Volume 21 | Issue 3 | July to September 2016 | ISSN 1445-9701

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 third edition of *Animal Health Surveillance Quarterly* for 2016.

During this quarter, we celebrated the 25th anniversary of the Australian Veterinary Emergency Plan (AUSVETPLAN). AUSVETPLAN documents provide important guidance to governments and industry through preferred approaches to the management of emergency animal disease (EAD) incidents. We are fortunate to have a favourable animal health status but challenges are constantly evolving and preparedness is critical. AUSVETPLAN documents are regularly updated to ensure their currency, and this anniversary is testament to the continued importance of these plans in Australia.

We also marked the 25th anniversary of Food Standards Australia and New Zealand (FSANZ) with a symposium in national food standards setting, where I delivered a presentation on One Health across the biosecurity continuum. The symposium focused on preparing for the future, with discussions about challenges and opportunities in the digital age, and the importance of science, engagement and shared responsibility.

I presented at the 4th International Conference on Responsible Use of Antibiotics in Animals on 26 September in The Hague, The Netherlands. A key theme during the conference was innovations in disease prevention and detection, and identifying new areas for exploration.

As you will read in this edition, our overall preparedness relies on a number of factors and activities, including animal disease surveillance, supportive technology, collaboration and well-planned emergency animal disease response arrangements.

Contents

Western Australia increases emergency animal disease response capability with Exercise APOLLO 2
Innovative software to enhance emergency animal disease response 3
Development of a formal emergency aquatic animal disease response agreement 4
Wildlife Health Australia 5
Aquatic animal health 9
State and territory reports 11
Quarterly statistics 30
National Animal Health Information System contacts 40

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).

animalhealth AUSTRALIA
www.animalhealthaustralia.com.au

Western Australia increases emergency animal disease response capability with Exercise APOLLO

Dr Claire Petterson,
Animal Health Australia

Foot-and-mouth disease (FMD), a highly contagious viral disease of cloven hoofed animals, is currently exotic to Australia and widely regarded to be the single greatest animal disease threat to Australian livestock industries.

Ongoing training and development of personnel who may be involved in a response to an exotic disease like FMD is an important component to improving Australia's capability and capacity to respond effectively to emergency animal disease incidents.

In May 2016, the Department of Agriculture and Food Western Australia (DAFWA) organised and hosted a 3-day national emergency response exercise, Exercise APOLLO. The exercise was part of the Boosting Biosecurity Defences project funded through the Government of Western Australia's Royalties for Regions program.

The aim of the exercise was to assess DAFWA's preparedness to respond to a major biosecurity incident. Exercise planning, conduct and evaluation ran over 12 months and included involvement from Animal Health Australia, the Australian Government Department of Agriculture and Water Resources and Queensland Department of Agriculture and Fisheries. Exercise APOLLO was the first exercise of its type to be held in Western Australia since 2006.

More than 180 people participated in the exercise, including staff from DAFWA, the Department of Agriculture and Water Resources and Animal Health Australia, as well as the national Rapid Response Team, a group of government personnel from around Australia with expertise in key emergency response positions. There was industry involvement from Western Australian Farmers Federation (Inc), Pastoralists and Graziers Association of Western Australia, Cattle Council of Australia, Australian Lot Feeders' Association, WoolProducers Australia and Dairy Australia. The Western Australian government agencies of Police, Health, Environment, Fire and Emergency Services and Main Roads also participated.

Exercise APOLLO was built on a scenario written for the national livestock standstill exercise, Exercise ODYSSEUS, which was held in 2014–15 (AHSQ Vol. 18 Issue 4). The ODYSSEUS discussion exercise involved a fictional outbreak of FMD in New South Wales and Queensland. While the ODYSSEUS scenario and data were used initially, the APOLLO planning team introduced a separate storyline based on a fictional trace from the Queensland source property to Western Australia.

Exercise APOLLO participants worked from a simulated Local Control Centre and State Coordination Centre. All external and field components were simulated by the Exercise Control team. The exercise gave participants the opportunity work through emergency response procedures and systems in a simulated situation, guided by the DAFWA incident management manuals and the Australian Veterinary Emergency Plan (AUSVETPLAN).

The exercise simulated the first 5 days of an FMD outbreak in south-west Western Australia. By the end of the fifth day, the scenario involved 12 infected properties, including a feedlot.

Activities simulated by participating personnel included disease tracing investigations, predictions on likely disease spread and implementation of disease control measures, such as livestock movement controls.

The exercise also assessed DAFWA's ability to plan for large-scale animal destruction and disposal, as well as providing an opportunity to use DAFWA's new emergency response IT platform and the software program, Maximum Disease and Pest Management (MAX).

Appointment of a dedicated exercise manager and planning team was critical to the success of an exercise of this scale, as was the use of the Rapid Response Team and cross jurisdictional and industry support. The exercise was highly commended by participants and observers for its logistics, planning and conduct.

Participants of Excercise Apollo work in the control centre at DAFWA

Innovative software to enhance emergency animal disease response

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

Australia's favourable animal health status supports our trade and market access, farm productivity, public health and wildlife biodiversity. Maintaining this unique health status requires not only an effective disease surveillance network but also the ability to respond rapidly to emergency animal diseases.

In response to the 2007 equine influenza outbreak, the Victorian Government began developing a new software program for use during an emergency animal or plant disease or pest response. Although many emergency management programs already exist, none were deemed capable of managing the complex needs of a biosecurity operation. To capture this complexity, developers worked with biosecurity data managers and subject matter experts.

The Maximum Disease and Pest Management (MAX) program was developed in a Microsoft SharePoint environment. The platform allows for the easy creation of customised templates to suit specific response needs.

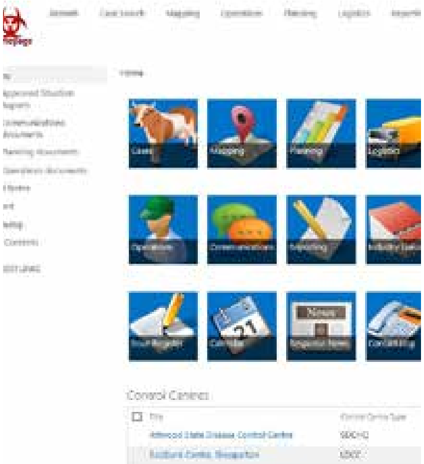

Figure 1 Screenshot of MAX homepage

MAX has been designed to reflect the unique organisational structure used in an emergency animal response (Figure 1). The homepage contains links corresponding to the different organisational sections, specifically Logistics, Operations and Planning. Within the Operations section, just as in the organisational structure outlined in Australian Veterinary Emergency Plan (AUSVETPLAN) manuals, there are links to Veterinary Investigations, Restricted Area Movement and Security and Infected Premises Operations.

MAX has integrated data warehousing, spatial tools and mobility tools that are accessible from a single login. The most important feature of MAX is the ability to directly capture data in the field. Staff can enter data through applications on Apple iOS devices or by directly logging into the secure biosecurity website. Once entered, the data can be immediately used for geospatial mapping, planning biosecurity activities or responding to emergency incidents (see Figure 2 and Figure 3).

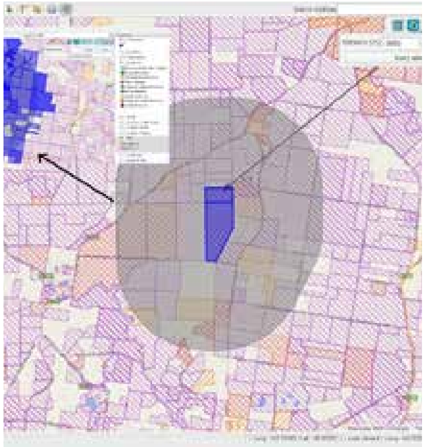

Figure 3 A 5 km buffer with inset properties within buffer

MAX was deployed in Victoria in its current form in 2013 and has more recently been rolled out to nearly all other jurisdictions in Australia, with interest internationally. This common platform allows for response template sharing between jurisdictions, promoting a more consistent biosecurity approach across Australia.

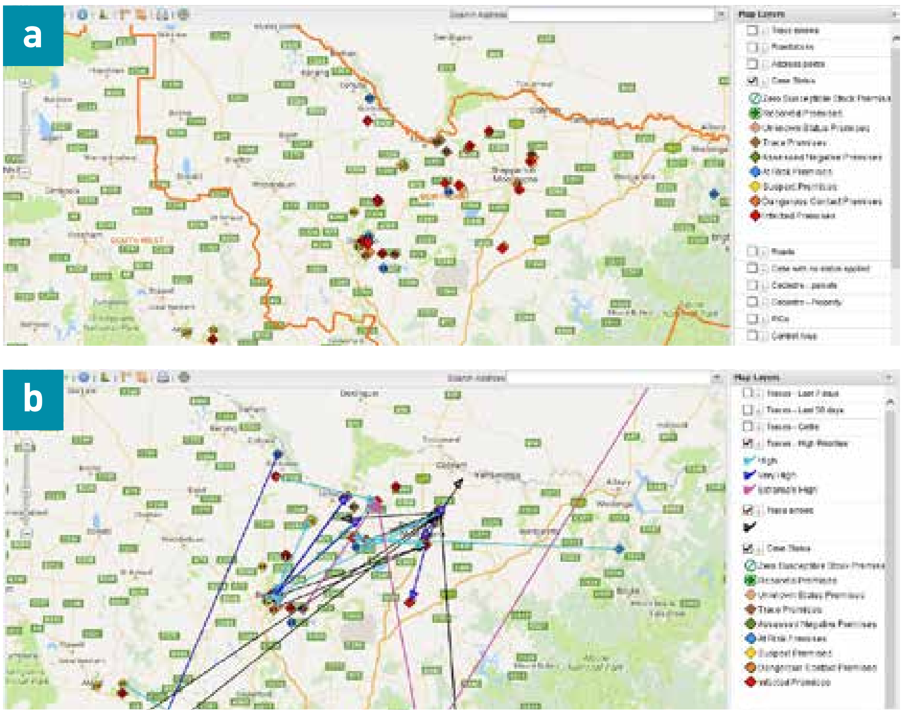

Figure 2 (a) Geospatial tools for mapping; (b) and for tracing

Development of a formal emergency aquatic animal disease response agreement

Jane Frances,
New South Wales Department of Primary Industries

In October 2014, Animal Health Australia commenced management of a new 4-year project, funded by the Department of Agriculture and Water Resources, dedicated to the development of a formal industry–government aquatic emergency animal disease response agreement.

As with the Emergency Animal Disease Response Agreement (EADRA) ADRA and the Emergency Plant Pest Response Deed (EPPRD), the Aquatic Deed will include detailed arrangements for participation and cooperation, risk management, detection and response, cost sharing, training and communication.

Australia already has a variety of systems in place to support aquatic animal health, including hotlines for reporting suspected diseases, response plans (AQUAVETPLAN) and a national strategic plan. Long-standing joint industry–government agreements are in place for responses to livestock emergency diseases (EADRA) and emergency plant pests and diseases (EPPRD). Our aquatic animal industries, as well as governments, have long recognised a need to formalise an agreement between government and industry for responding to emergency disease outbreaks affecting aquatic animals and the industries that rely on them.

Previous work on developing formal industry–government aquatic emergency animal disease response agreement focused on the abalone sector (aquaculture and wild capture). This new project aims to build on previous efforts and eventually cover most aquatic animal industries.

An Aquatic Deed Working Group has been formed to help guide the project. Representatives from all major aquatic industry sectors (tuna, abalone—aquaculture and wild capture, salmon, prawns, edible oysters, pearl oysters, barramundi and aquarium), together with government representatives, participate in the working group and provide advice on seeking solutions to some circumstances unique to aquatic industries and the environments in which they operate.

The Aquatic Deed Working Group regularly produces information and updates for stakeholders, which are available on the Animal Health Australia website.[1]

1 www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/development-emergency-aquatic-animal-disease-response-arrangements/

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)[2] 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—the Wildlife Health Information System (eWHIS)[3]—including submissions by WHA subscribers, state and territory WHA coordinators, researchers, and university, zoo and sentinel clinic veterinarians. During the quarter, 158 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.

2 www.wildlifehealthaustralia.org.au/Home.aspx

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

Wild bird mortality events—Newcastle disease and avian influenza exclusion

WHA received 52 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 14 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 38 events, based on clinical signs, history, prevailing environmental conditions or other diagnoses. In addition, avian paramyxovirus was excluded in 16 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, July to September 2016

Bird order	Common name for bird order[a]	Events reported[b]
Anseriformes	Magpie geese, ducks, geese and swans	2
Columbiformes	Doves and pigeons	4
Coraciiformes	Bee-eaters and kingfishers	1
Falconiformes	Falcons	1
Passeriformes	Passerines or perching birds	20
Pelecaniformes	Ibis, herons and pelicans	1
Psittaciformes	Parrots and cockatoos	22
Strigiformes	Typical owl and barn owls	1
Unidentified[c]	–	2

a Common names adapted from: del Hoyo and Collar, 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 that involved multiple bird orders (Columbiformes, Passeriformes and Psittaciformes).

c Wild bird faecal samples collected for disease exclusion testing as part of two ongoing disease events.

Table 1 Number of disease investigations reported into eWHIS, July to September 2016[a]

Bats[b]	Birds	Feral animals	Lizards & snakes	Marine mammals	Marine turtles	Marsupials	Monotremes
47	52	9	2	2	2	44	0

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 (NAQS).

During the quarter, pathogen-specific, risk-based surveillance occurred at sites in New South Wales, Queensland, Tasmania, and Western Australia with cloacal and faecal environmental swabs collected from 1089 waterbirds. Results are pending.

Salmonella isolated in two mass mortalities of house sparrows

In early August 2016, two house sparrow (*Passer domesticus*) mortality events were recorded in Tasmania. A number of dead sparrows were found on a property in the north-west of Tasmania and at least 12 sparrows were found dead on a property approximately 20 km south of Hobart (population declines were also noted in this location). In both locations, a proportion of the sparrow carcases were recovered from poultry runs or coops.

Seven dead birds representing both locations were submitted to the Animal Health Laboratory, Launceston. All birds were in moderate-to-poor body condition with some exhibiting slight soiling around the vent. Gross necropsies did not reveal any significant internal abnormalities. For both events, AI and avian paramyxovirus were excluded using PCR testing. Samples (cloacal swabs) were also collected for bacterial culture. *Salmonella enterica* subsp. *enterica* serotype Typhimurium (*S.* Typhimurium) was isolated from all seven sparrows. Further testing on the isolates identified the presence of *S.* Typhimurium phage type DT160 in birds from each location. Property owners from where the sparrows were submitted were notified of the results.

The first record of significant sparrow mortality from *S.* Typhimurium DT160 in Australia occurred in south-east Tasmania in June 2009.[4,5] *S.* Typhimurium DT160 is now considered enzootic in Tasmania and has been diagnosed in 13 investigations involving house sparrows, all from Tasmania.[6] Infected sparrows have the potential to be sources of infection for humans, native species of high conservation value and domestic animals.[7]

Chlamydiosis in a spotted turtle dove

In August 2016, a member of the public found a spotted turtle dove (*Spilopelia chinensis*) in suburban Melbourne, Victoria, and cared for the bird in their house for 3 days before contacting the Department of Economic Development, Jobs, Transport and Resources (DEDJTR). A DEDJTR veterinary officer attended the property and described the bird as having severe torticollis, depression and ataxia. The bird was euthanased and submitted to AgriBio Veterinary Diagnostic Services for necropsy with a provisional diagnosis of PPMV-1.

On necropsy, significant gross findings included breast muscle atrophy (poor nutritional condition) and marked yellow faecal–urate staining of feathers around the cloaca. The cloacal contents were pale and watery. The abdominal air sacs were thickened with scant deposits of pale exudate. A diffuse thin deposit of pale fibrin-like material was on the epicardium. The liver contained a few slightly pale, poorly defined foci, 2–3 mm diameter.

Significant histopathological findings were severe histiocytic meningitis, ependymitis and polyserositis with

4 Grillo T, 2009, *Animal Health Surveillance Quarterly*, Volume 14, Issue 3, pp. 6–8, Animal Health Australia.

5 Lloyd SJ, 2013, *Bugs, Birds, Bettongs & Bush: Conserving Habitats for Tasmania's Native Animals*, DPIPWE, Hobart.

6 National Wildlife Health Information System (eWHIS), up until 12 October 2016.

7 WHA, 2013, *Salmonella* Typhimurium *DT160 in house sparrows in Australia*, Wildlife Health Australia fact sheet, December 2013, www.wildlifehealthaustralia.com.au/FactSheets.aspx

prominent intralesional elementary bodies, mild histiocytic splenitis and multifocal hepatitis. A presumptive diagnosis of meningoencephalitis (caused by *Chlamydia psittaci*) and airsacculitis was made. Confirmation of the diagnosis was achieved by sequencing a product from a conventional pan-Chlamydiales PCR, the sequence having 98% similarity to *C. psittaci*. Real-time PCR tests for PPMV-1 were negative.

This case demonstrates the value of full diagnostic investigations in wildlife cases. In many cases, a presumptive diagnosis (in this case of PPMV-1) would have been made with no further investigations undertaken. However, a notifiable zoonotic disease was diagnosed, enabling appropriate notification to the Victorian Department of Health and Human Services.

C. psittaci is an obligate intracellular gram-negative bacterium. All bird species are susceptible but the disease is most commonly diagnosed in psittacine birds.[8] Prevention and control of avian chlamydophilosis relies on the identification, isolation and treatment of affected birds, quarantine and prophylactic treatment of potentially infected birds, and detection of carriers of the disease.

Australian bat lyssavirus

Reports to WHA for the quarter included 47 bats tested for Australian bat lyssavirus (ABLV) from New South Wales, Northern Territory, Queensland, South Australia, Victoria and Western Australia.

Bat submissions were made for a variety of reasons:

- 15 cases involved contact with a pet dog
- 14 cases involved contact with the potential for ABLV transmission to humans; of these
  - 4 were also associated with trauma (e.g. barbed wire fence entanglement)
  - 2 displayed neurological signs (e.g. aggression, manic behaviour)
  - 2 displayed other clinical signs (e.g. found on the ground)
  - 1 also involved contact with a pet dog
  - the remainder had no further history reported
- 4 bats were found dead
- 2 bats displayed neurological signs (e.g. aggression, incoordination, involuntary urination)
- 2 cases were associated with trauma
- 1 bat was found in a container from interstate
- 9 bats had no further history reported at this time.

During the quarter, two flying-foxes from New South Wales were confirmed positive for ABLV by fluorescent antibody test and PCR for pteropid ABLV ribonucleic acid (RNA). One was a grey-headed flying-fox (*Pteropus poliocephalus*) that presented with manic behaviour and neurological signs, and was euthanased. The other was an unidentified flying-fox (*Pteropus* sp.) exhibiting abnormal aggression. Potentially dangerous human contact was reported in both of these cases and an experienced public health official provided appropriate counselling and information.

More information on ABLV testing of bats in Australia is available in *ABLV Bat Stats*.[9]

Common wallaroo with maggot-infested skin lesions—screw-worm fly excluded

In July 2016, a juvenile common wallaroo (*Macropus robustus*) was found out of the pouch and without a dam on a rural block in the Ilparpa suburb of Alice Springs, Northern Territory. The animal was taken to a wildlife carer, who took the animal to a local veterinarian, who euthanased it due to severe and extensive maggot-infested skin papillomas. Samples of the affected skin from the wallaroo were submitted to the Berrimah Veterinary Laboratories, Darwin, for further investigation. A diagnosis of pox was made on the basis of typical gross appearance and histological examination of multiple papillomatous skin lesions in which there were abundant poxvirus-like intracytoplasmic inclusions. Fly larvae (maggots) from skin papillomas were identified to rule out screw-worm fly. The larvae were identified as *Chrysomya sp.*; either *C. saffranea* or *C. megacephala* but not *C. bezziana* (screw-worm fly).

Screw-worm fly maggots are insect parasites of warm-blooded animals, including domestic, native and feral wild animals, birds and humans. Australian native fauna have been shown to be susceptible to infection[10]. Screw-worm fly infections have been recorded in agile wallabies and red kangaroo at a Malaysian zoo.[11] Screw-worm fly eggs hatch to become flesh-eating maggots or larvae that invade all types of wounds or moist openings on animals and people. Both Old World screw-worm fly (*C. bezziana*) and New World screw-worm fly (*Cochliomyia hominivorax*) are exotic to Australia and are notifiable under state and territory legislation. Any suspected cases of screw-worm fly infestation in animals should be reported to the relevant state authority for investigation. Australia has a preparedness strategy for an incursion of screw-worm fly, as part of the Australian Veterinary Emergency Plan (AUSVETPLAN), which outlines the national response plan to control and eradicate screw-worm fly from Australia if it were introduced. In addition, Animal Health Australia manages a national Screw Worm Fly Surveillance & Preparedness Program[12] that ensures early detection of an incursion. In a 2014 analysis of the targeted surveillance program[13],

8 WHA, 2009, Chlamydia in Australian Wild Birds Mar 2009, Wildlife Health Australia fact sheet, March 2009, www.wildlifehealthaustralia.com.au/FactSheets.aspx

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

10 www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents/ (see both Disease Strategy for Screw-worm Fly and Operational Manual: Wild Animal Response Strategy)

11 Spradbery JP & Vanniasingham JA, 1980, 'Incidence of the screw-worm fly, Chrysomya bezziana, at the Zoo Negara, Malaysia', Malaysian Veterinary Journal 7(1): 28–32.

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

13 Fruean SN & East IJ, 2014, 'Spatial analysis of targeted surveillance for screw-worm fly (Chrysomya bezziana or Cochliomyia hominivorax) in Australia', Australian Veterinary Journal 92(7): 254–262.

the relative likelihood of a screw-worm fly incursion that would result in successful establishment of the fly in Australia was highest along the north coast, particularly the top of Cape York Peninsula. It is likely that feral animal populations would be important hosts in the spread of screw-worm fly should it enter and establish in northern Australia.[14]

Suspected rodenticide poisoning in possums

This quarter, suspected anticoagulant rodenticide poisoning was reported in seven individual brushtail possum (*Trichosurus vulpecula*) events from the Greater Brisbane and Gold Coast regions, Queensland. Possums were clinically assessed, at either Currumbin Wildlife Sanctuary or the RSPCA Queensland, as very weak with poor responsiveness and pale mucous membrane colour. Two possums presented with bleeding from the mouth and cloaca. Euthanasia was elected for three possums, due to the severity of clinical signs on examination, including one with an extremely low packed cell volume (PCV) of 0.04 L/L (reference range: 0.30–0.60 L/L[15]). The remaining four possums, with PCVs ranging from 0.09 to 0.12 L/L, recovered after treatment with blood transfusion and vitamin K injections. The presumptive diagnosis of anticoagulant rodenticide poisoning in these cases was based on a clinical presentation and/or response to treatment. History of recent pest control baiting and blood clotting times may further inform the diagnosis. As laboratory verification is not required to guide therapy, it is often not conducted, but could be considered to confirm diagnosis in future cases.

Cases of suspected rodenticide poisoning in possums commonly present to wildlife veterinary clinics in South East Queensland, with incidents largely involving subadults, females and their babies, with PCVs in these animals consistently below 0.15 L/L. Anticoagulant rodenticides suppress the vitamin K cycle that occurs in the liver, inhibiting the production of clotting factors in the blood and resulting in haemorrhage.[16,17] A number of first-generation rodenticides (applied as multiple-bait feedings) and second-generation rodenticides (applied as a single-bait feeding) are registered for use in Australia for vertebrate pest control,[18] with the latter restricted to use in and around buildings in Australia.[19] Studies into the effects of the second-generation anticoagulants (e.g. brodifacoum) on brushtail possums document similar clinical signs to these cases, in addition to prolonged blood clotting times.[20] Brushtail possums have a higher tolerance to first-generation rodenticides (e.g. warfarin) than to second-generation anticoagulants, with death occurring as a consequence of liver failure due to consumption of high doses.[21]

Poisoning can occur in non-target species (including mammal and bird species) as a result of primary exposure when consuming bait, or secondary risk through ingestion of poisoned animals.[22,23] Second-generation anticoagulant rodenticides are currently nominated for reconsideration by the Australian Pesticides and Veterinary Medicines Authority (APVMA) through the Chemical Review Program, on the basis of public health, worker safety and environmental safety concerns.[24] WHA continues to liaise with the APVMA program on the investigation of wildlife incidents. These brushtail possum cases illustrate possible unintentional poisoning of a non-target species and highlight the need to consider these risks when placing baits for pest species control.

14 WHA, 2011, *Exotic Screw-worm Fly Fact Sheet*, Wildlife Health Australia, July 2011, www.wildlifehealthaustralia.com.au/FactSheets.aspx

15 Johnson R & Hemsley S, 2008, 'Gliders and possums'. In: Vogelnest L & Woods R (eds), *Medicine of Australian Mammals*, CSIRO Publishing, Melbourne.

16 McLeod L and Saunders G (2013). *Pesticides Used in the Management of Vertebrate Pests in Australia: A Review*, Orange, NSW Department of Primary Industries.

17 Hadler MR, & Buckle AP, 1992). *Forty-five Years of Anticoagulant Rodenticides: Past, Present and Future trends*.

18 McLeod L & Saunders G, 2013, as above.

19 McLeod L & Saunders G, 2013, as above.

20 Littin KE, O'Connor CE, Gregory NG, Mellor DJ, & Eason CT, 2002, 'Behaviour, coagulopathy and pathology of brushtail possums (Trichosurus vulpecula) poisoned with brodifacoum', *Wildlife Research* 29(3): 259–267.

21 Jolly SE, Eason CT, Frampton C & Gumbrell RC, 1994, 'The anticoagulant pindone causes liver damage in the brushtail possum (Trichosurus vulpecula)', *Australian Veterinary Journal* 71(7): 220–220.

22 Brakes CR & Smith RH, 2005, 'Exposure of non-target small mammals to rodenticides: short-term effects, recovery and implications for secondary poisoning', *Journal of Applied Ecology* 42(1): 118–128.

23 McLeod L & Saunders G, 2013, as above

24 AVPMA, 2016, 'Chemicals nominated and prioritised for reconsideration', Australian Pesticides and Veterinary Medicines website, apvma.gov.au/node/10876 [accessed 24 October 2016]

Aquatic animal health

Shane Roberts, Primary Industries and Regions SA; and Nicole Stubin, Fisheries Research and Development Corporation

South Australian disease surveillance: a Pacific oyster focus

Aquatic animal health is critical to the success of fisheries and aquaculture management in South Australia.

Monitoring of production activities and requirements to report high mortalities and suspected disease incidents (passive surveillance) provides an early detection system to enable rapid emergency disease response. These requirements are outlined in legislation (e.g. Aquaculture Regulations 2016, *Livestock Act 1997*) and in industry-agreed policies (e.g. disease response plans).

In South Australia, passive surveillance of oysters is largely based on reports of mortalities, which generally occur annually during summer, and the subsequent investigations, which to date have ruled out infectious and notifiable diseases.

Another example of passive surveillance in South Australia is the abalone industry requirement to report mortalities and subsequent investigations, and for aquaculture abalone farmers to routinely batch test abalone for trade, which provides data on disease status.

Primary Industries and Regions SA (PIRSA) undertakes active surveillance to confirm disease status or freedom from disease for the purpose of emergency response or to support policy (e.g. livestock translocation). Active surveillance of oysters in South Australia has occurred as specific surveys for Pacific oyster mortality syndrome (POMS).

Effective and ongoing aquatic animal health surveillance is critical for proving that South Australia remains free from notifiable diseases, such as POMS. This freedom from disease provides for a sustainable and productive seafood industry and ongoing access to domestic and international seafood markets.

Pacific oyster mortality syndrome

POMS is a disease that is specific to Pacific oysters, causing mortalities of up to 100% in a matter of days. POMS is caused by a highly pathogenic ostreid herpesvirus 1 microvariant (OsHV-1 μvar) and is known to occur in New South Wales and Tasmania. South Australia is the only Pacific oyster-growing state in Australia to remain free of POMS.

With an estimated impact of more than $12 million, a February 2016 outbreak of POMS in Tasmanian oyster farms highlighted the need for rapid and effective management responses to aquatic animal health emergencies. After the detection of POMS in Tasmania, PIRSA immediately implemented the State Disease Response Plan for POMS to safeguard South Australia's $32 million oyster-growing industry.

No significant oyster mortalities occurred in South Australia following the Tasmanian outbreak but PIRSA's response to the outbreak included active surveillance to aid early detection and confirm South Australia's claim of freedom from POMS.

Prior to the Tasmanian POMS outbreak, South Australian oyster farmers regularly received consignments of oyster spat from well-established hatcheries in Tasmania. As part of the South Australian response, an immediate ban on live Pacific oyster imports, including spat, was implemented through a Livestock Standstill Notice and consignments received by South Australian producers up to 2 weeks prior to the POMS detection in Tasmania were tested using polymerase chain reaction (PCR) procedures. All 669 samples tested (from 22 consignments across 20 farms) returned negative results, enabling oyster farming (including intrastate movement of oysters and equipment) to proceed in South Australia. The ban on importing all life stages of Pacific oysters and oyster-farming equipment from Tasmania remains in place until 31 March 2017.

The ban on Pacific oyster imports has been vital to reduce the risk of POMS entering South Australia. However, the undersupply of Pacific oyster spat has created a challenge for South Australian oyster growers. The state government has worked closely with industry to ensure local supply of spat through:

- providing $320,000 in funding for two existing South Australia oyster hatcheries (Sustainable Aquatic Industries and EP Shellfish) to help increase Pacific oyster spat production
- enhancing the hatchery capacity at South Australian Research and Development Institute (SARDI), a division of PIRSA, which enabled it to commence Pacific oyster spat production
- providing assistance to new companies to establish hatcheries and nursery facilities in South Australia, with Cameron of Tasmania Pty Ltd and Eyre Shellfish Pty Ltd now approved to establish new operations on the Eyre Peninsula.

POMS is a disease that is specific to Pacific oysters, causing mortalities of up to 100% in a matter of days.

The threat of POMS being introduced into South Australia is ongoing, with commercial and recreational vessel movements between Australian ports. In July 2016, a construction barge arriving in South Australia (Port Adelaide) from New South Wales was discovered with 'thousands' of Pacific oysters attached to its hull. Fortunately, the company had contacted PIRSA and the barge was dry docked and quarantined immediately upon arrival. Of 54 oyster samples collected from the vessel and tested, one returned a positive result for OsHV-1 μvar. Given water temperatures were well below the generally accepted minimum threshold of 17°C for POMS outbreaks, it was unsurprising that prevalence was low and clinical disease was not evident. The barge was successfully isolated, de-fouled and cleaned, and the Australian Chief Veterinary Officer was notified. This incident did not constitute an outbreak, and South Australia remains free of POMS.

To further enhance surveillance for POMS in South Australia, PIRSA has engaged the South Australian state veterinary diagnostic laboratory (Gribbles) to establish local expertise to undertake PCR testing for OsHV-1 μvar. Previously, samples needed to be sent to the CSIRO Australian Animal Health Laboratory for testing, resulting in delays for diagnostic results due to sample dispatch times from South Australia's west coast. Establishing PCR testing capability in South Australia will facilitate ongoing active surveillance initiatives being progressed by industry with assistance from PIRSA and funded research projects, including the Commonwealth Cooperative Research Centres—Projects for Oysters.

South Australia's freedom from many significant diseases supports trade and market access, but it also demonstrates the need for ongoing surveillance in fisheries and aquaculture as an early detection system.

Continued passive surveillance for early detection and rapid response to disease threats is critical for eradication or effective containment of disease to reduce adverse impacts. Active surveillance can provide a complementary level of early detection and can support policy (e.g. livestock translocation measures) and facilitate trade and market access. Combining surveillance programs with appropriate disease response plans, emergency response training and border controls further enhances disease prevention and preparedness for our valuable fisheries and aquaculture industries and provides the tools to address known and unknown threats that may arise.

For more information contact PIRSA's Manager, Aquatic Animal Health Unit, Dr Shane Roberts, on 08 8429 0505 or shane.roberts@sa.gov.au.

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 18 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 Industries

During the quarter in New South Wales, 950 livestock disease investigations[25] were conducted to investigate suspect notifiable diseases or rule out emergency diseases.[26] The number of investigations by species of livestock is shown in Figure 4. Field investigations were conducted by government veterinary or biosecurity officers (645) and private veterinary practitioners (295). 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 1200 livestock sample submissions[27] related to field investigations of all types of diseases and conducted many tests for export, accreditation programs, targeted surveillance and regulatory activities.

The Department of Industry in New South Wales 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 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

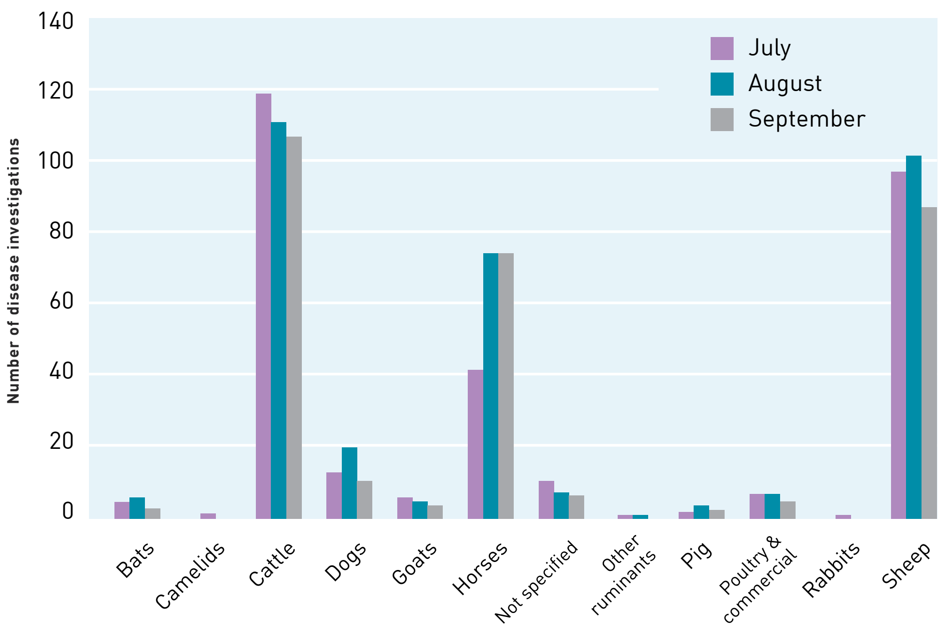

Figure 4 Number of field disease investigations to investigate suspect notifiable diseases or rule out emergency diseases, in New South Wales, July to September 2016

25 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.

26 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.

27 Some investigations involved multiple submissions.

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.

Anthrax report

During the quarter, no anthrax events were reported.

Anthrax was excluded as the cause of death in 38 mortality events. Of these, 31 involved cattle where alternate diagnoses included clostridial infection, hypomagnesaemia, hypocalcaemia, bloat, *Cheilanthes sieberi* toxicity, pneumonia caused by *Mannheimia haemolytica*, and polioencephalomalacia.

Six events involved sheep where alternate diagnoses included intestinal parasitism with *Trichostrongylus* spp., polioencephalomalacia, red gut (intestinal torsion), hypocalcaemia and clostridial infection.

One event involved a hippopotamus that died suddenly in a zoo and tested negative for anthrax at the laboratory.

Laboratory testing with polychrome methylene blue (PCMB) and/or polymerase chain reaction (PCR) was used in 19 of the investigations, of which 15 were also negative on the immunochromatographic test (ICT). Negative ICT results without laboratory investigation were obtained in 11 of the investigations.

The remaining eight investigations had anthrax ruled out on clinical evidence with an alternate diagnosis being found.

Wild bird surveillance for avian influenza

Australia-wide wild bird avian influenza (AI) surveillance includes targeted testing of waterbirds and investigation of deaths. Established in 2005, the surveillance program has tested more than 90,000 wild birds and has not identified any highly pathogenic AI viruses.

Samples for AI testing were available in four wild bird mortality events in New South Wales in the last quarter; all samples returned negative results. In one example, a mass mortality of Australian magpies (*Cracticus tibicen*) occurred at a shopping centre in the Central Coast region. More than 100 birds died suddenly over 2 weeks without other obvious clinical signs. Officers from Greater Sydney Local Land Services investigated and collected samples. Tests for AI, Newcastle disease and *Chlamydia psittaci* were negative. An organophosphate pesticide was detected and NSW Environment Protection Authority staff are investigating potentially deliberate poisoning of the birds.

New targeted surveillance project in alpacas

Mycoplasma haemolamae adheres to the surfaces of the red blood cells of alpacas and llamas. It was first diagnosed in South American camelids in the United States in 1990 and has since been detected in other countries worldwide. The organism has not been confirmed in Australia.

Australia began importing alpacas in 1982[28], 8 years before the first identification of the organism and 18 years before a PCR test was developed. Given that hundreds of live camelids have been imported from countries where the organism has been readily identified, such as Chile and Peru, it is possible that *M. haemolamae* is present in Australia but as yet undetected.

A surveillance project planned by a district veterinarian aims to determine the presence or absence of *M. haemolamae* in alpacas in south-eastern Australia by using a PCR test developed at the State Veterinary Diagnostic Laboratory, Menangle. The project will help establish notifiable disease surveillance networks and awareness among stakeholders in the alpaca industry. Producers participating in the study will complete a standard questionnaire to identify potential risk factors for infection with *M. haemolamae*, and samples will be collected from various sources (including an abattoir) and tested.

Although detection of the organism is not usually associated with clinical disease or significant losses, confirming its presence in the Australian alpaca herd would be an important consideration for field veterinarians investigating cases of wasting and anaemia.

28 Tuckwell C (1994). *The Peruvian Alpaca Industry*, Rural Industries Research and Development Corporation, Canberra.

Grass tetany in cattle on the Northern Tablelands

A beef producer east of Armidale contacted the district veterinarian in early August when she found four 3-year-old Angus cows dead in a paddock. The cows had calved 4 weeks earlier and had been grazing a barley crop.

The district veterinarian investigated, ruled out anthrax on clinical and geographic grounds, and conducted a necropsy of the most recently deceased cow. No abnormalities were detected grossly, and samples, including the aqueous humour of the eye, were taken to test for calcium and magnesium levels.

The district veterinarian noted that the barley that was being grazed was green and very short. In addition, the weather during that week had been cold and wet. Because of concerns over potential grass tetany, he advised the beef producer to remove the cows from the barley paddock. The cows were moved immediately but one of the cows collapsed in the process, showing an altered state of consciousness, tetanic spasms and eventual death.

The time since calving, the grazing history, the weather and the clinical signs were strongly suggestive of hypomagnesaemia. Low levels of magnesium in the submitted samples of aqueous humour were confirmed by the laboratory.

Advice was given on managing grass tetany and on magnesium supplementation, and no further deaths were observed.

Cycad neurotoxicosis ('zamia staggers') in cattle

In early August, a private veterinarian was called out to a 90 ha property near Moruya to look at a young beef cow staggering on her hindlimbs. The cow was part of a self-replacing herd of around 75 cows ranging in age from 18 months to 15 years, mostly of the Angus breed, with some Square Meaters. The calves had been weaned between 1 and 2 months earlier, and most of the cows were 7–8 months in calf.

The staggering cow was treated for infection, trauma and metabolic disturbances and then isolated and put onto hay. The veterinarian was called out about 3 weeks later to see a few more cattle affected in the same way, with knuckling on the hindlimbs but otherwise strong, bright and alert, with no evidence of sight impairment and eating well. Physical examination and blood testing of two of the affected cows did not reveal any significant findings apart from knuckling of the hindlimbs and mildly elevated muscle enzyme levels. The condition of the cow the veterinarian had examined and treated 3 weeks beforehand had not changed at all. He contacted the Local Land Services district veterinarian for help.

The owner told the district veterinarian that he had put all the cattle through the yards that day and had isolated seven cattle (aged 18 months to 14 years) showing definite hindlimb weakness and knuckling. All cattle were removed from their 'winter' paddock. One of the two cattle examined and blood sampled had gone down in the yards; she was lying on her sternum but continuing to eat and drink. The owner was comfortable to have a necropsy done on that individual the following day.

When the district veterinarian arrived at the property, another of the seven affected cows were down in sternal recumbency. The remaining five (two heifers and three heavy in calf) were displaying varying degrees of hindlimb ataxia and knuckling but were otherwise strong, very mobile and alert (Figure 5). No others from the herd were identified as being affected. The cow identified for the necropsy was lying on her side. She was euthanased.

A necropsy examination found mild nonspecific lesions in the spinal cord consistent with cycad neurotoxicosis. In addition, multiple depressed and darker areas on the liver surface, which were histopathologically consistent with telangiectasia.

The cattle had been in their winter paddock for a number of weeks. The pasture predominantly consisted of very short (about 600 kg DM/ha) native grasses. The cattle had access to about 4 ha of more elevated dry eucalypt forest with a low-to-moderate scattering of burrawangs (*Macrozamia communis*). A drive through the forest revealed that the majority of the burrawangs had fresh new growth and that a significant number of the young leaves had been eaten.

The burrawang is the most commonly occurring and widespread cycad in New South Wales, and the most southerly occurring cycad species in the world. It is endemic in eastern New South Wales, from the coast to the nearby slopes and ridges of the Great Dividing Range, extending from the Taree region in the north to near Bega on the Far South Coast.

Cycads are known to be poisonous to cattle, sheep, dogs and humans. Cattle are the usual victims of the neurological form of cycad poisoning; they ingest an unidentified neurotoxin in the leaves (particularly young leaves) when other feed is dry or scarce. Cycads also contain MAM (methylazoxymethanol) glycosides in their leaves and nuts, the latter being the most toxic. It is these compounds that are responsible for the liver and intestinal damage more commonly seen in sheep, dogs and humans with cycad poisoning.

The presumptive diagnosis, based on the history, access and clinical signs, was cycad neurotoxicosis, a condition that is not progressive once exposure to the toxin stops. However, there is no treatment and cattle do not recover. The toxin causes irreversible damage to the nerve fibres in the spinal cord, resulting in proprioceptive disturbance of the hindlimbs and causing knuckling over at the fetlocks, posterior weakness and posterior paralysis in more severely affected animals.

Cycads are known to be poisonous to cattle, sheep, dogs and humans.

The most effective way of preventing cycad poisoning is to prevent access of livestock to cycad plants with young leaves or nuts.

An interesting postscript is that, of the five remaining affected cattle, the three pregnant cows all calved with no help within 48 hours of each other about 4 weeks after the property visit. All the calves are strong, healthy and feeding well from their dams; they have no signs of neurotoxicosis. The owner is engaged in a project with Local Land Services to fence off the forest.

Figure 5 Cow showing knuckling of the hindlimbs due to cycad toxicity. Photo H. Schaefer.

Northern Territory

Elizabeth Stedman, Northern Territory Department of Primary Industry and Resources

During the quarter in the Northern Territory, 88 livestock disease investigations[29] were conducted to rule out emergency diseases[30] or investigate suspect notifiable diseases. The number of investigations by category of livestock is shown in Figure 6. Field investigations were conducted by government veterinary or biosecurity officers (62) and private veterinary practitioners (26). 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 167 livestock sample submissions[31] 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.

The Department of Primary Industry and Resources 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.

Bovine ephemeral fever causes mortality in cattle during dry season muster

At least 30 two-year-old cattle from a herd of 4500 were affected by bovine ephemeral fever (BEF), which resulted in the death of seven of the animals, on floodplain country in the Arnhem Land region during the dry season. The property manager noted that affected animals showed varying degrees of lameness, ataxia and recumbence during muster. Despite being the dry season, unseasonal rain fell 2 weeks prior to the first clinical cases.

Gross necropsy and histopathology of a range of tissues from two of the affected animals revealed no abnormalities. BEF virus, also known as three-day sickness, was detected by polymerase chain reaction (PCR) testing in blood samples from all four affected animals sampled, while serum viral neutralisation testing for BEF was negative for all samples. The presence of detectable BEF virus in the blood confirmed active viraemia and acute infection with BEF. Transmissible spongiform encephalopathy (TSE) was excluded in one animal by histopathological examination of the brain sites specified in the Australian and New Zealand standard diagnostic procedure for TSEs.

BEF is an arboviral disease of cattle transmitted by mosquitoes, which is commonly seen in the Northern Territory's Top End; older cattle in the region that have been through previous wet seasons, and have been exposed to and recovered from the virus, will have long-lasting immunity. In this outbreak, it's likely that unseasonal rain caused increased insect activity, which contributed to the morbidity and mortality in the naive cattle.

Sudden death and preputial swelling in steers

Following castration of a group of 250 young bulls in the dry season on a

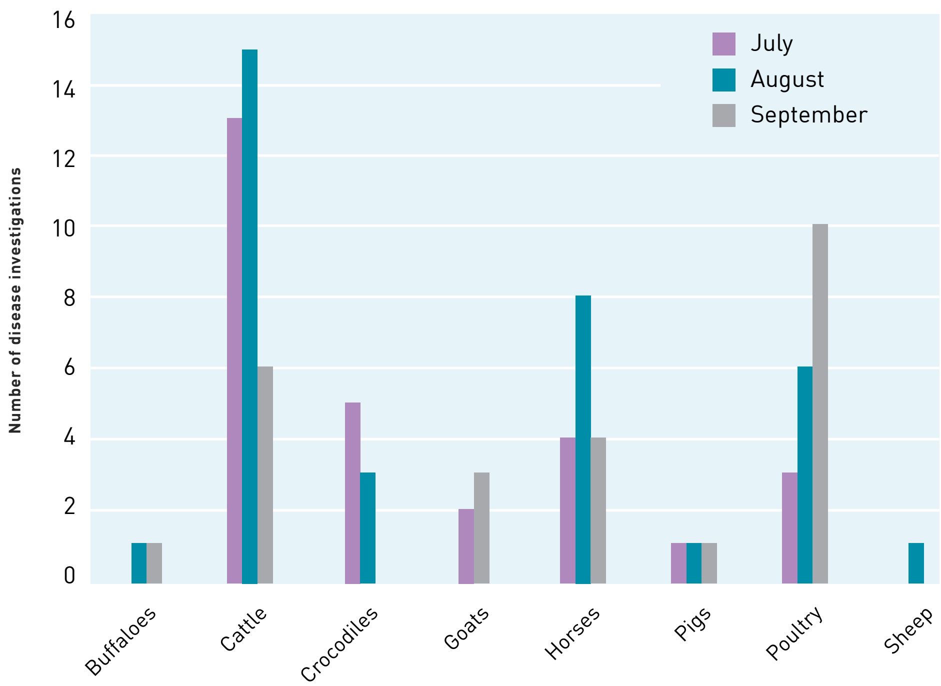

Figure 6 Number of field disease investigations in the Northern Territory to rule out emergency diseases or investigate suspect notifiable diseases, June to September 2016

29 Field investigation with laboratory diagnostic testing.

30 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.

31 Some investigations involved multiple submissions.

property outside Katherine, a steer was found dead and 12 further steers were noticed to have significant swelling in the preputial area (Figure 7). Urination and movement in the affected steers appeared normal. Necropsy of the deceased steer showed a patent and unremarkable ureter and urethra. The greater omentum was congested and inflamed and had migrated into the inguinal region of the abdominal cavity. Dissection of a hard mass in the prepuce revealed a mass of necrotic devitalised tissue. Histologically, the tissue from the castration wound infection showed evidence of a mixed bacterial infection, rather than a predominant presence of a primary clostridial infection, with a severe regional acute suppurative cellulitis and mild acute interstitial pneumonia. Poor hygiene at castration likely contributed to opportunistic infection; the other 12 steers in the herd recovered rapidly after antibiotic therapy.

Figure 7 Preputial swelling in recently castrated steers

Suppurative cholangiohepatitis in a steer

In July on a property near Katherine, an 8-month-old Brahman bull calf presented in recumbency, unable to stand and moderately dehydrated but without a fever and fairly bright. Laboratory testing on blood samples taken from the live animal revealed a mild neutrophilia. Clinical chemistry revealed moderately elevated total bilirubin and gamma-glutamyl transferase, suggestive of cholestasis and mild-to-moderate elevations in creatine phosphokinase and aspartate aminotransferase, suggestive of mild muscle damage, likely from recumbency. Infection with gastrointestinal parasites, bovine viral diarrhoea virus (BVDV)[32] and BEF virus were excluded. Treatment with antibiotics, nonsteroidal anti-inflammatories and fluid therapy was provided for 1 week but did not result in improvement so the calf was euthanased.

At necropsy, the most notable finding was an enlarged and haemorrhagic gall bladder (Figure 8) containing thickened bile. The liver was also enlarged. Other organs appeared to be normal.

Histopathologically, there was moderate subacute suppurative cholangiohepatitis and cholangitis and mild acute suppurative splenitis. Bacterial culture of the bile yielded a moderate growth of *Escherichia coli*, while the same organism was cultured in heavy growth from the liver and spleen. *Salmonella* enrichment culture was attempted, given that *Salmonella* spp. are known causes of cholangiohepatitis in calves, but culture was negative. Cholecystis and cholangiohepatitis may be descending, due to haematogenous infection of the bile ducts, or ascending, and predisposed by biliary stasis due to either mechanical or functional obstruction involving the intestine or gall bladder.

32 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 8 Enlarged haemorrhagic gall bladder in an 8-month-old bull calf

Mortality in poultry flock—avian influenza and Newcastle disease virus excluded

Sudden death in five chickens out of a flock of 60 was investigated in the Darwin region. Following the introduction of a new bird into the mixed-aged flock approximately 1 month previously, a number of birds in the flock had shown signs of sneezing, nasal discharge, swollen faces and ruffled feathers.

Necropsy and laboratory investigations of the dead birds revealed a moderate-to-mixed gastrointestinal parasite burden in two juvenile chickens. One adult layer was found to have moderate-to-severe uveitis, moderate keratitis and mild conjunctivitis, and a concurrent yolk peritionitis was diagnosed. A lymphocytic neoplasia affecting the lung, kidney, ovary and intestinal serosa was found in another adult layer hen, likely due to infection with lymphoid leucosis. Avian influenza type A and Newcastle disease virus infection were excluded in four birds via PCR testing.

Given the varied range of conditions in this case, the owner was given management and biosecurity advice, and no further losses have been reported.

Queensland

Greg Williamson, Queensland Department of Agriculture and Fisheries

During the quarter in Queensland, 751 livestock disease investigations[33] were conducted to investigate suspect notifiable diseases or rule out emergency diseases[34]. The number of investigations by species of livestock is shown in Figure 9.

Field investigations were conducted by government veterinary or biosecurity officers (48) and private veterinary practitioners (654). 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, Biosecurity Sciences Laboratory, processed 863 sample submissions[35] to rule out emergency diseases or investigate suspect notifiable diseases in animals. Sample submissions were also processed to substantiate proof of disease freedom certifications (126) and for accreditation programs (10) and targeted surveillance (185). There were 24 submissions related to wildlife, 9 for companion animals and 40 for aquatic species. In total there were 1209 animal health related submissions to Biosecurity Sciences Laboratory during the quarter.

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.

Varroa mite detection in Townsville

In June 2016, an Asian honey bee (*Apis cerana*) nest infested with varroa mite (*Varroa jacobsoni*) was detected at the Port of Townsville.

Asian honey bees are not known to occur in Townsville so the nest was removed, destroyed and examined. The nest was found to contain *V. jacobsoni*, one of a number of varroa mite species.

Since the first detection, nine other Asian honey bee colonies (total 10) have been found in Townsville and in each circumstance, the colonies were examined and destroyed, with only one additional colony found to contain varroa mite.

The Asian honey bee (not the European honey bee (*A. mellifera*) is the natural host of *V. jacobsoni* and *V. destructor*. *V. destructor* readily transfers host whereas *V. jacobsoni* has been observed reproducing on European honey bees at some overseas locations, raising concerns the same may happen here. Both varroa mite species are significant pests to bees and have the potential to debilitate and eventually kill untreated bee colonies.

Australia is free of *V. destructor*. *V. jacobsoni* has only ever been detected in Townsville. If established in Australia, varroa mite could severely affect a wide range of pollination-reliant food crops and crops that support primary food production, as well as honey production.

If established in Australia, varroa mite could severely affect a wide range of pollination-reliant food crops and crops that support primary food production, as well as honey production.

In response, Biosecurity Queensland has implemented a nationally cost-shared eradication program within the

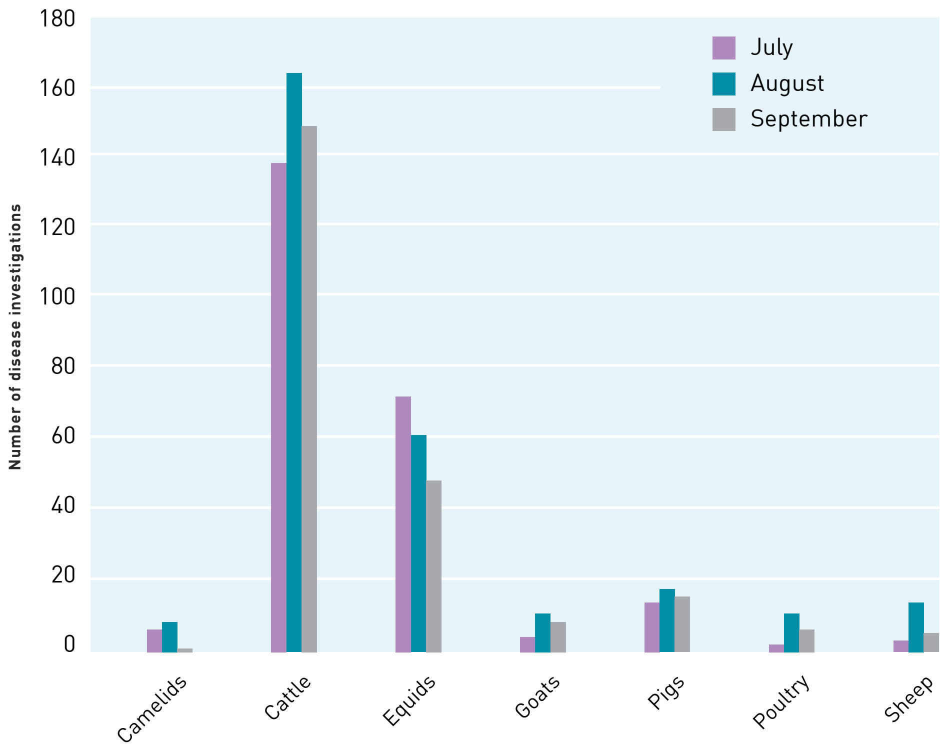

Figure 9 Number of field disease investigations in Queensland, July to September 2016

33 Field investigations with laboratory diagnostic testing.

34 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.

35 Some investigations involved multiple submissions.

Varroa mite (*Varroa jacobsoni*) on honey bee pupae

Townsville City Council local government area under the Emergency Plant Pest Response Deed. Activities include surveillance to detect and destroy feral Asian honey bee nests and swarms in the Townsville area and examination for the presence of varroa mite.

Additionally, surveillance of managed and feral European honey bee nests is taking place to confirm that *V. jacobsoni* has not infested the European honey bee population in the area.

For more information on varroa mite and Asian honey bees or to report sightings visit www.biosecurity.qld.gov.au or call 13 25 23.

Marshmallow poisoning in Dorper sheep—transmissible spongiform encephalopathy excluded

During September 2016, a flock of 60 White Dorper sheep on a Darling Downs property to the south of Toowoomba was grazing pastures dominated by marshmallow (*Malvia parviflora*). A 5-year-old heavily lactating ewe was found down and unable to rise. She appeared sleepy and had congested conjunctiva. She began chomping at the ground, then went into lateral recumbency and started paddling, and was euthanased.

Necropsy revealed multiple pale areas in the heart muscle and pneumonia in the apical lung lobes. Results of blood tests indicated marked hypocalcaemia, elevated urea levels and marked elevation of aspartate aminotransferase (AST) and creatine phosphokinase (CPK), indicating muscle damage. Histological findings revealed acute multifocal myocardial necrosis and severe tubular necrosis in the kidney. No skeletal muscle was available for examination.

No histological lesions suggestive of transmissible spongiform encephalopathy (TSE) were detected at the brain sites specified in the Australian and New Zealand standard diagnostic procedure for TSEs.

Marshmallow contains an unknown toxin that has been associated with necrosis of both cardiac and skeletal muscle. The myoglobin released from the damaged muscle causes acute tubular necrosis in the kidney. The hypocalcaemia was most likely secondary to the renal damage and heavy lactation.

After the stock were removed from the pasture no further cases have been reported.

Marek's disease in a small unvaccinated chicken flock

In late July a meat chicken establishment in the Rockhampton area experienced atypically high mortality. The property bred approximately 100 crossbred chickens for a specialist meat market. Over a period of a few weeks, chickens in the 3 to 12-month age group developed severe weight loss, weakness, paralysis and death. Approximately one-third of the flock of 100 birds died over a few weeks and another third were affected. All affected cases went on to die, typically within a few days of showing symptoms of paralysis.

An investigation by Biosecurity Queensland staff clinically examined three affected live birds. The birds showed weight loss and an asymmetrical leg paralysis. At a walk, the chickens were wobbly and ataxic with a hypermetric gait in one or both legs.

One bird was euthanased for necropsy. Gross findings included severe muscle wasting and unilateral thickening of the right sciatic nerve. Histological examination of samples by the Biosecurity Sciences Laboratory, Coopers Plains, revealed extensive infiltration of peripheral nerves, skin, intestinal mucosa and periocular connective tissue with neoplastic lymphocytes. There were also sparse multifocal tumour infiltrates in the heart, proventriculus, liver and central nervous system. These observations confirmed a diagnosis of Marek's disease.

Marek's disease is caused by a highly contagious herpesvirus, which causes lymphomatous infiltrates in tissues. These neoplastic infiltrates affect most body systems. The sciatic nerve is typically thickened producing an asymmetrical ataxia. Marek's disease causes high mortality.

Marek's disease can be prevented and controlled by vaccination but the lowest number of doses of vaccine available is a 1000-dose pack and the vaccine must be used within 1 to 2 hours of mixing. Vaccinating small specialist poultry flocks, such as this flock, is often not financially viable. In this case other recommended options include establishing a separate new flock, introducing only vaccinated birds in future, and instituting strict biosecurity measures. A private veterinarian is providing management advice to the owner.

South Australia

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

During the quarter in South Australia, 174 livestock disease investigations[36] were conducted to rule out emergency diseases[37] and investigate suspect notifiable diseases. The number of investigations by category of livestock is shown in Figure 10.

Subsidised field investigations were conducted by government veterinary or biosecurity officers (68) and private veterinary practitioners, who in 114 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 183 sample submissions[38] 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, 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.

Congenital dyserythropoietic anaemia in Murray Grey calves

In late May 2016, a cattle producer on the Yorke Peninsula reported the loss of five 3-week-old calves from a group of 50 Murray Grey cows. Deaths had occurred over a period of 6 weeks. Most affected calves were found dead but two were observed in lateral recumbency with paddling, severe jaundice and rotational nystagmus.

Pathological investigation revealed severe regenerative anaemia with secondary changes, including marked cholestasis in the liver. Interestingly, both the severe haemolysis and the moderate biliary hyperplasia indicated a subacute disease process because it takes a few days for the bone marrow to start producing and releasing nucleated red blood cells (nRBC) and for the biliary hyperplasia and fatty liver to develop. Polymerase chain reaction (PCR) testing for leptospirosis and bovine viral diarrhoea virus (BVDV)[39] was negative and there was no evidence of clostridial perfringens (focal symmetric encephalomalacia) or any other significant brain lesions. The diagnosis at this stage was open.

By early August, calf mortalities from this same group of cows had risen to a total of nine, and further investigation was undertaken. Necropsy revealed severe icterus (Figure 11) with significant histopathology, including marked splenic extramedullary haematopoiesis. There was

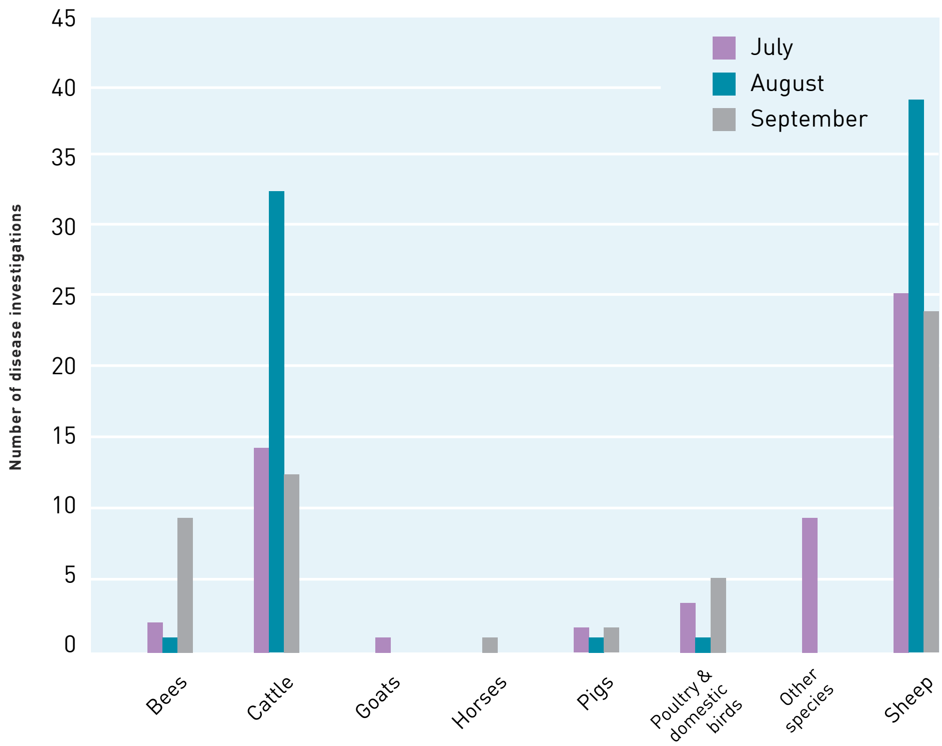

Figure 10 Number of disease investigations in South Australia, July to September 2016

36 Subsidised field investigation with laboratory diagnostic testing.

37 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-responseagreement

38 Some investigations involved multiple submissions.

39 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.

hepatocellular swelling, degeneration and necrosis with intracellular bile and bilirubin pigment in the liver. The kidneys contained renal tubular bilirubin pigment casts and epithelial cell pigmentation with renal tubular degeneration. Lymph nodes showed reactive lymphoid hyperplasia with extramedullary haematopoiesis (and erythroid hyperplasia), marked metarubricytosis and erythroid dysplasia. Test results were negative for internal parasites, salmonellosis, yersiniosis and cryptosporidiosis. Results were also negative for rotavirus and coronavirus.

The signalment, clinical presentation and histopathological findings within the liver, spleen, lymph nodes and kidneys in these calves led to a diagnosis of congenital dyserythropoietic anaemia (CDA) of Murray Grey calves.

CDA represents a rare group of genetic blood disorders with several subtypes that has been well described in humans, presenting with anaemia and the presence of multinucleated erythroid precursors in the bone marrow, associated with ineffective or defective erythropoiesis. A syndrome of CDA with dyskeratosis has been reported in Poll Hereford calves and a congenital haemolytic anaemia and jaundice of Murray Grey calves, previously reported in Australia, is also recognised as a type of bovine CDA. A few cases of this condition have been seen previously in South Australia.

Affected calves typically present with severe anaemia and jaundice with variable numbers of nRBC in the peripheral blood (inappropriate metarubricytosis and hyperbilirubinaemia). The bone marrow is typically hypercellular with high numbers of metarubricytes (nRBC) that exhibit binucleate and multinucleate morphology. Clinically, the calves show poor growth, ill-thrift, exercise intolerance, weakness and early death (by around 8 months of age). These CDA cases in Murray Greys did not show dyskeratosis and progressive alopecia as described in the affected Poll Hereford calves.

Further genetic analysis is being undertaken in this herd.

Figure 11 Necropsy of calf affected by congenital dyserythropoietic anaemia (CDA)

Further reading:

Jerrett I. 1992. Congenital dyserythropoiesis in a Murray Grey calf. *Veterinary Pathology Report (Australian Society for Veterinary Pathology)* 34: 23.

Nicholls TJ, Pritchard DH, Jerret IV & McKee JJ. 1992. A congenital haemolytic anaemia and jaundice in Murray Grey calves. *Australian Veterinary Journal* 69 (2), 39–40.

Foot-and-mouth disease exclusion in the south-east

During late July 2016, a producer in the south-east of the state purchased 10 Holstein calves from a nearby dairy. A few weeks later, two of the calves died and another two developed scouring and lameness.

Necropsy revealed erosive lesions with scabs around the mouth, in the nasal cavity and on the dental pad. There were no joint swellings or foot lesions.

Exclusion testing for vesicular viral diseases returned negative results for bluetongue virus ELISA (enzyme-linked immunosorbent assay), vesiculovirus serum neutralisation test, foot-and-mouth disease (FMD) virus isolation, FMD C ELISA for detection of antibodies, TaqMan real time PCR for FMD, swine vesicular disease antigen capture ELISA, vesicular stomatitis virus antigen capture ELISA, virus isolation for vesicular stomatitis and bovine herpesvirus 1 (PCR).

PCR positive test results confirmed the diagnosis of bovine viral diarrhoea virus 1 (BVDV-1)[40] with sequence analysis of the amplicon showing highest nucleotide similarity to BVDV-1 strain Trangie.

The producer was advised to test his whole herd for BVDV-1, especially to detect persistently infected animals. He was also advised to consider implementing a BVDV vaccination program. No further cases have been reported.

40 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.

Pasteurellosis in Merino lambs—bluetongue excluded

In July 2017, a feedlot operation in the mid-north of the state purchased 600 Merino lambs from the pastoral region of South Australia. About 35 of these lambs became ill with facial oedema soon after arrival at the feedlot and 25 of these died shortly thereafter.

Necropsy revealed oedema of the facial tissues and some oral ulceration. Yellow-tinged pleural fluid surrounded the consolidated lungs, along with haemorrhagic areas in the trachea with froth present. The liver and kidneys were yellow-tinged. A stress leukogram and inflammation were both evident on haematology. There was multifocal to coalescing myocardial necrosis, diffuse acute interstitial pneumonia and hepatic lipidosis. The alveolar damage was considered secondary to a septicaemia or endotoxaemia.

Results for both quantitative polymerase chain reaction (qPCR) testing for bluetongue virus and bluetongue virus antibody ELISA testing were negative. Brucellosis was also ruled out on tissue culture. A final diagnosis of septicaemic pasteurellosis was made based on histopathology and tissue culture.

These lambs were subjected to many stressful events leading up to their illness and death. Pastoral sheep and lambs are often not used to being handled, and these lambs had been assembled on their pastoral property of birth, then weaned, shorn and held in paddocks near the sheep yards before being trucked to the feedlot property. It is reasonable to assume that these management and environmental stressors led to the development of systemic pasteurellosis.

Tasmania

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

During the quarter in Tasmania, 276 livestock disease investigations[41] were conducted to rule out emergency diseases[42] or investigate suspect notifiable diseases. The number of investigations by category of livestock is shown in Figure 12. Field investigations were conducted by government veterinary or biosecurity officers (12) and private veterinary practitioners (264). Diagnostic testing for these cases was conducted at the state veterinary diagnostic laboratory.

During the quarter, the state veterinary diagnostic laboratory, Animal Health Laboratory, Launceston, processed 722 livestock sample submissions[43] 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 of the 343 livestock disease 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 disease investigations where presenting signs may be consistent with a national notifiable disease or suspected to be a new or emerging disease, if undertaken in consultation with DPIPWE senior veterinary officers and relevant samples are submitted to the state veterinary laboratory. These investigations receive highest priority.

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

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.

Pneumonic pasteurellosis in goats and dairy cattle

In August 2016 pneumonic pasteurellosis was diagnosed in a goat herd in northern Tasmania. Twelve Boer goat kids died within 24 hours of birth over a 10-day period. Prior to death the kids were lethargic, weak and failing to thrive despite appearing normal at birth.

Necropsy was undertaken on one of these animals. Marked lung consolidation and pleural effusion was evident. Histopathology confirmed the presence of extensive, acute fibrinopurulent pleuropneumonia. *Mannheimia haemolytica* was cultured from the lung tissue. *Mannheimia* organisms are gram-negative coccobacilli in the family Pasteurellaceae and are often opportunistic secondary invaders. *M. haemolytica* and some strains of *Pasteurella multocida* are common commensal organisms of the tonsils and nasopharynx of healthy sheep and goats.

For these organisms to cause infection, a combination of stressors leaves sheep and goats susceptible to respiratory viral infections that are rarely life-threatening but may predispose to secondary *M. haemolytica* infections. Common stressors include heat, overcrowding, exposure to inclement weather, poor ventilation, handling and transportation. The combination of stressors and primary infections are thought to break down the mucosal barrier integrity of the lower respiratory tract allowing *M. haemolytica* to colonise, proliferate and induce significant tissue damage, which often results in rapid death.

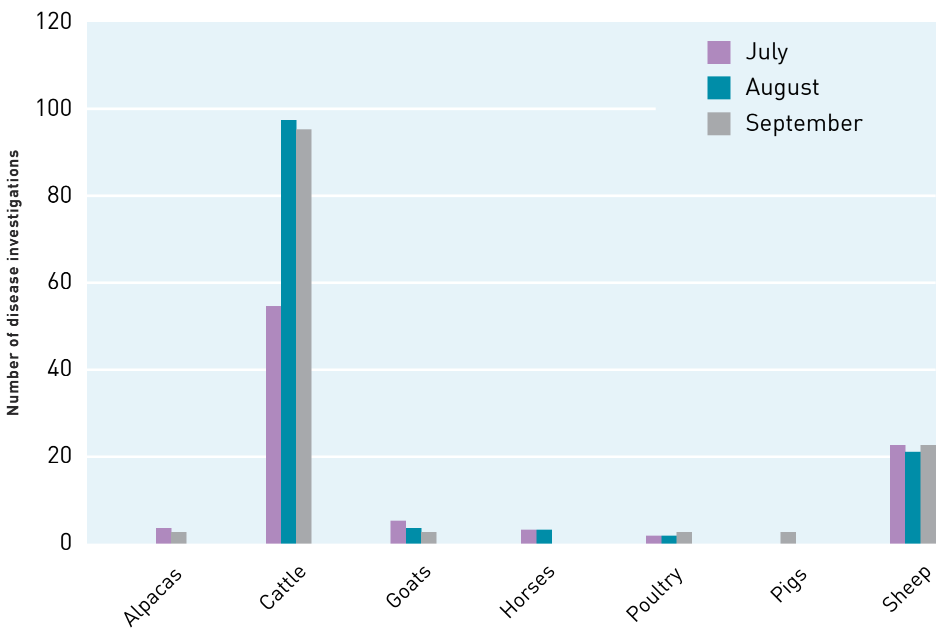

Figure 12 Number of field disease investigations in Tasmania to rule out emergency diseases or investigate suspect notifiable diseases, July to September 2016

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

42 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

43 Some investigations involved multiple submissions.

Survival of the acute phase of pneumonic pasteurellosis depends on the extent of lung involvement and damage in the lower respiratory tract. Animals that recover may have chronic respiratory problems, including reduced lung capacity and reduced weight gain. Reduction of known stressors, early identification of respiratory disease and introduction of effective antibiotic therapy are necessary to avoid high losses.

In July 2016, pneumonic pasteurellosis was also diagnosed in a herd of 600 Friesian dairy cows. Six rising 3-year-old heifers in the group died and 24 were febrile, coughing, exhibiting marked respiratory effort and had increased lung sounds.

On necropsy one of the heifers was found to have more than 5 L of serosanguinous fluid in the thorax, fibrinous pleuritis, necrotic plaques on the trachea, petecchial haemorrhages on pleura and pericardium and endocarditis. Marked diffuse subacute bacterial pleuropneumonia and diphtheritic laryngitis were diagnosed on histopathology. The lung histopathology was typical of pneumonic pasteurellosis. *M. haemolytica* and *P. multocida* were cultured from lung tissue. Real-time polymerase chain reaction (PCR) testing was used to detect the presence of bovine herpesvirus 1 (BHV-1), also known as infectious bovine rhinotracheitis (IBR), in the laryngeal mucosa. This test confirmed bovine respiratory disease (BRD) complex with initiating BHV-1 infection and secondary pneumonic pasteurellosis.

BRD complex is usually caused by a variety of pathogens, both viral and bacterial, which interact with each other. Bacterial pathogens often cause the acute syndrome by invading the respiratory tract that has been compromised by viral infections. Stressors such as calving, change of feed or changes in temperature and humidity contribute to the disease process. Pasteurella multocida and Mannheimia haemolytic are the most common bacteria involved. Fever is usually the first sign of BRD; inappetence, depression and dehydration usually occur about 24–36 hours later. Diagnosing a fever early can help establish timely treatment and reduce the severity of the symptoms.

In this case, affected heifers were segregated from the main herd and treatment included the administration of antibiotics, anti-inflammatories and parenteral fluids where necessary. Approximately 50 additional heifers developed clinical signs over a 3-week period but increased monitoring of the dairy herd during this time assisted early identification and treatment of these new cases, which helped to prevent any further deaths.

In both these cases the attending veterinarians worked with the owners to identify and mitigate risk factors contributing to the disease outbreaks.

Listeriosis in a Merino wether—transmissible spongiform encephalopathies excluded

Listeriosis was diagnosed in a 3-year-old Merino wether exhibiting abnormal neurological signs near Perth in July 2016. He was initially found to have a head tilt to the right and was circling to the right. Symptoms progressed to recumbency. On necropsy, multifocal neutrophil abscessation was found throughout the brainstem with mononuclear perivascular cuffing extending to the meninges. Gram-stain sections revealed gram-positive bacilli within the lesions. *Listeria monocytogenes* was cultured from the cervical spinal cord.

All brain sites specified in the Australian and New Zealand standard diagnostic procedure for transmissible spongiform encephalopathies (TSEs) were examined. No histological lesions suggestive of transmissible spongiform encephalopathy were detected.

Listeriosis is a sporadic bacterial infection caused by a small extremely resistant coccobacillus, *L. monocytogenes*, which grows under temperatures from 4 to 44°C. It can affect a wide range of animals, including humans. Encephalitis or meningoencephalitis is the most frequently recognised form. The disease course in sheep and goats is rapid and death may occur 24–48 hours after the onset of clinical signs. Initially affected animals are anorexic, depressed and disorientated and may circle towards the affected side. Facial paralysis and profuse salivation may develop on the affected side and terminally affected animals may become recumbent. The natural reservoirs of *L. monocytogenes* appear to be soil and mammalian intestinal tract. Grazing animals ingest the organism and contaminate vegetation and soil via their faeces. Animal-to-animal transmission occurs via the faecal–oral route. If the bacteria enter via minute wounds in the buccal mucosa, they may ascend the trigeminal nerve and result in localised infection of the brainstem and encephalitis. In encephalitis due to *Listeria* there are few gross lesions except for some congestion of the meninges. Microscopic lesions are confined primarily to the pons, medulla oblongata and anterior spinal cord. Listeriosis is confirmed only by isolation of *L. monocytogenes*. Serology is not used routinely for diagnosis because many healthy animals have high *Listeria* titres.

Outbreaks typically occur about 10 days after feeding poor quality silage.

Listeriosis most often occurs in winter or spring. Outbreaks typically occur about 10 days after feeding poor quality silage. The less acidic pH of spoiled silage favours the multiplication of *L. monocytogenes*. Removal or change of silage in the ration often stops the spread of listeriosis; feeding the same silage months later may result in new cases. It is believed that contaminated silage may result in latent infection of almost all the exposed flock but may only cause clinical disease in a few of these animals. In an outbreak, affected animals should be segregated. Spoiled silage should be avoided. As *L. monocytogenes* can infect humans, all suspect material should be handled with caution.

Victoria

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

During the quarter in Victoria, 521 livestock disease investigations[44] were conducted to investigate suspect notifiable diseases or rule out emergency diseases.[45] The number of investigations by species of livestock is shown in Figure 13. Field investigations were conducted by government veterinary or biosecurity officers (120) and private veterinary practitioners (401). All diagnostic testing was conducted at the state veterinary diagnostic laboratory, registered veterinary laboratories or CSIRO Australian Animal Health Laboratory.

During the quarter, the state veterinary diagnostic laboratory, AgriBio Veterinary Diagnostics Services, Bundoora, processed 519 livestock sample submissions[46] to investigate suspect notifiable diseases or rule out emergency diseases. Another 207 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 reproductive tract. The diseases most commonly diagnosed by species were gastrointestinal diseases in cattle, sheep and pigs and respiratory disease in poultry. 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 notifiable animal diseases (Table 18).

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..

Winter keratoconjunctivitis in steers

An outbreak of keratoconjunctivitis occurred in four of a recently purchased group of 10 Angus steers on a property near Tallangatta in north-east Victoria in July 2016. At purchase, one animal was observed already affected. The animal was treated with tetracycline powder and an eye patch but this did not resolve the issue. Three more cases appeared 6 weeks later, all presenting with blepharospasm, epiphora, corneal ulceration, scleral injection and corneal oedema. Ear notches tested for bovine viral diarrhoea virus (BVDV)[47] antigen collected from the four steers gave negative results. Conjunctival swabs taken from the four steers for culture and sensitivity showed mixed infection, including Moraxella bovoculi in two of the steers and Moraxella osloensis in one of the cases. The sensitivity results indicated both these organisms were sensitive to all antibiotics tested. The unusual feature of this outbreak was that keratoconjunctivitis, normally a problem in summer, was observed in winter in this herd. Anecdotal reports suggested other property owners in the surrounding district were suffering similar outbreaks.

Pink eye in sheep

In August 2016, *Moraxella bovoculi* caused a severe outbreak of pink eye in a flock of fine wool Merinos on a property near Benalla in north-east Victoria.

Two groups from the 202 ha property running 1200 sheep were affected. The first group consisted of 55 dry Merino ewes and cull wethers aged from 2.5 to

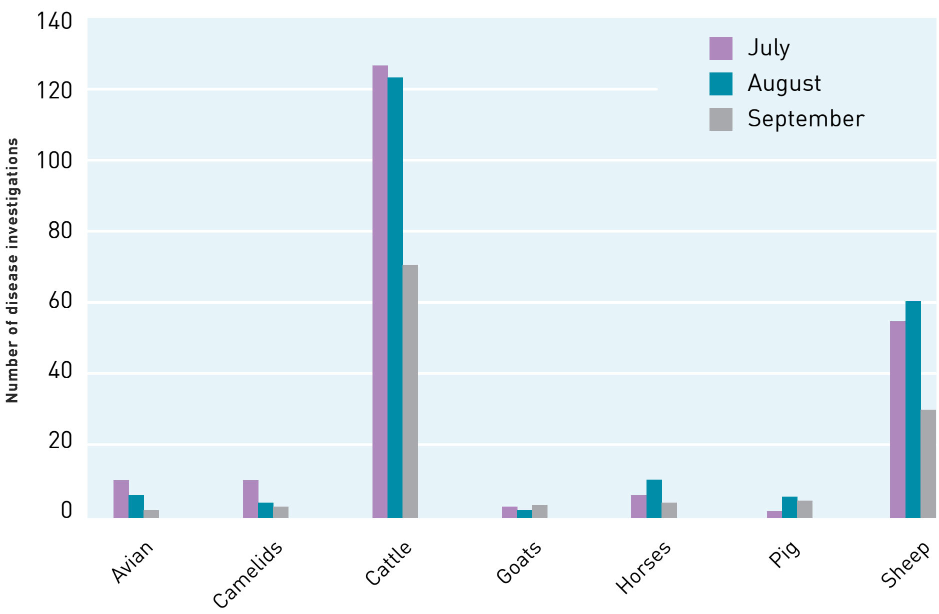

Figure 13 Number of field disease investigations to investigate suspect notifiable diseases or rule out emergency diseases, in Victoria, July to September 2016

44 Field investigation with laboratory diagnostic testing.

45 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.

46 Some investigations involved multiple submissions.

47 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.

5 years, all of which appeared to be blind in both eyes. *M. bovoculi* was cultured from a swab taken from the cornea of one of the affected sheep. All 35 of the second group of 14-month-old Poll Dorset lambs out of Merino ewes were affected sometime later, also with both eyes affected. This made mustering the animals for treatment almost impossible as the animals were effectively blind. The remaining stock on the property were unaffected despite only being separated from the affected animals by a single fence.

The cause of the infection remains unknown; it was a very wet winter with no evidence of fly activity or dust. All 900 sheep on the property, including both affected groups, were being fed whole barley grain in troughs. The grain was not abnormally dusty, and although it contained small numbers of weevils, is unlikely to have been the cause of the infection as both affected and unaffected mobs were fed the same feed.

The severity of the infection displayed in these sheep suggested a more virulent strain may have been circulating. Treatment with intramuscular oxytetracycline and topical 'terramycin' spray cured approximately 30% of affected sheep within 48 hours of treatment.

Hypocalcaemia in twin-bearing crossbred ewes

A flock of 200 twin-bearing crossbred ewes on a property of 2000 July-lambing ewes in central Victoria experienced an outbreak of hypocalcaemia at the time of lambing in July 2016. The other flocks on the property were unaffected.

Fourteen ewes were treated and responded, but 10 deaths were recorded in the paddock. The ewes had been fed on barley without supplemental limestone for 8 weeks after pregnancy scanning, before being depastured onto a paddock with approximately 2500 kg DM/ha improved perennial pasture.

A recumbent ewe with depression and deranged proprioception was examined alive (Figure 14), and a clotted blood sample was obtained for biochemical analysis. An aqueous humour sample was collected from a recently dead ewe in the same group. The differential diagnoses included hypocalcaemia and pregnancy toxaemia. Test results showed that both sampled sheep had hypocalcaemia.

Figure 14 Clinically affected crossbred ewe with hypocalcaemia

Pasture samples were collected from this paddock and another for comparison and analysed for feed quality and mineral content. Both pasture samples were found to be of excellent quality, being over 12.5 MJ ME/kg DM and 27% crude protein, with calcium to phosphorus ratios of 1:1. A dietary cation–anion difference calculation (DCAD) showed that the pasture grazed by the affected group of ewes was in the risk level, exceeding 350 mEq (calculated), when compared to the other pasture, which was not considered risky.

The mineral balance in the paddock—particularly the high levels of potash, the prolonged period of cereal grain feeding without supplemental calcium during mid to late pregnancy and the multiparous pregnancy status of these ewes put them at risk of hypocalcaemia.

Foot-and-mouth disease exclusion in sheep

Northern Victoria experienced a long wet spring this quarter, resulting in lush pasture growth. The high nitrogen diet from abundant pasture and chronic wet feet typically leads to feet problems in sheep, with the classic example being ovine interdigital dermatitis where the commensal bacterium *Fusobacterium necrophorum* penetrates the interdigital skin.

F. necrophorum is a ubiquitous gram-negative, nonmotile, nonspore-forming, noncapsulated, pleomorphic and obligate anaerobic organism. It is a normal inhabitant of the alimentary tract and faeces of animals and is therefore always present on grazed pastures. As an opportunistic pathogen, this organism can cause many necrotic infections, including foot abscesses in sheep (and cattle). However, many other organisms can invade skin that has been compromised by a prolonged wet environment and high nitrogen diet.

In August, a farmer from the Nagambie area of central Victoria reported 900 lame Merino weaner sheep with extensive growths at the coronets and lower limbs. A few sheep also had erosions of the lip commissures. Samples submitted to CSIRO Australian Animal Health Laboratory excluded foot-and-mouth disease and vesicular stomatitis, and confirmed the causal organism to be orf, commonly known as 'scabby mouth'. Some of the lesions fitted the description of strawberry footrot, a condition typically associated with *Dermatophilosis congolensis* and sometimes combined with orf. In this case, laboratory testing identified the bacteria associated with the orf to be *Streptococcus uberis*. This was an unexpected finding as *S. uberis* is typically seen in bovine and (dairy) ovine mastitis.

Options for managing the condition are limited and include reducing the overall nitrogen content of the diet by adding grain or hay, attempting to keep the animals' feet as dry as possible and the use of oral broad spectrum minerals, such as copper and zinc.

It is a normal inhabitant of the alimentary tract and faeces of animals and is therefore always present on grazed pastures.

Abortions due to *Chlamydia pecorum* in maiden ewes

Chlamydia pecorum caused an outbreak of late-term abortions in 60 of 1500 maiden Dorset–Merino cross ewes in early July 2016 on a property in the Upper Murray, north-east Victoria. The foetuses found ranged from 4 weeks pre-partum to full-term. Five aborted foetuses were necropsied with no obvious gross pathological signs. Foetal tissue samples, as well as placenta, thoracic fluid and stomach contents, were sent to AgriBio, Bundoora, for histopathology and bacteriology testing. A diagnosis of *C. pecorum* was made based on positive polymerase chain reaction (PCR) test results of the placentas. *C. pecorum* is an infrequently diagnosed cause of abortion in sheep and the outbreak proved to be self-limiting.

Western Australia

Jamie Finkelstein,
Department of Agriculture and Food Western Australia

During the quarter in Western Australia, 239 livestock disease investigations[48] were conducted to rule out emergency diseases[49] or investigate suspect notifiable diseases. The number of investigations by category of livestock is shown in Figure 15. Field investigations were conducted by government veterinary officers (58) and private veterinary practitioners (181). 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 509 livestock sample submissions[50], 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 capacity. Reports chosen are not necessarily representative of the full range of livestock disease incidents during the quarter.

Orofacial lesions in cattle—vesicular diseases excluded

In September 2016, DAFWA was notified by a private veterinarian of a disease investigation in the South West Agricultural Region that had detected erosions on the muzzle and a healing erosion on the tongue of one Friesian heifer from a group of 75. No clinical signs in other cattle on the property had been detected.

Whilst there was a very low index of suspicion of an exotic reportable vesicular disease, such as foot-and-mouth disease (FMD), a DAFWA field veterinary officer immediately conducted a further on-farm investigation in conjunction with the private veterinarian.

The DAFWA field veterinary officer and private veterinarian undertook a comprehensive field epidemiology investigation, which included sampling of the affected heifer and cohorts to facilitate the exclusion of exotic reportable vesicular disease involvement and to determine the endemic disease cause. Examination of the affected heifer and its cohorts revealed no further indicative signs of vesicular disease. When combined with

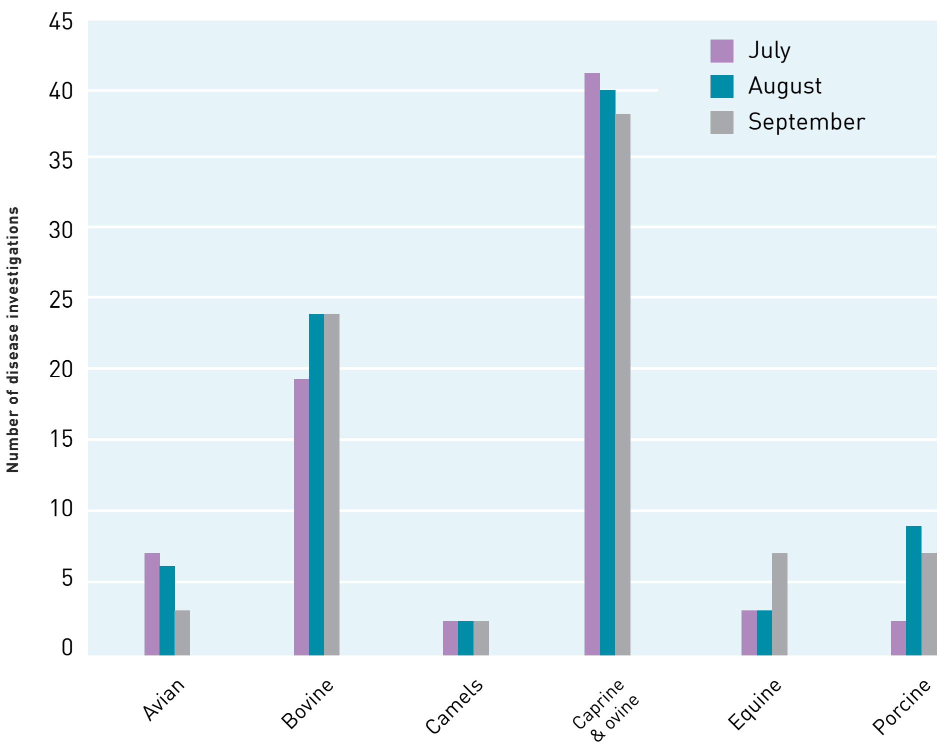

Figure 15 Number of field disease investigations in Western Australia to rule out emergency diseases or investigate suspect notifiable diseases, July to September 2016

48 Field investigation with laboratory diagnostic testing.

49 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.

50 Some investigations involved multiple submissions.

the outcomes of the field epidemiology investigation, this further lowered the index of suspicion of an exotic reportable vesicular disease.

The property involved is an agistment enterprise that also held horses in adjacent paddocks. Whilst no close contact between the horses and cattle occurred, blood samples were taken to exclude vesicular stomatitis, an exotic reportable disease with the potential to affect both cattle and horses. There was no evidence of disease in any of the horses examined.

The CSIRO Australian Animal Health Laboratory undertook testing of the cattle and horse samples to exclude exotic disease involvement, which was negative for FMD and vesicular stomatitis. The DAFWA laboratory undertook extensive testing and ruled out several endemic diseases, including bovine mucosal disease.

Secondary photosensitisation was identified as a potential cause based on the clinical presentation and the clinical biochemistry results, including mildly elevated glutamate dehydrogenase and gamma-glutamyl transferase indicating a mild hepatopathy. The latter is suggestive of secondary (hepatogenous) photosensitisation, which occurs following liver damage from, for example, consuming plant toxins. An on-farm investigation was undertaken for known toxic plants and while none were identified, no further cases of photosensitisation have been reported.

Neurological signs in sheep—scrapie excluded

In August 2016, a Central Agricultural Region producer reported 2-year-old Merino ewes showing neurological signs with three dead and approximately 20 affected from a flock of 350.

During the on-farm investigation, varying levels of clinical signs, from ataxia and staggering through to recumbency, and one sheep examined lacked a menace response.

Necropsy revealed no significant gross findings and a comprehensive sample set, including blood, ocular fluid and fresh and fixed samples, were submitted to the DAFWA laboratory.

The private veterinarian had included differential diagnosis of polioencephalomalacia and enterotoxaemia.

Histological examination was conducted to exclude transmissible spongiform encephalopathy (TSE), supporting Australia's TSE freedom assurance program, which involves investigating sheep and cattle of an appropriate age with clinically consistent signs. Histological examination excluded polioencephalomalacia, which was supported by clinical biochemistry confirming thiamine levels being within the normal reference range.

Histopathological examination did reveal extensive perivascular oedema within white-matter tracts of the brain, characteristic of enterotoxaemia. Toxin testing of small intestinal content for the epsilon toxin of *Clostridium perfringens* type D was positive, supporting a diagnosis of enterotoxaemia.

DAFWA provided disease management advice to this owner and no further disease has been reported.

Respiratory signs and sudden death in cattle—contagious bovine pleuropneumonia excluded

In September 2016, a private veterinarian investigated a report of respiratory signs in mixed-age cattle in the Rangelands Region, with 17 dead and 22 affected from a group of 3000.

Property investigation revealed affected animals had a rapid onset of respiratory distress, elevated temperature, dehydration, ruminal stasis and evidence of ketotic breath detected. Necropsy revealed purulent material within the lungs with large focal points of tissue damage.

The private veterinarian made a provisional diagnosis of bovine respiratory disease and submitted blood samples, tracheal swabs and various fixed tissues to the DAFWA laboratory for further investigation.

Property investigation revealed affected animals had a rapid onset of respiratory distress, elevated temperature, dehydration, ruminal stasis and evidence of ketotic breath detected.

Histopathological changes included extensive areas of the lung containing proteinaceous oedema, fibrin and infiltrates of neutrophils and macrophages. There was evidence of some of the neutrophils in the alveoli forming 'streaming oat cells' (streaming mononuclear cell), which may be suggestive of mannheimiosis. Small coccobacilli were present throughout the lung and immunohistochemistry for bovine virus diarrhoea virus (BVDV)[51] revealed multiple macrophages in the alveolar septae and adventitia of airways with cytoplasmic positive staining.

51 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.

The histopathology was determined consistent with severe bacterial pneumonia but it was noted that the coccobacilli were not typical of *Mannheimia* spp., *Haemophilus* spp. or *Pasteurella* spp. The pattern of staining with the BVDV immunohistochemistry was suggestive of an acute infection rather than a persistent infection, which can produce transient immunosuppression and predispose to bacterial infection.

Bovine respiratory disease was diagnosed based on the history, clinical examination and histopathological changes. The DAFWA laboratory undertook testing for contagious bovine pleuropneumonia (CBPP), an exotic reportable disease that may cause similar clinical signs if it was present in Australia. CBPP was excluded by polymerase chain reaction (PCR) testing and culture, both of which were negative.

Mastitis and decreased lambing in sheep—contagious agalactia excluded

In August 2016, a private veterinarian investigated a report from a South West Agricultural Region sheep producer of a decreased lambing percentage and weak lambs in a flock of crossbred ewes.

The farmer reported that stillbirths were not noted but lambs showed signs of weakness and depression with one 1-week-old lamb exhibiting hyperextension of the forelimbs and hindlimb paresis. This lamb had periods of apparent normality, moving well and feeding, but had deteriorated to lateral recumbency with its neck hyperextended.

During the on-farm investigation, a 7-year-old ewe was observed showing signs of weakness and depression progressing to lateral recumbency. Clinical examination of this ewe revealed signs of mastitis, with the udder being very hard with yellow-tinged fluid expressed.

Samples were collected from lambs and ewes, including a milk sample from the ewe with suspect mastitis. DAFWA laboratories undertook a range of range of testing on the lamb samples. While no significant findings were identified, common causes of neurological signs, such as polioencephalomalacia, were excluded, with thiamine in the normal reference range.

For the ewe, bacteriology supported a diagnosis of bacterial mastitis, with culture revealing a heavy pure growth of *Staphylococcus aureus*. Contagious agalactia was excluded as part of the diagnostic investigation, with mycoplasma culture negative results.

DAFWA laboratories ruled out exotic diseases that may present with similar presenting syndromes. These included bluetongue disease, Akabane and Schmallenberg viruses, which were all negative.

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. Johne's disease in cattle is endemic in south-eastern Australia but surveillance programs have not identified infection to be endemic in Western Australia or the Northern Territory, and active measures have been taken to stamp out any incursions in these jurisdictions. Table 3 shows the number of herds known to be infected.

Table 3 Herds[a] known to be infected with Johne's disease, at 30 September 2016

State	Cattle	Deer	Goats	Total
NSW	117	0	0	117
NT	0	0	0	0
Qld	na	na	na	na
SA	50	0	2	52
Tas	39	0	4	43
Vic	919	2	13	934
WA	0	0	0	0
Aus	**1,125**	**2**	**19**	**1,146**

a Includes herds participating in state test and control programs.
na = not available

The reporting of sheep flocks infected with Johne's disease has been replaced with the quarterly reporting of the number of sheep flocks inspected through 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 4 shows the number of PICs inspected and found with one or more infected animals.

Table 4 Summary of National Sheep Health Monitoring Project (NSHMP) inspected and infected line results, July to September 2016

State	Number of animals inspected	Number of PICs inspected	Number of PICs infected	Percentage of PICs infected
NSW	9,696	33	1	3.0
NT	0	0	0	0.0
Qld	280	1	0	0.0
SA	195,066	943	3	0.3
Tas	7,842	33	1	3.0
Vic	15,460	106	8	7.5
WA	98,720	287	4	1.4
Aus	**327,064**	**1,403**	**17**	**1.2**

PIC = property identification code

New 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, cattle, goats and sheep; the numbers of herds or flocks that have reached a status of Monitored Negative 1 or higher are shown in Table 5. For status definition, see the current species MAP manual[52]. Lists of alpaca, cattle and goat herds and sheep flocks assessed in the MAPs are available on the Endemic Disease Information System website[53]. Herd or flock testing is undertaken by a MAP-approved veterinarian. 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).

Table 5 Herds or flocks[a] with a Market Assurance Program status of at least Monitored Negative 1, 1 April to 30 September 2016

Quarter	Alpacas	Cattle	Goats	Sheep	Total
Apr–Jun 2016	19	344	26	382	771
Jul–Sep 2016					
NSW	9	136	7	155	307
Qld	0	0	4	1	5
SA	7	116	8	161	292
Tas	0	34	1	13	48
Vic	1	44	2	52	99
WA	0	0	0	4	4
Aus	**17**	**330**	**22**	**386**	**755**

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.

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 6 shows the number of accredited flocks at the end of the quarter.

Table 6 Ovine contagious epididymitis accredited-free flocks, 1 July 2015 to 30 September 2016

State	Jul–Sep 2015	Oct–Dec 2015	Jan–Mar 2016	Apr–Jun 2016	Jul–Sep 2016
NSW	858	846	872	861	861
Qld	77	79	79	73	72
SA	530	530	530	530	539
Tas	59	62	63	71	56
Vic	489	471	445	457	436
WA	194	183	184	184	184
Aus	**2,207**	**2,171**	**2,173**	**2,176**	**2,148**

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.

52 www.animalhealthaustralia.com.au/maps
53 edis.animalhealthaustralia.com.au/public.php?page=mapsearch&aha_program=3

Laboratory testing

Serological testing

Table 7 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 7 Results of serological testing for two equine viruses, 1 July 2015 to 30 September 2016

Quarter	No. of tests (equine infectious anaemia)	Positive (equine infectious anaemia)	No. of tests (equine viral arteritis)	Positive (equine viral arteritis)
Jul–Sep 2015	582	0	519	0
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				
NSW	294	0	280	0
NT	0	0	0	0
Qld	0	0	3	0
SA	0	0	0	0
Tas	0	0	0	0
Vic	171	0	155	2
WA	8	0	8	0
Aus	**473**	**0**	**446**	**2**

Table 8 summarises the results of laboratory testing for equine herpesvirus 1 on samples submitted to state and territory animal health laboratories during the quarter.

Table 8 Results of testing for equine herpesvirus 1, at 30 September 2016

Syndrome	EHV1 suspected but not confirmed	Negative	Positive	Total
Abortion	0	108	10	118
Neurological	0	14	1	15
Other	0	29	1	30
Total	**0**	**151**	**12**	**163**

Table 9 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)[54]. **Positive serological test results are not an indication of the presence of clinical disease**.

Table 9 Results of serological testing for three arboviruses, 1 July 2015 to 30 September 2016

Quarter	No. of tests (Akabane)	Positive (Akabane)	No. of tests (BEF)	Positive (BEF)	No. of tests (BTV)	Positive (BTV)
Jul–Sep 2015	498	22	576	33	882	37
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**

BEF = bovine ephemeral fever virus; BTV = bluetongue virus

54 namp.animalhealthaustralia.com.au

Surveillance activities

Bovine brucellosis

Australia declared freedom from bovine brucellosis (caused by *Brucella abortus*) in 1989.[55] Surveillance is maintained through abortion investigations and additional testing of cattle for export or other reasons. Table 10 shows 121 bovine abortion investigations and 316 investigations for other reasons were performed during the quarter; all were negative for bovine brucellosis.

Table 10 Bovine brucellosis testing, 1 July 2015 to 30 September 2016

Quarter	No. of tests (abortion)	Positive (abortion)	No. of tests (other reasons)[a]	Positive (other reasons)
Jul–Sep 2015	297	0	283	0
Oct–Dec 2015	177	0	196	0
Jan–Mar 2016	202	0	704	0
Apr–Jun 2016	132	0	376	0
Jul–Sep 2016				
NSW	3	0	239	0
NT	0	0	0	0
Qld	34	0	40	0
SA	22	0	0	0
Tas	1	0	0	0
Vic	28	0	8	0
WA	33	0	29	0
Aus	**121**	**0**	**316**	**0**

a A proportion of this 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*[56], 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 11 shows the number of animals sampled for BSE and scrapie and the points tally for cattle in the NTSESP[57] during the past 12 months. All samples tested were negative.

Table 11 Samples tested for transmissible spongiform encephalopathies (TSEs), 1 October 2015 to 30 September 2016

State	No. examined (cattle)	Points (cattle)	Positive (cattle)	No. examined (sheep)	Positive (sheep)
NSW	228	44,173.7	0	161	0
NT	21	8,306.2	0	0	0
Qld	130	37,837.2	0	21	0
SA	29	13,991.2	0	59	0
Tas	13	2,503.4	0	9	0
Vic	135	37,711.0	0	132	0
WA	29	13,820.7	0	135	0
Aus	**585**	**158,343.4**	**0**	**517**	**0**

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

56 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

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

Avian influenza

Australia is currently free from highly pathogenic avian influenza. A number of low pathogenic subtypes of avian influenza have been found in wild birds. Please consult the Wildlife Health Australia report in this publication for information on avian influenza in wild birds. During the quarter, 229 birds from 71 laboratory submissions were tested for avian influenza (excluding surveillance reported in the Wildlife Health Australia and Northern Australia Quarantine Strategy reports); no positive strains were detected (Table 12). Tests included competitive ELISA (enzyme-linked immunosorbent assay), haemagglutination inhibition, agar gel immunodiffusion, reverse-transcriptase PCR and virus isolation.

Table 12 Results of testing for avian influenza virus in poultry, 1 July to 30 September 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[58] in all Australian jurisdictions. Vaccination exceptions for broilers apply in Tasmania, Western Australia, Queensland and South Australia. During the quarter, 232 birds from 69 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 13 Results of testing for Newcastle Disease in poultry, 1 April to 30 June 2016[a]

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

ND = Newcastle disease

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 14 summarises *Salmonella* spp. isolations from animals reported to NEPSS.

Table 14 Salmonella notifications reported to the National Enteric Pathogen Surveillance Scheme (NEPSS), 1 July to 30 September 2016

Salmonella serovar	Birds[a]	Cats	Cattle	Dogs	Horses	Pigs	Sheep	Other	Total
Bovismorbificans	0	0	27	0	0	0	0	2	29
Dublin	0	0	10	3	0	1	1	0	15
Infantis	1	0	1	1	0	1	0	1	5
Typhimurium	5	4	28	4	4	9	2	2	58
Other	1	7	58	22	8	35	2	22	155
Total	**7**	**11**	**124**	**30**	**12**	**46**	**5**	**27**	**262**

a Includes both poultry and wild birds.

58 '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 and the electronic Wildlife Health Information System (eWHIS). Table 15 summarises NAQS animal testing for specific target diseases in Australia during the past five quarters.

Table 15 Disease testing and pest surveillance under the Northern Australia Quarantine Strategy (NAQS), 1 July 2015 to 30 September 2016

Target disease	Jul-Sep 2015		Oct-Dec 2015		Jan-Mar 2016		Apr-Jun 2016		Jul-Sep 2016	
	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive
Aujeszky's disease[a]	73	0	154	0	45	0	146	0	196	0
Avian influenza[a]	0	0	0	0	0	0	103	0	0	0
Classical swine fever	73	0	154	0	58	0	206	0	196	0
Japanese encephalitis	0	0	0	0	36	0	59	1[b]	0	0
Surra (*Trypanosoma evansi*)	73	0	183	0	16	0	199	0	244	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.[59] 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 18). 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 16 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.[60]

Table 16 Summary of fly trapping events conducted, 1 October 2015 to 30 September 2016[a]

Risk entry pathway	Conducted by	Oct–Dec 2015	Jan–Mar 2016	Apr–Jun 2016	Jul-Sep 2016
Torres Strait	NAQS	15	15	30	0
Livestock export ports	NT, Qld and WA governments	28	43	71	55

NAQS = Northern Australia Quarantine Strategy; NPA = Northern Peninsula Area of Queensland
a Excludes traps with identification results pending.

59 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).

60 Animal Health Australia. Screw Worm Fly Surveillance and Preparedness Program 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[61] and quarterly in the journal *Communicable Diseases Intelligence* and are replicated in *Animal Health Surveillance Quarterly* (Table 17) for five important zoonoses.

Table 17 National notifications of five zoonotic infections in humans, 1 July 2015 to 30 September 2016

Quarter	Brucellosis[a]	Chlamydia[b]	Leptospirosis	Listeriosis	Q fever
Jul–Sep 2015	3	3	17	14	148
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					
ACT	0	0	0	0	0
NSW	4	2	1	4	45
NT	0	0	0	0	2
Qld	2	0	11	1	51
SA	0	0	1	1	7
Tas	0	0	0	0	0
Vic	0	3	5	3	16
WA	0	0	1	4	0
Aus	6	5	19	13	121

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'.

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

National notifiable animal disease investigations

During the quarter, 601 national notifiable animal disease[62] investigations were conducted into suspect disease events. National notifiable animal diseases include a subset of emergency diseases.[63] Table 18 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.[64]

Table 18 Investigations for national notifiable animal diseases, July to September 2016

Disease	Species	State	Month	Response code[a]	Finding
African swine fever	Pig	NSW	Jul	3	Negative
Anaplasmosis in tick-free areas	Cattle	WA	Aug	2	Negative
Australian bat lyssavirus	Cattle	Qld	Sep	2	Negative
	Horse	NSW	Aug	2	Negative
	Horse	Qld	Aug	2	Negative (4 unrelated investigations)
	Horse	Qld	Jul	2	Negative (2 unrelated investigations)
	Horse	Qld	Sep	2	Negative (2 unrelated investigations)
Babesiosis in tick-free areas	Cattle	NSW	Jul	2	Negative
	Cattle	NSW	Sep	2	Negative
	Cattle	WA	Aug	2	Negative
Bluetongue—clinical disease	Cattle	SA	Jul	2	Negative
	Cattle	WA	Jul	2	Negative
	Sheep	NSW	Jul	2	Negative
	Sheep	SA	Aug	2	Negative
	Sheep	SA	Jul	2	Negative
	Sheep	SA	Jul	3	Negative
	Sheep	WA	Aug	2	Negative
	Sheep	WA	Jul	2	Negative
	Sheep	WA	Jul	2	Negative (2 unrelated investigations)
	Sheep	WA	Sep	2	Negative
Brucella abortus (excl. cattle)	Dog	WA	Jul	3	Negative
	Sheep	WA	Aug	2	Negative
Brucella canis	Dog	WA	Aug	2	Negative
	Dog	WA	Jul	3	Negative
	Dog	WA	Sep	2	Negative
Brucella melitensis	Dog	WA	Aug	2	Negative
	Dog	WA	Jul	3	Negative
	Sheep	WA	Aug	2	Negative
	Sheep	WA	Sep	2	Negative

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

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

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

Continued

Disease	Species	State	Month	Response code[a]	Finding
Brucella suis	Dog	NSW	Aug	2	Negative (11 unrelated investigations)
	Dog	NSW	Aug	2	Positive (8 unrelated investigations)
	Dog	NSW	Jul	2	Positive (2 unrelated investigations)
	Dog	NSW	Jul	2	Negative (11 unrelated investigations)
	Dog	NSW	Sep	2	Negative (14 unrelated investigations)
	Dog	NSW	Sep	2	Positive (2 unrelated investigations)
	Dog	Qld	Jul	2	Negative (2 unrelated investigations)
	Dog	Qld	Sep	2	Negative
	Dog	Qld	Sep	3	Positive
	Pig	NSW	Aug	2	Negative
	Pig	NSW	Sep	2	Negative (2 unrelated investigations)
	Pig	WA	Sep	2	Negative
Contagious agalactia	Sheep	WA	Aug	2	Negative
	Sheep	WA	Aug	2	Negative (2 unrelated investigations)
	Sheep	WA	Jul	2	Negative (3 unrelated investigations)
	Sheep	WA	Sep	2	Negative
Enzootic bovine leucosis	Cattle	NSW	Aug	2	Negative (2 unrelated investigations)
	Cattle	NSW	Jul	2	Negative (2 unrelated investigations)
	Cattle	Vic	Jul	2	Negative
Foot-and-mouth disease	Cattle	NSW	Aug	3	Negative
	Cattle	NSW	Jul	3	Negative (3 unrelated investigations)
	Cattle	SA	Aug	3	Negative
	Cattle	SA	Jul	3	Negative
	Cattle	SA	Sep	2	Negative
	Cattle	SA	Sep	3	Negative
	Cattle	Vic	Aug	3	Negative (3 unrelated investigations)
	Cattle	Vic	Jul	3	Negative (2 unrelated investigations)
	Cattle	WA	Sep	3	Negative
	Sheep	NSW	Sep	3	Negative
	Sheep	Qld	Aug	3	Negative
	Sheep	SA	Jul	3	Negative
	Sheep	Vic	Aug	3	Negative (3 unrelated investigations)
	Sheep	Vic	Jul	3	Negative
	Sheep	Vic	Sep	3	Negative
	Sheep	WA	Jul	3	Negative (2 unrelated investigations)
	Sheep	WA	Jul	3	Negative
Infection of bees with *Melissococcus plutonius* (European foulbrood)	Bees	NT	Jul	5	Positive
	Bees	NT	Sep	3	Negative
	Bees	Qld	Aug	2	Negative (12 unrelated investigations)
	Bees	Qld	Aug	2	Positive
	Bees	Qld	Jul	2	Positive (2 unrelated investigations)
	Bees	Qld	Jul	2	Negative (10 unrelated investigations)
	Bees	Qld	Sep	2	Negative (20 unrelated investigations)
	Bees	Qld	Sep	2	Positive (5 unrelated investigations)
	Bees	SA	Aug	2	Negative
	Bees	SA	Jul	2	Negative (2 unrelated investigations)
	Bees	SA	Sep	2	Negative (3 unrelated investigations)
	Bees	SA	Sep	2	Positive (3 unrelated investigations)

Continued

Disease	Species	State	Month	Response code[a]	Finding
Infection of bees with Paenibacillus larvae (American foulbrood)	Bees	NT	Sep	3	Negative
	Bees	Qld	Aug	2	Negative (2 unrelated investigations)
	Bees	Qld	Aug	2	Positive (11 unrelated investigations)
	Bees	Qld	Jul	2	Positive (9 unrelated investigations)
	Bees	Qld	Jul	2	Negative (3 unrelated investigations)
	Bees	Qld	Sep	2	Negative (13 unrelated investigations)
	Bees	Qld	Sep	2	Positive (13 unrelated investigations)
	Bees	SA	Aug	2	Positive (2 unrelated investigations)
	Bees	SA	Aug	2	Negative (4 unrelated investigations)
	Bees	SA	Jul	2	Positive (4 unrelated investigations)
	Bees	SA	Jul	2	Negative (5 unrelated investigations)
	Bees	SA	Sep	2	Positive (3 unrelated investigations)
	Bees	SA	Sep	2	Negative (5 unrelated investigations)
Infection with *Chlamydophila abortus* (ezoontic abortion of ewes, ovine chlamydiosis)	Sheep	WA	Jul	2	Negative
	Sheep	WA	Sep	2	Negative
Infection with classical swine fever virus	Pig	NSW	Jul	3	Negative
	Pig	WA	Aug	3	Negative
Infection with Hendra virus	Donkey	Qld	Sep	2	Negative
	Horse	NSW	Aug	2	Negative (25 unrelated investigations)
	Horse	NSW	Jul	2	Negative (23 unrelated investigations)
	Horse	NSW	Sep	2	Negative (19 unrelated investigations)
	Horse	NT	Aug	2	Negative
	Horse	NT	Jul	2	Negative
	Horse	NT	Sep	2	Negative
	Horse	NT	Sep	3	Negative
	Horse	Qld	Aug	2	Negative (55 unrelated investigations)
	Horse	Qld	Jul	2	Negative (71 unrelated investigations)
	Horse	Qld	Sep	2	Negative (45 unrelated investigations)
	Horse	SA	Sep	3	Negative
	Horse	Vic	Aug	3	Negative
	Horse	WA	Jul	3	Negative
Infection with *Mycoplasma mycoides* subsp. *mycoides* SC (contagious bovine pleuropneumonia)	Cattle	WA	Aug	2	Negative
	Cattle	WA	Sep	2	Negative
Infection with porcine epidemic diarrhoea virus	Pig	WA	Aug	3	Negative
	Pig	WA	Aug	3	Negative
Infection with vesicular stomatitis virus	Pig	WA	Aug	3	Negative
	Pig	WA	Aug	3	Negative
	Cattle	SA	Aug	3	Negative
	Cattle	SA	Jul	3	Negative
	Cattle	SA	Sep	3	Negative
	Cattle	Vic	Aug	3	Negative (3 unrelated investigations)
	Cattle	Vic	Jul	3	Negative (2 unrelated investigations)
	Cattle	WA	Sep	3	Negative
	Horse	WA	Sep	3	Negative
	Sheep	NSW	Sep	3	Negative
	Sheep	QLD	Aug	3	Negative
	Sheep	SA	Jul	3	Negative
	Sheep	Vic	Aug	3	Negative (3 unrelated investigations)
	Sheep	Vic	Jul	3	Negative
	Sheep	Vic	Sep	3	Negative

Continued

Disease	Species	State	Month	Response code[a]	Finding
Infestation of bees with *Varroa destructor* or *V. jacobsoni* (varroosis)	Bees	Qld	Aug	2	Negative (21 related investigations)
	Bees	Qld	Jul	2	Positive
	Bees	Qld	Jul	2	Negative (10 related investigations)
	Bees	Qld	Sep	2	Negative (30 related investigations)
Louping ill	Sheep	WA	Aug	3	Negative
Lumpy skin disease	Cattle	SA	Sep	3	Negative
Paratuberculosis—Johne's disease	Cattle	NSW	Aug	2	Positive
	Cattle	NSW	Jul	2	Negative (2 unrelated investigations)
	Cattle	Qld	Aug	2	Negative (2 unrelated investigations)
	Cattle	Qld	Jul	2	Negative (2 unrelated investigations)
	Cattle	Qld	Sep	2	Negative (2 related investigations)
	Cattle	Vic	Jul	2	Negative
	Cattle	Vic	Jul	2	Positive
	Cattle	Vic	Sep	2	Negative
	Goat	NSW	Jul	2	Negative
	Goat	Qld	Aug	2	Negative
	Goat	Qld	Jul	2	Negative
	Goat	Qld	Jul	2	Negative
	Llama	Qld	Aug	2	Negative
	Mammals	NSW	Aug	2	Negative
	Sheep	NSW	Jul	2	Negative
	Sheep	NSW	Sep	2	Positive
	Sheep	Vic	Aug	2	Negative
	Sheep	WA	Aug	2	Negative
Porcine reproductive and respiratory syndrome	Pig	NT	Aug	3	Negative
	Pig	WA	Aug	3	Negative
	Pig	WA	Jul	3	Negative
Post-weaning multisystemic wasting syndrome	Pig	WA	Aug	2	Negative
Salmonellosis—*S. abortus-ovis*	Sheep	WA	Jul	2	Negative (2 unrelated investigations)
Screw-worm fly—New World (*Cochliomyia hominivorax*)	Sheep	WA	Aug	2	Negative
Screw-worm fly - Old World - Chrysomya bezziana	Dog	Qld	Jul	2	Negative (2 related investigations)
	Sheep	WA	Aug	2	Negative
Sheep pox and goat pox	Sheep	WA	Sep	2	Negative
Surra—*Trypanosoma evansi*	Buffalo	NT	Aug	3	Negative
	Cattle	NT	Sep	3	Negative
	Horse	WA	Sep	3	Negative
Transmissible gastroenteritis	Pig	WA	Aug	3	Negative
	Pig	WA	Aug	3	Negative (2 unrelated investigations)
Tuberculosis (*Mycobacterium bovis*)	Cattle	Vic	Jul	2	Negative (1 granuloma examined)
Tularaemia	Marsupials	NSW	Sep	3	Positive
West Nile virus infection—clinical	Horse	NSW	Aug	2	Negative
	Horse	WA	Jul	3	Negative
	Sheep	NSW	Jul	2	Negative
	Sheep	WA	Aug	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

animalhealth AUSTRALIA

EMERGENCY ANIMAL DISEASE WATCH HOTLINE

1800 675 888

Animal Health Surveillance QUARTERLY

There were 1399 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
Brett Herbert	Aquatic Animal Health	02 6272 5402	Brett.Herbert@agriculture.gov.au
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
Janet Strachan	National Enteric Pathogens Surveillance Scheme	03 8344 5701	JanetES@unimelb.edu.au
Mark Trungove	National Notifiable Diseases Surveillance System	02 6289 8315	Mark.Trungove@health.gov.au
Bonnie Skinner	Surveillance information coordinator	02 6203 3943	BSkinner@animalhealthaustralia.com.au
Rob Barwell	Johne's disease coordinator	02 6203 3947	RBarwell@animalhealthaustralia.com.au
Skye Fruean	Northern Australia Quarantine Strategy	07 4241 7866	Skye.Fruean@agriculture.gov.au
State and territory coordinators			
Rory Arthur	New South Wales	02 6391 3608	Rory.Arthur@dpi.nsw.gov.au
Elizabeth Stedman	Northern Territory	08 8999 2035	Elizabeth.Stedman@nt.gov.au
Greg Williamson	Queensland	07 3330 4545	Greg.Williamson@daf.qld.gov.au
Celia Dickason	South Australia	08 8207 7807	Celia.Dickason@sa.gov.au
Mary Lou Conway	Tasmania	03 6233 6330	MaryLou.Conway@dpipwe.tas.gov.au
Karen Moore	Victoria	03 5430 4525	Karen.Moore@ecodev.vic.gov.au
Jamie Finkelstein	Western Australia	08 9368 3805	Jamie.Finkelstein@agric.wa.gov.au

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.

Editing: Viscarra Rossel & Associates. Front cover photo: Animal Health Australia.