DAFM laboratories during 2014.

Leptospira interrogans Hardjo is the most common serovar in bovine abortion associated with leptospirosis (Table 6). It is adapted to cattle who serve as the maintenance host. Abortion is the main manifestation of chronic leptospirosis and often the only clinical sign observed. *Leptospira* is labile and difficult to culture. Thus, diagnosis relies on the detection of antibody in foetal fluid and/or alternatively, the use of the fluorescent antibody test (FAT) in kidney, lung and adrenal glands impression smears by applying multivalent antisera.

	DAFM	AFBI
<i>Neospora caninum</i>	83(3.5%)*	30 (12.8%)
<i>Leptospira</i> Hardjo	114 (7.5%)	30 (12.8%)

Table 6: Total number of positive diagnoses and relative frequency compared to foetuses tested (in parenthesis) for *Neospora caninum* and *Leptospira* Hardjo, in DAFM and AFBI veterinary laboratories during 2014. *Percentage calculated with the total number of foetal submissions, not all these foetuses were tested for *Neospora caninum*.

Neosporosis is also a major cause of abortion in cattle (Table 6) and can follow an enzootic or epizootic pattern. Diagnosis is based on histological lesions (protozoal non-suppurative encephalitis and myocarditis) and/or by foetal serology (ELISA). It is important to remember that a positive result may not be significant, since the majority of calves infected with *Neospora* are born clinically normal and they would produce a positive precolostral titre. In addition, an infected foetus may produce a negative titre because of its gestational age, severity of infection or carcass autolysis. Maternal serology is of negligible help in the diagnosis of a single case of abortion, and it should only be used on a herd basis to investigate the association between seropositivity and abortion.

Hereditary and developmental abnormalities

COSME SÁNCHEZ-MIGUEL
NORMAN BEGGS

Abortion or stillbirths due to serious hereditary defects were diagnosed in 44 cases out of 2192 bovine foetal submissions to the DAFM veterinary laboratories during 2014 representing 2 *per cent* of the total number of submissions. This finding was similar to the prevalence of congenital defects observed in an earlier study of foetal submissions to Cork RVL (Crilly J. 2003).

Defects of the musculoskeletal system (24 cases) were the most frequently recorded developmental abnormality during 2014. They included brachygnathia, scoliosis and torticollis, arthrogryposis (accompanied by hydrocephalus, cleft palate and domed skull) and absence of limbs (amelia, Figure 27). Four of the cases included in this group were described as congenital joint laxity and dwarfism (dwarf calves) and six other foetuses exhibited defect of the nervous system (hydrocephalus or hydranencephaly), occasionally associated with musculoskeletal defects.



Figure 27: Congenital absence of forelegs (amelia) in a calf. (Photo: Cosme Sánchez-Miguel)

Abnormalities of the digestive system were recorded in seven animals. In six of these different sections of the intestinal tract were affected by atresia (atresia jejuni, coli or ani). One foetus was recorded with an enlarged liver which was determined by histology to be the result of a round cell tumour, presumably a hepatic lymphoma.



Figure 28: Bicephalus calf with two fully formed heads. (Photo: Cosme Sánchez-Miguel)

Kilkenny RVL (Toolan, 2014) reported the first congenital paunch calf syndrome recorded in Ireland during 2014. This is a homozygous recessive condition in the Romagnola breed characterised by marked abdominal distension as a result of subcutaneous oedema, ascites, a fibrotic liver with hepatic cysts and occasionally, a cardiac malformation like a septal defect or patent ductus arteriosus (Figure 29). In this case, genetic testing confirmed that the calf was homozygous

for the c.2503G>A mutation, hence confirming the congenital paunch calf syndrome.



Figure 29: Paunch calf syndrome in a Romagnola calf showing characteristic distended and enlarged abdomen. (Photo: Dónal Toolan)

Bovine mastitis

PATHOLOGY DIVISION, CVRL DAFM
NORMAN BEGGS

Mastitis is an inflammation of the mammary gland and is usually caused by bacterial infection. Sources of mastitis-causing bacteria can include other cows or the farm environment. A mastitis control programme can improve farm profitability by at least 1 cent per litre (Animal Health Ireland <http://www.animalhealthireland.ie/page.php?id=29>). AHI published “Cellcheck Farm guidelines for mastitis control” based on planning, monitoring and reviewing each segment of the lactation cycle and is available on the AHI website at www.animalhealthireland.ie.

AFBI and DAFM laboratories tested a total of 2492 bovine milk samples submitted by private veterinarians investigating outbreaks of mastitis in dairy farms during 2014. Identification of pathogens present in mastitis cases is important as it informs subsequent treatment and management decisions.

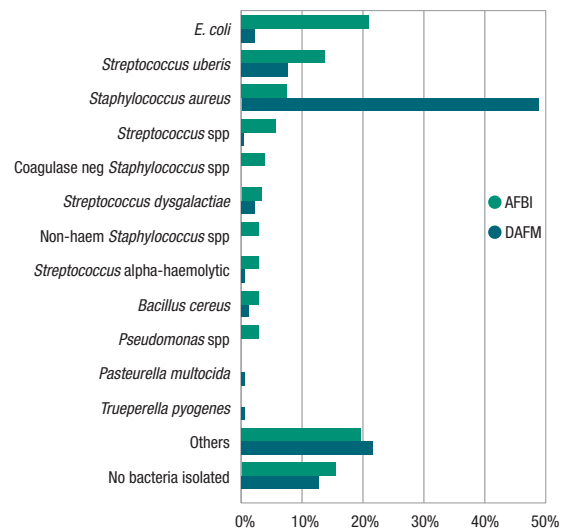


Figure 30: The relative frequency of detection of selected mastitis pathogens by DAFM (n=862) and AFBI (n=1630) veterinary laboratories during 2014.

Staphylococcus aureus was the most frequently identified mastitis pathogen in milk samples tested by DAFM laboratories (Figure 30). *Staphylococcus aureus* is an important cause of contagious mastitis and can prove difficult to treat and eliminate. It can cause a subclinical infection that increases somatic cell counts without grossly detectable changes in the milk or the udder. The relative frequency of this pathogen in submissions to DAFM laboratories is likely to be increased due to sampling bias where cows with persistent high somatic cell counts are chosen for culture. Infected animals pose an infection risk and should be segregated from the rest of the herd and milked last to prevent spread. Poor milking hygiene and improper milking machine function are significant factors that contribute to the spread of contagious mastitis pathogens within a herd.

E. coli was the most frequently detected pathogen in milk samples submitted to AFBI laboratories (Figure 30). *E. coli* is an opportunistic pathogen but may also represent faecal contamination of milk samples due to improper sampling technique. Correct hygienic teat preparation and cubicle

and calving box hygiene are the most important control measures to prevent *E. coli* infection and other environmental causes of mastitis. Research has shown that over 50 *per cent* of enterobacterial infections occurring in the first 100 days of lactation arose in quarters previously infected during the dry period. These findings suggest that chronic infections are important in the epidemiology of enterobacterial mastitis and that environmental management during the dry period may greatly impact the incidence of enterobacterial mastitis in the subsequent lactation (Bradley and Green, 2000).

Aseptic technique for milk sample collection

Materials

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

Technique

1. Samples should be taken prior to milking.
2. Tubes should be labelled prior to sampling.
3. Using a paper towel, loose hair and dirt should be removed from the underside of the udder and teats.
4. Teats should be washed using running water being careful not to wet the udder.
5. All teats should be dipped with teat dip and allowed to dry for at least one minute.

6. Beginning with the teats on the far side of the udder, teats should be cleaned thoroughly with alcohol spending at least ten seconds on each teat after all dirt has been removed. Change wipes or cotton wool as they become dirty and between each teat.
7. Using fresh clean gloves begin sampling with the teats on the near side of the udder. Remove the cap of the sampling tube and keep the top face down in the palm. Hold the open tube at an angle of 45 degrees. Using the free hand, discard a few streams of milk to the ground before collecting three or four streams in the tube. Do not allow teat ends to make contact with the tube. Close the tube immediately after collection of each sample.
8. If contamination occurs repeat the process using a fresh tube.
9. Place tubes at 4 degrees Celsius.
10. Dispatch samples to laboratory as soon as possible.

Bovine Respiratory disease

GERARD MURRAY
PAULINE BAIRD

Respiratory disease was diagnosed as the cause of death in 16.8 *per cent* of all bovine carcasses submitted to the DAFM and AFBI laboratories. The financial burden to farmers is not only due to the loss and disposal of a dead animal, but also to incurred veterinary costs, time spent in treating ill animals, lost production, increased feed and increased time to slaughter weight.

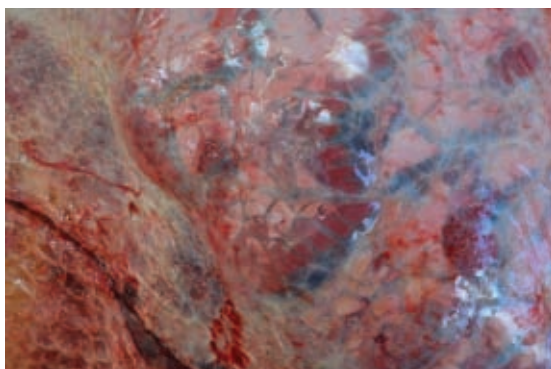


Figure 31: Air accumulation in the spaces between lung lobules due to interstitial emphysema secondary to pneumonia. (Photo: AFBI Omagh)

During 2014, 47 *per cent* of the respiratory disease diagnoses were made in calves younger than 10 weeks of age, more frequently than in any other age group. Among this cohort are cases of respiratory disease associated with a traumatic birth, including broken ribs and periparturient respiratory distress, which represented a 2.6 *per cent* of the diagnoses in this age group.

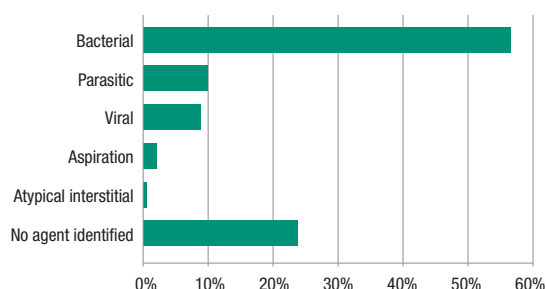


Figure 32: Relative frequency of pneumonia in cattle by aetiological group as diagnosed by DAFM and AFBI laboratories during 2014.

When considering all cattle age groups together, bacterial pathogens agents were the most frequently diagnosed causes of pneumonia followed by parasitic causes of pneumonia and viral infections (Figure 32). *Mannheimia haemolytica*, *Mycoplasma bovis*, *Pasteurella multocida* (Figure 33) and *Trueperella pyogenes* were the most common bacterial pathogens isolated.

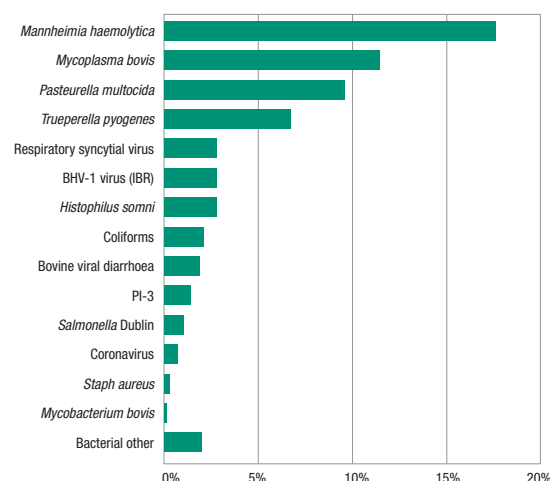


Figure 33: Relative frequency of diagnosed respiratory bovine pathogens as a percentage of the total respiratory disease cases where a primary pathogen was identified in DAFM and AFBI laboratories during 2014.

Vaccines to protect against some of the bacterial causes of respiratory disease are not available in the market. The main methods of prevention and control of bacterial respiratory disease are good husbandry and management as well as vaccination against primary viral pathogens which can initiate lung damage or damage the immune system. Management considerations include well ventilated, draught-free accommodation to protect young cattle from cold or heat stress and to minimise stress at weaning or when mixing different groups of animals. Attention to hygiene, particularly at feeders and drinkers and the housing of cattle of different ages in separate airspaces are also useful control measures.

Mycoplasma bovis remains a frequent finding in respiratory disease of young cattle. Thus, in AFBI laboratories 84 *per cent* of the *M. bovis* cases were diagnosed in animals less than one year of age. Pneumonia was the main finding associated with *M. bovis* in young cattle, with some also diagnosed with concurrent otitis media (Figure 34). In older cattle *M. bovis* infections can manifest as arthritis or mastitis. Introduction of *M. bovis* into naive herds is thought to be mainly by apparently healthy carrier animals although transmission can be delayed

for some time (Maunsell, 2011), and congenital infections may also occur. In young calves infected milk and infection from other calves are the most important sources of infection. *M. bovis* survives for long periods in cool, humid conditions and may persist in ponds or dirt for some time where the pathogen is protected from desiccation.

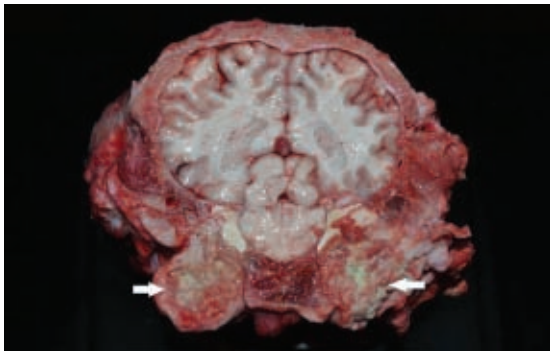


Figure 34: Pus filling both middle ear cavities (white arrows) in a case of *Mycoplasma bovis*-associated otitis media. (Photo: AFBI-Omagh)

Husk (*Dictyocaulus viviparus*) is regularly diagnosed over the summer and autumn months, peaking in September. This reflects increasing pasture contamination during the summer months. However occasional cases with adult lungworm in airways were detected in November and as late as mid-December (Figure 35).

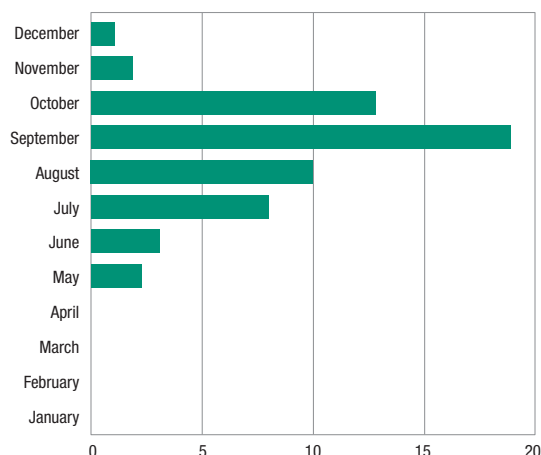


Figure 35: Cases of Husk (*Dictyocaulus viviparus*) by month of diagnosis in AFBI and DAFM veterinary laboratories during 2014.

In previous years, *D. viviparus* (Figure 36) infection was associated with young animals in the late summer to autumn of their first season at grass. However during 2014, 41 *per cent* of the husk cases in AFBI laboratories were detected in cattle over 2 years of age, and even animals up to 7 years of age were diagnosed with lungworm infections. As immunity to lungworm is relatively short lived repeated challenge every year to stimulate the immune response is required to maintain adequate immunity. It is thought that changing management practices such as year-round housing or use of anthelmintics with extended period of action can leave cattle unchallenged by lungworm over one or more grazing seasons such that mature animals may become vulnerable once again to lungworm infection.

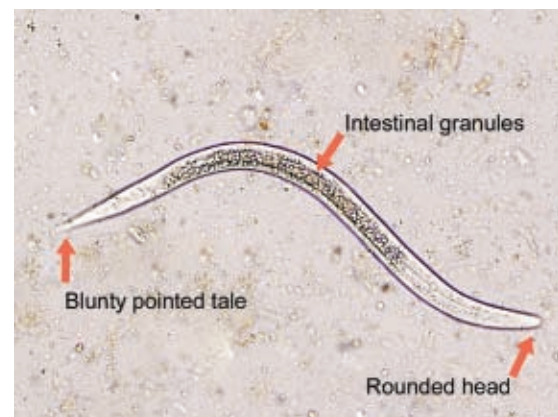


Figure 36: Microphotograph of a first stage larva (*Dictyocaulus viviparus*) isolated from the faeces of a weanling with patent lungworm infection by using the Baermann technique. (Photo: Cosme Sánchez-Miguel)

Bovine Viral Diarrhoea (BVD)

DAVID GRAHAM
MARIA GUEL BENZU
SAM STRAIN

IRELAND

A compulsory national BVD eradication programme began in Ireland on 1st January 2013. The programme is industry-led through a BVD Implementation Group (BVDIG) convened by Animal Health Ireland (www.animalhealthireland.ie). Legislation introduced by the Department of Agriculture, Food and the Marine (DAFM) requires that a tissue tag sample must be collected from all calves born after 1st of January 2013 and submitted for testing for BVD virus. Animals without a negative result cannot move, except to slaughter, while the status of the dam must be clarified following a positive result. 2014 saw the completion of the second compulsory year of testing. The level of compliance by farmers with the requirement to tag and test all calves born continued to be very high. Results were recorded on the database for 98.8 *per cent* of registered calves by the end of December, with the majority of untested calves being either recently born or dead.

Results

Substantial progress was made during the course of 2014, with the incidence of persistently infected (PI) calves detected falling by approximately one third from 2013 at animal and herd level. Overall 0.46 *per cent* of calves born during 2014 were considered PI, a considerable reduction from a 0.67 *per cent* in 2013. During 2014, 7.6 *per cent* of herds had one or more PI (compared to 11.3 *per cent* in 2013).

During 2014, the retention of PIs on farm continued to be a concern for the industry (2064 2014-born PIs still alive in 1205 herds), although data indicated a considerable improvement in disposal rates in 2014 when compared to 2013 (4,384 PIs were retained in 2,765 herds). These

improvements are due to a combination of a reduction in the actual numbers born as well as a greater rate of disposal. The BVDIG recommended the prompt disposal of PI animals following their identification. Two collaborative studies between AHI and the Centre for Veterinary Epidemiology and Risk Assessment (CVERA) at UCD have shown that retained PIs were on average 89kg lighter at slaughter than non-PI comrades born in the same herd (Graham *et al.*, 2015a). In herds with retained PIs the risk of PI calves born the following season increases dramatically compared to herds with no PIs being retained (Graham *et al.*, 2015b).

In June 2014, the Department of Agriculture, Fisheries and the Marine (DAFM) announced an enhanced compensation package to encourage the prompt removal of PIs, providing a payment of €120 for each beef breed calf and €100 for the second and subsequent dairy heifer, subject to their removal within a specified time.

Revised legislation

The BVD Regulations (2014) (<http://www.irishstatutebook.ie/pdf/2014/en.si.2014.0118.pdf>) replaced the BVD Order (2012) in March 2014. The two main changes were the awarding of National Reference Laboratory status for BVD to DAFM Veterinary Laboratory Services and the introduction of a specific prohibition on untested calves born after 1st January 2013 being moved to slaughter.

National Reference Laboratory (NRL)

During 2014, DAFM veterinary laboratories continued to provide testing in support of the Irish national BVD eradication programme, with an emphasis on blood samples submitted either from calves that had an initial positive or inconclusive test result or from their dams. 2,969 of 3,481 (85.3 *per cent*) of confirmatory samples from calves tested positive, suggesting that 14.7 *per cent* of calves with an initial positive or inconclusive result had been transiently infected (TI).

In addition, 6.5 *per cent* of dams of calves with an initial positive or inconclusive result tested positive. This is similar to the figure for 2013, and again indicates that the vast majority of PI calves are born as a result of their dams undergoing transient infection during the first trimester of pregnancy. A further 3,696 additional samples were also received, of which 648 (17.5 *per cent*) were positive.

NORTHERN IRELAND

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

AHWNl works within the framework of a Memorandum of Understanding with Animal Health Ireland which allows for the sharing of technical resources and seeks wherever possible to align the control and eradication programmes managed by each organization. Collaboration between the two organizations has been substantial particularly during the development phase of the voluntary BVD control programme which included developing and agreeing testing protocols, laboratory designation criteria, farmer and industry liaison and developing the detailed specification for programme database support. The cross-border collaboration on this programme was recognised as the “Best North-South Collaboration” at the Irish Times/Intertrade Ireland Innovation Awards in 2014.

In 2013 AHWNI launched its voluntary BVD control programme for cattle herds within Northern Ireland. This programme is based on a tag and test approach using DARD approved identity tags which take a small section of ear tissue which

can then be used to identify the presence of BVD virus. Where positive test results are found, further follow-up testing is required, the details of which can be found at www.animalhealthni.com. Up to the end of December 2014, 521,269 animals in 4,135 herds had been ascribed either a direct or an indirect disease status. Of the 322,850 animals with a direct test result, 1,661 (0.51 *per cent*) were identified as PI. 198,407 dams were ascribed an indirect test result and 281 of them (0.14 *per cent*) were identified as persistently infected. Twelve additional offsprings from PI dams were identified. It is anticipated that a compulsory Northern Ireland BVD eradication programme will be legislated for in 2015.

Fatal Poisonings

JOHN FAGAN
SEÁN FEE

During 2014, poisoning fatalities were diagnosed more frequently in cattle than sheep, with sporadic cases recorded in dogs, wild birds and a fox.

Cattle

Sixty-four poisoning fatalities in cattle were diagnosed on the island of Ireland during 2014, broadly similar to the previous 4 years (Table 7).

Year	Number of cases
2010	65
2011	47
2012	61
2013	75
2014	64

Table 7: the total number of cases of bovine deaths due to poisoning recorded in AFBI and DAFM veterinary laboratories during the period 2010-2014.

Poisonous agent	AFBI	DAFM
Lead	7	21
Copper	3	8
Ragwort	8	1
Halogenated Salicylanides	4	0
Yew	0	3
Nitrate	0	2
Selenium	0	2
Arsenic	1	0
Ivy	1	0
Other	0	3
Total	24	40

Table 8: The poisonous agents responsible for fatalities in cattle during 2014 in Northern Ireland (AFBI) and Ireland (DAFM).

LEAD

As in previous years lead remained the most common cause of fatal toxicity in cattle during 2014 (Table 8). Most cases were diagnosed during the spring and early summer, following the turn out of cattle to pasture (Figure 37) and again this should act as a reminder to livestock farmers to check their fields for discarded sources of lead before turn out at this time of year. Common sources include discarded lead batteries, lead based paints, crankcase oil and bonfire ash after lead containing products have been incinerated. Where clinical signs are observed, nervous signs such as convulsions, blindness, head-pressing or teeth grinding are frequently present, however many animals are found dead.

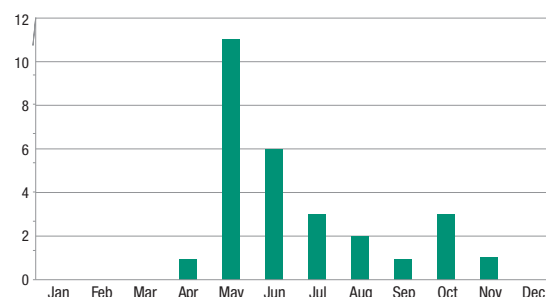


Figure 37: Number of cases of fatal lead toxicity by month during 2014 (n=28).

COPPER

Copper was the second most commonly diagnosed fatal toxicosis of cattle on the island of Ireland (Table 8) during 2014. The number of diagnosed cases has increased over the last number of years (Table 9). Most of the cases were observed in calves less than six months of age (eight cases). Copper is an essential element required for growth and production in cattle, however inclusion of excess copper in the diet is hazardous and chronic copper poisoning remains an important problem (Figure 38). Copper toxicity on the island of Ireland is usually associated with over-zealous copper supplementation. Copper supplementation should be restricted to herds with a history of copper deficiency or where the copper status has been assessed and determined to be low.

Year	Number of cases of copper toxicity
2010	5
2011	8
2012	9
2013	3
2014	11

Table 9: The number of cases of fatal copper toxicity recorded on the island of Ireland since 2010.

RAGWORT

Ragwort (*Senecio* spp.) was the most frequently diagnosed fatal plant toxicosis of cattle during 2014 and the third most important fatal toxicosis of cattle overall. Ragwort is a highly poisonous plant containing toxic pyrrolizidine alkaloids. All stages of the plant are toxic though the yellow flowers are more toxic than green parts of the plant. Ragwort is unpalatable to cattle and is only eaten at pasture when grass is very scarce, or during the weeks after mowing or spraying when it seems to be more palatable. Fodder such as hay or silage containing ragwort is frequently implicated in outbreaks of poisoning during winter months as the plant remains toxic even after drying or ensiling. While ragwort is a weed that is common in all counties of the island of Ireland it is interesting to note that in 2014 two thirds of the recorded nine cases in Ireland were seemingly clustered in the area of Downpatrick, County Down where six cases were diagnosed affecting five different farms.

HALOGENATED SALICYLANILIDES

Halogenated salicylanilides are anthelmintics used in the treatment of liver fluke infestations and include closantel and rafoxanide. Diagnosis of halogenated salicylanilides toxicity is made based on the presence of typical histological lesions within the white matter of the brain.

YEW

Yew (*Taxus* spp.) is a highly toxic evergreen tree common in graveyards and often grown as an

ornamental shrub/tree in parks and gardens. Most cases of yew toxicity occur when cattle gain access to yew after breaking out or when hedge trimmings are thrown over fences or branches are blown down in storms. All parts of the plant except the fleshy red part of the fruit contain toxic alkaloids which depress electrical conduction within the heart leading to arrhythmias and death.

NITRATE

Common sources of nitrate toxicity include plants, accidental ingestion of fertiliser and using contaminated water sources. Toxic levels of nitrates can occur in the roots and tops of cabbage, rape, kale, turnips, swedes and other plants, particularly immature plants which have been stressed by drought or frost. During 2014, two cases of nitrate poisoning on the same farm were diagnosed. The cows had accidentally gained access to a barrel containing urea and rainwater. Five other cows died in this outbreak.

SELENIUM

Selenium is a component of glutathione peroxidase, an enzyme that acts as an antioxidant during the release of energy. Selenium has a narrow safety margin and unnecessary supplementation can lead to toxicity. Clinical signs of toxicity include abnormal posture, unsteady gait, abdominal pain, diarrhoea and death.

ARSENIC

One case of arsenic poisoning was diagnosed in 2014 following access of grazing heifers to copper acetoarsenite (Paris green). Paris green has been used as a rodenticide and also as an insecticide.

Sheep

Thirty nine cases of fatal toxicoses were recorded in sheep in 2014 (Table 10), which represents a moderate increase compared to 2013 (31 cases) but is still considerably lower than that recorded during 2012 (75 cases).

Poisonous agent	AFBI	DAFM
<i>Pieris</i>	15	2
Copper	5	11
<i>Rhododendron</i>	2	0
Ivy	2	0
Azalea	1	0
Organophosphates	0	1
Total	25	14

Table 10: The poisonous agents responsible for fatalities in sheep during 2014.

COPPER

During 2014, copper was the second most frequently recorded cause of fatal poisoning in sheep (Figure 38) after ingestion of *Pieris* plants (forest flame) (Table 10). Copper is an essential element in the diet of sheep, however sheep are particularly susceptible to the toxic effects of copper. While all breeds of sheep are susceptible to copper toxicity breeds such as Charollais, Texel and Suffolk tend to be most susceptible. Cases of copper toxicity were evenly spread throughout 2014 with at least a single case diagnosed every month, with the exception of April. Cases of copper toxicity are associated with feeding concentrates supplemented with copper, grazing pastures dressed with pig slurry or due to excessive administration of copper.

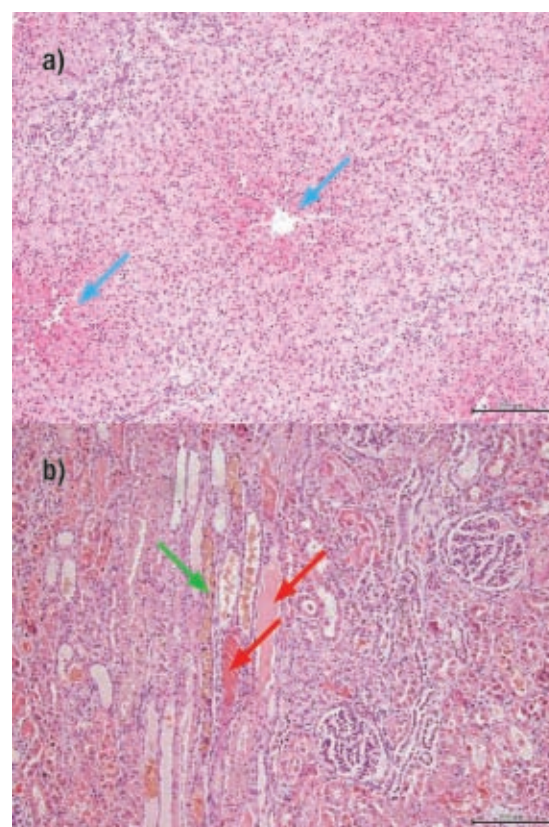


Figure 38: Photomicrographs of liver and kidney sections from cases of copper toxicity in a calf and a sheep. a) Periarterial hepatic necrosis in a calf (blue arrows); b) haemosiderin in tubular epithelium (green arrow) and homogenised luminal casts in sheep (red arrow). (Photo: Seán Fee)

POISONOUS PLANTS

As in previous years the majority of cases of plant toxicity diagnosed during 2014 in sheep were observed during the winter months when grass is likely to be scarce.

Ingestion of plant poisons accounted for 22 of the fatal ovine toxicoses recorded during 2014 (56 per cent). Plants from the Ericaceae family contain the toxic principle andromedotoxin and were responsible for 20 of those cases (95 per cent of the total), including 17 cases associated with *Pieris* spp. (Figure 39), two cases of *Rhododendron* poisoning and one case of azalea poisoning.



Figure 39: Leaves and buds of Japanese *Pieris* shrubs. (Photo: Alan Johnson)

Two cases of ivy poisoning were diagnosed during 2014. Ivy is sometimes considered as a tonic and occasionally a few sprigs are given to cattle, but ingestion of large quantities of leaves can cause poisoning and death.

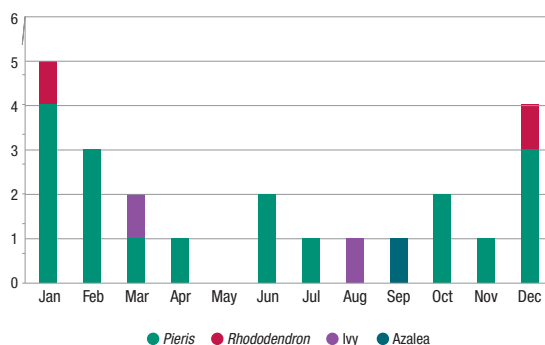


Figure 40: The frequency of fatalities in the island of Ireland due to the ingestion of poisonous plants by month during 2014.

Dogs

Two cases of fatal poisoning due to anticoagulant rodenticide toxicity were detected in dogs during 2014. One of the cases involved two collie dogs which presented with fatal intraperitoneal haemorrhage.

Wildlife

Carbofuran toxicity was recorded by AFBI as the cause of death of a falcon and a buzzard during

2014. In another case, AFBI detected carbofuran in the tissues of a decomposing raptor and in a fox recovered at the same site. Carbofuran is an insecticide and nematocide and its use has been banned in the EU. Poisoning due to coumarins was diagnosed by AFBI in a falcon. Toxic levels of coumarins and organophosphates were detected in a peafowl examined by AFBI.

Diseases of sheep

JASON BARLEY
COLM O'MUIREAGAIN

Similar to 2013, parasitic disease, respiratory disease and enteric diseases were the most commonly diagnosed causes of death in sheep of all ages on the island of Ireland (Figure 41). It was noticeable that the relative frequency of diagnoses due to parasitic disease in Northern Ireland was markedly reduced in 2014 (15 *per cent*) when compared to 2013 (34 *per cent*).

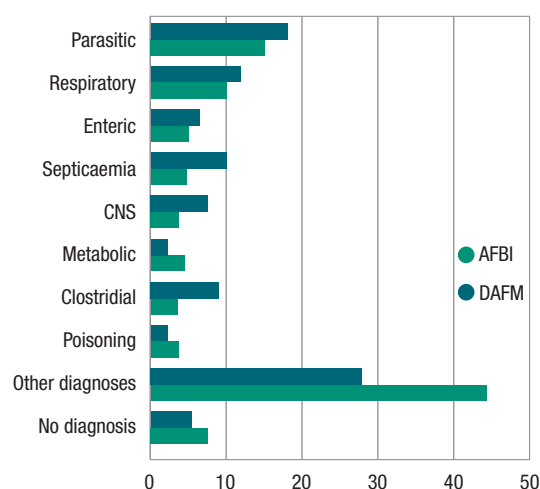


Figure 41: The relative frequency of diagnosed causes of mortality in sheep of all ages submitted for *post mortem* examination to AFBI (n=761) and DAFM (n=887) veterinary laboratories during 2014. CNS=central nervous system.

Respiratory diseases

During 2014 in Northern Ireland, Jaagsiekte (ovine pulmonary adenocarcinoma) was the most commonly diagnosed respiratory condition in sheep, accounting for 32 *per cent* of all respiratory disease diagnoses. It remains a more commonly diagnosed condition in Northern Ireland than in Ireland. The total number of diagnoses of Jaagsiekte increased to 3.2 *per cent* of all submissions, excluding abortions, from 2.9 *per cent* during 2013 and 2.2 *per cent* during 2012.

Mannheimia haemolytica remains a common cause of bacterial pneumonia in both Northern Ireland and Ireland. In Northern Ireland, *Pasteurella multocida* and *Trueperella pyogenes* were less common during 2014 (8 cases) than in 2013 (21 cases).

Enteric diseases

Colibacillosis, ovine neonatal enterotoxaemia ('watery mouth') and cryptosporidiosis are common causes of enteric disease in young lambs. Enteric viral infections (rotavirus and coronavirus) remain uncommon diagnoses on an all Island basis.

Other diagnoses

Similar to 2013 and 2012, septicaemia and toxemia were more commonly diagnosed in Ireland than Northern Ireland. The prevalence of clostridial disease was similar in both jurisdictions during 2014, thus repeating the pattern observed since 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. Listerial encephalitis remained the most frequently diagnosed central nervous system disease on the island of Ireland (46 cases) (Figure 42). Copper and *Pieris* spp (Forest Flame) were the most commonly diagnosed causes of poisoning in 2014.

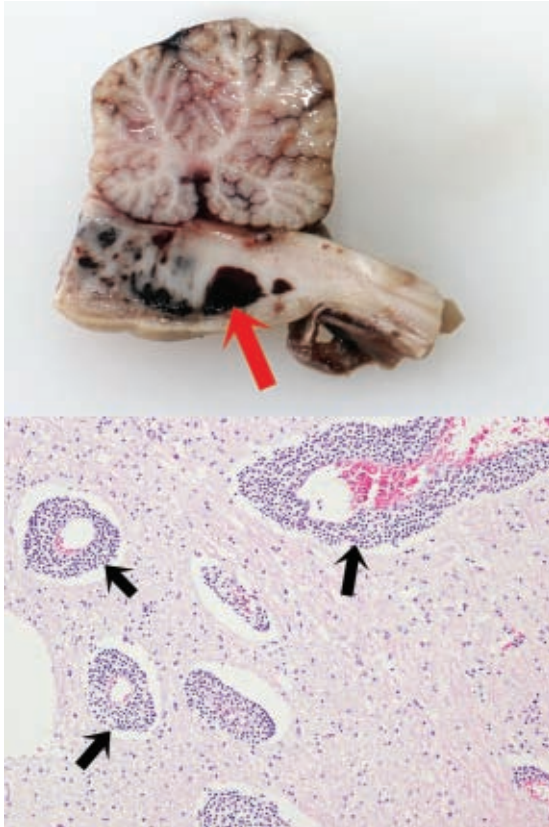


Figure 42: a) Lesions caused by listerial encephalitis in the brainstem of a lamb and b) photomicrograph showing characteristic perivascular cuffs in the midbrain of the lamb. (Photo: Cosme Sánchez-Miguel)

Parasitic diseases

Fasciolosis was diagnosed less frequently on *post mortem* examination of sheep during 2014 (particularly in Northern Ireland) compared to 2013. This was most probably due to the occurrence of weather conditions which were unfavourable to the mud snail (intermediate host). Of the submissions to AFBI laboratories, 3.5 *per cent* of diagnoses were for acute or chronic fasciolosis during 2014, compared to 14 *per cent* in 2013 (Figure 43). No comparable reduction in the frequency of diagnoses of fasciolosis was observed in ovine submissions to DAFM laboratories during 2014.

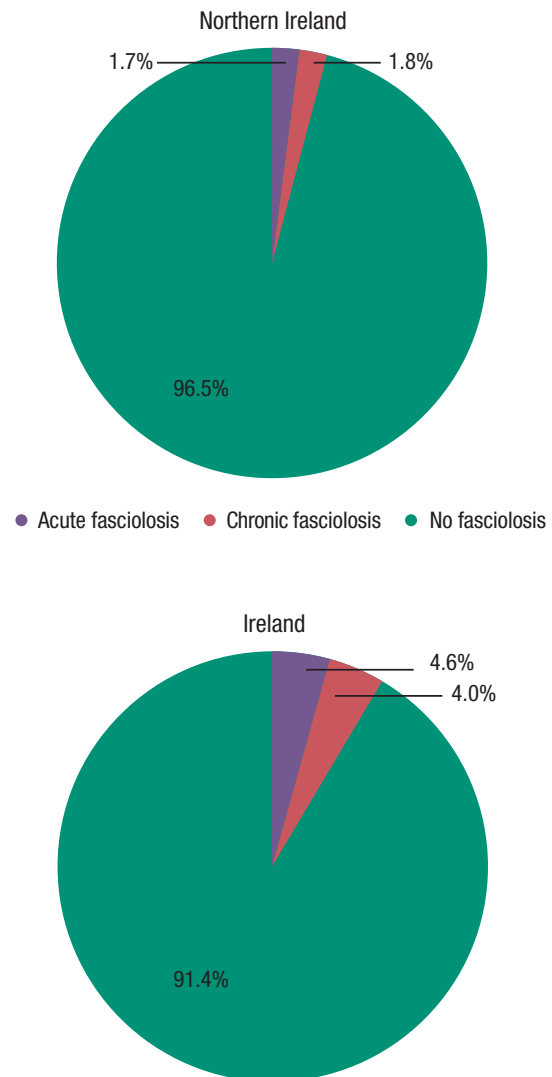


Figure 43: The percentage of all ovine mortality caused by acute and chronic liver fluke infection as diagnosed by AFBI (Northern Ireland) and DAFM (Ireland) laboratories during 2014.

In Northern Ireland during 2014 there was a relative reduction in the importance of chronic liver fluke disease in sheep of all ages and an increase in the detection of coccidiosis in lambs compared to previous years (Figure 44).

Since 2010 there have been several papers in the literature concerning the increasing levels of treatment failure associated with anthelmintic use in flocks in Northern Ireland and Ireland (McMahon

et al., 2013a, 2013 b and 2013c, and Keane *et al.*, 2014), suggesting that treatment failures associated with the presence of anthelmintic-resistant nematodes and liver fluke are not uncommon in sheep flocks on the island of Ireland.

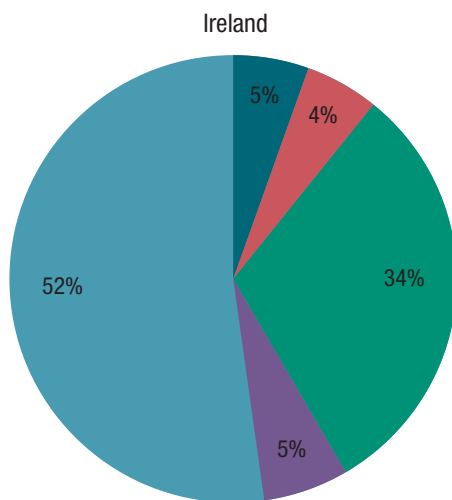
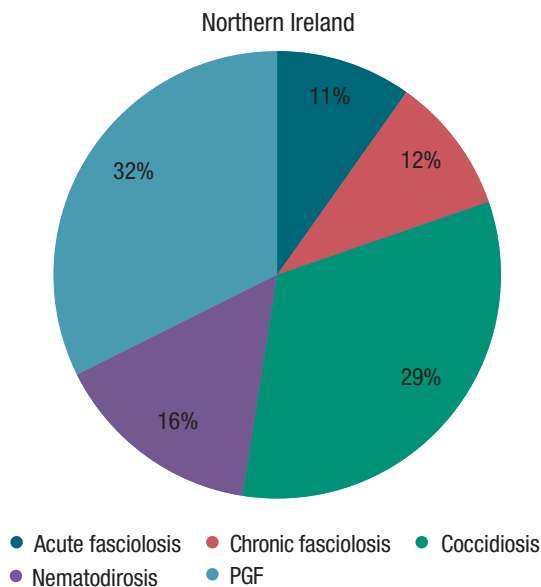


Figure 44: Specific endoparasitic conditions diagnosed during 2014 in sheep as a percentage of all ovine endoparasitic disease diagnoses made in Northern Ireland and Ireland.

A sustainable anthelmintic programme would improve flock health planning, define fluke and worm status of the flock and facilitate grazing

management. The basis of all such plans is the monitoring of faecal egg counts, thereby allowing evidence based treatment of significant worm burdens. Details of the monitoring programme may vary between flocks, but a basic scheme for gut worms and liver fluke is given below:

Monitoring gut nematodes in sheep flocks

- Check gimmers in early summer, especially if away-wintered or wintered on lamb pasture
- Check lambs three times from mid-summer to early winter at intervals of six weeks. Nematodiroisis treatment is additional and is undertaken on a forecast basis and as needed during early spring.
- Check ewes and rams pre-tupping

Monitoring liver fluke in sheep flocks

- Check gimmers in early summer
- Check lambs in midsummer /autumn / early winter
- Check ewes and rams pre-tupping

In each case, separate grazing groups should be checked. Grazing groups are defined as those sheep of a similar age and reproductive status grazing together.

To collect a mob sample for a pooled test for gut worm eggs, gather a group of sheep in the corner of a field for 5 to 10 minutes, then let them walk away, fresh dung samples can then be collected from the pasture. At least ten such samples should be collected from the pasture and each sample should be used to fill one pot, i.e. ten samples picked off the pasture means ten full pots. Samples must be fresh when collected and kept cool but not frozen in airtight pots before delivery to the lab within 48 hours. The samples will be pooled by the laboratory prior to testing.

Clostridial diseases 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.

The overall pattern of diagnosis of clostridial diseases during 2014 remains similar to 2013, with pulpy kidney disease the most commonly diagnosed clostridial disease on the island of Ireland. Pulpy kidney disease is caused by infection with *Clostridium perfringens* Type D (Table 11). 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 feed or increase in plane of nutrition which causes proliferation of the organism with the release of toxin. Rapidly autolytic kidneys ('pulpy kidneys'), glucosuria and the presence of serous clots in the pericardium are highly suggestive of pulpy kidney disease.

Enteric pathogen	Lambs DAFM	Lambs AFBI	Total lambs	Adults DAFM	Adults AFBI	Total adults
Blackleg	0	0	0	1	0	1
Black disease	0	0	0	3	6	9
Abomasitis	5	2	7	0	0	0
Malignant oedema	0	0	0	2	0	2
Enterotoxaemia	0	0	0	31	2	33
Pulpy kidney disease	31	11	42	0	0	0

Table 11: The frequency of diagnosis of Clostridial disease in sheep on *post mortem* examination in AFBI and DAFM veterinary laboratories during 2014.

Ovine abortion

JIM O'DONOVAN
CATHERINE FORSYTHE

The diagnosed causes of abortion in sheep during 2014 were broadly similar in Ireland and Northern Ireland. An abortion case is defined as a submission consisting of one or more ovine foetus(es) and/or foetal membranes. Individual farms may submit more than one case.

The percentage of cases in which the cause of abortion or stillbirth was identified (the diagnostic rate) was comparable in the two jurisdictions at 57.5 *per cent* for Ireland (252 cases) and 65.6 *per cent* for Northern Ireland (294 cases).

As in previous years toxoplasmosis and enzootic abortion of ewes (caused by *Chlamydophila abortus*) were the two most common diagnoses in both jurisdictions (Figure 45).

During 2014, leptospirosis was diagnosed as the cause of abortion in 5.1 *per cent* of cases of ovine abortion in Northern Ireland but no cases were diagnosed in Ireland (Figure 45). In Northern Ireland, the diagnosis of leptospirosis is based on antigen detection in the foetus (fluorescent antibody test) but this test is not routinely carried out in Ireland. Abortion due to *Salmonella* spp. was diagnosed in 5 sheep flocks in Ireland and Northern Ireland (Figure 45), three of them were identified as *Salmonella* Dublin while *S. Arizonae* and *S. Derby* were identified on one occasion each.

"Congenital abnormality" was recorded as the main cause of abortion in seven cases in Ireland and two cases in Northern Ireland. In some of these cases the abnormalities were sporadic (e.g. *Schistosomus reflexus* or angular limb deformities) but in others there were cranial and brain malformations which resembled the lesions associated with congenital Schmallenberg virus infection, although Schmallenberg virus was not detected in any of these cases.

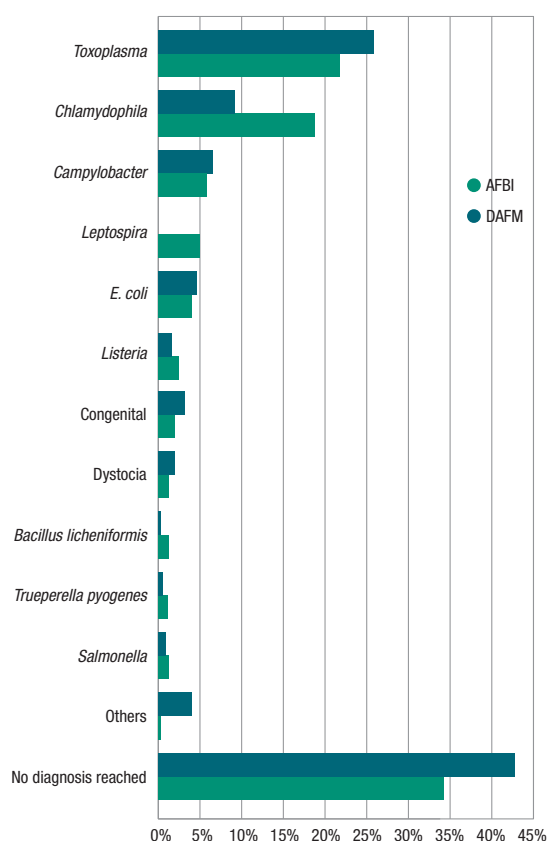


Figure 45: The relative frequency of the diagnosed causes of ovine abortion submitted for examination to DAFM (n=252) and AFBI (n=294) veterinary laboratories as a percentage of the total number of ovine abortions during 2014.

Diseases of Pigs

SIOBHAN CORRY
MÁIRE MCELROY

The pig industry is an important sector of the agricultural industry on the island of Ireland. The combined national herds of Northern Ireland and Ireland total over 2 million pigs. With feed costs making upwards of 80 *per cent* of the production cost and a short production cycle the pig population is heavily influenced by market conditions. Like cattle and sheep production a large proportion of pig meat produced on the island is exported and export requirements must be strictly adhered to. AFBI and DAFM laboratories provide diagnostic services to assist in disease control to improve productivity and to fulfil export requirements.

During 2014 there were a total of 251 submissions of pigs to AFBI (with a submission containing up to 3 individual pigs) and 215 individual pigs submitted to DAFM in a number of submissions. As in previous years the respiratory and digestive systems were the most commonly affected systems seen on *post mortem* submissions.

Continuing previous years' trend, pneumonia was one of the more common diagnoses. Pneumonia in pigs was often found to be associated with more than one agent and on some occasions no agent was identified, often associated with a history of prior antibiotic therapy. There was a rise in viral causes of pneumonia in pigs across the island of Ireland during 2014. A total of 11 cases of viral pneumonia were detected. Porcine reproductive and respiratory syndrome virus (PRRSV) was identified in four cases and swine influenza virus was identified in seven cases.

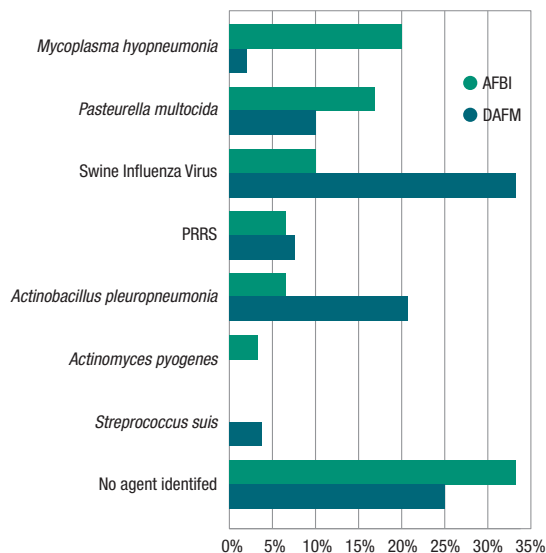


Figure 46: The relative frequency of aetiological agents identified in pig carcasses submitted to AFBI and DAFM veterinary laboratories and diagnosed with pneumonia during 2014. PRRS= Porcine Reproductive and Respiratory syndrome.

Actinobacillus pleuropneumoniae was the second most common respiratory pathogen isolated from cases of pneumonia in DAFM laboratories during 2014. It is a highly contagious pathogen of growing pigs causing severe, often fatal, fibrinous bronchopneumonia with an extensive pleurisy (Figure 47). Survivors have residual lesions and become carriers of the disease. There are many serotypes of the pathogen and immunity to one serotype does not confer full immunity to the other serotypes.

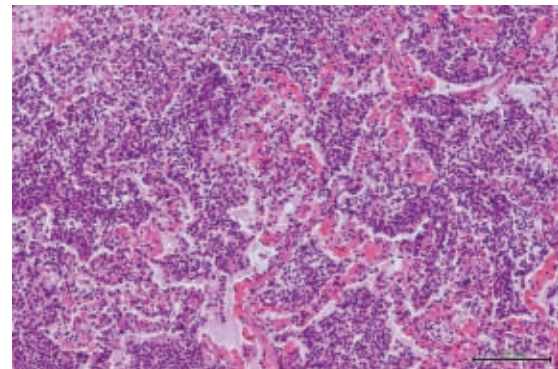


Figure 47: A photomicrograph from a case of *Actinobacillus pleuropneumoniae* in a pig. The alveoli contain fibrin, oedema fluid and neutrophils. Some of the neutrophils are streaming (oat shaped) similar to those seen in manheimiosis in cattle. (Photo: Siobhan Corry)

Gastrointestinal disorders were diagnosed in 26 per cent of porcine *post mortem* submissions to AFBI and 28 per cent of submissions to DAFM during 2014. Approximately half of these submissions were diagnosed with enteritis. Within the gastrointestinal diseases, rotavirus was the most commonly identified agent in DAFM porcine submissions during 2014 and *E. coli* the most commonly identified agent in AFBI submissions.

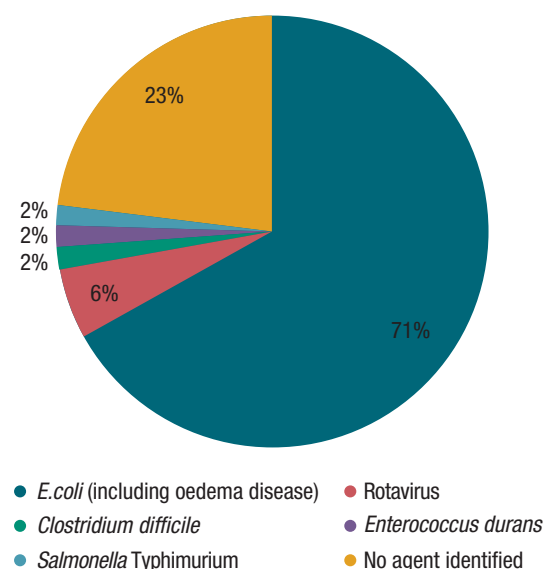


Figure 48: Causes of enteritis diagnosed in pigs on the island of Ireland in 2014.

In AFBI laboratories during 2014, seven *per cent* of the gastrointestinal disorders were diagnosed as torsion of abdominal organs and four *per cent* as gastric ulceration.

***Clostridium difficile* in piglets**

During 2014, the first reported case in Ireland of *C. difficile*-associated colitis was diagnosed as part of investigations by DAFM into a herd with a high morbidity, low mortality neonatal diarrhoea problem. *C. difficile* toxin ELISA was positive for 4/4 samples. Histopathologically there was an acute, superficial erosive and suppurative colitis and varying degrees of mesocolonic oedema (Figure 49). *C. difficile* is an emerging enteric pathogen in pigs, primarily neonates.

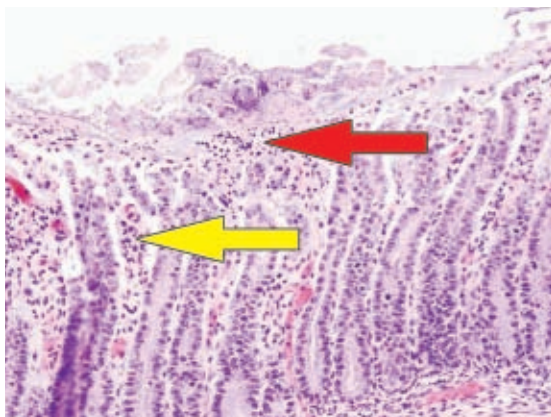


Figure 49: Photomicrograph of the colon of a neonatal piglet with *Clostridium difficile*-associated colitis. The red arrow indicates a superficial erosion with neutrophils spilling into the lumen. The yellow arrow indicates a neutrophilic exudate in the lamina propria. (Photo: Máire McElroy)

Abortion in pigs

Twenty eight submissions of foetuses were investigated for abortion in AFBI and DAFM veterinary laboratories during 2014.

An aetiological agent was identified in 8 of these investigations. *Leptospira* spp. was identified as the cause of the abortion in five of the cases,

Streptococcus suis was identified in two of the cases and *Corynebacterium* spp. in one case.

Diagnostic tools in pigs when investigating an abortion or still birth include necropsy on the foetus or foeti submitted and bacteriological culture of stomach contents to detect potential pathogens involved. When *Leptospira* is suspected, antibody testing can be carried out in foetal fluid. Porcine, equine and ruminant animals have no passive transfer of immunity *in utero* so the presence of antibodies to any of the *Leptospira* species implies that the foetus has been exposed to the organism. Samples of the lung, kidney and adrenal gland are also taken to look for the presence of *Leptospira* organisms using immunofluorescence testing. Tissue will also be tested for the presence of adenovirus, PRRSV and porcine circovirus type-2 (PCV2). If the foetus is under 70 days or under 16 cm it will also be tested for porcine parvovirus (PPV), after this age the foetus is immunocompetent and if infection by PPV occurs it usually results in the birth of healthy seropositive piglets.

Meningitis

Meningitis was identified on histopathology of the brain on nine submissions to DAFM and 10 submissions to AFBI veterinary laboratories during 2014. *Streptococcus suis* was identified as the cause of the meningitis in eight submissions, *E.coli* in three submissions and *Salmonella* Typhimurium in one case of meningitis.

Cardiac disease

Cardiac disease as a cause of mortality in pigs was identified in a total of 21 submissions on the island of Ireland during 2014. Pericarditis was seen most frequently followed by vegetative endocarditis (Figure 50). Pathogens isolated from the heart included *Streptococcus suis* in seven cases, *Pasteurella multocida* in four cases and *Salmonella* Typhimurium in one case.



Figure 50: Vegetative valvular endocarditis in the heart of pig. (Photo: Shane McGettrick)

Other diagnoses

PORCINE DERMATITIS AND NEPHROPATHY SYNDROME

Porcine dermatitis and nephropathy syndrome (PDNS) is characterised clinically by acute onset of skin lesions (raised purple lesions progressing to multifocal raised red scabs most prominent on the hind legs and ears but can extend to the flanks, forelegs and eventually cover the whole body, Figure 51), fever, lethargy, and is commonly fatal. It is mainly seen in grower-finisher pigs with the mean affected age being 12-16 weeks. The disease is generally sporadic but can occur in acute epidemic form with high mortalities. Differential diagnosis includes African and classical swine fever due to the similarities of the lesions.

At necropsy the kidneys may be enlarged and tan with multiple red or white foci in the cortex and lymph nodes may be enlarged and haemorrhagic. The lesions are due to a generalized vasculitis and a glomerulonephritis, suggestive of a hypersensitivity reaction characterized by deposition of antigen-antibody complexes. Many pathogens have been implicated in the development of PDNS but it has been shown that PCV2 is most likely to be the primary agent involved.



Figure 51: Multifocal to coalescing, irregularly shaped red skin lesions due to vasculitis and subsequent dermal necrosis on hind quarters of a pig with porcine dermatitis and nephropathy syndrome (PDNS). (Photo: Shane McGettrick)

Diseases of poultry

CATHERINE FORSYTHE
PATHOLOGY DIVISION CVRL

During 2014, 222 and 272 poultry carcasses from commercial and backyard flocks were examined by DAFM and AFBI veterinary laboratories respectively. In DAFM veterinary laboratories, septicaemia (23 *per cent*) was the most common diagnosis, followed by digestive system conditions (19 *per cent*) (Figure 52). In AFBI, conditions affecting the liver (19 *per cent*) were the most common diagnoses, followed by respiratory (14 *per cent*) and digestive diseases (13 *per cent*) (Figure 53).

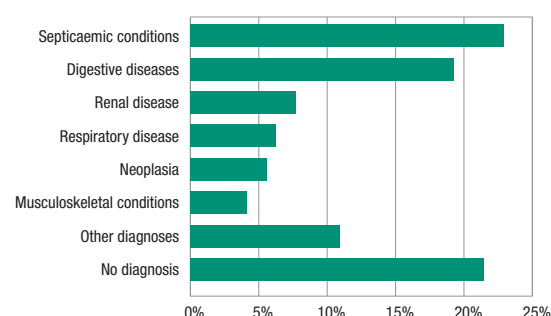


Figure 52: The relative frequency of the most commonly diagnosed causes of mortality in poultry in DAFM laboratories during 2014 (n=222).

The most frequent causes of septicaemia were *E coli*, *Staphylococcus aureus*, *Erysipelothrix rhusiopathiae* and *Pasteurella multocida*.

Protozoal hepatitis and typhlitis due to histomoniasis (*Histomonas meleagridis*) was a common digestive system problem diagnosed by DAFM in a range of bird categories including layers, broiler breeders, turkey breeders and backyard birds. Reports from the United Kingdom also noted that histomoniasis in chickens and turkeys became more prevalent in 2014 affecting indoor as well as outdoor birds. The reason for the increased prevalence is unknown but could be due to a change in virulence, emergence of different strains or interaction with other disease agents. Transmission is by ingestion

of either infected faeces or embryonated *Heterakis* eggs containing histomonads or ingestion of an earthworm containing infected *Heterakis* larvae. Histomonads are released into the intestinal lumen when the *Heterakis* eggs hatch and then invade the caecal wall. Two to three days after caecal infection, the protozoa reach the liver via hepatic-portal circulation, and can also be found in the bursa of Fabricius, kidney, pancreas, and spleen. In addition to vector-borne transmission, histomoniasis can spread directly through cloacal drinking, which is the retrograde peristalsis of urine and faecal contaminants from the vent into the bursa and caeca and this is important in rapid spread of the disease through turkey flocks. AFBI also diagnosed a number of cases of both histomoniasis and *Heterakis* infection in a range of avian species in Northern Ireland, indicating that these are significant agents of poultry disease throughout the island of Ireland. There is no licensed treatment for histomoniasis in poultry in the EU.

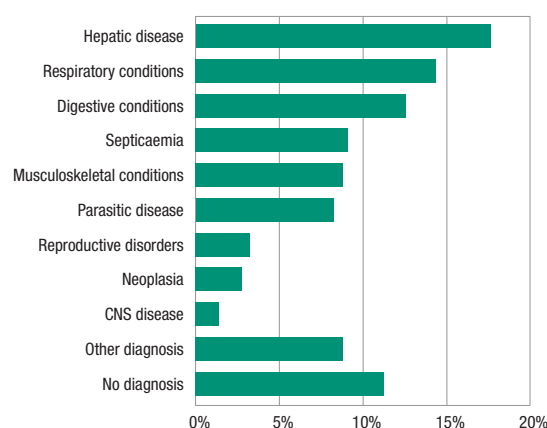


Figure 53: The relative frequency of the most commonly diagnosed causes of mortality in poultry in AFBI in 2014 (n=272). CNS=Central nervous system.

Ulcerative ventriculitis due to adenovirus continued to be detected by DAFM in intensively reared broilers during 2014. Multiple basophilic intranuclear inclusion bodies were observed in the nuclei of degenerating and necrotic glandular epithelial cells. Growth retardation and subsequent

reduced weight at the time of slaughter of broilers underline the economic impact of adenoviral gizzard erosion for poultry production. The role of fowl adenoviruses (FAdVs) as primary pathogens has been studied with regard to natural outbreaks of inclusion body hepatitis, hepatitis/hydropericardium syndrome and gizzard erosion. Outbreaks of gizzard erosion associated with FAdV serotype 1 (FAdV-1) infections have been reported from commercial broiler chickens in Japan, Korea and Europe. Vertical transmission has been described as an important route for the spread of FAdVs in general. Parent birds can serve as a viral reservoir from which transmission through the embryonated eggs may lead to introduction of FAdV-1 into progeny flocks and consequently to induction of adenoviral gizzard erosion in production broilers. Reduced hatchability of chicks has been reported in parent flocks.

Duodenal ulceration and secondary bacterial endocarditis were seen in a five week-old male duck. On histopathological examination, abundant colonies of Gram-positive cocco-bacilli bacteria forming chains were seen in the duodenal ulcer and on the heart valve, the appearance of which was consistent with streptococci. Streptococci are part of the normal intestinal and mucosal flora of most avian species. Infections are often thought to occur secondarily to other diseases.

Visceral gout (urate deposition) affecting the kidneys was diagnosed in 8 *per cent* of carcasses submitted to DAFM. Dublin RVL diagnosed gout in 2 day-old pheasants imported from France, where approximately 2000 out of 14000 chicks died. Cork RVL also diagnosed gout in 6 week-old ducks. Visceral gout was also seen in a liver sample submitted from a 17 day-old broiler breeder found dead with pale white plaques adherent to the liver and heart. The liver contained multifocal necrosis and inflammatory cell infiltration centred on eosinophilic material which contained the outlines of previous needle-like crystals (tophi). Similar tophi were also present on the capsular

surface. Urate deposition should not be considered as a disease entity, but as a sign of severe renal dysfunction that causes hyperuricaemia. Visceral urate deposition is generally due to failure of urinary excretion which may be due to obstruction of ureters, renal damage or dehydration. Dehydration due to water deprivation is a common cause of visceral urate deposition in domestic poultry. Outbreaks of visceral urate deposition have also been attributed to infectious causes such as nephrotoxic strains of infectious bronchitis virus and renal cryptosporidiosis, and non-infectious factors such as vitamin A deficiency, secondary to urolithiasis, mycotoxins such as oosporein, and feeding growing birds layer rations that are high in calcium and protein.

Marek's disease (MD) virus or Gallid herpesvirus 2 is the etiological agent responsible for MD in the chicken, a multifaceted disease most widely recognised by the induction of a rapid and extensive malignant T-cell lymphoma (Figure 54). Enlarged feather follicles (commonly termed skin leukosis) may be noted in broilers after defeathering during processing and are a cause for condemnation. Neural involvement is the classical form of MD, the clinical signs being partial or complete paralysis of the legs and wings. When the nerves controlling the neck muscles are affected, torticollis may be seen. Involvement of the vagus nerve can result in paralysis and dilation of the crop causing gasping and respiratory distress. MD is highly contagious among chickens and the most frequent mode of infection is through inhalation of infected dander. In most commercial broiler flocks vaccination takes place within 24 hours of hatching, however the condition is often seen in backyard flocks, and may present as an outbreak. Although turkeys are less susceptible, the condition can occur in those kept in close association with chickens.

In DAFM, diagnoses of neoplasia were mainly attributed to Marek's disease. Cutaneous MD was diagnosed in unvaccinated broilers which were reported to be uneven. Skin lesions were noticed

at slaughter. MD affecting the sciatic nerves was diagnosed in a Barnevelder backyard hen with paresis.

AFBI investigated a number of MD cases in 9 to 12 week old turkeys during 2014 showing ill thrift, lameness and high mortality. Consistent *post mortem* examination findings were grossly enlarged mottled spleens and other organs affected included liver, kidneys, lungs and occasionally tibial heads and hearts. Histological findings were suggestive of MD but not conclusive, and confirmatory real-time PCR was carried out at Pirbright Laboratory. A high level of MDV was detected in all samples tested. In this case, the unvaccinated turkeys were being reared on the same premises as a slow-reared broiler unit, which had been vaccinated for Marek's disease.

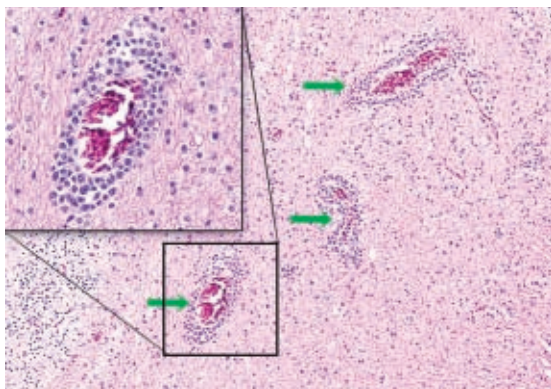


Figure 54: Widespread perivascular cuffing (arrows) in the cerebellum of a pheasant with suspected Marek's disease. Inset: Blood vessel surrounded by a compact lymphocytic cuff. (Photo: Cosme Sánchez-Miguel)

Respiratory diseases continued to be an important cause of mortality across the domestic bird species during 2014. In contrast to 2013 however, there were significantly fewer diagnoses made of infectious laryngotracheitis, which was a major problem during 2013.

Fungal infections were frequently diagnosed in cases of respiratory disease during 2014,

most often *Aspergillus* spp (Figure 55). In fungal infections, gross lesions are often characteristic, including grey, blue, green or black material, or pale yellow plaques visible on the air sacs, pleura, pericardium, peritoneum, bronchi and less often in the brain, eyes, heart, kidneys, liver or other sites. *Aspergillus fumigatus* can penetrate egg shells and infect the embryo leading to embryo death, or cause the hatching of an infected embryo with advanced lesions. As a result of this, when infected eggs hatch they will release large numbers of spores into the hatchery environment and air systems leading to severe outbreaks in birds less than three weeks of age. Ovo injection of embryos, a frequent method used for vaccination, can also lead to cross-contamination and infected embryos and navel infections in a contaminated environment.

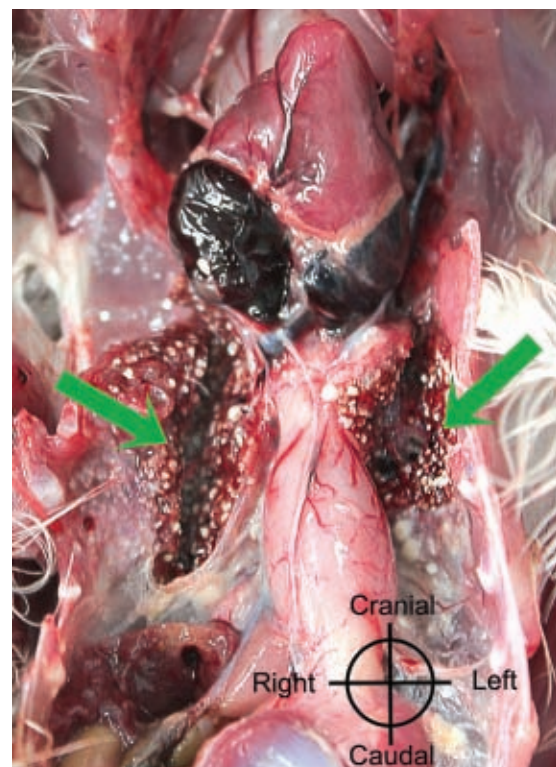


Figure 55: White nodules (1 to 5 mm) throughout the lungs and air sacs of a pheasant, consistent with a diagnosis of aspergillosis. (Photo: Cosme Sánchez-Miguel)

AFBI diagnosed fungal respiratory disease in chickens, turkeys and game birds as well as in a Gentoo penguin during 2014, demonstrating the susceptibility of all species. Although primarily a disease of the respiratory system it can affect all systems including the brain and eye. All ages of fowl can be infected, including unhatched eggs.

Environmental factors such as hygiene and stress are important factors in the development of fungal infections of adult birds. Inhalation of large numbers of spores from contaminated feed, litter and environment, or conjunctival infections will occur particularly where birds are debilitated or overcrowded and host defences are depressed.

Equine diseases

SIOBHAN CORRY
JOSE MARÍA LOZANO
URSULA FOGARTY

The Irish Equine Centre

The Irish Equine Foundation Ltd (trading as the Irish Equine Centre or IEC) is a registered charity. It is an independent organisation whose aim is to protect the wellbeing of Ireland's horse population. The IEC provides laboratory services for the diagnosis, management and prevention of diseases of horses on a whole island basis.

The IEC offers three main diagnostic services to the equine industry: Code of practice testing, clinical pathology service and *post mortem* examination. In this section, findings on *post mortem* examination are presented.

In total, 287 equine *post mortem* procedures were performed by the IEC during 2014.

Post mortem findings in different age groups are outlined in tables below. These tables outlined the more common findings in the cases examined, and every case could have more than one finding associated. Not every finding was classified as the cause of death.

Ninety-one adult horses in total were examined during 2014. All of them were screened for equine dysautonomia (all samples tested negative). In addition, across all age groups, those cases diagnosed as enteritis, typhilitis and colitis were also screened for *Campylobacter*, *Cryptosporidium*, *Listeria*, *Salmonella*, Clostridial toxins A, B, E and *C.difficile*.

In adult horses submitted for *post mortem* examination to the IEC, common findings included hepatic fibrosis (n=31), enteritis (n=13), torsion of the small intestine (n=4), cervical stenotic myelopathy (n=4), acute fracture of the pelvis (n=6),

and laminitis (n=3). In addition, findings in adult horses submitted for *post mortem* with a history of sudden death were more frequently related to head/neck trauma, other types of bone fracture and circulatory system acute haemorrhage (Table 12).

Diagnosis	Number of Cases
Trauma to the head and neck/ fracture of cervical vertebrae	10
Trauma/electrocution	5
Colitis / Typhlitis / Enteritis	4
Fractured pelvis and haemorrhage	2
Uterine related haemorrhage	1
Gastric rupture	1
Ruptured aorta	1
Ruptured PVC	1
Torsion of double colon	1
Septicaemia/toxaemia	1

Table 12: The findings on *post mortem* examination in cases of sudden death of adult horses at the Irish Equine Centre during 2014. Ninety-one horses were submitted for diagnosis. Every case may have more than one finding associated.

During 2014, there were a total of 53 *post mortem* examinations in newborn foals (Table 13). They were all screened for equine herpesvirus 1 (EHV-1), EHV-4 and equine viral arteritis (EVA). One was positive for EHV-1 and another one was positive for EHV-4. The most frequent causes of mortality were related to trauma during delivery, like fractured ribs and intracranial haemorrhage among others (Table 13). In some cases, findings refer to placental membranes submitted with the foal.

The congenital abnormalities found in newborn foals were flexion/extension/contraction of the limbs (n=7), scoliosis of the thoracic or cervical vertebrae (n=2), and one case each of diaphragmatic hernia, brachygnathia inferior, cleft palate and microphthalmia.

Diagnosis	Number of Cases
History of asphyxiation during the birth process/ red bag presentation	25
Placentitis	19
Fractured ribs/bruising	13
Intra-uterine compromise	11
Cervical placentitis	9
Glomerulo cystic lesions	9
Intracranial haemorrhage	8
Retained allantochorion	7
Placental insufficiency	7
Rupture bladder	3
Cardiac failure	2

Table 13: The most frequent findings on *post mortem* examination of newborn foals at the IEC during 2013. Fifty-three foals were submitted for diagnosis. Every case may have more than one finding associated.

During 2014 there were a total of 74 *post mortem* examinations in neonatal foals (foals up to 1 month of age) (Table 14). They were all screened for EHV-1, EHV-4 and EVA, and 1 was positive for EHV-1 and another one for EHV-4.

Diagnosis	Number of Cases
History of asphyxiation during the birth process/ red bag presentation	35
Enterocolitis – 16 haemorrhagic	33
Immune depletion	30
Renal failure	19
Foreign body pneumonia	14
Septicaemia	13
Multi organ failure	12
Intra uterine compromise	11
Intracranial haemorrhage	10
Fractured ribs + complications	9

Erosion of gastric/oesophageal zone	9
Sleepy foal disease (<i>Actinobacillus equuli</i>)	5
Joint ill	5
Trauma to head anterior thorax / sudden death	4
Urachal abscess	4
Neonatal isoerythrolysis	3
Small intestinal intussusception	3
Ruptured bladder	3
Intestinal impaction	3
Peritonitis	3

Table 14: The most frequent findings on *post mortem* examination of neonatal foals (foals up to 1 month of age) at the IEC during 2013. Seventy-four foals were submitted for diagnosis. Every case may have more than one finding associated.

Twenty foals of one to 6 months of age were examined at the IEC during 2014. Eight findings were associated with sudden death, including gastric rupture, traumatic injuries and acute haemorrhagic necrotising enteritis.

Description	Number of Cases
<i>Rhodococcus equi</i> pneumonia	29
Skeletal trauma or fracture	5
Gastric ulceration	4
Gastro-intestinal impaction	4
Colitis	3
Hepatic fibrosis	2
Pyloric stenosis	2

Table 15: The most frequent findings on *post mortem* examination of one to six month-old foals at the IEC during 2014. Twenty foals were submitted for diagnosis. Every case may have more than one finding associated.

A total of 128 equine abortions were examined at the IEC during 2014 (Table 16). Examined material is comprised of fetuses and placental membranes. All the fetuses are screened for EHV-1, EHV-4 (14 positives between the two of them) and EVA. Twenty-one fetuses were diagnosed with congenital abnormalities, the most common ones being glomerulocystic lesions (5 cases), scoliosis of the cervical or thoracic vertebrae (4 cases), contracted limbs (2 cases), cleft palate (2 cases) and deviation of the nasal bone (two cases).

Findings	Number of Cases
Chronic placental pathology	42
Torsion of cord	40
Incomplete/retained allantochorion	38
Cervical placentitis	27
Chronic placental pathology/placentitis	26
Incomplete/retained non-pregnant horn	22
In utero growth retardation	12
Placental insufficiency	10
Placental haemorrhage.	10
Necrosis of cervical region	5
Acute placental pathology/torsion of the umbilical cord	2
Chronic umbilical cord pathology	2
<i>Nocardia</i> infection	2
Twin pregnancy	1

Table 16: The most frequent findings on post-mortem examination of equine abortion cases including fetuses and/or placental membranes at the IEC during 2014 (n=128). Every case may have more than one finding associated.

Post mortem examination was carried out on 40 donkeys at the IEC during 2014. All of them were screened for AHV (2 positives) and equine

dysautonomia (all negative). Some of the more common findings included dentition problems (21 donkeys), hepatic fibrosis (27 donkeys), enteritis/typhlitis/colitis (23 donkeys) and chronic laminitis (17 donkeys).

AFBI and DAFM laboratories

The majority of equine *post mortem* analyses in the island of Ireland are carried out at the IEC, which is the only facility specialising in equine diagnostic pathology. Nevertheless, AFBI and DAFM veterinary laboratories complete a significant number of equine *post mortem* examinations and diagnostic tests throughout the year. In addition, the laboratories perform a number of equine specific tests for Code of Practice purposes or as part of export of horses requirements, and continue to be a national reference centre for some equine diseases, like contagious equine metritis, dourine and equine infectious anaemia.

In addition to diagnostic clinical samples sent by veterinary practitioners, the AFBI laboratories carried out 31 equine *post mortem* examinations during 2014. A number of these examinations were on behalf of other competent authorities as part of animal welfare investigations. Seven of 31 *post mortems* were fetuses sent to investigate abortion outbreaks. A full *post mortem* is carried out on the equine foetus and any obvious gross abnormalities are noted, the stomach contents are tested for bacteriological agents and the liver is tested for the presence of equine herpes virus (EHV-1 and 4). The lung, kidney and adrenal gland are tested for the presence of *Leptospira* organisms and a sample of foetal fluid is tested for the presence of antibodies to EHV and eight *Leptospira* serovars.

There were a wide and diverse number of diagnoses made during 2014. Parasitism (six cases) was the most commonly diagnosed cause of death with Cyathostomiasis noted in three cases. Hepatic disease was the second most commonly diagnosed cause of death (three cases) with hepatic lipidosis (fatty liver) noted in two cases.

During 2014, DAFM veterinary laboratories carried out 33 equine *post mortem* examinations and in addition 7 abortion outbreaks were investigated. In excess of 230 clinical samples were also received for laboratory testing, including some stomach contents and tissue samples from abortions for histology and pathogen identification.

Abortion diagnoses in DAFM veterinary laboratories included one positive for EHV-1 and one diagnosis of *Streptococcus equi*.

Diagnoses of *post mortem* equine examinations included salmonellosis (3 cases), septicaemia (4 cases) associated with *Pasterella*, *Salmonella* or *Streptococcus* infection, peritonitis (2 cases) and parasitic gastroenteritis (2 cases). An abnormally high number of cases of equine atypical myopathy were diagnosed by DAFM laboratories between October and November 2014. Athlone and Limerick RVL diagnosed six cases based on *post mortem* findings, and another six based in clinical pathology and symptoms. Aetiology is thought to be directly related to the ingestion of hypoglycin A, a toxin contained in seeds from the sycamore tree (*Platanus occidentalis*) and related trees from the maples family. The clinical signs included depression, sudden onset of muscle stiffness, colic-like clinical signs and dark-coloured urine.

Diseases of aquatic animals

NEIL RUANE
FILIPE NUNES

Statutory testing

The Fish Health Unit (FHU) at the Marine Institute and the Fish Diseases Unit (FDU) at the Agri-Food and Biosciences Institute are the national reference laboratories in Ireland and Northern Ireland respectively for diseases of finfish, molluscs and crustaceans, and they perform surveillance programmes for diseases listed under EU Directive 2006/88/EC. Under this directive, FHU and AFBI carry out surveillance for Infectious Haematopoietic Necrosis (IHN), Viral Haemorrhagic Septicaemia (VHS), Infectious Salmon Anaemia (ISA) and Koi Herpesvirus (KHV), and also routine surveillance for the two molluscan diseases caused by the parasites *Bonamia ostreae* and *Marteilia refringens*.

In addition to this, Commission Decision 2010/221/EU has granted Ireland and the UK additional guarantees in relation to freedom from the finfish diseases bacterial kidney disease (BKD), spring viraemia of carp (SVC) and gyrodactylosis (infestation with *Gyrodactylus salaris*). Following surveillance programmes, Commission Decision 2013/706/EU confirmed the disease free status of both Ireland and Northern Ireland in relation to koi herpesvirus disease. Commission Decision 2011/187/EC approved the national measures for preventing the introduction of Ostreid herpesvirus 1 μ var (OshV-1 μ var) in Pacific Oysters (*Crassostrea gigas*) into those areas of Ireland and Northern Ireland which remain free of the disease. At the end of 2014, 10 areas in Ireland remain free of the disease.

The FHU and FDU also provide a diagnostic service for the aquaculture industry, the wild fish sector,

Inland Fisheries Ireland and veterinarians, in relation to diseases currently not listed under EU Directives or by the OIE.

The FHU laboratory is accredited to ISO 17025 standards for a number of test methods, including those used for testing the above listed diseases. The FDU laboratory is ISO 17025 accredited for the following range of real-time RT-PCR and PCR assays: SAV (Salmonid alphavirus), IHN, VHS, ISA, KHV and GS. All other work in the laboratory is carried out at ISO 9001:2008 standard.

Diagnostic testing

During 2014 over 2,500 finfish in FHU and almost 2,000 in the FDU were tested for disease pathogens either as part of surveillance programmes, diagnostic samples received into the laboratory or screening tests for the aquaculture industry.

In Ireland the majority of the finfish species tested during 2014 were Atlantic salmon (*Salmo salar*, 88 *per cent*) and rainbow trout (*Oncorhynchus mykiss*, 5 *per cent*) along with a smaller number of Arctic char (*Salvelinus alpinus*), perch (*Perca fluviatilis*) and for the first time wrasse species. The use of wrasse species, such as goldsinny (*Ctenolabrus rupestris*) and corkscrew (*Symphodus melops*) as a biological control of sea lice is currently under investigation in Ireland (Figure 56) following successful trials in Norway and Scotland.



Figure 56: Wrasse species used as cleaner fish for sea lice control on marine farms. (Photo: Neil Ruane)

In Northern Ireland the main finfish species tested during 2014 were rainbow trout (73 *per cent*), atlantic salmon (10 *per cent*), brown trout (10 *per cent*), common carp including koi carp (3 *per cent*) and roach (4 *per cent*). Northern Ireland remains free of finfish diseases listed under EU Directive 2006/88/EC and Commission Decision 2010/221/EU.

As during 2013, the most significant disease to affect marine farmed finfish during 2014 in Ireland was amoebic gill disease (AGD) caused by the amoeba *Neoparamoeba perurans*. Due to improved monitoring and treatments, mortality due to the disease has not been as high as in previous years, although the new management practices added an extra cost to the farm. Other diseases affecting marine farmed Atlantic salmon in Ireland were pancreas disease, with two cases reported, and a single case of cardiomyopathy syndrome (CMS) which is caused by a totivirus, the piscine myocarditis virus. The disease is a chronic disease primarily affecting Atlantic salmon in their

second year at sea, however the clinical impact in Ireland so far has been very low. On the freshwater side, a number of rainbow trout farms continued to have problems during 2014 with rainbow trout fry syndrome caused by *Flavobacterium psychrophilum*.

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

During 2014, approximately 2,000 molluscs were tested by the FHU and 619 molluscs and crustaceans were tested by the FDU.

Samples received were principally Pacific oysters (*Crassostrea gigas*), and testing in this species focused on two pathogens Ostreid herpes virus-1 μ Var (OsHV-1 μ Var) and *Vibrio aestuarianus* (Figure 57). Samples received for OsHV-1 testing originated from sites which are part of the surveillance programme for the early detection of OsHV-1 μ Var or from sites where mortalities were reported. In Ireland, only 7 of 32 sites considered to be infected with OsHV-1 during 2014 reported mortalities consistent with the presence of OsHV-1 μ Var. During 2014, the virus was also detected in a new area bringing the number of infected sites to 33. In Northern Ireland, OsHV-1 was detected in Carlingford Lough during 2014 with 39 pacific oysters out of 120 testing positive by real-time PCR and confirmed by genetic sequence analysis.

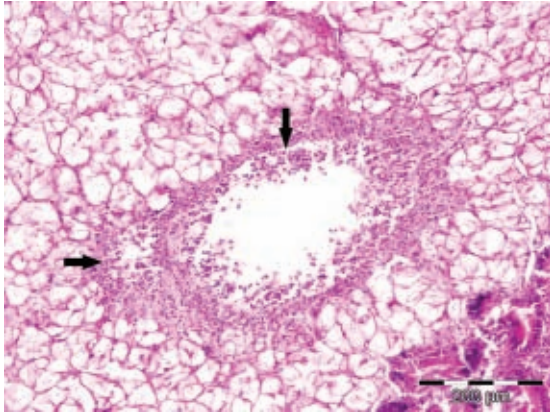


Figure 57: Cellular infiltration (arrows) associated with infection by *Vibrio aestuarianus* in Pacific oyster (*Crassostrea gigas*). (Photo: Neil Ruane)

Also, 90 native oysters (*Ostrea edulis*) and 60 mussels (*Mytilus edulis*) were screened for *Bonamia ostreae* and *Marteilia refringens*. The entire coastline of Northern Ireland is designated free from *Marteilia refringens* and *Bonamia ostreae* (with the exception of Strangford Lough and Lough Foyle where *Bonamia ostreae* has been found previously). Three hundred green crabs were screened for white spot syndrome virus (WSSV) and they all tested negative by real-time PCR.

Research

Under the Marine Institute Fellowship Programme, the FHU is collaborating with Galway & Mayo Institute of Technology on a PhD study entitled “Gill disease in Atlantic salmon with particular emphasis on amoebic gill disease”. The early stage of this study has focussed on the development of a robust molecular diagnostic method for detecting the amoeba which causes AGD. During a study visit to the Commonwealth Scientific Industry Research Organisation (CSIRO) in Australia this method was further validated and compared favourably with a range of previously published methods. It is currently being used on a number of farms in Ireland screening for amoebae.

Following reports of significant mortality in half grown and adult oysters associated with the presence of *Vibrio aestuarianus* in France during 2012, the FHU carried out both targeted surveillance for the pathogen during mortality episodes during 2013 as well as a retrospective survey on archive samples submitted to the laboratory between 2003 and 2012. As a result of this testing a number of sites were identified to be at a higher risk of mortality related to the presence of the bacterial pathogen. Three of these sites were followed in longitudinal studies during 2014 in an attempt to correlate levels of the bacterium with any observed mortality. An association between the mortality of adults or half grown oysters and the presence of the bacterium was demonstrated in 2 of the 3 sites in the survey.

Scientific Publications

S. McCleary, M. Giltrap, K. Henshilwood and N.M. Ruane. 2013. Detection of salmonid alphavirus RNA in Celtic and Irish Sea flatfish. *Diseases of Aquatic Organisms* 109: 1-7.

H.D. Rodger, S.J. McCleary and N.M. Ruane. 2014. Clinical cardiomyopathy syndrome in Atlantic salmon, *Salmo salar* L. *Journal of Fish Diseases* 37: 935-939.

N.M. Ruane, H.D. Rodger, L.J. McCarthy, D. Swords, M. Dodge, R.C. Kerr, K. Henshilwood and D.M. Stone. 2014. Genetic diversity and associated pathology of rhabdovirus infections in farmed and wild perch *Perca fluviatilis* in Ireland. *Diseases of Aquatic Organisms* 112: 121-130.

T.A. Clegg, T. Morrissey, F. Geoghegan, S.W. Martin, K. Lyons, S. Ashe and S.J. More. 2014. Risk factors associated with increased mortality of farmed Pacific oysters in Ireland during 2011. *Preventive Veterinary Medicine* 113: 257-267.

Parasitic Diseases

SEAMUS FAGAN
TONY PATTERSON

Liver and rumen fluke infections

During 2014, 6,770 bovine faecal samples were analysed for the presence of liver fluke eggs (3,345 by AFBI and 3,425 by DAFM) and 9.4 *per cent* of the samples were positive for liver fluke eggs (16 and 3 *per cent* in AFBI and DAFM laboratories respectively). This is a lower result compared to 2013 and may reflect the drier autumn and winter of 2013 (Figure 58).

During 2014, 6,813 bovine faecal samples were analysed for rumen fluke, and 41.9 *per cent* of them were positive for rumen fluke eggs (45.3 and 38.6 *per cent* in AFBI and DAFM laboratories respectively), a slight decrease compared to 42.8 *per cent* during 2013 (Figure 58).

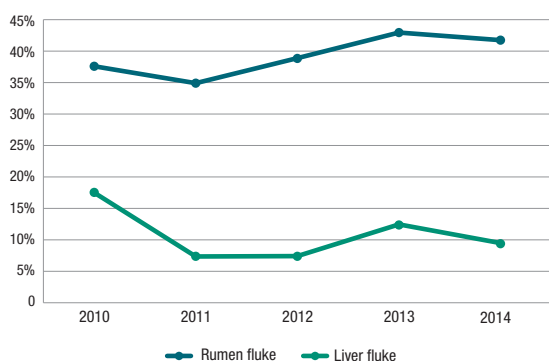


Figure 58: The relative frequency of positive bovine faecal samples for liver and rumen fluke eggs in the island of Ireland for the period 2010-2014.

Recent analysis of rumen fluke parasites collected in Ireland has shown that *Calicophoron daubneyi* appears to be the dominant species in cattle and sheep. This species of rumen fluke uses the mud snail (*Galba truncatula*) as its intermediate host, as does the liver fluke. It had been erroneously assumed before that *Paramphistomum cervi*, whose intermediate host is the water snail, was

the most common and significant rumen fluke in the island of Ireland.

A total of 1,720 ovine faecal samples were analysed for the presence of liver fluke eggs during 2014 (1,074 and 646 in AFBI and DAFM laboratories respectively), of which 10.2 *per cent* were positive (13.1 and 5.4 *per cent* in AFBI and DAFM laboratories respectively), a significant decrease compared to the 17.7 *per cent* positive samples during 2013. In addition, 19.9 *per cent* were positive for rumen fluke eggs during 2014 (23.7 and 13.3 *per cent* in AFBI and DAFM laboratories respectively), again a decrease compared to 2013 (23.3 *per cent*).

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

Strongyles

During 2014, 7,919 bovine faecal samples (3,649 and 4,270 in AFBI and DAFM laboratories respectively) and 3,006 ovine faecal samples (1,295 and 1,711 in AFBI and DAFM laboratories respectively) were examined for the presence of strongyle eggs. Egg counts above 500 per gram are considered to be positive, and based on this criterion 6.6 *per cent* of bovine faecal samples (5.4 and 7.6 *per cent* in AFBI and DAFM laboratories respectively) and 27 *per cent* of ovine faecal samples (17 and 35 *per cent* in AFBI and DAFM laboratories respectively) were found to be positive.

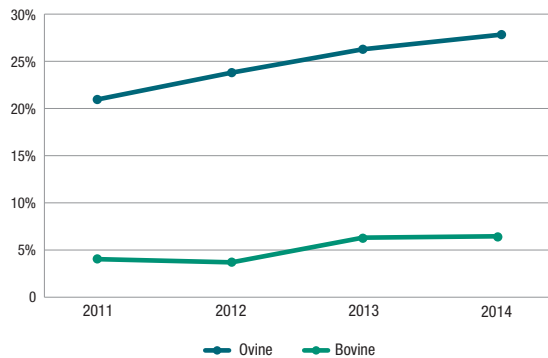


Figure 59: The relative frequency of positive bovine faecal samples for strongyles (>500 eggs/gram) on the island of Ireland for the period 2011-2014.

The number of strongyle eggs detected is consistently higher in sheep when compared to cattle. There may be a number of reasons for this, such as inherent resistance, age profile of the animals sampled, type of pasture grazed and the fact that it is more common for sheep to be outwintered than cattle. The number of ovine samples is considerably less than the number of bovine samples probably due to sheep farmers being more selective in the submission of samples and sending on average those with a higher load of parasites. It may also point towards a greater focus on parasite control in cattle herds and suggests that this is an area which requires further attention among sheep producers.

Nematodirus

Nematodiosis can be a significant cause of diarrhoea in sheep, particularly in young lambs. Development to the L3 larval stage takes place within the egg, and in the case of *Nematodirus battus* (the most significant species seen in Ireland and Northern Ireland), a prolonged cold period is required before hatching from the egg occurs. As a result, large numbers of L3 larvae appear on infected pastures in April, May and June when young suckling lambs are beginning to ingest more grass. If young naïve lambs ingest a significant amount of these larvae, severe clinical disease

can result. Faecal egg counts of over 200 eggs per gram are considered clinically significant in sheep (Figure 60).

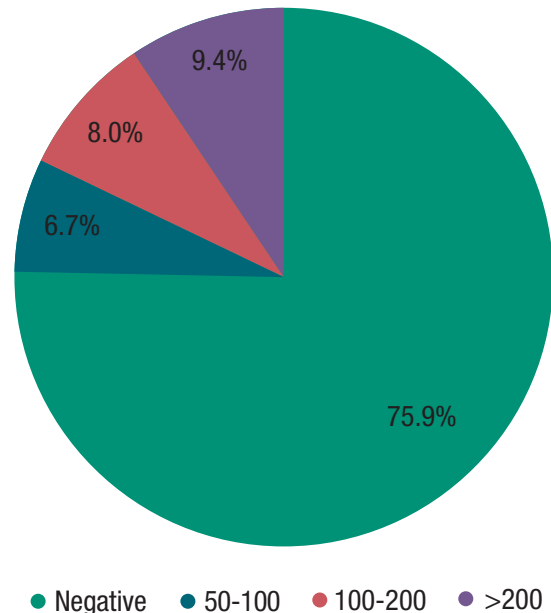


Figure 60: The relative frequency of positive ovine faecal samples for *Nematodirus* spp. detected in DAFM laboratories during 2014 (n=1711).

Coccidiosis

During 2014, 6,978 bovine faecal samples (3,847 and 3,131 in AFBI and DAFM laboratories respectively) were tested for the presence of coccidial oocysts, and 19.7 *per cent* of them were positive (Figure 61) (16.6 and 23.5 *per cent* in AFBI and DAFM laboratories respectively). As in previous years, the majority of the positive samples contained low number of oocysts (80 *per cent*) and would not be considered of clinical significance (Figure 61).

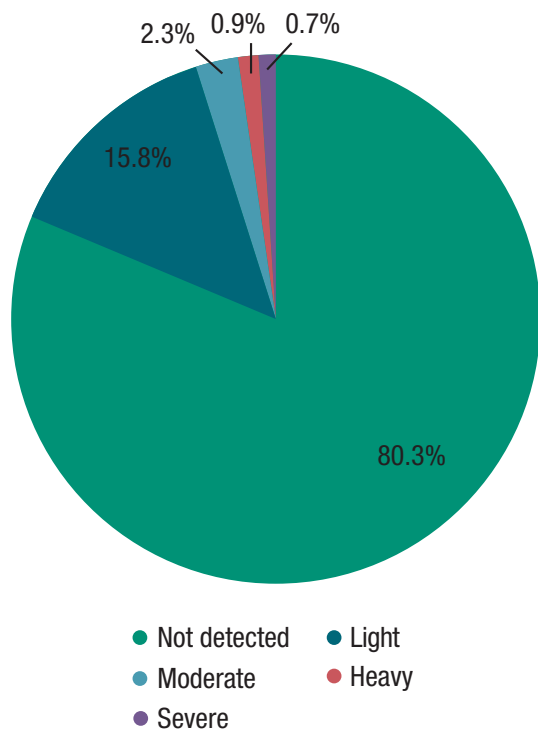


Figure 61: The breakdown of the results following analyses of bovine faecal samples for coccidial oocysts during 2014 in AFBI and DAFM laboratories (n=6,978).

Two thousand nine hundred and forty ovine faecal samples (1,326 and 1,614 in AFBI and DAFM laboratories respectively) were tested for the presence of coccidial oocysts during 2014. Of the total number of samples tested, 70.4 *per cent* were positive (61.4 and 77.9 *per cent* in AFBI and DAFM laboratories respectively), a moderate increase compared to 2013 (57.3 *per cent*). Most of the positive samples (79.1 *per cent*) contained a low number of oocysts (Figure 62). As in previous years, there was also a far higher percentage of positive ovine than bovine samples.

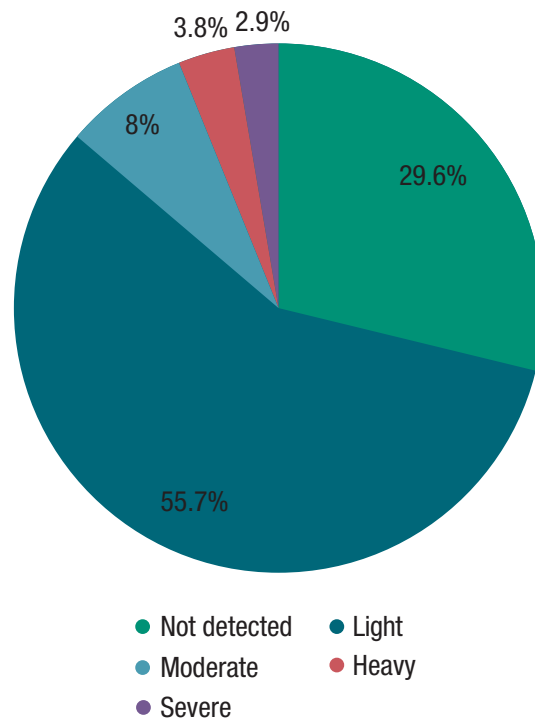


Figure 62: The breakdown of results following analyses of ovine faecal samples for coccidial oocysts during 2014 in AFBI and DAFM laboratories (n=2,940).

The percentage of samples positive for coccidial oocysts has risen in 2014 compared to 2013 and to 2012. (Figure 63).

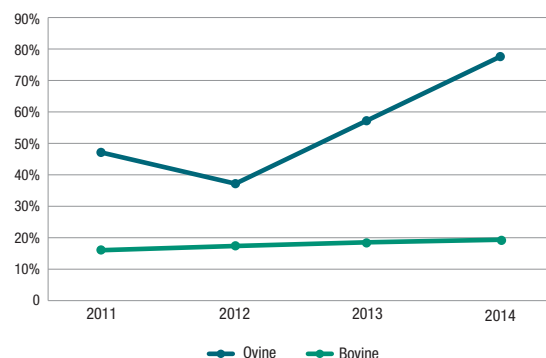


Figure 63: The relative frequency of bovine and ovine faecal samples positive for coccidial oocysts in the period 2011 to 2014.

Clinical chemistry

PATHOLOGY DIVISION, CVRL
JASON BARLEY

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 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.

Copper analyses

Copper deficiency may be described as either a primary or a secondary deficiency. Primary copper deficiency might result from inadequate copper in forage grown on deficient soils. Secondary deficiency might arise due to inhibition of copper absorption as a result of excess molybdenum or iron in the diet. Young growing cattle are particularly susceptible to copper deficiency but older cattle may also be affected. Clinical signs of copper deficiency include ill thrift, changes in hair colour, chronic diarrhoea, anaemia and increased susceptibility to infection due to a diminished immune response. Swayback (enzootic ataxia) is a specific condition associated with copper deficiency in lambs.

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

Copper analysis was carried out on 13,007 blood samples submitted to AFBI and DAFM laboratories during 2014 of which 2,119 (16.3 *per cent*) were found to be deficient (Figure 64).

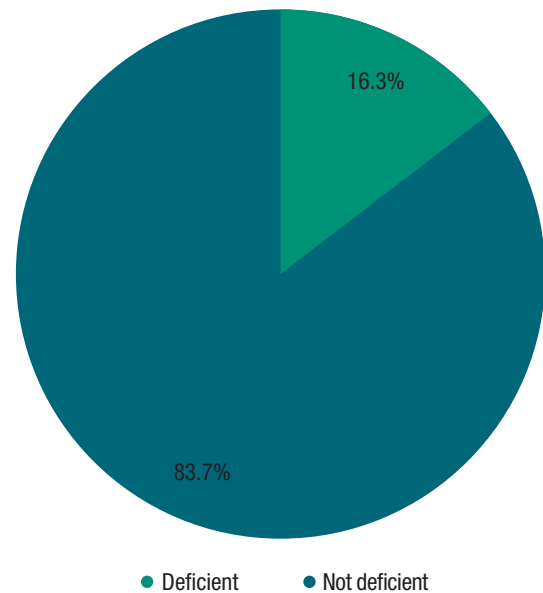


Figure 64: The relative frequency of bovine blood samples submitted to AFBI and DAFM laboratories during 2014 analysed for copper status and identified as deficient (less than nine micromoles per litre) or non-deficient (n=13,007).

Selenium analyses

Selenium is an essential component of the enzyme glutathione peroxidase (GSH-Px) which catalyses the reduction of hydrogen peroxide and lipid hydroperoxidases and prevents oxidative damage to body tissues. White muscle disease in calves, associated with selenium deficiency, is characterised by 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.

The selenium status of cattle can be determined either by directly measuring blood selenium levels or by measuring GSH-Px activity in red blood

cells. GSH-Px activity reflects incorporation of selenium into erythrocytes during erythropoiesis and therefore is an indicator of selenium status sometime earlier than the time of sampling. Submission of whole blood samples is required for both selenium and GSH-Px analysis.

During 2014, selenium status testing was carried out on 10766 bovine blood samples submitted to AFBI and DAFM laboratories of which 1,241 were found to be deficient (Figure 65).

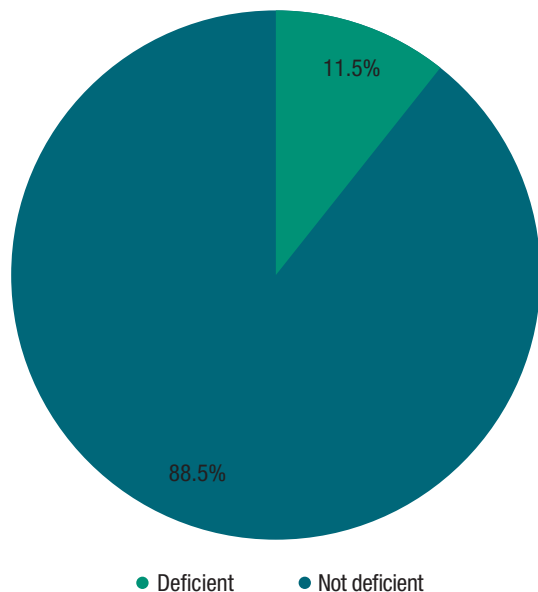


Figure 65: The relative frequency of bovine blood samples submitted to AFBI and DAFM laboratories during 2014 analysed for selenium status (either by blood selenium analysis or measurement of glutathione peroxidase activity) and were identified as deficient or non-deficient (n=10,766).

Iodine

DAFM regional veterinary laboratories do not carry out iodine analysis. In AFBI, plasma inorganic iodine is used to assess iodine status and gives an indication of current 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 of less than 60

micromoles per litre indicates low recent iodine intake.

Results should be interpreted on a herd basis as an individual low result does not necessarily mean that an animal is deficient and has not enough stored iodine to satisfy the needs of short term thyroxine production. A low result does indicate however that iodine intake on the day of sampling was low and prolonged intakes of this level are likely to result in deficiency.

During 2014 a total of 4,955 blood samples were tested for inorganic iodine in AFBI laboratories and 56 *per cent* of them were found to be deficient (Figure 66).

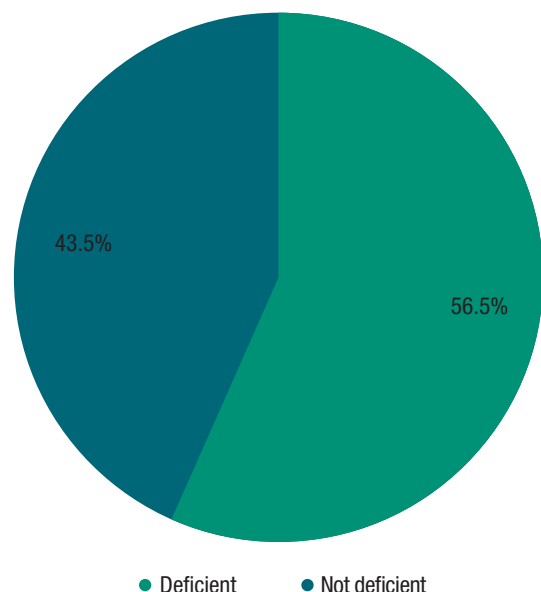


Figure 66: The relative frequency of bovine blood samples submitted to AFBI laboratories during 2014 analysed for inorganic iodine status and were identified as deficient or non-deficient (n=4,955).

Cobalt

Cobalt deficiency in ruminants occurs primarily in areas in which the soils are deficient in cobalt. In ruminants cobalt is needed in the manufacture of vitamin B12 which in turn is required for the metabolism of propionate through the

gluconeogenesis pathway, an important source of energy for the animal. The clinical signs of cobalt deficiency in ruminants include poor appetite, weight loss, muscle wasting and anaemia.

In sheep, white liver disease is associated with low liver cobalt levels and low plasma concentrations of vitamin B12. At necropsy the liver looks pale, swollen and greasy as a result of severe fatty infiltration causing hepatic failure.

Liver cobalt concentrations of less than 0.7 micromoles per kilogram wet weight are considered deficient. During 2014, a total of 146 ovine liver samples were tested in DAFM laboratories for cobalt and 34 *per cent* of them were found to be deficient (Figure 67).

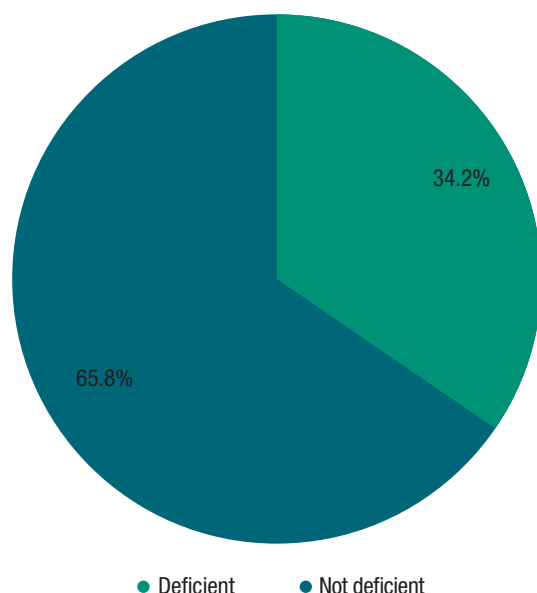


Figure 67: The relative frequency of bovine blood samples submitted to AFBI laboratories during 2014 analysed for inorganic iodine status and were identified as deficient or non-deficient (n=146).

Haematology

PATHOLOGY DIVISION, CVRL
JASON BARLEY

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

Wildlife Surveillance

ALAN JOHNSON
SEÁN FEE

AFBI and DAFM carry out surveillance on a range of wildlife species to detect the incursion of exotic diseases. They also assist in carrying out investigations into suspected wildlife crimes in association with the Partnership for Action against Wildlife Crime in Northern Ireland (PAW) and the National Parks and Wildlife Service (NPWS).



Figure 68: Hare submitted to Dublin regional veterinary laboratory for *post mortem* examination. (Photo: Shane McGettrick)

During 2014 the species submitted to DAFM veterinary laboratories for examination included hares (Figure 68), wood pigeons, swans, starlings and a number of raptor species including six peregrine falcons, three white-tailed sea eagles (Figure 69), three common buzzards, two sparrowhawks, two kestrels and one short-eared owl.



Figure 69: White-tailed Sea Eagle being examined in Cork RVL. (Photo: Pat Sheehan)

Samples collected at *post mortem* examination from a number of the cases were submitted to the State Laboratory for toxicology tests. Rodenticide poisons were detected in one Peregrine Falcon (bromadiolone and brodifacoum) and one White-tailed Sea Eagle (bromadiolone), but as the tests were qualitative rather than quantitative it was not possible to determine whether these toxins had contributed to the death of the birds. Carbofuran and alphachloralose poisoning was confirmed in four Peregrine Falcons and one Sparrowhawk submitted from the south east region in March and April. Pigeons (some alive and some dead) picked up in the same region were also positive and it was suspected that these were laced with the poisons, tethered and used as bait to attract and poison the raptors.

In some cases, deaths resulting directly or indirectly from shotgun injury were diagnosed during 2014. In February a nine-month-old White-tailed Sea eagle was found dead in the Lough Derg region of Tipperary. It was one of the first sea eagles to fledge from a nest in Ireland in over 100 years. An x-ray revealed a large number of shotgun pellets scattered throughout the carcass (Figure 70) as well as callus formation around a fractured left radius/ulna and tibia/fibula (Figure 71). The bird had not eaten in the recent past, was emaciated, and toxicology tests were negative.

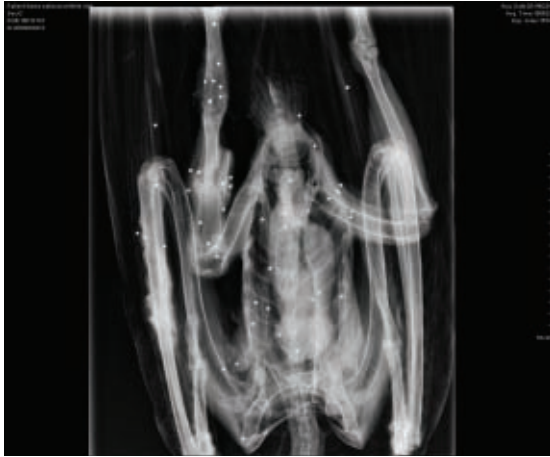


Figure 70: X-ray image of a white-tailed Sea Eagle with shotgun pellets. (Photo: Treaty Veterinary Clinic)



Figure 71: Callus in the left limb of a white-tailed Sea Eagle. (Photo: Allan Mee)

Based on the appearance of the callus on the limbs and the emaciated state of the bird it was estimated that the bird had been shot up to ten weeks previously and had struggled to feed itself before dying from starvation.

Echinococcus surveillance of wild foxes

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

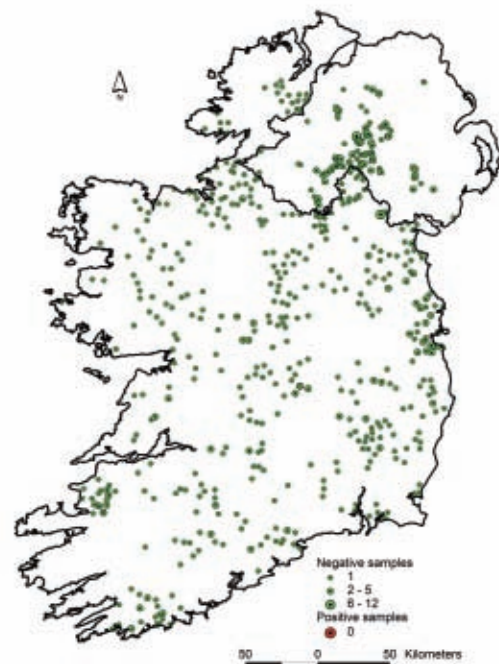


Figure 72: Location of the foxes tested for *Echinococcus multilocularis* during 2014.

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

In 2014, the intestinal contents of 526 foxes (195 by AFBI and 331 by DAFM) (Figure 72) were examined using the sedimentation and counting technique. All were negative for *E. multilocularis*.

Trichinella surveillance of wild foxes

Trichinella spiralis (Figure 73) is a nematode parasite that is significant internationally as a zoonotic agent, with the pig and man being the most important hosts. Numerous mammalian species can harbour the parasite and humans can develop severe disease following infection.



Figure 73: *Trichinella spiralis*. (Photo: Cosme Sánchez-Miguel)

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 one of the main sylvatic reservoir hosts in Europe. In 2014 Commission Regulation (EU) No 216/2014

(of 7 March 2014) laying down specific rules on official controls for *Trichinella* in meat contained specific amendments to the sections of Regulation (EC) No 2075/2005 referring to the requirements for wildlife testing. As a result, monitoring of red foxes for *Trichinella* spp. by DAFM ceased whilst 321 foxes were sampled by AFBI, all of which were negative.

Anthelmintic resistance

WILLIAM FITZGERALD
JASON KEEGAN

Currently, there are 5 classes of anthelmintics available for use in food producing animals. They are benzimidazoles, imidazothiazoles (levamisole among them), macrocyclic lactones (containing avermectins) and the more recent additions amino-acetonitrile derivatives such as Monepantel (commercially launched in 2010) and the spiroindoles including Derquantel (launched in 2011). The more recent products are prescription only in Ireland, a measure taken to minimise overuse of these products and the emergence of resistance to these anthelmintics amongst nematodes.

Anthelmintic Resistance (AR) is defined by the group SCOPS (Sustainable Control of Parasites) as the heritable (and therefore genetic) ability of the worm to survive a dose of anthelmintic which would normally be effective. A worm is said to be resistant if it survives exposure to the standard recommended dose of the anthelmintic and can pass this ability on to its offspring. Anthelmintic resistance was first reported in Ireland in 1993 and is a growing issue all over the island of Ireland and indeed, across Europe.

Ireland

In Ireland anthelmintic resistance appears to be more established in sheep, although AR has also been confirmed in cattle. In sheep, in order to be considered fully effective, an anthelmintic treatment must result in a reduction of faecal egg count (FEC) of at least 95 *per cent* with the lower confidence limit greater than 90 *per cent*. If these targets are not met, then AR is suspected.

Some of the factors which affect the rate of spread of AR include:

- Inappropriate dosing (this may include dosing too often; not administering the correct dose due to underestimating the weight of the animal to receive it; using faulty dosing equipment and using products incorrectly)
- Movement of animals harbouring resistant nematode populations, effectively seeding the pastures on which they graze with resistant nematodes
- Whole group anthelmintic treatment results in the exposure of all reproducing nematodes to anthelmintics. This kills off all of the susceptible nematodes leaving those resistant individuals within the animal free to release their resistant offspring onto pasture, quickly increasing the proportion of resistant nematodes on pasture. Leaving some animals in the group untreated may help to maintain a population of susceptible nematodes on pasture, known as an *in refugia* population, which may help delay the development of resistance.

SHEEP TECHNOLOGY ADOPTION PROGRAMME (STAP)

In 2013 established a sheep technology adoption programme (STAP). The aim of this programme is to increase profitability on Irish sheep farms by using the discussion group model to encourage and enable the dissemination of best management practices. STAP is a three year programme and participants are required to attend a number of discussion group meetings with agricultural facilitators or three discussion group meetings and a national event. Participants are also required to complete two technical tasks from a list of ten possible tasks, one of which is a drench test. This task was designed to assess the efficacy of anthelmintic treatments on Irish farms.

Summary of STAP findings to date:

1. Against *Trichostrongyle* nematodes

- Benzimidazoles (BZD) remain the most popular anthelmintic used on Irish sheep farms with approximately 46 *per cent* and 41 *per cent* of participating flocks reporting the use of BZDs in 2013 and 2014 respectively. However, results indicate that BZDs were effective on only approximately 30 *per cent* of the farms that had used them.
- Macrocyclic Lactones (ML) were the second most popular anthelmintic type, used on 28 *per cent* of participating farms in 2013 and 34 *per cent* in 2014. Of these farms, efficacy was established on 76 *per cent* and 71 *per cent* in 2013 and 2014, respectively.
- Levamisole based preparations were used on 23 *per cent* of participant farms in both years and were deemed to be effective only on 52 *per cent* of farms in 2013 and 56 *per cent* in 2014.

2. Against *Nematodirus* spp nematodes

- BZDs were used on 48 participating farms, where these nematodes were detected and were deemed to be effective on 100 *per cent* of them.
- MLs were used on 47 farms where *Nematodirus* was detected and were deemed to be effective on 94 *per cent* of them. However, *Nematodirus* spp are a dose-limiting species for MLs thus predisposing to lower efficacy with this class of drug.
- Levamisole was used on 20 farms and was deemed to be effective on 80 *per cent* of them.

These findings correlate with those published in 2012 which estimated AR to Benzimidazoles on Irish sheep farms at 90 *per cent*, to Levamisole at 40 *per cent* and to Macrocyclic Lactones at 11 *per cent*.

3. Only 51 *per cent* of the treatments administered across the fully compliant flocks within the STAP study were deemed effective. In a similar study in Scotland, treatment failure was indicated to be as high as 64 *per cent* of study flocks.

Typically, AR emerges within 10 years of the commercial release of new anthelmintic compounds. However, initial reports of AR to Monepantel, commercially launched in 2010, amongst sheep farms in the Netherlands were published in November 2014, only 4 years after commercial launching. Multi-drug resistant nematodes have been reported within the literature with some authors stating that it is far more prevalent than currently recognised.

Recently, a *Teladorsagia circumcincta* population resistant to BZDs, LEVs and MLs has been found in Ireland. This emphasises the importance of employing a variety of methods to combat nematode infections that may reduce the impact of disease while maintaining the efficacy of the recently introduced anthelmintics.

Antimicrobial resistance

ANGELA LAHUERTA-MARÍN

In Northern Ireland, bacterial isolates thought to be of clinical significance from post mortem and clinical pathology samples, may be tested for antimicrobial resistance (AMR). AMR is of particular concern in clinical cases of *E. coli*, *Staphylococcus aureus* and *Streptococcus uberis*. Laboratory testing and result interpretation are carried out by veterinary pathologists and microbiologists based at the disease investigation and surveillance (DSIB) unit AFBI.

The AMR testing method in use in AFBI is disk diffusion, which entails conformational growth of the bacteria under test on a standard sensitivity agar. Paper discs impregnated with different antibiotics at set concentrations are applied to the agar which has been inoculated with the isolate under test. When incubated at set temperatures and time the growth of the bacteria will be inhibited by some of the antibiotics producing a clear zone around the antibiotic disk and not by others (Figure 74). Interpretation of the zone will vary depending on the isolate under test, the animal species from which the sample originated and for each antimicrobial concerned. The Clinical and Laboratory Standards Institute (CLSI) guidelines are used for interpreting inhibition zones, determining whether the isolates are as sensitive, intermediate or resistant to each antimicrobial in study.

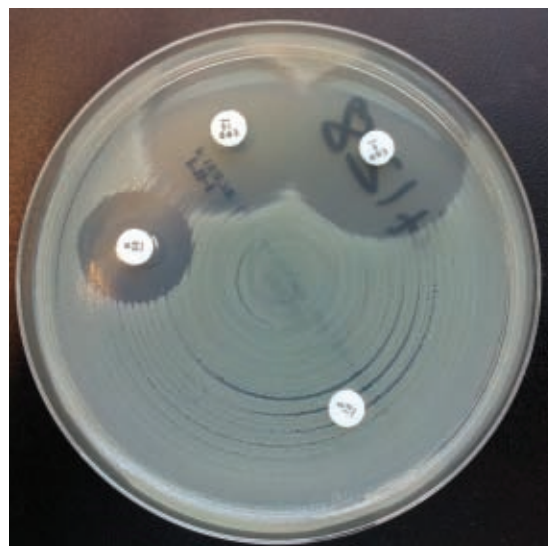


Figure 74: Antimicrobial resistance testing by the disk diffusion method. Inhibition zones demonstrate sensitivity of the bacteria (*Salmonella* in this case) to the antibiotic impregnated in the paper disk. (Photo: Áine O'Doherty)

Escherichia coli

E. coli isolates from routine samples from healthy livestock in Northern Ireland are not routinely tested for AMR. AMR testing on *E. coli* isolates is mainly performed if samples are coming from calves under 2 weeks of age and in cows with suspected mastitis.

Please note that data provided on pathogenic *E. coli* from Northern Ireland for 2010-2013 correspond to isolates and not individual animals. In fact, several colonies may have been taken from an individual animal sample/s.

	Bovine milk (n=212)	Bovine enteric (n=653)	Ovine enteric (n=66)	Porcine enteric (n=66)	Avian enteric (n=5)
Ampicillin	36	85	64	80	80
Erythromycin		100	100	100	100
Streptomycin	5				
Trimethoprim/ Sulphonamides	13	68	38	84	40
Tetracycline	22	81	73	88	80

Table 17: Antimicrobial susceptibility of *Escherichia coli* isolates from bovine milk and bovine, ovine, porcine and avian enteric submissions to AFBI laboratories during 2014, showing the relative frequency of non-sensitive isolates.

Staphylococcus aureus

As in the case of *E. coli*, *Staphylococcus aureus* AMR is not tested in routine samples, only in clinical cases from highly susceptible species such as pigs or horses submitted for *post mortem* investigation. In addition, microbiological isolation of *S. aureus* would also be indicated in the case of submissions of milk samples from clinical cases of bovine environmental mastitis.

Testing and interpretation is based on a CLSI method. Colonies are tested against a panel of 18 antimicrobials.

During 2014, a total of 158 isolates of *S. aureus* from different animal species had an antibiogram profile test performed to an 11-antimicrobial panel in AFBI laboratories (Table 18).

	Bovine milk (n=212)	Bovine enteric (n=653)	Ovine enteric (n=66)	Porcine enteric (n=66)	Avian enteric (n=5)
Ampicillin	48	25	17	73	8
Erythromycin	2	13	5	7	15
Trimethoprim/ Sulphonamides	0	0	0	7	8
Tetracycline	4	13	33	73	23
Cefoxitin	0	0	0	13	0

Table 18: Antimicrobial susceptibility of *Staphylococcus aureus* isolates from bovine milk and other bovine, ovine, porcine and avian submissions to AFBI laboratories during 2014 showing the relative frequency of non-sensitive isolates.

One *S. aureus* isolate from a pig submitted for *post mortem* to AFBI-Omagh disease surveillance laboratory was confirmed as livestock associated methicillin resistant *S. aureus* (LA-MRSA). The piglet was one of a group of five with a history of pneumonia and wasting. All piglets were positive to the porcine reproductive and respiratory syndrome virus (PRRS). *S. aureus* was isolated from spleen, lung and liver tissues from one of the piglets using standard bacteriology culture techniques. The *S. aureus* isolates were intermediately resistant to cefoxitin. Molecular characterisation showed that the strain belonged to the MLST clonal complex 398 lineage of LA-MRSA, was *spa* type t034 and encoded SCCmecV. This was the first time that LA-MRSA was isolated from pigs in the UK (Hartley *et al.*, 2014).

Streptococcus uberis

Streptococcus uberis culture and isolation is carried out only on milk samples from suspect mastitis cases submitted for examination by private veterinarians. *S. uberis* can also be a commensal organism in milk samples and its presence in milk samples has to be interpreted in conjunction with clinical history. If three or more different bacteria are isolated from a milk sample,

S. uberis is considered a commensal organism and AMR testing will not be carried out. All other *S. uberis* isolates from milk samples undergo AMR testing (Table 19).

Bovine milk (n=190)	
Ampicillin	33
Erythromycin	35
Trimethoprim/ Sulphonamides	14
Tetracycline	21
Cefoxitin	10

Table 19: Antimicrobial susceptibility of *Streptococcus uberis* isolates from bovine milk submissions to AFBI laboratories during 2014 showing the relative frequency of non-sensitive isolates.

S. uberis isolates are tested following CLSI guidelines against a panel of 18 antibiotics of veterinary and surveillance interest.

Zoonoses

MERCEDES GÓMEZ-PARADA

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

During 2014, DAFM and AFBI laboratories isolated and positively identified a number of zoonotic agents in the course of disease diagnostics. A few of the most common and unusual diseases are discussed in this section.

Campylobacteriosis

Campylobacter jejuni is mostly asymptomatic in animals but it can cause gastrointestinal disease in humans. Campylobacteriosis is recognised as the most common cause of food-borne gastroenteritis in humans worldwide. Asymptomatic carriers can shed the organism in their faeces for prolonged periods of time, contaminating food and water.

Like most intestinal pathogens, the main routes of infection are faecal-oral through ingestion of contaminated food and water.

C. jejuni can cause diarrhoea in young animals. In calves, signs vary from mild to moderate. Isolation of *C. jejuni* from diarrhoeic faeces is not in itself an indication of animal disease, but an indication of a zoonotic risk to anyone regularly handling the animal.

Campylobacteriosis in humans is typically a self-limiting disease characterised by abdominal pain, fever and diarrhoea. Symptoms last from 24 hours to 1 week.

During 2014, DAFM isolated *C. jejuni* in 161 bovine herds and in 13 ovine flocks.

Cryptosporidiosis

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

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

During 2014, DAFM detected *Cryptosporidium* spp. oocysts in 696 faecal samples from diarrhoeic calves out of 2,711 tested. These samples originated in approximately 537 herds. *Cryptosporidium* spp. oocysts were also detected in 85 intestinal samples from calves submitted for *post mortem* examination from 74 different herds. In ovine samples, *Cryptosporidium* spp. was

detected in 40 faecal samples from lambs of 29 different flocks and in 18 intestinal samples from *post mortem* examinations from 12 different flocks.

Erysipelas

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

Septicaemia is the most common clinical manifestation of erysipelas, but cutaneous and endocardial forms also exist. *E. rhusiopathiae* can also cause polyarthritis in lambs.

Animals may be carriers and shed the organism without showing clinical signs of disease. Carriers can shed erysipelas from faeces, urine, saliva, and oronasal secretions.

Direct infection is through breaks in the skin and through the mucous membranes (e.g. during artificial insemination). Indirect infection is by ingestion of contaminated foodstuffs and, possibly, via biting insects (red mite).

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

In intensively farmed pigs, up to 50 *per cent* are considered to be carriers. The bacteria commonly reside in tonsils. Clinical disease can be acute (septicaemia) and/or chronic (arthritis and/or

endocarditis). Acute signs are depression, fever, reluctance to stand, stiff gait and excessive squealing when handled. Anorexia and thirst are common. Skin discoloration may vary from widespread erythema and purplish discoloration of the ears, snout and abdomen, to diamond-shaped skin lesions, particularly on the lateral and dorsal regions. Lesions may be discrete, pink, purple and of varying size and they become raised and firm to touch within 2–3 days. These may disappear over a week or progress to a more chronic type of lesion, commonly referred to as diamond skin disease. If untreated, necrosis and separation of large areas of skin can occur; tips of ears and tail may become necrotic and slough. Abortion and agalactia have been reported. Mortality rates associated with the condition is variable.

In humans, *E. rhusiopathiae* causes three different syndromes: erysipeloid, a generalised cutaneous form, and a septicæmic form with endocarditis. The organism usually enters through cuts in the skin and there are no reports of people becoming infected orally.

During 2014, erysipelas was diagnosed by DAFM laboratories in two turkey flocks and one pig herd.

Leptospirosis

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

Some pathogenic leptospiral serovars are associated with one or more maintenance hosts, which act as reservoirs of infection, often wild species and occasionally domestic animals. Each serovar behaves differently within its maintenance host species than it does in other, incidental host species.

In maintenance hosts, leptospirosis is generally highly prevalent, has relatively mild acute clinical signs and infection persists in kidneys and, sometimes, the genital tract. Diagnosis in maintenance hosts is difficult because of relatively low antibody responses and the presence of few organisms in tissues.

In incidental hosts, leptospirosis is characterised by low prevalence of infection, severe clinical signs and a short phase of renal infection. There is a marked antibody response and large numbers of *Leptospira* in tissues making diagnosis less difficult.

It should be noted that characterisation of a host/serovar interaction as a maintenance or incidental host infection is not absolute.

Transmission among maintenance hosts is often direct (contact with infected urine, aborted materials or milk); in some host/serovars combinations transmission can also be venereal or transplacental. On the contrary, infection of incidental hosts tends to be indirect (contact with areas contaminated with urine of asymptomatic maintenance hosts), and environmental conditions play a critical role.

In maintenance and incidental hosts infection during pregnancy can result in abortion, stillbirth and birth of weak offspring or healthy but infected offspring.

Humans are susceptible to infection with most of the pathogenic serovars of *Leptospira*. Symptoms vary from subclinical infection to death due to renal and/or hepatic failure. Transplacental transmission, abortion and infection of infants through breast milk have been reported.

During 2014, DAFM diagnosed leptospirosis in two calves. Leptospirosis was suspected in several abortions in cattle, although definite involvement could not be confirmed as bacterial isolation or PCR are not routinely carried out.

Listeriosis

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

In adult ruminants, encephalitis and meningoen- cephalitis are the most common forms of listeriosis.

While human listeriosis is rare, mortality can reach up to 50 *per cent*, particularly among the elderly and the immunocompromised. Aborted fetuses and necropsy of septicaemic animals present the greatest infection risks to handlers. There are reported cases of fatal meningitis, septicaemias and papular exanthema after handling infected aborted material. Infection in pregnant women creates a great risk to the foetus, with possibility of abortion, stillbirth and neonatal infection and they should avoid completely contact with abortion material.

During 2014, DAFM identified listeriosis as the cause of abortion in 59 herds and 14 flocks. In addition, it was associated with encephalitis/ meningoencephalitis in 10 bovine herds.

Q fever

Coxiella burnetii is the aetiological agent of Q fever, a zoonotic bacterial infection associated, primarily, with parturient ruminants. Infection is usually subclinical, although it can cause infertility and sporadic abortions (necrotising placentitis).

The greatest risk of infection occurs at parturition by inhalation, ingestion or direct contact with birth fluids or placenta. *Coxiella burnetii* is also shed in milk, urine and faeces.

In humans, the majority of outbreaks have been associated with wind dispersal of contaminated, desiccated, reproductive materials.

Ticks may transmit the disease among ruminants but there is no evidence that ticks play any role in transmission to humans.

In humans, clinical presentation of Q fever can range from a self-limiting influenza-like illness to pneumonia, hepatitis and endocarditis.

During 2014, there were four Q fever positives samples recorded out of 308 serological submissions tested by DAFM.

Salmonellosis

Salmonellosis is caused by many species of *Salmonella*. Clinically, it is characterised by one or more of three major syndromes; septicaemia, acute enteritis and/or chronic enteritis. Young animals usually develop the septicaemic form, adult animals commonly develop acute enteritis, and chronic enteritis is more often seen in growing pigs and, occasionally, cattle. Pregnant animals may abort.

Asymptomatic carriers are a zoonotic risk in all host species.

The most common pathogenic serotypes of *Salmonella* are *S. Dublin* and *S. Typhimurium*.

In humans, the incidence of salmonellosis has increased in recent years. Transmission occurs via contaminated water and foodstuffs. Symptoms tend to be more severe in the very young, the elderly and the immunocompromised.

In samples other than fetuses submitted during 2014, DAFM identified *S. Dublin* in 110 bovine herds, 8 ovine flocks and 1 pig herd. *S. Typhimurium* was identified in 20 bovine herds and 10 porcine herds.

Other *Salmonella* isolates identified during 2014 included *S. Diarizonae*, which was isolated in one bovine herd and four ovine flocks and *S. Goldcoast*, isolated in one bovine herd.

Toxoplasmosis

Toxoplasma gondii is a protozoan parasite that infects humans and other warm-blooded animals, including sheep and goats. Members of the family Felidae are the only definitive hosts of *T. gondii*. Wild and domestic cats serve as the main reservoirs of infection. There are three infectious stages in toxoplasmosis; tachyzoites (rapidly multiplying forms), bradyzoites (in tissue cysts), and sporozoites (in oocysts). Toxoplasmosis can be transmitted by accidental ingestion of infectious oocysts in cat faeces, consumption of tissue cysts in undercooked infected meat, and by transplacental transfer of tachyzoites from mother to foetus. *T. gondii* is a significant cause of foetal death and resorption, abortion, and stillbirth in ewes and goats; which are particularly at risk when moved late in pregnancy to areas heavily contaminated with cat faeces (e.g. barns).

Toxoplasmosis is an important zoonosis and a major concern for people with immunosuppression and pregnant women (tachyzoites can migrate across the placenta and cause birth defects). Infection of women with *Toxoplasma* may occur by the methods outlined above or through contact with infected materials produced in ovine/caprine abortions.

During 2014, DAFM diagnosed toxoplasmosis as the cause of abortion in 55 flocks.

Surveillance of epizootic diseases

The health status of animals in the island of Ireland benefits from our island status and the geographical buffer provided by Great Britain and Western Europe. However, there is a real threat posed by diseases with the potential to spread rapidly, damage animal and human health, and affect trade. Trade globalisation has led to more frequent and longer distance movement of animals, animal products and people, while the international disease situation has in many cases deteriorated.

Ireland and Northern Ireland carry out on-going surveillance for such diseases under a range of programs, each tailored to the specific risk factors relevant to the disease. These activities are reported to the World Organisation for Animal Health (OIE) under international membership obligations, and fulfil an essential role in providing our trade partners and stakeholders with confidence in our disease status. In addition, they form a critical early warning system which, in the event of an outbreak, would be a crucial factor in disease detection and control.

Avian influenza

No cases of avian influenza were detected in Ireland during 2014. 27,718 serum samples from commercial poultry flocks were tested for antibodies to H5/H7 influenza. One hundred and sixty-six samples were tested using virus isolation and 415 samples were tested by PCR. No positives were detected.

Newcastle disease

No cases of Newcastle disease were detected in Ireland during 2014. One hundred and sixty-six samples were tested using virus isolation and 365 samples were tested by PCR. Paramyxovirus 1 (PMV-1), the aetiological agent for Newcastle

disease, was isolated in 2 occasions, one in chicken and one in turkey, and in both cases genetic sequencing of the isolates showed they were lentogenic vaccinal virus.

Bluetongue

During 2014 in Northern Ireland, a surveillance sample of 2,600 indigenous cattle was tested for bluetongue (BT) antibody during 2014, none of which were positive. Two imported cattle were tested by BT virus PCR. Both were negative.

During 2014 in Ireland, 233 imported cattle were tested for BT antibodies, with 21 testing positive. Thirty-three cattle were tested by PCR for BT, with no positives. Two hundred and ninety-one deer were tested for antibodies to BT, with no positives detected. Thirteen imported sheep were tested for antibodies, and 10 of them were positive. Three sheep were tested by PCR, with no positives detected.

Enzootic bovine leucosis

In Ireland 1,366 sera were tested for antibodies to EBL during 2014 and three suspect cases (bovine tumours) were tested by PCR. No positives were detected.

Bovine spongiform encephalopathy

In Ireland, no BSE cases were detected during 2014. Thirteen suspect cases were confirmed negative by the National Reference Laboratory. For Northern Ireland in 2014 there were no confirmed cases of BSE. One clinical suspect submission was confirmed as negative by the laboratory.

Foot-and-mouth disease

There were no suspect cases of FMD in Ireland or Northern Ireland during 2014.

Classical swine fever

During 2014 in Ireland, 1751 samples of porcine sera were tested for antibodies to CSF by ELISA and no positives were detected. A total of 85 samples were also tested for CSF PCR and no positives were detected.

African swine fever

During 2014 in Ireland, 79 samples were tested for ASF virus by PCR and 42 were tested for ASF antibody by ELISA. No positives were detected.

A selection of abstracts from published scientific papers

JOSE MARÍA LOZANO

Influence of modifiable risk factors on the incidence of stillbirth/perinatal mortality in dairy cattle

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Bovine perinatal mortality is defined as the death of a full-term calf before, during or up to 48 h after calving. Recent studies indicate that the prevalence of bovine perinatal mortality is increasing, particularly in Holstein primiparae. Factors leading to a greater incidence of dystocia are the most important modifiable variables influencing the risk of perinatal mortality. Modifiable predictors are largely (age at first calving, breeding method, sire, calving management, feto-maternal health status and gestational nutrition) or moderately (calf breed, sex, gestation length) under the control of the dairy farm manager. Unlike non-modifiable

risk factors, such as primiparity and fetal plurality, these factors can be manipulated to reduce the incidence of perinatal mortality.

Bovine paramphistomes in Ireland

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Paramphistome infections have been associated with significant morbidity, caused chiefly by the activity of juvenile flukes in the intestine of the ruminant final host. Most cases have been reported in tropical and sub-tropical areas. However, recent reports of an apparent increase in the incidence of rumen fluke and its geographical range in Europe have renewed interest in a parasite previously thought to be of little significance in temperate regions. Moreover, the identity of rumen flukes present in the British Isles is currently being revised. As a result, work is underway throughout Europe to review and re-assess the clinical and economic significance of rumen flukes. During the present study, historical diagnostic laboratory records were interrogated for recent changes in the incidence of rumen fluke in Ireland. Three cattle herds were monitored for the presence of paramphistome eggs using coprological analysis over a period of 2 months (in the case of a group of housed steers) and 14 months (in the case of

two extensively operated farms), respectively. Adult rumen fluke collected following slaughter were weighed and typed in two loci. We found that *Calicophoron daubneyi* is the most common if not only paramphistome species present in Ireland and that infections in cattle are now much more prevalent than was the case five or six years ago. The phylogenetic relationship of our isolates to the only published sequence and to *C. daubneyi* isolates from Northern Ireland was analysed. Genetic heterogeneity was similar all over the island and comparable to that of *Fasciola hepatica*, a fact that may have implications for the parasite's ability to develop resistance to the very limited number of drugs currently available for treatment. The same haplotypes predominated throughout the island. Although the clinical significance of *C. daubneyi* is still uncertain, considering the apparent pervasiveness of the parasite, rumen fluke should be considered a differential diagnosis when treating scour or ill-thrift in young calves, and goats and sheep of any age.

High level of treatment failure with commonly used anthelmintics on Irish sheep farms

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Background:

In 2013 a Technology Adoption Program for sheep farmers was established to encourage the implementation of best management practices on sheep farms in Ireland. There were 4,500 participants in this programme in 2013. As part of this programme, farmers had the option to carry out a drench test to establish the efficacy of their anthelmintic treatment.

Results:

Flock faecal samples were collected before and after treatment administration and gastrointestinal nematode eggs enumerated. In total there were 1,893 participants in the task, however only 1,585 included both a pre- and post-treatment faecal sample. Of those, 1,308 provided information on the anthelmintic product that they used with 46%, 23% and 28% using a benzimidazole (BZ), levamisole (LEV) and macrocyclic lactone (ML) product respectively. The remaining farmers used a product inapplicable for inclusion in the task such as a flukicide or BZ/LEV combination product. Samples were included for analysis of drench efficacy if the pre-treatment flock egg count was ≥ 200 eggs per gram and the interval post-sampling was 10–14 days for BZ products, 4–7 days for LEV products and 14–18 days for ML products. These criteria reduced the number of valid tests to 369, 19.5% of all tests conducted. If the reduction post-treatment was $\geq 95\%$ the treatment was considered effective. Only 51% of treatments were considered effective using this criterion. There was a significant difference in efficacy between the anthelmintic drug classes with BZ effective in only

30% of treatments, LEV effective in 52% of cases and ML effective in 76% of cases.

Conclusions:

Gastrointestinal nematode anthelmintic treatments, as practiced on Irish farms, have a high failure rate. There was a significant difference between the efficacies of the anthelmintic classes with BZ the least effective and ML the most effective.

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