Surveillance

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Surveillance is published as the Ministry for Primary Industries' authoritative source of information on the ongoing biosecurity surveillance activity and the health status of New Zealand's animal and plant populations in both terrestrial and aquatic environments. It reports information of interest both locally and internationally and complements New Zealand's international reporting.

Contents

Editorial

The importance of science for biosecurity

An effective biosecurity system without science doesn't make sense: it can't work. Taking the current example of myrtle rust, we need to understand the pathogen biology, pathogenicity and modes of infection, genetics of host resistance, pathways, mechanisms and modelling of spread, diagnostics and pre-visual symptom detection, chemical and biological treatments, social perceptions of value and socialising of new technologies, kaupapa and mātauranga Māori… the list goes on. At the border we increasingly need new sensor technologies for detection, an understanding of complex networks and data analytics. For interventions and control of incursions we need the science of epidemiology, semiochemicals, mating disruption and other breeding and genetic approaches, and to be exploring the new territories of gene drive and gene editing. Underpinning all this we need core systematics, taxonomy and the curation and development of data collections.

Most of the science needed and the capability for all this is in New Zealand. It is embodied in entities such as B3 and the Biological Heritage National Science Challenge, and in partner organisations such as CRIs, universities and within MPI itself. But to capitalise on this, we need an integrated approach. Science providers have different drivers, and different investment funds also have differing objectives. There are also different levels and scales: incursions require short term, critical responses, and long-term science requires time and consultation.

This is why strategy development is so important. Biosecurity 2025 provides five strategic directions, and at least three of these – a team of 4.7 million, a toolbox for tomorrow and smart, free-flowing information – rely heavily on science as action plans are developed. Much of the relevant science is also signalled in two very recent initiatives, the Primary Sector and the Conservation and Environment Roadmaps. These provide guidance and direction for new science and technology and associated capability that we need to be addressing over a 10–20-year period. Not surprisingly, there is strong emphasis on science such as smart digital technologies, data connectivity and management, genomics and gene technology, and the impacts of climate change. These all are intrinsic to biosecurity science. As well, however, there are more intricate themes that reflect changing perceptions and challenges. Biosecurity and biodiversity are co-dependent, and biosecurity problems are increasingly seen as not restricted to commercial environments or the natural estate. Our ability to collect large amounts of data means that analysis of complex systems and large biological and physical networks and ecosystems should lead to better management.

These strategies have also consolidated and developed the core concepts of people and values as lying at the heart of primary production systems, environmental management and biosecurity. Individuals, rural and urban communities, iwi, social structures and networks – all are integral parts of the biosecurity system. This impacts on the acceptability of biological and chemical treatments and control measures, of new gene technology, the value of taonga and iconic species and of historical and familiar environments, and reflects the often profound impact of incursions on community and regional economics and sustainability. There are social science and kaupapa and mātauranga Māori issues here that are critical.

As we consider biosecurity science in the future, it is clear that we need a broad, comprehensive perspective. But we also need a science culture – an acceptance that science as evidence is at the core of good policy, regulations and standards. In MPI we have been working to ensure that such a culture exists. It means developing an MPI science strategy that sets out a culture of science excellence, ethics, collaboration and accessibility, and provides a framework for science investment. We have an advisory Science Board that reports directly to the Senior Leadership Team on MPI science and technology issues, a regular science conference, and science seminars, to engage a wider, increasingly science-literate constituency within MPI.

This year we have also awarded an inaugural Director General's Science Prize, and significantly this went to the team that carried out the ground-breaking research on *Theileria*, the agent associated with bovine anaemia in New Zealand. The research, including new work on risk factors, surveillance, diagnostics and practical tools for farmers, resulted in a collection of papers in a special issue of the *NZ Veterinary Journal.*

The award highlights the high level of science expertise within MPI and the importance of science in meeting MPI's Grow and Protect objectives. Science and technology is at the centre of MPI's future biosecurity development, and underpins our role in facilitating protected sector growth.

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International animal trade

Animal imports

The MPI Animal Imports Team (AIT) is responsible for developing and amending import health standards (IHSs) that outline biosecurity import requirements for live animals, germplasm and animal products. AIT also provides advice to the public and technical advice to staff at the border.

Some IHSs require that the animal or animal product is accompanied by a current import permit, to assist with clearance at the border. AIT is also responsible for issuing these permits, of which 3 188 were issued during 2016 (**Table 1**). Note that the number of permits is not necessarily related to the volume of trade: for example, a single permit might be issued for several horses.

Numbers of live animal imports in 2016 are listed in **Table 2**. These are estimates based on importers' stated intentions and may differ from the numbers actually imported.

The following is a summary of new or amended import health standards issued during 2016.

Natural sausage casings

This was issued on 10 August 2016 for trade in natural sausage casings from recognised countries with negotiated veterinary certificates.

Dog semen

The IHS for semen from dogs was amended on 8 August 2016 to include the agreed Australian veterinary certificate in the country-specific veterinary table.

Sheep and goat semen and embryos

The IHS for sheep and goat semen and embryos was amended on 10 November 2016 to remove the measures for tuberculosis and Crimean-Congo haemorrhagic fever.

Exports of live animals and germplasm

Export figures for live animals and germplasm for the year 2016 are presented in Tables 3 and 4.

TABLE 1: Number of import permits issued by Animal Imports Team, 2016

Category	Product type	Total
Animal products	Animal feed	19
	Animal product	99
	Bee	34
	Dairy	3
	Egg	7
	Equine	1
	Fertiliser	1
	Fibre	14
	Fish	3
	Hides/skins	6
	Meat	4
	Porcine	20
	Poultry	1
	Tissue	1
	Wool	1
	Total	**214**
Biologicals	General	378
	Restricted	202
	Total	**580**
Embryos	Bovine	22
	Caprine	3
	Laboratory animals	1
	Ovine	8
	Total	**34**
Live animals	Butterfly	5
	Camelid	18
	Caprine	1
	Dog/cat	111
	Dog/cat – quarantine	1 652
	Equine	38
	Fish	14
	Hatching eggs	8
	Insect	4
	Invertebrate	55
	Laboratory animals	46
	Marine invertebrates	10
	Ovine	7
	Rabbit	5
	Small animals	3
	Zoological	24
	Total	**2 001**
Semen	Bovine	90
	Canine	1
	Caprine	5
	Cervine	2
	Equine	5
	Ovine	8
	Porcine	2
	Total	**113**
Transit	All	246
	Total permits issued	3 188

TABLE 2: Live animal imports by species

Species	Total
Alpaca/llama	120
Marine invertebrates/fish	195
Caprine	14
Cat	2 452
Zoo	31
Dog	5 295
Horse	1 433
Guinea pig	23
Invertebrate	645
Laboratory animal	199
Ovine	11
Rabbit	4
Reptile (zoo)	43
Spider (zoo)	3
Total	**10 468**

Table 3 compares live animal and germplasm exports from 2008 to 2016 and **Table 4** shows the global distribution by region of the numbers of exports for 2016.

In 2016 there was a small decrease in exports of day-old chicks and poultry hatching eggs (**Table 3**). The ongoing trade in day-old chicks is believed to be driven by disease outbreaks in the poultry industries of Asia, the US and Europe. The number of day-old broiler chicks for breeding exported to Asia is growing rapidly and China may become our fourth largest export market for these animals. There is an ongoing export trade to the Pacific Islands in day-old chicks from both broiler and layer bloodlines (**Table 4**).

Shipments of racehorses have remained consistent in 2016 (**Table 4**).

Exports of live cattle have almost doubled since 2015 to 40 506 in 2016 (**Table 3**). The majority of exports were to China and this sees a return to average numbers.

Germplasm exports in 2016 (**Table 3**) have increased slightly. Bovine semen exports were similar to 2015 with 1.25 million semen straws exported, whereas exports of cervine and equine semen

TABLE 3: Comparison of live animal and germplasm exports from 2008 to 2016

	2016	2015	2014	2013	2012	2011	2010	2009	2008
Bees (packages (kg), queen and bumble)	31 211	40 675	44 116	36 737	8 776	37 180	37 523	34 621	27 435
Bovine embryos	457	437	536	850	1 801	950	943	1 077	915
Bovine semen	1 253 030	1 251 776	1 596 560	1 573 105	1 160 455	1 085 082	1 073 877	1 237 044	785 939
Canine semen	33	47	420	9	41	12	166	56	48
Cats & dogs	3 507	4 045	4 278	5 980	6 151	5 873	4 247	3 999	5 051
Cervine semen	2 275	1 557	816	325	220	275	2 590	3 001	1 833
Equine semen	6 324	4 119	3 032	3 265	3 324	2 362	2 670	5 195	4 214
Ferrets	0	0	0	0	374	760	825	1 397	1 801
Live alpacas & llamas	80	228	200	156	456	404	198	375	353
Live cattle	40 506	21 186	85 732	36 573	39 636	30 499	16 150	12 847	17 075
Live deer	0	28	0	0	65	31	15	46	115
Live goats	1 184	0	35	0	0	979	58	190	6
Live horses	2 706	2 713	2 622	2 853	2 886	3 308	2 292	2 469	2 512
Live sheep	300	45 166	1 082	380	421	177	307	124	118
Ovine embryos	2 778	825	1 836	1 737	0	320	114	230	1 652
Ovine semen	6 492	5 049	5 518	1 877	7 271	11 819	4 954	10 374	19 921
Poultry (day-old chicks)	2 442 609	2 221 689	1 700 483	1 270 703	1 136 530	1 342 542	1 324 543	1 098 192	854 678
Poultry (hatching eggs)	3 700 891	4 076 927	3 036 075	2 536 565	2 365 466	3 173 403	5 185 128	3 860 755	5 275 056

TABLE 4: Volume of live animal and germplasm exports to various regions in 2016

	Africa	Asia	Australia	Canada	Central & South America	Europe	Middle East	Pacific Islands	United States	Total
Aquatic animals			78			480				558
Bee packages		40		26 044						26 084
Bees, queen & bumble		1 640		3 487						5 127
Birds (large)		282				2			20	304
Birds (small)		16	2		14	1				33
Bovine embryos			310			147				457
Bovine semen	244 303	26 601	248 219		439 200	183 267			111 440	1 253 030
Canine and feline semen		4	29							33
Caprine semen		4 439								4 439
Cats and dogs	17	300	2 071	78	20	612	16	85	308	3 507
Cervine embryos				111					88	199
Cervine semen			152	558	598	687			280	2 275
Equine semen			6 324							6 324
Live alpacas and llamas		11	3			66				80
Live cattle		40 506								40 506
Live goats		1 163						21		1 184
Live horses	4	707	1 890			42		20	43	2 706
Live sheep		19	170		89	10		12		300
Other		2	31			7			6	46
Ovine embryos		900	1 653		225					2 778
Ovine semen			5 143	50	1 299					6 492
Poultry (day-old chicks)		1 517 928					27 360	897 321		2 442 609
Poultry (hatching eggs)		741 690					117 720	2 841 481		3 700 891
Zoo animals			16				12		1	29

have again increased from the previous year. The number of ovine embryos exported was the highest since 2008 and ovine semen exports were also increased from last year. Australia's change in import conditions means that exports of ovine semen and embryos will probably decrease in 2017.

Bees, cats and dogs, alpacas and llamas have all decreased significantly in 2016.

The majority of other animal exports showed fairly consistent trade, with no significant changes.

Number of export certificates issued

During 2016 there were 53 Overseas Market Access Requirements (OMARs) or export certificates issued and notified as notices under the Animals Products Act 1999. Of these, 17 represented new requirements while the rest were amendments to existing requirements, due to changes.

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Animal Health Laboratory

The Ministry of Primary Industries (MPI)'s Animal Health Laboratory (AHL) plays a vital role in protecting New Zealand's livestock and aquaculture industries nationwide from new and emerging infectious diseases.

The AHL is a high-containment facility with specialised equipment and procedures that enable us to work safely with exotic or zoonotic organisms and exotic disease investigation samples. Our staff are highly qualified and experienced in the science disciplines of pathology, virology, bacteriology, molecular biology and bioinformatics, with specialist knowledge of exotic and emerging pathogens. The AHL maintains international best practice operations, with accreditation and certification to ISO/IEC 17025, AS.NZS 2243.3 and MPI Registered Laboratory Programme and Transitional and Containment Facility regulations.

Construction of the National Biocontainment Laboratory, an $87 million investment to meet international best practice for handling organisms that cause disease in animals and humans, continues to be of great interest to stakeholders, and large numbers of local and overseas officials and industry visitors have visited the Wallaceville site.

Highlights of 2016 included eight scientific papers associated with the outbreak of *Theileria orientalis* Ikeda. This information helps on-farm diagnosis and management of theileriosis. We continue to invest in laboratory preparedness for the potential threat of a foot-and-mouth disease (FMD) outbreak in New Zealand. Accreditation was achieved for a suite of diagnostic tests for FMD, following international proficiency testing. To better support urgent control measures, one of our scientists has started PhD studies on new technology to enable early field detection of the FMD virus. Our scientists are also gaining experience in FMD-infected countries, training laboratory personnel in Laos and Myanmar to support the OIE SEAFMD campaign to control FMD in Southeast Asia and China.

National Biocontainment Laboratory

The National Biocontainment Laboratory Project (NBLP) began in 2012 after MPI

January

June

December

The NBL under construction during 2016: in January, June and December

identified a need to replace the existing high-level biocontainment facilities at the Wallaceville campus. Construction of the NBLP made significant progress during 2016. The first half of the year saw completion of the anchor piles, reinforced concrete foundation pads, basement floor and beams, plus installation of the four-tonne base isolators and slider bearings that will provide critical seismic protection. In mid-April, the arrival of a 28-metre tower crane to move loads of up to 12 tonnes provided a visible sign that construction was underway. The first of the 12-metre steel columns arrived on site in October, with the outline of the building becoming more apparent as further steel was erected in the lead-up to Christmas.

During 2016, the MPI project team worked towards integrating the NBL with the wider Wallaceville site, including services, linkage to other buildings and security requirements. Planning for the eventual transition of staff and equipment to the new building also got underway. This work has continued during 2017, with the development of operating procedures, training needs, relocation plans and investigating procurement options for new equipment.

Supporting surveillance programmes

The AHL carries out surveillance diagnostic work for a number of important pathogens including avian influenza, transmissible spongiform encephalopathy and arboviruses. Tests may include direct detection of the pathogenic organism or indirectly measuring an animal's immune response to determine whether infection is present or has been present in the past. Depending on the objectives of the surveillance programme, pathogens being tested for may include endemic or exotic organisms, or both.

A new surveillance programme that started in 2016 examines bee pathogens. This programme has enrolled 60 apiaries from around the country, with 1 000 bees per apiary sent to the laboratory every 6 months. AHL staff have been establishing test methods for the target pathogens. The aims of this study are to examine the geographic distribution of bee pathogens in New Zealand and interactions between apiary management practices, productivity, colony loss and climate. Another programme is monitoring exotic arboviruses such as bluetongue virus. Each year about 640 cattle are blood-sampled from around New Zealand and tested for antibodies specific to a range of arboviruses (see Arbovirus surveillance programme annual report, page 28).

Facilitating trade

The AHL functions as the national veterinary reference centre for New Zealand and one of its core functions is diagnostic testing that supports international trade by New Zealand's primary industries. In 2016 more than 6 000 tests were performed to directly support exports and imports (**Table 1**).

Throughput

The AHL is a centre of science excellence and maintains its accreditation and certification to national and international standards. The laboratory is divided into four science disciplines: virology, immunology, bacteriology and aquatic animal diseases, each with its own team. Teams consist of expert senior scientists, scientists and technicians capable of carrying out the complex analyses and investigations presented to us on a daily basis. There are more than 450 test methods available at the AHL, many of them only available within New Zealand from the AHL. Tests range from classical and well-established techniques, for example virus isolation, virus neutralisation, ELISA and microscopy/pathology, to molecular analysis and state-of-the-art technologies such as real-time PCR, Next Generation sequencing and bioinformatics analysis. Where testing cannot be offered within New Zealand, the AHL subcontracts the work overseas to accredited reference laboratories.

The AHL is constantly working to enhance diagnostic capability by implementing new or improved tests to ensure we lead the way in veterinary laboratory diagnostics in New Zealand. Capability has been further enhanced through the purchase of several high-throughput nucleic acid extractors and additional real-time PCR machines.

TABLE 1: Summary of test numbers and description of work conducted by AHL, 2016

Purpose of testing	Number of tests/accessions	Description of work
Exotic disease investigations	9 736/246	(1) Testing to rule out the presence of exotic pathogens. (2) Identification of reptiles and amphibians that cross our borders.
Cost-recovery diagnostics	1 914/148	Encompasses cost-recovered diagnostic testing and project work, much of which utilises capability not available elsewhere.
Surveillance projects (Crown-funded)	7 675/163	Testing to support surveillance programmes including TSE, arbovirus and avian influenza.
Import/export/trade (cost recovery)	6 200/652	(1) Import and export testing to maintain overseas trade for primary industries. (2) Trade in companion animals and animal travel overseas (e.g., racehorses) (3) Quality assurance reference testing for industry partners.
Artificial breeding (AB)	856/127	Specific testing for AB purposes to rule out presence of various pathogens, including some exotic diseases.
Quality assurance	1 528/128	The AHL participates in 92 programmes of inter-laboratory proficiency testing through 11 international authorised reference partners in Australia, North America and Europe to provide assurances of our testing processes and to meet the requirements of ISO 17025.

Supporting incursion investigations

One of the AHL's priorities is to support incursion investigations by performing a wide range of diagnostic tests. This involves using a combination of traditional laboratory techniques and state-of-the-art technologies to rule out or identify exotic pathogens. It is essential to work with these organisms under conditions of high security.

Summarised below are some of the major incursion investigations that the AHL supported during the 2016 calendar year. Most tests were performed by the Bacteriology & Aquatic Animal Diseases and Immunology & Virology teams. The few tests that we could not undertake were subcontracted to internationally recognised and accredited laboratories around the world.

Aquatic

Continuing the trend of recent years, there was a large number of aquatic investigations requiring a wide range of diagnostic tests. Shellfish species including cockles, mussels, oysters, paua, pipi, toheroa and tuatua were tested for a range of diseases including abalone viral ganglioneuritis, aquabirnavirus, *Bonamia*, haplosporidians, ostreid herpesvirus-1, *Perkinsus*, *Rickettsia* and various bacterial pathogens. Fish submissions including kokopu, pilchard, salmon, snapper, trevally and trout were also tested for a number of diseases. A number of bacteria including *Pseudoalteromonas*, *Shewanella*, *Proteus* and *Vibrio* were isolated from some of the shellfish and fish samples submitted, including two probably undescribed species of *Vibrio*. Investigations into the cause of tailfin rot in rock lobsters have continued, without conclusion to date. An eel with a head lesion was submitted and a non-infectious cause was confirmed.

Testing continued in support of the MPI biosecurity response to *Rickettsia*-like organisms in salmon. Extensive work and use of advanced methods such as whole-genome sequencing identified three strains of a *Rickettsia*-like organism that are related but distinguishable from *Piscirickettsia salmonis*. Delimiting surveillance testing of oysters for *Bonamia ostreae* was performed. A submission of newts for ranavirus testing helped MPI's response team who are eradicating a population of European mountain newts from the Coromandel area.

Avian

Chicken samples submitted as part of a number of investigations were tested for a range of viral diseases including avian influenza virus, Newcastle disease and infectious bursal disease. Avian bacterial pathogens tested for and identified included avian mycoplasmas, *Avibacterium paragallinarum*, *Pasteurella multocida* and *Ornithobacterium rhinotracheale*.

Bee pathogens

Tests for American foulbrood and European foulbrood by PCR were negative. In support of other investigations into bee mortalities and a suspected poisoning case, tests were carried out for *Nosema ceranae*, *N. apis*, Israeli acute paralysis virus, *Lotmaria passim* and deformed wing virus. In two cases both *N. ceranae* and deformed wing virus (both known to occur in New Zealand) were identified and could have been contributing to the problems seen in these apiaries.

Bovine

Bovine submissions were tested for a wide range of pathogens including anthrax, *Campylobacter*, *Chlamydia*, *Dichelobacter nodosus*, enteroviruses, herpesviruses, *Leptospira*, mycoplasmas, parapoxviruses, *Pasteurella multocida*, pestiviruses, poxviruses, *Salmonella*, *Theileria orientalis* Ikeda strain, *Treponema* and *Yersinia*. A number of submissions were also cultured for bacteria and species such as *Actinobacillus lignieresii*, *Escherichia coli* (non-O157), and *Lactococcus, Mannheimia, Moraxella* and *Streptococcus* were isolated from samples.

Canine

A wide variety of investigative testing was carried out in dogs, including for anaplasmosis, brucellosis, leishmaniasis, leptospirosis, canine babesiosis, canine distemper virus, canine heartworm (microfilaria), canine parvovirus, canine circovirus, enteric coronavirus, cryptosporidiosis, *Clostridium perfringens*, *C. difficile*, *Ehrlichia canis*, mycoplasmas, *Rickettsia* and *Borrellia* (the cause of Lyme disease). A number of ticks were identified from dogs, in some cases exotic species that were usually associated with recent international travel.

Fungal culture performed on an abdominal mass from a dog isolated three species of fungi: *Microascus cinereus*, *M. cirrosus* and *Scopulariopsis gracilis*. These organisms have been reported in the scientific literature as opportunistic pathogens.

Caprine

Samples from goat investigations were tested for *Chlamydia*, *Mycoplasma*, herpesviruses, *Treponema*, *Dichelobacter* and other bacterial pathogens. Caprine herpesvirus-2 was identified from one case.

Equine

Numerous submissions relating to equine investigations were received throughout the year. Testing for adenovirus, *Anaplasma*, *Brucella*, *Chlamydia*, equine influenza virus, equine infectious anaemia virus, *Leptospira*, piroplasm, alphaviruses, flaviviruses, equine herpesviruses-1 and -4, equine rhinitis virus and equine viral arteritis was undertaken on a variety of samples.

Fisheries forensics

An AHL staff member, in collaboration with scientists at a Crown Research Institute, carried out testing that assisted in the successful prosecution of a person who was illegally trading paua meat.

Ovine

Scrapie was ruled out from a middle-aged ewe showing central nervous signs. Other ovine investigations involved testing

and identifying endemic pathogens such as herpesviruses, *Mycoplasma* and *Chlamydia*. Q-fever and brucellosis was excluded from one submission.

Porcine

Samples from two investigations were submitted and classical swine fever and Aujesky's disease were ruled out. Porcine lymphotropic herpesvirus-2 was identified from one submission.

Wildlife and captive animals

Investigations that began last year continued into the cause of encephalitis in black stilt (kaki) chicks. Further tests including whole-genome sequencing have not elucidated a pathogenic causative agent. Fungal culture of a granuloma sample from a kea revealed the infection was not due to a fungus. Numerous suspect exotic lizards and other reptiles were identified. Tests on a number of birds from a zoo with a respiratory disease were all negative for *Chlamydia psittaci*. Samples from parrots tested negative for Pacheco's disease by PCR but were positive for avian adenovirus-1. Tissue samples from a dead capybara and a number of capybara in contact with the animal tested negative for *Burkholderia pseudomallei*.

Other species

A blood sample from an alpaca tested negative for haemotrophic mycoplasmas, piroplasm and *Anaplasma phagocytophilum*. Cervine tissues were submitted for poxvirus PCR and cowpox was excluded from a human patient.

Exotic disease preparedness

Over the last year the AHL has continued to advance preparedness for exotic disease incursions, with new or improved diagnostic capability for high-priority diseases such as anthrax, bovine ephemeral fever, bovine viral diarrhoea type 3 and porcine reproductive and respiratory syndrome.

Further substantial progress has been made in foot-and-mouth disease (FMD) preparedness, with IANZ accreditation for all the important diagnostic tests, and further sequencing capability has been developed. Two AHL staff took part in a New Zealand-funded FMD project in Southeast Asia, where they tested numerous FMD-positive samples, gaining invaluable first-hand experience of working with the virus.

A new whole-genome sequencer was purchased, providing improved capability for identifying new or emerging pathogens.

National and international connections

The AHL maintains an extensive network of national and international contacts for subcontracting tests, for access to reference material and for technical advice. In addition, technical delegations from trading partners visit the AHL to assure themselves of New Zealand's testing capability. During the year AHL experts represented NZ on the following multinational animal disease working groups:

- International Veterinary Biosafety Workgroup, a multinational group that promotes best practice in microbiological biocontainment and safety in veterinary laboratories that have national responsibility for the health of large animals, and which operate at biosafety levels 3 and 4 – Joseph O'Keefe;
- FluLabNet, an EU-organised collaborative network on influenza – Wlodek Stanislawek;
- Global Foot-and-Mouth Disease Research Alliance, a network of international laboratories that work collaboratively to improve the control and prevention of FMD – Richard Spence;
- Sub-committee of Aquatic Animal Health Standards, an Australian and New Zealand committee that provides technical advice on aquatic animal health issues in support of policy planning – Brian Jones & Cara Brosnahan; and
- National Laboratory Task Group, an Australian and New Zealand committee that provides technical advice on animal health laboratory diagnostics in support of policy planning – Wendy McDonald.

Staffing and structure

See **Table 2, page 12**.

Staff publications in scientific and technical journals

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Ha H-J (2016). The contribution of the Animal Health Laboratory for Bacteriology (Ministry for Primary Industries) to investigations of disease in New Zealand's wildlife. *Kokako* 23(2), 24.

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TABLE 2: Staffing and structure	
Director, Diagnostic and Surveillance Services	Veronica Herrera (Wellington)
Director, National Biocontainment Laboratory Project	Joseph O'Keefe
Animal Health Laboratory Manager	Wendy McDonald (Acting)
Bacteriology and Aquatic Animal Diseases	
Manager	Hye Jeong Ha
Principal Advisor	Brian Jones
Scientists	Diana Jaramillo, Henry Lane, Cara Brosnahan, Sharon Humphrey
Technical staff	Yen Yen Yuen, Smriti Nair, Courtenay O'Sullivan, David Burr, Mary Ann Tuboltsev
Immunology	
Manager	Richard Spence
Scientists	Rick Clough, Barbara Binney, Edna Gias, Rudolfo Bueno, Richard Swainsbury
Technical staff	Michaela Hannah (0.6 FTE), Emma Bramley, Tais Garcia, Amy Bradshaw
Technical Resource Co-ordinator	Judy Jenner
Biosafety Officer	Kanishka Fernando (0.7 FTE)
Virology	
Manager	Grant Munro
Principal Advisor	Wlodek Stanislawek
Scientists	David Pulford, Edna Gias, Richard Hall, Della Orr
Technical staff	Mike Hansen, Ickel Marie Bueno, Sylvia Ohneiser, Maree Joyce, Harriet Sowman, Rana Fathizargaran
Containment Laboratory	
Supervisor	Bryan Schroeder
Technical assistants	Barbara Black, Mary Mewett
Quality Assurance	
Adviser	Irina Bolotovski

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Animal Health Surveillance

The following tables present animal health data collected by MPI from various sources during 2016.

Table 1 is a summary of the numbers of laboratory submissions from sick farmed animals, from the major livestock and avian populations.

Table 2 (pages 15-16) lists the number of *Salmonella* serotypes by animal species diagnosed by veterinary pathology laboratories.

Table 3 (page 17) presents a summary of the results for the salmon surveillance programme in 2016. This programme is run annually for health surveillance in approved establishments for export of salmon to Australia for human consumption. Testing is conducted by the Animal Health Laboratory, Wallaceville.

Table 4A (pages 17-18) presents a cumulative list of investigations conducted by the MPI Incursion Investigation (Animals and Marine) Team more than once during the period 2010–2016 that have resulted in exclusion of OIE-notifiable diseases or other selected significant exotic diseases.

Table 4B (page 18) presents a list of significant investigations conducted during 2016 by the MPI Incursion Investigation (Animals and Marine) Team into suspected exotic or emerging diseases that have been confirmed as positive. These include exotic disease or vector incursions or newly emerged diseases, occurrences of diseases in new host species, first detections of disease agents established in New Zealand, and interceptions with no resulting transmission or establishment of organisms.

TABLE 1: Number of cases and diagnoses received from veterinary diagnostic laboratories during 2016

Cattle	
Total sick animal cases	**16 129**
Abnormalities of reproductive system	**3**
Neospora caninum	0
C. fetus ssp. venerealis	0
Pestivirus infection	0
Abortion	**628**
Neospora caninum	134
Mycotic abortion	4
Pestivirus infection	11
Leptospira spp.	11
Congenital defects	**14**
Ill thrift/diarrhoea	**8 726**
Pestivirus infection	207
Gastrointestinal parasitism	29
Johne's disease – suspicious and confirmed	1 407
Trace element deficiency	311
Yersinia spp.	344
Rotavirus	485
Nervous signs	**403**
Listeria monocytogenes	2
Hepatic encephalopathy	1
Metabolic disease	21
Malignant catarrhal fever	5
Polioencephalomalacia	3
Histophilus somnus	0
Sudden death	**964**
Clostridium spp.	4
Respiratory disease	**541**

Pigs	
Total sick animal cases	**90**
Abortion	**3**
Ill thrift/diarrhoea	**35**
Nervous signs	**3**
Sudden death	**30**

Sheep	
Total sick animal cases	**1366**
Abnormalities of reproductive system	**4**
Brucella ovis	0
Abortion	**221**
Campylobacter fetus spp. fetus	26
Other Campylobacter spp.	2
Toxoplasma gondii	38
Salmonella Brandenburg	30
Congenital defects	**1**
Ill thrift/diarrhoea	**459**
Johne's disease	21
Trace element deficiency	19
Gastrointestinal parasitism	27
Nervous signs	**67**
Listeria monocytogenes	8
Polioencephalomalacia	0
Clostridium spp.	2
Respiratory disease	**54**
Sudden death	**273**
Gastrointestinal parasitism	7

Farmed deer	
Total sick animal cases	**131**
Abortion	**1**
S. zooepidemicus	0
Congenital defects	**0**
Ill thrift/diarrhoea	69
Johne's disease	9
Trace element deficiency	5
Yersinia spp.	**6**
Nervous signs	12
Malignant catarrhal fever	**0**
Sudden death	47
Gastrointestinal parasitism	0
Malignant catarrhal fever	4

Horses	
Total sick animal cases	**6 238**
Abortion	**54**
S. zooepidemicus	*0*
Circulatory disease	**71**
Ill thrift/diarrhoea	**1 277**
Gastrointestinal parasitism	10
Nervous signs	**242**
Respiratory disease	**747**
Streptococcal infection	68
Sudden death	**28**

Lamoids	
Total sick animal cases	**350**
Abortion	**2**
Ill thrift/diarrhoea	**198**
Gastrointestinal parasitism	3
Nervous signs	**19**
Respiratory disease	**8**
Sudden death	**22**

Avian species	
Total number of submissions	**824**

Goats	
Total sick animal cases	**491**
Abortion	**10**
Ill thrift/diarrhoea	**250**
Gastrointestinal parasitism	11
Respiratory disease	**28**
Nervous signs	**36**
Listeria monocytogenes	0
Caprine arthritis encephalitis	0
Sudden death	**37**
Clostridium perfringens D (enterotoxaemia)	0
Gastrointestinal parasitism	0

TABLE 2: *Salmonella* serotypes isolated from animals during 2016

Serotypes	Avian	Bovine	Camelid	Canine	Equine	Feline	Ovine	Porcine	Reptile
Salmonella Abortusequi	0	0	0	0	0	0	0	0	0
Salmonella Abortusovis	0	0	0	0	0	0	0	0	0
Salmonella Adelaide	0	1	0	0	0	0	0	0	0
Salmonella Agona	0	3	0	0	0	0	0	0	0
Salmonella Albany	0	0	0	0	0	0	0	0	0
Salmonella Amager	0	0	0	0	0	0	0	0	0
Salmonella Amsterdam	0	0	0	0	0	0	0	0	0
Salmonella Anatum	0	0	0	0	0	0	0	0	0
Salmonella Banana	0	0	0	0	0	0	0	0	0
Salmonella Bere	0	0	0	0	0	0	0	0	0
Salmonella Brancaster	0	0	0	0	0	0	0	0	0
Salmonella Brandenburg	0	52	0	5	1	0	30	0	0
Salmonella Bredeney	0	0	0	0	0	0	0	0	0
Salmonella Cubana	0	0	0	0	0	0	0	0	0
Salmonella Eastbourne	0	0	0	0	0	0	0	0	0
Salmonella Emek	0	3	0	0	0	0	0	0	0
Salmonella Fresno	0	0	0	0	0	0	0	0	0
Salmonella Give	0	0	0	0	0	0	0	0	0
Salmonella Heidelberg	0	0	0	0	0	0	0	0	0
Salmonella Hvittingfoss	0	0	0	0	0	0	0	0	0
Salmonella Johannesburg	0	0	0	0	0	0	0	0	0
Salmonella Kedougou	0	0	0	0	0	0	0	0	0
Salmonella Kentucky	0	1	0	0	0	0	0	0	0
Salmonella Kiambu	0	0	0	0	0	0	0	0	0
Salmonella Kottbus	0	0	0	0	0	0	0	0	0
Salmonella Lexington	0	0	0	0	0	0	0	0	0
Salmonella Litchfield	0	0	0	0	0	0	0	0	0
Salmonella Liverpool	0	0	0	0	0	0	0	0	0
Salmonella Livingstone	0	0	0	0	0	0	0	0	0
Salmonella London	0	0	0	0	0	0	0	0	0
Salmonella Luckenwalde	0	0	0	0	0	0	0	0	0
Salmonella Mana	0	0	0	0	0	0	0	0	0
Salmonella Mbandaka	0	0	0	0	0	0	0	0	0
Salmonella Meleagridis	0	0	0	0	0	0	0	0	0
Salmonella Minnesota	0	0	0	0	0	0	0	0	0
Salmonella Mississippi	0	0	0	0	0	0	0	0	0
Salmonella Molade	0	0	0	0	0	0	0	0	0
Salmonella Montevideo	0	0	0	0	0	0	0	0	0
Salmonella Muenster	0	0	0	0	0	0	0	0	0
Salmonella Nchanga	0	0	0	0	0	0	0	0	0
Salmonella Onderstepoort	0	0	0	0	0	0	0	0	3
Salmonella Oranienburg	0	0	0	0	0	0	0	0	0
Salmonella Orion	0	0	0	0	0	0	0	0	0
Salmonella Paratyphi	0	0	0	0	0	0	0	0	0
Salmonella Poona	0	0	0	0	0	0	0	0	0
Salmonella Potsdam	0	0	0	0	0	0	0	0	0
Salmonella Pullorum	0	0	0	0	0	0	0	0	0
Salmonella Rideauf	0	0	0	0	0	0	0	0	0

Continued p. 16

TABLE 2: *Salmonella* serotypes isolated from animals during 2016 (continued)

Serotypes	Avian	Bovine	Camelid	Canine	Equine	Feline	Ovine	Porcine	Reptile
Salmonella Rissen	0	0	0	0	0	0	0	0	0
Salmonella Rough	0	0	0	0	0	0	0	0	0
Salmonella Ruiru	0	1	0	0	0	0	0	0	0
Salmonella Salford	0	0	0	0	0	0	0	0	0
Salmonella Schwarzengrund	0	0	0	0	0	0	0	0	0
Salmonella Singapore	0	0	0	0	0	0	0	0	0
Salmonella Tennessee	0	0	0	0	0	0	0	0	0
Salmonella Thompson	0	1	0	0	0	1	0	0	0
Salmonella Typhisuis	0	0	0	0	0	0	0	0	0
Salmonella Uganda	0	0	0	0	0	0	0	0	0
Salmonella Victoria	0	0	0	0	0	0	0	0	0
Salmonella Virchow	0	0	0	0	0	0	0	0	0
Salmonella Wangata	0	0	0	0	0	0	0	0	0
Salmonella Warragul	0	0	0	0	0	0	0	0	0
Salmonella Weltevreden	0	0	0	0	0	0	0	0	0
Salmonella Westhampton	0	0	0	0	0	0	0	0	0
Salmonella Worthington	0	0	0	0	0	0	0	0	0
Salmonella Yoruba	0	0	0	0	0	0	0	0	0
Salmonella Zanzibar	0	1	0	0	0	0	0	0	0
Salmonella arizonae	0	0	0	0	0	0	0	0	0
Salmonella bareilly	0	0	0	0	0	0	0	0	0
Salmonella bovismorbificans	0	89	0	1	0	2	2	0	0
Salmonella california	0	0	0	0	0	0	0	0	0
Salmonella choleraesuis	0	0	0	0	0	0	0	0	0
Salmonella derby	0	0	0	0	0	0	0	0	0
Salmonella dublin	0	0	0	0	0	0	0	0	0
Salmonella enterica	0	0	0	0	0	1	1	0	0
Salmonella enteritidis	0	6	0	1	0	1	0	0	0
Salmonella hadar	0	0	0	1	0	0	0	0	0
Salmonella havana	0	0	0	0	0	0	0	0	0
Salmonella hindmarsh	0	10	0	0	0	0	28	0	0
Salmonella houtenae	0	0	0	0	0	0	0	0	0
Salmonella infantis	0	0	0	0	0	0	0	0	0
Salmonella newington	0	0	0	0	0	0	0	0	0
Salmonella newport	0	0	0	0	0	0	0	0	0
Salmonella reading	0	4	0	0	0	0	0	0	0
Salmonella saintpaul	0	1	0	3	0	0	0	0	1
Salmonella senftenberg	0	2	0	0	0	0	0	0	0
Salmonella typhi	0	0	0	0	0	0	0	0	0
Salmonella typhimurium	6	118	0	7	10	5	5	1	0
Unspecified	0	1	1	1	1	3	0	0	1
Total	**6**	**294**	**1**	**19**	**12**	**13**	**66**	**1**	**5**

TABLE 3: Salmonid surveillance during 2016

Number of salmon farms visited	19
Number of farms with significant mortalities	0
Number of farms where significant infectious disease was detected through this programme	0

Laboratory examinations	No of farms	No of samples	No of positives
Viral cultures	19	1 980	0
Myxobolus cerebralis	10	660	0
Yersinia ruckeri	19	1 980	1*
Aeromonas salmonicida	19	1 980	0
Renibacterium salmoninarum	7	420	0

*The endemic strain of *Yersinia ruckeri* (serotype 01b) was isolated from one farm (serotyped by AAHL in Geelong, Australia)

TABLE 4A: Cumulative list of significant[*A] negative investigations of suspected exotic diseases 2008–2013

Disease agents investigated and confirmed as negative[1]	2010	2011	2012	2013	2014	2015	2016	Total
Aeromonas salmonicida (fish) *B			3		2		3	8
African horse sickness				2				2
Africanised honeybee (*Apis mellifera scutella*)/ cape bee (*Apis mellifera capensis*) *B	1	1				3		5
Akabane virus		2	1	1	1	1		6
Anaplasmosis			5	3	2	2	1	13
Anthrax	4	1	1	3	4	2	4	19
Avian influenza: highly pathogenic notifiable avian influenza and Newcastle disease *B	10	7	8	4	3	5	3	40
Avian influenza: low-pathogenicity notifiable avian influenza *B			6	2	2	1		11
Avian polyomavirus *C			1	2			2	5
Babesia canis, B. gibsoni, B. felis	5		5	2	1	1	2	16
Bluetongue		4	6		2	4	1	17
Brucella abortus	2	2	3	2	2	1	1	13
Brucella canis	4	6	8	6	5	9	12	50
Brucella melitensis			2		1	1	1	5
Bovine herpesvirus type 5		1	1	2	2			6
Bovine theileriosis/babesiosis (exotic strains)		2	3	6	1			12
Bovine viral diarrhoea type II	1	3	2		6	1	6	19
Burkholderia mallei (glanders) and B. *pseudomallei* (melioidosis)	1				1	2	1	5
Canine distemper virus	1		1	1	2	3	1	9
Canine influenza	1	1				2		4
Canine transmissible venereal tumour		2						2
Classical swine fever	1	1					1	3
Chlamydophila abortus (enzootic abortion)		1	1		1		2	5
Colony collapse disorder	4	2						6
Contagious agalactia		2					1	3

Table 4A continued

Contagious bovine pleuropneumonia	1		2	1			1	5
Ehrlichia canis	7	3	1	1	1		3	16
Equine piroplasmosis	8	5	2	3	2	3	1	24
Equine herpesvirus type 1 (abortion strains, neuropathogenic strains)	2		3	1	6	1	9	22
Equine infectious anaemia/equine viral arteritis	14	7	14	17	4	7	11	74
Equine influenza		2	1	2	3	2	2	12
European foulbrood (bees) *B	4	4	4	3	7	8	6	36
Exotic ticks		6		3	3	15	11	38
Fish/shellfish mortality (wild or managed, marine) – exclusion of exotic and novel infectious disease agents	6	4	6	5	4	11	2	38
Haemorrhagic septicaemia *(Pasteurella multocida* – toxogenic strains)	4	9	7	3		1	1	25
Heartworm *(Dirofilaria immitis)*		3	2			3	1	9
Hydatids *(Echinococcus* spp.*)*	3	1	1			1	4	10
Infectious bovine rhinotracheitis (exotic strains)		1	4	1		2	1	9
Infectious bursal disease	4	3	2	5	1	3	1	19
Israeli acute paralysis virus (bees) *B	2	2	3	1	3	7	1	19
Leishmaniasis	1	1	2				5	9
Leptospira (exotic strains)	1	1	2	1	3	1		9
Mycoplasma bovis	3	4	3	1	4		6	21
Mycoplasma mycoides mycoides (large colony)		1	2					3
Myxomatosis		1	1	2		1		5
Nosema ceranae (bees)	*C	1	1	1	2	2	2	9
Ornithobacterium rhinotracheale	2		2	1	1	*C		6
Perkinsus marinus and P. *olseni* (molluscs)		2	1	2	2		3	10
Porcine reproductive and respiratory syndrome	2	1			1	2		6
Poxviruses (ruminants and camelids)			4	1	1	2	1	9
Psittacine herpesvirus (incl. Pacheco's disease)				2			3	5
Pulmonary adenomatosis virus			2					2
Q fever (*Coxiella burnetti*)			3	1	2		2	8
Rabies	1		1	1				3
Rinderpest		1	2					3
Ross River virus		1	1				1	3
Salmonella (exotic strains)	2	2	4	4	2	1	1	16
Small hive beetle (*Aethina tumida*) (bees) *B	2	5	1		2	1	1	12
Slow paralysis virus, acute bee paralysis virus (bees) *B	2				1			3
Tracheal mite (*Acarapis woodi*) (bees) *B	2	3	2	1	3	9	3	23
Transmissible spongiform encephalopathy agents (scrapie, BSE, chronic wasting disease, FSE) *B		3	4	3	5	1	16	
Trichinella spiralis	1			1				2

Continued p. 17

Notes to Tables 4A and 4B

*A The investigations listed in Table 4A are those that have resulted in exclusion of an OIE-notifiable disease or other significant diseases investigated more than once in the time period. This is not a definitive list of all investigations conducted. Some investigations resulted in multiple exclusions using specific laboratory methods, and these are recorded against each disease. The data were retrieved and analysed from the Notification and Investigation Manager Application database. Regular quarterly investigation reports are published in *Surveillance*.

*B Investigations reported here are in addition to the tests in the MPI active surveillance programmes for these disease agents. See Roper (2015) (honey bee exotic pest and disease surveillance), Stanislawek *et al.* (2015) (avian influenza surveillance), Vink (2015) (TSE surveillance) and Table 3 above (salmon surveillance).

*C These previously exotic disease agents have become established in New Zealand, either during the year if indicated in a time column, or previously if indicated next to the disease agent name. They may remain the subject of exotic disease investigation for the purpose of describing an emerging disease, potential new animal host species, or as suspected new incursions.

*D These involved a single imported dog in each case. Biosecurity control measures were implemented to prevent transmission of the organisms. Vectors capable of transmitting these disease agents are not present in New Zealand (Bingham, 2016a and b).

*E These represent post-border incursions of an exotic tick species capable of vectoring disease. MPI biosecurity responses resulted in eradication of the organisms (Bingham, 2016b).

TABLE 4A: Cumulative list of significant[*A] negative investigations of suspected exotic diseases 2010–2016 (continued)

Disease agents investigated and confirmed as negative[1]	2010	2011	2012	2013	2014	2015	2016	Total
Tropilaelaps clareae and *T. koenigerum* (bees) *B	2	3	3	1		4	1	14
Tularaemia (*Francisella tularensis*)			1			2		3
Viral haemorrhagic septicaemia (fish)			1		1		1	3
Viral vesicular disease	6	12	7	5	4	9	16	59
West Nile virus	1	2	1		4	1	3	12
Total	**118**	**129**	**159**	**111**	**108**	**142**	**147**	**914**

TABLE 4B: List of significant positive investigations of suspected exotic diseases 2016

Disease agents/vectors investigated and confirmed as positive[1] (host species)	Number of positive investigations in 2016
Brown dog tick (*Rhipicephalus sanguineus*) *E	1
Lynxacarus radovskyi (cat)* F	1
Erhlichia canis (dog) *D	1
Leishmania spp. (dog) *D	1

*F This is a first report for this mite New Zealand (see reference below) (Buckle, 2016)

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Avian influenza surveillance programme

New Zealand's avian influenza surveillance programme is multi-faceted, incorporating active surveillance of resident wild birds, and enhanced passive surveillance. New Zealand has never had a case of highly pathogenic avian influenza virus (infection with influenza A virus of high pathogenicity in wild birds or poultry (World Organisation for Animal Health, 2016).

Wild bird surveillance

Since 2004 the Ministry for Primary Industries (MPI), in conjunction with the New Zealand Fish and Game Councils, the Department of Conservation and other stakeholders, has annually carried out surveillance for avian influenza viruses (AIVs) in targeted migratory and resident birds. The first 6 years of surveillance focused on migratory birds, in particular the bar-tailed godwit (*Limosa lapponica*), and red (lesser) knot (*Calidris canutus*), on their arrival each year from late September to November, at Miranda, their main North Island arrival site. These birds were targeted for surveillance because of their migration pathway, along which avian influenza viruses may be present: directly from the Arctic regions of Asia and North America in the case of the godwit, and from Arctic regions via the Pacific coast of Asia in the case of the knot. However, surveillance over this period indicated that migratory birds pose a very low risk for the introduction of high-pathogenicity avian influenza viruses into New Zealand, as no avian influenza virus was ever isolated. Since then, surveillance has been focused on resident birds, mainly waterfowl.

New Zealand is not on a migration pathway for waterfowl as observed in the northern hemisphere, although vagrant waterfowl from Australia are occasionally encountered. Nevertheless, since 2004, non-migratory waterfowl, predominantly mallard ducks (*Anas platyrhynchos*) have also been sampled in the summer months throughout New Zealand, with a particular focus on coastal areas where they might have had contact with migratory shorebirds.

In 2016, cloacal and oropharyngeal swabs were collected from 963 healthy resident mallard ducks (**Table 1, Figures 1 & 2**). A Fish & Game banding programme provided a convenient opportunity for MPI to collect samples from ducks for avian influenza surveillance at the same time. Individual bird samples were tested by the influenza A real-time RT-PCR TaqMan assay (Spackman *et al.,* 2003) with modified primers to accommodate genomic changes in matrix gene of some avian influenza viruses circulating in birds in the Asia and Pacific regions. Positive or suspect samples were then tested using real-time H5 and H7 RT/PCR TaqMan assay (Slomka *et al.*, 2007; Sidoti *et al.,* 2010) and conventional H5, H7 RT-PCRs to obtain genomic information.

TABLE 1: Active surveillance for avian influenza viruses in wild birds, 2016

Location	Number of mallard ducks sampled	Number of samples tested (cloacal & oropharyngeal)	Number of RT/PCR positives		Confirmed H5 or H7 isolates
			H5	H7	
Kerepihi, Hauraki Plains, Waikato	320	640	131*	0	0
Mouth of Kaituna River, Bay of Plenty	320	640	21*	0	0
Gisborne and Wairoa, Hawke's Bay	194	388	0	0	0
Lake Te Rotokare, Hawke's Bay	129	258	11*	0	0
Total	**963**	**1 926**	**163**	**0**	**0**

*The amino acid pattern of the HA cleavage site was consistent with low-pathogenic H5 viruses in all of the examined samples.

Influenza A RNA was detected in 79.2 percent of the 963 ducks sampled (cloacal, oropharyngeal or both samples), a much higher incidence than in the previous year (33.5 percent). Influenza subtype H5 RNA was confirmed in 163 samples from three locations in North Island, but no H5 viruses were isolated. This was the highest number of H5-positive samples ever detected in wild ducks in one year in New Zealand and also coincided with very high prevalence of AIV. Unfortunately no H5 virus was isolated and this is probably due to a low titre and/or viable virus in the original sample, or variable fitness of these strains for culture in embryonated eggs. Mixed infection with other AIVs could also have contributed (Lindsay *et al.*, 2013). No influenza subtype H7 was found in the samples collected in 2016.

Selected H5-RNA-positive samples were examined by partial HA genome sequencing. The amino-acid pattern of the HA cleavage site of all examined samples was consistent with low-pathogenic H5 strains. The results are summarised in **Table 1**.

To obtain information on AI virus subtypes other than H5 and H7 circulating in mallard ducks in New Zealand, virus isolation was also carried out on a random selection of the remaining influenza A RT/PCR-positive samples, and the influenza virus subtypes H3, H4, H10 and H11 were isolated.

Figure 1: AHL Senior Technician Maree Joyce (left) and Incursion Investigator Kelly Buckle collecting samples from wild ducks, Kaituna River mouth

Figure 2: Wild ducks penned in wire mesh cages await processing by Fish & Game staff for banding programme and MPI AI surveillance, Gisborne area

Enhanced passive surveillance

MPI operates a 24/7 toll-free exotic pest and disease emergency hotline and receives calls relating to sick and dead wild and domestic birds from members of the public, veterinarians, regional laboratory pathologists and others. Where reports relate to native birds, they are handled collaboratively with the Department of Conservation.

A risk assessment determines the need to investigate the report further. Key information used in the profile includes:

- history of the event: numbers affected and timeline of events;
- signs observed in dying birds;
- species of bird/s affected;
- availability of fresh samples (where unavailable, follow-up is instigated);
- location; and
- epidemiological trends over space and time.

Based on the risk assessment, the investigation is either stood down or expanded to look for a potential exotic or emerging disease aetiology.

A rapid field service is in place for sample collection and submission of unexplained bird deaths (Rawdon *et al.,* 2007), using MPI-approved suppliers. A standardised investigation protocol co-ordinated by the AHL (Wallaceville) is applied to submissions. This includes necropsy and sample collection for histology, bacteriology and virology. The presence of avian influenza is assayed using influenza A real-time RT-PCR TaqMan (Spackman *et al.,* 2003), with follow-up using real-time H5 and H7 RT/PCR TaqMan assays to exclude H5 and H7 subtypes (Slomka *et al.*, 2007; Sidoti *et al.,* 2010). Virus isolation is performed on samples that are positive in PCR assays (Stanislawek *et al.,* 2002).

Reports on avian disease and mortality investigations are published quarterly in *Surveillance* as part of the IDC report of suspect exotic disease investigations. In 2016, eleven such investigations were conducted (**Table 2**). No H5 or H7 viruses were isolated from any of the samples submitted for these investigations, and in all cases exotic disease was excluded.

MPI also collects data from approved veterinary diagnostic laboratories on avian submissions from veterinary practitioners. **Table 3** summarises submission data from across the MPI passive surveillance system (Watts *et al.*, 2016).

TABLE 2: Avian mortality reports and investigations, 2016

Month	Reports	Investigations
January	1	1
February	4	1
March	4	0
April	4	4
May	1	0
June	2	0
July	3	2
August	2	0
September	1	1
October	1	0
November	2	2
December	0	0

TABLE 3: Table 3: Avian submissions to MPI's passive surveillance system, 2004–2016

Year	Submissions from approved veterinary diagnostic laboratories	Submissions via MPI 0800 number	MPI investigations
2004	116	30	8
2005	340	85	8
2006	360	154	24
2007	33	60	14
2008	120	37	10
2009	163	*151	7
2010	174	25	7
2011	142	19	7
2012	290	19	8
2013	664	19	6
2014	385	30	13
2015	503	45	14
2016	824	28	11

*This aberration was due to a toxicity event in August of that year, involving grey side-gilled sea slugs (*Pleurobranchaea maculata*) in the Auckland region.

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Wildlife disease surveillance

Wildlife surveillance is an important part of New Zealand's national surveillance system for exotic and emerging pests and disease. The purpose of the Ministry for Primary Industries (MPI)'s wildlife surveillance programme is to:

- facilitate early detection of exotic and emerging diseases;
- support New Zealand's statements of freedom from specific pests and diseases;
- provide baseline information on endemic disease occurrence in New Zealand wildlife; and
- support fulfilment of New Zealand's international reporting obligations.

The MPI national exotic pest and disease notification system provides for the reporting and investigation of unusual disease events in all animals, including wildlife. The MPI pest and disease emergency hotline (0800 80 99 66) helps New Zealanders to meet their obligations under section 44 of the Biosecurity Act 1993, which requires every person to report to MPI any suspected cases caused by organisms not normally seen or otherwise detected in New Zealand. This enables the appropriate investigation of suspected cases of exotic or emerging diseases that are identified in wildlife by organisations or individuals working outside of MPI surveillance programmes.

In addition to investigating reported events, MPI undertakes annual active surveillance in wild birds for avian influenza viruses (see Avian influenza surveillance programme report, page 18) and monitoring of routine disease diagnoses by veterinary diagnostic laboratories to detect possible indications of occurrence that may indicate an emerging disease requiring further investigation. MPI receives anonymised commercial laboratory summaries from feral animals, captive animals and wild native animals meeting a sick animal case criterion. Reports of particular interest are summarised in the quarterly articles reviewing diagnostic cases in each edition of *Surveillance*.

Alongside MPI's wildlife activities, causes of mortalities of threatened or critically endangered native species are monitored by the Department of Conservation (DOC), as part of a DOC contract undertaken by Wildbase Pathology (part of the Institute of Veterinary, Animal and Biomedical Sciences, or IVABS, at Massey University, Palmerston North). Certain animals found dead in the field or in captive facilities are sent to the laboratory for post-mortem examination by veterinary wildlife pathologists and the results held in the Huia database at IVABS.

Details of wildlife cases held in the Huia wildlife disease database and investigated by MPI disease investigators over the previous year are discussed below.

Wildlife cases processed by veterinary laboratories

Records of wildlife mortality are held in the Massey Pathology and Huia wildlife disease databases, jointly owned by DOC and Massey University and maintained by Wildbase Pathology at IVABS. Most cases involve mortalities in indigenous birds, in particular threatened species submitted by DOC for diagnosis by Wildbase Pathology. These databases also hold some case records from surveillance activities, private veterinary laboratories and researchers. **Figure 1** shows numbers of avian cases compared to numbers of cases involving other types of wildlife from 2012 to 2016. The number of avian cases submitted in 2016 decreased slightly compared to 2015 and comprised 88 percent of all submissions, with native lizards (skinks and geckos) 4 percent, tuatara (*Sphenodon* spp.) 2 percent, cetaceans (whales and Hector's dolphins, *Cephalorhynchus hectori*) 1 percent, pinnipeds (mainly NZ sea lions, *Phocarctos hookeri*) 1 percent, amphibians 1 percent, and native fish and bats < 1 percent. Other wild mammals (mustelids and rabbits) totalled just over 2 percent.

Mortalities of both juvenile and adult yellow-eyed penguins or hōiho (*Megadyptes antipodes*) continued to be of concern in the coastal Otago region. Predation by mustelids and dogs was the main cause of mortalities of kiwi (*Apteryx* spp.). Mustelid predation of blue ducks or whio (*Hymenolaimus malacorhynchos*) occurred in several areas during re-introduction programmes. There was an increase in the number of lizard and tuatara necropsies performed and a moderate decrease in the number of marine mammal, native fish and bat necropsies.

Figure 1: Numbers of wildlife cases in birds and other taxonomic groups recorded in the Massey Pathology and Huia Wildlife Disease databases, 2012–2016

Disease surveillance of highly threatened species such as kakapo (*Strigops habroptila*), black stilt (*Himantopus novaezelandiae*), hihi/stitchbird (*Notiomystis cincta*) and the endangered species and subspecies of kiwi, continued throughout the year. A small number of wild introduced birds were examined because of the interest in preventing transmission of diseases such as malaria, beak-and-feather disease and salmonellosis from introduced birds to native species.

The geographic distribution of avian wildlife cases examined in 2016 is shown in **Figure 2**. The highest numbers of cases submitted were from the Manawatu/Whanganui, Wellington and Otago regions. Cases from the Manawatu/Whanganui region included those from the National Wildlife Centre at Mt Bruce/Pukaha, and Tongariro National Park. The Wellington submissions included those from Wellington Zoo, Zealandia, Mana Island, Kapiti Island and the Chatham Islands.

Otago submissions included those from the highly endangered population of yellow-eyed penguins of coastal Otago. Waikato cases included those from Otorohanga, Mangatautari and Hamilton Zoo. The Canterbury region contains Mt Cook National Park as well as captive breeding centres for threatened species at Twizel, Willowbank and Peacock Springs. Many cases submitted from the Auckland region were of threatened species from offshore islands including Tiritiri Matangi, Motutapu and Ponui. Moderate numbers of cases were submitted directly from locally administered wildlife sanctuaries, including Bushy Park, Mangatautari, Cape Kidnappers and Zealandia.

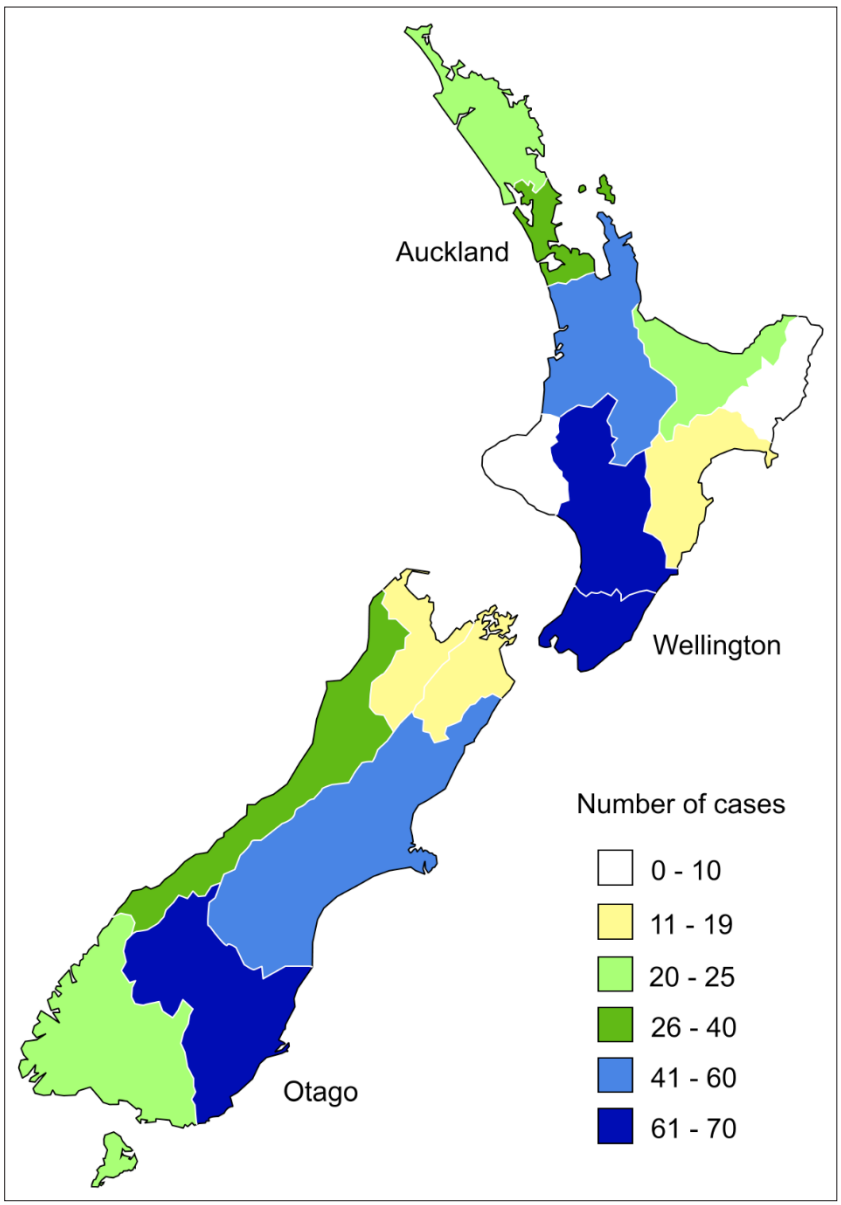

Figure 2: Number of avian cases submitted to Wildbase Pathology in 2016 by region

Wildlife cases of special interest in 2016

Respiratory aspergillosis in endangered native birds

Respiratory aspergillosis continues to be a common cause of mortality in endemic New Zealand birds. The numbers of some species affected (e.g., kiwi and penguins) varies markedly between years, while certain other species including hihi (*Notiomystis cincta*), kakariki (*Cyanoramphus* spp.) and shore plover (*Thinornis novaeseelandiae*) are more consistently affected (**Figure 3**).

Until recently, kiwi held in captive facilities have been prominent among aspergillosis cases, with 17 cases reported between 1997 and 2011. Most of the affected birds were held in enclosures with a soil base that was usually planted with native vegetation and contained leaf litter brought in to provide ground cover and encourage foraging. Low levels of *Aspergillus fumigatus* spores were detected in almost all kiwi houses sampled in 2012, but in several instances the levels were high (Glare *et al.*, 2014). However, since 2013, no aspergillosis cases have been recorded in kiwi.

In yellow-eyed penguins, however, numerous cases of aspergillosis have been seen during the last 3 years. The birds affected have been mainly adults brought into care after leg and flipper injuries (Hunter *et al.*, 2016). These birds were clearly stressed, initially from trauma in the wild, then from treatment and handling in their captive environment; some were also infected with avian malaria.

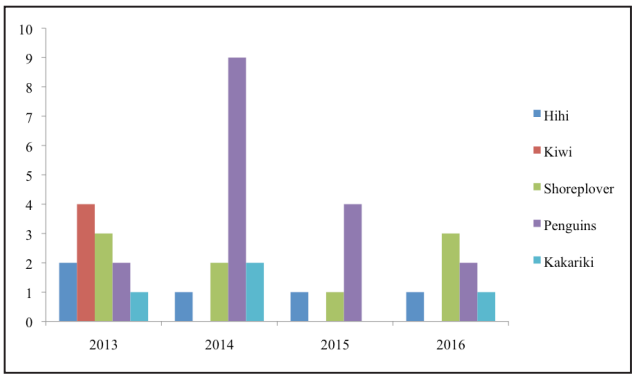

Figure 3: Cases of respiratory aspergillosis in some endangered birds necropsied at Wildbase Pathology, 2013–2016

The recurring aspergillosis mortalities seen in hihi, kakariki and shore plover have occurred in both free-living birds and birds held in large, open and well-ventilated enclosures that would seem unlikely to harbour high numbers of fungal spores. This suggests that these species are particularly vulnerable to infection, possibly owing to immunosuppression caused by environmental or nutritional stress. There is also the possibility that some of these endangered species may possess decreased immunocompetence through having experienced a breeding bottleneck during translocation or captive rearing.

Metabolic bone disease in kaka from urban Wellington

The Zealandia wildlife sanctuary now provides an overflow of birds, particularly kaka (*Nestor meridionalis septentrionalis*), into the surrounding parks and residential gardens of Wellington. Many city gardens have proven to be rich in natural foods and nesting cavities, and most local residents greatly enjoy the presence of the birds in their gardens. Unfortunately this has led to the feeding of birds with unsuitable foods such as cheese, nuts and various grains including corn and maize. Many of these common foodstuffs have a ratio of phosphorus to calcium that is too high for rapidly growing birds – for example corn 25:1 and cashew nuts 16:1, when the ideal ratio is about 1:2 (Roudybush, 1997). Such feeding may cause hypocalcaemia and osteoclastic bone resorption followed by replacement of bone with fibrous connective tissue. In a survey of Wellington residents whose gardens were visited by kaka in 2012, 22 percent admitted to feeding common household foods to the wild birds (Linklater, 2016).

The natural diet of kaka consists of fruit, nectar, invertebrates and sap obtained by removing bark from trees, and the birds' nutritional status is likely to be a limiting factor in their reproductive success (Beggs & Wilson, 1991). In an urban setting, exotic trees such as conifers and eucalypts are significantly more likely to be damaged than native trees (Charles & Linklater, 2014). Kaka chicks spend a long period (more than 10 weeks) in the nest before fledging, and during this time they are completely reliant on food obtained by their parents.

The affected kaka (see **Table 1, page 24**) were all juveniles or fledglings and were observed to be in poor body condition. They displayed a variety of beak and limb deformities. Some showed weakness, abnormal stance, difficulty in walking and had broken feather shafts on the wings and tail. Some had severe limb deformities and multiple limb fractures, necessitating euthanasia. One affected chick was found dead in its nest, and another on a walkway. Radiographs of the affected birds showed a range of lesions, including poor bone density, bowing of long bones, folding and other fractures of long bones, excessive spinal curvature, and malformed synsacrums and sternums.

On gross post-mortem examination many of the birds had beak deformities, with softening of the premaxillae and mandibles, which were easily bent (**Figure 4**). Many long bones were affected, particularly the tibiotarsi, which were often rotated or deviated and malleable to digital pressure. Folding fractures, sometimes multiple, were also seen in many long bones. These abnormalities are summarised in **Table 1.**

Histopathology of samples of abnormal bone showed variable thinning of cortical bone, but most of the trabecular bone spicules, and the endosteal surface of the cortical bone, were covered in thick osteoid in often disorganised seams containing plump osteocytes. There was an increase in both osteoblast and osteoclast activity in the marrow, particularly around the primary spongiosa, and replacement by abundant loose connective tissue. There were often several small islands of hypertrophied chondrocytes bordered by both mineralised bone and osteoid within the primary spongiosa.

Figure 4: An affected juvenile kaka showing a "scissor beak" deformity. Photograph by Stuart Hunter

The re-introduction of kaka to Wellington does have the potential to provoke a human/wildlife conflict, as pointed out recently by Linklater (2016), who suggested that kaka should be removed, or at least reduced in numbers, from Wellington city gardens mainly because of the damage they do to exotic trees. This opinion provoked an outcry from many Wellingtonians, 80 percent of whom are reported to enjoy having the birds around their homes (Linklater, 2016). However, the development of metabolic bone disease in kaka indicates that Wellingtonians should be discouraged from providing artificial foods for the birds.

Tuberculosis in wild birds and marine mammals

Several cases of avian tuberculosis have now been seen in Australasian harriers (*Circus approximans*) in New Zealand. The mycobacteria have caused granulomatous lesions in the feet (Hunter & Alley, 2014) and in the oral cavity (Alley *et al*., 2004). In 2016, a wild harrier from Canterbury was seen to lose weight and died soon after arrival at the vet clinic. At necropsy it was found to have numerous granulomatous lesions in the lungs, liver and mesentery, which contained many intralesional acid-fast-staining rods. The route of infection in this case could not be determined but it is assumed to be from eating the infected carcasses of backyard poultry, wild game birds and other birds. Advanced avian tuberculosis was also found in an aged pukeko (*Porphyrio melanotus*) that was kept in captivity with two weka (*Gallirallus australis*), both of which had intestinal avian tuberculosis.

Two further cases of tuberculosis were seen in New Zealand sea lions from the Otago coast during 2016. The lesions seen were similar to previous cases of tuberculosis seen in South Island and Auckland Islands marine mammals and are caused by *Mycobacterium pinnipedi* (Cousins *et al*., 2003; Duignan, 2003). This same organism was also responsible for tuberculous granulomas found in a Hector's dolphin that was found dead near Kaikoura.

TABLE 1: Cases of metabolic bone disease in kaka confirmed by post-mortem examination at Wildbase Pathology, 2008–2016

Bird No	Year	Month examined	Age of bird	Lesions
1	2008	January	Neonate	Unstable tarsal joints. Healed tibiotarsal fractures.
2		December	Juvenile	Severe generalised fibrous osteodystrophy.
3	2011	December	3–5 weeks	Splayed legs. Rotational (tibiotarsal) deformities.
4		December	3–5 weeks	Splayed legs. Rotated legs. Dislocated stifle(s).
5	2013	December	3–4 weeks	Osteopenia. Folding fractures in multiple bones.
6		December	Juvenile	Generalised limb deformities.
7	2015	November	Juvenile	"Scissor beak" deformity.
8		December	Juvenile	Severe generalised limb deformities.
9		December	Juvenile	Severe generalised limb deformities.
10	2016	January	Fledgling	Malleable bones. Rotational limb deformities.
11		January	Fledgling	Malleable long bones. "Scissor beak" deformity.

Wildlife cases notified via the MPI exotic pest and disease hotline

Exotic causes of disease were ruled out in all wildlife investigations conducted by MPI in the past year.

MPI investigates cases of mass mortality in wild birds, and this year several such events were reported. In one case, a DOC ranger in the Firth of Thames reported paralysis affecting a variety of wild birds over about 3 weeks in late January and early February. The syndrome included progressive paralysis of the hind limbs, spreading to involve the head and neck and resulting in death. The birds remained alert and continued to eat before developing the final stages of paralysis. Although predominantly waterfowl (mallards and paradise ducks) were killed, a number of shorebirds were also affected, predominantly ruddy turnstones (*Arenaria interpres*), red knots (*Calidris canutus*), banded dotterels (*Charadrius bicinctus*), pied oystercatchers (*Haematopus ostralegus*) and black-backed gulls (*Larus dominicanus*). Eight birds showed clinical disease: three mallard ducks, (*Anas platyrhynchos*), a paradise shelduck (*Tadorna variegata*), a red knot, a banded dotterell, a wrybill (*Anarhynchus frontalis*) and a godwit (*Limosa lapponica*). These were submitted to Wildbase Pathology for post-mortem examination. No significant gross or histological lesions were identified in any of the birds. The absence of haemorrhage or inflammatory lesions in major organs excluded exotic viral diseases. Botulism was suspected because of the clinical presentation, season (very low recent rainfall associated with an El Nino summer) and locality (the Firth of Thames has previously experienced similar large-scale botulism events). Botulism is a difficult disease to confirm, and testing for *Clostridium botulinum* toxin genes by PCR failed to detect the agent. Direct toxin testing was unavailable, which would have been more biologically sensitive, but nevertheless botulism was considered the most likely cause of this outbreak.

In April, an outbreak of suspected toxicity in captive ducks was reported from a Gisborne lifestyle block. On the first day, one duck died, followed by six the next day. Clinical signs included flaccidity followed by death. The farm veterinarian noted that the feed bag was almost empty, and suggested a change of feed and frequent changing of water dishes. Unfortunately, no samples were available at the time of notification. No further ducks became ill, so epidemiologically this was considered to be a toxic point exposure such as botulism or aflatoxicosis, rather than a propagating disease.

Three suspected cases of Pacheco's disease (psittacine herpesvirus) were reported and ruled out during the year. In one, three juvenile parrots had been bought recently and two had become ill, with one dying. Histology on the liver of the dead bird found multifocal necrosis with intranuclear inclusion bodies. Polyomavirus PCR testing had already been conducted and was negative. DNA from blood samples was available from the two live parrots, and fixed liver from the dead one, but Pacheco's disease PCR was negative for all three. PCR for adenovirus, for which hepatic intranuclear inclusion bodies are also characteristic, was positive on the liver sample. The DNA product was sequenced

to psittacine adenovirus 1. A number of avian adenoviruses of fowl are endemic in New Zealand poultry, and a serological survey of pigeons in New Zealand found that positive titres were common in all the areas sampled (Black et al 2004). There have also been suspect cases of adenovirus in parrots, including a 2010 MAF Biosecurity New Zealand exotic disease investigation into an African grey parrot (*Psittacus erithacus*) with a positive psittacine adenovirus PCR result and consistent histopathology. However, the present investigation appears to be the first characterisation through sequencing of psittacine adenovirus in parrots in New Zealand. In a second case, a Derbyan parrot (*Psittacula derbiana*) had histological evidence of hepatitis and splenitis, with inclusion bodies present. The bird had appeared healthy before dying, and had no obvious cause of death at gross postmortem. PCR tests at the IDC (Wallaceville) for the exotic differentials Pacheco's disease, avian polyomavirus and psittacine adenovirus were all negative. A third case, in November, involved an aviary with hand-reared cockatoos. Over a 3-week period 10 of 17 cockatoos aged between 3 weeks and 3 months died. Five birds were submitted to a regional laboratory. Hepatomegaly was a feature of gross postmortem, with necrotising hepatitis and intranuclear inclusion bodies identified in hepatocytes on histopathology. While the inclusion bodies were probably due to an avian adenovirus, Pacheco's disease is an exotic differential for inclusion body hepatitis. Liver samples from necropsied birds and cloacal swabs from in-contact birds were submitted to the AHL, where PCR testing ruled out Pacheco's disease. Further PCR testing confirmed the diagnosis of adenovirus, which sequencing identified as psittacine adenovirus 1. Psittacine adenovirus, and more specifically psittacine adenovirus 1, have previously been recorded in New Zealand (Bingham 2010; Bingham 2017). Exotic disease was ruled out and the investigation closed.

In addition to avian disease, MPI receives notifications of unusual lesions in wild game. In June a case of suspected hydatidosis in a feral pig was reported by a pig hunter from Northland. Hydatid disease, caused by *Echinococcus granulosus*, is exotic to New Zealand, having been eradicated. Another exotic cause of cysts can be the tapeworm *Cysticercus cellulosae/Taenia solium*. Endemic causes of the lesions include parasitism (e.g., from migrating roundworms such as *Ascaris suis*) and tuberculosis. During sampling it was noted that the liver contained about 20 solid to cystic pale nodules 1–3 cm in length scattered throughout the parenchyma. Culture of the frozen and thawed samples yielded moderate mixed bacterial growth that was considered insignificant. Histopathology showed that the lesions consisted of a predominantly eosinophilic infiltrate containing occasional parasite sections consistent with larval trematodes (flukes). As part of the life cycle, young flukes migrate through the liver parenchyma before reaching the biliary tract, where they mature. It was considered most likely that this was a case of normal parasite migration through the liver of this pig.

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Transmissible spongiform encephalopathies (TSE) surveillance programme

New Zealand is free from the main TSEs, namely bovine spongiform encephalopathy (BSE) of cattle, classical scrapie of sheep and goats, and chronic wasting disease (CWD) of deer. The TSE surveillance and risk management measures implemented in New Zealand have been described in previous annual reports (e.g, Vink, 2016). Surveillance for CWD is not mandated by the World Organisation for Animal Health (OIE), but is carried out to assure New Zealand's trade partners of freedom from this disease.

A combination of passive and active surveillance activities are performed for the three abovementioned TSEs. The passive surveillance programme consists of a targeted scheme under which veterinary practitioners submit brain material from animals showing clinical signs of neurological disease. The veterinarians and farmers are compensated for supplying the samples. Testing is performed by histopathology at accredited veterinary diagnostic laboratories. When histopathology cannot rule out a TSE diagnosis, an IDEXX TSE enzyme immunoassay (EIA) (IDEXX Laboratories Inc., Westbrook, Maine, USA) test is done at MPI's Investigation and Diagnostic Centres (IDCs). **Table 1** shows the numbers of samples tested in 2016.

New Zealand performs type B surveillance for BSE as specified by Chapter 11.4 of the OIE Terrestrial Animal Health Code (OIE, 2017a). BSE points have been accumulated since 2005 and New Zealand has consistently maintained well in excess of the required 150 000 points. BSE testing in 2016 generated 36 533 BSE points and all tests were negative.

The numbers of samples submitted under the incentivised passive surveillance programme have declined since 2005. Specifically, the number of deer submissions for CWD declined sharply in 2008 following the imposition of a maximum of two submissions per farm per year. The annual sample numbers have remained more or less stable since 2009 **(Figure 1)**. Although samples are submitted year-round, there is a clear seasonal trend, with a peak from July to September **(Figure 2)**. To complement the low submission numbers for classical scrapie and CWD, active surveillance has been performed since 2010. Samples from normal adult animals sent to slaughter were routinely collected from meat processing plants across the country. In 2016, 320 sheep and 336 deer were tested; these numbers were based on a sample size calculation designed to detect disease at a low prevalence in the population. All samples tested negative. The farms of origin of the sampled sheep and deer demonstrated reasonable geographic spread across the North Island as well as the South Island, which appeared to be representative of the underlying farm density **(Figure 3)**.

In October 2009, the first detection of a case of atypical scrapie/Nor98 in a New Zealand-born sheep was

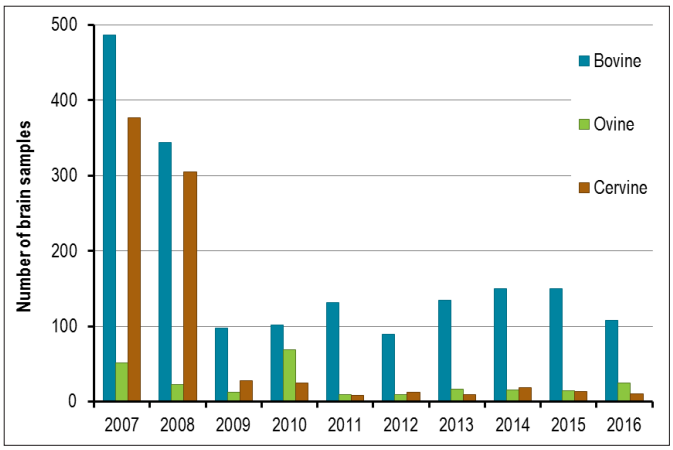

Figure 1: Numbers of brain samples tested for BSE, scrapie and CWD under the incentivised passive surveillance scheme from 2007 to 2016

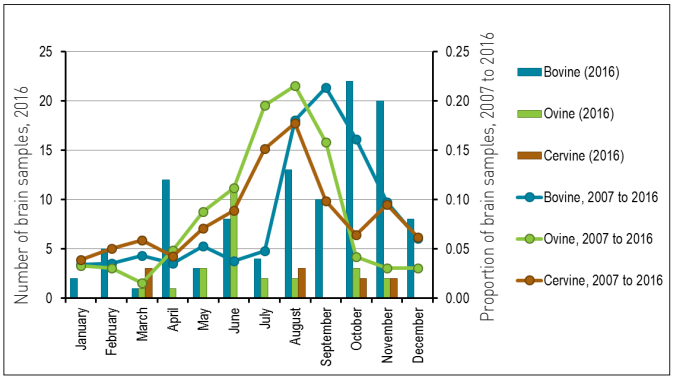

Figure 2: Numbers of brain samples tested for BSE, scrapie and CWD under the incentivised passive surveillance scheme during 2016 (left axis, bars), and trend by calendar month of samples submitted from 2007 to 2016 (right axis, lines)

TABLE 1: Numbers of samples tested for transmissible spongioform encephalopathies (TSEs) in 2016, by passive and active surveillance

			Source of test tissue		Surveillance stream
Species	**Tissue**	**Test type**	**Routine surveillance**	**Imported animal**	
Cattle	Brain	Histopathology	108*	–	Passive
		IDEXX TSE ELISA	2	0	Passive (rule-out)
Deer	Brain	Histopathology	10	–	Passive
		IDEXX TSE ELISA	0	0	Passive (rule-out)
	MRLN†	IDEXX TSE ELISA	336	–	Active
Sheep	Brain	Histopathology	25	–	Passive
		IDEXX TSE ELISA	0	0	Passive (rule-out)
	MRLN	IDEXX TSE ELISA	320	–	Active

* This level of testing earned 36 533 surveillance points for BSE in accordance with Chapter 11.4 of the 2013 OIE Terrestrial Animal Health Code. These points are calculated from clinical suspect and fallen stock cases submitted by veterinary practitioners under the surveillance programme.

† Medial retropharyngeal lymph node

confirmed (Kittelberger & McIntyre, 2009; Kittelberger *et al.*, 2010). MPI strongly supports the view of the World Organisation for Animal Health (OIE) that atypical scrapie is "clinically, pathologically, biochemically and epidemiologically unrelated to 'classical' scrapie, may not be contagious and may, in fact, be a spontaneous degenerative condition of older sheep" (OIE, 2017b), and considers it to be a negligible biosecurity risk (Vink & McIntyre, 2014). The sensitivity of detection of the prion causing classical scrapie is higher in lymphoid tissue than in brain tissue, and the atypical scrapie/Nor98 prion is not detected in lymphoid tissue (Meloni *et al.*, 2012). Research at the IDC showed that testing of medial retropharyngeal lymph node (MRLN) tissue from sheep and goats with the IDEXX TSE test had high diagnostic sensitivity and specificity (Kittelberger *et al.*, 2014). As the active surveillance programme specifically targets classical scrapie, the MRLN samples of sheep and deer taken were analysed using this test.

The design and implementation of TSE surveillance will continue to be informed and refined by requirements and guidelines determined by the OIE, new knowledge, tests, standards and market access needs.

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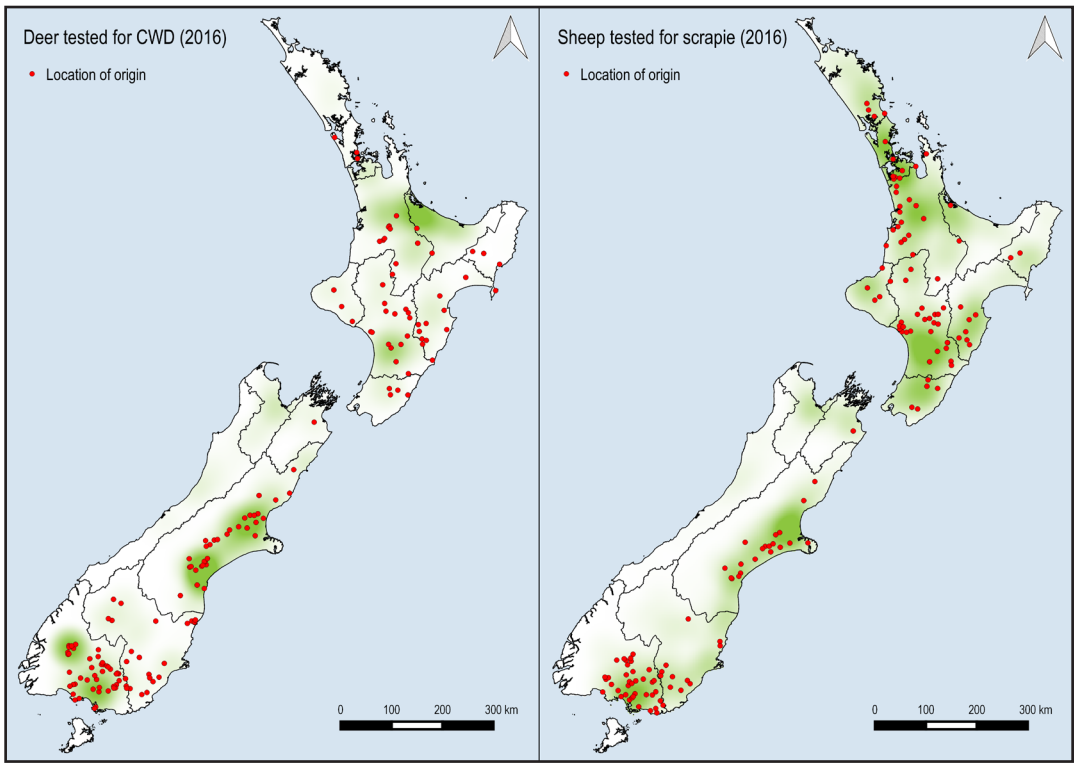

Figure 3: Locations of farms submitting sheep samples for classical scrapie (left; n = 161) and deer samples for CWD (right; n = 170) during 2016. Up to two animals were sampled per location. The underlying heatmap represents the density of farms with sheep and deer respectively (source: FarmsOnLine)

Arbovirus surveillance programme

Introduction

The arbovirus surveillance programme was instigated in 1991 to provide assurance of New Zealand's freedom from arboviruses, particularly bluetongue virus, which affect sheep and cattle. Other arboviruses of veterinary concern include epizootic haemorrhagic disease virus and Akabane virus.

Arboviruses are taxonomically diverse but their general characteristics include infection of vertebrates. They replicate in and are spread by insect vectors in the biting midge genus *Culicoides* (Diptera: Ceratopogonidae) (Ryan *et al*., 1991) (**Figure 1**). New Zealand is the only place in the world apart from Antarctica where the *Culicoides* genus is not present. However, there is a low likelihood that the route of introduction to New Zealand would be through windborne dispersal of the vector species *C. brevitarsis* from Australia owing to its wider distribution, high abundance and documented dispersal capability (Burgin *et al*., 2013). Studies of other arthropod incursion events suggest that *C. brevitarsis* could be blown from Australia to New Zealand in the predominant westerly winds of the region (Burgin *et al*., 2013).

In New Zealand, *C. brevitarsus* and *C. wadai* are of particular importance owing to their tolerance of cooler environments (Ryan *et al*., 1991) and are likely to establish in some parts of New Zealand.

The surveillance strategy has three components:

- an early warning system for reporting suspicious cases;
- herd testing; and
- vector surveillance.

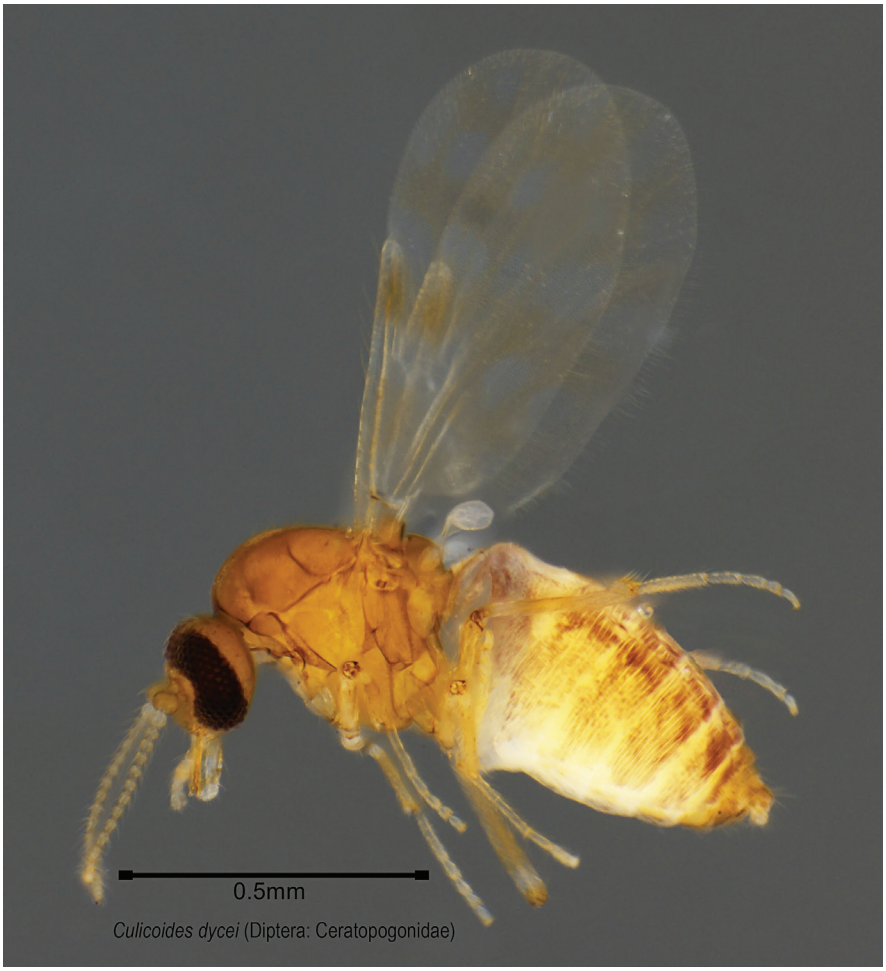

Figure 1: Blood-feeding *Culicoides dycei* (Photo: Carol Muir, MPI Plant Health & Environment Laboratory, Christchurch)

Early warning system

The Ministry for Primary Industries maintains an exotic pest and disease hotline that enables early reporting of suspected new to New Zealand pests and diseases. This can be used to report suspicious cases of diseases in farm animals. Exotic terrestrial animal pest and disease investigations are managed by MPI's Diagnostic & Surveillance Services Directorate, Wallaceville.

Herd testing

During 2017 blood was collected from 640 cattle on 32 farms in four districts that are considered to be most favourable for survival and establishment of *Culicoides* spp. These are the areas where cattle would most likely be infected if the vector was present. Blood samples were taken for serological testing after the possible period of virus transmission.

Vector surveillance

Light traps for vector surveillance have been placed in areas around New Zealand where wind-blown dispersal and subsequent establishment are likely. The traps attract the winged adult midges as they fly during dawn and dusk. They also catch other insects that are of no consequence. Catches are examined under a microscope to confirm absence of *Culicoides* spp.

There were 12 light traps on cattle farms operating this season. The traps contained green light-emitting diodes to maximise trapping efficiency (Bishop *et al*., 2004, 2006). Vector surveillance was undertaken from February to April inclusive, the period during which conditions are considered most favourable for midge activity. Ideal trapping nights are when the overnight temperature does not fall below 14°C. Traps are not deployed during weeks of the full moon, whose light would compete with the light attractant. The light traps are run on three consecutive nights of each selected week.

Test results

The aim of herd testing is to detect serological evidence of exposure to

bluetongue, epizootic haemorrhagic disease and Akabane viruses. All 640 blood samples sent to the Animal Health Laboratory, Wallaceville, tested negative for antibodies to epizootic haemorrhagic disease virus by the agar-gel immunodiffusion test and also tested negative to Akabane virus and bluetongue virus antibodies by enzyme-linked immunosorbent assay.

Insect samples were processed by MPI's Plant Health and Environment Laboratories in Auckland and Christchurch. It was estimated that 337 711 insects were screened, but no *Culicoides* spp. were found. There were 102 native midges (Ceratopogonidae) trapped, which suggests that the traps ought to catch *Culicoides* sp. if these are present in New Zealand. This year the traps caught fewer native Ceratopogonidae than in the previous season, which may reflect the adverse weather events experienced in many parts of the country in late autumn.

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Honey bee exotic pest and disease surveillance report

This report summarises surveillance activities for the year 1 July 2016 to 30 June 2017.

Honey bee exotic disease surveillance is conducted by AsureQuality Ltd on behalf of the Ministry for Primary Industries (MPI). It is a multifaceted programme consisting of:

- hive inspection and sampling;
- maintaining records of beekeepers, apiaries, hives and bee diseases in an apiary database;
- carrying out beekeeper extension and education;
- screening and investigating exotic bee disease enquiries; and
- reporting on activities and findings.
- Surveillance is conducted for the following exotic honey bee diseases and pests:
- European foulbrood (*Melissococcus plutonius*);
- small hive beetle (*Aethina tumida*);
- the parasitic fly (*Braula coeca*);
- tracheal mite (*Acarapis woodi*);
- Asian mites (*Tropilaelaps clareae* and *T. koenigerum*);
- African and Africanised honey bee (*Apis mellifera scutellata*);
- Cape honey bee (*Apis mellifera capensis*);
- other exotic *Apis* species (e.g., the Asian honey bee, *Apis cerana)*; and
- bee viruses such as Israeli acute paralysis virus (IAPV).

Hive inspection and sampling

The hive inspection and sampling programme has three components:

- high-risk-area inspection and sampling;
- sampling of adult bees from apiaries supplying bees for export; and
- investigation of suspect exotic honey bee diseases.

High-risk areas

Throughout New Zealand, 19 geographic areas – 12 in the North Island and seven in the South Island – have been classified as high risk because they have the greatest potential for entry of exotic honey bee diseases and pests. They include ports, airports, Transitional Facilities, cities, tourist destinations and areas of high hive concentration (e.g., kiwifruit-growing areas). Four of these high-risk areas (Auckland, Wellington, Christchurch and Dunedin) have received further analysis and had "elevated high risk zones" identified within the high-risk area. In these four areas, at least 50 percent of targeted apiaries are located in these elevated-high-risk zones.

The target is to inspect and sample a total of 350 apiaries from the high-risk areas. All hives in each apiary are:

- inspected for signs of exotic bee diseases and pests, with any suspicious bees or larvae and pupae and suspect life stages of small hive beetle and *Braula* being taken for testing and lab diagnosis;
- sampled by taking at least 80 bees from each hive and testing some for internal mites using the tracheal sectioning method; and
- tested for external mites by applying a 24-hour miticide treatment and a sticky board.

In total, 355 apiaries were inspected as part of high-risk-site surveillance. These apiaries were all inspected by Authorised Persons – Level 2 (AP2s). Meeting this target is always challenging as a number of the apiaries selected for inspection are found to have no hives on site. Many of these apiaries belong to new beekeepers who lack both experience with and knowledge of varroa control; they usually lose all hives in their apiary owing to varroa mite infestation.

Export apiaries

Each beekeeper who supplied bees for export was required to provide a sample of bees from up to 25 of their supply apiaries. This was the low-risk component of the programme. The bees were tested for external and internal mites, with a target of 300 samples.

A total of 323 low-risk apiaries contributed to the programme this season and no exotic mites were found. There has been a stabilisation of low-risk samples submitted as part of the bee export process over the last two seasons, which was much higher in the previous years. This reflects the fact that the two main exporters have a stable supply base, while high honey prices have made other beekeepers less interested in supplying live bees for export.

Investigation of suspected exotic honey bee diseases

Each year MPI and AsureQuality Ltd receive calls from beekeepers reporting suspected exotic bee pests, bee diseases or unusual symptoms in hives. AsureQuality works with MPI's Investigation Diagnostic Centre (Wallaceville) to

TABLE 1: Number of apiaries surveyed and samples taken in 2016–2017

Samples tested	Routine samples (apiaries)	Suspect samples	Results	MPI specification for routine samples
Internal parasites	355	0	All negative	350
External parasites	355	0	All negative	350
European foulbrood	355	3	All negative	350 inspections, with any suspect larvae sampled for laboratory diagnosis
Small hive beetle	355	0	All negative	350 inspections, with any suspect beetle or larvae sampled for laboratory diagnosis
Exotic bee species	355	0	All negative	350 inspections, with any suspect bees sampled for laboratory diagnosis

screen these calls and determine whether sampling is justified.

A total of 14 calls were received that resulted in further investigation and sometimes sampling. These included calls in relation to suspect European foulbrood, unexplained bee and bumblebee deaths, unusual insects found in hives, Harlequin ladybirds, suspect bee poisoning, unusual brood symptoms and suspect imported beeswax. In many cases, on interviewing the callers, it was determined that the observed symptoms could be explained by endemic bee diseases or beekeeper mismanagement. All tests were negative for exotic pests and diseases in the cases investigated (**Table 1, page 30**).

Results

All high-risk apiaries inspected and sampled for the listed exotic pests and diseases were negative. As of 31 August, 39.6 percent of the samples taken from low-risk apiaries had been processed, with no targeted organisms found.

Inspection reports

This year, the use of a mobile smartphone app was implemented to record inspection data, replacing the manual inspection sheets and printed maps of previous years. This has had a considerable impact on our ability to manage inspection targets, allowing us to view inspection data in real time. This meant national and regional targets could be tracked on a daily basis, which resulted in better communication and enabled any issues to be handled in a timely manner.

Apiary database

AsureQuality Ltd maintains an apiary database that contains information on beekeeping enterprises in New Zealand. As of 23 June 2017 there were 7 802 beekeepers managing 792 767 hives on 50 140 apiaries. New beekeepers are still entering the industry at record levels, with 1 754 new registrations in the 12 months to 23 June, resulting in a net increase of 1 067 beekeepers. Just over 40 percent of them have less than two seasons' experience, which is a substantial increase on recent years.

There is a real need to provide ongoing education about exotic disease identification, which is paramount to increasing the sensitivity of the passive surveillance programme. Educating the industry in the identification of exotic pests and diseases greatly increases the chances of finding an incursion sooner. This is because vastly more hives can be inspected by an educated industry than by targeted surveillance at high-risk sites.

It is a legal requirement that all beekeepers are registered and provide the location of their apiaries. Apiaries are geo-referenced, which enables planning of detailed disease surveys. Beekeepers are required to inspect their hives annually and report any cases of American foulbrood (*Paenibacillus larvae larvae)* and suspect exotic honey bee diseases. They must also furnish a return each year updating all apiary records and stating that their hives have been inspected.

Beekeeper extension and education

During the 12-month period, AsureQuality Apiculture Officers were invited to a number of hobby clubs, beekeeping meetings and commercial beekeeper field days. Apiculture Officers take these opportunities to provide information on exotic pests and diseases of honey bees.

Each year, AsureQuality Ltd, on behalf of MPI, reports on the exotic surveillance programme in *Surveillance* to keep New Zealand beekeepers informed about surveillance activities.

Technical development

AsureQuality Ltd maintains a group of apicultural technical experts who are competent in bee disease recognition and control. This year, additional training sessions were held across the country to give training in using the Esri Collector App for data collection and a guide for sample submissions to the MPI Plant Health and Environment Laboratory, so that AP2s can stay up to date with the current demands of the programme.

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Reports from National Pest Management Strategies: Bovine tuberculosis

TBfree New Zealand

On 1 July 2013, OSPRI New Zealand (OSPRI) was established as a new organisation. At the same time, TBfree New Zealand (TBfree NZ) took over from the Animal Health Board (AHB) as the agency responsible for implementing the National Pest Management Plan (NPMP) for bovine tuberculosis (TB) control. OSPRI has two core programmes: TBfree NZ, which manages the eradication of bovine TB in New Zealand; and the National Animal Identification and Tracing (NAIT) scheme, which provides a livestock traceability mechanism to enhance New Zealand's biosecurity and animal emergency response capability.

The third NPMP for TB control was introduced in July 2011. Its primary objectives, to be achieved by 1 July 2026, are:

- to eradicate TB from wildlife over at least 2.5 million hectares of Vector Risk Areas (VRAs, defined as areas where wildlife maintenance hosts of TB are present), including two extensive forest areas representing difficult operational terrain; and
- to maintain TB freedom in wildlife in Vector Free Areas (VFAs), including areas where TB has been eradicated from wildlife.

A secondary objective was to maintain the national infected herd period prevalence level below 0.4 percent during the term of the plan.

Review of the National Bovine Tuberculosis Pest Management Plan

During 2014–2015, and as required under the Biosecurity Act, the National Bovine Tuberculosis Pest Management Plan (NPMP) for bovine tuberculosis was reviewed. To make the review independent, a Plan Governance Group (PGG) was established by the existing TB Plan funding parties. Its function was to oversee a joint programme of work that reviewed the existing plan and research findings, and then to develop an amended TB NPMP proposal.

Following consultation with farmers on the amended TB NPMP, it was submitted to the Minister for Primary Industries for consideration. The amended NPMP for bovine tuberculosis came into effect on 1 July 2016.

The objectives of the 2016 amended NPMP are:

1. To eradicate bovine TB from New Zealand, with three milestones:
   - TB freedom for cattle and deer herds by 2026;
   - TB freedom for possum populations by 2040; and
   - biological eradication of bovine tuberculosis by 2055.
2. To maintain the infected cattle and deer herd period prevalence below 0.2 percent.

A more targeted, risk-based approach to disease management and vector control will be fundamental to achieving the plan's proposed new objectives. Policies and measures to implement the new approach are detailed, along with any transitional arrangements, in the National Operational Plan.

The NPMP includes new arrangements to ensure it is funded in an equitable, secure and sustainable manner. It also enables funding shares to change over time to reflect changes in circumstances or benefits received by funders. These changes have resulted in a reduction from the $80m budgeted for TB control in 2015–2016, to an average of $60m/year for the period of the amended NPMP. Despite the reduction in funding, OSPRI expects to ensure that cost-effective control of TB will continue and should:

- prevent, avoid and manage animal health implications relating to TB infection;
- prevent, avoid and manage livestock production losses and associated costs of TB infection to industry;
- satisfy market and consumer assurance requirements;
- maintain and build on the significant gains made in managing TB;
- realise cost savings and gains in overall effectiveness from a single national programme, without duplication in separate industry or regional programmes;
- facilitate economies of scale in the design and delivery of operations; and
- enable a skilled workforce and organisational capability to be maintained, in order to address the challenges posed by TB across NZ.

Progress towards eradication

The organism *Mycobacterium bovis*, the cause of bovine tuberculosis, is the pest to be managed in the Biosecurity (National Bovine Tuberculosis Pest Management Strategy) Order 1998. In December 2011 the national infected herd period prevalence rate fell below 0.2 percent, a level that was originally set to be achieved by 30 June 2013. The key objective of the TB strategy as proposed in 2001 was thus achieved 18 months early. However, owing to an upsurge in numbers of infected herds in the VFA during 2012–2013, the annual infected herd period prevalence rose to 0.21 percent. Most of these cattle and deer herds were still classified as infected at the start of the 2013–2014 financial year, so New Zealand's infected herd period prevalence for that period remained at 0.21 percent. In September 2014, the national infected herd period prevalence fell to 0.2 percent and it has remained below that level throughout the 2014–2015, 2015–2016 and 2016–2017 financial years.

By maintaining its infected herd period prevalence rate at ≤ 0.2 percent for 3 successive years, New Zealand meets the standard set by the World Organisation for Animal Health (OIE) to be classified as officially TB-free. To retain this status, New Zealand will need to maintain its infected herd period prevalence at or below 0.2 percent. While New Zealand meets the OIE standard, this does not mean that TB has been eradicated from its cattle and deer herds. However, eradication of bovine TB from all New Zealand cattle and deer herds

by 2026 is one of the objectives of the current TB strategy.

Tuberculosis in cattle

At 30 June 2017, 49 cattle herds (0.07 percent point prevalence) were classified as infected with TB. During the preceding 12 months, of the 55 infected herds, 22 (41 percent) tested clear. Of the 67 931 clear-status herds, 32 (0.05 percent) were identified as having become newly infected during 2016–2017. Among these 32 herds, 16 (50 percent) were considered to have become infected by contact with infected wildlife, eight (25 percent) had residual infection in the herd, five (15.6 percent) were infected after introduction of TB-infected cattle from herds not known to be infected, two (6.25 percent) had been infected by the introduction of cattle from herds that were known to be infected and one was undetermined. The increase in the number of new infected herds in 2016–2017 is related to a greater-than-expected increase in numbers of infected herds on the west coast of the South Island, in areas that have yet to receive the full impact of the pest management programme. In addition, herds classified as infected have to retain that status for a longer time, to reduce the risk of residual infection causing future herd infection, and this has the effect of reducing the clearance rate. The 12-month infected-herd period prevalence to 30 June 2017 was 0.10 percent.

During the 12 months to 30 June 2017, 3.29 million cattle (2.47 million dairy cattle and 0.82 million beef cattle) were tested with the intradermal caudal fold tuberculin (CFT) test (Prionics Lelystad tuberculin, 3 000 IU/dose). From these, 258 skin-test-positive animals were identified and slaughtered.

An additional 5 817 cattle considered to be non-specific responders to the CFT test were given an ancillary serial test (standard or special antigen, gamma-interferon [Bovigam™]). There were 418 reactors (7.2 percent) to these tests and all were slaughtered. At slaughter, 44 (11 percent) of these reactors had TB lesions or *M. bovis* was cultured from pooled lymph-node samples. Ancillary parallel testing (gamma-interferon) was undertaken on 10 773 caudal-fold-test-negative cattle from infected herds. There were 123 reactors to the parallel tests and all were slaughtered. At slaughter, 37 (30 percent) had TB lesions or *M. bovis* was cultured from pooled lymph node samples.

In total, 799 reactor cattle (24 per 100 000 tested) were slaughtered, of which 111 (14 percent) either had visible TB lesions or yielded *M. bovis* on culture.

A further 50 tuberculous cattle (2.1 per 100 000 slaughtered) were detected during routine meat inspection of the 2.4 million cattle sent for slaughter during the previous 12 months.

The 12-month period prevalence of TB in cattle (111 tuberculous reactors and 50 infected cattle found during routine slaughter) for the 2016–2017 financial year was 1.6 per 100 000 cattle (base cattle population = 10 million).

Tuberculosis in deer

At 30 June 2017, five deer herds (point prevalence = 0.22 percent) were classified as TB-infected. During the preceding 12 months, of the four infected herds, none tested clear. In addition, one (0.04 percent) of the 2 288 clear-status herds was identified as infected. The 12-month infected-herd period prevalence to 30 June 2017 was 0.22 percent.

During the 12 months to the end of June 2017, 175 119 deer were tested with the mid-cervical intradermal tuberculin (MCT) test (Prionics Lelystad tuberculin, 3 000 IU/dose). Of these, 49 test-positive animals were identified and slaughtered.

An additional 423 deer considered to be non-specific responders to the MCT test were given an ancillary serial test with either the comparative cervical test (CCT) or the IgG1 ELISA test (ETB and modified ETB). There were eight reactors (1.9 percent) and all were slaughtered. No ancillary parallel testing (IgG ELISA test) was undertaken in 2016–2017.

In total, 57 reactor deer (three per 10 000 tested) were slaughtered, of which none had visible lesions of tuberculosis or yielded *M. bovis* on culture.

In addition, TB was detected in two deer during routine meat inspection of 294 000 deer sent for slaughter during the preceding 12 months. The 12-month period prevalence of tuberculosis in farmed deer for the 2016–2017 financial year was 0.2 per 100 000 (base farmed deer population = 1 million).

Prevalence of tuberculosis

The point prevalence of infected cattle and deer herds at 30 June 2017 was 0.08 percent (up from 0.06 percent last year) and the 12-month period prevalence for 2016–2017 was 0.11 percent (up from 0.09 percent last year).

Tuberculosis in wildlife

Tuberculous possums and occasionally other wildlife (pigs, deer, cats, ferrets, stoats, hedgehogs and hares) have been associated historically with persistent infection in cattle and deer herds in 32 separate areas of New Zealand. Areas containing wildlife maintenance hosts of TB are classified as VRAs. Possums (*Trichosurus vulpecula*) are considered to be the main TB maintenance host and are the main wildlife vector of TB in cattle and farmed deer. However, in a number of VRAs, ferrets (*Mustela furo*) are also regarded as an important vector. As a result of intensive possum control over a number of years, TB has been eradicated from both wild and domestic animals in 17 small VRAs, leaving 15 VRAs where tuberculous wild animals remain.

In work undertaken to meet the NPMP objectives in the 2016–2017 financial year, possums were controlled on 1.56 million ha of land (1.21 million ha by ground control and 0.35 million ha by aerial control). The cumulative area under vector control has grown to about 6.7 million ha (25 percent of New Zealand's land area) over a 5-year timeframe. Wildlife surveillance for bovine TB was undertaken on an additional 4.28 million hectares.

At June 2017, VRAs covered about 8 million hectares (30 percent of New Zealand's land area). During the 2016–2017 financial year, wildlife surveys were undertaken in VRAs to provide objective data to:

- support areas where the possum population is in the process of becoming proven to be TB-free;
- determine whether buffer areas are restricting movement of TB-infected wild animals into VFAs;
- provide guidance for determining the need and priority for vector control operations; and
- support research programmes.

Table 1 shows species and numbers of wild animals surveyed (or provided from Landcare Research projects) and the number that were found with TB in 2016¬–2017.

In 2016–2017, all TB-infected wild animals were found in existing VRAs. Knowing where TB animals are to be found and where they are absent, will enable better and more cost-effective targeting of measures to eradicate TB from wildlife in New Zealand.

VFAs account for 70 percent of the total land area, and in 2016–2017 contained 18 percent of infected cattle herds. In VFAs, wild animal surveys are undertaken to determine whether TB-infected wild animals are present in at-risk areas. The risks in VFAs are threefold:

- from TB-infected wild animals migrating from adjacent VRAs;
- from hunters unwittingly liberating TB-infected wild animals; and
- from hunters dumping TB-infected carcasses (or parts thereof), which can then infect local scavengers, especially feral pigs and ferrets.

Surveys are also undertaken to assure OSPRI that TB has been eradicated from former VRAs, to determine whether wild animals are the source of any new livestock infection seen in VFAs, and to determine whether wild animals may have become infected from contact with infected cattle or deer. In 2016–2017, a total of 154 possums, 323 wild pigs, 83 ferrets and 10 deer were surveyed from 16 sites. All were found to be TB-free.

Success of the current NPMP

During the first year of the new NPMP, VRA status was revoked in 230 198 hectares of VRA after proof-of-freedom case review. This land consisted of 18 Vector Control Zones (VCZ). The result is within the objectives of the TB Plan, whereby 440 000 hectares are expected to be declared free of TB in possums during the first two years.

The total number of infected cattle and deer herds was 54 (49 cattle and five deer herds) and the infected herd period prevalence was 0.11 percent, well below the 0.2 percent target.

The role of traceability in disease surveillance monitoring and response

The control of animal diseases and pests that threaten biosecurity and the natural environment in New Zealand relies on the co-operation of government agencies, industry organisations and businesses, and individuals among both the primary sector and the wider public.

MPI is tasked with maximising export opportunities, improving agricultural productivity, ensuring that food is safe, increasing sustainable resource use and protecting New Zealand from biological risks. In support of their initiatives, government and industry are partners and co-investors in two major programmes managed by OSPRI: TBfree (National Bovine Tuberculosis Pest Management Plan) and NAIT (National Animal Identification and Tracing programme). OSPRI has capability in areas of biosecurity, animal health, traceability and pest management and partners with industry and government to provide these services.

The TB programme is directed at the eradication of TB from New Zealand, while NAIT is the national radio-frequency identification device (RFID) livestock traceability programme, capable of tracing livestock to their place of origin in the case of disease or residue outbreak, and for tracking stock movements, including those to saleyard and slaughter.

In the event of a disease response, NAIT Ltd seeks to work with government by performing traceback of identified premises, and any other premises where identified or infected animals may have been, alongside any livestock depots, saleyards or processing plants where animals may have interacted. Prompt traceback in any disease event is paramount to identifying premises and animals of interest, and their related animal cohorts. This enables the immediate quantification of the magnitude of the disease outbreak and the likely spread of infection, subject to the parameters of the disease. Decisions can then be made regarding treatment, quarantine, slaughter and other mechanisms of control and response. Furthermore, the ability to identify and prioritise action in the disease response, including treatment and slaughter, is paramount to making decisions and deploying resources. NAIT provides this ability and therefore is an integral component of disease management, response and recovery.

TABLE 1: Numbers of wild animals sampled and number with TB in 2016–2017

	Possums	Wild pigs	Wild deer	Ferrets	Others
Number sampled	3 571	2 575	99	3 678	25 stoats 11 feral cats 3 weasels
Number and (percentage with TB)	24 (0.64)	14 (0.54)	2 (2.0)	20 (0.54)	0

The effectiveness of national traceability programmes relies on the timely participation of farmers, saleyard managers and meat processors. However, even in an emergency where livestock movements may be pending, there remains the capacity to examine historical activity of particular premises and their animal movements that will inform the quantification of disease spread and infection probabilities. Equally, during a response, investigators need to use all information available to locate premises and animals and quantify animal movements and history. NAIT's national database provides one of the major mechanisms for this. It can report data from multiple premises, locations, regions and animal movements to and from locations or regions. It is also supported by other mechanisms (such as the Animal Status Declaration) that are manual, paper-based tools that can be examined if and when investigators attend identified infected premises.

NAIT plays a role in underpinning not only response efforts to help mitigate impacts on livestock industries and any associated costs, but also in the medium and longer-term recovery where premises require status determination and ongoing observation, and may remain under case management for extended periods. The recent *Mycoplasma bovis* disease response is an example of how NAIT has been used to locate premises and livestock and track livestock movements to support MPI's response. This is additional to the usual response activities such as epidemiological analysis, farmer engagement, liaison with industry and veterinary case management.

Aside from emergency response, NAIT helps surveillance and management of residue, treatment, contaminant, food safety and disease issues by assigning status to premises and individual animals. For example, the ongoing management of the TBfree NZ programme relies on information such as the status of premises, and animal identification for TB diagnosis and case management.

NAIT will play a key role in ongoing monitoring and surveillance, thus reducing industry and government cost impacts in the event of disease response and recovery activities documented in government/industry agreements. This will also enable response activity decisions to be made on the basis of risk, priority and available resourcing, informed by status of individual animals and premises. Equally, the future of traceability will be in the underpinning of livestock and livestock product residue and contaminant monitoring, national level endemic disease surveillance and the management of both these aspects domestic and export market access.

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American foulbrood

American foulbrood (AFB) is caused by the bacterium *Paenibacillus larvae larvae*. This disease of honey bees has been regulated by an Apiaries Act since 1907. In October 1998 responsibility for managing AFB to reduce the reported incidence of the disease was transferred to the National Beekeepers' Association Incorporated (NBA). The NBA developed a Pest Management Strategy (PMS) and became the management agency for the strategy. The PMS retained many of the provisions from the previous Apiaries Act 1969 plus some new ones. More information can be found at www.afb.org.nz. Recently, owing to an amendment to the legislation, Pest Management Strategies have been renamed Pest Management Plans (PMPs). Additionally, in April 2016 the National Beekeepers Association was replaced by Apiculture New Zealand, which is the organisation under which the AFB management agency now operates. Key features of the American foulbrood PMP are:

- An apiary is a place where bees are kept and every apiary must be registered. In addition, all hives must be inspected annually by an approved beekeeper, who must also report on the disease status of the hives.
- Any case of AFB must be reported within seven days to the management agency.
- To become approved, beekeepers must first pass a competency test on AFB recognition and control and then submit a hive and AFB management plan to the management agency or its contractor, AsureQuality Ltd. This is called a Disease Elimination Conformity Agreement (DECA).
- Beekeepers must submit samples of bees and/or honey for AFB testing if so requested.
- All hives with AFB symptoms must be destroyed, although some equipment can be sterilised by heating in paraffin wax at 160°C for at least 10 minutes.
- Antibiotics cannot be used to control AFB in New Zealand.
- The AFB Plan is funded by an apiary fee levied under the Biosecurity (American Foulbrood – Apiary and Beekeeper Levy) Order 2003. All beekeepers are required to contribute through a base fee of $20, plus $15.17 per apiary (+ GST). Beekeepers with fewer than four apiaries and fewer than 11 hives pay the base fee plus one apiary fee. Those above the thresholds are levied a base fee plus $15.17 for each apiary registered on 31 March, the date the levy is assessed.

Hive inspection and audit programme to 31 May 2017

AsureQuality Ltd collates beekeeping and AFB disease statistics to 31 May each year for the management agency, which encompasses a full beekeeping season. Between 1 June 2016 and 31 May 2017, a total of 2 907 cases of AFB were found by beekeepers (0.33 percent of hives) and/or AsureQuality staff in 1 017 apiaries (2.76 percent). Corresponding AFB infection rates for 2015–2016 were 1 704 hives (0.25 percent) and 1 747 apiaries (2.41 percent).

As of 31 May 2017 there were 3 813 beekeepers with DECAs and a Certificate of Inspection Exemption (49 percent of beekeepers). These beekeepers are permitted to inspect their own hives for AFB and make reports to AsureQuality on the authorised forms. During the reporting period 652 new DECAs were approved.

Large numbers of new, relatively inexperienced beekeeper entering the industry pose a challenge for the AFB disease control programme, which operates best with a high percentage of competent beekeepers. Additionally, the increasing movements of hives around the country for manuka honey production is increasing the pressure on beekeepers to keep detailed traceability records in relation to AFB disease discovered.

Apiary register and statistics

There were 3 939 beekeepers who owned 50 070 hives on 6 148 apiaries that required a Certificate of Inspection as of 5 July 2017. This means they have to engage the services of an approved beekeeper to inspect and report on the AFB status of their hives. The percentage of beekeepers in this category continues to grow despite record numbers of DECA agreements being approved. There is currently not the training capacity (which supports the DECA approval process) to cope with the number of beekeepers entering the industry. As a result, non-approved beekeepers now outnumber

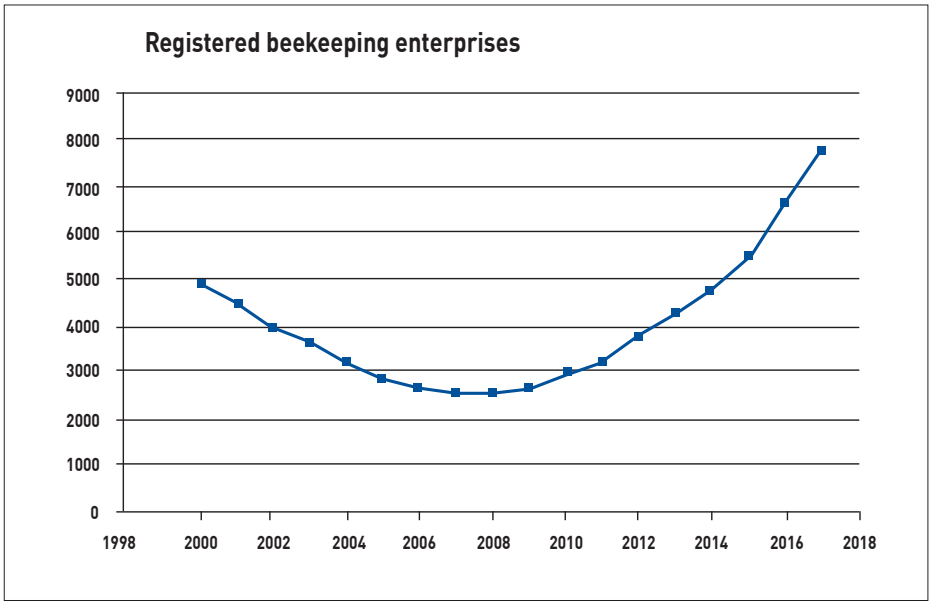

Figure 1: Number of beekeepers, 2000–2017

Continued on page 37

Annual reports from industry surveillance and disease control programmes: *Brucella ovis* accreditation scheme 2016

Numbers of animals tested in 2016 were slightly down compared to 2015 (**Table 1**). The overall infection rate (reactors/samples tested) was 1 percent.

The infection rate should be treated with caution as it is skewed by several flocks with a > 25 percent infection rate that have had subsequent eradication tests.

As in previous years, the figure includes animals from a large number of commercial properties as well as flocks previously accredited (ram-breeder flocks and some commercial flocks). The infection rate for ram-breeder flocks will be significantly lower, but data is limited since relevant information is not always provided on laboratory submission forms.

Table 1 also shows that not all flocks with reactors had any further investigation during 2016.

TABLE 1: *Brucella ovis* testing and eradication, 2016

Area	Flocks with reactors*	Flocks with eradication in progress or completed
Far North & Auckland	1	1
Waikato, Waitomo & BOP	4	0
Taranaki &Wanganui	3	2
East Coast	6	3
Hawke's Bay	3	3
Manawatu & Rangitikei	0	0
Wairarapa & Wellington	2	1
Marlborough & Canterbury	3	0
Otago & Southland	6	3

*Infected flocks are those that have had *B. ovis* reactors identified but not always confirmed by further testing.

Some of the above flocks, especially where there are only one or two reactors, may have had subsequent testing performed on the reactor samples, e.g., ELISA and/or gel diffusion, and their owners have opted not to re-test on the basis of results obtained.

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Infectious bursal disease eradication programme

In 1993, a low-virulence strain of infectious bursal disease (IBD) was identified in commercial poultry in New Zealand. As a result, in 1994 an IBD eradication programme funded and supervised by industry was put into place. Both active and passive surveillance are important parts of the programme, with passive surveillance taking place both on farms and in processing plants. No cases of IBD have been confirmed in commercial poultry since 1999.

During 2016, the two private poultry laboratories screened a total of 12 290 blood samples collected under the whole-flock testing programme. Samples were screened using the IDEXX FlockChek ELISA. There 103 reactors in 40 flocks and of these:

- 34 reactors from 12 flocks re-tested negative;
- 36 reactors from 20 flocks were not retested as they had already been sent for processing (where the poultry have been sent to slaughter the next placement of poultry in the shed is tested for IBD); and
- samples from 33 reactors in eight flocks were sent for VNT at Wallaceville and tested negative.

Further investigation if required includes blood sampling, serology, collection of bursa for histology and PCR testing to conclude that IBD is not present.

Reference

Brook M (2003). Poultry Disease Surveillance in New Zealand. *Surveillance* 30(1), 12–14.

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American foulbrood – from page 36

approved beekeepers for the first time in recent history.

There were 7 836 beekeepers operating 811 357 hives on 50 211 apiaries as of 31 May 2017, compared to 6 735 beekeepers, 42 175 apiaries and 684 046 hives at the same time last year **(Figure 1)**. The expansion of the beekeeping industry is a continuing trend driven by high honey prices in the commercial sector and increasing ecological awareness driving many to take up beekeeping as a hobby.

The main increases were again in the North Island, where 75 percent of the new beekeepers were registered and 83 percent of the new hives are established. The beekeeper split between islands continues to move in favour of the North Island and is largely driven by manuka honey production, which is much more prevalent in the North Island.

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Poultry health surveillance

The tables presented here summarise results of health testing in the poultry industry during 2016. **Table 1** summarises serological test results. **Table 2** summarises *Salmonella* serotypes cultured from feed sources, environmental swabs and poultry samples. This report is based on information received from poultry testing laboratories.

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TABLE 1: Serological test results summary: Poultry – 2016

Disease	Number tested	Number positive	Vaccination status*
Newcastle disease†	2 168	33‡	
Egg drop syndrome	1 750	94	(V)
Chicken anaemia	1 866	1 300	V
Avian encephalomyelitis	3 196	3 058	V
Infectious bronchitis	6 429	4 737	V
Reovirus	776	682	V
Infectious laryngotracheitis	938	644	(V)
Mycoplasma gallicepticum	18 824	54	
Mycoplasma synoviae	10 316	63	
Mycoplasma meleagridis	0	0	
Salmonella Pullorum	8 735	0	
Infectious bursal disease	12 290	105♠	See IBD eradication programme report, page 37
Avian influenza	2 921	0	

*V = All vaccinated

(V) = Some vaccinated

† New Zealand has never experienced an outbreak of Newcastle disease. A subclinical enteric strain of avian paramyxovirus type 1 (AMPV-1), with an intracerebral pathogenicity index (ICPI) of 0.00-0.16, is endemic in this country

‡ Maternal antibody; positives were from hatching eggs in quarantine – hatched chicks showed titre as parents/donors had been vaccinated for Newcastle disease virus in the US

♠ Resolved as negative by subsequent investigation: see IBD eradication programme annual report, page 37

TABLE 2: Serotypes of *Salmonella* isolated during the year 2015

Salmonella isolates	Finished and feed sources	Broiler samples*
Agona	1	7
Derby		4
Bovisorbificans		22
Infantis		9
Senftenberg		8
Typhimurium 42		1
Typhimurium 191		1
Salmonella spp.		1
Group B		1
Group C		3
Rissen		1
Mbandaka	1	
Typhimurium	4	
sp. untypable	3	
Brandenberg	2	
Stanley	2	
Typhimurium PT56	2	
Enterica	1	
Total positive / total tested	**16 / 4 150**	**59 /3 683**

* Samples include environmental swabs and whole carcass rinse birds

Quarterly review of diagnostic cases

Gribbles Veterinary Pathology

Bovine

A weaned Angus heifer calf from Central Hawke's Bay presented with a 10-cm protruding soft-tissue mass between the shoulder blades. The farmer reported several similar lumps in calves of the same age. All the affected calves were possibly the progeny of a single bull. Histologically, the mass was composed of sheets of well-differentiated adipocytes within a light supporting stroma. Given the young age of the calf, the mass was considered likely to be a **congenital lipoma.** Congenital lipoma and congenital infiltrative lipoma have been reported in cattle, but very rarely. One report described congenital infiltrative lipomas in an inbred calf, suggesting a genetic abnormality (Agerholm *et al.*, 2015). From the clinical history, a heritable trait was considered possible in this case.

Another unusual tumour was diagnosed in a rising-two-year-old Hereford heifer killed at a West Coast region meat processing plant. A white, focal, 10-mm-diameter mass was observed in the ventricle wall. The lesion was collected and processed for histology to rule out *Cysticercus bovis.* Histological examination revealed a neoplasm composed of pleomorphic spindle cells with features suggestive of cardiomyocytes. The tumour was diagnosed as a **rhabdomyosarcoma.** Differential diagnoses for focal lesions in the myocardium include cysticercosis, bacterial abscess, degenerate sarcocysts, peripheral nerve sheath tumours and other tumours.

One of several autumn ***Neospora caninum*** **abortion** outbreaks occurred on an Otorohanga district dairy farm. At least 16 of 200 cows aborted over the course of a week. Fixed tissue samples were collected from one of the aborted calves. Neosporosis was confirmed through demonstration of multifocal nonsuppurative inflammatory lesions in the brain, heart and muscle, and positive *Neospora* immunofluorescent antibody titres of > / = 1:2000, 1:2000 and 1:600 in three aborted cows. Risk factors for *N. caninum* abortion include age and parity of cows, seropositivity for *N. caninum*, presence, age and behaviour of farm dogs, and presence of previously aborted cows in the herd.

Gastrointestinal parasitism was the cause of wasting and death in cattle on several farms in the southern North Island during May. On one South Wairarapa sheep-and-beef property, four rising-one-year-old Friesian cross bull calves lost condition and developed watery diarrhoea. One calf subsequently died and another was euthanased. Histology revealed small intestinal villus blunting, crypt abscesses and nematodes. An abomasum sample was available from one calf and this revealed severe changes including mucosal hyperplasia, fibrosis, and nests of ***Ostertagia spp.*** Faecal egg counts in four calves were 1 000, 1 450, 7 450 and 10 500 eggs per gram. Serum pepsinogen activity was 4.4 IU/L in one calf (reference range 0–3).

In another case, six of 100 rising-two-year-old Friesian bulls on a Central Hawke's Bay property lost condition over a period of weeks after being moved onto a grass paddock. The abomasum from one of these had severe nodular hyperplasia, loss of parietal and chief cells, and numerous nests of ***Ostertagia spp.*** Bulls on this property had concurrent **selenium deficiency**. Four bulls tested had serum selenium levels of < 30 nmol/L (reference range 140–2 000).

Five one-year-old beef heifers on a Hastings district farm developed diarrhoea and became blind while being fed on a kale crop. A faecal egg count of 300 eggs per gram was not considered significant. Multiple tissue samples were collected from one of the dead heifers. Histologically, the only finding of note was the presence of multifocal laminar necrosis of the deeper laminae of the cortical gyri, confirming a diagnosis of **polioencephalomalacia.** In brassica crops, high plant sulphur concentrations may contribute to induced thiamine deficiency and outbreaks of polioencephalomalacia (Hill & Ebbett, 1996).

Chronic copper toxicity was diagnosed in a South Taranaki herd of 250 Friesian cross cows. Four cows became inappetant, dull and jaundiced. Two died. The cows had been receiving palm kernel expeller as a large proportion of the diet. There were no other reported sources of copper supplementation. On post-mortem examination of one cow, body condition was good and the fat and mucous membranes were yellow. The liver had rounded margins, a gritty texture and an enhanced lobular pattern. The kidneys were dark red with faint white foci. Liver copper concentration was elevated, at 5 670 µmol/kg (reference range 95–3 000). Histopathology was characteristic of a haemolytic crisis caused by copper toxicity. There was diffuse hepatic centrilobular to midzonal necrosis and abundant haemoglobin pigment in the kidney.

A 7-year-old Friesian cow in Taranaki showed signs of anorexia, weight loss and lethargy. She was marginally anaemic, with a red blood cell count of 4.68 x 10^{12}/L (reference range 5–7.7 x 10^{12}). Serum magnesium concentration was 0.17 mmol/L (reference range 0.59–1.08). There was a nucleated red blood cell count of 229 per 100 white blood cells and basophilic stippling was noted in the red blood cells, which was considered a possibly indicative of lead poisoning. However, a Perls iron stain showed that the inclusions in the red blood cells were due to iron, indicating that the cow was probably developing a siderocytic anaemia as a result of **hypomagnesaemia**.

Three animals from a herd of dairy cattle in south Taranaki showed rather non-specific signs of illness, including pyrexia, decreased gastrointestinal sounds and some respiratory signs. They were being supplemented with palm kernel expeller. Haematological examination showed a non-specific lymphopenia in all the cattle, which also had mild haemoconcentration suggesting dehydration, but there was no hyperfibrinogenaemia or neutrophilia. Serum biochemical examination revealed markedly elevated serum GDH (1 559, 2 800 and 2 881 U/L; reference range 5–35), serum GGT (252, 287 and 345 U/L; reference range

3–47) and serum bilirubin (49, 64 and 146 umol/L; reference range 0–8). Two animals had hypophosphataemia of 0.38 and 0.69 mmol/L (reference range 1.3–3.3). Serum copper concentrations were then measured. One was normal at 19 umol/L and two were significantly increased at 76 and 31 umol/L (reference range 8–20). This was consistent with **severe hepatobiliary disease** caused by **chronic copper toxicity,** which was probably related to the feeding of palm kernel expeller.

A 6-month-old Friesian calf died suddenly on a North Canterbury farm. It was one of three recent deaths in a mob of 200. The other two affected animals were not examined as they had been dead too long. At post-mortem examination the calf was noted to have black discolouration of the muscles of the inner thigh of one hind leg, with surrounding oedema. Histological examination showed a necrotising myositis with large numbers of bacteria typical of *Clostridium* spp. Culture produced a pure growth of *Clostridium,* which when subjected to MALDI was identified as ***Clostridium septicum***, the agent of **malignant oedema**.

In a group of 100 rising-one-year-old Friesian cattle on a South Canterbury farm three animals died over a 2-day period and two more were sick. The animals were on pasture and hay and had been moved onto the property 8 days previously. One animal was presented for post-mortem examination. It had excess fluid in the abdomen and chest, the kidneys were pale and there was red-stained perirenal oedema. Histological examination revealed lesions of toxic renal tubular injury consistent with **acorn toxicity**. Subsequent investigation revealed that the animals had been grazing an area with oak trees just before being moved to the current property.

Cases of **bovine adenovirus infection** were diagnosed on seven farms in North, Mid and South Canterbury and on the West Coast. The affected animals were 8–9-month-old calves and they were either found dead or were acutely ill with diarrhoea. From two to five animals were affected in groups of 100–150 animals. The most notable clue to the cause of infection was the presence of viral inclusions in endothelial cells in the kidney, but inclusions were also seen in sections of intestine and mesenteric lymph node. Bovine adenovirus infection is typically seen in animals of this age in autumn. In recent years up to three cases have been diagnosed each year but the number of cases seen this year is far more than usual. The reason for this increase is unknown.

Swabs from the eyes of four six-month-old Friesian/Jersey cross heifers were received as part of an investigation into an outbreak of "pinkeye". The heifers showed an ocular inflammation consistent with **infectious bovine keratoconjunctivitis** (IBK), which was unexpected because the group had been vaccinated using a trivalent *Moraxella bovis* vaccine. No *M. bovis* was isolated from any of the samples but *M. bovoculi* was isolated in mixed growth from three of the four animals tested. The significance of this organism in the pathogenesis of IBK is controversial. It is commonly isolated from clinical cases, but can also be found in normal animals. Overseas, experiments with a variety of vaccines using *M. bovoculi* bacterin have not demonstrated consistent benefits, but there appear to be large genomic differences between isolates, which could be a factor contributing to the variable performance of these vaccines (Dickey *et al.*, 2016).

Serum samples from six adult dairy cows from Canterbury were received to test the group's copper, selenium and cobalt status. Selenium and cobalt (Vitamin B12) results were all within normal limits but the serum copper concentrations were all < 6 umol/L, with a mean of 4 (adequate range 8–20). This was consistent with a diagnosis of **copper deficiency.**

An 8-month-old Friesian bull from South Canterbury was noted to be weak and had red colouration of the urine. Mucous membranes were pale on clinical examination. Puddles of red urine were noted on the ground. The animal had been grazing kale for the previous 2 weeks and kale anaemia was suspected. A complete blood count showed a haematocrit of 0.10 (reference range 0.240.4), confirming anaemia. About 16 percent of the red blood cells contained Heinz bodies. No organisms resembling *Theileria* spp. were seen. The presence of a Heinz body anaemia, in conjunction with the history of recent grazing of a brassica crop, supported the submitting veterinarian's suspicion of Heinz body anaemia caused by **S methyl cysteine sulphoxide toxicity**, also known as **kale anaemia**.

There were several cases of **bovine abortion** associated with ***Salmonella* Brandenburg** infection this quarter. In one case, 14 animals from a group of 2 000 rising-two-year-old heifers from mid-Canterbury aborted over a few days. Samples were received from one of these animals and *Salmonella Brandenburg* was isolated.

Seven of a group of 30 six-month-old dairy heifers from Northland were ill-thrifty and lethargic and one died. Anaemia was suspected as mucous membranes were pale in numerous animals. This was supported by haematocrits ranging from 0.21 to 0.28 (reference range 0.24–0.4). There was anisocytosis with occasional *Theileria* spp. seen on blood smears. The heifers remained ill-thrifty and developed diarrhoea, but further testing on several was negative for bovine viral diarrhoea antibodies by ELISA, negative for *Salmonella*, *Yersinia* and *Campylobacter* on faecal culture, and they had unremarkable biochemistry including normal serum copper and selenium levels. Occasional coccidial oocysts were seen on faecal examination. The heifers continued to do poorly and another died a month after the initial presentation. Histopathology showed an acute-on-chronic necrotising myopathy in the heart and skeletal muscle, acute centrilobular necrosis in the liver, subacute interstitial pneumonia in the lungs, acute multifocal necrosis in the spleen, steatitis and oedema around a lymph node, and chronic exocrine atrophy and fibrosis in the pancreas, consistent with a diagnosis of **zinc toxicity**. This can cause ill-thrift, lethargy, diarrhoea and anaemia. The

zinc concentration in a liver sample was normal at 340 µmol/kg (reference range 612–918 in untreated animals), but this does not rule out zinc toxicity since there is no storage organ for zinc, and current tissue zinc levels may not reflect chronic pancreatic damage.

An adult dairy cow from Northland was losing weight despite being dried off. On clinical examination she had very pale mucous membranes, tachycardia, a jugular pulse and a temperature of 38.4°C. She had a regenerative anaemia (haematocrit 0.16, reference range 0.24–0.4; RBC 2.88 x 10^{12}/L, reference range 5–7.7 x 10^{12}; haemoglobin 55 g/L, reference range 85–130; absolute reticulocytes 23.04 x 10^{9}/L, reference range 0-1 x 10^{9}/L; 1 nucleated red cell/100 leukocytes, reference range 0; and 130 *Theileria* spp. per 1 000 red cells on the blood smear. All these signs were consistent with a diagnosis of **theileriosis**.

Two adult dairy cows from a herd of 140 in Northland aborted. Histopathology of the placenta from one showed multifocal necrosis of villi and a possible protozoal tissue cyst. Serology showed that both cows were negative for BVD antibody by ELISA test, but both had *Neospora* spp. IFAT titres ≥ 1:2000, consistent with ***Neospora caninum* abortion**.

***Neospora caninum* abortion** was also diagnosed in a four-year-old Friesian cow from Northland, which had aborted about 10 weeks before full term. Histopathology of the fetus showed multifocal cerebral necrosis and gliosis with myocarditis and nephritis. PCR testing of fetal stomach contents was positive for *Neospora* spp.

Three of 110 rising-two-year-old Friesian cows from Northland died over a 3-day period. Post-mortem examination of one showed a severe haemorrhagic enteritis. Histopathology of the kidney and colon showed intranuclear endothelial viral inclusions consistent with **bovine adenovirus** infection. This typically causes outbreaks of haemorrhagic diarrhoea, recumbency and death in young cattle.

Eighteen cows out of 300 on a Central Otago farm were found dead about 3 hours after morning milking. About 20 more appeared unwell and six were in ventral recumbency with signs of colic, their hind legs extended backwards and their heads extended forwards, resting on the ground. They were bloated and bellowed in pain if their heads were lifted. There were no significant findings on post-mortem examination of one of the dead cows. The water trough was replenished automatically and the water contained only a small amount of bloat oil. Another group of cows on the same water system in a nearby paddock were unaffected. One affected cow was still alive a week later but was losing weight. Post-mortem examination after euthanasia showed no obvious gross or histopathological lesions. Urea toxicity was suspected but these cows had no direct access to urea in their feed or water. However, urea was being added to the water sprayed onto the paddocks by a centre-pivot irrigation system, and the spray was able to reach the water trough in the affected paddock. **Acute urea toxicity** was considered to be the likely cause of the deaths.

Several of a group of 200 yearling dairy beef animals on an Otago grazing farm developed a severe bilateral ulcerative conjunctivitis. Swabs taken from the conjunctival sacs of three affected animals were negative on bacterial culture, but pooled swabs were positive for **infectious bovine rhinotracheitis virus** on PCR testing.

Two of 230 weaned beef calves on an Otago sheep-and-beef farm were found dead. A post-mortem examination of one dead calf estimated to have been dead less than 12 hours showed very rapid post-mortem decomposition and a clostridial disease was suspected. Bone marrow from one of the ribs was cultured and produced a moderate, pure growth of ***Clostridium sordellii***, a species that was not included in the clostridial vaccine the calves had received. Although the role of *C. sordellii* in the death of these calves is uncertain, the isolation of the organism in pure growth suggests its possible significance.

Ovine

A sheep farmer in the Rangitikei district reported diarrhoea in the majority of a flock of 350 seven-month-old lambs grazing new pasture. About 10 lambs died. The lambs had been drenched with a combination macrocyclic lactone and levamisole drench 4 days before veterinary attention was sought. Gross post-mortem examination was remarkable only for watery, green contents in the small and large intestines. A faecal sample contained 1 000 parasite eggs per gram. Histology revealed severe hyperplastic changes in the abomasum and marked blunting of the villi in the small intestine, accompanied by large numbers of nematodes, confirming a diagnosis of **enteric parasitism.**

Over a period of 36 hours a farmer on a mid-Canterbury farm found 102 lambs dead in a group of 900. About 15 were sick but improving. The lambs had been yarded and shorn the previous day and then released into a paddock of linseed and clover. There were no gross or histological lesions and the linseed was negative for nitrate when tested at the veterinary clinic. Unfortunately, it was too late to test for cyanide in the rumen contents of any dead lambs but the clover and linseed were tested and cyanide was detected in the linseed. No cyanide was detected in the clover. The sudden death of so many lambs was consistent with a toxicity event and the presumptive cause was **cyanide poisoning**.

A sheep farm in Marlborough had three hoggets die over a short period in a group of 1 500 that had been grazing in a vineyard. One animal was presented for post-mortem examination. It had been standing in a corner of a pen with its head down. There were no parasites and the faecal egg count was zero. A wide range of tissues were submitted to the laboratory for examination and there were typical histological lesions of **encephalitic listeriosis** in the brainstem.

In an unrelated case, histological lesions of **encephalitic listeriosis** were also found in the brain of a hogget grazing pasture in the Nelson area. It was presented for veterinary examination

lying down and paddling.

Three mixed-age ewes from a flock of 1 000 Romney sheep in Northland had progressive weight loss over 1–3 months. One was euthanased for post-mortem examination. This animal had watery faeces, a clear peritoneal effusion and enlarged intestinal lymph nodes. Histopathology showed granulomatous ileocolitis, lymphadenitis and hepatitis, with acid-fast organisms seen on Ziehl-Neelson-stained sections. Serum samples from all three affected sheep were positive for ***Mycobacterium avium* ssp. *paratuberculosis* (MAP)** antibody by ELISA testing, consistent with a diagnosis of **Johne's disease**.

Several mixed-age ewes from a flock in south Auckland were found dead. One died during yarding and another was recumbent with diarrhoea. Post-mortem examination of one showed a congested abomasum and small intestine with a friable, congested liver. A faecal sample yielded a growth of ***Salmonella* Hindmarsh**, suggesting an outbreak of **salmonellosis**.

A group of 200 mixed-age Merino ewes on an Otago farm were yarded for crutching. While in the yards they were exposed to urea fertiliser. Within a short period many developed severe nervous signs (lateral recumbency, paddling, blindness, nystagmus, twitching), began foaming at the mouth and died within 30–60 minutes. More than 50 died. The pH of the rumen contents in two dead ewes was high (8.6 and 8.2; reference range 6–7 for ruminants on pasture), supporting a diagnosis of **urea toxicity**.

Three crossbred Merino ram hoggets from a group of 200 on an Otago farm were found dead and a few horned rams in the mob showed purulent exudate and separation at the base of their horns, which had not been seen at crutching a month previously. The group was brought into the yards for further examination. Twenty of the rams had scrotums that were red and hot on palpation. One had a scrotum more than three times the normal size with very firm testes and another had testes that were markedly unequal in size. Ten horned rams had a severe purulent inflammation of the horn base. In one animal a horn had become completely detached, leaving the central core of bone. Two rams with testicular lesions were killed and necropsied. In one ram both testes were ablated by abundant purulent material, leaving no recognisable normal testicular tissue. In the other ram, one testis appeared normal while the other was enlarged with areas of haemorrhage, oedema and significant loss of normal testicular tissue. Culture of the exudate identified a heavy pure growth of ***Histophilus somni*.** The cause of the horn lesion was not identified.

Canine

In a litter of eight Schnauzer puppies in the Auckland region, four died and the remainder were not suckling or feeding well. The puppies were treated with clavulanic acid–amoxicillin and cefovecin antimicrobials and were fed by tube. One of the surviving puppies had a seizure and then became apparently paralysed, with muscle wasting in the hindquarters. Pus was seen to ooze from one hind leg. Post-mortem examination showed that the pelvis of both kidneys was markedly dilated and the prostate and urinary bladder were distended by yellow material and were adherent to adjacent structures. Histopathology revealed a severe suppurative cystitis, prostatitis and bilateral pyelitis with peritonitis and meningoencephalitis. There was also osteomyelitis and soft-tissue necrosis in the right hind limb. The diagnosis was **neonatal septicaemia** resulting from either an ascending urinary tract infection, or from right hind limb trauma.

A six-month-old female Border Collie from a rural area in mid-Canterbury had diarrhoea for eight weeks before she was presented for examination when worms were seen in her faeces. A faecal egg count was 5 800 **ascarid** eggs per gram of faeces. Interestingly, she also had a positive result in an antigen ELISA test on the faeces for ***Giardia* spp.** and on faecal culture there was a heavy growth of a ***Campylobacter* sp.** consistent with *C. upsaliensis* or *C. helveticus*. Both of these species can be isolated from healthy dogs. *C. upsaliensis* has been associated with diarrhoea in dogs but *C. helveticus* is found more frequently in healthy animals than in those with gastroenteritis. It was not possible to differentiate these two organisms by the routine methods used in the laboratory. It is likely that the diarrhoea was multifactorial, but the parasitism was considered the most significant finding. Clinical parasitism in dogs is not commonly seen at this laboratory.

There were several cases of **leptospirosis** in dogs during this quarter. A 7-year-old female Huntaway from the Tararua district was anorexic and lethargic and showed some abdominal discomfort. Biochemistry on a serum sample revealed azotaemia. Other biochemical and haematological parameters were normal. Serology revealed a *Leptospira* Pomona titre ≥ 1:1 600, a Hardjo-bovis titre of 1:100 and a Copenhageni titre of 1:100, indicating ***Leptospira* Pomona infection**.

A seven-year-old female Huntaway from northern Hawke's Bay was depressed, anorexic, dehydrated and slightly underweight. She showed some incontinence and her urine specific gravity was 1.022 (a dehydrated dog with normal renal function would be expected to have USG > 1.030.) Routine biochemistry revealed azotaemia. Serology revealed a *Leptospira* Pomona titre ≥ 1:1 600, a Hardjo-bovis titre of 1:200 and a Copenhageni titre of ≥ 1:1 600, indicating infection by ***Leptospira* Pomona and *L.* Copenhageni**.

An eight-year-old male Huntaway from the Tararua district had been anorexic, lethargic and vomiting for 5 days. In-clinic testing revealed increased urea and creatinine. Serology revealed a *Leptospira* Pomona titre of 1:200, a Hardjo-bovis titre of 1:1 600 and a negative Copenhageni titre, indicating infection by ***Leptospira* Hardjo-bovis**.

Equine

A five-year-old Standardbred gelding from Northland had been diagnosed clinically with inflammatory bowel disease, resulting in proliferative structures within the small colon. It had been treated with fenbendazole for 5 days

and corticosteroids for 2 weeks, but the rectum had prolapsed. Histopathology of the small colon wall showed a severe **eosinophilic colitis** with ulceration and fibrosis. Idiopathic eosinophilic enteritis is regarded as part of the inflammatory bowel disease complex in horses. Other differentials might include multisystemic eosinophilic epitheliotropic disease, parasitism or fungal infection.

A bronchoalveolar lavage (BAL) sample from a 6-year-old mare from Otago was received for cytological evaluation and culture. Most of the cells in the cytospin preparations were macrophages (normal for equine BAL) but there were numerous mast cells present (6 percent), which was considered suspicious for allergic or inflammatory airway disease. Rare fungal spores could also be seen and were considered likely to be significant as the sample did not appear obviously contaminated. ***Aspergillus fumigatus*** was isolated from the fluid, supporting a diagnosis of possible **mycosis**.

A 3-year-old Warmblood gelding from the Tararua district showed rapid loss of weight, lethargy and diarrhoea. Haematology showed changes consistent with inflammation and there was an increased fibrinogen level (9 g/L; reference range 2–4). There was also significant hypoalbuminaemia (16 g/L; reference range 27–39) but other biochemical parameters were normal. A faecal sample was submitted and ***Campylobacter jejuni*** was isolated.

A horse of unspecified age and sex in the Taihape area showed mild anorexia, depression, slightly increased heart and respiration rate and a temperature of 39.2°C. Blood tests showed azotaemia, with creatinine 231 umol/L (reference range 75–126) and urea 10.9 mmol/L (reference range 5.0–9.7). There was also hypophosphataemia (0.31 mmol/L; reference range 0.92–1.66), hypomagnesaemia (0.49 mmol/L; reference range 0.59–1.02) and hyperbilirubinaemia (69 umol/L; reference range 17–41). Other liver enzymes were normal. There was hyperglobulinaemia (46 g/L; reference range 20–39) and hyperfibrinogenaemia (8 g/L; reference range 2–4), indicating inflammation. Another sample 5 days later showed that the azotaemia and hyperbilirubinaemia had resolved. Serology revealed a *Leptospira* Pomona titre ≥1:1 600. This was considered to be a likely case of renal disease caused by ***Leptospira* Pomona infection**.

In another case, serology on the blood from a 15-year-old mixed-breed mare with signs of recurrent uveitis revealed a titre of 1:800 to *Leptospira* Pomona, 1:800 to *Leptospira* Tarassovi and was negative for *Leptospira* Hardjo-bovis. This indicated exposure to and likely infection with ***Leptospira* Pomona and Tarassovi.**

Feline

A 4-month-old domestic shorthaired cat from Auckland had persistent diarrhoea with frank blood for a week after it was acquired from an animal rescue organisation. Faecal testing showed the presence of coccidial oocysts, consistent with a diagnosis of **coccidiosis**.

Avian

A six-year-old eclectus parrot (*Eclectus roratus*) from the Auckland region had acute anorexia and fever. Lung nodules were noted on radiography. Examination of a blood smear showed toxic granulation in heterophils. The parrot then died and post-mortem samples were submitted for histopathology and culture. Histopathology showed multifocal necrotising hepatitis and splenitis with bacilli, and a mild bronchopneumonia. ***Salmonella* Typhimurium phage type 99** was isolated from the spleen, lung and liver. This was consistent with a diagnosis of **salmonellosis** and possibly aspiration pneumonia caused by weakness.

Piscine

Several giant kokopu (*Galaxias argenteus*) kept in a Northland aquarium developed skin-reddening under the jaw and then died. Their water quality was considered normal in terms of ammonia, nitrite and pH levels, although the history included ingress of groundwater into the tank containing the affected fish. Fish in other tanks on the property were unaffected. Post-mortem examination of two fish showed reddening of the ventrum, particularly around the mandibular, pectoral and tail base regions. Histopathology of multiple organs showed a fibrinous pericarditis, dermatitis, branchitis and stomatitis with bacteria and multifocal thrombosis, suggestive of **bacterial septicaemia**. Temperature fluctuation can increase the susceptibility of fish to bacterial infections, and this may have happened when groundwater entered their tank.

Porcine

A North Canterbury pig farm with 20 breeding sows sells weaners to several finishers. The piglets are weaned at 8 weeks. Several weaners from one litter became unwell soon after arriving at a finishing farm. They were ill-thrifty and were either slaughtered or died. Histological examination of tissues from one of the affected piglets revealed lesions typical of **porcine circovirus 2 infection**.

Reptilian

An adult tuatara (*Sphenodon* sp.) from Northland had an area of apparent callus formation on the sternal region. A biopsy from the edge of the lesion was composed of necrotic keratin or exudate containing filamentous or "train-track" bacterial chains, and also mats of septate fungal hyphae consistent with a mixture of **dermatophilosis and mycotic dermatitis**. A contaminated environment, excessive humidity, abrupt temperature change and immune suppression were all considered possible contributors to this problem.

Rodent

A three-year-old male guinea pig from Whanganui presented with progressive pruritus and alopecia. Topical antiparasitic treatment with selamectin failed to halt the progression of the disease. Skin biopsies were collected and revealed eosinophilic dermatitis with marked epidermal acanthosis, hyperkeratosis and eosinophilic pustules. Rare intracorneal mites and mite eggs were identified, consistent with severe **cutaneous acariasis**. The usual cause in guinea pigs is ***Trixacarus caviae.*** Migrating mites may cause severe pruritus, leading to loss of condition and lethargy. In some cases vigorous scratching may precipitate convulsive seizures. Human contacts may develop urticaria.

A 4-year-old-female guinea pig was presented to a Christchurch veterinary clinic with haematuria and a very painful urinary bladder. No uroliths were detected. Bacteria were seen on examination of the urine sediment and there was a heavy growth of ***Corynebacterium renale*** on culture.

New Zealand Veterinary Pathology

Bovine

A carry-over mature cow in a dairy herd in the Whangarei region had mild fever at the time of calving, then one week later developed profuse, bloody diarrhoea with a mild fever. A sick-cow panel showed changes that were consistent with dehydration and inappetence. Johne's serology was negative, but culture of the faeces revealed the presence of ***Salmonella*** **Typhimurium phage type 101.** This phage type has long been associated with enteritis in dairy cattle in New Zealand (Midwinter, 1998).

A group of yearling cattle in the Taupo district exhibited ill-thrift and diarrhoea despite being regularly drenched. Faeces were submitted for a faecal egg count and culture. No eggs were found but ***Yersinia pseudotuberculosis*** was isolated on culture. **Enteric yersiniosis** was diagnosed.

Fifty animals out of a beef mob of 450 rising-two-year-olds in the Waitaki district appeared to be ill-thrifty and were not gaining weight as expected. The animals had been drenched recently. Serum samples from 10 animals were submitted for trace-element testing. Serum copper levels were low in all animals tested (2.9–7.1 umol/L; reference range 8.0–20), meaning that copper stores in the livers of these animals were exhausted**. Copper deficiency** was diagnosed.

An autumn-calving 9-year-old cow in the Waikato district exhibited jaundice, with weakness, submandibular oedema and inappetence. Haematology revealed the presence of a regenerative anaemia, with numerous parasites visible in the red cells, consistent with ***Theileria orientalis***, a classic picture of **clinical theileriosis**.

An autumn-calving mature cow in the Waikato district was coughing, lost condition and appeared "tucked up" 3 weeks after calving. The veterinarian submitted faeces for lungworm testing. A Baermann preparation revealed the presence of eight ***Dictyocaulus*** **spp**. larvae per gram of faeces, suggesting that **lungworm** was contributing to the clinical signs seen.

A dairy property in the Matamata-Piako district experienced three abortions in mid-gestation. A fetus from one of these abortions was submitted to the laboratory. Fetal necropsy was unremarkable, but histology revealed multifocal necrosis with gliosis in the brain, typical of abortion caused by ***Neospora*** **infection**. ***N. caninum*** remains an important cause of mid-gestation abortion, and histological examination of foetal tissues, especially the brain and the heart, remains the gold standard for diagnosis.

A group of 6-month-old calves in Ashburton had severe scour. Faecal egg counts on three of the calves ranged from 300 to 650 eggs per gram. Pooled faecal samples were submitted for culture and both ***Salmonella*** **Tymphimurium** and ***Yersinia pseudotuberculosis*** were isolated. These animals probably had multifactorial disease with combined **yersiniosis, salmonellosis and parasitism**. *Campylobacter upsaliensis* was also isolated from this group of calves but is considered unlikely to have been clinically significant.

A 3-year-old crossbred cow from the Manawatu district had blindness, with blue/opaque eyes suggesting corneal oedema. The animal was euthanased and brain was submitted for the transmissible spongiform encephalopathy surveillance programme. Histology revealed the presence of marked perivascular lymphocytic cuffing with leukocytoclastic large vessel vasculitis affecting the brain and the meninges. **Malignant catarrhal fever**, typically caused by **ovine herpesvirus type 2**, was diagnosed.

A group of autumn-born calves in the Manawatu district had diarrhoea. Faecal samples were negative for rotavirus and *Salmonella*, but faecal antigen testing for **bovine coronavirus** was positive and moderate numbers of **cryptosporidia** were seen on microscopic examination of a modified acid-fast stain preparation of the faeces. Coronavirus is less common than rotavirus as a cause of enteritis in calves, accounting for about 11 percent of submissions.

A group of young cattle in the Waipa district exhibited diarrhoea, with loose and bloody scour. Samples from two animals were submitted for analysis and had moderate numbers of **coccidial** oocysts and ***Salmonella*** **Bovismorbificans**. Both coccidiosis and salmonellosis likely contributed to the clinical signs in this case.

A calf in the Waikato district that had previously been vaccinated with a 5-in-1 vaccine died with post-mortem changes grossly consistent with blackleg. A sample of affected muscle was submitted for anaerobic culture, and ***Clostridium septicum*** was isolated, along with a ***Bacteroides*** sp. Without histologic assessment of the affected muscle it is difficult to assess the significance of this isolate, as the presence of a myositis was not confirmed. In general, vaccination for clostridial myositis is effective at preventing the disease. Occasional failures of vaccination may be due to problems with storage of the vaccine, or failure to administer the necessary two doses.

A group of 59 calves in New Plymouth arrived home from grazing off-farm. They appeared poorly grown and four that were persistently infected with bovine viral diarrhoea (BVD) had been removed from the group 2 weeks prior to presentation. Testing revealed moderate numbers of coccidial oocysts in faeces from many of the animals, as well as moderate numbers of *Theileria* spp. organisms visible on blood smears. Crucially, two more animals were identified as BVD-antigen-positive on testing, and it is likely that they were persistently infected. Multiple aetiologies were likely responsible for the ill-thrift in these animals, including **theileriosis, coccidiosis and bovine viral diarrhoea.** Studies have shown that in a group of

beef animals, the presence of persistently infected animals will slow growth in non-persistently infected animals, presumably because of the metabolic cost of the ongoing viral challenge within the group.

A group of 2-year-old Friesian heifers in the Tasman district experienced sudden deaths, with two animals dying within a 24-hour period. The animals had a putrid blood-tinged mucoid discharge from the anus. Histology on samples from the two dead animals revealed very poorly preserved intestines, but the abomasa were better preserved and amphophilic intranuclear inclusion bodies were visible within the vascular endothelium of the abomasal submucosa, consistent with **bovine adenovirus infection**. Bovine adenoviruses are frequently isolated from clinically normal cattle, but may cause sporadic enteric disease. Virus tends to localise in endothelial cells of blood vessels, causing thrombosis and focal areas of ischemic necrosis, leading to the haemorrhagic enteritis that was noted clinically.

Ovine

Six animals from a group of 800 two-tooth ewes in south Waikato died suddenly and about 11 appeared ill. The animals had a robust drenching history and spore counts were low on the property this season. Culture of faeces from two affected animals revealed the presence of ***Salmonella*** **Hindmarsh**. **Salmonellosis** was diagnosed.

A large sheep property in the Ruapehu district lost about 200 animals over a two-month period, with about a hundred found dead by farm staff. The animals were well vaccinated for clostridial disease and up to date with drenching, but not vaccinated for leptospirosis. Histology on one animal submitted revealed the presence of multiple lesions, including a chronic interstitial nephritis, a chronic active enteritis consistent with bacterial enteritis, and a bacterial bronchopneumonia. PCR on urine revealed the presence of leptospiral nucleic acid, suggesting that the animal was likely shedding leptospires. Culture of the gut contents revealed the presence of ***Listeria monocytogenes***. **Enteric listeriosis complicated by leptospirosis and bronchopneumonia** was diagnosed. The mixed picture here suggests that a number of aetiologies were likely contributing to the increased mortality.

A sheep from the Taupo district had skin lesions that were initially thought to be due to photosensitisation. Histology samples from the liver and skin were submitted. The liver was histologically normal, ruling out underlying liver disease. However, examination of skin biopsies revealed a marked papillomatous epidermal hyperplasia with a markedly expanded spinous layer and ballooning degeneration/vacuolation. The histologic lesions were considered consistent with **contagious pustular dermatitis (orf virus infection)**.

Five out of a mob of 600 mature ewes in the Carterton district died suddenly and six others were febrile, with temperatures up to 39.1°C. Necropsy of one sheep revealed watery intestinal contents and purple discolouration of the intestinal wall. ***Salmonella*** **Hindmarsh** was isolated from the intestinal contents and faeces of affected animals. **Enteric salmonellosis** is a relatively common cause of deaths in adult ewes but is only rarely identified in lambs. Infection may be maintained in a herd by subclinical carriers, but stressful events including feed changes, bad weather, transport, yarding and mustering can cause increased shedding of the organism, resulting in an outbreak of disease.

Equine

A 5-month-old colt in the Auckland region had a 3-day history of non-pruritic 20-mm alopecic skin lesions on the trunk and neck. No other animals on the property were affected. No arthrospores were seen on assessment of a KOH preparation of hairs taken from the margins of the affected lesions, but dermatophyte culture yielded a growth of ***Trichophyton*** **sp**. *T. equinum* is the most common cause of dermatophytosis in horses worldwide, but *T. verrucosum* and *T. mentagrophytes* are also possible aetiologies in this case. The incubation period after natural infection with *T. equinum* varies from 1 to 6 weeks. *Trichophyton* infections are usually acquired directly or indirectly from exposure to reservoir hosts such as rodents or their immediate environment (Scott & Miller, 2011).

A 4-year-old Standardbred mare in the Papakura district experienced rapid weight loss and emaciation. Blood work in the referral practice revealed markedly low albumin. Gross postmortem, performed by the referring veterinarian, was unremarkable except for the presence of an enlarged, impacted stomach. Histologic examination of small-intestinal sections revealed a marked lymphoplasmacytic infiltrate within the lamina propria of the mucosa. This was accompanied by numerous larval cyathostomes in the colonic mucosa and submucosa. Chronic **lymphocytic/plasmacytic enteritis complicated by larval cyathostominosis** was diagnosed. In this case the enteritis may have contributed to or been indicative of a degree of immunocompromise, which may also have worsened the clinical disease caused by the cyathostomes.

A 22-year-old Clydesdale horse in Invercargill had a corneal ulcer of about 10 days' duration. Initial treatment with orbenin (cloxacillin) failed and the horse was referred for specialist treatment. Cytologic examination of corneal scrapings revealed necrotic debris, suppurative inflammation and branching fungal hyphae. **Fungal keratitis** was diagnosed on the basis of the cytology. Unfortunately fungal culture was unsuccessful, so the species of fungus involved could not be determined.

Canine

A 5-month-old puppy in the Auckland region had soft faeces for 12 days prior to presentation. It had been fed a raw food diet since 10 weeks of age. Faecal cultures were negative, but ***Giardia*** antigen testing on faeces was positive. Feeding raw diets to dogs has been associated with an increased risk of shedding bacterial pathogens, but an association with protozoal zoonoses such as giardia and cryptosporidium has not been established.

A farm dog from Northland was lethargic, dehydrated and inappetant. Biochemistry revealed a marked azotaemia, with urea 66.7 mmol/L

(reference range 3.6–11.4) and creatinine 606 µmol/L (reference range 53–123). Symmetric dimethylarginine was also elevated, at 65 µg/dL (reference range 0–14). The dog also had elevated globulins (55 g/L; reference range 17–39) and elevated amylase, likely the result of decreased renal function. Alanine aminotransferase was 163 IU/L (reference range 0–75). Leptospirosis MAT revealed a titre of 1:400 for *Leptospira* Copenhageni and > 1:3 200 for *L.* Pomona. **Leptospirosis** caused by ***L.* Pomona** was considered the likely diagnosis in view of the clinical signs, chemistry and serology. Further dilution testing on the MAT revealed a final *L.* Pomona titre of 1:25 600. The recommended diagnostic criteria for leptospirosis infection is a fourfold increase in titre over acute and convalescent samples. However, dogs with severe clinical signs and very high initial titres may not survive to provide a convalescent titre.

Caprine

A goat property in the Matamata-Piako district had an outbreak of abortions. The owner collected some samples and submitted them to the laboratory, where titres for ***Toxoplasma*** were 1:1 024 on the fetal thoracic fluid. **Toxoplasmosis** is not as commonly seen in goats as in sheep, but this may be due to more rigorous preventative vaccination of dairy goats.

Feline

A 4-month old kitten in the Buller district had a severe cough. A faecal sample was submitted for lungworm testing by Baermann apparatus. Lungworm larvae of both ***Aelurostrongylus abstrusus*** and ***Capillaria aerophilia*** were present in the faeces, resulting in a diagnosis of severe **lungworm infection**. Cats acquire *Aleurostrongylus* infection by eating intermediate mollusc hosts such as snails and slugs, or paratenic hosts including rodents, birds, amphibians and reptiles.

Zoo animal

A 14-month-old young chimpanzee from a zoological collection exhibited chronic intermittent diarrhoea. Faecal culture revealed the presence of ***Campylobacter jejuni***, which was considered the likely cause.

SVS Laboratories

Bovine

Out of a group of 60 two-year-old heifers with a history of diarrhoea 6 months previously, three died and three presented with swelling of the limbs. Necropsy tissues from one heifer revealed a chronic granulomatous enteritis (with evidence of **coccidiosis**) and oedema of multiple tissues. Owing to the unusual chronicity of the tissue reaction to coccidia, which suggested an underlying immunosuppression, the in-contact heifers were tested for **bovine viral diarrhoea virus** (BVDv) with a positive result for viral antigen on RT-PCR. This contrasted with BVD tests performed the previous year at another laboratory, which indicated that they were recovered, transiently infected animals (such that the heifers were kept on-farm for a further year). The current positive BVDv test therefore confirmed them as persistently infected.

A group of mixed-aged dairy cows grazing on swedes in the South Waikato district showed skin lesions consistent with photosensitivity. Serum biochemistry in one cow showed elevated GGT (623 U/L; reference range 1–36) and high bilirubin (27.9 umol/L; reference range 0–13), indicating biliary damage and cholestasis, consistent with **secondary photosensitisation** caused by **swede toxicity.**

An 8-month-old Hereford heifer from the Waipa district was euthanased on welfare grounds. Histopathology of necropsy tissues revealed a severe bronchointerstitial pneumonia with concomitant **lungworm** larval infestation. There was also gastroenteric parasitism and serous atrophy of fat, indicating **cachexia**. Cultures of lung tissue yielded ***Pasteurella multocida*** and ***Mannheimia haemolytica***, consistent with the histological findings.

***Salmonella* Bovismorbificans** was isolated from a group of 2-week-old scouring dairy calves born in early winter (June) in the Waipa district.

Late-term abortion in a South Waikato dairy cow was investigated. RT-PCR tests on fetal stomach contents were positive for both **BVD virus** and ***Neospora caninum***. Histopathology on fetal tissues revealed multifocal encephalitis lesions consistent with **neosporosis**. It is typical of *Neospora* to remain latent in the dam's tissues following earlier infection, then to reactivate after an immunosuppressive event such as nutritional stress, or, as in this case, immunosuppression caused by a superimposed infection with BVD virus.

Out of a group of thirty 10-month-old R1 dairy heifers in the south Waikato district, five died acutely with dysentery. Salmonellosis was suspected but cultures were negative. Histopathology on necropsy tissues showed abomasitis and enterocolitis with marked submucosal oedema throughout and multifocal perivasculitis consistent with **bovine adenovirus**. Viral inclusion bodies could not be seen owing to partial tissue autolysis but RT-PCR for **bovine adenovirus** was positive on fresh abomasum and small intestine. Further investigation revealed nutritional and climatic stress factors: the heifer group sizes had been slightly increased while the number of days on rotation also increased by 2, coinciding with a wintery cold snap at the end of May.

In another case of bovine adenovirus, a yearling dairy heifer initially presented as dull and off-colour but appeared to respond to antibiotics. Two days later she had severe scour, followed by recumbency and death. Histopathology on a range of well-preserved tissues revealed abomasitis and diffuse enteritis with marked submucosal oedema and vasculitis. Basophilic intranuclear inclusion bodies were seen in endothelial cells, consistent with a diagnosis of **bovine adenoviral infection**.

A mob of 30 nine-month old Jersey bulls were coughing, afebrile and had lost weight; lungworm infestation was suspected clinically. Haematology revealed a marked eosinophilia (6.1×10^9/L in one bull; reference range 0-2.4×10^9/L) and a moderate eosinophilia of 3.7×10^9/L in another; in

light of the clinical suspicions this was suggestive of a peripheral inflammatory reaction to **lungworm** larval infection (but no faeces were available for larval detection). Lungworm infection is not often seen in groups of pasture-grazing cattle in New Zealand, but since the clinician was from the UK he was familiar with these typical signs. On follow-up, the bulls responded well to treatment for lungworm.

A 2-year-old Angus bull was lame, with an ulcerated proliferative lesion on a forelimb heel bulb (**Figure 1**). Histology showed a chronic ulcerated proliferative and suppurative lesion in which there were long black filamentous rods on silver staining. The morphological appearance was typical of the papillomatous form of **digital dermatitis,** although typical spirochaete-forms were not clearly visible on silver stains, which may be due to the chronicity of the lesion, with overgrowth of anaerobes such as fusobacteria.

Caprine

Two 1-year-old dairy does showed neurological signs of circling, suggestive of **listeriosis.** The does were euthanased and histopathology of the brain revealed typical lesions of suppurative encephalitis in the brain stem and colliculus, plus a more diffuse, non-suppurative meningitis. Listeriosis is commonly associated with poorly preserved silage/baleage.

Five does from a Matamata dairy goat farm aborted after eating silage from a pit that had been flooded during the autumn. A fetus was submitted for necropsy and harvesting of tissues. ***Aspergillus fumigatus*** was detected by RT-PCR on the fetal stomach contents, giving a diagnosis of abortion caused by **aspergillosis.**

Porcine

A litter of non-commercial 10-week-old weaner piglets in the Opotiki district showed scouring , coughing and dyspnoea, progressing to death. A field necropsy revealed pleural adhesions, consolidated pneumonia and pericarditis. Histopathology revealed a pyogranulomatous bronchointerstitial pneumona and fibrosing pleuritis, endocardial vascular thrombosis and hepatocellular necrosis. The lung and heart lesions were consistent with those caused by ***Actinobacillus pleuropneumoniae***, although lung tissues were too contaminated to isolate this bacterium on culture.

Figure 1: Angus bull with papillomatous digital dermatitis on a forelimb heel bulb (photo: Robert Visser, Visser Vets)

Equine

A Thoroughbred weanling in the Waikato region presented with weight loss. Serum albumin was down to 20 g/L (reference range 28–38). A week later, weight loss was more severe and the serum albumin had dropped to 12 g/L. ***Lawsonia intracellularis*** was detected by RT-PCR in a faecal sample, consistent with a diagnosis of **equine proliferative enteropathy.** This is the typical age group affected by this pathogen. *L. intracellularis* is a Gram-negative microaerophilic obligate intracellular pathogen that invades the apical cytoplasm of crypt cells of the distal ileum. It requires actively dividing host cells for its own multiplication and induces host-cell proliferation, causing thickening of the ileal mucosa, which in the horse causes the most consistent finding of hypoproteinaemia. Diarrhoea may be seen in some cases, but is not a consistent finding. This is in contrast to the disease in pigs, in which diarrhoea is a typical finding but hypoproteinaemia is not (Vannucci *et al.*, 2014).

Canine

Two Huntaway dogs from a sheep-and-beef station in the Kawerau district presented with collapse and jaundiced mucous membranes. Biochemistry results showed severe azotemia (creatinine 483 umol/L; reference range 45–135) and urea (32.9 mmol/L; reference range 2.6–10.2), increased liver enzymes (ALP 562 U/L; reference range 0–185) and high bilirubin (216.1 umol/L; reference range 0–6), consistent with renal and hepatic disease. *Leptospira* serology was positive, giving a diagnosis of **leptospirosis,** and a further MAT for IgG of individual serovars gave a titre of 1:200 for ***Leptospira* Copenhageni**. This district was badly affected by flooding during autumn, which is a favourable environment for leptospiral organisms.

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Quarterly report of investigations of suspected exotic diseases

Exotic disease investigations are managed and reported by the MPI Diagnostic & Surveillance Services, Wallaceville. The following is a summary of investigations of suspected exotic disease during the period from April to June 2017.

Exotic vesicular diseases ruled out

A veterinarian from Northland phoned the MPI exotic pest and disease hotline to report ulcers in the mouth of a single cow on a dairy farm, which had first been noticed two days previously. The veterinarian provided a description of the lesions, including photographs showing a tongue swollen by large nodules with occasionally ulcerated centres. The lesions were distinct from those that would be seen in foot-and-mouth disease (FMD) and other exotic diseases of concern. Based on the lesion appearance, timing and the fact that only one cow was affected, exotic disease was ruled out as a cause of disease in this case. Endemic disease such as woody tongue (caused by *Actinobacillus ligniersii*) was considered the most likely cause. The investigation was closed.

A hunter informed MPI via the exotic disease and pest hotline of granulomatous lesions around the face and lower limbs in a Himalayan tahr *(Hemitragus jemlahicus)* he had shot that day near Tekapo, in South Canterbury. The hunter was primarily concerned about the presentation being potentially consistent with that of FMD. The tahr was small, and prior to being shot appeared weak and was walking with difficulty. Thickened skin lesions were present on the face, affecting especially the mouth, base of the horns (**Figure 1**) and multiple sites on the lower limbs (**Figure 2**). The horn base had similar proliferative changes, while the horns were in very poor condition, with pieces broken off or generally eroded, dull and flaking. Photographs were reviewed by the Incursion Investigator and it was determined that the presentation was not consistent with that of FMD, but aligned with either a parapox or papillomatous condition. Under the direction of an Incursion Investigator, the hunter returned to collect fresh and fixed skin and visceral tissue samples. Histology revealed no significant lesions in sections of the liver, kidney or lung. The face and lower limb lesions consisted of an excessively folded and attenuated epidermal layer that exhibited marked hyperkeratosis. In areas the dermis contained many lymphocytes and plasma cells, and in places there were large pustules composed of degenerate neutrophils. No viral inclusion bodies were seen. Findings were consistent with contagious pustular dermatitis (orf), caused by parapoxvirus. Fresh samples underwent molecular testing at MPI's Animal Health Laboratory. Molecular assays excluded the presence of exotic poxviruses (orthopox, capriprox, leporipox) and confirmed the presence of ovine parapox (orf virus) by partial genome sequencing. The tahr was shot in an area neighbouring farmland with sheep, indicating a potential pathway for an environmental source of parapox virus. No further cases were identified. Although outbreaks of parapoxvirus in young tahr have been documented in the Southern Alps (Kater & Hansen, 1962), this report represents an isolated incident in an adult exhibiting stunted growth (given its estimated age from the horn length). In previous outbreaks adults were not affected, indicating a degree of acquired immunity. It appears conceivable that the individual reported here was more susceptible to severe or chronic infection owing to its stunted growth. Exotic disease was excluded and the investigation was stood down.

Figure 1: Lesions on the face and base of the horns in a Himalayan tahr (photo: Jim Peffers).

Figure 2: Lesions on the lower limbs (photo: Jim Peffers)

Neurological condition in cattle investigated

A pathologist notified MPI via the exotic pest and disease hotline of a farm where 10 of 220 calves (4.5 percent) showed neurological signs of ataxia. One of the calves was euthanased by the farm veterinarian and tissues were collected. Histology performed on the spinal cord showed degeneration of the ventral, lateral and dorsolateral white matter tracts but a specific cause of these changes was not determined.

A field visit was carried out to the affected property and calves were examined by a veterinary neurologist. On examination one of the calves was tetraplegic, one severely tetraparetic and weak, and the remaining six affected calves showed very mild to moderate dysmetric ataxia and mild weakness. Neurologic examinations of the first two calves and one of the latter revealed evidence of upper-motor-neuron involvement, with good tone and hyperactive thoracic and pelvic limb reflexes, as well as crossed extensor reflexes. No evidence of brain or of central nervous disease was detected. The conclusion from examination was that clinical signs were consistent with a focal spinal cord lesion.

The most severely affected calf was euthanased and radiographs taken. These showed severe disruption to the articular processes C4-5, with loss of joint space and marked modelling without marked bony proliferation. This was considered

consistent with an aseptic process, including trauma and aseptic necrosis. The calves had been vaccinated for *Moraxella* sp. intramuscularly in the neck some weeks prior to onset of clinical signs. The most probable cause of these cases of cervical myelopathy appears to have been an unusual reaction to an oil adjuvant present in the vaccine. The exact tissue site of deposition of this somewhat irritant vaccine was not known. An infectious cause of the presenting syndrome was excluded and the investigation stood down.

Exotic mycoplasmas excluded

A veterinary pathologist contacted an MPI Incursion Investigator to discuss an outbreak of coughing in calves. The pathologist had been contacted by a farm veterinarian about a case where up to 40 of a mob of 100 crossbred 6–7-month-old dairy replacement calves had presented with coughing, nasal discharge and loss of condition. Faecal samples were negative for enteric parasites and lungworm. Coughing can be a feature of *Mycoplasma bovis,* an organism exotic to New Zealand. The farm veterinarian submitted nasal swabs from four calves to MPI's Animal Health Laboratory (AHL) for *Mycoplasma* diagnostics. All four swabs were positive to a generic *Mycoplasma* / *Acholeplasma* PCR. Subsequent sequencing showed a 99 percent identification with *Mycoplasma bovirhinis*, a species that has previously been identified in association with *Mycoplasma* bronchiolitis in New Zealand (Fairley, 1997). However, *M. bovirhinis* can be found in the respiratory tract of both healthy and pneumonic cattle (Nicholas *et al.*, 2008). There were no mortalities associated with this case, so no further diagnostic work could be carried out to determine the significance of the *M. bovirhinis* detection. Nevertheless, the exotic differential *M. bovis* was ruled out and the investigation closed.

A veterinary pathologist contacted the duty MPI Incursion Investigator to discuss what appeared to be an increasing frequency of coughing in mobs of rising-two-year-old cattle. These cases could not be attributed to lungworm and there were no associated mortalities. However, the pathologist had received tissues from one outbreak where an affected animal had died from another cause. Lung histopathology revealed neutrophilic bronchiolitis with peribronchial lymphoid hyperplasia – lesions suggestive of *Mycoplasma* infection, possibly caused by *M. dispar*. The clinical history of coughing animals that were not suffering impaired performance, combined with the relatively mild pathology, meant it was unlikely that the exotic *Mycoplasma bovis* was involved. Tracheal swabs submitted to the AHL tested positive to a generic *Mycoplasma* / *Acholeplasma* PCR. Sequencing confirmed *Mycoplasma dispar*, which has been previously identified in New Zealand (Hodges *et al.*, 1983). An exotic *Mycoplasma* was ruled out and the investigation closed.

Mycoplasma ovis confirmed

A pathologist reported via the exotic pest and disease hotline that haematology results from several 8–10-month-old sheep indicated a regenerative anaemia, with inclusions visible on the surface of red blood cells. The presumptive diagnosis for the haematological changes was disease caused by *Mycoplasma ovis*, this condition having been identified morphologically in New Zealand using light microscopy in 1967. Molecular testing was undertaken to confirm that diagnosis. Of 38 sheep tested by PCR, 32 were positive (84 percent; 95% CI = 70–93%). DNA sequencing undertaken on a sample of nine PCR-positive animals confirmed a 99–100 percent match to *M. ovis*. All of the 130 sheep undergoing haematology screening had haematocrits within the reference range (0.22–0.4), although a number were at the low end of the range (range = 0.23–0.42; mean and median = 0.35; standard deviation = 0.03), indicating that the agent may affect haematological parameters and could have had a small clinical effect on the flock. In addition, PCR testing was carried out for *Theileria* and *Babesia,* with all tests negative. The investigation has confirmed the presence of *Mycoplasma ovis* and the absence of a number of other blood-borne exotic agents.

Hydatid cyst excluded

A hunter called the MPI exotic pest and disease hotline after returning home from a trip in the Rimutaka Forest Park where he killed a deer with pale, solid lumps within the parenchyma of the lungs. The associated lymph nodes were swollen and grey in colour. Photos but not tissue samples were taken and the carcass was left in the forest in a location that was difficult to access. The notifier's somewhat blurry photographs showed pink lungs with pale, poorly demarcated foci of possibly more solid material. The notifier indicated the lesions were not cystic and there was no obvious fluid on the cut surface. Hydatid disease is exotic to New Zealand. Deer and red deer in other countries have been reported with hydatid disease, although this is often linked to a cycle with the local wild canid species (Brunetti & Rosen, 1970; Onac *et al.*, 2013). We could find no historical reports of hydatid disease in feral New Zealand deer. Based on the description of the lesions as well as the photographs, hydatid disease was considered very unlikely, though no cause of the lesions was confirmed. Owing to a lack of tissue for testing, and the low likelihood of disease, the investigation was closed.

Equine "trumpet nose" investigated

A veterinarian contacted MPI via the exotic disease and pest hotline to discuss an increase in cases of rhinitis in horses from various properties he had serviced in the Waikato region over the previous 4 weeks. The syndrome was characterised by mild serosanguinous nasal discharge, nasal congestion and in some cases oedema of the muzzle area. There was no evidence of pyrexia, and mild coughing was only rarely reported. Submandibular lymph node enlargement was either unremarkable or absent. Findings were consistent with "trumpet nose" syndrome (Bosson, 1999), for

which no specific aetiology has been determined. A Thoroughbred training yard with a number of current cases was selected for further investigation. Of the 13 horses at the yard, 11 were affected, with four having evidence of external nasal swelling around the nares/muzzle. Endoscopic examination was carried out in four acutely affected cases and nasal washings and blood samples were collected from all 13 horses. Scoping identified mild oedema of the rostral nasal turbinates, with a mild serous-to-mucopurulent film widespread across mucosal surfaces of the nasal cavity. In the four horses that were scoped, the pharynx, larynx and guttoral pouches were normal in three, while in the fourth there were mild (considered incidental) changes to the larynx including mild swelling of the epiglottis and small bilateral inflammatory ("kissing") lesions on the arytenoid cartilages. Blood and nasal fluid samples were collected and submitted to the AHL (Wallaceville) where equine influenza and equine viral arteritis (EVA) were ruled out by haemagglutination inhibition and PCR tests. Serological tests for equine herpesviruses (EHV) did not indicate a role for EHV-1, -2 or -4 in the respiratory syndrome. Although a single endemic EHV-2 virus was isolated during virus culture from one of the acutely affected horses, this was consistent with the previous investigation (Bosson, 1999) and was considered to be incidental, representing normal respiratory flora. Similarly, *Streptococcus equi equi* (the cause of strangles), equine adenovirus and equine rhinitis viruses A and B were ruled out based on culture or lack of evidence of seroconversion in acute and convalescent samples. The possibility remains that this syndrome results from an environmental exposure, perhaps involving sensitisation to allergens such as fungi, although haematology and cytology of nasal flush samples did not indicate an increase in eosinophils. It is of interest to note that the condition that was widespread in the autumn of 2016 occurred at a time when an unprecedented number of facial ezcema cases were occurring, given the ideal autumn conditions for fungal growth on pasture. Exotic disease was excluded and the investigation was stood down.

Equine arboviruses excluded

An equine clinician in the Waikato contacted MPI to report signs of epistaxis in two horses, one which also had cranial neurological deficits, was hypersensitive and mildly pyrexic (38.5ºC; reference range 37.3–38.2). The horses were New Zealand-bred, one a miniature, the other an Arab. Infectious diseases causing neurological signs in horses include the endemic equine herpesviral meningoencephalopathy (EHM) caused by specific strains of equine herpesvirus type 1 (EHV-1), and exotic causes including arboviruses such as alphaviruses of the Togaviridae family, for example eastern equine encephalitis virus (EEV), Western EEV, Venezuelan EEV, and flaviviruses (Flaviviridae family, e.g., West Nile virus and Murray Valley encephalitis virus). Whole-blood EDTA samples, serum and nasal swabs from the affected and two in-contact horses were submitted to the AHL (Wallaceville). Serological testing for EHV-1 and EHV-4 was negative. Molecular assays for EHV-1 and -4, alphaviruses, flaviviruses, and generic herpesviruses all gave negative results. Both horses recovered uneventfully over 2–3 weeks, and no further horses became unwell. The presentation was attributed to head trauma (e.g., kicking). Exotic disease was excluded and the investigation was closed.

EVA and EIA ruled out

A veterinary pathologist phoned MPI to report a case of rapid-onset illness and death in a 3-year-old filly from a Waikato stud. The horse had no travel history. The autopsy showed widespread petechial haemorrhage across serosal membranes, and a complete blood count indicated there was a thrombocytopaenia (low platelets). Equine infectious arteritis (EIA) and equine viral arteritis (EVA), both exotic, can produce similar lesions. Agar-gel immunodiffusion for EIA and virus-neutralisation test for EVA were both negative. No other samples were available and no other horses were reported sick. As exotic disease had been ruled out, the investigation was closed.

An equine veterinarian contacted MPI via the exotic pest and disease hotline to report a 10-year-old farm horse that had presented with weakness and ataxia that especially affected the hind limbs. The veterinarian reported that another horse aged 23 years on the same property had also shown signs of limb weakness and ataxia, but had gradually improved. Neither horse had urinary incontinence or reduced tail or anal tone. There were no other clinical abnormalities, with normal appetites, mentation and rectal temperatures throughout. Two other equines on the property had no signs of disease. While equine herpesvirus type 1 (EHV-1) is not an exotic disease, there has only been one recorded outbreak of its neurological manifestation, equine herpesvirus myeloencephalopathy (EHM), in New Zealand. Exotic infectious diseases causing neurological signs in horses include arboviruses and flaviviruses (see previous article). Whole-blood EDTA samples and serum from the horse tested negative for antibodies to equine herpesvirus type 1 (EHV-1), EHV-4 and the exotic diseases equine infectious anaemia (EIA) and equine viral arteritis (EVA). PCR tests were also negative for the antigens to EHV-1, EHV-4, alphaviruses, flaviviruses and generic herpesviruses. Haematological and biochemical changes were unremarkable and the sera tested negative for lolitrem (the toxin that causes ryegrass staggers). The 10-year-old horse was euthanased after it collapsed and cast itself 2 days later. At necropsy, cerebrospinal fluid, brain tissue and spinal cord were collected but histological and cytological findings were unremarkable and no changes consistent with EHV myeloencephalopathy were identified. EHV-1 and exotic viral infections were excluded and the investigation was stood down.

Equine piroplasmosis excluded

An AHL scientist contacted the duty Incursion Investigator (II) to discuss the case of a 10-year-old New Zealand-based Thoroughbred mare that was being prepared for export to Australia. She had been imported from the US 10 months previously. Before coming to New Zealand the mare had been tested for equine piroplasmosis (caused by *Theileria equi* and *Babesia caballi*) by IFAT and cELISA and returned a positive IFAT test to *B. caballi*. However, the mare was negative on the cELISA test, which is the OIE-preferred test owing to its greater specificity, and this met the New Zealand Import Health Standard. Notwithstanding this result, the Overseas Market Access Requirement (OMAR) for horses being exported to Australia requires that the horse must not have had a positive result to both an IFAT and a cELISA test for *T. equi* or *B. caballi* during the 12 months prior to export. The AHL scientist informed the duty II that a blood sample from the mare had been subcontracted to an overseas laboratory for testing. This test was IFAT-positive but cELISA-negative for *B. caballi*. Given the difficulties with interpreting the IFAT test for *B. caballi* and complying with Australian OMAR requirements, repeat blood samples were collected from the mare and submitted to an OIE reference laboratory for piroplasmosis (Washington State University), where negative results were returned to both tests, for both *T. equi* and *B. caballi*.

The original IFAT-positive test for *B. caballi* was attributed to test interpretation and test specificity issues. Exotic disease was ruled out and the investigation closed. The mare was eligible for export to Australia.

Brucella canis excluded

AHL staff contacted investigators after a veterinarian submitted serum samples for *Brucella canis* rule-out from a 5-year old dog with bilateral orchitis and epididymitis. The Christchurch-based dog was NZ-bred but its parents had been imported. *B. canis* is exotic to New Zealand. The serum tested negative in the *B. canis* rapid slide agglutination test. Subsequently during surgery it was determined that the scrotal swelling was the result of an inguinal hernia. Exotic disease was excluded and the investigation was stood down.

A veterinarian contacted MPI via the exotic pest and disease hotline after examining and subsequently neutering a dog with severe unilateral swelling of the epididymis that was suggestive of epididymitis. The dog was New Zealand-bred. Serum and fresh epididymis tissue was submitted to the AHL (Wallaceville), where *B. canis* was excluded after a *B. canis* rapid slide agglutination test. Bacterial culture isolated *Escherichia coli* in pure growth. Exotic disease was excluded and no further action was required.

Canine-tick-borne diseases excluded

A veterinarian notified MPI of a dog that was showing signs of anaemia, with exotic-tick-borne disease as a differential. The dog been imported 3 years previously from Europe (with different places of residence including Portugal and the UK), so tick-borne disease was considered a remote possibility but could not be excluded. Blood tested negative by molecular assay for a number of tick-borne diseases including *Babesia, Ehrlichia, Anaplasma* and Lyme disease. The dog was diagnosed with immune-mediated haemolytic anaemia and went on to make a satisfactory recovery.

Canine leishmaniasis excluded

An official veterinarian called the exotic pest and disease hotline to report that a dog imported from the UK had a lesion and leishmaniasis (a disease exotic to New Zealand) could not be excluded. The dog had a small mass on the lateral metatarsal region of its right hind leg. Although it had been seen by a veterinarian in the UK and a benign histiocytoma appeared to be the prime differential, no confirmatory tests had been undertaken and leishmaniasis remained a possible cause. A fine-needle aspirate was not suggestive of *Leishmania,* and PCR and IFA tests were negative. Exotic disease was excluded and the investigation stood down.

A Gribbles veterinary pathologist called the exotic pest and disease hotline after receiving blood samples from a sick dog that had been imported 2 years previously from the United Arab Emirates. The dog was a 13-year-old Irish terrier that had been unwell over the previous 3 weeks with vague clinical signs including weight loss and lethargy. Haematology revealed a mild anaemia and a biochemistry panel indicated raised globulins. Findings were potentially consistent with diseases exotic to New Zealand including chronic ehrlichiosis and leishmaniasis. New Zealand Import Health Standards for dogs do not require testing for *Leishmania* or *Ehrlichia* owing to the absence here of suitable vectors (phlebotamine sandflies and the brown dog tick, *Rhipicephalus sanguineus*, respectively). Samples were submitted to the AHL (Wallaceville) for serological and molecular assays for *Leishmania* spp. and *Ehrlichia canis*. Serological assays were negative for *Leishmania,* but positive (1:400 titre) in the *Ehrlichia* IFAT. Molecular assays carried out on whole blood were negative. Findings excluded leishmaniasis and were consistent with the dog's history of having been treated for a tick-borne disease (presumed to be *E. canis*) while living in Dubai. Exotic disease was excluded and the investigation was stood down.

An AHL scientist contacted the duty Incursion Investigator after detecting a low positive titre (1:80; positive = ≥ 1:40) in the *Leishmania* IFAT in an 8-year-old male Collie dog bound for export to Australia. *Leishmania infantum* is a trypanosomal disease transmitted primarily by phlebotamine sandflies, and is common in many parts of the

world, particularly southern Europe. It is considered to be exotic to New Zealand, although imported dogs are occasionally found carrying the parasite, which can remain dormant for months or years. The dog's travel history revealed that it had been bred in the UK before being exported to New Zealand at the age of 2 years in 2011. It had no clinical signs indicative of leishmaniasis and was in very good health. Further samples (blood and conjunctival swabs) were collected and submitted to the AHL (Wallaceville) for serological and molecular assays for *Leishmania,* both with negative results. The low positive IFAT titre in the initial sample was further investigated and determined to have resulted from a reagent that was not performing adequately. Exotic disease was excluded and the dog was allowed entry to Australia.

Pacheco's disease ruled out

A veterinary pathologist called the MPI exotic pest and disease hotline to report a disease outbreak in an aviary. Over a 3-week period, 10 of 17 hand-reared cockatoos aged between 3 weeks and 3 months died. Five birds were submitted to a regional laboratory. Hepatomegaly was a feature of gross postmortem, with necrotising hepatitis and intranuclear inclusion bodies identified in hepatocytes on histopathology. While the inclusion bodies were deemed most likely attributable to an avian adenovirus, an exotic differential for inclusion-body hepatitis is Pacheco's disease. Liver samples from necropsied birds and cloacal swabs from in-contact birds were submitted to the AHL (Wallaceville), where PCR testing ruled out Pacheco's disease. Further PCR testing confirmed the diagnosis of adenovirus and sequencing identified the adenovirus as psittacine adenovirus 1. Psittacine adenovirus and more specifically Psittacine adenovirus 1 have previously been recorded in New Zealand (Anonymous 2010; Anonymous 2017). Exotic disease was ruled out and the investigation closed.

Avian poxvirus excluded

A veterinary pathologist called MPI to report possible poxviral lesions in a tui (*Prosthemadera novaeseelandiae*) held by a rehabilitator in Auckland. Poxviral disease has not previously been reported in tui. Photographs of the lesions sent to MPI for evaluation showed locally extensive loss of feathers around the beak commisures and extending down the ventral neck, with complete alopecia, severe diffuse lichenification and crusting in that region. Photos were circulated around the wildlife veterinary community and the consensus was that similar lesions had been seen in captive birds fed artificially on nectar, and these had been due to nectar dripping down the face. The rehabilitator had been holding the bird for 5 months, which was longer than specified by the DOC permit. Steps were undertaken to address the issues by both the local veterinarian and DOC office. Poxvirus was ruled out based on the unusual circumstances of this bird, and on the basis of the photographs. The investigation was closed.

Rabbit mortalities investigated

A rabbit owner reported to MPI via the exotic pest and disease hotline that 16 rabbits had died over a few days. The owner was a producer of rabbit meat and over the years had had several episodes of mortality. She had not vaccinated her rabbits against rabbit haemorrhagic disease (RHD) and thus RHD was considered highly probable. However, to confirm the presumptive diagnosis and determine the strain type if RHD virus was detected, liver samples were tested from two of the rabbits that had died. Both samples tested positive for the New Zealand field strain of rabbit haemorrhagic disease virus type 1 (RHDV1) using PCR and DNA sequencing, thus confirming that exotic strains of calicivirus were not associated with these rabbit deaths.

A rabbit owner reported to MPI via the exotic pest and disease hotline that six out of 12 (50 percent) of her pet rabbits had died acutely over the previous 6 months. She had vaccinated four out of 12 of her rabbits for rabbit haemorrhagic disease (RHD); three of these dying presumably from RHD. A liver sample collected from one of the dead rabbits was confirmed as the RHD virus NZ field strain using PCR and DNA sequencing, thus confirming that exotic strains of RHD virus were not associated with these rabbit deaths. Vaccinated rabbits that die are likely to have been overwhelmed by the viral challenge brought on by exposure and secretion of virus from infected unvaccinated rabbits.

A rabbit breeder called the exotic pest and disease hotline to report intermittent deaths of adult and young (3-4-month-old) rabbits over the previous 2–3 weeks. The informant bred NZ Whites for sale for meat and to institutions carrying out laboratory work. The most recent death occurred in an 8-month-old adult rabbit that had not been vaccinated against RHD. The breeder maintained a programme of vaccination but this was sporadic, depending on when the correct number of rabbits had reached the appropriate age. Post-mortem examination revealed blood-tinged fluid around the nose and mouth, petechial haemorrhages in the trachea, congested lungs and blood-tinged fluid in the thoracic cavity and epicardial sac. A third adult (2 years old that had been vaccinated 11 months earlier) subsequently died along with three of her 3-week-old kittens and a further kitten (all unvaccinated). The adult had similar haemorrhagic changes to the previously case, although petechia were also evident in the bowel. Liver samples were collected from two adults and four kittens and submitted to Landcare Research, where PCR and sequencing confirmed the presence of the New Zealand field strain of RHDV1 in the first does sampled (unvaccinated), but was negative in the samples collected from the other doe and her kittens, indicating another cause of death such as

septicaemia. Exotic disease was ruled out and the investigation closed.

A member of the public from the Waimakariri district called the exotic pest and disease hotline to report mortalities in her rabbits. The notifier had 63 adult rabbits and 31 kittens. In the previous four months she had purchased adult rabbits for breeding. Only three of the adult rabbits were known to have been vaccinated for the New Zealand-endemic RHDV1. Ten of the kittens had been vaccinated but the rest had been too young for vaccination. The owner had lost four adult rabbits in 4 days and was concerned that an exotic strain of RHDV was responsible for the deaths. The duty Incursion Investigator and the AHL (Wallaceville) submitted liver samples from two rabbits to Landcare Research for PCR testing. This confirmed that the mortalities were attributable to the New Zealand field strain of RHDV1.The notifier later reported that she lost 60 presumably unvaccinated adult rabbits. At the peak of the outbreak seven adult rabbits died daily. The three vaccinated adults survived. There was only one death in the vaccinated kittens, which may not have been attributable to RHDV as the kittens received booster vaccinations or primary vaccinations at the start of the outbreak. Exotic disease was ruled out and the investigation was closed.

A Christchurch rabbit breeder called the exotic pest and disease hotline to report having lost eight of 50 adult rabbits in a 6-day period. She described the rabbits as going from being fine to dull to dead within 12 hours or less. One rabbit had discharged a little blood from its nostrils. The dead rabbits were either not vaccinated for RHD virus, or their vaccination status was not current. At the request of the duty Incursion Investigator, two rabbits were submitted to a commercial pathology laboratory. There were no significant findings on gross postmortem: both were in good body condition and had full stomachs, the latter finding being consistent with sudden death. However, on histopathological examination lesions typical of RHD were identified, including severe acute hepatocellular necrosis, multifocal fibrin thrombosis and glomerular haemorrhage and multifocal fibrin thrombosis in the lungs. Further PCR testing by Landcare Research confirmed the New Zealand field strain of RHDV1.

Two weeks after the apparent end of the outbreak, the breeder reported that overall she had lost 22 unvaccinated rabbits ranging in age from 4 months to 5 years, over an 11-day period. As exotic disease was ruled out, the investigation was closed.

A member of the public from northern Waikato called the exotic pest and disease hotline to report deaths in her pet rabbits, which she bred and showed. She had been keeping rabbits for three years and had 30 ranging in age from 8 weeks to 2 years. Only two of the rabbits had been vaccinated against RHD virus. In a 4-day period three rabbits had died – two suddenly and one after displaying weakness and head tremors for 8 hours. Visible haemorrhage did not feature in the presentation. At the request of an Incursion Investigator the notifier presented a rabbit to a commercial veterinary laboratory for post-mortem examination. Gross postmortem revealed multifocal haemorrhage and histopathology revealed severe generalised hepatic necrosis and disseminated intravascular coagulation. These findings were consistent with RHD virus infection. A liver sample was submitted to Landcare Research, where PCR and sequencing confirmed the presence of the New Zealand field strain of RHDV1. Exotic disease was ruled out and the investigation closed.

A member of the public called the exotic pest and disease hotline to report the death of two of her 10 rabbits over 3 days. The rabbits had died suddenly and there were no bloody discharges as are sometime seen with RHD virus. The two 9-month-old rabbits had not been vaccinated against the endemic RHDV1. The duty Incursion Investigator had one of the rabbits submitted to a commercial pathology laboratory. Gross postmortem revealed patchy reddening of the lungs and histopathology showed widespread and severe acute necrosis of hepatocytes, and in the lung there was congestion of alveolar septal capillaries with proteinaceous fluid in alveoli. These findings were consistent with RHDV1. A liver sample was submitted to the AHL (Wallaceville) and PCR testing was subcontracted to Landcare Research. The New Zealand field strain of RHDV1 was confirmed. Exotic disease was ruled out and the investigation closed. The notifier was advised to discuss the questionable vaccination status of her eight remaining rabbits with her veterinarian.

A member of the public from Dunedin called the exotic pest and disease hotline to report the death of one of her 10 pet rabbits. The unvaccinated 6-month-old rabbit had "screamed and seizured" before dying. The notifier had been advised on a Facebook rabbit page that the death might have been due to RHDV), possibly an exotic strain, and that she should contact MPI. The duty Incursion Investigator and the AHL (Wallaceville) had a liver sample from the rabbit submitted to Landcare Research for PCR testing and sequencing. This confirmed that the rabbit had the New Zealand field strain of RHDV1. The notifier subsequently lost another one-year-old rabbit whose vaccination status was uncertain. Four of the remaining eight rabbits were current in their vaccinations. The notifier was advised to contact her veterinary practice to discuss vaccinating the other four remaining rabbits whose vaccination was not up to date or whose vaccination status was uncertain. Exotic disease was ruled out and the investigation closed.

Small hive beetle ruled out

A small commercial beekeeper called the exotic pest and disease hotline to report possible small hive beetle (*Aethina tumida*) larvae in one hive out of 24 on the property. The larvae were found

infesting the comb of a dead hive, near dead bee brood. A photo and some of the larvae were submitted, and small hive beetle larvae were ruled out. The larvae were those of a fly, *Megaselia scalaris* (Diptera: Phoridae). Exotic pests were ruled out, and the investigation was stood down.

European foulbrood excluded

An apiary contractor checking beehives for disease noticed dead and dying bee larvae in one of two hives at a Hamilton apiary. The larvae were found curled in their cells, in a half-moon shape. These signs can be caused by the exotic disease European foulbrood or EFB (a bacterial disease caused by *Melissococcus plutonius*), the endemic "half-moon syndrome" (caused by dysfunctional queens), or parasitic mite syndrome (PMS). Larvae samples tested negative for EFB by PCR. Half-moon syndrome or PMS, both management-related diseases, were considered the most likely cause of the presentation. Exotic disease was excluded and the investigation was closed.

Bumblebee mortality investigated

A member of the public in Auckland called the exotic pest and disease hotline to report that over the previous few months, from December to March, she had noticed several dead and dying bumblebees each day on the path where she regularly walked. Bee experts from AsureQuality said that die-offs were normal among bumblebees in late summer/early autumn each year, and although December was early to be seeing this behaviour, it was probably within normal disease limits. No unusual spike in bumblebee disease has been noted in Auckland or elsewhere this year. The investigation was stood down.

Exotic ticks excluded

A Manawatu veterinarian called the exotic pest and disease hotline to report a cat that presented with "insects" on its fur and was concerned that they could be ticks. While cats can pick up the endemic cattle tick (*Haemaphysalis longicornis*), the exotic tick *Rhipicephalus sanguineus* is a differential. Specimens were submitted to an MPI consultant entomologist and identified as the endemic mite *Androlaelaps casalis*, found on birds and mammals and also in leaf litter. They are facultatively parasitic as well as predatory on other invertebrates. The veterinarian reported that the mites did not cause any apparent discomfort to the cat and the infestation was eliminated with an ectoparasecticide treatment. An exotic tick incursion was ruled out and the investigation closed.

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Marine surveillance annual report

This annual report includes summary information for the Marine High Risk Site Surveillance (MHRSS) national programme and the Marine Invasive Taxonomic Service (MITS) for the winter and summer periods between June 2016 and May 2017.

The targeted surveillance programme for non-indigenous marine species focuses surveillance activities at 11 high-risk ports and associated marinas around the country (**Figure 1**). Surveillance is designed to detect the presence of non-indigenous and potentially invasive marine flora and fauna, including selected species that have documented international impacts and which would likely impact our environment and economy if they were to establish in New Zealand. The programme also aims to monitor changes in the distribution of established non-indigenous or pest species at these high-risk locations, to inform regional marine biosecurity.

The majority of marine pests targeted are listed in the New Zealand Register of Unwanted Organisms (https://www.mpi.govt.nz/protection-and-response/finding-and-reporting-pests-and-diseases/registers-and-lists/) under the Biosecurity Act 1993. These include primary target species that are not currently known to be present in New Zealand (Northern Pacific sea star *Asterias amurensis*, European shore crab *Carcinus maenas*, the marine aquarium weed *Caulerpa taxifolia*, Chinese mitten crab *Eriocheir sinensis* and Asian clam *Potamocorbula amurensis*) and secondary target species that are locally present in various areas around New Zealand (Australian droplet tunicate *Eudistoma elongatum*, Asian bag mussel *Arcuatula senhousia*, Mediterranean fanworm *Sabella spallanzanii* and the clubbed tunicate *Styela clava*). All unidentified suspect samples collected during surveillance activities are sent for identification to MITS, a marine taxonomic clearing house funded by MPI and operated by the National Institute for Water and Atmospheric Research (NIWA). All of these identifications are subsequently entered into the marine non-native species database for future reference. The data are accessible at www.marinebiosecurity.org.nz.

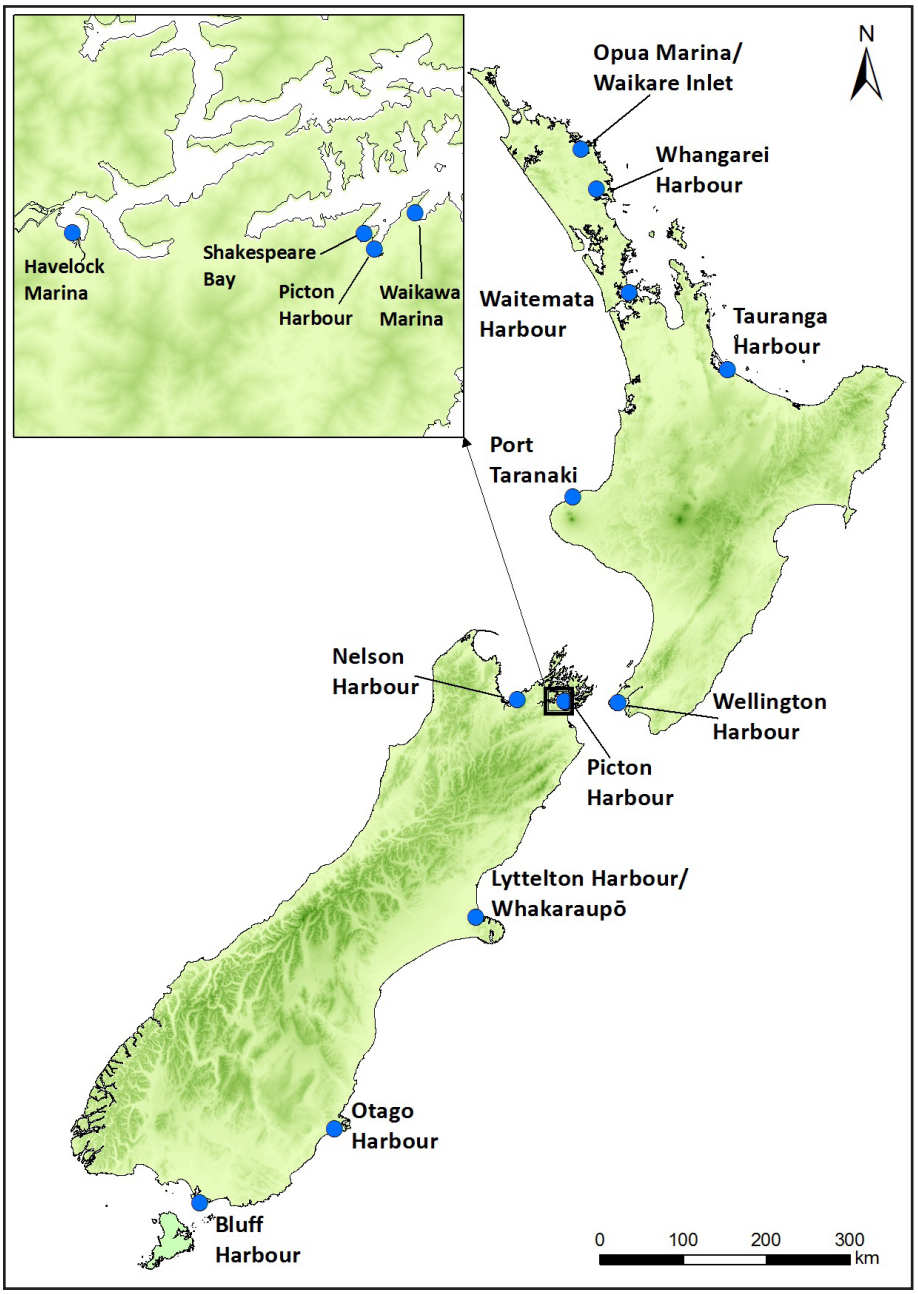

Figure 1: Locations of the 11 high-risk ports and associated marinas surveyed by the Marine High Risk Site Surveillance (MHRSS) programme

Sample collection

In total, 2 849 sites were surveyed during the 2016 winter sampling period (June to September) and 2 923 sites were surveyed during the summer sampling period (November 2016 to May 2017). These rounded figures represent 98.1 percent and 100.7 percent of the target number of sites, respectively. The lower target number for the winter survey was due to the presence of a leopard seal in the Waitemata Harbour, which prevented any diving activity owing to the associated health and safety risks. Habitats sampled included soft and hard surfaces such as mud and gravel bottoms, rocky shores and artificial structures

including marina pontoons, pilings, moorings, jetties and vessel berths. Sampling techniques used included epibenthic sled tows, crab box traps, crab condos and diver and shore searches (**Table 1**). No primary target species were detected during the survey period across all high-risk sites, but at least one of the four secondary target species was found in nine of the ports surveyed (**Table 2, page 62**).

Number of specimens collected by the MHRSS and sent to MITS

Seventy-one specimens were sent to MITS for identification, with 24 collected in winter and 47 in summer. Suspect specimens found at high-risk sites represented 13 taxonomic groups and included 11 non-indigenous species (**Table 3, page 63**).

Two of these were new records for New Zealand. Both were caprellid amphipods. *Caprella* cf. *penantis* was found in Tauranga Harbour on swing moorings near Mount Maunganui, during the winter survey; *C. scauroides* was found in the Waitemata Harbour during summer. Two species also represented a MHRSS programme range extension. The cryptic kelpfish *Chironemus maculosus* was found in Port Taranaki during the winter survey. This species is normally found in southern Australia and has only been previously recorded from New Zealand from Cook Strait. The second species was the light-bulb ascidian *Clavelina lepadiformis*, which was found in Seaview Marina, Wellington Harbour, during the summer survey. *C. lepadiformis* has been previously recorded from Nelson and Picton during MHRSS programme surveys, and from Mana Marina in Porirua Harbour.

TABLE 1: Sampling methods used for high-risk sites surveyed in 2016–2017

Method	Target species	Non-target species	Habitat	Spatial coverage	Effectiveness
Epibenthic sled tows	*Asterias amurensis* ***Eudistoma elongatum*** ***Arcuatula senhousia*** *Potamocorbula amurensis* ***Sabella spallanzanii*** ***Styela clava***	***Acentrogobius pflaumii*** ***Chaetopterus sp.*** ***Charybdis japonica*** *Didemnum* sp. *Grateloupia turuturu* *Hypnea* sp. ***Pyromaia tuberculata*** ***Theora lubrica*** ***Tritia burchardi***	Subtidal soft sediments Particular focus on known shellfish beds (for *Asterias*) and areas next to public access (e.g., wharves, boat ramps, marinas for *Caulerpa, Sabella*).	Narrow width but 100 m tow length and high replication enables a reasonably large area to be sampled (ca 3 500m^2 per location).	Reliable sample collection including asteroids, infaunal and epifaunal bivalves and polychaetes and macroalgae.
Crab (box) traps	*Asterias amurensis* *Carcinus maenas* *Eriocheir sinensis* ***Styela clava***	*Acentrogobius pflaumii* ***Charybdis japonica*** ***Pyromaia tuberculata***	Adjacent to wharf pilings and other artificial habitats. Shores and shallow subtidal habitats, breakwalls and saltmarsh, with a focus on habitats with complex physical structure.	Area sampled depends on dispersion of bait odour. High replication possible.	Quick to deploy and recover, so high replication is possible. Effectively samples other species of crabs (e.g., *Hemiplax hirtipes, Notomithrax* spp. and ***Ovalipes catharus***) and echinoderms (e.g., *Patiriella regularis, Coscinasterias muricata*). Also samples a wide range of fish species. Biofouling species may also be incidentally captured with this method if attached to mobile organisms attracted to the traps (e.g., *Styela clava* attached to masking crabs).
Crab condos	*Carcinus maenas* *Eriocheir sinensis*	*Acentrogobius pflaumii* ***Charybdis japonica*** ***Metapenaeus bennettae*** *Pyromaia tuberculata* ***Tritia burchardi***	Intertidal and shallow subtidal banks of rivers. Particular focus on brackish-water habitats with complex physical structure (e.g., saltmarsh or fringing vegetation).	High replication possible. Availability of suitable estuarine habitat may limit deployment.	Effectively samples other species of crabs (e.g., *Austrohelice crassa, Hemiplax hirtipes*). Higher rates of detection of crabs than baited traps in some conditions.
Shoreline searches	*Carcinus maenas* *Eriocheir sinensis* ***Eudistoma elongatum*** ***Arcuatula senhousia*** ***Sabella spallanzanii*** ***Styela clava***	***Chaetopterus* sp.** ***Charybdis japonica*** ***Clavelina lepadiformis*** ***Didemnum* sp.** ***Grateloupia turuturu*** ***Hypnea* sp.**	Sloping sandy shorelines, intertidal rocky reefs and areas where drift material is likely to accumulate. Wind direction on preceding days is a useful guide to where material may accumulate.	Wide: can cover long stretches of intertidal habitat quickly.	Used effectively in delimitation studies of *Styela*. Access to intertidal areas may be limiting.
Diver searches	**Arcuatula senhousia** *Asterias amurensis* *Carcinus maenas* ***Eudistoma elongatum*** ***Sabella spallanzanii*** ***Styela clava***	***Chaetopterus* sp.** ***Charybdis japonica*** ***Clavelina lepadiformis*** ***Didemnum* sp.** ***Grateloupia turuturu*** ***Botrylloides giganteum***	Wharf piles, marina piles and pontoons and other artificial structures; intertidal and shallow subtidal reefs.	Good: large numbers of piles or areas of hard substratum can be searched in detail.	Feasibility dependent on water currents, weather, water clarity and safety issues for divers.

Representative list of non-indigenous species (NIS) that are likely to be detected by each sample method. Species in **BOLD** have been detected using this method during the present or previous surveillance programmes.

TABLE 2: Summary of marine high-risk sites surveyed in 2016–2017

Location	Sampling round	Target number of sites	Actual number of sites	Target species found	Non-target species found
Opua	Winter 2016	248	249	*Eudistoma elongatum, Styela clava*	*Pyromaia tuberculata, Theora lubrica*
	Summer 2016–2017	248	249	*E. elongatum, S. clava*	*Amathia verticillata, Charybdis japonica, P. tuberculata, T. lubrica, Tritia burchardi*
Whangarei	Winter 2016	243	242	*Arcuatula senhousia, E. elongatum, Sabella spallanzanii, S. clava*	*A. verticillata, Botrylloides giganteum, C. japonica, Ficopomatus enigmaticus, P. tuberculata, T. lubrica, T. burchardi*
	Summer 2016–2017	243	246	*A. senhousia, E. elongatum, S. spallanzanii, S. clava*	*Acentrogobius pflaumii, A. verticillata, Arenigobius bifrenatus, B. giganteum, C. japonica, F. enigmaticus, Metapenaeus bennettae, Polyandrocarpa zorritensis, P. tuberculata, Symplegma brakenhielmi, T. lubrica, T. burchardi*
Auckland/ Waitemata	Winter 2016	486	429	*A. senhousia, S. spallanzanii, S. clava*	*A. pflaumii, A. verticillata, A. bifrenatus, B. giganteum, C. japonica, Limaria orientalis, M. bennettae, P. tuberculata, T. lubrica, T. burchardi, Undaria pinnatifida*
	Summer 2016–2017	486	491	*A. senhousia, S. spallanzanii, S. clava*	*A. pflaumii, A. verticillata, Apocorophium acutum, B. giganteum, Caprella scauroides, C. japonica, L. orientalis, M. bennettae, P. tuberculata, S. brakenhielmi, T. lubrica, T. burchardi, U. pinnatifida*
Tauranga	Winter 2016	243	246	*S. clava*	*Caprella cf.1 penantis, T. lubrica, U. pinnatifida*
	Summer 2016–2017	243	246	*S. spallanzanii, S. clava*	*A. verticillata, B. giganteum, U. pinnatifida*
New Plymouth/Port Taranaki	Winter 2016	243	241	No target species detected	*Chironemus maculosus, Grateloupia turuturu, U. pinnatifida*
	Summer 2016–2017	243	243	No target species detected	*T. lubrica, U. pinnatifida*
Wellington	Winter 2016	243	239	*S. clava*	*T. lubrica, U. pinnatifida*
	Summer 2016–2017	243	243	No target species detected	*Clavelina lepadiformis, T. lubrica, U. pinnatifida*
Picton & Havelock	Winter 2016	243	244	*S. spallanzanii, S. clava*	*C. lepadiformis, T. lubrica, U. pinnatifida*
	Summer 2016–2017	243	244	*S. clava*	*C. lepadiformis, T. lubrica, U. pinnatifida*
Nelson	Winter 2016	243	243	*S. clava*	*C. lepadiformis, G. cf.1 turuturu T. lubrica, U. pinnatifida*
	Summer 2016–2017	243	245	*S. spallanzanii, S. clava*	*A. verticillata, C. lepadiformis, T. lubrica, U. pinnatifida*
Lyttelton	Winter 2016	243	244	*S. spallanzanii, S. clava*	*G. turuturu, T. lubrica, U. pinnatifida*
	Summer 2016–2017	243	242	*S. clava*	*T. lubrica, U. pinnatifida*
Otago	Winter 2016	243	244	*S. clava*	*U. pinnatifida*
	Summer 2016–2017	243	248	*S. clava*	*U. pinnatifida*
Bluff	Winter 2016	225	228	No target species detected	*Caprella mutica, U. pinnatifida*
	Summer 2016–2017	225	226	No target species detected	*U. pinnatifida*

[1] cf. (Latin for confer = compares with) indicates that the specimen resembles the named species very closely, but has certain minor features not found on the type specimen/s. Whether it is a different population of the named species or a different species altogether would require more research.

Number of specimens collected by other MPI programmes and sent to MITS

MITS also received 97 samples that were collected and submitted as part of MPI investigations into exotic marine organisms, generally following notifications via the MPI exotic pest and disease hotline. From all submissions to MITS, 425 specimens were identified. Identifications were completed rapidly, with non-urgent samples identified in 6 days on average and urgent samples taking 1 day on average.

Additional resources for the MHRSS and MITS programmes

Annual reports and the New Zealand Marine Pest Identification Guide are available to read and download from http://www.mpi.govt.nz/news-and-resources/publications/ and https://www.mpi.govt.nz/document-vault/10478, respectively. Most of the information collected from marine biosecurity surveillance programmes has now been uploaded and made available via the Marine Biosecurity Porthole webpage (www.marinebiosecurity.org.nz), which houses data from these MPI-funded programmes, MITS identifications and other verified observations. Anyone with an interest in marine biosecurity can access recent information on what has been recorded in New Zealand waters: where (and in many

TABLE 3: Specimens collected and identified by MITS from each sampling locality, 2016–2017

Location	Taxonomic identification	
	Taxonomic group	Species
Opua	Ascidian	*Hypsistozoa fasmeriana*
Whangarei	Ascidians	***Botrylloides giganteum***, *Cnemidocarpa nisiotis, Microcosmus squamiger,* ***Polyandrocarpa zorritensis***, *Styela plicata,* ***Symplegma brakenhielmi***
	Anthozoan	*Actinothoe albocincta*
	Bivalve	*Corbula zelandica*
	Decapod	*Metadromia wilsoni*
Auckland/ Waitemata	Alga	*Cladostephus spongiosus*
	Amphipods	***Apocorophium acutum***, *Caprella cf. equilibria,* ***Caprella scauroides*** *Jassa cf. marmorata*
	Ascidians	*Botrylloides magnicoecum,* ***Symplegma brakenhielmi***, *Synoicum haurakiensis*
	Decapod	*Pilumnus novaezealandiae*
Tauranga	Amphipod	***Caprella cf[1] penantis***
	Annelid	*Salmacina australis,*
	Ascidians	*Aplidium phortax, Asterocarpa humilis, Botrylloides leachii, Botrylloides* sp.[2], *Corella eumyota, Pyura rugata, Styela plicata*
	Sponge	*Unidentifiable*[3]
New Plymouth/ Port Taranaki	Bivalve	*Linucula hartvigiana*
	Fishes	*Acanthoclinus fuscus,* ***Chironemus maculosus***
Wellington	Algae	*Codium fragile, Galene meridionalis, Gigartinaceae*[2], *Polysiphonia strictissima*
	Anthozoan	*Alcyonium* sp.
	Ascidians	*Botrylloides leachii,* ***Clavelina lepadiformis***, *Pyura subuculata,* ***Styela clava***
	Bivalves	*Aulacomya maoriana, Bartschicoma edgari, Corbula zelandica*
	Decapod	*Phylladiorhynchus pusillus*
	Echinoderm	*Allostichaster insignis*
	Fish	*Pseudophycis breviuscula*
	Nudibranch	*Pleurobranchaea maculata*
	Other	*Terrestrial plant material*
Picton/ Havelock	Annelids	*Chaetopterus chaetopterus* sp. B, *Megalomma suspiciens, Pista pegma*
	Fish	*Gobiomorphus gobioides*
Nelson	Alga	***Grateloupia cf.[1] turuturu***
	Annelid	*Parasabella aberrans*
	Fish	*Trachelochismus sp.*
Lyttelton	Alga	***Grateloupia turuturu***
	Ascidians	*Polyzoa reticulate, Pyura pulla*
	Bivalve	*Mytilus galloprovincialis*
Otago	Ascidian	*Botryllus stewartensis*
	Bryozoans	*Celleporina proximalis, Sertularella robusta*
	Nudibranch	*Aphelodoris luctuosa*
Bluff	No specimens submitted	

Non-indigenous species are in **BOLD**. Range extensions are indicated in **BLUE**. New to New Zealand species are in **RED**.

[1] cf. (Latin for confer = compares with) indicates that a specimen resembles the named species very closely, but has certain minor features not found on the type specimen/s. Whether it is a different population of the named species or a different species altogether would require more research into the species' population variations.

[2] Molecular techniques required for identification to species level

[3] Lacking morphological characteristics necessary for identification

cases when) it was reported. The website enables users to view sites surveyed and examine distribution records for individual species. It also gives information about significant marine pests and contains a catalogue that enables information and reports to be downloaded.

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Quarterly report of investigations of suspected exotic marine and freshwater pests and diseases

Exotic marine and freshwater pest and aquatic disease investigations are managed and reported by MPI Diagnostic & Surveillance Services, Wallaceville. The following is a summary of investigations of suspected exotic marine and freshwater diseases and pests during the period from April to June 2017.

Tuatua mortality on Ninety Mile Beach

A member of the public called the MPI exotic pest and disease hotline to report a large number of dead tuatuas (*Paphies subtriangulata*) along Ninety Mile Beach. The notifier reported that the tuatuas appeared to have worms inside them. Tuatua specimens were submitted to the MPI Animal Health Laboratory (AHL) for diagnostic testing. Some of the worms were submitted to the Marine Invasive Taxonomic Service (MITS) for identification and to ascertain their role, if any, in the mass mortality.

Diagnostics showed that a large proportion of the tuatuas were affected with a type of *Rickettsia*-like organism (RLOs). RLOs have been associated with many shellfish mass mortalities in the last few years and appear to be an emerging issue. However, we could not determine the species of RLO and hence were unable to determine whether this RLO was the cause of these shellfish mortality events.

The worms were damaged in transit and therefore the taxonomist was only able to identify them to the phyletic level of Nemertea (roundworms) and not to genus or species. Nemertea are more likely to be opportunistic feeders than parasitic. It was concluded that the tuatua mortality was probably due to multifactorial factors: presence of the RLOs, possibly adverse environmental conditions and the possibility that the worms had opportunistically attacked already weakened and immunocompromised animals. Exotic disease was ruled out and the investigation was closed.

Tuatua mortality on Waitarere Beach, Horowhenua

A member of the public reported a shellfish mortality event at Waitarere Beach in the Horowhenua district. Thousands of dead tuatuas (*Paphies subtriangulata)* were seen washed up on the beach. Horizons Regional Council and the Mid Central District Health Board (DHB) were also aware of the event, as biotoxin monitoring was being undertaken in the area. Live samples were collected and submitted to the MPI Animal Health Laboratory (AHL) for diagnostic testing. Histopathology was consistent with a bacterial infection. Some gill tissues in the samples were heavily affected by a *Rickettsia*-like organism (RLO). Samples tested negative for oyster herpesvirus and *Perkinsus* spp. by real-time PCR. Bacteriology test results showed a prevalence of several naturally occurring bacterial isolates. There was no histopathological evidence that the mortality was associated with *Rhizosolenia* diatom blooms, whose presence had been recorded at the time of the event. Rapid changes in environmental conditions at the time (such as high wave exposure and/or low salinity from stormy weather) were likely to have been important contributing factors. It was concluded that the tuatua mortality was probably due to multiple factors. A summary of the laboratory results was provided to Horizons Regional Council, the Mid Central DHB and other stakeholders including iwi. As there was no evidence of an exotic pathogen, the investigation was closed.

Lightbulb ascidian range extension

During the summer round of the Marine High Risk Site Survey in Wellington, the exotic lightbulb ascidian *Clavelina lepadiformis* was found at Seaview Marina (41.24956 S, 174.90184 E). This species was first found in New Zealand at Nelson in 2008, and appeared to be already established at that time. *C. lepadiformis* has since been found in Picton Harbour and at Mana Marina, Wellington. Despite its already having been found in the Wellington region, the detection of *C. lepadiformis* at Seaview was considered a range extension for this species, owing to the significant geographical separation between Mana Marina (on the west coast of the Wellington region) and Seaview Marina (within Wellington Harbour). The specimen was identified and lodged at MITS.

Tuatua mortality, Coromandel Peninsula

MPI received reports of a tuatua (*Paphies subtriangulata)* mortality on Waihi Beach, Coromandel Peninsula. Live specimens were collected and submitted to MPI's Animal Health laboratory (AHL) for diagnostic testing.

Histopathology was consistent with a bacterial infection. Some gill tissues in the samples were heavily affected by a *Rickettsia*-like organism. Samples tested negative for oyster herpesvirus and *Perkinsus* spp. by real-time PCR. Bacteriology test results showed a prevalence of several naturally occurring bacterial isolates. Rapid changes in environmental conditions at the time (such as high wave exposure and/or low salinity from stormy weather) were likely to have been important contributing factors. It was concluded that the tuatua mortality was probably due to multiple factors. A summary of the laboratory results was provided to the Bay of Plenty Regional Council and other stakeholders. As there was no evidence of an exotic pathogen, the investigation closed.

Japanese mantis shrimp range extension confirmed

NIWA notified MPI that the Japanese mantis shrimp (*Oratosquilla oratoria*) had been reported from Mangonui Harbour, Northland. A member of the public with an interest in taxonomy had emailed photos of these shrimps to NIWA after a flounder fisher showed them to him. They had been caught in flounder nets in the upper reaches of the Mangonui Harbour, in about a metre of water at low

tide. Both male and female adult shrimp had been caught over subsequent days, indicating the presence of an established population. NIWA was able to confirm from photos that these were *O. oratoria* and not a native species. This represents a northern range extension for this species, which was previously known only from the Kaipara and Hokianga Harbours on the west coast and the Bay of Islands on the east coast. The range extension was noted and will be communicated to stakeholders via Marine High Risk Site Surveillance networks.

Greasyback prawn range extension confirmed

A NIWA scientist was approached by a commercial fisher regarding some prawns he was catching in the intertidal zone on the western side of the mouth of the Waitakaruru River, Firth of Thames. Apparently he had known about the prawns in the area for about 5 years, and regularly took them for bait. Photos submitted of frozen specimens were suspected to be *Metapeneaeus bennettae*, the greasyback prawn. This species is native to Australia and exotic to New Zealand, where it was first recorded in 2009. There had been previous anecdotal reports from the Firth of Thames, but to confirm these a frozen sample was sent to MITS. The samples were confirmed as *M. bennettae*, extending its known range in New Zealand, which already included Auckland and Whangarei harbours.

Shellfish mortality at Hokio Beach investigated

A member of the public contacted the Mid Central District Health Board (DHB) after consuming shellfish collected from Hokio Beach, near Levin. The shellfish appeared stranded on the surface of the beach at near the mouth of the Hokio Stream, and some appeared to be dead, with seabirds scavenging them. While the notifier had otherwise felt well after consuming them, he had in retrospect wondered if he should report the incident. The DHB in turn reported the event to MPI and an investigation was initiated to consider whether a disease was affecting the shellfish. The notifier was unsure what type of shellfish were involved.

A contractor was sent to the area to collect samples. Near the mouth of the Hokio Stream there was some shell debris of mostly tipitipi (*Dosinia* spp.) but no evidence of a recent or significant mortality. Even though it was unclear what species of shellfish (if any) were affected, a sample of 10 tuatua (*Paphies subtriangulata*) was collected in the lower intertidal zone. These were submitted to the MPI Animal Health Laboratory, where they tested negative to *Perkinsus olseni*. Histopathology revealed that these tuatua had recently spawned, and *Rickettsia*-like organisms, often associated with bacteria, were seen on the gills and palps of seven of them. No significant pathology was reported. With no further reports of dead or dying shellfish from the area, the investigation was closed.

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National invasive ant surveillance programme annual report 2017

Introduction

The National Invasive Ant Surveillance programme (NIAS) detects newly established exotic ant species in New Zealand and provides information on range extensions of species already known to be established. Ants are widely dispersed through human activity and commonly intercepted in air and sea cargo including fresh produce, timber, sea containers and personal baggage. They are major urban pests, invading homes, shops, cafes, etc., where food is readily available. They also threaten natural biodiversity by displacing native invertebrate species and encouraging horticultural pests. Invasive ants such as Singapore ant (*Trichomyrmex destructor* = *Monomorium destructor*) gnaw holes in fabric and rubber goods, remove rubber insulation from electric and phone lines, and damage polyethylene cables. Cars parked overnight in infested areas can fail to start the next day after the ants have shorted ignition systems (Global Invasive Species database, 2017).

High-risk sites for ant entry are determined by pathway and site risk analyses undertaken annually. High-risk sites include seaports, airports, sea container storage and repair sites and Transitional Facilities that receive international freight. Sites are then scheduled to be surveyed from mid-summer to early autumn each year.

The identified risk sites are surveyed by ground teams co-ordinated by AsureQuality Ltd. Small plastic pottles, alternately baited with carbohydrate (sugar solution) or protein (peanut butter, oil and sausage meat) (**Figure 1**) are placed in grid formation. Additional pottles are used to collect live ants where these are found by visual inspection. Pottles are left out at each site for about two hours under favourable environmental conditions to maximise the number of foraging ants collected while also reducing the risk of the bait drying out and becoming less attractive to ants (**Figure 2**).

For the first time in 2017, dome-type ant traps (a long-term trapping system) were used on a trial basis at the Ports of Auckland. These traps consist of a base section containing a glycol-filled capture chamber coated with Teflon and three types of attractive baits (honey, peanut butter and shrimp paste), with a plastic dome cover over the top (**Figure 3**). Ants attracted to the baits fall into the capture chamber and are preserved in the glycol. The general principle is the same as with a pitfall trap but the capture chamber is raised up and housed in a unit that can be deployed on hard surfaces (i.e., no ground excavation is required). These traps can be left deployed for a period of days or weeks before being retrieved and contents examined.

Figure 1: NIAS protein pottle deployed at Auckland International Airport, with native *Iridomyrmex suchieri* workers foraging on bait (Photo: Paul Craddock, Flybusters Consulting Ltd)

Figure 2: Surveying at the Port of Auckland during NIAS, 2016 (Photo: Paul Craddock, Flybusters Consulting Ltd)

Figure 3: Dome trap deployed on Jellicoe Wharf at Ports of Auckland (Photo: Paul Craddock, Flybusters Consulting Ltd)

Twenty-three traps were deployed in the multi-cargo area of the Ports of Auckland for 27 days (26 January–22 February 2017), giving an effective total of 621 trap-days. This was done to test the practical application of these traps for further use on an ongoing basis. The multi-cargo area is a known hot spot for exotic ant activity (FBA Consulting 2016), and is also the type of environment the traps were designed to monitor. Pottle surveillance was also undertaken in the area where the traps were deployed, to compare dome trap performance with pottle surveillance.

GPS locations and associated data are recorded on hand-held data loggers. All samples are tracked electronically from the field to identification in the laboratory. Pottles and the dome traps are sent to the Flybusters Antiants Consulting Ltd diagnostic laboratory for initial identification. Suspect exotic ant specimens are sent to MPI's Plant Health and Environment laboratory (PHEL) (Tamaki) for validation of ID. Once an exotic ant find has been validated, an investigation is initiated to track down and eradicate nests near the location of the original find.

Results

In the 2017 season, 44 618 pottles were deployed, with 13 pottles recording new exotic ants. Of these, 9 were confirmed from active established nests (**Table 1**) . Four dome traps caught exotic ants, and of these one was confirmed to be from an active established nest (**Table 2**).

Pottle deployment varies from year to year owing to variations in site selection and weather. Climate is a significant factor that affects ant distribution, behaviour and the number and size of nests. The environmental factors to which ants are sensitive include air and soil temperature, rainfall and soil moisture deficit. Accordingly, favourable conditions during the lead-up to the surveillance period have been implicated as a cause of increased interceptions: the presence of more nests means more

TABLE 1: Location and numbers of ant detections in pottles during NIAS, 2017

Species	Location	No of nests found
Paratrechina longicornis	Opua Marina, Northland	1
Paratrechina longicornis	Ports of Auckland	0
Paratrechina longicornis	Ports of Auckland	0
Paratrechina longicornis	LPC City Depot, Christchurch	0
**Trichomyrmex destructor*	Port Nelson	1
+*Monomorium dichroum*	Port of Tauranga	1
Tapinoma melanocephalum	CSL Containers, Auckland	2
Monomorium dichroum	Port of Tauranga	0
Paratrechina longicornis	Port of Tauranga	0
Tapinoma sp.	Port of Timaru	1
Paratrechina longicornis	Ports of Auckland	1
Paratrechina longicornis	Opua Marina, Northland	1
Paratrechina longicornis	Ports of Auckland	1

* Previously known as *Monomorium destructor* (D. Gunawardana, pers. comm.)

+ *Monomorium dichroum* was identified as *Monomorium* sp., (D. Gunawardana pers.comm)

TABLE 2: Location and numbers of ant detections in dome traps at Ports of Auckland during NIAS, 2017NIAS, 2017

Species	Trap number	No of nests found
Paratrechina longicornis, Tapinoma melanocephalum	2	0
Tapinoma melanocephalum	5	0
Paratrechina longicornis	8	1
Paratrechina longicornis	12	0

interceptions are likely (Gunawardana *et al*., 2013; Browne *et al*., 2012; Porter, 1988).

The weather from winter 2016 to summer 2017 was considered to be good for supporting ant populations. In particular, the mild winter and spring of 2016 will have encouraged ant activity and nest expansion in early spring/summer. Summer was more variable, with dry patches and cooler temperatures slowing ant activity somewhat. Anecdotal observations showed that ant activity began earlier in spring this season, but then had a late summer hiatus as the weather was more variable. Mixed weather over January also meant more interruptions of NIAS field operations than usual.

Four exotic species were recorded in pottles (**Table 1**), including *Monomorium indicum, Paratrechina longicornis* (crazy ant), *Trichomyrmex destructor* (*Monomorium destructor* – Singapore ant) and *M. dichroum*. All these ants and their associated nests were destroyed. The 2017 season again demonstrates the value of early intervention in preventing the establishment and spread of exotic ant species in New Zealand.

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National Fruit Fly Surveillance Programme 2016–2017

New Zealand's National Fruit Fly Surveillance Programme entails seasonal monitoring for the presence of economically important fruit flies, using lure traps placed at high-risk locations throughout the country. This programme was initiated in the mid-1970s to help provide assurance that New Zealand is free from economically important fruit flies, and as an early warning of fruit fly incursions to assist in an eradication effort.

There are currently about a hundred species of fruit fly listed on the MPI website as regulated organisms. The absence of economically important fruit flies enables the country to export fresh produce without treatment for fruit fly, thus facilitating trade. It also enables crops susceptible to fruit fly to be grown here without the need to manage fly populations and the damage they cause. As an illustration of how important this is, horticulture exports in 2016 earned $5.1 billion, and more than 80 percent of fresh and processed fruit exports by value were of species that are considered hosts for fruit flies (Horticulture New Zealand, 2016).

Fruit flies belong to the family Tephritidae, which includes more than 4 500 species. The economically important species monitored here are Mediterranean fruit fly *(Ceratitis capitata)*, Oriental fruit fly *(Bactrocera dorsalis),* and Queensland fruit fly *(B. tryoni)* (**Figure 2, page 70**).

Since 1989 there have been 10 recorded interceptions of exotic economically important fruit flies: seven in Auckland and three in Northland. Six of these interceptions (including one in February 2015) involved *Bactrocera tryoni* (Queensland fruit fly). Other incursions have involved *Ceratitis capitata* (Mediterranean fruit fly – one case in May 1996), *B. passiflorae* (Fiji fruit fly – one case in 1990), *B. papaya* (papaya fruit fly – one case in 1996), and the most recent was *B. tau* (Tau fruit fly – one case on 21 January 2016. The May 1996 *C. capitata* and February 2015 *B. tryoni* detections resulted in an eradication programme being initiated, but none of the other finds were from established breeding populations (as determined from heightened surveillance).

AsureQuality has conducted fruit-fly surveillance for MPI (formerly the Ministry of Agriculture and Forestry) for almost 20 years. In all, 7 732 fruit-fly traps were serviced fortnightly in 149 individual "trap runs" by AsureQuality staff servicing the North and South Islands (**Table 1**). A trap run is a set of traps from within a defined geographic area, which are serviced by a trained trapper, and the number of traps in a run ranges from 7 to 104, with the mean being 52. Traps are placed in the centres of cells making up a grid located in a high-risk area. Within each cell, a host tree is selected for trap placement using a hierarchical ranking system.

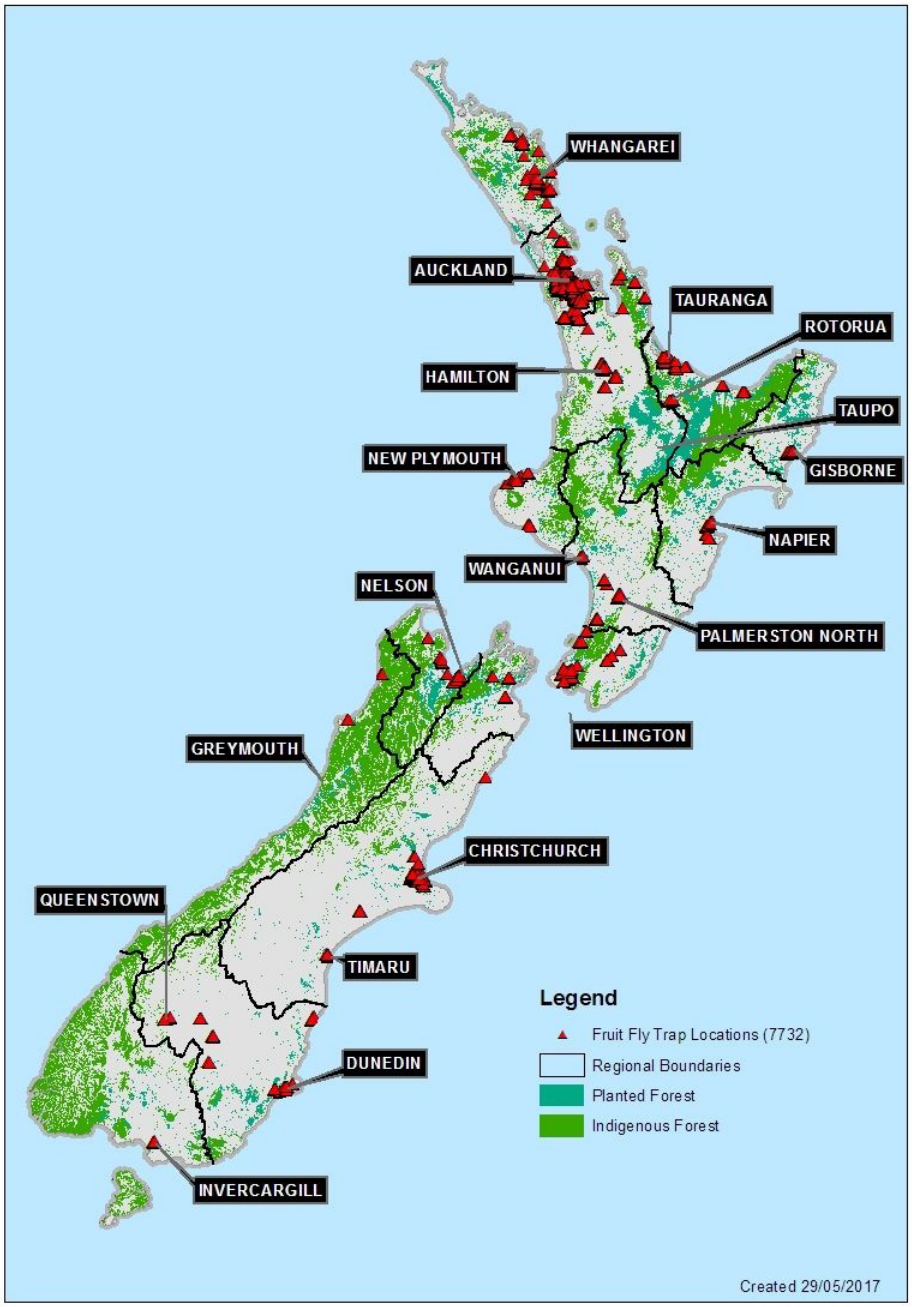

Figure 1: Map of New Zealand showing distribution of trap sites for fruit fly surveillance, 2016–2017

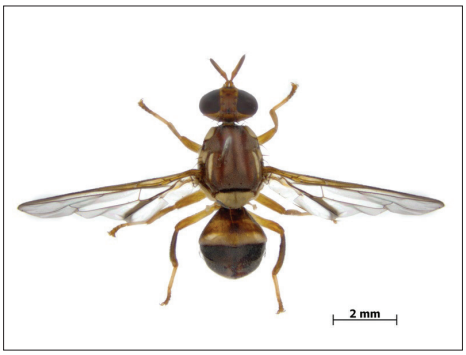

Figure 2: Queensland fruit fly (*Bactrocera tryoni*)

TABLE 1: Numbers of traps and trap runs by region, 2016–2017 season

Region	Number of trap runs	Number of traps
Auckland/Northland	71	5 001
Waikato/Bay of Plenty	18	672
Lower North Island	28	928
Upper South Island	20	757
Lower South Island	12	374
Total	**149**	**7 732**

A pheromone-impregnated fruit-fly lure and a plastic strip impregnated with an insecticide (dichlorvos) are placed in Lynfield-type fruit-fly traps, which are inspected every 13–15 days. Suspect flies are submitted to either the Tamaki or Christchurch Investigation and Diagnostic Centres for taxonomic identification.

Although the Fruit Fly Surveillance Programme season ran from early October 2016 until early July 2017, each region has its own start and finish dates based on local temperature, which is considered to accurately reflect the risk of fruit-fly establishment. This season's sampling effort ran from 3 October 2016 to 3 July 2017.

Trapping

Each trap is clearly labelled "Fruit Fly Trap" and displays the MPI and AsureQuality logos and a freephone contact number. The distance between the centres of cells that contain the traps depends on the efficacy of each lure and biology of targeted species. For example, cells that contain trimedlure and cuelure traps measure 400 x 400 m, while those that contain methyl eugenol traps are 1200 x 1200 m. The minimum size of any trapping run is two adjacent grid cells, and both cells are selected so as not to overlap if possible. An example of a run in the western suburbs of Auckland is shown in **Figure 3**.

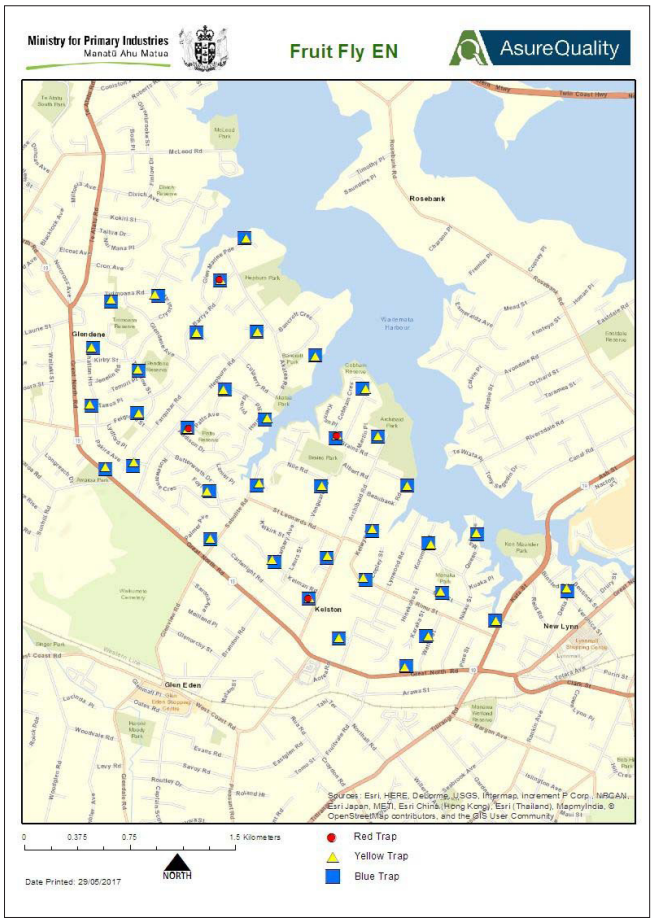

Figure 3: A grid made up of cells overlaid on an aerial photograph, showing the run of Queensland and Mediterranean fruit fly (yellow and blue) traps and Oriental fruit fly (red) traps in the western suburbs, Auckland

Figure 4: Fruit fly trap containing cuelure for Queensland fruit fly

Host trees are preferentially selected as close to the grid centre as possible, and the trees themselves are ranked by four host-preference types: evergreen fruit trees, deciduous fruit trees, New Zealand native evergreen trees with fleshy fruit, and gooseberry bushes.

Traps are placed so that they are protected from direct sunlight, wind and dust, and are typically located at least 1.3 m above the ground, in an area of dappled light within the foliage and not beneath the canopy (**Figure 4**). This increases the chance of attracting the target species. To avoid cross-contamination between lures the traps are placed at least 3 m apart, and also at least 3 m from any other insect trap (e.g., for codling moth or gypsy moth).

Any fly 3–15 mm long is regarded as suspect. Suspect flies are sent to the diagnostic laboratory within two working days after trap servicing. Nil returns are also submitted, to confirm that the traps on the run have been checked. New traps are used at the start of each season, and all traps and lures are destroyed within two weeks after the end of the season.

Trappers attend refresher courses every year on trap servicing, where they are also updated on any changes of procedure.

Results

In terms of meeting the programmes objectives, the 2016–2017 surveillance programme was a success. There were 2 804 routine submission events, with a total of 5 624 suspect fly samples. A further two suspect samples were forwarded for taxonomic determination as a result of trapper passive surveillance within the fruit fly programme (i.e., when a trapper notices a specimen of concern that is at the trapping site but not in the trap.)

Table 2 records that 5 624 suspect fly submissions were made. The Auckland and Northland regions recorded the highest number of suspect samples (1 853, or 33 percent of the total). The number of traps per run ranged from seven to 104 (mean = 52, S.E. = 0.6), with a total deployment of 7 732 traps (**Table 1**). Just under half of the submissions (48 percent) were made from October to January (**Table 2**). The number of suspect sample submissions generally followed a similar pattern to previous years (**Figure 5**), with the majority of submissions made between October and February. The increased number of sample submissions from October to December 2014 compared to the same time period in 2015 and 2016 is attributed to warmer temperatures and higher rainfall early in 2014. This indicates that a trapping season from September to June/July sufficiently spans the period when fruit flies are most likely to be caught.

This past season, MPI favoured starting the surveillance programme in October to maximise the chance of detecting fruit fly incursions, based on temperature and likelihood of introduction and establishment modelling conducted by Plant & Food Research Ltd for MPI. Thus the 2016–2017 season did not have any suspect samples in September but did have some in July. This period is considered the best compromise of operational effectiveness and biological considerations. The increase in temperature at this time increases insect activity and the season is long enough for plenty of trap days to gather a large sample size.

TABLE 2: Numbers of suspect submissions by region, 2016–2017 season

Month/ region(s)	Auckland/ Northland	Waikato/Bay of Plenty	Lower North Island	Upper South Island	Lower South Island	Total
October 2016	226	26	73	196	71	592
November 2016	235	30	116	379	120	880
December 2016	330	27	133	374	178	1 042
January 2017	178	21	98	304	179	780
February 2017	102	20	97	157	114	490
March 2017	153	35	102	140	103	533
April 2017	142	27	105	165	73	512
May 2017	223	15	98	122	52	510
June 2017	153	15	0	0	0	168
July 2017	111	6	0	0	0	117
Total	**1 853**	**222**	**822**	**1 837**	**890**	**5 624**

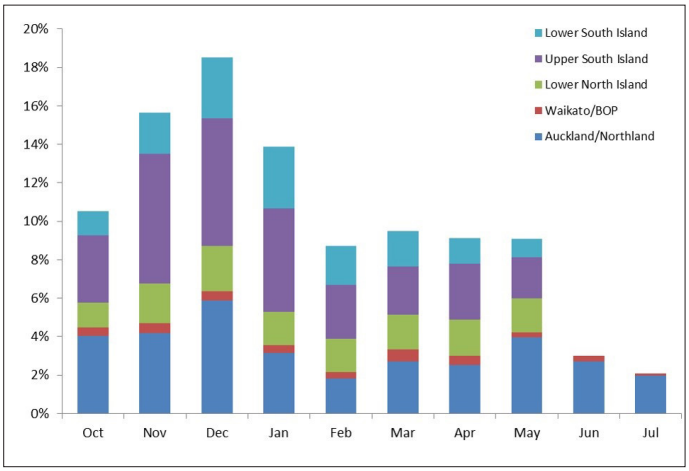

Figure 5: Fruit fly sample submissions by month and year

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National saltmarsh mosquito surveillance programme 2016–2017

In 2016–2017 no new detections of exotic mosquitoes were reported by the National Saltmarsh Mosquito Surveillance Programme (NSP). This is the first full year of operation of the NSP under the current contract with MPI. In 2016 the NSP methodology was revised to expand the coverage of target surveillance habitat adjacent to high-risk Transitional Facilities, while also reducing it in habitats that had been previously positive for the exotic saltmarsh mosquito *Aedes camptorhynchus*. With no detections of *Ae. camptorhynchus* since 2006, previous site positivity is no longer considered a factor of habitat risk. However, the risk factor of ground pool habitat adjacent to ports of entry now has additional significance in the context of Transitional Facilities being regarded as virtual "point of entry" and not previously a major consideration for exotic mosquito surveillance.

While the geographical scope of target habitat has been revised, the mosquito sampling methodology, human resources and systems remain largely unchanged. However, enhancements in data management and field recording of sample data has continued to evolve through use of smart phone applications linked to the NSP database. Use of such technology provides for a secure chain of custody for field samples linked to collecting data and tracking of samples to the Mosquito Consulting Services (NZ) Ltd laboratory and reporting on the database (**Figures 1 and 2**).

Figure 1: Sampling saltmarsh mosquito habitat

Figure 2: MCSNZ proprietary field sample app in use

TABLE 1: Larval mosquitoes identified, 2016–2017

Ae. antipodeus	2 269
Cx. pervigilans	13 229
Cq. irucunda	0
Ae. notoscriptus	3
Cx. quinquifasciatus	56
Ae. subalbirostris	244
Cs. tonnoiri	0
Ae.australis	103
Cq. tenuipalpis	0
Op. fuscus	85
Total	**15 989**

TABLE 2: Adult mosquitoes identified, 2016–2017

Ae. antipodeus	939
Cx. pervigilans	765
Cq. irucunda	169
Ae. notoscriptus	425
Cx. quinquifasciatus	78
Ae. subalbirostris	22
Cs. tonnoiri	87
Ae.australis	0
Cq. tenuipalpis	6
Op. fuscus	8
Total	**2 499**

In 2016–2017 the NSP surveillance detected 10 mosquito species. All were either native or otherwise long-established non-native. There were 15 989 larvae and 2 499 adult mosquitoes collected and identified to species during the year (**Tables 1 & 2**). There were no new exotic species detected by NSP field surveillance during the year.

This year, significantly more mosquito larvae were collected than in any previous years (n = 15 989), compared to the long-term annual average (2010-2017) of 11 400 (σ = 2 304) (**Figure 3**). The increased numbers of larvae in collections were largely from new NSP sampling locations adjacent to high-risk Transitional Facilities in Auckland and Tauranga. It is a positive outcome that changes in the NSP methodology have resulted in increased returns from mosquito collections (in current terms, of existing New Zealand species only) and should be viewed as an enhancement of the likely detection of exotic mosquito species potentially utilising saline and brackish ground pool habitats.

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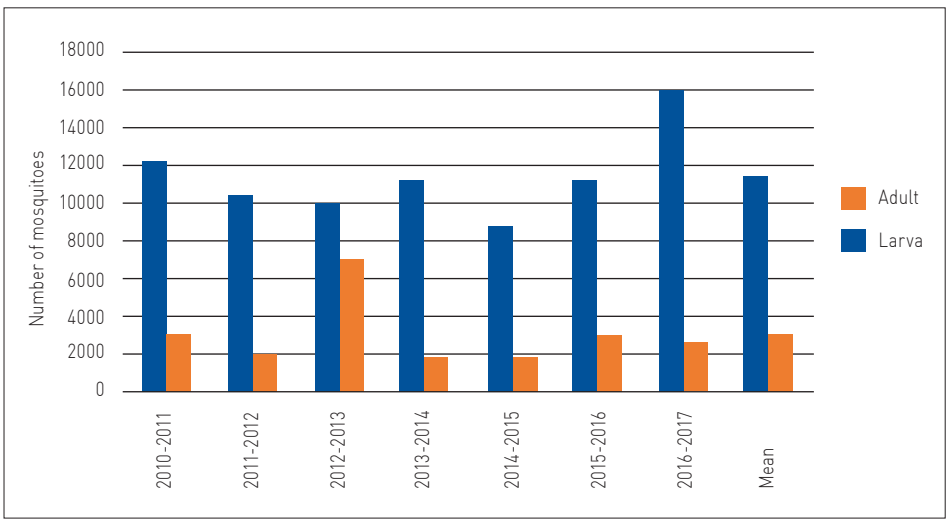

Figure 3: Annual NSP collection totals

High risk site surveillance programme annual report 2016–2017

The High Risk Site Surveillance (HRSS) programme is a Ministry for Primary Industries (MPI) surveillance programme focused on post-border risk pathways, targeting vegetation (primarily trees and shrubs) and wooden materials. The primary objective of the HRSS programme is to detect new plant pests that could have negative impacts on plantation forests, native forests and urban trees.

Methods

The HRSS programme identifies high-risk sites, where the risk of introduced organisms is high owing to movement of tourists and cargo. Risk Site Areas (RSAs) are grouped based upon identified clusters of sites, and include ports, Transitional Facilities (TFs) where containers are unloaded, tourist venues and golf courses. Relative risk and the required probability of detection are calculated to improve allocation of surveillance resources. Surveillance transects are assigned within RSAs to cover areas of potential host vegetation and provide discrete, repeatable "packets" of intensive surveillance. Field surveyors thoroughly inspect trees, shrubs and woody material within transects. Suspect samples assessed by the field surveyor to be a biosecurity risk are collected and submitted to an MPI-approved laboratory for identification. New records are reported through MPI's exotic disease and pest hotline (0800 80 99 66) for further action and validation is recorded in MPI's Plant Pest Information Network (PPIN) database.

The HRSS is administered by AsureQuality, which also carries out surveillance in the Wanganui-Manawatu region, while SPS Biosecurity does the necessary fieldwork throughout the rest of New Zealand. HRSS programme methods are further detailed in Stevens (2011). Data collection and sample submission is fully electronic, so the diagnosticians can access the data on each sample while examining it.

Changes made to the risk model in previous years to enable a risk factor to be allocated to each individual RSA throughout New Zealand were maintained this season. For efficiency, all risk and calculated risk sites are mapped in geographic information systems (GIS) to better allocate limited surveillance resources. The probability of detection (Carter, 1989) is increased by repeated surveying, so RSAs with the highest calculated risk were inspected up to four times during the season.

In early May 2017 HRSS staff were deployed to assist in the Myrtle Rust Response led by MPI. Consequently round 3 of the HRSS survey was extended by two months, to 31 July. To co-ordinate submissions and diagnostics reports and finalise the 2016-2017 annual report the decision was made to cut off reporting from the end of May 2017, so transect inspections have not been reported for the full year.

Results

Field surveillance

During the 2016–2017 season 449 RSAs were surveyed and 6 060 transect inspections were completed. Most surveillance (94 percent of all transects) was carried out around TFs or in vegetation-rich areas near TFs.

Table 1 shows the calculated biosecurity risk for the 10 regions most at risk, compared to the actual transect inspections completed in each. Auckland has the highest biosecurity risk, which is directly related to the volume of passengers entering the country and imported goods being unloaded there.

TABLE 1: Calculated regional risk compared with percentage of transect inspections completed in 2016–2017

Region	Calculated biosecurity risk (percent)	Completed transect inspections (percent)
Auckland	48	46.2
Bay of Plenty	16	12.0
Mid-Canterbury	10	10
Hawke's Bay	6	4.4
Dunedin	4.8	3.2
Wellington	4.7	6.1
South Canterbury	3	1.8
Waikato	2.4	2.8
Nelson	2	1.7

Source: Saavedra Roman *et al.*, 2017

Each year the HRSS programme inspects nearly a thousand tree species. Commercial species are specifically targeted but many pests have multiple hosts and in many RSAs there are insufficient commercial species planted to provide a representative sample. Therefore a wide cross-section of native and urban exotic tree species are also inspected. This year, on average, about 220 specimens of each species were inspected, and about 34 trees per transect.

Diagnostics

Most diagnostic support for the HRSS programme is provided by Scion's Forest Health Reference Laboratory (FHRL). MPI's Investigation and Diagnostic Centre, Plant Health and Environment Laboratory (PHEL) identified samples not associated with woody-stemmed trees and shrubs (e.g., from palms and tree ferns), or suspected of containing viruses, bacteria or nematodes. PHEL was also responsible for validating all new to New Zealand identifications.

From July 2016 to May 2017 the diagnostic labs received 843 potential risk organism submissions. After diagnosis these were divided into three sample categories: entomology (insects), mycology (fungi) and "inconclusive or other" (**Table 2**). This season there were fewer insect specimens and plant samples that showed insect damage, compared to the last 3 years. Conversely, the

TABLE 2: Summary of potential risk organisms by category, 2013–2017

Sample category	2013-2014 percent	2014-2015 percent	2015-2016 percent	2016-2017 percent
Entomology	61	61	52	42
Mycology	16	18	26	34
Inconclusive or other	23	21	22	24
Total	**100**	**100**	**100**	**100**

Source: Saavedra Roman *et al.*, 2017

TABLE 3: Diagnostic trends from 2013 to 2017 (FHRL and PHEL)

Type	2013-2014	2014-2015	2015-2016	2016-2017
Number of submissions	860	651	841	843
Species identified	1 154	896	1 109	1 117
Species new to NZ	2	0	7	9
Detections significant to PPIN	153	135	159	164
Significant detections (percent of total submissions)	18	21	20	20

Source: Saavedra Roman *et al.*, 2017

numbers of fungal samples were higher than last season because the weather was particularly conducive to fungal growth. Samples that yielded inconclusive results were further examined by the pathology laboratory to rule out fungal damage. In about four percent of all samples bacteria, viruses or nematodes were identified. In 20 percent of samples no insect or pathogen damage was identified, nor were organisms isolated that could have caused the damage.

In total, 1 117 diagnostic identifications were made during the season, of which about 61 percent were identified to species level, and 143 PPIN reports were prepared by FHRL (including one of a new to New Zealand species) for MPI. All species identified by FHRL were fully evaluated within 15 days for their potential biosecurity threat, and 85 percent of insect identifications were completed within 15 days. The HRSS programme generated 89 samples that were submitted directly to PHEL, plus 11 samples were submitted by FHRL. In addition to the eight new to New Zealand PPIN reports, 21 PPIN reports were generated out of direct submissions to PHEL. The results show that the surveillance programme is effective in detecting new organisms, that the surveyors are able to recognise new species, and that the identification process is robust.

FHRL and PHEL reported that the quality of submissions from the field was of the same high standard as the previous year.

Discussion

The number of significant samples identified provides one measure of the effectiveness of a surveillance programme and provides important data for MPI to meet the HRSS programme objectives. **Table 3** shows the number of samples received and lists significant identifications (species new to New Zealand, new host associations and new distribution records) from 2013 to 2017.

Conclusion

The effectiveness of the HRSS programme is enhanced by allocating surveillance resources to areas of highest risk rather than randomly surveying the whole country.

The reported number of new to New Zealand species has continued to increase, although the percentage of significant detections has remained constant over the last 5 years. There is a clear correlation between sample submissions and significant detections, and increasing the number of submissions could increase the number of PPIN reports.

The increased numbers this season of organisms new to New Zealand, new host associations and extensions of distribution (164) provides confidence that the HRSS programme reduces risk of exotic pests having a negative impact to New Zealand's natural and plant production systems.

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Gypsy moth surveillance programme annual report 2016-2017

Gypsy moth, *Lymantria dispar*, is a severe defoliator of trees and is described as both an economic and environmental high-impact pest. A major outbreak of gypsy moth in New Zealand could severely impact the horticulture, forest and tourism industries and might also affect the indigenous flora.

It was recognised that high-risk pathways existed for the accidental importation of gypsy moth from other countries, such as international shipping, imported used vehicles and cargo containers. Thus in 1992 the Gypsy Moth Surveillance Programme (GMSP) was developed to provide early warning of gypsy moth incursions, to facilitate eradication and assist with assurance of New Zealand's status as a country free from gypsy moth. To achieve this the GMSP conducts seasonal monitoring with pheromone traps placed on specific hosts at strategic locations, and a communication programme is carried out using letters, leaflets, cards and reports to promote the biosecurity message about this unwanted species.

AsureQuality has delivered the GMSP, both as part of MPI and for MPI, for almost 20 years.

Trapping

The surveillance season runs from mid October to early May. Pheromone traps are placed in cells making up a grid that is strategically located in areas regarded as high risk for an incursion of gypsy moth. Each cell measures 750 x 750 metres and contains a single pheromone trap for the duration of the surveillance season. The minimum size of each grid is two adjacent cells. In coastal areas a buffer zone is used to intercept any moths that might fly to land from nearby vessels, and it is only one grid cell in width. The distribution of surveillance locations throughout New Zealand is shown in **Figure 1**, and an example of a grid overlying a topographical map is shown in **Figure 2**.

Within each cell, a host tree is selected for trap placement, using a hierarchical ranking of the most suitable host trees, as close to the grid centre as possible. The traps are attached to the trunk or a branch of a suitable host tree (or, rarely, an artificial structure) and are located 1.3–2 metres above the ground. Each trap is a green delta trap with two sticky internal sides and is clearly labelled "Gypsy Moth Trap", displaying MPI and AsureQuality logos and a freephone contact number (**Figure 3**). Each trap contains a commercial disparlure pheromone lure to attract male gypsy moths. Lures are independently tested and calibrated before each surveillance season and are replaced once during the season, after they have been in the field for 12–14 weeks.

Measures are in place to ensure the programme is robust. New traps are used at the start of each season and all traps and lures are destroyed within two weeks after the end of the season. To avoid sampling bias, gypsy moth traps are not placed in trees bearing any other pheromone traps. Traps are replaced immediately if they are recorded as missing or deemed by the trapper to be significantly damaged.

Trappers attend annual refresher courses on trap-servicing procedures and any changes of procedure.

Results

The gypsy moth trapping season ran from 24 October 2016 to 3 May 2017. The number of traps per run ranged from four to 83 (mean = 42.5), with a total

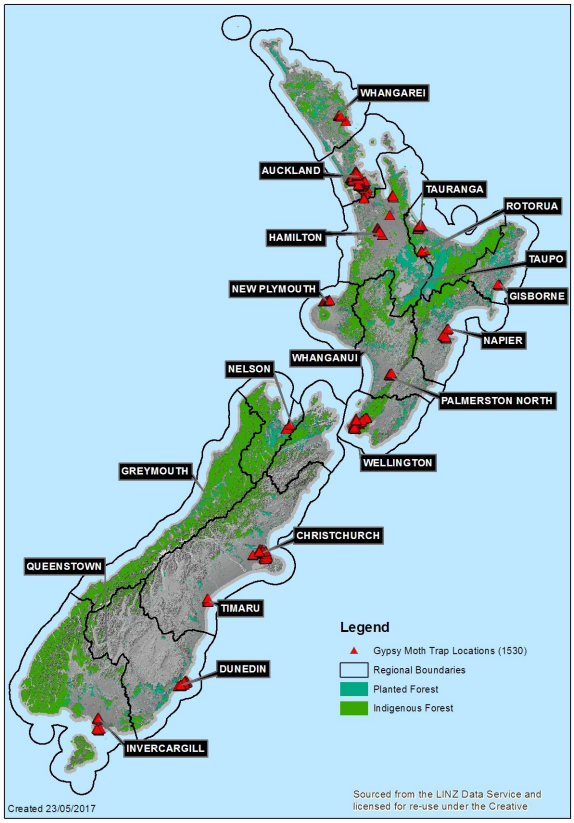

Figure 1: Map of New Zealand showing distribution of trap sites for gypsy moth surveillance, 2016-2017

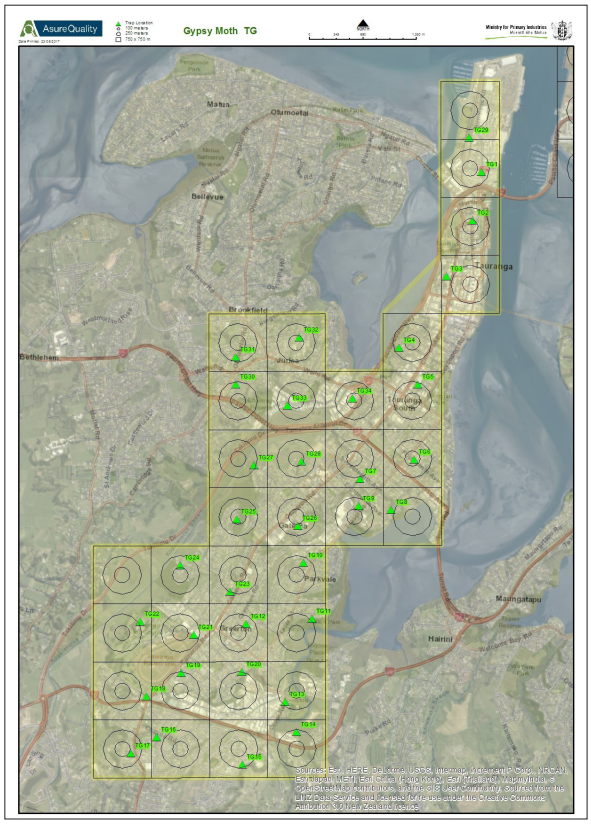

Figure 2: Example of a trapping grid overlying a topographical map, North Shore, Auckland. Each cell within the grid measures 750 x 750 metres.

Figure 3: Checking a gypsy moth pheromone trap attached to a tree

deployment of 1 530 traps. A trap run is a series of traps within a defined geographic area that are serviced by one trapper, and the number of traps in a trap run varied from four to 83. Any suspect moths were submitted to the Scion diagnostic laboratory for identification to family level. Combining the trap run data across the season gave a total of 20 652 trap servicing/inspection events.

In total there were 149 suspect moths submitted. The lower North Island recorded the highest number of submission events (45, or 32 percent of the total) and the highest number of suspect moths (48, or 32 percent) (**Table 1**). The largest fraction of submissions (23 percent) was made during November (**Figure 4; Table 1**). The percentages of sample submission events per month during the trapping season is shown in **Figure 4**. The majority of submissions were received from November to February, with about 75 percent of the total in those four months. The number of samples submitted diminishes in autumn (April and May).

Table 1 shows the number of samples submitted each month by region. The lower North Island has the most submissions, in November and December.

No gypsy moths were found during the entire season. Moth specimens submitted were mainly of the family Noctuidae (66 percent). Other moth families normally represented in the samples collected annually, with this season's figures in parentheses, include: Tortricidae (0 percent), Geometridae (9 percent), Oecophoridae (4 percent), Crambidae (5 percent), Tineidae (0 percent), Arctiidae (0 percent), Pyralidae (1 percent) and Hepialidae (8 percent). Miscellaneous moth families made up the remaining 7 percent.

The 2016–2017 surveillance season was a success in terms of meeting the programme's objectives. No new incursions of gypsy moth were recorded. Large numbers of samples were collected and submitted for taxonomic determination and the samples were obtained by a scientifically robust sampling process.

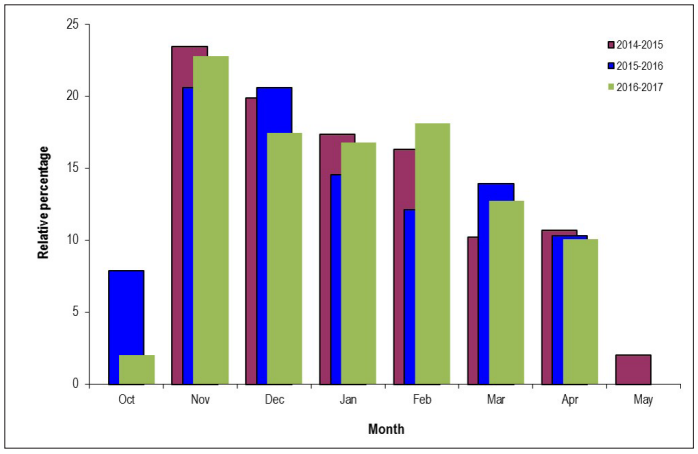

Figure 4: Percentage of gypsy moth sample submission events by month

Acknowledgements

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TABLE 1: Numbers of submission events and suspect samples submitted during the 2014–2015 surveillance season, by region

		Number of samples submitted by month							
Region	Number of submission events	October 2016	November 2016	December 2016	January 2017	February 2017	March 2017	April 2017	Total
Auckland/ Northland	34	0	6	3	7	6	6	8	36
Waikato/Bay of Plenty	23	0	5	4	5	6	2	1	23
Lower North Island	45	0	17	13	6	4	5	3	48
South Island	39	3	6	6	7	11	6	3	42
Total	**141**	**3**	**34**	**26**	**25**	**27**	**19**	**15**	**149**

Exotic plant and environment investigations report: April to June 2017

The Ministry for Primary Industries' (MPI) Incursion Investigation teams and the Plant Health Environment Laboratory (PHEL) teams investigate and diagnose suspect exotic pests and diseases in the plant and environment sectors. Investigators and scientists are based in Auckland and Christchurch. These teams provide field investigation, diagnostic testing and technical expertise on new pests and diseases affecting plants and the environment. They also have surveillance and response functions and carry out research and development to support surveillance and incursion response activities.

Agricultural pests

A North Otago farmer notified MPI of a suspect exotic grass growing in a paddock planted with imported lucerne seeds from Canada. About 20 plants per ha (6 ha lucerne in total) were found. The lucerne seeds had been purchased in October 2016 and sown that December. The lucerne was produced for grazing. The suspect exotic grass was identified by a botanist at PHEL Tamaki as barnyard grass, ***Echinochloa crus-galli***. This species is permitted entry into New Zealand but only under the Import Health Standard – Seed for Sowing schedule for *Echinochloa*, which lists *Sclerospora graminicola* (a fungus), *Trogoderma* spp. (beetles) and Ustilaginales (smut fungi) as quarantine pests. As precautionary measure the notifier was advised to pull out the barnyard grass and feed it to livestock. The seed consignment, consisting of 25 tonnes imported in 2015, was traced and import documentation showed that *E. crus-galli* seeds had been present. These were not found on inspection in New Zealand but there was insect contamination present so the seeds were fumigated before clearance. Of the total consignment, only 5 tonnes were still in stock. The risk that this barnyard grass contamination could be a vector for pests and diseases was evaluated, overall it was considered negligible to low and the investigation was closed.

A grower from Matamata had collected several larvae from capsicum plants and submitted them to Plant & Food Research because he believed they were the yellow-striped armyworm, *Spodoptera ornitogalli*, an unwanted organism not established in New Zealand. Plant & Food Research diagnosed ***S. litura***, a species already present, and this was confirmed by PHEL entomologists.

A notifier believed that Johnson grass, *Sorghum halepense,* was growing alongside State Highway 1 and the Putaruru end of Whites Rd, between Harris Road and the State Highway. *S. halepense* is a noxious weed subject to eradication under the National Interest Pest Response (NIPR) programme. Several clumps of suspected Johnson grass were seen. A Landcare Research Allen Herbarium botanist looked at photos supplied and determined that they were not of Johnson grass. Samples were collected by AsureQuality and submitted to the herbarium for formal identification. The grass was a mixture of cocksfoot (***Dactylis glomerata***) and **barnyard grass** (***Echinochloa crus-galli***). The genus *Echinochloa* contains about 30 species found in tropical and temperate regions around the world, with *E. crus-galli* native to Europe. Barnyard grass is a strong, fast-growing summer annual 30–120 cm high and was the species mistaken for Johnson grass. Both barnyard grass and cocksfoot are established in New Zealand.

Horticultural pests

An Auckland rug retailer reported finding a 3 cm black-and-yellow-striped dragonfly with orange spots when opening an imported Persian rug. The notifier was concerned it might be exotic. The specimen was sent to PHEL and confirmed as **Megarhyssa nortoni**, a wood wasp parasite introduced to New Zealand as a biological control agent of *Sirex noctilio,* a serious pest of radiata pine.

A photo of a fly was sent to PHEL Tamaki. Entomologists viewed the photo and ruled out exotic fruit fly. The picture was considered most likely to be ***Drosophila hydei***, one of the larger vinegar flies present in NZ.

Reports of brown marmorated stink bug

MPI was notified of a suspect brown marmorated stink bug (BMSB, *Halyomorpha halys*) found in a holiday complex in Whitianga. PHEL identified an adult female **BMSB** from photos submitted. An investigation was initiated to determine the likely source, as there was no direct association between the interception and imported risk goods. Two separate site inspections by MPI and a contractor found no further BMSB. Information sheets were distributed throughout the apartments to raise awareness. PHEL determined that the single female had not mated, and ovary development indicated that it had recently come out of diapause. The absence of mating was consistent with the scenario that it was likely a hitch-hiker, associated with tourists that had stayed at the motel. A conference call was held with Government Industry Agreement (GIA) partners, and further work was agreed upon to deal with the residual risk, including a continued enhanced awareness campaign. BMSB traps were deployed in late February and remained in place until 25 April. Only one insect was caught, and was identified as the endemic New Zealand vegetable bug, *Glaucias amyoti*. Further diagnostics included haplotype analysis and isotope tracing. The likelihood of an established BMSB population was considered low, but isotope and haplotype analysis of this specimen confirmed the original assumption that it was a hitch-hiker and not from an established New Zealand population. Isotope and haplotype analysis has limitations, as there are not many reference samples globally from different populations. The analysis suggested that the Whitianga interception possibly originated from Europe.

An unusual-looking bug was noticed on a car imported from Japan that had been sent to a car-grooming facility

in preparation for sale. A second bug was later found, and this time it was collected and photos were sent to PHEL (Christchurch) for identification. The bug was identified as the **yellow spotted stink bug (YSSB), *Erthesina fullo***, a species absent from New Zealand. The grooming involved degreasing and high-pressure steam cleaning of the entire underside, plus a similarly thorough cleaning of the interior, which mitigated the risk of further YSSB being present on the vehicle. Tracing revealed the vehicle to be one of four for the importer; it had been shipped from Osaka, unloaded at Wellington seaport and pre-cleared by MPI. YSSB has been detected previously, associated with imported goods from Asia, usually as solitary individuals. It is not considered a high pest risk to New Zealand and thought likely to have a low risk of establishment, but its presence is considered a likely indicator of the similar but very high risk brown marmorated stink bug (BMSB, *Halyomorpha halys*), which is also present in Japan. Hence BMSB fact sheets were provided to agents representing the other vehicles present on the same vessel. Encouragingly, when these agents were contacted most of them were already aware of BMSB.

A single live suspect BMSB was found in a car boot in Te Awamutu. The car had recently been parked near Auckland Airport for 3 weeks. A photo supplied to PHEL (Tamaki) was identified as the green vegetable bug, *Nezara viridula*. Cooler temperatures at the end of the season result in some *N. viridula* adults becoming increasingly brown in colour rather than green, and thus they are more readily confused with BMSB.

A commercial fruit grower found a suspect BMSB on his front door. The detection was not associated with any imported goods. He had identified the insect from a pest book that had information on Pentatomidae (stink bugs). The notifier provided photos of the insect to rule out BMSB and PHEL confirmed the insect was a brown shield bug, *Dictyotus caenosus*, a species already present in New Zealand.

A commercial grower found an insect on a plant about 5 m away from his vineyard and was convinced it looked identical to BMSB. Brown vegetable bug (***Nezara viridula***) was identified from submitted photos by PHEL (Tamaki). This species is present in New Zealand.

Forest and timber pests

When a Kookaburra brand cricket set purchased from Rebel Sport in Whanganui 15 months previously was finally used after 14 months, a wicket broke and a hole was found inside, along with a hard-packed clay-like material. No signs of life were seen and there was no hole in the wicket to indicate that anything had exited the wood. The wicket was placed in a freezer to kill anything alive inside. The notifier was advised to test all the wickets from the set and if any sounded hollow or showed signs of weakness in the wood they should be sent to PHEL. One affected wicket, was sent to PHEL (Tamaki) for destructive sampling, which found large galleries that were likely caused by **cerambycid (longhorn beetle)** larvae, but no live activity was found, nor any larvae or beetles.

A caller had received 300 broom handles that had been fumigated and exported from Sri Lanka. While assembling the brooms a live wood borer was found in one of the handles. The caller contained it and placed it in a freezer. All the handles were inspected but only the one insect was found. It was identified as the **powder post beetle, *Sinoxylon unidentatum***, which is not established in New Zealand. A work request was issued to have the consignment of handles fumigated to mitigate any biosecurity risk.

Staff at Oxted Resources contacted MPI after a customer brought back a gift item imported from the UK with borer infestation. Oxted contacted MPI and all customers who had purchased this or other wooden items, and checked their own stock for borer damage. No further borer were found. The infested sample was sent to PHEL (Tamaki), where another species of powder post beetle, ***Dinoderus minutus***, was identified. This species is not present in New Zealand though it is commonly intercepted in imported bamboo goods, but the economic risk is considered low.

AsureQuality notified MPI of a wooden item purchased from India that had holes and dust, and submitted it to PHEL (Tamaki). The owner of the wooden souvenir had agreed to its being destructive analysed. Diagnostics confirmed the beetle was ***Sinoxylon unidentatum***, which is not present in New Zealand. The biosecurity issue had been mitigated, the notifier was advised of the result and the investigation was closed.

MPI was notified of infestations of the **dampwood termite, *Porotermes adamsoni*,** present in the Lyttelton Port Company's (LPC) wharf timbers. Although the infestation was first recorded in the 1950s (and likely present earlier) and has since been under long-term management, LPC is currently repairing the wharf and generating infested waste timber that requires treatment or disposal, and sought advice from MPI. After extensive review and consultation, in 2013 *P. adamsoni* was removed from MPI's Unwanted Organisms Register. This was in recognition of its low impacts, multiple detections of established colonies from Northland to Canterbury, and a lack of tools to detect populations elsewhere. Nonetheless MPI supported LPC's good corporate citizenship in setting out to treat infested timber in order to limit the further spread and establishment of *P. adamsoni* in New Zealand. MPI's advice resulted in a plan to map known *P. adamsoni* infestations (past and present) in the wider port area, and to treat infested timbers by deep burial at a council landfill. Environment Canterbury (ECan) was also advised in case future treatment options may be considered that could require resource consent, such as burning the risk timbers, and so that ECan biosecurity staff could assist. In future termites will be sent to MPI for identification whenever they are found in new areas of the port, to confirm that

only *P. adamsoni* is present. MPI put LPC in contact with an Australian termite pest management specialist, as LPC wishes to review its control and surveillance options, e.g., options that do not require entire wharf rebuilds to manage the termites.

General biosecurity pests and contaminants

The exotic ant ***Monomorium dichroum*** (formerly *Monomorium* sp.) was found at the Port of Tauranga through the National Invasive Ant Surveillance Programme (NIAS). On 15 March a nest was found near the perimeter fence line of the container storage terminal at Sulphur Point, where empty containers were stacked along the fenceline. The nest was treated with insecticide and toxic bait was laid in the area and along the fenceline. A follow-up visit was undertaken and no further ants were found.

Two exotic ant species were detected at Mt Maunganui seaport through the National Invasive Ant Surveillance Programme (NIAS). The species found were ***Monomorium dichroum*** (formerly *Monomorium* sp.) and **brown crazy ant, *Paratrechina longicornis***. Both were found next to electrical outlets used to power refrigerated shipping containers. Both species were detected through delimiting surveillance. The site was sprayed with a non-repellent residual insecticidal spray, and toxic bait was deployed. A follow-up visit occurred a month later, after bad weather and flooding hampered efforts to revisit the site sooner. No further exotic ants were seen but as a precaution the area was re-sprayed and the toxic bait was replenished.

Again the exotic **brown crazy ant, *Paratrechina longicornis*,** was found at Port of Tauranga on 9 February through the National Invasive Ant Surveillance Programme (NIAS). More than 20 workers were found in a baited trap set outside a large packhouse, and the site was revisited on 15 March to undertake eradication. However, owing to freight operations being carried out in this area, access time was limited to just over an hour. Surveillance around the site was undertaken using baited pottles to attract foraging ants. No ant activity was seen. The building perimeter was treated with a non-repellent residual insecticidal spray and toxic bait was laid in the area. A follow-up visit was not made until 19 April owing to cargo movements, poor weather, flooding and high winds. On the second visit no ants were seen, but as a precaution the area was re-sprayed with a non-repellent residual insecticidal spray and toxic bait was laid.

There were two detections of the **brown crazy ant, *Paratrechina longicornis,*** at Opua Marina, on 20 March and 4 April, via the National Invasive Ant Surveillance Programme (NIAS). The first find was located in a garden area between a large commercial building and the edge of a carpark adjacent to the boat ramp and marina docks. Attractant bait was laid to assess the extent of the infestation and the exact location of the ants. A nest appeared to be present in a planter box, which was treated with a residual insecticidal spray. Toxic bait stations were laid in the vicinity of the find, around the car park, buildings and garden. On a follow-up visit on 21 March there was no further exotic ant activity and dead ants were seen nearby. The second detection was located in a garden area by the water's edge, next to boat-mooring pontoons about 200 m north of the previous find. Attractant bait was laid out to 50 m from the site to lure any foraging ants present. A nest was found in the garden and a non-repellent residual insecticidal spray was used to treat it. Toxic bait stations were also deployed in the surrounding area. No ant activity was seen during a follow-up visit the next day.

A caller reported finding a single live millipede in a package of eftpos units from Australia. Photos indicated it was the **Portuguese millipede (*Ommatoiulus moreleti*)**, a species not established in New Zealand. The notifier was asked to freeze the millipede and send it to PHEL (Tamaki) for confirmation, and to inspect the consignment again for further individuals. As just one millipede was found, it was most likely an isolated hitchhiker.

An employee at a Transitional Facility found a cockroach on the outside of the packaging when he was wrapping up a package. Photos were submitted to PHEL (Tamaki} and the insect was identified as a female **harlequin cockroach (*Neostylopyga rhombifolia*)**, a species not present in New Zealand. It had a strange-looking body full of fine black sand and might have been dead for some time. One ovary was intact; the other was destroyed. There were some eggs but they were not fully developed. The oviducts were empty, indicating a non-reproductive female. The conclusion was that this female cockroach was still immature and was a lone hitchhiker.

Ants were associated with a replacement car door imported from Europe. The number of ants suggested a colony within the door cavity. Worker ant specimens were collected and identified by PHEL (Christchurch) as **Argentine ant**, ***Linepithelma humile***, a species established in New Zealand.

A suspect black widow spider was found in a box of machinery imported from China. Photos were emailed to a local Department of Conservation office, from where they were forwarded to PHEL Christchurch. The images were of excellent quality and enabled positive identification of the false katipo spider, ***Steatoda capensis***, an exotic species already present and widely distributed throughout New Zealand.

A notifier had seen ants emerging from the gap in the boot and from beneath the window panes while cleaning his car. The car had been imported from Japan and purchased 23 weeks previously from a dealer in Auckland. Throughout this period it had been parked outside and in use. A sample was sent to PHEL (Christchurch) and subsequently identified as the **white-footed house ant, *Technomyrmex jocosus*.** This species is

established in New Zealand and is not a biosecurity problem.

A microwave oven purchased from Harvey Norman was found to have cockroaches living inside the inaccessible body of the oven. Apparently the infestation was first noticed soon after receiving the oven, but it was not reported to MPI for nearly 3 months. In the interim, attempts to kill the cockroaches were unsuccessful. Traceback using the oven's model and serial number determined that it had been imported from Thailand in one of four consignments received between 25 December 2015 and 8 February 2017. Given the unfavourable habitat packaged microwave ovens provide to cockroaches, and the highly favourable habitat they provide when in regular use (heat, humidity and access to food), it was considered unlikely that the cockroaches had originated from Thailand. Specimens subsequently provided to PHEL (Tamaki) confirmed the species was the German cockroach, ***Blattella germanica***, which is very common in New Zealand and throughout the world.

An MPI officer reported that a NIWA technician had found two live strange-looking larvae in a parcel of laboratory equipment (non-risk goods) imported from the UK. The organisms were submitted to PHEL (Tamaki) after freezing and identified as larvae of the Australian carpet beetle, ***Anthrenocerus australis***. This species is established in New Zealand and no biosecurity problem.

The owner of a cleaning and pest-treatment business advised that a client reported ants invading her property and the neighbour's for at least 18 months. Ants had attacked a cherry blossom tree and infested the house. A photo was requested along with specimens to confirm the identification. The photo showed Argentine ant, ***Linepithema humile***, a species established in New Zealand. When advised of this, the notifier initiated a baiting and eradication programme.

A Lincoln University academic notified MPI of a suspect red imported fire ant (*Solenopsis invicta)* report on the NatureWatch website, a citizen science and community-based monitoring project on New Zealand's biodiversity (http://naturewatch.org.nz/observations/5644384). FBI Consulting was engaged to visit the Wellington site, inspect and collect samples for a definitive identification. After a complete inspection no ants were found, possibly owing to cool temperatures. However, a sample of ants had been retained by the original finder and these had been provisionally identified as ***Monomorium antarcticum*** (southern ant), an endemic New Zealand species. The specimens were forwarded to an MPI-approved laboratory, where this identification was confirmed. Ants collected by the notifier had been initially misidentified as *Solenopsis invicta*. This is not surprising as the two species are very similar in appearance and require microscopic examination by an expert to distinguish them. The correct identification was posted on the Naturewatch website.

Recently purchased netball uniforms were found covered in mould. Although they had been printed and sewn in New Zealand, the fabric came from China and the notifier sought clarification as to whether this was of significance to MPI and whether the uniforms were safe for children to wear. Photos provided by the notifier were consistent with **mould** growing on the fabric. It was explained that fungal spores are typically present on the surface of all commodities, whether imported or not, and that like bacteria, fungal spores are in the air and everywhere. Mostly they are not evident, but given the right environmental conditions (mostly moisture and heat), they grow and become visible as mould. With some exceptions, surface moulds are not regulated by MPI on imported goods. In addition, as the fabric had been screen-printed and sewn into a garment in New Zealand, it is possible the mould originated here and not in China. In summary, the mould represented a negligible biosecurity risk and no action was considered necessary by MPI. Although no assurance was provided regarding the safety of the mould to children (this being beyond the scope of biosecurity), it was pointed out that supermarkets sell a range of products designed for sterilising clothing.

Chestnut growers expressed concern about potential illegal importation of Chinese chestnuts, as roasted chestnuts were being offered for sale at the Auckland night market. Fresh chestnuts are a prohibited import but they can be imported frozen or preserved under the Import Health Standard NPP Human (http://www.mpi.govt.nz/document-vault/1663). When an Incursion Investigator visited the night market on 28 May the stall holder confirmed that the chestnuts had been imported frozen from China.

An electrician contracted to connect power to a new prefabricated house in Christchurch found suspect redback spiders underneath. The notifier was originally from Australia and familiar with redbacks, but did not collect any specimens to confirm the identification. The house was constructed from used sea containers, which the electrician said had been repurposed in China and outfitted in Australia before shipping to New Zealand. However, when the property developer was contacted it became apparent that the house had been manufactured entirely in China and had not been in Australia. Nevertheless he arranged for a pest control operator to visit the site and apply spider treatments. MPI frequently receives reports of suspect redback spiders that turn out to be other species, most commonly the false katipo spider, ***Steatoda capensis***.

A member of the public photographed an unusual butterfly in her garden on 15 March 2017. The photos were sent to a senior ecologist from Wildland Consultants Ltd, who identified it as ***Graphium choredon*** (Lepidoptera: Papilionidae)**, the bluebottle or blue triangle butterfly** of eastern Australia,

and this was subsequently confirmed by PHEL. The ecologist was contacted by a reporter from *The Press*, who contacted MPI to see if it was investigating the report. MPI had not been notified of the find, but a formal notification was soon received via the pest and disease hotline. *G. choredon* is not known to be established in New Zealand and is a new to New Zealand species in terms of the HSNO Act 1996. *G. choredon* is native to eastern Australia and south and southeast Asia. Its natural habitat is mainly rain forest and monsoon forest, and it is a common garden butterfly wherever introduced camphor laurel (*Cinnamomum camphora*) grows. Host plants also include species of *Beilschmiedia, Cinnamomum, Cryptocarya, Endiandra, Litsea, Neolitsea, Doryphora, Geijera, Planchonella, Cleorodendrum* and *Annonna,* with some of these genera having New Zealand members, including tawa (*Beilschmiedia tawa*), taraire (*B. tarairi*), mangeao (*Litsea calicaris*) and tawapou (*Planchonella costata*). Site inspection showed that the property had no host plants. The nearby Prebbleton Rugby Club park was surveyed and did not have any of the target plant genera. A laurel tree (not *Cinnamomum camphora*) sited at the entrance to Glenwood Drive, about 100 m from the detection site, was inspected. Pink eggs of a pentatomid bug, most likely the New Zealand vegetable bug, *Glaucias amyoti*, were found on one laurel leaf. A neighbouring property was inspected but no target plants were found. No *G. choredon* life stages were seen on any of the plants inspected. Several monarch butterflies were observed flying in the area. The investigation was closed as the site visit did not reveal any biosecurity issue and the butterfly was assumed to be a solitary detection with its pathway unknown. The literature suggests that the butterfly would be unlikely to survive the Canterbury winter.

Plant diseases

Environment Southland found a suspect potato wart at an Invercargill rest home. A sample was sent to PHEL Tamaki and identified as powdery scab (**Spongospora subterranea**). Powdery scab is established in New Zealand and is a common disease of potato.

A caller to the exotic pest and disease hotline reported that leaves of hedge plants at their property were turning brown and falling off. Samples of stems, leaves, roots and soil were collected and sent to PHEL (Tamaki) for testing. The hedge trees were identified as *Cinnamomum camphora* (camphor tree) and pathologists isolated a ***Phytophthora* sp.** aligned closely with *P. multivora*. This species attacks trees of all ages, has been found on various hosts in New Zealand and is not a biosecurity risk.

A pathologist at PHEL Tamaki was notified of blueberry plants affected by two suspect exotic pathogens, the bacterium *Xylella fastidiosa* and blueberry scorch virus. The notifier, who was not a commercial grower, had lost about 150 of 200 plants bought from a commercial grower about 3 years previously. Both mycologists and virologists requested samples for diagnostics. *X. fastidiosa* was ruled out by testing of the samples and MPI virologists found no viruses or pathogens. The plant deaths have been attributed to **abiotic factors**.

Storage pests

A consignment of chickpeas from Turkey was checked and little black bugs were found in one of the bags. The recipient, Ceres Ltd, was worried about possible pea weevil infestation. The consignment of 12 tonnes was put into quarantine at the Ceres Ltd premises while a sample was sent to PHEL (Tamaki), where entomologists identified **cowpea weevil (*Callosobruchus maculatus*)**. This species is not present in New Zealand so the entire consignment was frozen for 12 days to kill all the insects.

A notifier found one live maggot under a banana skin. The bananas, from Ecuador, had been purchased at a local supermarket. Identification from photos was inconclusive but molecular analysis identified it as the Indian meal moth (***Plodia interpunctella***). This species is established in New Zealand and not a biosecurity risk.

Peanut candy from Vietnam, purchased at a store in Christchurch, was found to have bugs inside. The bugs looked like weevils, being creamy-coloured with a brown head and what also seemed to be eggs. A sample of the candy was analysed by PHEL (Christchurch) and the infestation was found to be caused by ***Plodia interpunctella***, the Indian meal moth, a species established in New Zealand.

Live insects were found feeding on a product importing for use as an animal feed additive. The description provided was consistent with a pest of stored products. Specimens were subsequently identified by PHEL Tamaki as the warehouse moth, ***Cadra cautella***, a species established in New Zealand and not a biosecurity risk.

Staff in a commercial food kitchen found a large number of insects in rice imported from Italy. A sample of the insects was submitted to PHEL (Tamaki) and identified as maize weevil, *Sitophilus zeamais*. This species is established in New Zealand.

A notifier had bought a packet of Turkish dried figs at the local supermarket and found a live worm inside. She was advised to freeze the figs and to submit a photo of the contaminant. A larva of the Indian meal moth, ***Plodia interpunctella***, was identified from the submitted photos by PHEL (Christchurch). This is a common storage pest and already present in New Zealand.

A caller found two live weevils in a package of Indian rice that had probably been imported in bulk and repacked in New Zealand. The weevils were described as about 4 mm long and the notifier killed them with boiling water. He was advised to freeze the remaining rice and to inspect it for further insects. The description fitted a *Sitophilus* species,

but photos sent to PHEL (Tamaki) subsequently confirmed maize weevil, ***Sitophilus zeamais***, which is present in New Zealand.

Seed contamination

The notifier had ordered seeds of *Amaranthus*, *Lunaria* and *Mimosa* from a New Zealand website. When subsequently the seeds arrived by post from Greece she contacted MPI to find out whether she could keep them. Photos of the seeds and the packaging were submitted and seeds of ***Mimosa pudica***, ***Lunaria annua*** and ***Amaranthus* sp.** were identified. Imported seeds must comply with the Import Health Standard "Seeds for Sowing". *M. pudica* and *L. annua* are classified as "basic" under this schedule and must either be accompanied by a phytosanitary certificate or be inspected on arrival in New Zealand. As the seeds of these species appeared to be clean they were left with the notifier. However, the *Amaranthus* seeds were not identified to species, so a biosecurity risk could not be ruled out and they were destroyed at PHEL (Tamaki).

The Museum of Transport and Technology in Auckland was going through its inventory and found some imported flower, grass and vegetable seeds from the UK, arranged as a showcase. They believed that the seeds might have been imported as far back as 1910. The seeds were enclosed in bubble-type plastic attached to a wooden frame. The notifier wanted to know whether they could keep the seeds or whether they should send them for inspection. The inventory was inspected by a PHEL (Tamaki) botanist and Incursion Investigator. Most of the seeds were of species that are already present in New Zealand and can be legally imported as "basic" or under specific schedules of the Import Health Standard. However there were some gorse (**Ulex europaeus**) seeds and unlabelled seeds present. Gorse ***s***eed is prohibited from entry into New Zealand, and the other unlabelled seeds might not be of species that are present. These seeds were imported long before the Biosecurity Act 1993 and the Hazardous Substances and New Organisms Act 1996 came into force, so their biosecurity risk was never assessed. However, the overall risk was considered low because the seeds will not be used for the purpose of sowing, are securely contained and may not be viable any more.

A woman returning from Japan found a seed pod in her luggage. She was not sure whether the pod had come with her from Japan and wanted assistance with identifying it. The pod was sent to PHEL (Tamaki) where a botanist identified it as the common garden pea (***Pisum sativum***). The pod was disposed in the quarantine bin at PHEL.

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PEST WATCH: 6 MAY 2017 – 7 JULY 2017

Biosecurity is about managing risks: protecting New Zealand from exotic pests and diseases that could harm our natural resources and primary industries. MPI's Diagnostic and Surveillance Services (DSS) directorate devotes much of its time to ensuring that new organism records come to its attention, and to following up as appropriate.

This information was collected from 6 May to 7 July 2017. The plant information is held in the MPI Plant Pest Information Network (PPIN) database. Wherever possible, common names have been included. Records in this format were previously published in the now discontinued magazine *Biosecurity*.

To report suspect new pests and diseases to MPI phone 0800 80 99 66.

Validated new to New Zealand reports

Type	Organism	Host	Location	Submitted by	Comments
Insect	*Nephus binaevatus* no common name	*Phormium tenax* NZ flax	Auckland	PHEL (General Surveillance)	A southern African species. Has in the past been introduced into California for control of mealybugs.

If you have any enquiries regarding this information please contact surveillance@mpi.govt.nz.

Veterinary Diagnostic Laboratories

GRIBBLES VETERINARY PATHOLOGY

- AUCKLAND
  Courier: 37–41 Carbine Road, Mount Wellington, Auckland 1060
  Postal: PO Box 12049, Penrose, Auckland 1642
  Tel: 09 574 4701 Fax: 09 574 5304

- HAMILTON
  Courier: 57 Sunshine Ave, Hamilton 3240
  Postal: PO Box 195, Hamilton 3240
  Tel: 07 850 0777 Fax: 07 850 0770

- PALMERSTON NORTH
  Courier: 840 Tremaine Avenue, Palmerston North 4440
  Postal: PO Box 536, Palmerston North 4440
  Tel: 06 356 7100 Fax: 06 357 1904

- CHRISTCHURCH
  Courier: 7 Halkett Street, Christchurch 8140
  Postal: PO Box 3866, Christchurch 8140
  Tel: 03 379 9484 Fax: 03 379 9485

- DUNEDIN
  Courier: Invermay Research Centre, Block A, Puddle Alley, Mosgiel, Dunedin 9053
  Postal: PO Box 371, Dunedin 9053
  Tel: 03 489 4600 Fax: 03 489 8576

NEW ZEALAND VETERINARY PATHOLOGY

- HAMILTON
  Courier: Cnr Anglesea and Knox Streets, Hamilton
  Postal: PO Box 944, Hamilton
  Tel: 07 839 1470 Fax: 07 839 1471

- PALMERSTON NORTH
  Courier: IVABS Building, 1st Floor, Massey University, Tennant Drive, Palmerston North
  Postal: PO Box 325, Palmerston North
  Tel: 06 353 3983 Fax: 06 353 3986

SVS LABORATORY

- HAMILTON
  Physical Address:524 Te Rapa Road Hamilton 3200
  Postal Address:PO Box 10304 Hamilton 3241
  Tel: 0800 SVS LABS (0800 787 522) or 07 444 5101
  Email: info@svslabs.nz

To report suspected exotic land, freshwater and marine pests, or exotic diseases in plants or animals, call:

0800 80 99 66

PLANT HEALTH & ENVIRONMENT LABORATORY (TAMAKI)
Diagnostics and Surveillance Services (MPI)
Courier: 231 Morrin Road, St Johns, Auckland 1140
Postal: Freepost 120201, MPI DSS, PO Box 2095, Auckland 1140

ANIMAL HEALTH LABORATORY
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Courier: 66 Ward Street, Wallaceville, Upper Hutt 5018
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PLANT HEALTH & ENVIRONMENT LABORATORY (CHRISTCHURCH)
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New Zealand Government

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