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Animal Health Surveillance QUARTERLY

Newsletter of Australia's National Animal Health Information System

Message from the Australian Chief Veterinary Officer

Dr Mark Schipp
Australian Chief Veterinary Officer

Welcome to the fourth and final edition of *Animal Health Surveillance Quarterly* for 2016.

As 2016 drew to a close, the 5th Australasian Veterinary Education Forum of the Australasian Veterinary Boards Council was held in Melbourne. The VET2031 theme focused on futures methods to imagine the year 2031 and the place of veterinary graduates in that society. This provided an opportunity for veterinary schools, veterinary boards, government officials and younger veterinarians to consider the direction of veterinary education and preparation for the future.

I participated in the One Health EcoHealth 2016 International Congress on 4–7 December in Melbourne. This showcased strategies and approaches for understanding and improving the health of people, animals and ecosystems and reducing global risks. It brought together the One Health and EcoHealth communities and aimed to create an inclusive platform for collaboration and scientific debate between the different sectors for mutual benefit in the future.

Before the congress, I presented at its Dogs and People workshop, which focused on mastering stakeholder engagement. With local and international speakers, a range of perspectives and experiences were shared, highlighting the importance of well-considered and fit-for-purpose stakeholder involvement for successful and sustainable future outcomes.

The end of this quarter marks the end of my 1-year term as chair of Animal Health Committee (AHC). AHC provides national leadership and develops science-based and nationally consistent policy on animal health issues. During the year, AHC identified surveillance and traceability as key priorities to support Australian industries and trade, enhance emergency preparedness and maintain our favourable animal health status. I encourage you to read more about AHC and its work through its newsletter, Vetcommuniqué[1].

This quarter has provided opportunities to both reflect on the work of 2016, and importantly, plan activities that may support positive outcomes in the future.

1 www.agriculture.gov.au/animal/health/committees/communique

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Animal Health Surveillance Quarterly is a veterinary science publication that provides a topical summary of animal health matters and reports of animal health surveillance activities undertaken in Australia during the previous 3-month period. As part of the National Animal Health Information System (NAHIS), this report contributes to Australia's annual animal health report to the World Organisation for Animal Health (OIE).

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Mycoplasma mastitis in Tasmania

Sue Martin, Tasmanian Department of Primary Industries, Parks, Water and Environment (DPIPWE)

***Mycoplasma bovis*, formerly referred to as *Mycoplasma agalactiae* subsp. *bovis*, is a significant, costly and highly contagious pathogen of cattle worldwide. *M. bovis* has been known to cause mastitis, pneumonia and arthritis in cattle, as well as abortion, otitis media, meningitis and keratoconjunctivitis.**

M. bovis was first isolated in the US in 1961 in a bovine mastitis case, and it was first reported in Australia 9 years later.

Tasmanian data

The Department of Primary Industries, Parks, Water and Environment (DPIPWE) has been recording *M. bovis* infections in Tasmania since 1990.

Of submissions to the Animal Health Laboratory, Launceston, from disease investigations and follow-up surveillance for the past 5 years (2012 to 2016 inclusive), *M. bovis* has been detected in 55 cases representing 25 individual cattle herds. Of these, 24 were dairy herds.

Assessment of submissions made to the Animal Health Laboratory showed that the majority of *M. bovis* detections involve mastitis as the primary clinical presentation yet the organism remains a relatively minor contributor to mastitis. *M. bovis* has only been detected in an average of 4.2% of 976 bovine milk submissions since 2012. The annual average percentage of positive detections ranged from 1.7 to 10.5% between 2012 to 2016. *M. bovis* has rarely been isolated on culture as the sole pathogen in mastitis cases, with only eight confirmed in the past 5 years in Tasmania.

Organism characteristics

Most *mycoplasma* species are susceptible to desiccation and sunlight but only *M. bovis* can survive for long periods in the environment in cool humid conditions.

M. bovis is capable of colonising and surviving in the upper respiratory tract and vagina, and can survive in the presence of large numbers of leukocytes in the milk, which results in a highly contagious, purulent interstitial mastitis.

Outbreaks of mastitis may occur concurrently with outbreaks of vaginitis and vestibulitis. *Mycoplasma* mastitis may be associated with an increased incidence of arthritis, pneumonia and occasionally abortion due to haematogenous spread of the organism.

Transmission and outbreaks

It is thought that *mycoplasma* mastitis develops either by *M. bovis* infection disseminating from upper respiratory tract exposure and colonisation to the mammary gland (*M. bovis* has been isolated from nasal secretions of cows with mastitis), or introduced into the teat canal via fomites, including milking equipment, sponges, teat dip, hands and washcloths.

The organism can persist for months in the mammary gland. Some cows become shedders of *M. bovis* without experiencing severe clinical mastitis.

Aerosol transmission of *M. bovis* is possible.

Once the organism is in the mammary gland, disease spreads rapidly from the infected quarter to all other quarters. Cows of all ages and any stage of lactation may become infected. Those in early lactation are generally the most severely affected, and dry cows the least affected.

Bulk mastitis treatments dispensed via a common cannula and poor hygiene management promote rapid transmission of the organism within a herd.

Outbreaks of *mycoplasma* mastitis most commonly occur in large herds where cows are brought in from other farms or from public saleyards without any quarantine procedures in place, and where milking hygiene practices are suboptimal. Outbreaks

usually occur weeks or months after an infected animal is introduced into a herd.

Clinical signs and diagnosis

The clinical signs of mycoplasma mastitis include a sudden marked drop in milk production, gross abnormality of the milk without obvious signs of systemic illness (other than mild fever in recently calved cows) and a mostly smooth, almost painless swelling of the udder in lactating cows. The milk yield in high producing cows may fall to almost nil between one milking and the next, and in most cases all four quarters will be affected.

Initially milk from affected quarters may appear normal but on standing, a fine sandy or flocculated deposit may settle out, leaving a whey-like supernatant. Within a few days, the secretion is typically tan to brown with flaky sediments in a watery fluid. There are generally no firm clots. Leukocyte counts in the milk are very high (usually more than 20 million per mL).[2]

Response to treatment is poor. Swollen udders may become grossly atrophied and many do not return to production so the economic impacts of the disease can be severe. Although clinical signs tend to be most obvious following recent infection, the disease may persist in herds over a prolonged period of time, with clinically healthy cows shedding the organism in their milk. Control of the disease relies on early identification of the pathogen.

A presumptive diagnosis of mycoplasma mastitis can be made on clinical grounds due to the unusual characteristic clinical findings but confirmation by polymerase chain reaction (PCR) testing and/or culture is needed. Mycoplasma culture is a highly sensitive test for identifying *M. bovis* in clinical samples and, unlike some other diagnostic tests, can also be used to identify other species of *Mycoplasma*. But it requires specialised reagents and has a labour-intensive process and long wait times for results.

M. bovis can be detected directly from milk and tissue samples using a specific real-time PCR assay targeting the uvrC gene. The PCR sequence discriminates against *Mycoplasma leachii* (formerly *Mycoplasma* sp. serogroup 7), a closely related *Mycoplasma*. This PCR assay is equivalent to the culture technique in terms of sensitivity, with the advantage that it only takes hours to yield results compared to weeks with conventional cultures.

Serology testing, such as the enzyme-linked immunosorbent assay (ELISA), is not useful for routine diagnosis due to the high seroprevalence with a population but its high specificity means it can be a useful diagnostic tool to identify *M. bovis*-free herds.[3]

Prevention and treatment

Currently there are no commercially available vaccines in Australia effective for *M. bovis* infections and all currently approved antibiotics for mastitis (intramammary or systemic) are ineffective at killing *M. bovis.*

Any animal discovered to be infected, even if they appear to spontaneously resolve, should be considered infected for life. Culling all positive cows is the only effective way to control *M. bovis*-induced mastitis in a dairy herd.

Affected animals should be culled immediately or placed in strict isolation until sale because the disease spreads so rapidly.

All new cows should be quarantined and tested before being introduced into the herd, to prevent introduction of *M. bovis* into a naïve population.

Sound hygiene management practices should be in place to prevent spread of *M. bovis* should it unexpectedly infect the herd.

Once eradicated, bulk milk cell counts are a useful monitoring tool but frequent bulk milk PCR sampling is recommended for surveillance in problem herds and areas.

2 Radostits, OM, Gay, CC, Blood DC & Hinchcliff, KW (Eds) 2000, *Veterinary Medicine: A textbook of the diseases of cattle, sheep, pigs, goats and horses*, 9th Edition, Harcourt Publishers Ltd, London, pg. 637.

3 Wawegama NK, Markham PF, Kanci A, Schibrowski M, Oswin S, Barnes TS, Firestone SM, Mahony TJ & Browning GF 2016, Evaluation of an IgG ELISA as a serological assay for detection of *Mycoplasma bovis* infection in feedlot cattle, *Journal of Clinical Microbiology* JCM-02492-15.

New biosecurity laws strengthen protection in Queensland

Janine Barrett, Queensland Department of Agriculture and Fisheries

New laws introduced in Queensland on 1 July 2016 ensure a modern risk-based approach to biosecurity.

Previous biosecurity legislation was out of date, inconsistent and lacked the flexibility required to enable rapid responses to changing risks. Globally we face more biosecurity threats due to increased global travel, rising trade in animal and plant products and diversity of land use.

The *Biosecurity Act 2014* improves Queensland's capability to prevent and respond to animal disease, and the health risks associated with zoonoses.

The new tools and powers of the Act allow the Queensland Government's response to be tailored to the nature and challenge of each specific biosecurity threat.

Authorised officers have more flexibility in working with the community, allowing them to deliver better services with fewer disruptions and lower costs to the community. Decisions made under the Act will depend on the likelihood and consequences of the risk, helping us to manage risks more appropriately.

General Biosecurity Obligation

The new Act makes it clear that biosecurity is everybody's business. Introduction of the general biosecurity obligation (GBO) requires everyone to take reasonable and practical steps to prevent or minimise biosecurity risks to the economy, agricultural and tourism industries, the environment and our lifestyle. People do not need to know about all biosecurity risks but they are expected to know about the risks associated with their day-to-day work and hobbies.

To meet the GBO, people in Queensland need to:

- take all reasonable and practical steps to prevent or minimise each biosecurity risk
- minimise the likelihood of the risk causing a biosecurity event, and limit the consequences of such an event
- prevent or minimise the adverse effects the risk could have, and refrain from doing anything that might exacerbate those adverse effects.

A biosecurity risk exists when dealing with any pest, disease or contaminant, or with something that could carry one of these. This includes moving or keeping a pest, disease or contaminant, or animals, plants, soil and equipment that could carry a pest, disease or contaminant.

A biosecurity event is caused by a pest, disease or contaminant that is, or is likely to become, a significant problem for human health, social amenity, the economy or the environment.

Specific requirements

In some cases, specific requirements are prescribed for a particular risk because of the likelihood and seriousness of the consequences. These include arrangements for treating pests, diseases, contaminants and carriers, restrictions on moving them inside or outside a biosecurity zone, or a mandatory code of practice for reducing risk.

Specific requirements are not provided for all situations because that would remove flexibility to innovate and find better ways of managing risks. Nor is it practical to prescribe specific requirements for every potential biosecurity threat in every possible circumstance.

Everyone in Queensland needs to take an active role in managing the biosecurity risks under their control. If a person's activities are likely to pose a biosecurity risk, they are expected to know about the risks posed by what they do, and to ensure they do not spread pests, diseases or contaminants.

Reasonable and practical steps

What are 'reasonable and practical steps' will depend on the risk and the circumstances, including:

- the likelihood of the risk occurring (more action is expected for risks that occur more often)
- the adverse impact it could have (more action is expected for potentially serious impacts, such as human deaths, extensive productivity losses or other significant economic or community losses)
- what the person knows, or should reasonably be expected to know, about the risk (a person should know how dangerous the pests and diseases associated with their activities potentially are and how those pests and diseases are spread)
- ways to minimise the risk, including equipment and work practices.

Additional considerations may include:

- how effective a particular action would be in reducing the risk
- how feasible and expensive it would be
- whether the cost is grossly disproportionate to the risk.

Guidance on what is reasonable and practical has been provided in many ways, including through web pages, fact sheets and demonstrations, together with new forms, procedures, guidelines and systems to meet people's needs.

Continued obligations and fresh approaches

There continue to be obligations for registering stock animals, reporting their movements to allow for disease tracing and telling inspectors of suspect notifiable pests, diseases and events. There are biosecurity orders, zones, movement controls and emergency order areas that can be used to help manage, reduce or eradicate pests or diseases (e.g. cattle tick, white spot disease in prawns) across all or part of the state.

There is now more scope for industry initiatives, including establishment of compliance agreements and industry accreditation schemes, which use industry knowledge about best practice risk management for their unique circumstances.

The new biosecurity laws in Queensland have introduced new concepts and fresh approaches to provide stronger and more flexible protection for agriculture, the environment and the community.

Queensland biosecurity inspector inspecting cattle

Livestock disease recognition and reporting survey in Western Australia

Marion Seymour, Jamie Finkelstein, Leo Loth, Katie Webb and Suzy Norton, Department of Agriculture and Food, Western Australia

If an outbreak of an emergency animal disease were to occur in Australia, early detection would be essential to limit the spread of disease and facilitate control and eradication.

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) modelled that the cost to Australia of an outbreak of foot-and-mouth disease (FMD) would reduce from $52 billion (over 10 years for a large multistate outbreak) to $6 billion if the disease was detected early and limited in its extent of spread at the time of detection.[4]

An effective animal health surveillance system is essential for this early detection, should an incursion occur, and for demonstrating proof of freedom from emergency animal diseases.

The Department of Agriculture and Food, Western Australia (DAFWA) is implementing activities that aim to reduce the amount of time it would take to detect an outbreak of a reportable disease, by building capability to recognise and report suspicion of disease.

To inform the implementation of these activities and to ensure that they are delivered most effectively for all Western Australian livestock industry stakeholders, DAFWA conducted a structured survey to:

- obtain an increased understanding of Western Australian livestock farmers' knowledge of—and attitudes towards—reporting suspicion of emergency animal diseases, such as FMD
- identify the key drivers and barriers in livestock disease reporting.

Our approach

DAFWA used stratified random sampling to select Western Australian commercial cattle, goat, pig and sheep producers using the DAFWA Stock Brand and PIC (property identification code) Register database.[5] Farm properties were stratified by agricultural region and then, to target commercial producers, only properties with at least 50 sheep or goats, 20 pigs or 10 cattle were included in the sampling frame.

To achieve a target of 300 responses, we randomly selected approximately 3000 livestock producers, taking into account an anticipated response rate of 10% based on literature review. The number of samples selected from each agricultural region was representative of the total number of properties with cattle, goats, pigs and sheep within each region of the state.

Summary of responses

Of the 3000 selected farmers, 454 responded and completed all or parts of the survey. Our analysis of the results showed that Western Australian farmers:

- know the signs of FMD (more than 75% of participants selected FMD correctly)
- understand the necessity to report early [81%, 77–85% at 95% confidence interval (CI)] to an appropriate person/organisation (96%, 94–98% at 95% CI).

We have summarised the responses from survey respondents.

1. **What type of livestock do you currently have on your property?** Respondents farmed sheep 68.3%, beef cattle 58.6%, goats 17.7%, dairy cattle 17.0% and pigs 15.9% (farms could stock more than one species).
2. **You observe your livestock and notice that some are lame or reluctant to move. For each option, please indicate if you would be likely to contact a veterinarian. (Options: 1%, 5%, 10% and 20% incidence levels.)** If only 1% of the livestock group was affected, most respondents (83–95%, binomial CI 78–87%) indicated they would not contact a veterinarian. With 5% or more of the group affected, at least 63% (CI 58–69%) of respondents would report these signs to a veterinarian (Figure 1).

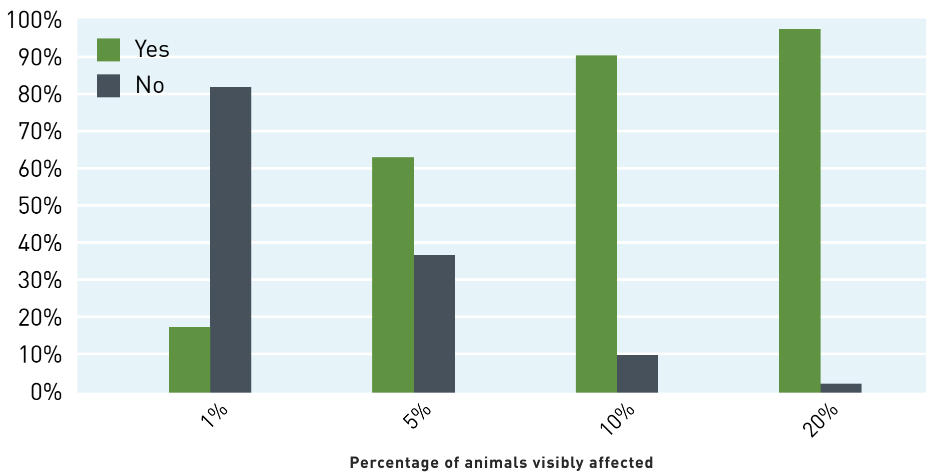


Figure 1 Likelihood to contact a veterinarian by incidence of animals lame or reluctant to move, 2016

4 Buetre, B, Wicks, S, Kruger, H, Millist, N, Yainshet, A, Garner, G, Duncan, A, Abdalla, A, Trestrail, C, Hatt, M, Thompson, LJ & Symes, M 2013, *Potential Socioeconomic Impacts of an Outbreak of Foot-and-mouth Disease in Australia*, ABARES research report, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra, September. CC BY 3.0

5 spatial.agric.wa.gov.au/brands/scripts/QueryPIC.asp

3. **Imagine you observe your livestock and notice some are drooling from the mouth, they are reluctant to move and seem lethargic. Please indicate if you would be likely to contact a veterinarian if the following number of livestock is affected? (Options: 1%, 5%, 10% and 20% incidence levels.)**
If only 1% of the livestock group was affected, most (67%, CI 62–72%) would not report these signs to a veterinarian. With 5% or more of the group affected, at least 81% (CI 77–85%) would report (Figure 2).

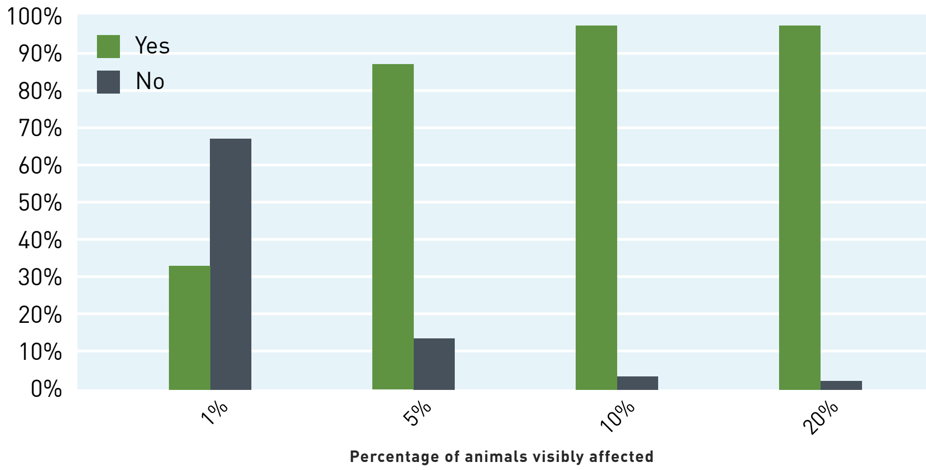


Figure 2 Likelihood to contact a veterinarian by incidence of animals drooling from the mouth, reluctant to move and seemingly lethargic, 2016

4. **Australia is currently free from the livestock disease, FMD. If FMD did occur in Western Australia, is it likely this would impact on any of the following? (Options: livestock movements, chicken meat and egg industries, livestock sales, the horse industry, the Australian economy, livestock and livestock product export markets, your farming business profit, tourism.)**
More than 95% of respondents identified the severe impact FMD would have on livestock movements and sales, the Australian economy, export markets and farm profitability.

5. **Which of the following livestock are affected by FMD? (Options: cattle, goats, horses, pigs, poultry, sheep.)**
Most respondents correctly identified cattle and sheep (> 84%, CI 80–87%) and pigs and goats (> 62%, CI 57–67%) but incorrectly horses (33%, CI 28–37%).

6. **If your livestock had FMD, what signs of disease would you expect to see in livestock? (Options: abnormal breathing, diarrhoea drooling and slobbering, high death rates in very young stock, lameness, swollen joints, or blisters/ulcers in or around the mouth/feet.)**
More than 75% of respondents selected the FMD symptoms of blisters, lameness and salivation, and 42% (CI 37–47%) correctly identified high death rate in very young stock.

7. **If you noticed unusual signs of disease in your livestock, where would you obtain advice? (Options: neighbours or friends, family members, agricultural producer groups, veterinarian, stock agent, agricultural consultant, DAFWA staff, Emergency Animal Disease Watch Hotline, DAFWA website, internet or social media.)**
Contacting a veterinarian ranked the highest (96%, CI 94–98%), followed by DAFWA staff and the internet (both 75%). Friends, family, stock agents and consultants would also be asked for advice (> 40%).

8. **Have you contacted a veterinarian in the past 5 years about livestock disease?**
192 respondents (51%, CI 46–57%) said they had contacted a veterinarian in the past 5 years.

9. **When you contacted a veterinarian in the past about livestock disease, what were the main reasons that prompted you to call them?**
Enquiries were made about large number of sick animals (48/192), death (64/192), signs of disease (99/192) and/or animal welfare (128/192 respondents).

10. **On occasions when you observed signs of disease in your livestock but did not contact a veterinarian, please indicate what the main reasons were.**
More than 70% felt that they knew the cause of the disease and were confident that they could manage the issue.

11. **In your opinion, what are the reasons for livestock producers and veterinarians to investigate livestock disease?**
More than 85% of respondents identified market access, minimising disease impact, food safety, improving production, animal welfare and surveillance as reasons.

12. **About how often do you access information about livestock health and disease from the following sources? (Options: local workshops, meetings or field days, rural newspapers/magazines, radio interviews, DAFWA email newsletters, non-DAFWA email newsletters, DAFWA website, non-DAFWA websites, DAFWA Twitter, DAFWA Facebook, DAFWA YouTube, other DAFWA social media.)**
Printed media (34%) and radio (20%) were accessed weekly (Figure 3).

13. **Which of the following devices do you use to connect to the internet? (Options: computer, iPad/tablet or smart phone.)**
The computer was mostly used (94%, CI 91–96%) to access the internet, followed by a smart phone (55%) and tablet or iPad (44%).

14. **Please specify how often you use the following social media tools? (Options: Facebook, Twitter, YouTube, LinkedIn, apps.)**
More than 50% of all respondents never used Facebook or YouTube. More than 85% of respondents never used Twitter or LinkedIn.

Discussion

The results indicate that it is highly likely that livestock farmers would recognise signs of a reportable disease such as FMD in their animals and that they would report this to a veterinarian. Likely endemic diseases with small numbers of animals affected were unlikely to be reported.

The survey identifies the local veterinarian as the most trusted and consulted person on animal health and production. In 2014, a national survey reported similar findings.[6] 51% of respondents indicated they had contacted their veterinarian in the past 5 years.

Farming information is still sought through more traditional communication channels (radio, newspapers and special interest magazines). Social media was not frequently used to gather animal health information by the producers surveyed. These findings are important when selecting the most effective media sources to inform the farming community.

6 AHA & PHA 2014, *Vets a Trusted Source for Producers—4 July 2014*, Farm Biosecurity website, Animal Health Australia (AHA) and Plant Health Australia (PHA), Canberra www.farmbiosecurity.com.au/vets-a-trusted-source-for-producers

Although these results indicate that communications with producers to date have been effective, capacity building in disease detection needs to continue. DAFWA intends to repeat this survey to continue to monitor livestock farmers' knowledge of and attitudes towards reporting emergency animal diseases, such as FMD, and to continue to monitor the key drivers and barriers in livestock disease reporting.

DAFWA attempted to minimise response bias by using a standardised survey questionnaire that involved a representative sample of the Western Australian livestock farming community. It was, however, not completely possible to avoid leading questions with the multiple-choice structure of the questionnaire.

Recognising that the number of livestock carried on a property varies across the regions, the most frequently reported population sizes for beef cattle, goats and sheep were consistent with existing understanding of Western Australian livestock management systems. However, with the small sample size, the herd sizes of the dairy cattle and pig producers may not be indicative of the commercial herd sizes and this could not be accounted for in the interpretation of the data.

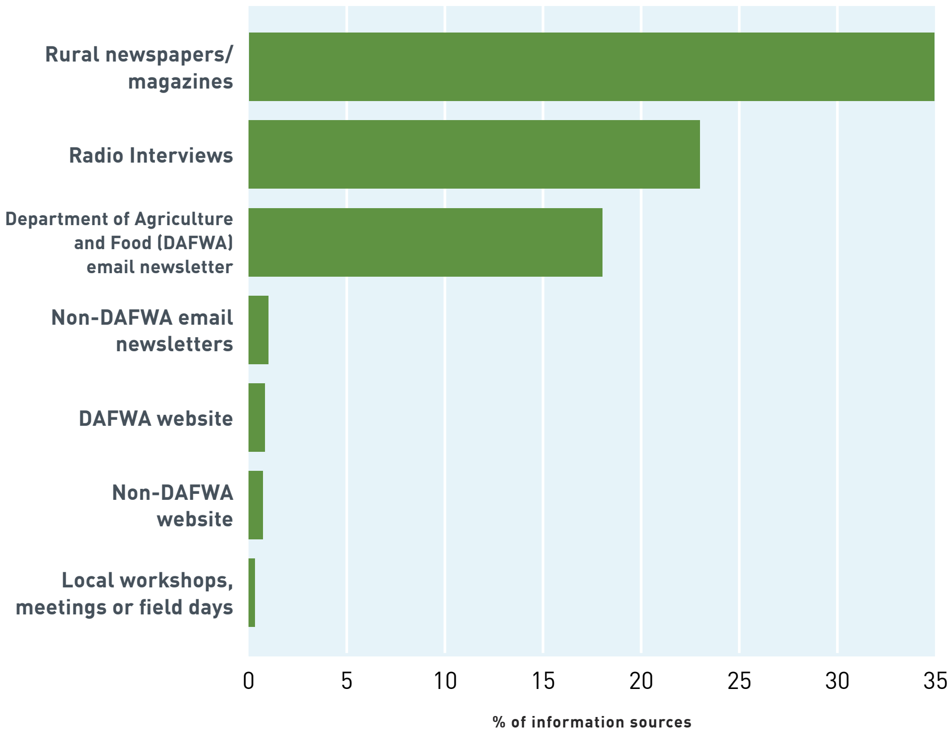


Figure 3 Information sources accessed at least once per month for animal health and disease reasons, 2016

Unusual liver disease in young dogs

Kevin de Witte, Chief Veterinary Officer, Northern Territory Department of Primary Industry and Resources

In late August 2016, a private veterinarian alerted the Department of Primary Industry and Resources (DPIR) to an unusual presentation of unexplained and severe liver failure and ascites in three young dogs.

The affected dogs belonged to various owners from various rural properties within a 5 km radius in the Darwin rural area. The three cases occurred within a 6-week period. Liver disease is unusual in young dogs, and, up until shortly before their death, mild illness had been noted only in some of the animals.

After investigation and liaison with other private veterinarians in the area, the DPIR identified a further six cases consistent with the case definition of 'any young dog in the Darwin region with unexplained ascites and liver failure since August 2016'. Of the nine known cases, five dogs had died or been euthanased because of a lack of cost-effective treatment options and poor prognosis. The dogs were all large breed and aged between 4 months and 5 years. The main presenting sign in all dogs was severe abdominal distention, of between a few days to 6 weeks duration.

Haematology from six of the cases showed mild nonregenerative anaemia, with mild-to-moderate elevations in bilirubin, alkaline phosphatase and gamma-glutamyl transferase and low serum albumin. Some of the dogs displayed low but normal blood urea nitrogen levels, likely due to hepatic dysfunction.

Necropsy of three cases revealed the main findings to be severe ascites, with the fluid being watery and either clear or blood-tinged, and firm slightly shrunken liver (Figure 4). Histopathological examination of liver tissue has shown a consistent moderate-to-severe chronic diffuse hepatic fibrosis, as a sequel to a significant degree of hepatic necrosis, with no evidence of inflammatory or neoplastic disease occurring. In addition to this finding, one case displayed acute gastroduodenal ulceration, while two cases had other no notable findings (Figure 5 and Figure 6).

With the apparent minimal inflammatory nature of the liver lesions, a limited source hepatotoxin is suspected, although the nature of the liver lesions is not suggestive of a specific toxin. As yet, no common source of possible toxin exposure has been identified but it is considered that the most likely route of intoxication was by ingestion. History, gross and histopathological examination has excluded common toxicoses, such as aflatoxin, cycad palm, blue-green algae and toxic mushroom, infectious canine hepatitis and leptospirosis.

The last known case occurred in late November 2016. Other similar age dogs from the affected households, including siblings of affected dogs, remain clinically healthy so an infectious aetiology is deemed less likely. However, since the lesions were chronic at the time of presentation, a prior infection causing liver necrosis and fibrosis has not been definitively ruled out. Referral viral testing on liver and serum using general mammalian isolation at the CSIRO Australian Animal Health Laboratory has so far failed to detect a viral cause in samples submitted from four of the cases.

The DPIR continues to liaise with private veterinarians and is investigating any terminal cases submitted to Berrimah Veterinary Laboratory for their potential public health and animal health significance.

There are no known associated human health concerns. Dog owners are advised to monitor their animals closely and contact their regular veterinarian if they are concerned about any signs of ill health.

Figure 4 Gross image of liver. The liver was small, diffusely firm and bronze in colour, with vague patchy red discolouration. The liver had a slight rugose feel to the surface, and diffusely there was an exaggerated zonal pattern. Fibrin tags between diaphragm and liver.

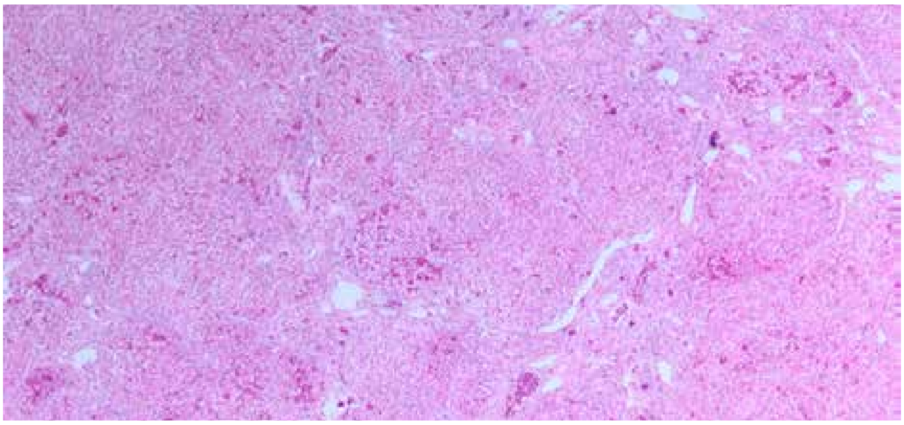


Figure 5 Liver histology of affected dog (hematoxylin and eosin stain). The normal lobular architecture has been replaced by disorganised islands of hepatocytes separated by fibrous tissue. Lymphatic vessels are distended.

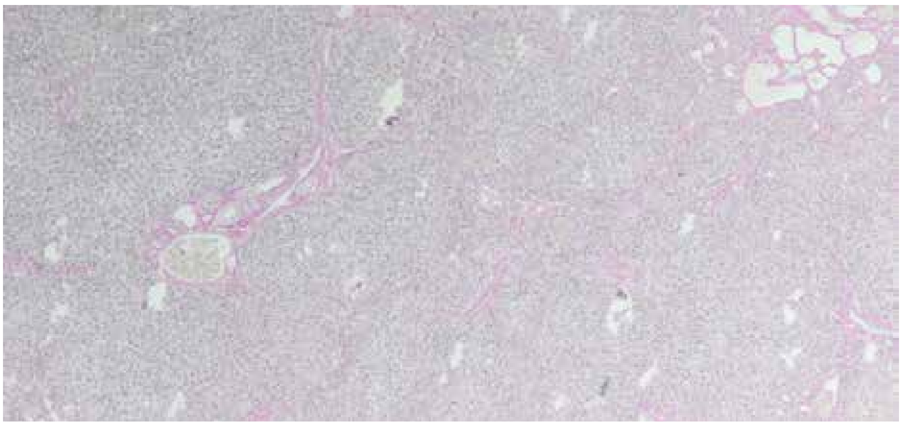


Figure 6 Liver histology of affected dog (Van Geisen stain). Note pink staining of fibrous tissue.

Wildlife Health Australia

Tiggy Grillo, Keren Cox-Witton, Sam Gilchrist and Silvia Ban, Wildlife Health Australia; and Iain East, Australian Government Department of Agriculture and Water Resources

Wildlife Health Australia (WHA) is the peak body for wildlife health in Australia. WHA was established as the Australian Wildlife Health Network in 2002 as an Australian Government initiative to coordinate wildlife health surveillance information across Australia, to support Australia's animal health industries, human health, biodiversity, trade and tourism. WHA collates information from multiple sources into a national database—[Wildlife Health Information System (eWHIS)](http://www.wildlifehealthaustralia.com.au/ProgramsProjects/eWHISWildlifeHealthInformationSystem.aspx)[7]—including submissions by WHA subscribers, state and territory WHA coordinators, researchers, and university, zoo and sentinel clinic veterinarians. During the quarter, 278 wildlife disease investigation events were reported into eWHIS (Table 1). This report details some of the disease and mortality events in free-living wildlife recorded in eWHIS this quarter. WHA thanks all those who submitted information for this report.

Wild bird mortality events—Newcastle disease and avian influenza exclusion

WHA received 78 reports of wild bird mortality or morbidity investigations from around Australia during the quarter; investigations may involve a single animal or multiple animals (e.g. mass mortality event). A breakdown of the bird orders represented is presented in Table 2. Reports and samples from sick and dead birds are received from members of the public, private practitioners, universities, zoo wildlife clinics and wildlife sanctuaries. Avian influenza (AI) was excluded by polymerase chain reaction (PCR) testing for influenza A in 16 of the events as part of Australia's general (sick and dead bird) AI surveillance program. AI exclusion testing was not warranted in the remaining 62 events, based on clinical signs, history, prevailing environmental conditions or other diagnoses. In addition, avian paramyxovirus was excluded in 14 events by PCR testing specific for Newcastle disease (ND) virus and/or pigeon paramyxovirus 1 (PPMV-1).

Table 2 Wild bird disease investigations reported into eWHIS, October to December 2016

Bird order	Common name for bird order[a]	Events reported[b]
Anseriformes	Magpie geese, ducks, geese and swans	6
Columbiformes	Doves and pigeons	2
Falconiformes	Falcons	2
Passeriformes	Passerines or perching birds	29
Pelecaniformes	Ibis, herons and pelicans	3
Psittaciformes	Parrots and cockatoos	37

a Common names adapted from: del Hoyo, J & Collar, NJ 2014, *HBW and BirdLife International Illustrated Checklist of the Birds of the World, Volume 1—Non-passerines*, Lynx Editions, Barcelona (courtesy of the Australian Government Department of the Environment and Energy).

b Disease investigations may involve a single or multiple bird orders (e.g. mass mortality event). This quarter there was one wild bird event which involved multiple bird orders, which were Columbiformes and Passeriformes.

7 www.wildlifehealthaustralia.com.au/ProgramsProjects/eWHISWildlifeHealthInformationSystem.aspx

Table 1 Number of disease investigations reported into eWHIS, October to December 2016[a]

Bats[b]	Birds	Feral animals	Lizards & snakes	Marine mammals	Marine turtles	Marsupials	Monotremes
135	78	8	2	2	1	51	1

a Disease investigations may involve a single animal or multiple animals (e.g. mass mortality event).

b The majority of bat disease investigations are single bats submitted for Australian bat lyssavirus testing.

Avian influenza surveillance

Australia's National Avian Influenza Wild Bird (NAIWB) Surveillance Program comprises two sampling components: pathogen-specific risk-based surveillance by sampling of apparently healthy, live and hunter-killed wild birds; and general surveillance by investigating significant unexplained morbidity and mortality events in wild birds, including captive and wild birds within zoo grounds (with a focus on exclusion testing for AI virus subtypes H5 and H7). Samples from sick or dead birds were discussed earlier. Sources for targeted wild bird surveillance data include state and territory government laboratories, universities and samples collected through the Northern Australia Quarantine Strategy.

During the quarter, pathogen-specific risk-based surveillance occurred at sites in Queensland, South Australia and Western Australia, with cloacal and faecal environmental swabs collected from 759 waterbirds. Results are pending.

Salmonella isolated in mass mortalities involving house sparrows and spotted turtle-doves

In October 2016, more than 30 birds were found dead within the grounds of a pet shelter in an inner Melbourne suburb. Daily mortalities of house sparrows (*Passer domesticus*) and at least two dead spotted turtle-doves (*Streptopelia chinensis*) presented dead or moribund over a period of more than 1 month.

Dead birds were submitted to the Victorian veterinary diagnostic laboratory, AgriBio, Bundoora, for investigation. Gross pathology of examined birds included enlarged livers with multifocal pallor and enlarged spleens. AI, avian paramyxovirus and *Chlamydia* spp. were excluded by PCR testing. Histopathological lesions included histiocytic and lymphoplasmacytic hepatitis and splenitis with numerous intracytoplasmic and extracellular gram negative coccobacilli. A *Salmonella* isolate recovered from the liver and faeces of submitted birds (both *P. domesticus* and *S. chinensis*) was referred to the Microbiological Diagnostic Unit Public Health Laboratory (Melbourne University) for identification, where it was identified as *Salmonella enterica* subsp. *enterica* serotype Typhimurium DT160 (*S.* Typhimurium DT160). The Department of Health and Human Services was notified.

This is the first diagnosis of S. Typhimurium DT160 in wild birds in Victoria (and in mainland Australia). S. Typhimurium DT160 is considered enzootic in Tasmania and has been diagnosed in 13 investigations involving house sparrows.[8]

Infected wild birds (e.g. sparrows) have the potential to be sources of infection for humans, domestic animals and native animal and bird species.[9] *S.* Typhimurium has significant zoonotic potential, with a small number of human cases diagnosed in Australia to date.

8 National Wildlife Health Information System (eWHIS) as at 12 October 2016.

9 WHA 2013, Salmonella *Typhimurium DT160 in House Sparrows in Australia*, Fact Sheet, December 2013, Wildlife Health Australia. www.wildlifehealthaustralia.com.au/FactSheets.aspx

Nocardiosis in a pantropical spotted dolphin

An adult female pantropical spotted dolphin (*Stenella attenuata*) was found stranded at Wooyung Beach, New South Wales, on the morning of 12 November. Several attempts to refloat and release the animal were unsuccessful. On the same day, the dolphin was transported for treatment at Sea World marine animal park on the Gold Coast, Queensland. Initial assessment revealed a 2.01 m animal in poor body condition weighing 54.5 kg. The animal was not very responsive.

Blood was collected from the caudal tail fluke and test results showed severe dehydration, moderate inflammation and evidence of renal and hepatic disease. Antibiotics (cefovecin), intravenous fluids and cortisone were administered to the animal but it died shortly after.

A necropsy was conducted the following day. Gross findings included a pyometra (Figure 7) and small abscesses of approximately 5 mm in diameter on the surface of the brain (Figure 8).

Histopathological examination of tissues revealed severe suppurative

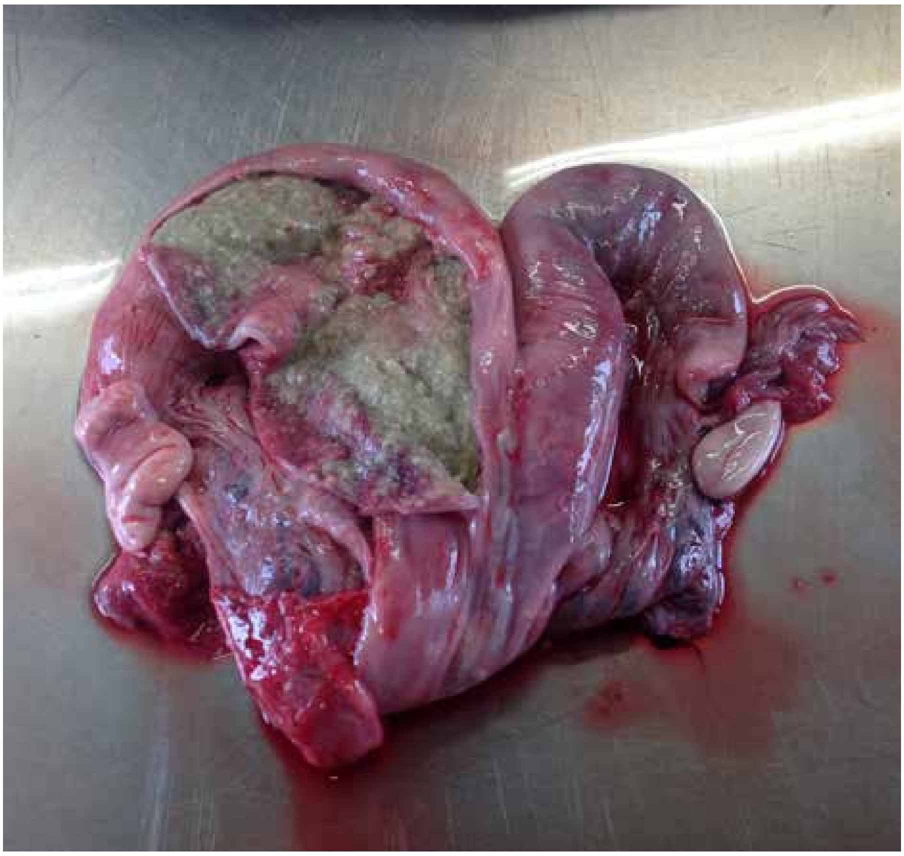


Figure 7 Pyometra in pantropical spotted dolphin

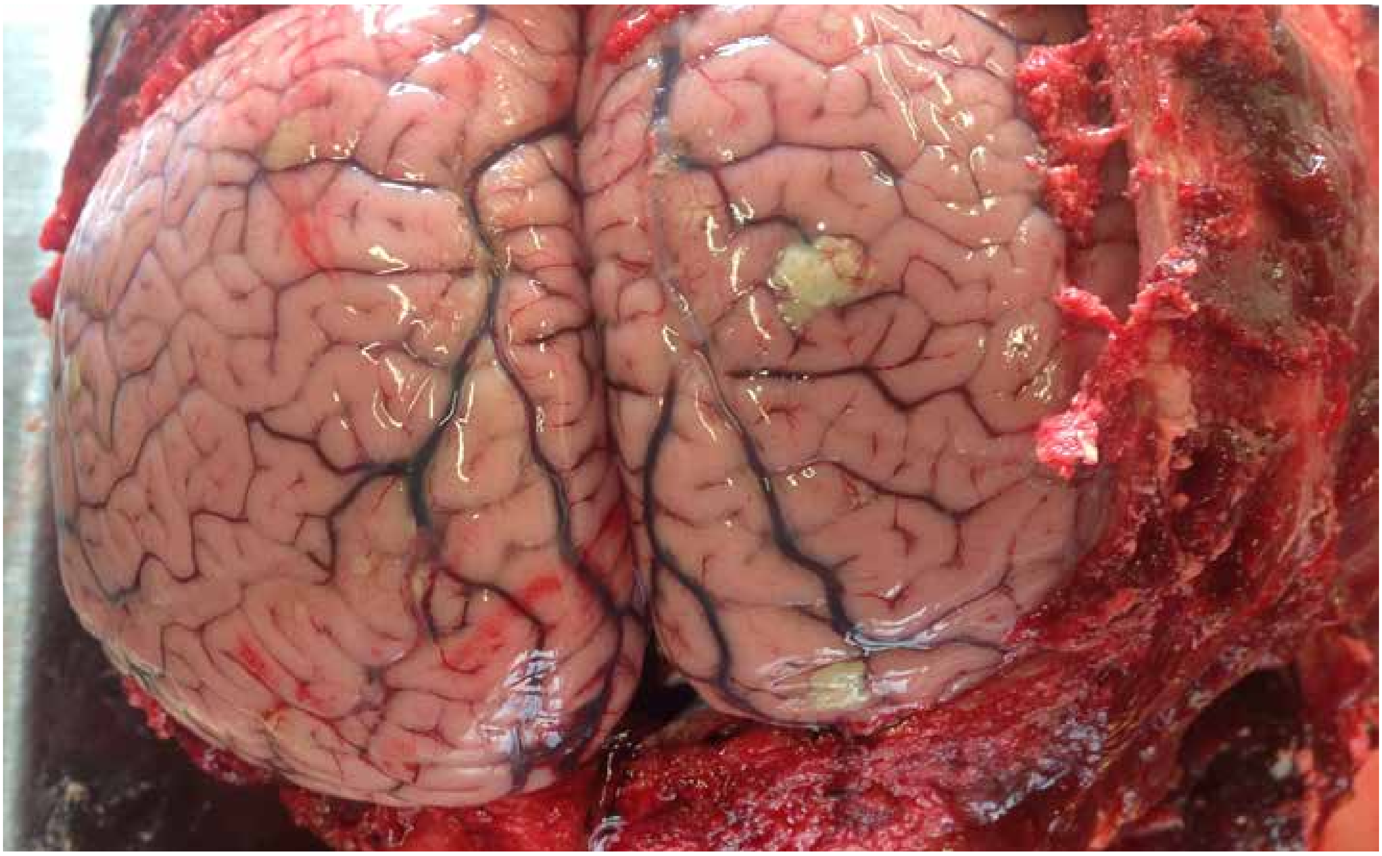


Figure 8 Small abscesses visible on the surface of the dolphin's brain

meningoencephalitis, chronic nonsuppurative pneumonia, suppurative endometritis and mild multifocal interstitial nephritis, consistent with nocardiosis. Bacterial cultures of cerebrospinal fluid, uterine contents, meninges, cerebellum, brain and liver all grew *Nocardia brasiliensis*.

Nocardia spp. are aerobic actinomycete bacteria present in soil, water and marine sediments that can infect animals and humans, causing localised and systemic disease. Infection can occur through inhalation, inoculation through skin lesions and ulcers in the gastrointestinal tract,[10] and very strong wind and heavy rain may increase risk of exposure to the pathogen.[11] Humans, companion animals, livestock and wildlife species are susceptible to infection, with immunocompromised hosts at higher risk of severe and disseminated infections. There are no reports of human-to-animal transmission of *Nocardia* spp.[12]

Nocardiosis caused by *Nocardia asteroides*, *N. farcinica*, *N. brasiliensis*, *N. cyriacigeorgica* and *N. levis* have been described in cetaceans in captivity and in the wild in other countries.[13] The systemic form is most typically observed, with lungs and thoracic lymph nodes involved, and sometimes the brain; one case of systemic form with mastitis in a beluga whale (*Delphinapterus leucas*) and one report of pulmonary form in a Pacific bottlenose dolphin (*Tursiops aduncus*) have also been described.[14] In Australia, *Nocardia* sp. infection was previously described from an unidentified cetacean species, with encapsulated purulent lesions in the liver and multiple small abscesses in the lung.[15]

Since nocardiosis is more likely to occur in immunosuppressed individuals, investigations of predisposing factors, presence of toxic agents or concurrent infections are recommended.[16] In this case, additional serological tests from the dolphin detected low-to-moderate titres of *Toxoplasma* spp., *Brucella* spp. and cetacean morbillivirus. It was serologically negative for leptospirosis.

Toxoplasmosis has been previously diagnosed in Australia in the Australian humpback dolphin (*Sousa sahulensis*)—previously known as the Indo-Pacific humpbacked dolphin (*Sousa chinensis*)—based on clinical signs, gross pathology, serology, bacteriology, histopathology, electron microscopy and immunohistochemistry findings.[17] A number of Australian marine mammal species have been shown to have serological evidence of exposure to *Brucella* sp. but there have been no confirmed cases of clinical brucellosis (e.g. culture positives). Strains of *Brucella* sp. isolated from marine mammals have genetic and biochemical differences from other *Brucella* spp. and are considered new: *B. ceti* from cetaceans and *B. pinnipedialis* from seals.[18]

10 St Leger, JA, Begeman, L, Fleetwood, M, Frasca, S, Garner, MM, Lair, S, Trembley, S, Linn, MJ & Terio, KA 2009, Comparative pathology of nocardiosis in marine mammals, *Veterinary Pathology Online* 46(2): 299–308.

11 Vogelnest, L & Woods, R (Eds) 2008, *Medicine of Australian Mammals*, CSIRO Publishing, Collingwood.

12 Tryland, M, Nesbakken, T, Robertson, L, Grahek-Ogden, D & Lunestad, BT 2014, Human pathogens in marine mammal meat—a northern perspective, *Zoonoses and Public Health* 61(6): 377–394.

13 St Leger et al. 2009 (as above).

14 St Leger et al. 2009 (as above).

15 Ladds, P 2009, *Pathology of Australian Native Wildlife*, CSIRO Publishing, Collingwood.

16 St Leger et al. 2009 (as above).

17 Bowater, RO, Norton, J, Johnson, S, Hill, B, O'Donoghue, P & Prior, H 2003, Toxoplasmosis in Indo–Pacific humpbacked dolphins (Sousa chinensis) from Queensland, *Australian Veterinary Journal* 81(10): 627–632.

18 WHA 2011, *Australian Marine Mammals and Brucella*, Fact Sheet, March 2011, Wildlife Health Australia, Mosman. www.wildlifehealthaustralia.com.au/FactSheets.aspx

Morbilivirus has been detected in several cetacean species in Australia, is known to cause immunosuppression, and concurrent infections have been described.[19,20] The cause of morbidity and eventual mortality of the present case was most likely due to a systemic infection with *N. brasiliensis*, possibly secondary to cetacean morbillivirus infection.

Australian bat lyssavirus

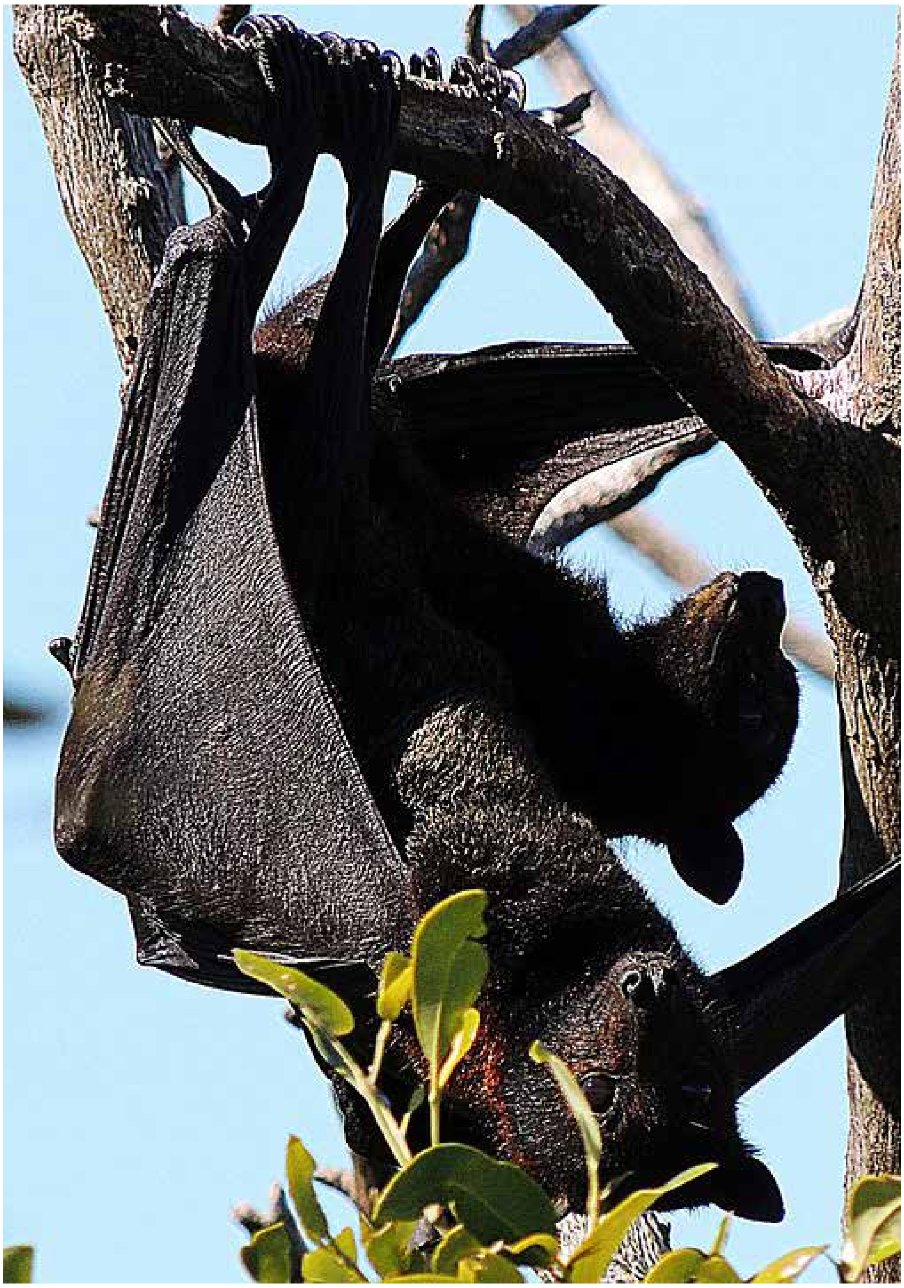
Reports to WHA for the quarter included 135 bats tested for Australian bat lyssavirus (ABLV) from the Australian Capital Territory, New South Wales, Northern Territory, Queensland, South Australia, Victoria and Western Australia.

Bat submissions were made for a variety of reasons:

- 54 cases involved contact with the potential for ABLV transmission to humans; of these
  - 17 were also associated with trauma (e.g. barbed wire fence or netting entanglement)
  - 1 displayed neurological signs (e.g. paralysis)
  - 1 was associated with a cluster of dead bats
  - 1 was found dead
  - the remainder had no further history reported
- 42 cases involved contact with a pet dog (36) or cat (6)
  - 6 bats were found dead
  - 5 cases were associated with trauma
  - 5 bats displayed neurological signs (e.g. aggression, paralysis, tremors)
  - 3 bats were associated with an event involving mass abandonment of pups.
  - 20 bats had no further history reported at this time.

19 WHA 2013, *Cetacean Morbilliviruses in Australian Whales and Dolphins*, Fact Sheet, June 2013, Wildlife Health Australia, Mosman. www.wildlifehealthaustralia.com.au/FactSheets.aspx

20 Kemper, CM, Tomo, I, Bingham, J, Bastianello, SS, Wang, J, Gibbs, SE, Woolford L, Dickason C & Kelly, D 2016, Morbillivirus-associated unusual mortality event in South Australian bottlenose dolphins is largest reported for the Southern Hemisphere, *Royal Society Open Science* 3(12): 160838.



During the quarter, four black flying foxes (*Pteropus alecto*), three from Queensland and one from the Northern Territory, were confirmed positive for ABLV by fluorescent antibody test and PCR for pteropid ABLV ribonucleic acid (RNA).

In the Northern Territory case, the flying fox had been seen around a backyard for a few days with reduced approach (flight) distances before falling to the ground where a pet dog may have been exposed. The dog owners elected to have all possible in-contact dogs and people vaccinated against rabies and the exposed dog was quarantined at home for 2 months.

In one of the Queensland cases, the flying fox presented with neurological signs, including marked aggression and tremors, and poor body condition. The other two flying foxes were rescued from a single colony and submitted for testing due to potentially dangerous human contact. An experienced public health official provided appropriate counselling and information in these cases.

More information on ABLV testing of bats in Australia is available in [ABLV Bat Stats](www.wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx).[21] ABLV is a nationally notifiable disease in Australia. Cases of suspect ABLV infection or exposure should be reported to the Emergency Animal Disease Watch Hotline on 1800 675 888.

21 www.wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx

Aquatic animal health

Brett Herbert, Australian Government Department of Agriculture and Water Resources

Aquatic animal health and surveillance in New South Wales

The New South Wales aquatic environment supports a diverse range of activities, including commercial fishing, aquaculture, recreational angling, shipping, tourism and general recreation.

During the 2014–2015 period, NSW Department of Primary Industry (DPI) valued the New South Wales aquaculture industry at approximately $60.7 million and wild fisheries at approximately $96 million.[22]

Aquatic animal health monitoring and management is important to prevent impacts of aquatic animal disease on these industries, the state's economy, social amenity, human health and the environment.

NSW DPI Aquatic Biosecurity surveillance priorities are focused on disease and pest risks with potential for significant impacts on the New South Wales economy, market access, interstate and export trade, and industry productivity. Surveillance activities reflect a partnership between farmers, industry, the community and government for ensuring healthy and productive aquatic animal industries.

Examples of surveillance activities for aquatic animal diseases that are listed as declared in New South Wales under the *Fisheries Management Act 1994* are detailed in the following sections. None of these diseases are known to affect human health.

It is important to note that the NSW Government is consolidating all biosecurity legislation under a single Act, the *Biosecurity Act 2015*. The Act and Biosecurity Regulation 2016 are scheduled to commence in 2017. Aquatic animal diseases will be managed under the new legislation.

Infection with *Marteilia sydneyi*

Infection with *Marteilia sydneyi,* also known as Queensland unknown, affects the native Sydney rock oyster (SRO; *Saccostrea glomerata*) and is caused by the cercozoan parasite *Marteilia sydneyi*.

Infection with *Marteilia sydneyi* has caused devastating effects in two of the state's largest oyster-farming areas (Georges and Hawkesbury rivers), and is known to occur in eight New South Wales estuaries. The SRO is the main species of oyster cultured in the state, with production valued at approximately $34.8 million in 2014–15. *Marteilia sydneyi* infection usually occurs between January and April, with diseased oysters losing condition and dying throughout winter.

In response to infections with *Marteilia sydneyi*, the NSW Government has implemented a program that enables rapid response to suspected outbreaks, active surveillance following new outbreaks, aquatic animal health expertise and technical capacity at the NSW DPI Elizabeth Macarthur Agriculture Institute, and quarantine and closure provisions that place restrictions on the movement of oysters and cultivation materials between estuaries. Current risk-based movement restrictions are based on disease prevalence calculated from surveillance results at each of the known *Marteilia sydneyi* affected areas.

Pacific oyster mortality syndrome

Pacific oyster aquaculture in New South Wales was valued at approximately $4 million in 2014–15. The species is not native to the state and it is considered a pest species in all estuaries except Port Stephens. However, triploid (functionally sterile) Pacific oysters can provide an alternative commercial species for farmers, particularly those impacted by *Marteilia sydneyi* disease.

In late 2010, ostreid herpesvirus 1 microvariant (OsHV-1 μvar), which causes Pacific oyster mortality syndrome (POMS), was detected in farmed Pacific oysters in the Georges River. Passive surveillance during early 2011 identified POMS in wild Pacific oysters from Port Jackson in Sydney Harbour, an area where there is no active oyster cultivation. In 2013, POMS was detected in the Hawkesbury River and in the nearby Brisbane Water estuary.

The NSW Government responded immediately to the 2013 POMS outbreak by placing movement controls on the oyster industry in affected estuaries to help prevent further spread of the virus, and engaging with the relevant national committees. As a result, a national surveillance plan was implemented in selected New South Wales, South Australian and Tasmanian estuaries to determine the distribution of POMS within Australia. The surveillance plan was funded by the Australian Government Department of Agriculture and Water Resources, CSIRO Australian Animal Health Laboratory and the governments of New South Wales, South Australia and Tasmania.

In New South Wales this surveillance program, as well as continued passive surveillance of farmed Pacific oysters, has so far returned negative results for POMS outside of the four confirmed locations.

Ongoing targeted surveillance is undertaken in the Georges and Hawkesbury rivers as part of POMS research projects undertaken by NSW DPI and the University of Sydney.

In 2016, POMS was detected for the first time in Tasmania, with significant impacts on the local and interstate industries. An emergency disease response was initiated by the Tasmanian Government, which included convening of the Aquatic Consultative Committee on Emergency Animal Diseases.[23]

22 NSW DPI data extract for 6-Jan-2017; ongoing validation will change this data.

23 dpipwe.tas.gov.au/biosecurity/aquatic-pests-and-diseases/aquatic-biosecurity-threats/poms

In response to the detection of POMS in Tasmania, New South Wales and South Australia implemented movement restrictions to minimise the risk of spread of POMS through importation of Pacific oysters to New South Wales and South Australia for cultivation. In 2016, and in acknowledgement of similar risk profile between New South Wales and Tasmanian POMS-affected areas, New South Wales amended the formal movement restrictions to allow importation of triploid Pacific oyster spat cultivated in accordance with an approved protocol to New South Wales POMS-affected areas only. South Australian movement restrictions remain in place.

Betanodavirus

Viral nervous necrosis (VNN) or betanodavirus can cause neurological disease in finfish and is a major pathogen of a wide range of marine species. Betanodavirus has caused significant mortalities and economic losses in aquaculture worldwide. It was detected for the first time in New South Wales in an Australian bass (*Macquaria novemaculeata*) hatchery in 2004.

In 2016, betanodavirus was detected in and eradicated from a fish farm in north-eastern New South Wales, the second time it has caused impacts on a commercial fish farm in the state.

In New South Wales, Australian bass are usually produced for release into the wild and into farm dams. Betanodavirus has been detected in estuarine environments in New South Wales but is not known to occur in freshwater impoundments.

An annual active surveillance program was implemented in 2005, requiring all hatcheries to submit samples of fish for betanodavirus testing before a stocking permit is issued. This surveillance aims to reduce the risk of translocating betanodavirus from hatcheries to wild fish populations.

The NSW Government will continue to monitor and manage aquatic animal diseases through the implementation of movement controls, active and passive surveillance programs, education and other measures to reduce the impacts of aquatic diseases on the community, economy and environment.

Prawns

Hatchery-reared tiger prawns (*Penaeus monodon*) and king prawns (*Penaeus plebejus*) are imported into New South Wales from Queensland for cultivation in prawn farm ponds and to restock wild populations in coastal lake systems. The tiger prawn industry in New South Wales was valued at approximately $5.1 million during the 2014–15 financial period.

Prawns translocated into New South Wales for wild stocking are routinely tested for viruses and diseases to ensure their safety for release into the environment. This surveillance has ensured that prawns stocked into the New South Wales wild environment are not infected with any diseases of concern. This surveillance provides confidence that measures are taken to limit the risks from diseases inadvertently translocated into New South Wales.

The recent outbreak of white spot disease, caused by white spot syndrome virus (WSSV), in prawn farms in South East Queensland has highlighted the importance of screening of stock intended for entry into New South Wales aquaculture. NSW DPI is working with the New South Wales prawn industry to further strengthen biosecurity measures for prawn aquaculture.

For more information on aquatic animal disease management in New South Wales, contact NSW DPI Aquatic Biosecurity on 02 4982 1232, aquatic.pests@nsw.dpi.gov.au or visit www.dpi.nsw.gov.au/biosecurity/aquatic.

State and territory reports

Under the Australian constitution, state and territory governments are responsible for animal health services within their respective borders (jurisdictions). The governments develop and administer legislation governing the surveillance, control, investigation and reporting of disease and chemical residues and contaminants, as well as legislation relating to animal welfare. The governments deliver their services through government-appointed or government-accredited animal health personnel (district veterinarians, regional veterinary officers and local biosecurity officers). They also provide extension services to industry and the community.

The 'State and territory reports' summarise disease investigations undertaken within jurisdictions and describe a selection of interesting cases. Test results from national notifiable animal disease investigations are reported in Table 17 of 'Quarterly statistics'.

Unless otherwise stated, disease events involving wildlife are reported by Wildlife Health Australia.

New South Wales

Rory Arthur, New South Wales Department of Primary Industry

During the quarter in New South Wales, approximately 896 livestock and other animal disease investigations[24] were conducted to investigate suspect notifiable diseases or rule out emergency diseases.[25] The number of investigations by species of livestock is shown in Figure 9. Field investigations were conducted by government veterinary or biosecurity officers (681) and private veterinary practitioners (215). All diagnostic testing was conducted at the state veterinary diagnostic laboratory or CSIRO Australian Animal Health Laboratory.

During the quarter, the State Veterinary Diagnostic Laboratory at the Elizabeth Macarthur Agricultural Institute, Menangle, processed approximately 1300 livestock sample submissions[26] related to field investigations of all types of diseases and conducted many tests for export, accreditation programs, targeted surveillance and regulatory activities.

The NSW Department of Industry is obliged under the *Stock Diseases Act 1923* and the *Animal Diseases and Animal Pests (Emergency Outbreaks) Act 1991* to detect and manage notifiable disease outbreaks. The risks to government of failure to detect these diseases are managed by an active district-based disease and pest surveillance program. Part of the program requires government veterinary officers to investigate potential notifiable disease outbreaks and unusual diseases that may be new, emerging or difficult to diagnose. The officers also conduct targeted surveillance projects, inspections of livestock at saleyards and monitoring of

24 All field investigations by government veterinary officers plus those by private veterinarians where the government purchased the laboratory diagnostic test results because a notifiable or emergency disease was a differential diagnosis.

25 Emergency diseases are a subset of notifiable disease defined as diseases listed in the Emergency Animal Disease Response Agreement www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

26 Some investigations did not involve suspected notifiable diseases.

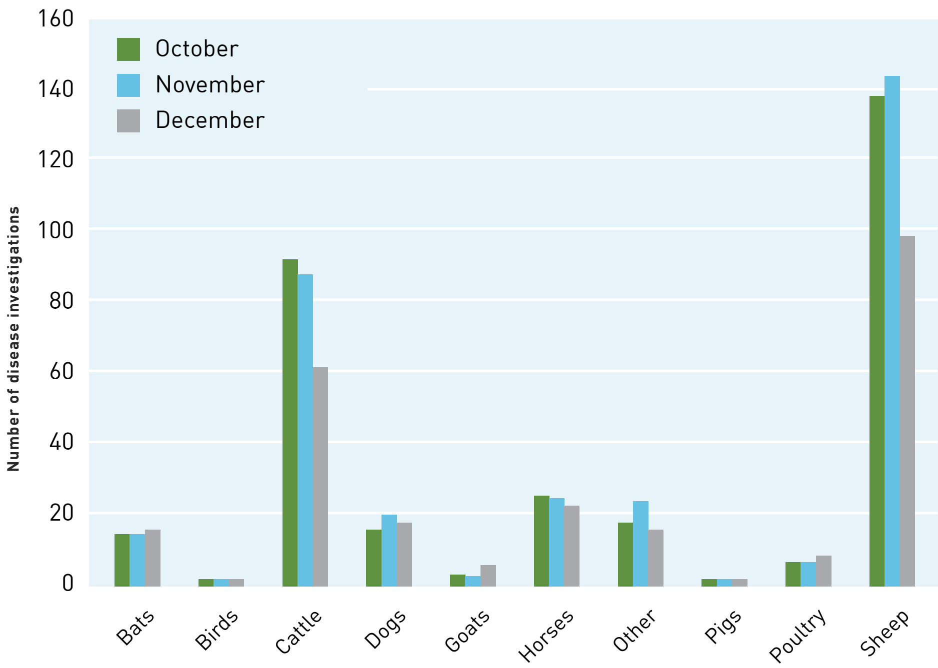


Figure 9 Number of field disease investigations to investigate suspect notifiable diseases or rule out emergency diseases, in New South Wales, October to December 2016

compliance programs. The outcome is district-based early detection of notifiable diseases and valid reports on the animal pest and disease statuses of all districts in New South Wales. These reports are aggregated at state level, for subsequent official reporting to Animal Health Australia and, through the Commonwealth of Australia, to the World Organisation for Animal Health (OIE). The surveillance program is supported by a government veterinary diagnostic laboratory with world-class diagnostic facilities and by research staff who design and improve diagnostic tests and, working with field veterinarians, investigate the epidemiology of diseases that have significant biosecurity impacts.

The following case reports are a selection of field investigations chosen to highlight surveillance and diagnostic capacity. Reports chosen are not necessarily representative of the full range of livestock disease incidents during the quarter.

Dramatic increase in Australian bat lyssavirus exclusions

In November 2016, NSW Department of Primary Industry (DPI) noted a dramatic increase in the number of bats submitted for Australian bat lyssavirus (ABLV) testing. Pup abandonment and misadventure of adults, likely because of a flying fox feed shortage on the east coast of Australia, increased the numbers of both human and animal interactions with flying foxes.

Bats are sent to the State Veterinary Diagnostic Laboratory at the Elizabeth Macarthur Agricultural Institute for ABLV exclusion testing; this most commonly occurs following potentially high-risk interactions with domestic animals, humans, or both (Figure 10). All November submissions returned negative results for ABLV.

The results of the ABLV tests help NSW DPI to make recommendations on how to manage animals potentially exposed to lyssavirus, in line with the Australian Veterinary Emergency Plan (AUSVETPLAN). NSW Health is notified of ABLV-positive results and all results from human exposure cases. NSW Public Health Units manage the human health aspects of these cases. ABLV testing is reported in the 'Wildlife Health Australia' report.

Private veterinarians are integral to the management of ABLV infection and exposure cases, including the submission of bats to the laboratory. Private veterinarians can obtain advice from the NSW DPI website[27] or from their local district veterinarian. Cases of potential ABLV infection or exposure should be reported to the Emergency Animal Disease Watch Hotline.

ABLV is a notifiable endemic virus found in Australian bats. It has been found in both fruit bats (Megachiroptera) and insectivorous bats (Microchiroptera). All bats in Australia are considered potentially infectious. In other countries, a variety of other mammals have been infected with other lyssaviruses but so far in Australia, horses and humans are the only other species known to have been infected with ABLV. Infection with lyssavirus is invariably fatal once clinical signs are present.

People concerned about exposure may call the Emergency Animal Disease Watch Hotline on 1800 675 888.

27 www.dpi.nsw.gov.au/content/biosecurity/animal/humans/bat-health-risks

Lymphoma in a bull—enzootic bovine leucosis excluded

In October, a private veterinarian in the Riverina region contacted Local Land Services to help investigate the death of a 3-year-old Shorthorn bull from an undiagnosed chronic disease. Over several months before its death, the bull had lost weight and become increasingly lethargic. No other cattle were affected. All livestock were grazing improved pastures and had little or no access to poisonous plants. The owner drenched the affected bull for intestinal parasites and liver fluke, to no effect. When the bull was examined by the private veterinarian, it had a fever and was treated with antibiotics (oxytetracycline) but died shortly afterwards.

A necropsy by the district veterinarian revealed multiple adhesions between the lungs and the chest wall, with fibrotic lung tissue containing pockets of pus. There was haemorrhage on the epicardium. In the abdominal cavity, multiple adhesions were present between the liver and the diaphragm. The liver was enlarged and a purplish, with extensive multifocal white spots throughout the tissue. The gall bladder was grossly distended. A solid tissue mass measuring 8 cm x 6 cm was found in the intestine.

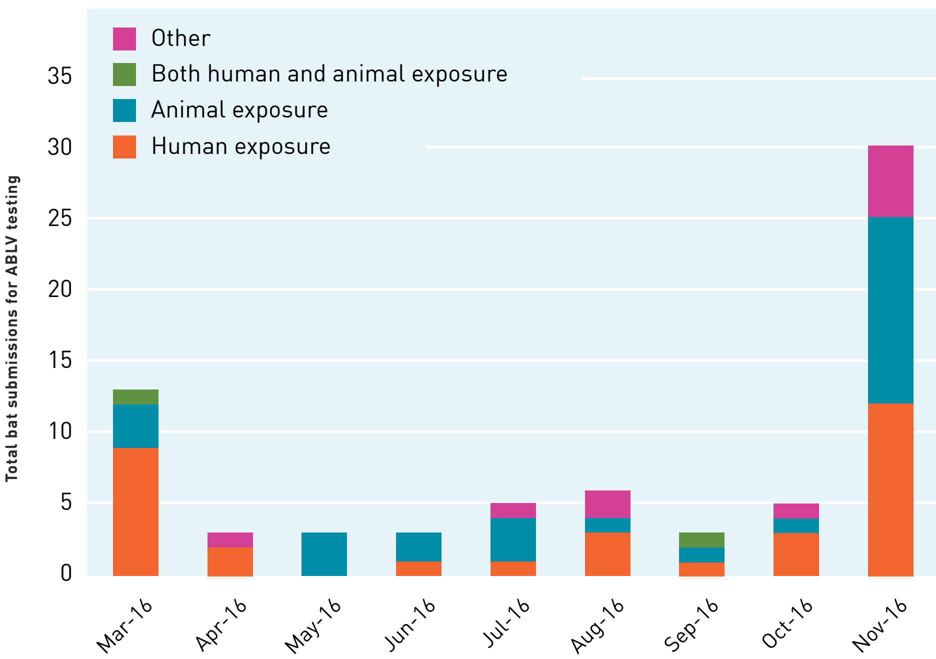


Figure 10 Reasons for Australian bat lyssavirus (ABLV) testing at the State Veterinary Diagnostic Laboratory, New South Wales, March to November 2016

Histopathology of the liver, lungs and intestinal mass confirmed that the mass was a round cell tumour, most consistent with lymphoma. Lymphoma in cattle can be in the form of enzootic bovine leucosis (EBL), which is associated with bovine leukaemia virus, or a sporadic form of cancer that is not related to EBL. An EBL ELISA (enzyme-linked immunosorbent assay) was performed on arterial blood and ruled out the EBL form of lymphoma.

Although EBL is uncommon in New South Wales, it occurs occasionally in beef cattle. The virus is transmitted horizontally through direct contact or through the shared use of contaminated instruments (e.g. needles or ear tag applicators) or rectal gloves between animals. Approximately 3% of cattle infected with EBL will develop malignant disease. EBL was eradicated from Australian dairy herds in 2012.

Bovine anaemia due to *Theileria orientalis* in calves

Cases of bovine anaemia due to *Theileria orientalis* were first diagnosed in 2006 in naïve adult cattle introduced into the Kempsey district of the North Coast region. The disease occurs in adult cattle introduced to the area from tick-free areas and in homebred calves aged 6 to 12 weeks.

Most of the cases have been caused by *T.* orientalis variant Ikeda. The more pathogenic types—namely *T. parva* (East Coast Fever) and *T. annulata* (tropical or Mediterranean theileriosis)—are exotic to Australia. This report describes a case of bovine theileriosis in homebred beef calves and some of the difficulties experienced in preventing and treating it.

Two 8-week old calves became ill from a group of 40 cows and calves grazing improved pasture. They were lethargic and reluctant to move with the group when changing paddocks.

One calf became recumbent before reaching the yards. It had a rectal temperature of 37.2°C, dry pellet-like faeces covered in mucus and very pale mucous membranes. The second calf had pale mucous membranes, a rectal temperature of 40.1°C and an increased respiratory rate.

The first calf died shortly after clinical examination. At necropsy, its carcase was pale and slightly jaundiced and the spleen was about double its normal size. The liver was enlarged and ochre coloured.

Laboratory testing supported a diagnosis of bovine anaemia due to *T. orientalis*. There was evidence of a regenerative anaemia in both calves and the presence of organisms consistent with *Theileria* sp.

Anaemia due to *T. orientalis* remains a frustrating disease for both producers and veterinarians in the North Coast region. Treatment options are limited. We need further research to give us a better understanding of why there has been an increase in the disease and to develop improved treatment and prevention strategies.

Treatments used most commonly include antibiotics (oxytetracyclines) and imidocarb, an antiprotozoal agent. Some veterinarians are using a coccidiostat (toltrazuril) as a prophylactic. Further trials of the efficacy of some of these treatments are required. Blood transfusions may be an option and are used quite widely in New Zealand. Minimising stress on affected animals remains an important part of management. Handling should be minimised but if it is necessary, it should be done quietly and slowly.

Lead poisoning in cattle

In November near Hay, in south-western New South Wales, a large group of steers from two separate properties were being grazed on several travelling stock routes. One steer suddenly became blind and was euthanased. Post-mortem blood sampling revealed very high levels of lead (4.72 µmol/L).

The cattle were evacuated from the stock route because of rising floodwaters and returned to their home properties, where they were tested for lead residues. Blood lead levels above background were found in another five cattle, which were detained. After the floodwaters subsided, the search continued for the source of the lead. A chewed battery was found on one of the travelling stock routes that had been used.

Listeriosis in sheep

Abortion, scouring, neurological signs and more than 30 deaths occurred in sheep when poorly made round-bale silage was fed to them on a Southern Tablelands property. Cattle fed the silage were unaffected. Some recovered sheep suffered marked fleece breaks, causing fleece shedding.

Crossbred and Merino sheep of all ages, and cattle, had been fed the purchased silage in August and September 2016 to supplement inadequate pasture. The silage had been marketed as containing predominantly red clover but it actually contained mainly mature native grasses. The plastic wrapping around the bales was intact but the moisture content of the silage appeared low and the bales contained firmly compressed dry blocks of grass.

The silage was palatable to the livestock and no abnormalities were seen following feeding of the first bales. Then the owner noticed scouring and abortions in late-pregnant ewes in several flocks. Some sheep lay down and died within 24 hours. Others were found dead in dams, suggesting they had been feverish. Despite an attempt to gather and burn all the remaining silage, animals were later found dead or dying, with straws of silage protruding from their mouths. This corresponded to the observation of cranial nerve deficits in some sheep 2 to 3 weeks into the outbreak. Affected sheep had drooping of one ear and one side of the mouth, as well as slobbering and an inability to control their tongue movements. Some sheep circled before lying down and dying. Cases continued to occur for 3 weeks after silage feeding ceased.

Treatment of affected sheep with penicillin led to early improvement, and some of the treated sheep recovered.

Severe multifocal subacute necrosuppurative encephalitis and nonsuppurative meningitis were observed in samples submitted from a recumbent Merino weaner that had died less than 12 hours previously. The lesions were specifically characteristic of listeriosis. It is not clear why these particular bales of silage permitted growth of *Listeria monocytogenes*, but it is possible that a lack of moisture in the grass prevented adequate fermentation and insufficient reduction in pH of the silage.

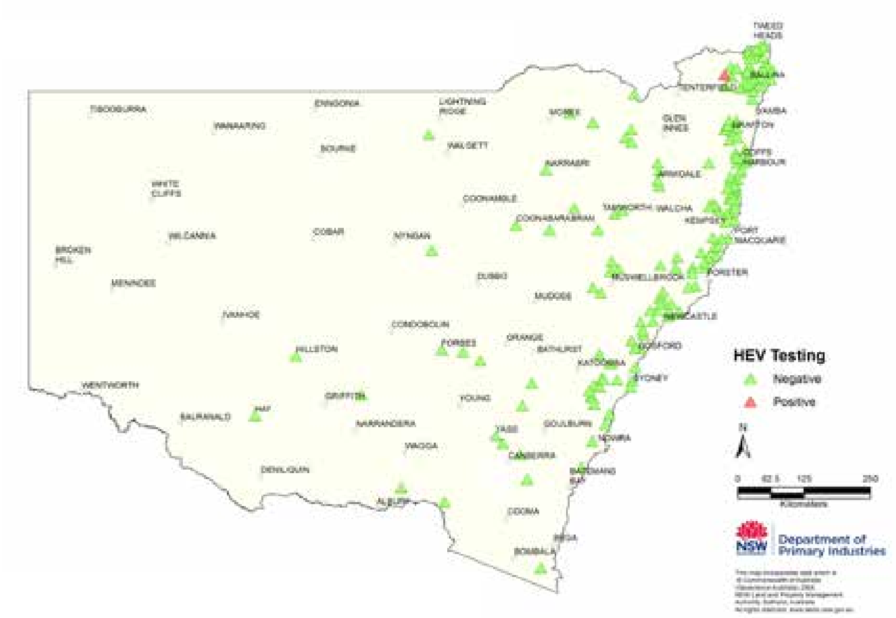


Figure 11 Locations of negative sample tests for Hendra virus (HEV) exclusion in horses, and single positive January to December 2016. Excludes sample locations for which no coordinates were available.

Hendra virus ruled out in south-west horses

Hendra virus infection of horses in New South Wales is infrequent and, so far, has been confined to the northern coastal regions. Active surveillance is conducted all over the state when the cause of illness in horses is unknown, and particularly when signs progress quickly, with rapid deterioration.

In October, in the town of Hillston in south-western New South Wales, two horses died within 36 hours of each other. One of the horses, a mare, developed lethargy and discomfort, which quickly progressed to strong twitching of the shoulder and neck muscles when the mare was standing, and laboured breathing when she was lying down on her side. She died overnight. A gelding in the same paddock developed the same signs that morning and died late the following afternoon. The district veterinarian was called and noted little grass remaining in the horses' paddock, and that the horses had had potential access to a number of toxic plants, including oleander (*Nerium oleander*), heliotrope (*Heliotropium*) and Paterson's curse (*Echium plantagineum*).

A necropsy revealed congestion of the conjunctivae and mucous membranes, increased fluid in the pericardial sac and petechial haemorrhages in the heart. The lungs were congested and had a dark red–purple discoloration.

Although a provisional diagnosis of plant poisoning was made, samples were taken to exclude Hendra virus infection, as there were reports that little red flying foxes were in the area. However, none of their favoured eucalyptus trees were flowering and there was no evidence of flying fox activity over the horses' paddock. Samples were negative for Hendra virus, and the pathologists at the State Veterinary Diagnostic Laboratory diagnosed myocarditis, potentially from a cardiac glycoside found in oleanders.

The map (Figure 11) shows the approximate locations where samples were taken from horses in 2016 to exclude Hendra virus infection. There was one positive case detected in an unvaccinated horse in New South Wales in 2016. The areas of highest risk are considered to be regions adjacent to the north coast. The map illustrates that samples for exclusion of Hendra virus infection are received from most parts of the state where flying foxes exist.

Northern Territory

Elizabeth Stedman, Northern Territory Department of Primary Industry and Resources

During the quarter in the Northern Territory, 49 livestock and other animal disease investigations[28] were conducted to investigate suspect notifiable diseases or rule out emergency diseases.[29] The number of investigations by species of livestock is shown in Figure 12. Field investigations were conducted by government veterinary or biosecurity officers (29) and private veterinary practitioners (20). All diagnostic testing was conducted at the state veterinary diagnostic laboratory or CSIRO Australian Animal Health Laboratory.

During the quarter, the state veterinary diagnostic laboratory, Berrimah Veterinary Laboratories, Darwin, processed 104 livestock sample submissions[30] to investigate suspect notifiable diseases or rule out emergency diseases. Sample submissions were also processed to substantiate proof of disease freedom certifications, and for accreditation programs and targeted surveillance.

The Department of Primary Industry and Resources (DPIR) in the Northern Territory provides a free disease investigation service to livestock owners for diagnosis of notifiable emergency exotic and endemic disease, including zoonotic diseases. Subsidies are available to private veterinarians for significant disease investigations in livestock. Berrimah Veterinary Laboratories provide free diagnostic testing for exclusion of notifiable disease for all disease investigations.

The following case reports are a selection of field investigations chosen to highlight surveillance and diagnostic capacity. Reports chosen are not necessarily representative of the full range of livestock disease incidents during the quarter.

Lead toxicity in a dog

An 8-year-old female cattle dog from the Darwin region was presented to the Berrimah Veterinary Laboratories for necropsy after it was treated for acute seizures, tachycardia and hyperthermia by a private veterinarian in December. The veterinarian reported the dog was euthanased after it became refractory to treatment over a half-hour period. The case was admitted to exclude neurological emergency animal diseases, particularly rabies and Australian bat lyssavirus (ABLV).

Necropsy found the dog to be in fair body condition. There was evidence of diarrhoea, and the stomach contained a small amount of water and mucus mixed with small stones and plant material. There were no significant gross or histological findings on examination of a wide range of tissues, including the brain.

On questioning the owner later, it was discovered that another two dogs from the same property had shown similar clinical signs and died over the previous few months. The owners reported that the dogs had access to an area of the property where lead sinkers were being made by smelting old car batteries.

Toxicology testing showed the liver to have a markedly elevated level of lead (110 µmol/kg wet wt, reference < 2 µmol/kg), supporting a diagnosis of lead toxicity in the dog. The case was referred to the local health authority to investigate human health ramifications.

Pregnancy toxaemia deaths in mustered cattle—bovine ephemeral fever excluded

DPIR veterinary officers investigated sudden death in a mixed herd of 50 previously unhandled Brahman-cross cattle, which had been mustered by helicopter in the Darwin region in late October. The herd had been held and then trucked to the station yards before being processed and offered water and hay rations. During processing, several

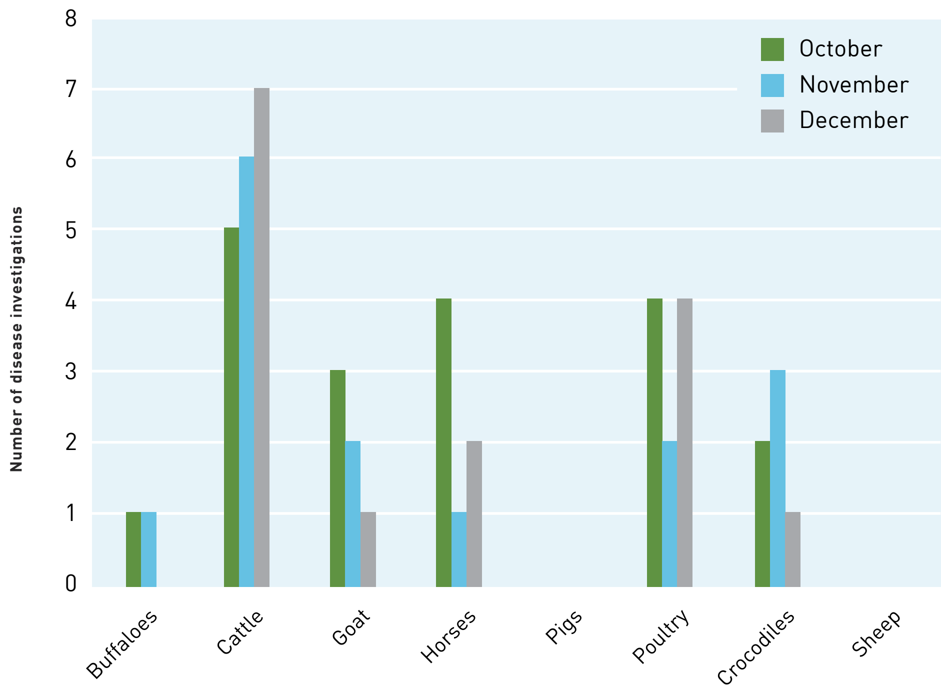


Figure 12 Number of field disease investigations to investigate suspect notifiable diseases or rule out emergency diseases, in the Northern Territory, October to December 2016

28 Field investigation with laboratory diagnostic testing.

29 Emergency diseases are a subset of notifiable disease defined as diseases listed in the Emergency Animal Disease Response Agreement www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

30 Some investigations involved multiple submissions.

of the younger heifers displayed signs of panting, agitation and varying degrees of lameness and ataxia. Three heifers died over the next 2 days.

Necropsy of one of the heifers revealed it to be approximately 30 months old and in moderate-to-poor body condition. There was extensive carcase bruising and the bones appeared to be unusually brittle. The liver was diffusely pale (Figure 13), the gall bladder was enlarged and the omasum was dry and hard. The heifer was approximately 7-months pregnant with a bull calf. Pathology results consistent with pregnancy toxaemia showed elevated muscle enzymes (creatine kinase 2805 units/L; reference 35–280 and aspartate aminotransferase 250 units/L; reference 42–132) and elevated β-hydroxybutyrate levels (7.7 mmol/L; reference 0–0.5 mmol/L). Bovine ephemeral fever was excluded by polymerase chain reaction (PCR) testing.

It is likely that the stress of mustering, transport and yarding of unhandled cattle, combined with the increased energy requirements of late pregnancy, led to the development of pregnancy toxaemia in these heifers over an 8-day period.

Australian bat lyssavirus exclusion in a dog

In November a 1-year-old indoor–outdoor male crossbred dog was presented to a private veterinarian in the Darwin rural area for unusual behaviour and 'mild fitting' over one and a half days. On clinical examination, the dog was found to be hyperaesthetic, hypertonic with knuckling in the hindlimbs, with a slight head tilt to the right side, and an intact pupillary light reflex. The dog was unable to apprehend to eat or drink, and despite supportive care, it continued to deteriorate and was euthanased.

Necropsy found the dog to be in light body condition, with minimal adipose tissue. The carcase was dehydrated and the oral mucous membranes were pale with some mucosal reddening and petechial haemorrhages on the upper rostral lip. Multiple small foci of haemorrhages were noticed involving the skin between the toes of all feet, the scrotum and the lower limbs, with the foci involving the toes dark red and centrally thickened. Small areas of haemorrhage were found in the body musculature, and there were petechial to ecchymotic haemorrhages involving the serosa and mucosa of the stomach and intestines. The stomach was empty of food but the intestines contained what appeared to be frank blood. The mesenteric lymph nodes were prominent and mottled red–black. The rectum contained soft normal faeces. The brain was grossly unremarkable.

Histopathology revealed a very mild regional nonsuppurative meningitis and regional encephalitis. A multifocal necrotising pododermatitis and regional acute necrotising suppurative bronchiolitis were found, and likely caused by exposure to a necrotising contact or inhaled irritant. The severe acute gastrointestinal haemorrhage was likely secondary to a coagulopathy.

At CSIRO Australian Animal Health Laboratory, Australian bat lyssavirus and rabies were excluded by immunofluorescent antibody testing on the brain and salivary gland and real-time TaqMan assay and immunohistochemistry on the brain. Morbillivirus (canine distemper) was excluded by immunohistochemistry on the brain. Toxicology testing for lead, metaldehyde and snake venom failed to confirm a diagnosis, and virus isolation attempts from brain tissue using multiple cell lines were unsuccessful. While a definitive diagnosis was not reached in this case, the cause is likely

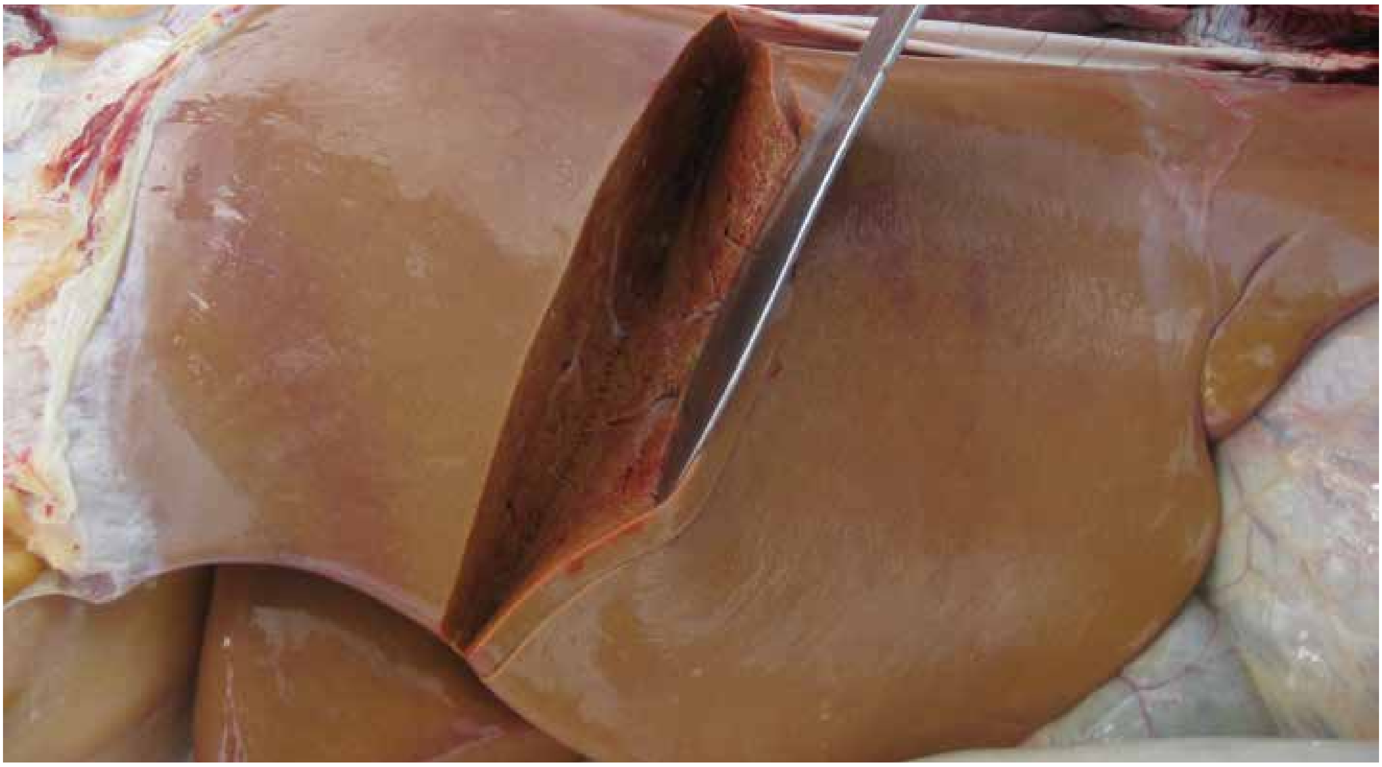


Figure 13 Diffusely pale liver in a pregnant heifer affected by pregnancy toxaemia

to be of an infectious or toxic aetiology. One other dog in the household continues to remain clinically well.

Nervous signs in a persistently infected steer—transmissible spongiform encephalopathy excluded

In October, a 3-year-old Brahman-cross steer in a paddock of 100 steers on an extensive beef production property outside Katherine showed nervous signs, including apprehension, nervous of entrance and hyperaesthesia. The manager had noticed the steer was significantly stunted in comparison to other similarly aged steers in the paddock. The steer was euthanased and the case referred for transmissible spongiform encephalopathy (TSE) exclusion.

On necropsy this animal had an abnormal brain (mild-to-moderate bilateral hydrocephalus and cerebellar hypoplasia) and the spleen was smaller than expected. Agar gel immunodiffusion (AGID) on the serum sample for bovine viral diarrhoea virus (BVDV)[31] antibody was negative but BVDV antigen ELISA (enzyme-linked immunosorbent assay) of tests on the spleen, brain and spinal cord samples were all positive. These results confirmed this animal was a BVDV persistently infected bull. Histopathology of brain sites specified in the Australian and New Zealand standard diagnostic procedure for TSE excluded TSE in this animal, but revealed the brain and spinal cord had extensive multifocal but generally mild nonsuppurative meningoencephalomyelitis. BVDV PI animal is not expected to have persistent inflammation in the brain, hence infection with another endemic virus such as arbovirus as the cause of the meningoencephalomyelitis was considered given this animal was likely to be immunosuppressed. A further attempt was made to isolate BVDV from splenic tissue, however viable virus could not be detected. Likewise, attempts to isolate virus from the brain and spinal cord samples were unsuccessful.

31 Only bovine viral diarrhoea virus type 1 (BVDV-1) is present in Australia. The severe BVDV-2 form in Europe and North America has not been found in Australia.

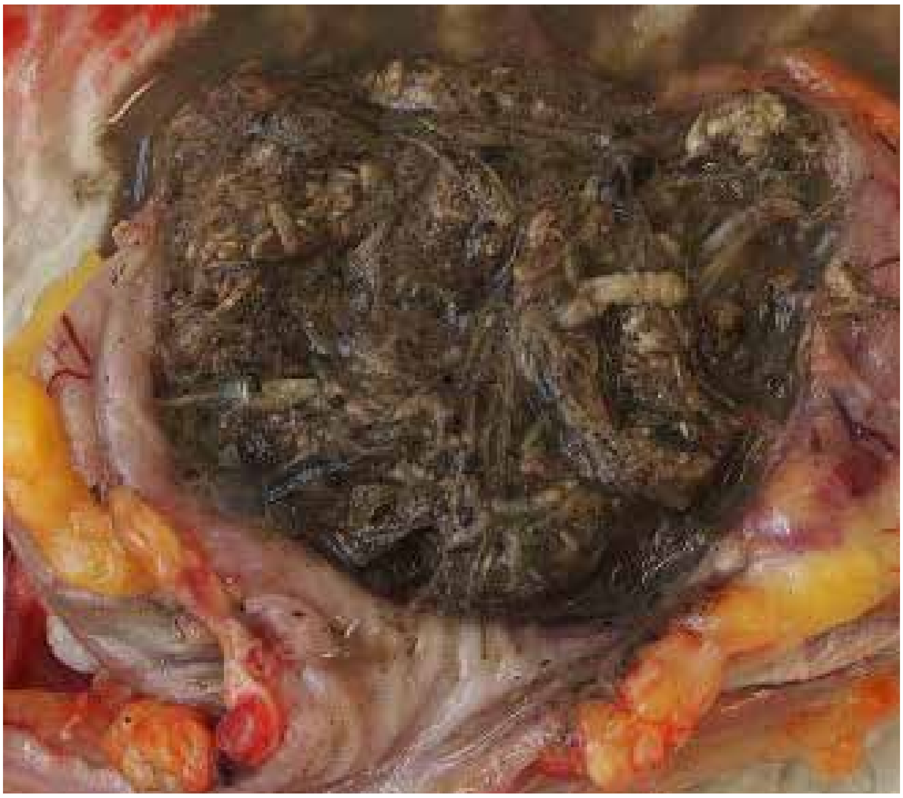


Figure 14 Maggots visible in the crop of a bird after sudden death

Type 1 BVDV is endemic in the Northern Territory, and in utero infection with BVDV can result in malformation of the brain with cerebellar hypoplasia and hydrocephalus. Persistently infected cases are not often recognised.

Sudden death in mixed poultry—Newcastle disease and avian influenza excluded

A hobby farm reported the sudden death of 11 birds from a free-range mixed-poultry flock of 15 birds outside Darwin in November, during the wet season. There had been no recent management changes or introduction of new birds.

Eight chicken, duck and guinea fowl carcases of mixed ages and sexes together with abundant motile maggots in varying stages of development were submitted for examination. Necropsy revealed all birds to be in good body condition. There were no specific gross findings, apart from the presence of several nonmotile maggots present in the crop of four birds (Figure 11), and incidental mixed parasitic helminth infections in some of the birds. Newcastle disease and avian influenza were excluded by virus specific polymerase chain reaction (PCR) tests on cloacal and tracheal swab samples from these birds. Entomology examination of the maggots confirmed there were none consistent with those of the New World screw-worm fly (*Cochliomyia hominivorax*) or Old World screw-worm fly (*Chrysomya bezziana*). Histopathology of a range of fixed tissue samples from these birds did not reveal any underlying microscopic disease processes.

Warm and humid weather with abundant available organic matter is the ideal condition for growth of blowfly maggots and putrefaction bacteria, including *Clostridium botulinum*, which produces the botulinum toxin. The presence of ingested nonmotile maggots in the birds in this case is highly suggestive of botulism by the consumption of toxin-laden maggots. A presumptive diagnosis of botulism was made in this case based on this circumstantial evidence and by exclusion of infectious diseases via laboratory investigation. Cases of botulism in poultry are seen annually during the wet season in the northern part of the Northern Territory. Poultry owners are advised to prevent birds from having access to possible sources of the toxin by removing decaying food scraps, animal carcases and rotting vegetation. No further losses have been reported after a pen site clean-up.

Queensland

Greg Williamson, Queensland Department of Agriculture and Fisheries

During the quarter in Queensland, 713 livestock disease investigations[32] were conducted to investigate suspect notifiable diseases or rule out emergency diseases.[33] The number of investigations by species of livestock is shown in Figure 15.

Field investigations were conducted by government veterinary or biosecurity officers (117) and private veterinary practitioners (596). Diagnostic testing was conducted at the state veterinary diagnostic laboratory and CSIRO Australian Animal Health Laboratory.

Disease investigations were also carried out on animals other than livestock (88) and aquatic animals (67).

The Biosecurity Sciences Laboratory also processed sample submissions to substantiate proof of disease freedom certifications (109), for accreditation programs (19) and targeted surveillance (1073). The majority of the surveillance activities were aquatic (918), as a result of the ongoing emergency response to white spot syndrome virus (WSSV) in prawns. In total there were 2069 animal health-related submissions to Biosecurity Sciences Laboratory during the quarter.

32 Field investigations with laboratory diagnostic testing.

33 Emergency diseases are a subset of notifiable disease defined as diseases listed in the Emergency Animal Disease Response Agreement www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

The following case reports are a selection of field investigations chosen to highlight surveillance and diagnostic capacity. Reports chosen are not necessarily representative of the full range of livestock disease incidents during the quarter.

White spot disease in prawns triggers emergency animal disease response

White spot disease (WSD), a highly contagious viral infection that affects crustaceans, emerged on prawn farming properties in South East Queensland, triggering an emergency response by Biosecurity Queensland to contain and eradicate the disease.

In late November 2016, white spot syndrome virus (WSSV) was detected in giant tiger prawns (*Penaeus monodon*), with white spot-like shell lesions from a farm on the Logan River. Affected ponds presented with mass mortality of up to 80% of prawns within 7 days of the first signs of prawns swimming abnormally at the water surface. White spots on the prawns developed into classical (WSD) lesions with multiple round-to-coalescing calcified opacities on the carapace and, as the epidemic progressed, along the abdominal segments (Figure 16 and Figure 17).

A presumptive diagnosis of WSD based on gross pathology and histopathology was confirmed by WSSV-real time PCR (qPCR) testing at the Biosecurity Sciences Laboratory and corroborated by qPCR results at CSIRO Australian Animal Health Laboratory. Histopathology showed multiple WSSV basophilic Cowdry Type A intranuclear inclusions in most ectodermal and some endodermal tissues. The subcuticular epithelium, stomach epithelium and caudal tegmental glands had the highest density of inclusions, while the gills, antennal gland and haematopoietic tissues had some inclusions.

National response arrangements were established, including AQUAVETPLAN, which sets out agreed disease response, destruction, disposal and decontamination activities. The national Aquatic Consultative Committee on Emergency Animal Diseases was activated and continues to meet.

As part of the response, mitigation measures were used to minimise disease spread via birds feeding on infected prawns. Affected production ponds were isolated and treated with chlorine to destroy the virus and potential hosts. Disposal and decontamination, which includes emptying of ponds, is ongoing.

In early December 2016, some prawns sampled from a section of the Logan River tested PCR positive. Further

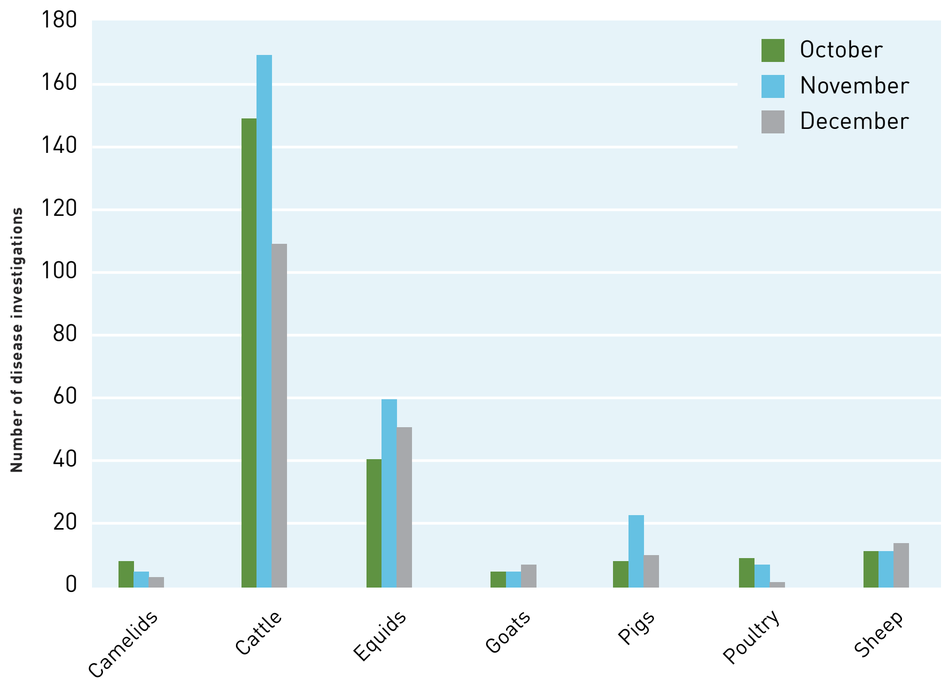


Figure 15 Number of terrestrial livestock disease investigations in Queensland, October to December 2016

Figure 16 Giant tiger prawns with white round-to-coalescing lesions characteristic of white spot disease

Figure 17 Cuticular layer of epithelium excised from a giant tiger prawn with calcified lesions typical of white spot disease

sampling will be undertaken to determine whether disease has established in the environment.

Movement restrictions were put into place with clear signage at boat ramps and along the waterways outlining the limitations.

WSD is widespread throughout prawn farming regions in Asia and the Americas, where it has caused severe losses. The gross value of prawn production in Australia in 2015–16 was $413 million, and in 2015 the industry employed 5000 people. Australia was one of the few countries in the world with a prawn farming industry that had remained free of WSD.

Exclusion of rabies and Australian bat lyssavirus in a dog

In December 2016, rabies virus (RV) and Australian bat lyssavirus (ABLV) were excluded as the cause of acute severe neurological disease in a 6-year-old crossbred cattle dog on Horn Island. Horn Island is in the Torres Strait of Far North Queensland. The owner had returned home to find her dog withdrawn and fearful when approached. During the evening, clinical signs progressed to growling, restlessness and howling, followed by frothing at the mouth and seizures, with death of the dog in the early morning. During a seizure, the owner was scratched. The affected dog and a companion dog had been observed eating a black flying fox (*Pteropus alecto*) 20 days earlier. The bat had not been tested.

The owner, a nurse, suspected ABLV infection and contacted the Emergency Animal Disease Watch Hotline (1800 675 888). A rabies-vaccinated veterinary officer from the Department of Agriculture and Water Resources Northern Australia Quarantine Strategy (NAQS) performed a necropsy later that morning and collected a full range of fresh and fixed tissues, including brain, using appropriate personal protective equipment. The remainder of the dog and contaminated waste was disposed of by deep burial. Local public health medical officers initiated post-exposure prophylaxis of the owner with rabies vaccine pending the results.

Fluorescent antibody tests (FAT) of fresh brain were negative for lyssaviruses (including RV and ABLV) at the Biosecurity Sciences Laboratory, as were variant-specific polymerase chain reaction (PCR) assays for each of the known variants of ABLV (pteropid/flying fox-variant ABLV and yellow-bellied sheathtail-variant ABLV). The negative FAT results were corroborated at both the Queensland Health Forensic and Scientific Services Laboratory (QHFSS) and CSIRO Australian Animal Health Laboratory. Negative pteropid- and yellow-bellied sheathtail-variant ABLV PCR tests were corroborated at CSIRO Australian Animal Health Laboratory. In addition, pan-lyssavirus PCR and RV-specific PCR were negative at both QHFSS and CSIRO Australian Animal Health Laboratory.

Histological sections revealed no abnormality of the brain and marked congestion and alveolar oedema of the lung. No alternative diagnosis for the dog was made but the clinical signs suggest an undetermined toxicity.

Australia, Papua New Guinea (PNG) and Timor-Leste are free of classical rabies, and animals in the Torres Strait are not rabies vaccinated. The islands of the Torres Strait, PNG and Timor-Leste are relatively close to islands in the Indonesian archipelago that have rabies, placing them at relatively high risk of rabies. Illegal movement by boat of animals incubating rabies is the single greatest risk pathway for the introduction of rabies into Australia.

Rabies is a nationally notifiable disease for which Australia has an agreed national response policy (AUSVETPLAN Disease Strategy) and strict conditions apply to the importation of dogs and other live animals into Australia.

NAQS conducts surveillance and extension activities across northern Australia in collaboration with state and territory biosecurity agencies. Activities include raising awareness about rabies and the restrictions on southward movement of live animals through the Torres Strait to mainland Australia, monitor dog health in remote communities for rabies-like clinical signs, and detect the illegal movement of animals from PNG.

ABLV is a rabies-like virus in Australian flying foxes and at least one species of microbat. Fatal spillover of ABLV has been detected in three people and two horses, all in Queensland. The history of recent contact with a bat helped raise suspicion of lyssavirus infection. Potentially infectious contact between bats and pets, particularly dogs, occurs frequently. Biosecurity Queensland advises owners to take all reasonable steps to prevent animals coming into contact with bats. Owners that know or suspect their pet has had contact with a bat should seek urgent veterinary advice about options for mitigating the risk of ABLV infection.

The One Health approach used in this case, which integrated the skills and resources of federal and state biosecurity agencies and state and local health officers, met the challenge of providing a timely response to a potentially serious incident in this remote community.

Sporadic lymphosarcoma in a calf

In November, a 10-week-old Droughtmaster calf in a breeding herd of 400 on a property in the Central Highlands region was noticed by the owner to have abnormal lumps around the head, face and shoulders. Closer examination revealed numerous raised areas around the head, and the retropharyngeal, submandibular, prescapular and femoral regions. The calf also had a nasal discharge and was breathing heavily (Figure 18). The owner reported loss of body condition but the calf still had a body condition score of 2.5 out of 5.

The calf was euthanased and a necropsy performed. The tissues appeared generally pale, with significant generalised lymphadenomegaly. The inguinal and lumbar lymph nodes measured approximately 12 to 15 cm x 6 cm x 5 cm. All mesenteric lymph nodes were significantly enlarged. Some lymph nodes, particularly the lumbar and superficial lymph nodes, appeared reactive with many having purplish necrotic areas. The kidneys and the liver were significantly enlarged, both resembling the size expected to be found in a mature adult cow. The liver appeared to have a fibrotic capsule. The urinary bladder and urethras were sampled because they appeared thickened and abnormally elongated. Petechial haemorrhages were noted on the peritoneum, pleura and epicardium.

Figure 18 Droughtmaster calf with large swelling below the ear and serous nasal discharge due to sporadic lymphosarcoma

Histological examination of the heart and lung revealed infiltration with malignant lymphoid cells, predominantly in the atrial connective tissue and valves, and to a lesser extent in the myocardium and the perivascular, peribronchiolar and subpleural tissues in the lung. A grossly visible nutmeg pattern of the liver corresponded to massive periportal and intrasinusoidal malignant lymphocytic infiltration. Many other organs, including the kidney and urinary bladder, and the lymph node samples had marked proliferation of malignant lymphocytes.

An ELISA (enzyme-linked immunosorbent assay) for enzootic bovine leucosis was negative. A diagnosis of sporadic lymphosarcoma was made on the basis of the negative result and histology. Sporadic lymphosarcoma is a rare condition of unknown aetiology. There are no specific management practices for its prevention.

Extension of pigeon paramyxovirus to north Queensland

In December 2016, four separate racing pigeon lofts in Cairns experienced mortalities among their racing pigeon flocks. The four lofts had all purchased birds from an auction 2 weeks earlier. The birds sold had been transported from Brisbane to Cairns by truck. Birds died following a sudden onset of depression, 'fluffed up appearance', watery diarrhoea, conjunctivitis and neurological symptoms, including holding the head in a twisted position.

When government officers first investigated the four lofts, approximately 80 birds had died from a total at-risk group of approximately 400. Another 100 birds were sick. Eight sick birds were taken for laboratory examination.

On necropsy, all the birds sampled had marked pallor of the viscera, particularly the kidneys. The cloacal bursa of one bird was markedly enlarged and approximately 20 mm in diameter. Histology revealed moderate-to-severe subacute nephritis and mild cholangiohepatitis.

PCR for influenza A was negative. Seven of the birds were PCR positive for both Newcastle disease (a paramyxovirus with cross-reactivity) and pigeon paramyxovirus (PPMV). Further pathotyping at CSIRO Australian Animal Health Laboratory found the sequence data from virus isolates were similar to PPMV-1 strains circulating in Victoria in 2015. The detected paramyxovirus was PPMV and not virulent or exotic Newcastle disease virus.

This is the first known occurrence of pigeon paramyxovirus in Queensland. The movement of caged birds is unregulated in Australia, making tracing the origin of the disease difficult. The birds had come from a loft in Brisbane that has not suffered similar illness. It was considered inevitable that this disease, which is relatively widespread in south-eastern Australia, would occur in Queensland.

The loft owners have implemented voluntary on-site biosecurity, including destruction, disinfection and movement controls. Biosecurity Queensland is providing ongoing advice on biosecurity measures, including vaccination. There have been no records of PPMV infecting commercial poultry in Australia.

South Australia

Celia Dickason, Biosecurity South Australia, Department of Primary Industries and Regions, South Australia

During the quarter in South Australia, 170 livestock and other animal disease investigations[34] were conducted to rule out emergency diseases and investigate suspect notifiable diseases. The number of investigations by category of livestock is shown in Figure 19.

Subsidised field investigations were conducted by government veterinary or biosecurity officers (93) and private veterinary practitioners, who in 83 cases submitted samples to the state diagnostic veterinary laboratory or CSIRO Australian Animal Health Laboratory for subsidised testing to exclude or confirm notifiable diseases.

During the quarter, the state veterinary diagnostic laboratory, Gribbles Vetlab, processed 176 sample submissions to rule out emergency diseases and investigate suspect notifiable diseases. Sample submissions were also received requiring testing for export, accreditation programs and targeted surveillance.

Biosecurity SA, a division of Primary Industries and Regions South Australia (PIRSA), maintains close communication with rural private veterinary practitioners, who make a valuable contribution to surveillance by investigating potential incidents of notifiable diseases and significant disease events. Biosecurity SA has an Enhanced Disease Surveillance Program to promote disease incident investigations in South Australian livestock. In partnership with the National Significant Disease Investigation Program, the state program funds laboratory submissions for suspect infectious diseases in livestock and subsidises contracted private veterinary practitioners for costs incurred in investigating unusual disease events. Biosecurity SA offers training and refresher courses in emergency animal disease detection and necropsy technique to practitioners, and provides ongoing technical support, when required.

The following case reports are a selection of field investigations chosen to reflect a range of livestock disease incidents during the quarter.

Sudden death in lambs with severe haemonchosis

In mid-December, a pastoral producer from the Lameroo area reported deaths in his 5 to 6-month-old Suffolk lambs. The lambs had previously been healthy, and had been weaned and drenched for worms 2 to 4 weeks earlier. Deaths had begun 7 days prior to the report, with a loss of 10 animals out of a group of 280 lambs. Due to the remoteness of the property, no veterinary visit was requested initially, and a diagnosis of possible annual ryegrass toxicity was made. The producer was advised to move the lambs into a new paddock and feed them fresh barley hay.

However, lamb deaths continued to a total of 17, and a veterinary investigation was undertaken on 23 December. A thick layer of immature parasitic roundworms, identified as *Haemonchus contortus* (barber's pole worm), was observed in the abomasum at necropsy. Blood samples revealed profound anaemia. Histological changes within the abomasum and intestinal tract were compatible with gastrointestinal parasitism (verminosis). Very high faecal worm egg counts (up 10,400 eggs per gram) were noted in all samples.

The Lameroo–Pinnaroo area has an expected low annual rainfall of 250 to 300 mm so internal parasite problems are not usually seen. 2016 was a year of unusually high rainfall, even during the usually dry spring and summer months. This resulted in an ideal environment for outbreaks of parasitic and fungal conditions. Haemonchosis is almost unknown in this region but it is one of the few internal parasites that can clearly be seen in the abomasum, producing very high faecal worm egg counts.

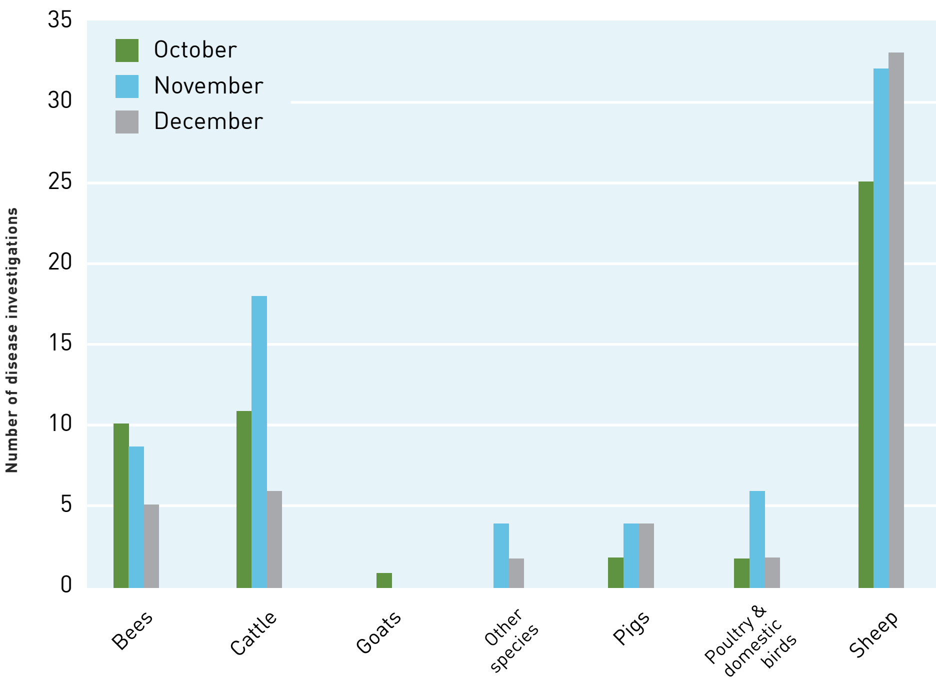


Figure 19 Number of disease investigations in South Australia, October to December 2016

34 Subsidised field investigation with laboratory diagnostic testing.

Further investigation revealed that the lambs had been drenched (wormed) with an anthelmintic ineffective against *Haemonchus* spp. Advice was provided on worm resistance testing and the use of appropriate worm control. All remaining lambs were then given an appropriate anthelmintic, with no further deaths reported.

Focal symmetrical encephalomalacia in lambs

In November, focal symmetrical encephalomalacia (FSE), also known as pulpy kidney disease, was diagnosed as the cause of death of 17 animals from a group of 1300 crossbred lambs in the south-east. The lambs had been purchased 4 weeks earlier from Queensland, with unknown vaccination and deworming history.

The lambs were placed onto a clover and grass pasture when they arrived, and then brought into sheep yards a month later for worming, when the deaths occurred suddenly overnight.

Haemonchosis (infestation with barber's pole worm) was noted on necropsy, but there were no other significant gross lesions. Brain histopathology revealed microscopic vascular lesions compatible with focal symmetrical encephalomalacia (FSE). This diagnosis was supported by a significantly elevated glucose level within the aqueous humour.

Outbreaks of FSE are due to an epsilon toxin produced by *Clostridium perfringens* type D, which causes damage to the vascular and nervous systems. *C. perfringens* is part of the normal gut flora but certain conditions can cause these bacteria to multiply and produce more toxin. One factor in many outbreaks is the change in diet, and more particularly a rising plane of nutrition, where low fibre and increased starch levels can cause increased proliferation of the bacteria in the intestines. Outbreaks can be controlled by feeding animals a diet containing more roughage. FSE may be prevented by the appropriate use of clostridial vaccine.

In this particular case, stress of handling and parasitic damage to the intestinal wall may have increased absorption of the toxin. The producer was advised to vaccinate his lambs as soon as possible.

Pneumonia and death in lambs

In December, a Murraylands region lamb feedlot producer reported 16 deaths from a group of 200 lambs aged 3 to 5 months. The lambs had been purchased during the previous month from a number of different properties, including from Kangaroo Island. On entry to the feedlot, the lambs had been vaccinated against clostridial diseases (5-in-1 vaccine), injected with vitamin B_{12} and drenched for worms. Deaths began a few weeks after introduction, as well as signs of respiratory distress in some animals.

Veterinary examination revealed pyrexia, mild diarrhoea and increased respiratory effort and rate. Severe pleurisy and pulmonary abscessation was observed on necropsy. The liver appeared pale and mottled. Histopathology confirmed moderate, multifocal acute neutrophilic hepatitis and severe fibrinosuppurative pleuritis, with bronchopneumonia.

These findings are typical of bacterial infection, most likely the extension of a severe bronchopneumonia. Although a heavy growth of *Escherichia coli* was cultured, this was complicated by the growth of mixed skin and environmental flora, suggestive of contamination. *E. coli* has been implicated in pneumonia in lambs but would be expected to be a secondary opportunistic pathogen rather than a primary one. A wide variety of bacteria have been associated with pleurisy and pneumonia in lambs but the pathogenesis is multifactorial, with bacterial colonisation and infection being facilitated by stressors, such as weather and environmental conditions, overcrowding, handling and deworming.

It is suspected that the introduction of stressed lambs from areas remote from the feedlot, like Kangaroo Island, led to the spread of bacterial respiratory disease and subsequent death. While end-stage respiratory disease is relatively easy to diagnose from clinical signs, the early stages can be subtle in lambs under feedlot conditions.

Affected lambs responded well to oxytetracycline antibiotics, and management was advised to provide the lambs with adequate shelter and bedding in the unusually wet, cool and humid conditions seen during this spring and summer.

Tasmania

Sue Martin, Tasmanian Department of Primary Industries, Parks, Water and Environment

During the quarter in Tasmania, 256 livestock disease investigations[35] were conducted to rule out emergency diseases[36] or investigate suspect notifiable diseases. The number of investigations by category of livestock is shown in Figure 20. Field investigations were conducted by government veterinary or biosecurity officers (6) and private veterinary practitioners (250). Diagnostic testing for these cases was conducted at the state veterinary diagnostic laboratory or CSIRO Australian Animal Health Laboratory.

During the quarter, the state veterinary diagnostic laboratory, Animal Health Laboratory, Launceston, processed 535 livestock sample submissions[37] to rule out emergency diseases or investigate suspect notifiable diseases. Sample submissions were also processed to substantiate proof of disease freedom certifications, and for accreditation programs and targeted surveillance.

Six field investigations were conducted by government veterinary or biosecurity officers and 250 investigations were undertaken by private veterinary practitioners. During this quarter, two of these investigations were subsidised by the National Significant Disease Investigation (NSDI) Program. Private practitioners often liaise with veterinary officers from the Department of Primary Industries, Parks, Water and Environment (DPIPWE) in the event of unusual disease events. Full support for laboratory costs and additional funding under the NSDI Program is available for approved disease investigations where presenting signs maybe consistent with events clinically consistent with national notifiable diseases or suspected to be a new or emerging disease. These investigations receive highest priority.

Diagnostic samples of field investigations were processed by the state veterinary diagnostic laboratory.

The following case report was chosen to highlight surveillance and diagnostic capacity. It does not represent the full range of livestock disease incidents during the quarter.

Neurological disease in a horse

In November 2016, Hendra virus and West Nile virus were excluded by polymerase chain reaction (PCR) testing and serology in an 8-year-old warm blood mare that presented with abnormal neurological signs. The eventing horse had travelled widely in Australia, arriving in Tasmania from the Hunter Valley in early August. The horse had attended an equine event in south-east Tasmania 1 week prior to clinical signs. The horse had no history of Hendra virus vaccination. Initially the horse exhibited ataxia, somnolence and fever, and progressively deteriorated over the following 4 days. The horse had a serous nasal discharge.

The differential diagnosis included equine herpesvirus 1 (EHV-1), plant toxicity, West Nile virus (WNV), Ross River virus (RRV) and Hendra virus infection.

Blood samples and nasal and ocular swabs were collected, and the owner was directed to isolate the affected horse until testing results were received. EDTA (ethylenediaminetetraacetic acid) blood samples and nasal and ocular swabs returned negative results for Hendra virus TaqMan assay in the M gene and N gene and West Nile virus TaqMan assay, and serum samples returned negative results for the detection of equine antibody to G protein on the Hendra indirect ELISA (enzyme-linked immunosorbent assay), the Murray

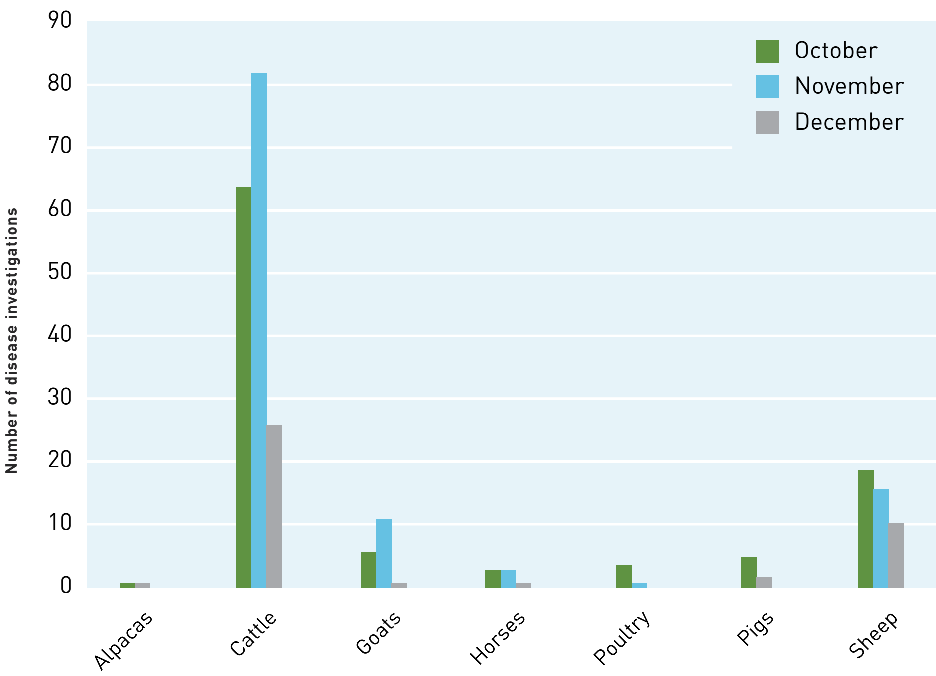


Figure 20 Number of field disease investigations in Tasmania to rule out emergency diseases or investigate suspect notifiable diseases, October to December 2016

35 Field investigation with laboratory diagnostic testing at the state veterinary laboratory.

36 Emergency diseases are a subset of notifiable disease defined as diseases listed in the Emergency Animal Disease Response Agreement www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

37 Some investigations involved multiple submissions.

Valley encephalitis virus IgM antibody capture ELISA and the West Nile virus IgM antibody capture ELISA at CSIRO Australian Animal Health Laboratory.

High antibody titres were returned for Ross River virus, EHV-1 and EHV-4. These viruses are endemic in Tasmania, and other cases of EHV-1 had been reported over the winter months.

Anti-inflammatory treatment had been instituted during the course of the disease. Following the laboratory results, the affected horse was isolated for a further 4 weeks and made a slow recovery.

Symptoms of both EHV-1and EHV-4 include fever, depression, nasal discharge and lack of appetite. EHV-1 is the most significant of the five strains of herpesviruses that can cause disease in horses in Australia because it is relatively widespread, causing respiratory and nervous symptoms, abortions and stillbirths. EHV-4 usually causes upper respiratory tract disease. EHV-1 is a common cause of respiratory infections in young horses and most have developed antibodies by the time they are adults. However, once infected, horses carry the virus for life and the virus may resurface and be excreted if the horse becomes stressed. Adult horses can be affected by the nervous form of the disease with symptoms ranging from mild temporary ataxia to severe incoordination and recumbency. The disease is highly contagious; horses usually contract the disease from inhaling infected droplets or eating contaminated feed. There is no specific treatment for EHV-1. The infected horse must be isolated for at least 30 days from the onset of signs, and hygiene practices need to be in place to prevent the spread of infection to other horses.

Ross River virus, Murray River encephalitis virus and Kunjin virus are arboviral diseases spread by biting insects. In horses, some cases of arboviruses may cause neurological or musculoskeletal signs, such as staggering, incoordination, weakness and depression. Unusually wet weather and flooding can lead to an increase in mosquito populations, which in turn increases the risk of transmission of arboviral disease. Measures to avoid contact between horses and mosquitos, such as removing stagnant water sources, can help reduce the risk of disease.

Victoria

Karen Moore, Victorian Department of Economic Development, Jobs, Transport and Resources

During the quarter in Victoria, 335 livestock and other animal disease investigations[38] were conducted to investigate suspect notifiable diseases or rule out emergency diseases.[39] The number of investigations by species of livestock is shown in Figure 21. Field investigations were conducted by government veterinary or biosecurity officers (114) and private veterinary practitioners (225). All diagnostic testing was conducted at state registered veterinary diagnostic laboratories or CSIRO Australian Animal Health Laboratory.

During the quarter, the state veterinary diagnostic laboratory, AgriBio Veterinary Diagnostics Services, Bundoora, processed 713 livestock sample submissions[40] to investigate suspect notifiable diseases or rule out emergency diseases. Another 332 sample submissions were processed to substantiate proof of disease freedom certifications, and for accreditation programs and targeted surveillance.

Across all species, nonspecific clinical patterns were most commonly reported, followed by signs associated with the gastrointestinal tract, the central nervous system and the respiratory tract. The diseases most commonly diagnosed by species were gastrointestinal diseases in cattle, goats and pigs and diseases of the central nervous system in sheep. Cases of clinical disease where no definitive disease agent was identified were reviewed in the context of the surrounding circumstances, and exotic or emergency diseases were excluded where appropriate. Test results from exotic or emergency animal disease exclusion testing are routinely recorded as suspect emergency animal diseases (Table 17).

The following case reports are a selection of field investigations chosen to highlight surveillance and diagnostic capacity. Reports chosen are not necessarily representative of the full range of livestock disease incidents during the quarter.

Enzootic ataxia in crossbred lambs

On four separate properties in south-west Victoria during the quarter, enzootic ataxia was diagnosed as the cause of hindlimb weakness and recumbency in 109 crossbred ewe and ram lambs aged 10 to 16 weeks.

Producers reported sudden death, weakness and recumbency, hindlimb ataxia, reduced proprioception and paralysis in otherwise healthy lambs. Necropsy was largely unremarkable with rib fractures being the only gross lesion.

The diagnosis of enzootic ataxia was confirmed with histopathology of formalin-fixed cervical spinal cord and brain and fresh liver samples for copper concentrations. Copper concentrations ranged from 0.02 to 0.05 mmol/kg (normal range: 0.23 to 3.67 mmol/kg)

Enzootic ataxia, also known as 'sway back', is caused by copper deficiency. The greatest demand for copper by grazing sheep is in ewes during late pregnancy and early lactation. An adult ewe normally needs about 3.7 mg/day. In late pregnancy with twins, this requirement almost trebles to 10.5 mg, and almost doubles again during lactation (approximately 20.7 mg/day).

Deficiency during gestation causes the delayed form of ataxia seen in these outbreaks, with clinical signs due to degenerative axonopathy of the spinal cord and osteoporosis.

In southern Australia, the two main causes of copper deficiency in sheep are low copper levels in plants due to naturally copper-deficient soils, and an induced deficiency caused by ingestion of excessive levels of molybdenum (most commonly) and sulfur in pasture.

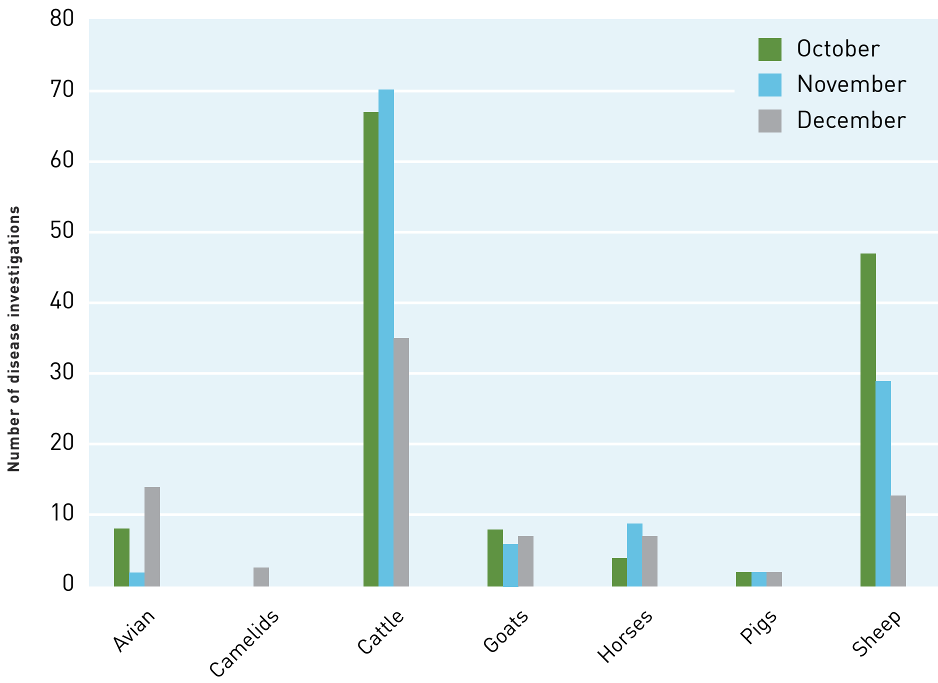


Figure 21 Number of field disease investigations to investigate suspect notifiable diseases or rule out emergency diseases, in Victoria, October to December 2016

38 Field investigation with laboratory diagnostic testing.

39 Emergency diseases are a subset of notifiable disease defined as diseases listed in the Emergency Animal Disease Response Agreement www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

40 Some investigations involved multiple submissions.

These recent outbreaks were likely due to the high winter and spring rainfall experienced in the Western District (42% wetter than average). Rapid pasture growth after good winter rains reduces the concentration of copper in pasture and predisposes sheep to a deficiency during late winter and spring.

The producers were advised that currently affected lambs could not be cured.

Future prevention would include seasonal analysis and ensuring pregnant ewes lambing down on high-risk pasture were supplemented with copper mid gestation. A copper ruminal bolus or subcutaneous injection are the most reliable method of supplementation; mineral licks and oral drenching do not ensure 100% treatment and are short lasting. Care must be taken to ensure supplementation does not lead to copper toxicity.

Foot-and-mouth disease exclusion in crossbred ewes

A producer in central Victoria reported an increase in deaths across an entire flock of 2000 crossbred ewes and lambs in early December 2016.

One lamb was reported to have a shifting lameness in all four limbs. One ewe, which had been shedded for shearing, was found recumbent the following morning, and was euthanased for necropsy examination that afternoon. The cyanotic change about the muzzle and upper lip was the striking necropsy finding, along with a mottled liver.

Clotted and EDTA (ethylenediaminetetraacetic acid) blood samples were submitted for foot-and-mouth disease (FMD) and bluetongue virus (BTV) exclusion testing from this ewe and five of her cohorts, with negative findings.

Histopathology of the lip skin showed a severe multifocal-to-coalescing pyogranulomatous dermatitis with intralesional club-forming colonies

('Splendore-Hoeppli' phenomenon[41]). Small gram-negative bacilli were confirmed within these deposits. A diagnosis of cutaneous actinobacillosis was made.

The infection is believed to have occurred after the skin on the muzzle had been macerated and subsequently damaged by 4 months of grazing extremely wet pastures, which matured in late November.

Hindlimb paralysis in lambs

For several years intermittently, a property north-east of Wangaratta has had lambs develop hindlimb paresis/paralysis, primarily post-marking.

In mid-November 2016, a 6 to 7-week-old ewe lamb in reasonable condition (body condition score 2 to 3 out of 5), which was bright, alert and suckling well, presented dragging its hindlimbs. The lamb had been marked, treated with 6-in-1 multicomponent adjuvant vaccine and ovine Johne's disease sheep vaccine and 'chip dipped' (in an immersion cage) for lice 2 weeks prior. Hindlimb paresis developed a week post-marking and subsequently progressed to paralysis. Physical examination showed severe deficits in pain response in the hindlimbs, while the tail stump was scabbed over but still raw.

The lamb was euthanased for necropsy. No visual lesions were found in the cervical region indicative of a post-vaccination reaction. Oedematous swelling was observed in the meninges and along the spinal cord resulting in a U-shaped distortion of the spinal cord in the sacral area, which appeared exacerbated by a raised section of the vertebral floor.

Laboratory results showed occasional large vacuoles in the white matter with plaques of red blood cells and inflammatory cells. Large round empty spaces were present in the meninges. Haematology and biochemistry were unrewarding apart from an elevated white cell count. Swabs taken of both the meninges and spinal cord cultured *Pantoea agglomerans*, which may represent either contamination or opportunistic bacterial infection. The final diagnosis was subdural haemorrhage. It was not clear whether the haemorrhage was the result of trauma or adjacent infection.

The producer was advised to treat affected lambs when found with penicillin and to consider sepsis control at marking and post-marking.

41 Asteroid bodies; radiating or annular eosinophilic deposits of host-derived materials, and possibly of parasite antigens, which form around fungi, helminths or bacterial colonies in tissue.

Western Australia

Jamie Finkelstein,
Department of Agriculture and Food Western Australia

During the quarter in Western Australia, 291 livestock disease investigations[42] were conducted to rule out emergency diseases or investigate suspect notifiable diseases.[43] The number of investigations by category of livestock is shown in Figure 22. Field investigations were conducted by government veterinary officers (71) and private veterinary practitioners (220). All diagnostic testing was conducted by the Department of Agriculture and Food Western Australia (DAFWA) or CSIRO Australian Animal Health Laboratory.

During the quarter, DAFWA processed 728 livestock sample submissions,[44] which included submissions to rule out emergency diseases or investigate suspect notifiable diseases. Sample submissions were also processed to substantiate proof of disease freedom certifications, and for accreditation programs and targeted surveillance.

DAFWA, in partnership with private veterinarians and industry, works to protect Australia's reputation as a producer of safe wholesome livestock and livestock products.

Key aims of livestock disease surveillance are early detection of reportable diseases and demonstrating Australia's absence of, and capacity to detect, reportable diseases to support domestic and export market access for Australia's livestock and livestock products.

Given that reportable diseases may present similarly to diseases endemic in Australia, a key objective is prompt investigation of cases presenting with clinical signs consistent with a reportable disease. This has the dual purpose of assisting the affected producer to manage the disease event by definitively diagnosing the endemic disease cause, as well as supporting the wider livestock sector by demonstrating freedom from reportable diseases, which is vital to maintaining Australia's favourable animal health status and market access.

The following case reports are a selection of field investigations chosen to highlight surveillance and diagnostic capability. Reports chosen are not necessarily representative of the full range of livestock disease incidents during the quarter.

Surveillance for pig reportable diseases

With several of Australia's national notifiable diseases affecting pigs, the DAFWA Animal Disease Surveillance Project encourages the investigation of cases where pigs are showing indicative clinical signs. As part of routine animal disease surveillance activities, DAFWA undertook testing for several notifiable diseases in the last quarter, including but not limited to Aujeszky's disease, porcine reproductive and respiratory syndrome, and classical swine fever. Included in this report is an overview of two such cases.

Abortion investigation—Aujeszky's disease and porcine reproductive and respiratory syndrome excluded

In October 2016, a private veterinarian investigated a report from a producer in the Southern Agricultural region of abortion in Large White–Landrace cross sows, with three of 600 sows affected. The producer reported that the sows had aborted approximately 10 days before anticipated farrowing.

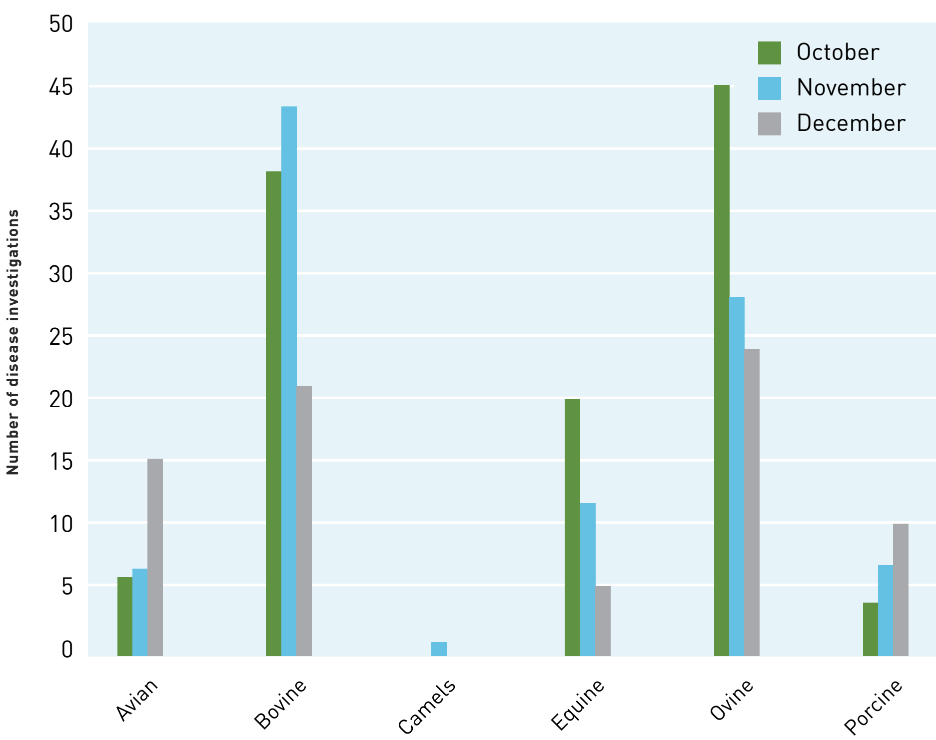


Figure 22 Number of field disease investigations in Western Australia to rule out emergency diseases or investigate suspect notifiable diseases, October to December 2016

42 Field investigation with laboratory diagnostic testing.

43 Emergency diseases are a subset of notifiable disease defined as diseases listed in the Emergency Animal Disease Response Agreement www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

44 Some investigations involved multiple submissions.

On-farm investigation revealed there had been no change to feed, water or other management practices. The private veterinarian submitted samples to DAFWA Diagnostic Laboratory Services from four aborted foetuses and blood samples from the affected sows.

Histological examination revealed that the placental tissue was infiltrated with both degenerated and intact neutrophils, along with small numbers of lymphocytes. Within the chorionic villi, there was a broad range of lesions varying from small-to-moderate numbers of infiltrating neutrophils and loss of epithelium within individual villi to multiple regions, in which there was a complete loss of placental architecture and large numbers of inflammatory cells.

The pattern of inflammation and necrosis in the placental tissues from all aborted foetuses was typical of an acute bacterial infection rather than that of viral aetiology. DAFWA Diagnostic Laboratory Services undertook culturing of liver, lung and placenta samples, which resulted in the growth of haemolytic *Escherichia coli* from each of the aborted foetuses, supporting a diagnosis of *E. coli* placentitis.

To ensure there was no exotic reportable disease involvement, as well as provide data to support demonstration of proof of disease freedom, the CSIRO Australian Animal Health Laboratory and DAFWA Diagnostic Laboratory Services undertook testing for Aujeszky's disease and porcine reproductive and respiratory syndrome, both of which were negative on polymerase chain reaction (PCR) testing. DAFWA Diagnostic Laboratory Services tested for leptospirosis—due to the potential for this disease to transmit from livestock to farm workers—which was negative.

Post-weaning wasting investigation—porcine reproductive and respiratory syndrome and classical swine fever excluded

In December 2016, a private veterinarian investigated a report from a producer in the South-Western Agricultural region of post-weaning wasting in mixed sex 6 to 12-week-old crossbred pigs, with a mortality of 6%.

Necropsy of four pigs revealed evidence of severe ulcerative colitis in two, and evidence of peritonitis, pleurisy and pleural effusion in the other two. Swabs, fresh samples and fixed samples were submitted to DAFWA Diagnostic Laboratory Services, with the private veterinarian providing a provisional diagnosis of salmonellosis.

Histological examination identified severe ulcerative typhlitis in two of the pigs, with the colon mucosa being diffusely and moderately oedematous with extensive infiltration of the lamina propria by neutrophils. Multifocal superficial erosion and attenuation of epithelium was evident. The caecum had severe diffuse ulceration associated with a dense adherent exudate of degenerate neutrophils. DAFWA Diagnostic Laboratory Services undertook bacterial culture, with *Salmonella enterica* subsp. *enterica* serovar Typhimurium isolated.

One of the pigs had multifocal thickening of alveolar septa with increased numbers of lymphocytes and reactive macrophages present. The splenic capsule and omentum were expanded by multifocal infiltrate of macrophages, lymphocytes and neutrophils.

Extensive hepatocellular necrosis with histiocytic infiltration present throughout the liver tissue was seen in another pig. These lesions were identified as typical of an infarction but it was noted that hepatitis has been reported in cases of acute porcine circovirus 2 (PCV-2) associated disease. PCV-2 immunohistochemistry was positive within hepatocytes and within peribronchiolar lymphoid tissue of the lung, alveolar septa and enteric mucosa. This was determined as suggestive of a systemic PCV-2 infection in this pig.

Based on the history, necropsy and laboratory findings, an aetiological diagnosis of salmonellosis was made for three of the pigs and PCV-2 associated disease for the fourth.

CSIRO Australian Animal Health Laboratory and DAFWA Diagnostic Laboratory Services undertook testing for porcine reproductive and respiratory syndrome, classical swine fever and influenza A virus, each of which were negative on PCR testing.

Neurological signs in horses—Hendra virus and equine encephalitidies excluded

In November 2016, a DAFWA veterinarian and a private veterinarian investigated a report from a Pilbara owner of two horses showing neurological signs.

The history involved a 20-year-old mare presenting with tachycardia, muscle tremors, weight-shifting and response to stimuli that lead to seizures. The mare was euthanased by the private veterinarian due to welfare issues. A 6-year-old gelding held in the same paddock subsequently presented with similar clinical signs. The gelding had been previously vaccinated for Hendra virus.

The DAFWA veterinarian conducted an on-site risk assessment, in conjunction with the private veterinarian, and determined that the likelihood of Hendra virus infection was low. To definitively exclude Hendra virus infection, testing was undertaken at DAFWA Diagnostic Laboratory Services and CSIRO Australian Animal Health Laboratory, which returned negative results on PCR testing.

The gelding subsequently deteriorated and was euthanased. Given the negative results for Hendra virus infection, a necropsy was performed and a comprehensive sample set was submitted to DAFWA Diagnostic Laboratory Services for further diagnostic investigation. This included samples from the affected horses' cohorts in neighbouring paddocks, as well as water, feed and hay. The differential diagnosis included organophosphate or strychnine poisoning.

Strychnine, fluoroacetate and organophosphate were not detected on a general toxin screen but the gelding's faeces returned positive results for annual rye grass toxicity (ARGT). ARGT was detected in hay samples, where investigation revealed the hay had been sourced from outside the Pilbara region. Histological examination of the brain revealed no significant pathological findings. ARGT is often associated with protein leakage from blood vessels in the cerebellar meninges but this is often not apparent in horses and an absence of the lesion does not exclude ARGT as the cause.

Given the history, clinical signs and laboratory findings, ARGT was determined the most likely cause and no new cases were reported by the owner after the infected hay was removed as a feed source.

CSIRO Australian Animal Health Laboratory and DAFWA undertook testing for a large number of reportable diseases that could present similarly, including Eastern equine encephalitis, Western equine encephalitis, Venezuelan equine encephalitis, Australian bat lyssavirus, Murray Valley encephalitis and West Nile virus, each of which were negative.

Eperythrozoonosis in lambs

In October 2016, a private veterinarian investigated a report from a producer in the Central Agricultural Region of weakness and sudden deaths in 5-month-old Merino lambs of mixed sex, with six dead and 100 affected from a flock of 1000.

The producer advised that two lambs had been found dead and several had collapsed when moved for shearing. Physical examination of affected lambs revealed pale mucous membranes, with no other significant abnormalities. The flock had been treated with a 6-in-1 multicomponent adjuvant vaccine and drenched for internal parasites approximately 6 weeks prior. The private veterinarian submitted a comprehensive sample set of blood, blood films, fresh samples and fixed samples to DAFWA Diagnostic Laboratory Services.

Histological examination revealed foci of haemosiderosis with occasional erythrophagocytosis within the spleen. Within the liver, Kupffer cells frequently contained a small quantity of brown pigment, presumed to be haemosiderin. Evidence of a haemolytic event was supported by biochemistry results, which revealed elevated levels of phosphorus and free plasma iron.

Further testing revealed that copper levels, both trichloroacetic acid (TCA)-soluble copper and total copper, were normal. Minimal variation between TCA and total copper indicated absence of thiomolybdate binding, which can occur secondary to excessive molybdenum intake and result in signs that are the same as primary copper deficiency. It was determined these results ruled out copper deficiency as a cause. Zinc levels were determined to be normal. A faecal worm egg count excluded intestinal parasitism as a cause.

Blood films revealed the presence of ghost cells, further indicating a haemolytic process but with a regenerative anaemia evident. Blood samples were tested for *Mycoplasma ovis* (formerly *Eperythrozoon ovis*) with both antibody and PCR testing returning positive results.

Based on the history, clinical and laboratory findings, DAFWA Diagnostic Laboratory Services diagnosed eperythrozoonosis. This is a disease of sheep and goats, caused by *M. ovis*, known to cause ill-thrift (most likely during spring), which can lead to mortalities in more susceptible animals.

DAFWA provided the private veterinarian and farmer with management advice to mitigate the impact and minimise the likelihood of a reoccurrence.

Quarterly statistics

Endemic disease monitoring

Johne's disease

In Australia, Johne's disease occurs primarily in dairy cattle and sheep and to a lesser extent in beef cattle, camelids, deer and goats. Infection in sheep occurs to varying extents across the sheep-producing regions of southern Australia.

Investigations for Johne's disease in alpacas, cattle, deer, goats and sheep are reported in Table 17 (Investigations for national notifiable animal diseases). There is also reporting of sheep flocks infected with Johne's disease through quarterly reporting of the National Sheep Health Monitoring Project (NSHMP) and the number of property identification codes (PICs) identified as having one or more infected animals. Sampling is from participating abattoirs and data is only for animals older than 2 years sourced directly from a property. Table 3 shows the number of PICs inspected and found with one or more infected animals.

Table 3 Summary of National Sheep Health Monitoring Project (NSHMP) inspected and infected line results, October to December 2016

State	Number of animals inspected	Number of PICs inspected	Number of PICs infected	Percentage of PICs infected
NSW	15,365	39	2	5.1
NT	0	0	0	0
Qld	0	0	0	0
SA	174,066	892	10	1.1
Tas.	27,880	115	0	0
Vic.	28,247	150	14	9.3
WA	12,621	47	6	12.8
Aus.	**258,179**	**1,243**	**32**	**2.6**

PIC = property identification code

Approaches based on risk assessment and management have been developed to control Johne's disease in all affected species. Market assurance programs (MAPs) are in operation for alpacas, goats and sheep; the numbers of herds or flocks that have reached a status of Monitored Negative 1 or higher are shown in Table 4. For status definition, see the current species MAP manual.[45] Lists of alpaca and goat herds and sheep flocks assessed in the MAPs are available on the Endemic Disease Information System website.[46] Herd or flock testing is undertaken by a MAP-approved veterinarian. The MAP for cattle ceased on 1 November 2016, with herds moving to industry-specific (beef or dairy) assurance scores. These risk profiling tools have different levels of biosecurity and testing, with higher levels requiring veterinary supervision. Information about components of the National Johne's Disease Project can be obtained from state coordinators and Animal Health Australia's Johne's disease coordinator, Rob Barwell (tel. 02 6203 3947).

45 www.animalhealthaustralia.com.au/maps

46 edis.animalhealthaustralia.com.au/public.php?page=mapsearch&aha_program=3

Table 4 Alpaca, goat and sheep herds or flocks[a] with a Market Assurance Program status of at least Monitored Negative 1, 1 July to 31 December 2016

Quarter	Alpacas	Goats	Sheep	Total
Jul–Sep 2016	17	22	386	425
Oct–Dec 2016				
NSW	9	6	153	168
Qld	0	5	1	6
SA	7	8	161	176
Tas.	0	1	13	14
Vic.	1	3	50	54
WA	0	0	4	4
Aus.	**17**	**23**	**382**	**422**

a There are no herds or flocks in Northern Territory in the MAPs.

Ovine contagious epididymitis

Contagious epididymitis, caused by *Brucella ovis*, is present in commercial sheep flocks at a low level that varies around the country. Voluntary accreditation programs (usually in stud flocks) for ovine contagious epididymitis freedom operate in all states. Table 5 shows the number of accredited flocks at the end of the quarter.

Table 5 Ovine contagious epididymitis accredited-free flocks, 1 October 2015 to 31 December 2016[a]

State	Oct–Dec 2015	Jan–Mar 2016	Apr–Jun 2016	Jul–Sep 2016	Oct–Dec 2016
NSW	846	872	861	861	861
Qld	79	79	73	72	72
SA	530	530	530	539	539
Tas.	62	63	71	56	59
Vic.	471	445	457	436	436
WA	183	184	184	184	180
Aus.	**2,171**	**2,173**	**2,176**	**2,148**	**2,147**

a There are no herds or flocks in Northern Territory in the MAPs. Herds or flocks in Free or Protected zones have an equivalent status of Monitored Negative 1 or better because of the zone status.

Laboratory testing

Serological testing

Table 6 summarises the results of serological testing for two equine viruses on samples submitted to state and territory animal health laboratories during the quarter. Positive serological test results are not an indication of the presence of clinical disease.

Table 6 Results of serological testing for two equine viruses, 1 October 2015 to 31 December 2016

Quarter	No. of tests (equine infectious anaemia)	Positive (equine infectious anaemia)	No. of tests (equine viral arteritis)	Positive (equine viral arteritis)
Oct–Dec 2015	1,348	0	483	0
Jan–Mar 2016	629	0	603	2
Apr–Jun 2016	825	0	943	4
Jul–Sep 2016	473	0	446	2
Oct–Dec 2016				
NSW	948	0	369	0
NT	0	0	0	0
Qld	55	16	36	0
SA	1	0	0	0
Tas.	0	0	0	0
Vic.	293	0	137	0
WA	5	0	5	0
Aus.	**1,302**	**16**	**547**	**0**

Table 7 summarises the results of laboratory testing for equine herpesvirus 1 on samples submitted to state and territory animal health laboratories during the quarter.

Table 7 Results of testing for equine herpesvirus 1 (EHV-1), at 31 December 2016

Syndrome	EHV1 suspected but not confirmed	Negative	Positive	Total
Abortion	0	10	0	10
Neurological	1	11	0	12
Other	0	19	0	19
Total	**1**	**40**	**0**	**41**

Table 8 summarises the results of serological testing for three arboviruses on samples submitted to state and territory animal health laboratories for the National Arbovirus Monitoring Program (NAMP).[47] Positive serological test results are not an indication of the presence of clinical disease.

Table 8 Results of serological testing for three arboviruses, 1 October 2015 to 31 December 2016

Quarter	No. of tests (Akabane)	Positive (Akabane)	No. of tests (BEF)	Positive (BEF)	No. of tests (BTV)	Positive (BTV)
Oct–Dec 2015	196	12	534	47	786	10
Jan–Mar 2016	217	0	789	34	1,403	71
Apr–Jun 2016	548	66	951	35	1,513	91
Jul–Sep 2016	454	28	757	39	1,021	32
Oct–Dec 2016	**197**	**3**	**577**	**10**	**888**	**57**

BEF = bovine ephemeral fever virus; BTV = bluetongue virus

47 http://namp.animalhealthaustralia.com.au

Surveillance activities

Bovine brucellosis

Australia declared freedom from bovine brucellosis (caused by Brucella abortus) in 1989.[48] Surveillance is maintained through abortion investigations and additional testing of cattle for export or other reasons. Table 9 shows 33 bovine abortion investigations and 147 investigations for other reasons were performed during the quarter; all were negative for bovine brucellosis.

Table 9 Bovine brucellosis testing, 1 October 2015 to 31 December 2016

Quarter	No. of tests (abortion)	Positive (abortion)	No. of tests (other reasons)[a]	Positive (other reasons)
Oct–Dec 2015	177	0	196	0
Jan–Mar 2016	202	0	704	0
Apr–Jun 2016	132	0	376	0
Jul–Sep 2016	121	0	316	0
Oct–Dec 2016				
NSW	1	0	56	0
NT	0	0	0	0
Qld	8	0	8	0
SA	1	0	28	0
Tas.	0	0	0	0
Vic.	5	0	17	0
WA	18	0	38	0
Aus.	**33**	**0**	**147**	**0**

a Some testing information is derived from pre-export testing of cattle destined for live export markets where the importing country requires testing. The total number of tests each quarter may therefore vary, depending on total cattle exports to particular markets.

National Transmissible Spongiform Encephalopathies Surveillance Program

The National Transmissible Spongiform Encephalopathies Surveillance Program (NTSESP) is an integrated national program jointly funded by industry and government to demonstrate Australia's ongoing freedom from bovine spongiform encephalopathy (BSE) and classical scrapie, and to provide early detection of these diseases should they occur. The program, based on the World Organisation for Animal Health (OIE) *Terrestrial Animal Health Code*[49], involves testing of samples from cattle and sheep with clinical signs consistent with BSE or scrapie respectively, as well as from fallen and casualty slaughter cattle. Points are assigned to cattle samples according to the animal's age and subpopulation category (i.e. the likelihood of detecting BSE). Australia's target is to achieve a minimum of 150,000 points over a rolling 7-year period. Table 10 shows the number of animals sampled for BSE and scrapie and the points tally for cattle in the NTSESP[50] during the past 12 months. All samples tested were negative.

Table 10 Samples tested for transmissible spongiform encephalopathies (TSEs), 1 January to 31 December 2016

State	No. examined (cattle)	Points (cattle)	Positive (cattle)	No. examined (sheep)	Points (sheep)	Positive (sheep)
NSW	269	45,948.7	0	147	0	0
NT	15	4,781.9	0	0	0	0
Qld	159	51,849.4	0	34	0	0
SA	33	15,984.0	0	52	0	0
Tas.	21	4,045.9	0	5	0	0
Vic.	167	40,751.5	0	102	0	0
WA	37	19,060.0	0	137	0	0
Aus.	**701**	**182,421.4**	**0**	**477**	**0**	**0**

48 www.agriculture.gov.au/SiteCollectionDocuments/animal-plant/animal-health/pet-food-safety/brucella-abortus-colour.doc

49 OIE 2014, Bovine spongiform encephalopathy, In: Terrestrial Animal Health Code, World Organisation for Animal Health, Paris, www.oie.int/index.php?id=169&L=0&htmfile=chapitre_bse.htm

50 www.animalhealthaustralia.com.au/programs/biosecurity/tse-freedomassurance-program

Avian influenza

Australia is currently free from highly pathogenic avian influenza (AI). A number of low pathogenic subtypes of AI have been found in wild birds. Please consult the Wildlife Health Australia report in this publication for information on AI in wild birds. During the quarter, 281 birds from 98 laboratory submissions were tested for AI (excluding surveillance reported in the Wildlife Health Australia and Northern Australia Quarantine Strategy reports); no positive strains were detected (Table 11). Tests included competitive ELISA (enzyme-linked immunosorbent assay), haemagglutination inhibition, agar gel immunodiffusion (AGID), reverse-transcriptase polymerase chain reaction (PCR) and virus isolation.

Table 11 Results of testing for avian influenza virus in poultry, 1 October to 31 December 2016[a]

H5 positive	H7 positive	Positive for a non-H5, non-H7 strain
0	0	0

a Excludes surveillance reported in the Wildlife Health Australia and Northern Australia Quarantine Strategy reports and testing conducted for import purposes.

Newcastle disease

Australia is currently free from virulent Newcastle disease or exotic Newcastle disease, (caused by avian paramyxovirus serotype 1) even though precursor and endemic avirulent viruses are present in Australia. Vaccination against virulent Newcastle disease using a combination of live lentogenic virus (V4) and a killed vaccine is required in commercial chicken flocks[51] in all Australian jurisdictions. Vaccination exceptions for broilers apply in Tasmania, Western Australia, Queensland and South Australia. During the quarter, 291 birds from 98 laboratory submissions were tested for Newcastle disease (Table 13). Please consult the Wildlife Health Australia report in this publication for information on avian paramyxovirus in wild birds.

Table 12 Positive laboratory submission results for testing for Newcastle disease (ND) in poultry, 1 October to 31 December 2016[a]

Virulent strain of ND virus	Peats Ridge strain of ND virus	Lentogenic V4 or V4-like strain of ND virus	Other paramyxovirus
0	0	4	5

a Excludes testing for import purposes.

Salmonella surveillance

The National Enteric Pathogen Surveillance Scheme (NEPSS) is operated and maintained on behalf of the Australian Government and state and territory governments by the Microbiological Diagnostic Unit at the University of Melbourne. Data on isolates of *Salmonella* spp. and other pathogens are submitted to NEPSS from participating laboratories around Australia. Annual reports of both human and nonhuman isolates are available on request and detailed data searches are provided on request to NEPSS. Table 13 summarises *Salmonella* spp. isolations from animals reported to NEPSS.

Table 13 Salmonella notifications reported to the National Enteric Pathogen Surveillance Scheme (NEPSS), 1 October to 31 December 2016

Salmonella serovar	Birds[a]	Cats	Cattle	Dogs	Horses	Pigs	Sheep	Other	Total
Bovismorbificans	0	0	3	0	0	0	0	5	8
Dublin	0	0	8	1	0	0	0	0	9
Infantis	0	0	3	0	0	0	0	0	3
Typhimurium	9	3	17	6	3	8	1	6	53
Other	6	1	16	4	0	20	1	10	58
Total	**15**	**4**	**47**	**11**	**3**	**28**	**2**	**21**	**131**

a Includes both poultry and wild birds.

51 'Commercial chicken flocks' are defined in state and territory legislation.

Northern Australia Quarantine Strategy

In recognition of the unique biosecurity risks associated with Australia's extensive and sparsely populated northern coastline, the Australian Government Department of Agriculture and Water Resources conducts an animal disease surveillance program as an integral component of its Northern Australia Quarantine Strategy (NAQS). This surveillance program aims to provide early detection of exotic and emerging pests and diseases of significance to agriculture, public health and the environment. Information is derived from the use of sentinel animals, structured surveys, vector trapping and community reporting projects. In addition, NAQS contributes surveillance data to the National Arbovirus Monitoring Program (NAMP) and the electronic Wildlife Health Information System (eWHIS). Table 14 summarises NAQS animal testing for specific target diseases in Australia during the past five quarters.

Table 14 Disease testing and pest surveillance under the Northern Australia Quarantine Strategy (NAQS), 1 October 2015 to 31 December 2016

Target disease	Oct–Dec 2015		Jan–Mar 2016		Apr–Jun 2016		Jul–Sep 2016		Oct–Dec 2016	
	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive
Aujeszky's disease[a]	154	0	45	0	146	0	196	0	189	0
Avian influenza[a]	0	0	0	0	103	0	0	0	0	0
Classical swine fever	154	0	58	0	206	0	196	0	189	0
Japanese encephalitis	0	0	36	0	59	1[b]	0	0	45	0
Surra (*Trypanosoma evansi*)	183	0	16	0	199	0	244	0	207	0

a Excludes testing in wild birds.
b A single pig from Moa Island, Torres Strait, tested positive to Japanese encephalitis (JE) on ELISA test for antibodies. Results from follow-up testing with Flavivirus group plaque reduction neutralisation test were consistent with an antibody response following exposure to JE virus (i.e. antibody titres for JE virus were four-fold higher than titres for Murray Valley encephalitis and Kunjin viruses). No clinical signs consistent with JE were observed in this pig (or other animals) sampled during this survey. JE virus is endemic in Papua New Guinea and is known to circulate in Torres Strait on a seasonal basis. Surveillance for JE conducted by both NAQS and Queensland Health has found no evidence of circulation of JE on the mainland this year. Queensland Health was notified of this finding and they have since conducted follow-up investigations and awareness campaigns in Torres Strait as a public health measure.

Screw-worm Fly Surveillance and Preparedness Program

The Old World screw-worm fly (OWS) and New World screw-worm fly (NWS), Chrysomya bezziana and Cochliomyia hominivorax, respectively, are exotic to Australia and suspicion of infestation in animals is notifiable under state and territory animal health legislation.[52] The OWS is a significant production disease of livestock throughout its range and is considered a greater threat to Australian livestock industries than NWS due to the proximity of its distribution to Australia (potential entry through the Torres Strait) and traffic of livestock export vessels returning from Asia to Australian ports. Surveillance is conducted by targeted fly trapping and livestock myiasis monitoring in addition to unplanned investigations of myiasis (reported in 'National notifiable animal disease investigations' and Table 17). Fly trapping is conducted at locations suitable for local OWS establishment following a potential incursion; in areas neighbouring livestock export ports and the Northern Peninsula Area (NPA) of Queensland. Table 15 summarises fly trapping events over the past year. No screw-worm flies were detected. Further information on the screw-worm fly program is available on the Animal Health Australia website.[53]

Table 15 Summary of fly trapping events conducted, 1 January to 31 December 2016[a]

Risk entry pathway	Conducted by	Jan–Mar 2016	Apr–Jun 2016	Jul–Sep 2016	Oct–Dec 2016
Torres Strait	NAQS	15	30	15	15
Livestock export ports	NT, Qld and WA governments	43	71	55	40

NAQS = Northern Australia Quarantine Strategy
a Excludes traps with identification results pending.

52 Australian Government Department of Agriculture and Water Resources National List of Notifiable Animal Diseases www.agriculture.gov.au/pests-diseases-weeds/animal/notifiable (updated November 2015; cited 10 November 2016).

53 www.animalhealthaustralia.com.au/what-we-do/disease-surveillance/screw-worm-fly

Public health

The National Notifiable Diseases Surveillance System (NNDSS) coordinates the national surveillance of more than 50 communicable diseases or disease groups. Unit records of disease notifications made to the state or territory health authority, under the provisions of the public health legislation in their jurisdiction, are supplied daily to the Office of Health Protection, Australian Government Department of Health. The data are published weekly on the NNDSS website[54] and quarterly in the journal Communicable Diseases Intelligence and are replicated in *Animal Health Surveillance Quarterly* (Table 16) for five important zoonoses.

Table 16 National notifications of five zoonotic infections in humans, 1 October 2015 to 31 December 2016

Quarter	Brucellosis[a]	Chlamydia[b]	Leptospirosis	Listeriosis	Q fever
Oct–Dec 2015	2	6	16	22	109
Jan–Mar 2016	2	2	47	27	117
Apr–Jun 2016	3	1	36	23	102
Jul–Sep 2016	6	5	19	13	121
Oct–Dec 2016					
ACT	0	0	0	0	0
NSW	1	7	2	6	52
NT	1	0	1	0	0
Qld	2	0	10	4	59
SA	0	0	1	2	11
Tas.	0	0	1	0	0
Vic.	0	2	6	9	7
WA	2	0	5	0	3
Aus.	**6**	**9**	**26**	**21**	**132**

a Bovine brucellosis (*Brucella abortus*) was eradicated from the Australian cattle herd in 1989 and is presently considered an exotic animal disease in Australia. Caprine and ovine brucellosis (caused by *B. melitensis*) has never been reported in Australian sheep or goats. Swine brucellosis (caused by *B. suis*) is prevalent in small areas of northern Australia and northern New South Wales where it occurs in feral pigs, with human cases predominantly seen in recreational feral pig hunters.

b Also known as 'psittacosis' or 'ornithosis'.

54 www9.health.gov.au/cda/source/cda-index.cfm

National notifiable animal disease investigations

During the quarter, 623 national notifiable animal disease investigations[55] were conducted into suspect disease events. National notifiable animal diseases include a subset of emergency diseases.[56] Table 17 lists investigations conducted by disease finding confirmed. Note that more than one disease may be investigated for a single disease event (an outbreak of morbidity or mortality). In addition, a single investigation may involve more than one animal.

Details about selected investigations are provided in the 'State and territory reports' section of this publication and are available by contacting the relevant state or territory NAHIS program coordinator (see contact details on last page).

Information regarding Australia's emergency preparedness and outbreak response management is available from the Australian Government Department of Agriculture and Water Resources.[57]

Table 17 Investigations for national notifiable animal diseases, October to December 2016

Disease	Species	State	Month	Response code[a]	Finding
African swine fever	Pig	SA	Dec	3	Negative
	Pig	SA	Nov	3	Negative
	Pig	Vic	Nov	3	Negative
	Pig	WA	Dec	3	Negative (2 unrelated investigations)
Anaplasmosis in tick-free areas	Cattle	WA	Nov	2	Negative
	Cattle	WA	Oct	2	Negative (2 unrelated investigations)
Australian bat lyssavirus[b]	Cat	Vic	Nov	3	Negative
	Dog	NT	Nov	3	Negative
	Dog	Qld	Dec	3	Negative
	Horse	Qld	Dec	2	Negative
	Horse	Qld	Nov	2	Negative
	Horse	Qld	Oct	2	Negative
	Horse	Vic	Oct	3	Negative
	Pig	SA	Dec	3	Negative
	Primate	Vic	Oct	3	Negative
Babesiosis in tick-free areas	Cattle	NSW	Dec	2	Negative (2 unrelated investigations)
	Cattle	NSW	Nov	2	Negative
	Cattle	NSW	Oct	2	Negative (2 unrelated investigations)
	Cattle	WA	Nov	2	Negative (2 unrelated investigations)
	Cattle	WA	Oct	2	Negative (2 unrelated investigations)
Bluetongue—clinical disease	Cattle	SA	Dec	2	Negative
	Cattle	SA	Oct	3	Negative
	Cattle	Vic	Oct	3	Negative
	Cattle	WA	Nov	2	Negative
	Cattle	WA	Nov	3	Negative
	Sheep	NSW	Nov	2	Negative (2 unrelated investigations)
	Sheep	Qld	Oct	2	Negative
	Sheep	SA	Oct	2	Negative (2 unrelated investigations)
	Sheep	Tas	Oct	3	Negative
	Sheep	Vic	Dec	3	Negative
	Sheep	WA	Dec	2	Negative (3 unrelated investigations)
	Sheep	WA	Oct	2	Negative (2 unrelated investigations)
Brucella abortus (excl. cattle)	Alpaca	Vic	Dec	2	Negative
	Goat	Vic	Dec	2	Negative
	Goat	Vic	Nov	2	Negative
	Horse	Qld	Nov	2	Negative
	Pig	Qld	Oct	2	Negative

55 National List of Notifiable Animal Diseases www.agriculture.gov.au/pests-diseases-weeds/animal/notifiable

56 Emergency Animal Disease Response Agreement, Schedule 3 www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement/

57 www.agriculture.gov.au/animal/health/livestock-movement-australia

Continued

Disease	Species	State	Month	Response code[a]	Finding
Brucella melitensis	Sheep	WA	Oct	2	Negative
Brucella suis	Dog	NSW	Dec	2	Negative (12 unrelated investigations)
	Dog	NSW	Nov	2	Negative (25 unrelated investigations)
	Dog	NSW	Nov	2	Positive (3 unrelated investigations)
	Dog	NSW	Oct	2	Negative (11 unrelated investigations)
	Dog	NSW	Oct	2	Positive (2 unrelated investigations)
	Dog	Qld	Dec	2	Negative (2 unrelated investigations)
	Dog	Qld	Nov	2	Negative (3 unrelated investigations)
	Dog	Qld	Oct	2	Positive (2 unrelated investigations)
	Dog	Qld	Oct	2	Negative (2 unrelated investigations)
	Dog	Qld	Oct	3	Positive
	Pig	NSW	Nov	2	Negative
	Pig	Qld	Nov	2	Negative
	Pig	SA	Dec	2	Negative
Contagious agalactia	Sheep	WA	Nov	2	Negative
Equine encephalomyelitis (Eastern, Western and Venezuelan)	Horse	WA	Nov	3	Negative
Equine influenza	Horse	Vic	Dec	3	Negative
Foot-and-mouth disease	Cattle	NSW	Dec	3	Negative
	Cattle	NSW	Nov	3	Negative (2 unrelated investigations)
	Cattle	NSW	Oct	3	Negative
	Cattle	SA	Dec	3	Negative
	Cattle	Vic	Dec	3	Negative (3 unrelated investigations)
	Cattle	Vic	Nov	3	Negative
	Cattle	Vic	Oct	3	Negative
	Cattle	WA	Nov	3	Negative (2 unrelated investigations)
	Cattle	WA	Oct	3	Negative
	Sheep	Vic	Dec	3	Negative (2 unrelated investigations)
	Sheep	Vic	Nov	3	Negative (2 unrelated investigations)
	Sheep	Vic	Oct	3	Negative
	Sheep	WA	Dec	3	Negative
Infection of bees with *Melissococcus plutonius* (European foulbrood)	Bees	NT	Nov	3	Negative (7 unrelated investigations)
	Bees	NT	Oct	3	Negative (2 unrelated investigations)
	Bees	NT	Oct	3	Positive (2 unrelated investigations)
	Bees	Qld	Dec	2	Negative (12 unrelated investigations)
	Bees	Qld	Dec	2	Positive
	Bees	Qld	Nov	2	Negative (9 unrelated investigations)
	Bees	Qld	Nov	2	Positive (3 unrelated investigations)
	Bees	Qld	Oct	2	Negative (9 unrelated investigations)
	Bees	Qld	Oct	2	Positive (3 unrelated investigations)
	Bees	SA	Dec	2	Negative (4 unrelated investigations)
	Bees	SA	Dec	2	Positive
	Bees	SA	Nov	2	Positive
	Bees	SA	Nov	2	Negative (8 unrelated investigations)
	Bees	SA	Oct	2	Positive (3 unrelated investigations)
	Bees	SA	Oct	2	Negative (8 unrelated investigations)

Continued

Disease	Species	State	Month	Response code[a]	Finding
Infection of bees with Paenibacillus larvae (American foulbrood)	Bees	NT	Nov	3	Negative (7 unrelated investigations)
	Bees	NT	Oct	3	Negative (3 unrelated investigations)
	Bees	NT	Oct	5	Positive
	Bees	Qld	Dec	2	Negative (4 unrelated investigations)
	Bees	Qld	Dec	2	Positive (9 unrelated investigations)
	Bees	Qld	Nov	2	Negative (3 unrelated investigations)
	Bees	Qld	Nov	2	Positive (8 unrelated investigations)
	Bees	Qld	Oct	2	Negative (4 unrelated investigations)
	Bees	Qld	Oct	2	Positive (8 unrelated investigations)
	Bees	SA	Dec	2	Negative (3 unrelated investigations)
	Bees	SA	Dec	2	Positive (5 unrelated investigations)
	Bees	SA	Nov	2	Negative (4 unrelated investigations)
	Bees	SA	Nov	2	Positive (8 unrelated investigations)
	Bees	SA	Oct	2	Positive (7 unrelated investigations)
	Bees	SA	Oct	2	Negative (8 unrelated investigations)
Infection with African horse sickness virus	Horse	WA	Oct	3	Negative
Infection with Aujeszky's disease virus	Pig	SA	Dec	3	Negative
	Pig	Vic	Nov	3	Negative
	Pig	WA	Dec	3	Negative
	Pig	WA	Nov	3	Negative
	Pig	WA	Oct	3	Negative
Infection with classical swine fever virus	Pig	SA	Dec	3	Negative
	Pig	SA	Nov	3	Negative (2 unrelated investigations)
	Pig	Vic	Nov	3	Negative
	Pig	WA	Dec	2	Negative (3 unrelated investigations)
	Pig	WA	Dec	3	Negative (2 unrelated investigations)
	Pig	WA	Nov	2	Negative
	Pig	WA	Nov	3	Negative (2 unrelated investigations)
Infection with duck herpesvirus 1 (duck viral enteritis/duck plague)	Bird[c]	WA	Nov	2	Negative
Infection with Hendra virus	Dog	NSW	Oct	2	Negative
	Dog	Qld	Dec	3	Negative
	Horse	NSW	Dec	2	Positive
	Horse	NSW	Dec	2	Negative (21 unrelated investigations)
	Horse	NSW	Nov	2	Negative (21 unrelated investigations)
	Horse	NSW	Oct	2	Negative (12 unrelated investigations)
	Horse	NT	Dec	2	Negative
	Horse	NT	Oct	2	Negative
	Horse	Qld	Dec	2	Negative (48 unrelated investigations)
	Horse	Qld	Nov	2	Negative (53 unrelated investigations)
	Horse	Qld	Oct	2	Negative (37 unrelated investigations)
	Horse	Tas	Nov	3	Negative
	Horse	Vic	Dec	3	Negative
	Horse	Vic	Nov	3	Negative
	Horse	Vic	Oct	3	Negative
	Horse	WA	Nov	3	Negative (2 unrelated investigations)
	Pig	SA	Dec	3	Negative

Continued

Disease	Species	State	Month	Response code[a]	Finding
Infection with influenza A viruses in swine[d]	Pig	SA	Oct	3	Positive
	Pig	WA	Dec	2	Negative (2 unrelated investigations)
	Pig	WA	Nov	2	Negative
	Pig	WA	Nov	3	Positive
Infection with *Mycoplasma mycoides* subsp. *mycoides* SC (contagious bovine pleuropneumonia)	Cattle	WA	Nov	2	Negative
	Cattle	WA	Oct	2	Negative (2 unrelated investigations)
Infection with porcine epidemic diarrhoea virus	Pig	WA	Nov	3	Negative
	Pig	Vic	Oct	3	Negative
Infection with rabies virus	Dog	NT	Nov	3	Negative
	Dog	Qld	Dec	3	Negative
	Dog	Vic	Dec	3	Negative
Infection with *Salmonella* Gallinarum (fowl typhoid)	Bird	WA	Dec	2	Negative
Infection with *Taenia saginata* (*Cysticerus bovis*)	Cattle	Vic	Dec	2	Negative
Infection with *Theileria parva* (East Coast fever) or *T. annulata* (Mediterranean theileriosis)	Cattle	WA	Nov	2	Negative
	Cattle	WA	Oct	2	Negative (2 unrelated investigations)
Infection with vesicular stomatitis virus	Cattle	NSW	Dec	3	Negative
	Cattle	NSW	Nov	3	Negative (2 unrelated investigations)
	Cattle	NSW	Oct	3	Negative
	Cattle	SA	Dec	3	Negative
	Cattle	Vic	Dec	3	Negative (3 unrelated investigations)
	Cattle	Vic	Nov	3	Negative
	Cattle	Vic	Oct	3	Negative
	Cattle	WA	Nov	3	Negative (2 unrelated investigations)
	Cattle	WA	Oct	3	Negative
	Sheep	Vic	Dec	3	Negative (2 unrelated investigations)
	Sheep	Vic	Nov	3	Negative (2 unrelated investigations)
	Sheep	Vic	Oct	3	Negative
Infestation of bees with *Acarapis woodi* (Acariasis tracheal mite)	Bees	Qld	Dec	2	Negative (12 unrelated investigations)
	Bees	Qld	Nov	2	Negative (14 unrelated investigations)
	Bees	Qld	Oct	2	Negative (7 unrelated investigations)
Infestation of bees with *Tropilaelaps clareae* or *T. mercendesae* (Tropilaelaps mite)	Bees	Qld	Dec	2	Negative (17 unrelated investigations)
	Bees	Qld	Nov	2	Negative (32 unrelated investigations)
	Bees	Qld	Oct	2	Negative (14 unrelated investigations)
Infestation of bees with *Varroa destructor* or *V. jacobsoni* (varroosis)	Bees	Qld	Dec	2	Negative (17 unrelated investigations)
	Bees	Qld	Nov	2	Negative (32 unrelated investigations)
	Bees	Qld	Oct	2	Negative (14 unrelated investigations)
Malignant catarrhal fever—wildebeest-associated	Cattle	WA	Nov	2	Negative
Nipah virus infection	Pig	SA	Dec	3	Negative

Continued

Disease	Species	State	Month	Response code[a]	Finding
Paratuberculosis—Johne's disease	Alpaca	Vic	Oct	2	Negative
	Cattle	NSW	Dec	2	Negative
	Cattle	NSW	Nov	2	Positive
	Cattle	NSW	Nov	2	Negative (2 unrelated investigations)
	Cattle	NSW	Oct	2	Positive (3 unrelated investigations)
	Cattle	Qld	Dec	2	Negative
	Cattle	Qld	Nov	2	Negative
	Cattle	Qld	Nov	2	Positive
	Cattle	Qld	Oct	2	Negative (7 unrelated investigations)
	Cattle	Vic	Nov	2	Negative (2 unrelated investigations)
	Cattle	Vic	Oct	2	Negative (2 unrelated investigations)
	Cattle	WA	Dec	2	Negative
	Cattle	WA	Nov	2	Negative
	Cattle	WA	Oct	2	Negative
	Goat	NSW	Oct	2	Positive
	Sheep	NSW	Nov	2	Positive
	Sheep	NSW	Oct	2	Negative
	Sheep	WA	Nov	2	Negative
	Sheep	WA	Oct	2	Negative
Porcine reproductive and respiratory syndrome	Pig	WA	Dec	3	Negative (3 unrelated investigations)
	Pig	WA	Nov	3	Negative (3 unrelated investigations)
	Pig	WA	Oct	3	Negative
Salmonellosis (S. *abortus-ovis*)	Sheep	WA	Oct	2	Negative
Sheep pox and goat pox	Sheep	WA	Nov	3	Negative
Surra (*Trypanosoma evansi*)	Horse	WA	Oct	3	Negative
Transmissible gastroenteritis	Pig	WA	Nov	3	Negative
Tuberculosis (*Mycobacterium bovis*)	Cattle	NSW	Oct	2	Negative (2 granulomas examined)
West Nile virus infection—clinical	Bird	SA	Dec	3	Negative (2 unrelated investigations)
	Horse	Tas	Nov	3	Negative
	Horse	Vic	Dec	2	Negative
	Horse	WA	Nov	3	Negative

a **Key to response codes**
1 = Field investigation by government officer
2 = Investigation by state or territory government veterinary laboratory
3 = Specimens sent to the CSIRO Australian Animal Health Laboratory (or CSIRO Entomology)
4 = Specimens sent to reference laboratories overseas
5 = Regulatory action taken (biosecurity or police officers)
6 = Alert or standby
7 = Eradication

b Australian Bat Lyssavirus testing in bats is reported in the WHA report.

c Poultry or other domestic bird.

d Laboratory detection was determined to be an incidental finding. Sequencing of the influenza virus most closely correlated with older human-origin 'seasonal' influenza A viruses for the HA and NA genes, and to pandemic H1N1 2009 viruses for the internal genes.

animalhealth AUSTRALIA

EMERGENCY ANIMAL DISEASE WATCH HOTLINE

1800 675 888

Animal Health Surveillance QUARTERLY

There were 1629 calls to the Emergency Animal Disease Watch Hotline during the quarter.

The Emergency Animal Disease Watch Hotline is a toll-free telephone number that connects callers to the relevant state or territory officer to report concerns about any potential disease situation.

Anyone suspecting an exotic disease outbreak should use this number to get immediate advice and assistance.

National Animal Health Information System contacts

The National Animal Health Information System (nahis.animalhealthaustralia.com.au) collects summaries of animal health information from many sources; detailed data are maintained by the source organisations. Please contact the relevant person if further details are required.

Name	Role	Phone	Email
Ian Langstaff	NAHIS program manager	02 6203 3909	ILangstaff@animalhealthaustralia.com.au
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Corissa Miller	Australian Government NAHIS coordinator	02 6272 3645	Corissa.Miller@agriculture.gov.au
Venessa McEniery	Australian Milk Residue Analysis Survey	03 9810 5930	VMcEniery@dairysafe.vic.gov.au
Tiggy Grillo	Wildlife Health Australia	02 9960 7444	TGrillo@wildlifehealthaustralia.com.au
Courtney Lane	National Enteric Pathogens Surveillance Scheme	03 8344 5713	Courtney.Lane@unimelb.edu.au
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Animal Health Australia is a not-for-profit public company established by the Australian Government, state and territory governments, and major national livestock industry organisations to manage national animal programs on behalf of its members. Every effort is made to ensure that the information in *Animal Health Surveillance Quarterly* is accurate at the time of publication; however, it is subject to change as a result of additional or amended data being received. Further information on the outcome of cases that were pending at the time of printing may be found at www.animalhealthaustralia.com.au/ahsq.

To receive an email notification of new editions, contact ahsq@animalhealthaustralia.com.au.

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